Complete Software Guide for Junos® OS for the QFX Series, Release 13.2X51-D15

Release

13.2X51-D15

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Complete Software Guide for Junos® OS for the QFX Series, Release 13.2X51-D15
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The information in this document is current as of the date on the title page.

YEAR 2000 NOTICE

Juniper Networks hardware and software products are Year 2000 compliant. Junos OS has no known time-related limitations through the year 2038. However, the NTP application is known to have some difficulty in the year 2036.

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About the Documentation

Documentation and Release Notes

To obtain the most current version of all Juniper Networks® technical documentation, see the product documentation page on the Juniper Networks website at http://www.juniper.net/techpubs/.

If the information in the latest release notes differs from the information in the documentation, follow the product Release Notes.

Juniper Networks Books publishes books by Juniper Networks engineers and subject matter experts. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration. The current list can be viewed at http://www.juniper.net/books.

Supported Platforms

For the features described in this document, the following platforms are supported:

- QFX Series standalone switches

Using the Examples in This Manual

If you want to use the examples in this manual, you can use the **load merge** or the **load merge relative** command. These commands cause the software to merge the incoming configuration into the current candidate configuration. The example does not become active until you commit the candidate configuration.

If the example configuration contains the top level of the hierarchy (or multiple hierarchies), the example is a *full example*. In this case, use the **load merge** command.

If the example configuration does not start at the top level of the hierarchy, the example is a *snippet*. In this case, use the **load merge relative** command. These procedures are described in the following sections.

Merging a Full Example

To merge a full example, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration example into a text file, save the file with a name, and copy the file to a directory on your routing platform.

   For example, copy the following configuration to a file and name the file **ex-script.conf**. Copy the **ex-script.conf** file to the **/var/tmp** directory on your routing platform.

   ```
   system {
     scripts {
       commit {
         file ex-script.xsl;
       }
     }
   }
   interfaces {
     fxp0 {
       disable;
       unit 0 {
         family inet {
           address 10.0.0.1/24;
         }
       }
     }
   }
   ```

2. Merge the contents of the file into your routing platform configuration by issuing the **load merge** configuration mode command:

   ```
   [edit]
   user@host# load merge /var/tmp/ex-script.conf
   load complete
   ```

Merging a Snippet

To merge a snippet, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration snippet into a text file, save the file with a name, and copy the file to a directory on your routing platform.

   For example, copy the following snippet to a file and name the file **ex-script-snippet.conf**. Copy the **ex-script-snippet.conf** file to the **/var/tmp** directory on your routing platform.

   ```
   commit {
     file ex-script-snippet.xsl; }
   ```

2. Move to the hierarchy level that is relevant for this snippet by issuing the following configuration mode command:

```
[edit]
user@host# edit system scripts
[edit system scripts]
```

3. Merge the contents of the file into your routing platform configuration by issuing the **load merge relative** configuration mode command:

```
[edit system scripts]
user@host# load merge relative /var/tmp/ex-script-snippet.conf
load complete
```

For more information about the **load** command, see the *CLI User Guide*.

Documentation Conventions

Table 1 on page cxxiii defines notice icons used in this guide.

Table 1: Notice Icons

Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.

Table 2 on page cxxiii defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the **configure** command: user@host> **configure**
`Fixed-width text like this`	Represents output that appears on the terminal screen.	`user@host>` **show chassis alarms** `No alarms currently active`
Italic text like this	• Introduces or emphasizes important new terms. • Identifies guide names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS CLI User Guide* • RFC 1997, *BGP Communities Attribute*

Table 2: Text and Syntax Conventions *(continued)*

Convention	Description	Examples
Italic text like this	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# **set system domain-name** *domain-name*
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	• To configure a stub area, include the **stub** statement at the **[edit protocols ospf area area-id]** hierarchy level. • The console port is labeled **CONSOLE**.
< > (angle brackets)	Encloses optional keywords or variables.	**stub <default-metric *metric*>;**
| (pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	**broadcast | multicast** **(*string1* | *string2* | *string3*)**
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	**rsvp { # Required for dynamic MPLS only**
[ ] (square brackets)	Encloses a variable for which you can substitute one or more values.	**community name members [*community-ids*]**

Indention and braces ({ })	Identifies a level in the configuration hierarchy.	[edit]
		routing-options {
		  static {
		    route default {
		      nexthop *address*;
		      retain;
		    }
		  }
		}

; (semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
GUI Conventions		
Bold text like this	Represents graphical user interface (GUI) items you click or select.	• In the Logical Interfaces box, select **All Interfaces**. • To cancel the configuration, click **Cancel**.
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select **Protocols>Ospf**.

Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can send your comments to **techpubs-comments@juniper.net**, or fill out the documentation feedback form at https://www.juniper.net/cgi-bin/docbugreport/. If you are using e-mail, be sure to include the following information with your comments:

- Document or topic name
- URL or page number
- Software release version (if applicable)

Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active J-Care or JNASC support contract, or are covered under warranty, and need post-sales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the *JTAC User Guide* located at http://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf.
- Product warranties—For product warranty information, visit http://www.juniper.net/support/warranty/.
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: http://www.juniper.net/customers/support/
- Search for known bugs: http://www2.juniper.net/kb/
- Find product documentation: http://www.juniper.net/techpubs/
- Find solutions and answer questions using our Knowledge Base: http://kb.juniper.net/
- Download the latest versions of software and review release notes: http://www.juniper.net/customers/csc/software/
- Search technical bulletins for relevant hardware and software notifications: https://www.juniper.net/alerts/
- Join and participate in the Juniper Networks Community Forum: http://www.juniper.net/company/communities/
- Open a case online in the CSC Case Management tool: http://www.juniper.net/cm/

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: https://tools.juniper.net/SerialNumberEntitlementSearch/

Opening a Case with JTAC

You can open a case with JTAC on the Web or by telephone.

- Use the Case Management tool in the CSC at http://www.juniper.net/cm/.
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see http://www.juniper.net/support/requesting-support.html.

PART 1

QFX5100 Switch Overview

CHAPTER 1

QFX5100 Switch Overview

QFX5100 Switch Hardware Overview

The QFX5100 line of switches is Juniper Network's second generation of top-of-rack switch solutions for data centers and campus distribution or aggregation environments. The QFX5100 portfolio consists of high-performance fixed-configuration switches that add higher port densities, additional scalability, and improved latency to the QFX Series.

This topic covers:

QFX5100 Hardware

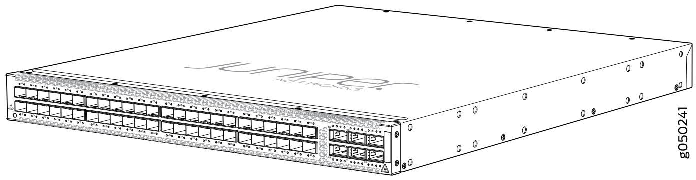
QFX5100 switches offer two compact 1 U product SKUs and a 2 U product SKU that provide wire-speed packet performance, very low latency, and rich set of Layer 2 and Layer 3 features. In addition to a high-throughput Packet Forwarding Engine, the performance of the control plane running on all the QFX5100 product SKUs is enhanced by the 1.5 Ghz dual core Intel CPU with 8 GB of memory and 32 GB of solid-state drive (SSD) storage.

The QFX5100 line of switches include both 10GE and 40GE fixed-configurations:

- QFX5100-48S

  As shown in Figure 1 on page 4, the QFX5100-48S is a 10-Gigabit Ethernet Enhanced Small Form-Factor Pluggable (SFP+) top-of-rack switch with 48 SFP+ ports and 6 Quad SFP+ (QSFP+) ports. Each SFP+ port can operate as a native 10 Gbps port or as a 1 Gbps port; each QSFP+ port can operate at native 40 Gbps speed or as 4 independent 10 Gbps port speeds. The 6 QSFP+ ports can be used as either access ports or as uplinks. The QFX5100-48S provides full duplex throughput of 1.44 Tbps. The QFX5100-48S has a 1 U form factor and comes standard with redundant fans and redundant power supplies. The model can be ordered with either ports-to-FRUs or FRUs-to-ports airflow and with AC or DC power supplies.

Figure 1: QFX5100-48S Switch

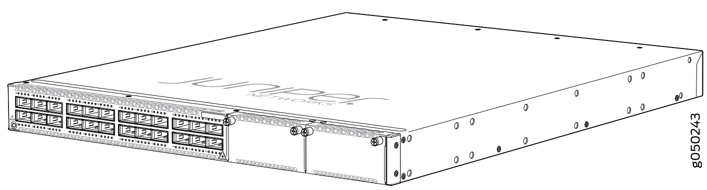


- QFX5100-24Q

  As shown in Figure 2 on page 4, the QFX5100-24Q is a 40-Gigabit Ethernet QSFP+ switch with 24 high-density QSFP+ ports. Each QSFP+ port can operate as a native 40 Gbps port or as 4 independent 10 Gbps ports. The QFX5100-24Q has a 1U form factor and comes standard with redundant fans and redundant power supplies. The model can be ordered with either ports-to-FRUs or FRUs-to-ports airflow and with AC or DC power supplies.

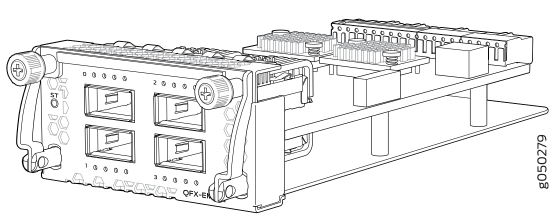
  The QFX5100-24Q has two module bays for the optional expansion module, QFX-EM-4Q, which can add a total of 8 additional QSFP+ ports to the chassis. When fully populated with QFX-EM-4Q Expansion Modules, the QFX5100-24Q is equivalent to 128 interfaces (96 + 16 + 16). Of these total ports, 104 logical ports are available for 10G port channelization. All ports on the QFX5100-24Q and QFX-EM-4Q can be configured as either access ports or as uplinks. The QFX5100-24Q provides full duplex throughput of 2.56 Tbps.

Figure 2: QFX5100-24Q Switch



  As shown in Figure 3 on page 4, the QFX-EM-4Q is an expansion module for the QFX5100-24Q. The module provides 4 additional QSFP+ ports that can be hot-inserted or hot-removed from the switch.

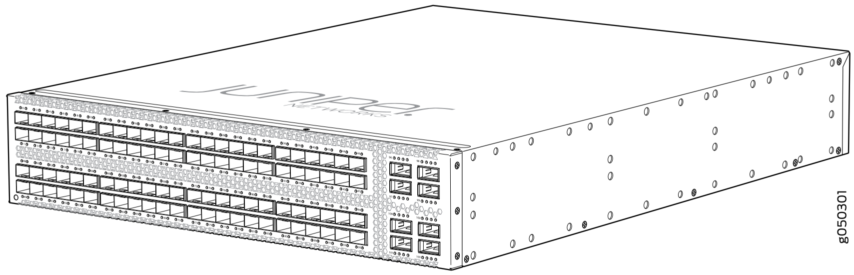
Figure 3: QFX-EM-4Q Expansion Module



- QFX5100-96S

  As shown in Figure 4 on page 5, the QFX5100-96S is a is a 10-Gigabit Ethernet Enhanced Small Form-Factor Pluggable (SFP+) top-of-rack switch with 96 SFP+ ports and 8 Quad SFP+ (QSFP+) ports. Each SFP+ port can operate as a native 10 Gbps port or as a 1 Gbps port; each QSFP+ port can operate at native 40 Gbps speed or as 4 independent 10 Gbps port speeds. The 8 QSFP+ ports can be used as either access ports or as uplinks. The QFX5100-96S has a 2 U form factor and comes standard with redundant fans and redundant power supplies. The model can be ordered with either ports-to-FRUs or FRUs-to-ports airflow and with AC or DC power supplies.

Figure 4: QFX5100-96S Switch



System Software

QFX Series devices use the Junos operating system (OS), which provides Layer 2 and Layer 3 switching, routing, and security services. Junos OS is installed on a QFX5100 switch's 8-gigabyte (GB) internal flash drive. The same Junos OS code base that runs on QFX5100 switches also runs on all Juniper Networks EX Series switches, and J Series, M Series, MX Series, and T Series routers.

For more information about which features are supported on QFX Series devices, see *QFX Series Software Features Overview*.

You manage the switch using the Junos OS command-line interface (CLI), accessible through the console and out-of-band management ports on the device.

Related Documentation

- *QFX5100 Switch Models*

PART 2

Software Feature Support

CHAPTER 2

Software Feature Support for the QFX Series

QFX5100 Software Features Overview

This topic lists the Juniper Networks QFX Series software features supported on the QFX5100 switch and the Junos operating system (Junos OS) release in which they were introduced.

- Table 3 on page 10—Administration Features
- Table 4 on page 10—Class-of-Service (CoS) Features
- Table 5 on page 10—High Availability and Resiliency Features
- Table 6 on page 11—Interface Features
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- Table 12 on page 13—Network Management and Monitoring Features
- Table 13 on page 14—Port Security Features
- Table 14 on page 14—Security
- Table 15 on page 15—Storage and Fibre Channel Features
- Table 16 on page 15—System Management Features

NOTE: The command-line interface (CLI) on the QFX Series might display configuration statements that are not supported. However, configuring an unsupported statement on a device has no effect on the operation of the device.

Table 3: Administration Features

Feature	QFX5100
System logging (syslog) over IPv4	Junos OS 13.2X51-D10
Licensing	Junos OS 13.2X51-D10

Table 4: CoS Features

Feature	QFX5100
Class of service (CoS)—Class-based queuing with prioritization	Junos OS 13.2X51-D10
CoS—Multidestination	Junos OS 13.2X51-D10
CoS support on link aggregation groups (LAGs)	Junos OS 13.2X51-D10
Enhanced transmission selection (ETS)	Junos OS 13.2X51-D10
CoS rewrite rules	Junos OS 13.2X51-D10
Queue shaping	Junos OS 13.2X51-D10
Priority-based flow control (PFC)	Junos OS 13.2X51-D10
Re-marking of bridged packets	Junos OS 13.2X51-D10
Weighted random early detection (WRED) tail-drop profiles	Junos OS 13.2X51-D10
802.3X Ethernet PAUSE autonegotiation enhancements	Junos OS 13.2X51-D10
Layer 3 ingress packet classification and egress rewrite rule class-of-service features	Junos OS 13.2X51-D10
Software buffer configurability	Junos OS 13.2X51-D10

Table 5: High Availability and Resiliency Features

Feature	QFX5100
Graceful protocol restart for BGP	Junos OS 13.2X51-D10
Graceful protocol restart for OSPF	Junos OS 13.2X51-D10
Link aggregation groups (LAGs)	Junos OS 13.2X51-D10
Support for 32 members in a link aggregation group (LAG)	Junos OS 13.2X51-D10
Multichassis link aggregation	Junos OS 13.2X51-D10
Virtual Router Redundancy Protocol (VRRP)	Junos OS 13.2X51-D10

Table 5: High Availability and Resiliency Features *(continued)*

Feature	QFX5100
In-Service Software Upgrade (ISSU)	Junos OS 13.2X51-D15
Zero Touch Provisioning (ZTP)	Junos OS 13.2X51-D15

Table 6: Interface Features

Feature	QFX5100
Auto-channelization	Junos OS 13.2X51-D15
Interface ranges	Junos OS 13.2X51-D10
Interface channelization	Junos OS 13.2X51-D10
VLAN-tagged Layer 3 logical interfaces	Junos OS 13.2X51-D10
Digital optical monitoring (DOM)	Junos OS 13.2X51-D10
IPv4 over generic routing encapsulation (GRE) tunnels— encapsulation support	Junos OS 13.2X51-D10

Table 7: IP Address Management Features

Feature	QFX5100
Static addresses	Junos OS 13.2X51-D10
IPv4 support for telnet	Junos OS 13.2X51-D10
IPv6 support for neighbor discovery, router advertisements, stateless autoconfiguration, SSH, Telnet, ping, traceroute, path MTU, static routing, dynamic routing (BGP, IS-ISv6, OSPFv3), MLDv1 and v2, graceful restart, virtual routers, SNMP, CoS, VRRPv3, Radius, TACACS+, AAA, NTP, and syslog	Junos OS 13.2X51-D10

Table 8: Layer 2 Network Protocol Features

Feature	QFX5100
802.1Q VLAN tagging	Junos OS 13.2X51-D10
BPDU protection for spanning-tree protocols	Junos OS 13.2X51-D10
Jumbo frames on routed VLAN interfaces (RVIs)	Junos OS 13.2X51-D10
Link Layer Discovery Protocol (LLDP)	Junos OS 13.2X51-D10
Loop protection for spanning-tree protocols	Junos OS 13.2X51-D10

Table 8: Layer 2 Network Protocol Features *(continued)*

Feature	QFX5100
Root protection for spanning-tree protocols	Junos OS 13.2X51-D10
Spanning tree: • Spanning Tree Protocol (STP) • Rapid Spanning Tree Protocol (RSTP) • Multiple Spanning Tree Protocol (MSTP) • VLAN Spanning Tree Protocol (VSTP) • RSTP and VSTP concurrent configuration	Junos OS 13.2X51-D10
VLAN ranges	Junos OS 13.2X51-D10
Proxy ARP	Junos OS 13.2X51-D10
Redundant trunk groups	Junos OS 13.2X51-D10
Unified forwarding table	Junos OS 13.2X51-D10

Table 9: Layer 3 Protocol Features

Feature	QFX5100
Bidirectional Forwarding Detection (BFD)	Junos OS 13.2X51-D10
Border Gateway Protocol (BGP)	Junos OS 13.2X51-D10
BGP for IPv6	Junos OS 13.2X51-D10
BGP monitoring protocol (BMP) v 3	Junos OS 13.2X51-D15
BGP support for advertising multiple paths to IPv6 addresses	Junos OS 13.2X51-D15
Intermediate System-to-Intermediate System (IS-IS)	Junos OS 13.2X51-D10
IS-ISv6	Junos OS 13.2X51-D10
Open Shortest Path First (OSPF) v2	Junos OS 13.2X51-D10
OSPFv3	Junos OS 13.2X51-D10
Per-packet load balancing (ECMP)	Junos OS 13.2X51-D10
64 ECMP paths	Junos OS 13.2X51-D15
Routing Information Protocol versions 1 and 2 (RIPv1 and RIPv2)	Junos OS 13.2X51-D10
Routed VLAN interfaces (RVIs)	Junos OS 13.2X51-D10

Table 9: Layer 3 Protocol Features *(continued)*

Feature	QFX5100
Static routes	Junos OS 13.2X51-D10
Virtual router routing instances for unicast protocols	Junos OS 13.2X51-D10
Virtual router routing instances for multicast protocols	Junos OS 13.2X51-D10

Table 10: Multicast Protocol Features

Feature	QFX5100
IGMPv1 and v2	Junos OS 13.2X51-D10
IGMPv3	Junos OS 13.2X51-D10
IGMPv1 and v2 snooping	Junos OS 13.2X51-D10
IGMP querier	Junos OS 13.2X51-D10
IGMP filtering	Junos OS 13.2X51-D10
Multicast Listener Discovery (MLD) Protocol , v1 and v2	Junos OS 13.2X51-D10
Protocol Independent Multicast sparse mode (PIM SM)	Junos OS 13.2X51-D10
Protocol Independent Multicast source-specific multicast (PIM SSM)	Junos OS 13.2X51-D10
Bidirectional Forwarding Detection (BFD) for PIM	Junos OS 13.2X51-D10

Table 11: MPLS Features

Feature	QFX5100
Multiprotocol Label Switching (MPLS)	Junos OS 13.2X51-D10
MPLS statistics	Junos OS 13.2X51-D15
MPLS auto bandwidth	Junos OS 13.2X51-D15

Table 12: Network Management and Monitoring Features

Feature	QFX5100
Local port mirroring	Junos OS 13.2X51-D10
Remote port mirroring	Junos OS 13.2X51-D10
RMON	Junos OS 13.2X51-D10

Table 12: Network Management and Monitoring Features *(continued)*

Feature	QFX5100
sFlow monitoring technology	Junos OS 13.2X51-D10
Simple Network Management Protocol version 1 (SNMPv1) and SNMPv2, and SNMPv3.	Junos OS 13.2X51-D10
Uplink failure detection	Junos OS 13.2X51-D10
Junos OS automation script support	Junos OS 13.2X51-D10
Automation enhancements for QFX5100 switches	Junos OS 13.2X51-D15
Network analytics (traffic and queue statistics)	Junos OS 13.2X51-D10
Network analytics enhancements with CLI changes	Junos OS 13.2X51-D15

Table 13: Port Security Features

Feature	QFX5100
Automatic recovery for port error disable conditions	Junos OS 13.2X51-D10
MAC limiting	Junos OS 13.2X51-D10
MAC move limiting	Junos OS 13.2X51-D10
Persistent MAC learning (sticky MAC)	Junos OS 13.2X51-D10
Static ARP support	Junos OS 13.2X51-D10
Storm control (broadcast, unicast, and multicast)	Junos OS 13.2X51-D10
DHCP snooping	Junos OS 13.2X51-D10
Dynamic ARP inspection (DAI)	Junos OS 13.2X51-D10
Unicast reverse-path forwarding (RPF)	Junos OS 13.2X51-D10
Unknown Layer 2 unicast forwarding	Junos OS 13.2X51-D10

Table 14: Security

Feature	QFX5100
Firewall filters and rate limiting	Junos OS 13.2X51-D10
Enhanced firewall filter classification of CPU generated packets	Junos OS 13.2X51-D15
Policing	Junos OS 13.2X51-D10

Table 14: Security *(continued)*

Feature	QFX5100
Policer action for MPLS firewall filters	Junos OS 13.2X51-D15
Filter-based forwarding	Junos OS 13.2X51-D10

(For a list of supported firewall filter match conditions and actions, see "Firewall Filter Match Conditions and Actions" on page 4419.)

Table 15: Storage and Fibre Channel Features

Feature	QFX5100
Data center bridging technologies: priority-based flow control (PFC), enhanced transmission selection (ETS), and Data Center Bridging Capability Exchange protocol (DCBX) including IEEE DCBX and DCBX version 1.01	Junos OS 13.2X51-D10
Fibre Channel over Ethernet (FCoE)	Junos OS 13.2X51-D10
FCoE Initialization Protocol (FIP)	Junos OS 13.2X51-D10
FCoE transit switch (FIP snooping)	Junos OS 13.2X51-D10
2500 FIP snooping sessions	Junos OS 13.2X51-D10
DCBX application protocol TLV exchange	Junos OS 13.2X51-D10
VN_Port to VN_Port FIP snooping to enable configuring virtual links between VN_Ports without sending traffic through an FCoE forwarder (FCF)	Junos OS 13.2X51-D10
Fibre Channel fabrics (FCoE to Fibre Channel gateway, Fibre Channel interfaces)	Not Supported
Graceful restart for FCoE-FC gateway	Not supported
Fibre Channel load balancing, maximum session limit, disabling fabric WWN verification check	Not supported
FCoE OxID hash control	Not Supported

Table 16: System Management Features

Feature	QFX5100
Configuration rollback	Junos OS 13.2X51-D10
Online insertion and removal (OIR)	Junos OS 13.2X51-D10
VMM	Junos OS 13.2X51-D10
Guest virtual machine (VM)	Junos OS 13.2X51-D15

Related Documentation

PART 3

Junos OS Basics

CHAPTER 3

Overview

Software Overview

QFX5100 Software Features Overview

This topic lists the Juniper Networks QFX Series software features supported on the QFX5100 switch and the Junos operating system (Junos OS) release in which they were introduced.

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NOTE: The command-line interface (CLI) on the QFX Series might display configuration statements that are not supported. However, configuring an unsupported statement on a device has no effect on the operation of the device.

Table 17: Administration Features

Feature	QFX5100
System logging (syslog) over IPv4	Junos OS 13.2X51-D10
Licensing	Junos OS 13.2X51-D10

Table 18: CoS Features

Feature	QFX5100
Class of service (CoS)—Class-based queuing with prioritization	Junos OS 13.2X51-D10
CoS—Multidestination	Junos OS 13.2X51-D10
CoS support on link aggregation groups (LAGs)	Junos OS 13.2X51-D10
Enhanced transmission selection (ETS)	Junos OS 13.2X51-D10
CoS rewrite rules	Junos OS 13.2X51-D10
Queue shaping	Junos OS 13.2X51-D10
Priority-based flow control (PFC)	Junos OS 13.2X51-D10

Table 18: CoS Features *(continued)*

Feature	QFX5100
Re-marking of bridged packets	Junos OS 13.2X51-D10
Weighted random early detection (WRED) tail-drop profiles	Junos OS 13.2X51-D10
802.3X Ethernet PAUSE autonegotiation enhancements	Junos OS 13.2X51-D10
Layer 3 ingress packet classification and egress rewrite rule class-of-service features	Junos OS 13.2X51-D10
Software buffer configurability	Junos OS 13.2X51-D10

Table 19: High Availability and Resiliency Features

Feature	QFX5100
Graceful protocol restart for BGP	Junos OS 13.2X51-D10
Graceful protocol restart for OSPF	Junos OS 13.2X51-D10
Link aggregation groups (LAGs)	Junos OS 13.2X51-D10
Support for 32 members in a link aggregation group (LAG)	Junos OS 13.2X51-D10
Multichassis link aggregation	Junos OS 13.2X51-D10
Virtual Router Redundancy Protocol (VRRP)	Junos OS 13.2X51-D10
In-Service Software Upgrade (ISSU)	Junos OS 13.2X51-D15
Zero Touch Provisioning (ZTP)	Junos OS 13.2X51-D15

Table 20: Interface Features

Feature	QFX5100
Auto-channelization	Junos OS 13.2X51-D15
Interface ranges	Junos OS 13.2X51-D10
Interface channelization	Junos OS 13.2X51-D10
VLAN-tagged Layer 3 logical interfaces	Junos OS 13.2X51-D10
Digital optical monitoring (DOM)	Junos OS 13.2X51-D10
IPv4 over generic routing encapsulation (GRE) tunnels— encapsulation support	Junos OS 13.2X51-D10

Table 21: IP Address Management Features

Feature	QFX5100
Static addresses	Junos OS 13.2X51-D10
IPv4 support for telnet	Junos OS 13.2X51-D10
IPv6 support for neighbor discovery, router advertisements, stateless autoconfiguration, SSH, Telnet, ping, traceroute, path MTU, static routing, dynamic routing (BGP, IS-ISv6, OSPFv3), MLDv1 and v2, graceful restart, virtual routers, SNMP, CoS, VRRPv3, Radius, TACACS+, AAA, NTP, and syslog	Junos OS 13.2X51-D10

Table 22: Layer 2 Network Protocol Features

Feature	QFX5100
802.1Q VLAN tagging	Junos OS 13.2X51-D10
BPDU protection for spanning-tree protocols	Junos OS 13.2X51-D10
Jumbo frames on routed VLAN interfaces (RVIs)	Junos OS 13.2X51-D10
Link Layer Discovery Protocol (LLDP)	Junos OS 13.2X51-D10
Loop protection for spanning-tree protocols	Junos OS 13.2X51-D10
Root protection for spanning-tree protocols	Junos OS 13.2X51-D10
Spanning tree: • Spanning Tree Protocol (STP) • Rapid Spanning Tree Protocol (RSTP) • Multiple Spanning Tree Protocol (MSTP) • VLAN Spanning Tree Protocol (VSTP) • RSTP and VSTP concurrent configuration	Junos OS 13.2X51-D10
VLAN ranges	Junos OS 13.2X51-D10
Proxy ARP	Junos OS 13.2X51-D10
Redundant trunk groups	Junos OS 13.2X51-D10
Unified forwarding table	Junos OS 13.2X51-D10

Table 23: Layer 3 Protocol Features

Feature	QFX5100
Bidirectional Forwarding Detection (BFD)	Junos OS 13.2X51-D10
Border Gateway Protocol (BGP)	Junos OS 13.2X51-D10

Table 23: Layer 3 Protocol Features *(continued)*

Feature	QFX5100
BGP for IPv6	Junos OS 13.2X51-D10
BGP monitoring protocol (BMP) v 3	Junos OS 13.2X51-D15
BGP support for advertising multiple paths to IPv6 addresses	Junos OS 13.2X51-D15
Intermediate System-to-Intermediate System (IS-IS)	Junos OS 13.2X51-D10
IS-ISv6	Junos OS 13.2X51-D10
Open Shortest Path First (OSPF) v2	Junos OS 13.2X51-D10
OSPFv3	Junos OS 13.2X51-D10
Per-packet load balancing (ECMP)	Junos OS 13.2X51-D10
64 ECMP paths	Junos OS 13.2X51-D15
Routing Information Protocol versions 1 and 2 (RIPv1 and RIPv2)	Junos OS 13.2X51-D10
Routed VLAN interfaces (RVIs)	Junos OS 13.2X51-D10
Static routes	Junos OS 13.2X51-D10
Virtual router routing instances for unicast protocols	Junos OS 13.2X51-D10
Virtual router routing instances for multicast protocols	Junos OS 13.2X51-D10

Table 24: Multicast Protocol Features

Feature	QFX5100
IGMPv1 and v2	Junos OS 13.2X51-D10
IGMPv3	Junos OS 13.2X51-D10
IGMPv1 and v2 snooping	Junos OS 13.2X51-D10
IGMP querier	Junos OS 13.2X51-D10
IGMP filtering	Junos OS 13.2X51-D10
Multicast Listener Discovery (MLD) Protocol , v1 and v2	Junos OS 13.2X51-D10
Protocol Independent Multicast sparse mode (PIM SM)	Junos OS 13.2X51-D10
Protocol Independent Multicast source-specific multicast (PIM SSM)	Junos OS 13.2X51-D10

Table 24: Multicast Protocol Features *(continued)*

Feature	QFX5100
Bidirectional Forwarding Detection (BFD) for PIM	Junos OS 13.2X51-D10

Table 25: MPLS Features

Feature	QFX5100
Multiprotocol Label Switching (MPLS)	Junos OS 13.2X51-D10
MPLS statistics	Junos OS 13.2X51-D15
MPLS auto bandwidth	Junos OS 13.2X51-D15

Table 26: Network Management and Monitoring Features

Feature	QFX5100
Local port mirroring	Junos OS 13.2X51-D10
Remote port mirroring	Junos OS 13.2X51-D10
RMON	Junos OS 13.2X51-D10
sFlow monitoring technology	Junos OS 13.2X51-D10
Simple Network Management Protocol version 1 (SNMPv1) and SNMPv2, and SNMPv3.	Junos OS 13.2X51-D10
Uplink failure detection	Junos OS 13.2X51-D10
Junos OS automation script support	Junos OS 13.2X51-D10
Automation enhancements for QFX5100 switches	Junos OS 13.2X51-D15
Network analytics (traffic and queue statistics)	Junos OS 13.2X51-D10
Network analytics enhancements with CLI changes	Junos OS 13.2X51-D15

Table 27: Port Security Features

Feature	QFX5100
Automatic recovery for port error disable conditions	Junos OS 13.2X51-D10
MAC limiting	Junos OS 13.2X51-D10
MAC move limiting	Junos OS 13.2X51-D10
Persistent MAC learning (sticky MAC)	Junos OS 13.2X51-D10

Table 27: Port Security Features *(continued)*

Feature	QFX5100
Static ARP support	Junos OS 13.2X51-D10
Storm control (broadcast, unicast, and multicast)	Junos OS 13.2X51-D10
DHCP snooping	Junos OS 13.2X51-D10
Dynamic ARP inspection (DAI)	Junos OS 13.2X51-D10
Unicast reverse-path forwarding (RPF)	Junos OS 13.2X51-D10
Unknown Layer 2 unicast forwarding	Junos OS 13.2X51-D10

Table 28: Security

Feature	QFX5100
Firewall filters and rate limiting	Junos OS 13.2X51-D10
Enhanced firewall filter classification of CPU generated packets	Junos OS 13.2X51-D15
Policing	Junos OS 13.2X51-D10
Policer action for MPLS firewall filters	Junos OS 13.2X51-D15
Filter-based forwarding	Junos OS 13.2X51-D10

(For a list of supported firewall filter match conditions and actions, see "Firewall Filter Match Conditions and Actions" on page 4419.)

Table 29: Storage and Fibre Channel Features

Feature	QFX5100
Data center bridging technologies: priority-based flow control (PFC), enhanced transmission selection (ETS), and Data Center Bridging Capability Exchange protocol (DCBX) including IEEE DCBX and DCBX version 1.01	Junos OS 13.2X51-D10
Fibre Channel over Ethernet (FCoE)	Junos OS 13.2X51-D10
FCoE Initialization Protocol (FIP)	Junos OS 13.2X51-D10
FCoE transit switch (FIP snooping)	Junos OS 13.2X51-D10
2500 FIP snooping sessions	Junos OS 13.2X51-D10
DCBX application protocol TLV exchange	Junos OS 13.2X51-D10

Table 29: Storage and Fibre Channel Features *(continued)*

Feature	QFX5100
VN_Port to VN_Port FIP snooping to enable configuring virtual links between VN_Ports without sending traffic through an FCoE forwarder (FCF)	Junos OS 13.2X51-D10
Fibre Channel fabrics (FCoE to Fibre Channel gateway, Fibre Channel interfaces)	Not Supported
Graceful restart for FCoE-FC gateway	Not supported
Fibre Channel load balancing, maximum session limit, disabling fabric WWN verification check	Not supported
FCoE OxID hash control	Not Supported

Table 30: System Management Features

Feature	QFX5100
Configuration rollback	Junos OS 13.2X51-D10
Online insertion and removal (OIR)	Junos OS 13.2X51-D10
VMM	Junos OS 13.2X51-D10
Guest virtual machine (VM)	Junos OS 13.2X51-D15

Related Documentation

Configuration File Terms

Table 31 on page 26 lists the various configuration file terms used for the QFX Series and their definitions.

Table 31: Configuration File Terms

Term	Definition
active configuration	Current committed configuration of a switch.
candidate configuration	Working copy of the configuration that allows users to make configurational changes without causing any operational changes until this copy is committed.
configuration group	Group of configuration statements that can be inherited by the rest of the configuration.
commit a configuration	Check configuration for proper syntax, activate and mark as the current configuration file running on the switching platform.

Table 31: Configuration File Terms *(continued)*

Term	Definition
configuration hierarchy	Junos OS configuration consists of a hierarchy of statements. There are two types of statements: container statements, which contain other statements, and leaf statements, which do not contain other statements. All the container and leaf statements together form the configuration hierarchy.
default configuration	Default configuration contains the initial values set for each configuration parameter when a switch is shipped.
rescue configuration	Well-known configuration that recovers a switch from a configuration that denies management access. You set a current committed configuration to be the rescue configuration through the CLI.
roll back a configuration	Return to a previously committed configuration.

Related Documentation

- Loading a Previous Configuration File on page 1136
- Reverting to the Rescue Configuration on page 165
- Understanding Configuration Files on page 1126

Format for Specifying IP Addresses, Network Masks, and Prefixes in Junos OS Configuration Statements

Many statements in the Junos OS configuration include an option to specify an IP address or route prefix. This option is represented in one of the following ways:

- ***network/prefix-length***—Network portion of the IP address, followed by a slash and the destination prefix length (previously called the subnet mask). For example, 10.0.0.1/8.
- ***network***—IP address. For example, 10.0.0.2.
- ***destination-prefix/prefix-length***—Route prefix, followed by a slash and the destination prefix length. For example, 192.168.1.10/32.

You enter all IP addresses in classless mode. You can enter the IP address with or without a prefix length, in standard dotted notation (for example, 1.2.3.4), or hexadecimal notation as a 32-bit number in network-byte order (for example, 0x01020304). If you omit any octets, they are assumed to be zero. Specify the prefix length as a decimal number from 1 through 32.

Related Documentation

- Format for Specifying Filenames and URLs in Junos OS CLI Commands on page 57

In-Service Software Upgrade (ISSU) System Requirements

To perform an in-service software upgrade (ISSU), your device must be running Junos OS Release 13.2X51-D15 or later.

NOTE: ISSU does not support extension application packages developed with the Junos SDK.

- In-Service Software Upgrade (ISSU) Protocol and Process Support on page 28

In-Service Software Upgrade (ISSU) Protocol and Process Support

Table 32 on page 28 lists the protocols and processes that are supported during an ISSU. Protocols that are not supported might cause packet loss.

Table 32: ISSU Protocol Support

Protocol	Junos OS Release
Graceful Routing Engine switchover (GRES)	Junos OS 13.2X51-D15 and above
Internet Group Management Protocol (IGMP)	Junos OS 13.2X51-D15 and above
Layer 2 MAC routes	Junos OS 13.2X51-D15 and above
Layer 3 unicast and multicast routes	Junos OS 13.2X51-D15 and above
Layer 2 multicast routes	Junos OS 13.2X51-D15 and above
Link Aggregation Control Protocol (LACP) NOTE: Configure LACP before you issue an ISSU. The LACP **periodic fast** mode is not supported. Instead, configure the **periodic slow** mode. If you configure the **periodic fast** mode, the configuration can be committed without any commit or system log error messages, but you might experience a larger than expected amount of traffic drops. Traffic drops occur because the LACP links go down during an ISSU. Link changes are processed after an ISSU is complete.	Junos OS 13.2X51-D15 and above
Multicast Listener Discovery (MLD) snooping	Junos OS 13.2X51-D15 and above
Spanning tree protocols: • Multiple Spanning Tree Protocol (MSTP) • Rapid Spanning Tree Protocol (RSTP) • Spanning Tree Protocol (STP) • VLAN Spanning Tree Protocol (VSTP)	Junos OS 13.2X51-D15 and above

Related Documentation

- Understanding In-Service Software Upgrade (ISSU) on page 40
- Performing an In-Service Software Upgrade (ISSU) on page 106

Junos OS Commit Model for Router or Switch Configuration

The router or switch configuration is saved using a commit model—a candidate configuration is modified as desired and then committed to the system. When a configuration is committed, the router or switch checks the configuration for syntax errors, and if no errors are found, the configuration is saved as **juniper.conf.gz** and activated. The formerly active configuration file is saved as the first rollback configuration file (**juniper.conf.1.gz**), and any other rollback configuration files are incremented by 1. For example, **juniper.conf.1.gz** is incremented to **juniper.conf.2.gz**, making it the second rollback configuration file. The router or switch can have a maximum of 49 rollback configurations (numbered 1 through 49) saved on the system.

On the router or switch, the active configuration file and the first three rollback files (**juniper.conf.gz.1, juniper.conf.gz.2, juniper.conf.gz.3**) are located in the **/config** directory. If the file **rescue.conf.gz** is saved on the system, this file should also be saved in the **/config** directory. The factory default files are located in the **/etc/config** directory.

There are two mechanisms used to propagate the configurations between Routing Engines within a router or switch:

- Synchronization—Propagates a configuration from one Routing Engine to a second Routing Engine within the same router or switch chassis.

  NOTE: The QFX3500 switch has only one Routing Engine.

  To synchronize configurations, use the **commit synchronize** CLI command. If one of the Routing Engines is locked, the synchronization fails. If synchronization fails because of a locked configuration file, you can use the **commit synchronize force** command. This command overrides the lock and synchronizes the configuration files.

- Distribution—Propagates a configuration across the routing plane on a multichassis router or switch. Distribution occurs automatically. There is no user command available to control the distribution process. If a configuration is locked during a distribution of a configuration, the locked configuration does not receive the distributed configuration file, so the synchronization fails. You need to clear the lock before the configuration and resynchronize the routing planes.

  NOTE: When you use the **commit synchronize force** CLI command on a multichassis platform, the forced synchronization of the configuration files does not affect the distribution of the configuration file across the routing plane. If a configuration file is locked on a router or switch remote from the router or switch where the command was issued, the synchronization fails on the remote router or switch. You need to clear the lock and reissue the synchronization command.

Related Documentation

- *Configuring Junos OS for the First Time on a Router or Switch with a Single Routing Engine*

- commit on page 319

Junos OS Package Names

You upgrade the Juniper Networks Junos OS on the QFX Series by copying a software package to your switch or another system on your local network and then installing the new software package on the switch.

A software package name is in the following format:

NOTE: **A signed domestic package is used as an example only. Other types of software packages might be available in future releases.**

***package-name-m.nZx.y*-domestic-signed.tgz**

where:

- ***package-name*** is the name of the package—for example, **jinstall-qfx**.
- ***m.n*** is the software release, with ***m*** representing the major release number and ***n*** representing the minor release number—for example, **11.1**.
- ***Z*** indicates the type of software release, where **R** indicates released software and **B** indicates beta-level software.
- ***x.y*** represents the maintenance software release, with ***x*** representing the maintenance software release number and ***y*** representing the maintenance software spin number—for example, **1.5**.

A sample switch software package name is:

```
jinstall-qfx-11.1R1.5-domestic-signed.tgz
```

Related Documentation

- Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches on page 121
- *Upgrading Software on a QFabric System*
- Software Installation Overview on page 109

NTP Time Server and Time Services Overview

When configuring the Network Time Protocol (NTP), you can specify which system on the network is the authoritative time source, or time server, and how time is synchronized between systems on the network. To do this, you configure the router or switch to operate in one of the following modes:

- Client mode—In this mode, the local router or switch can be synchronized with the remote system, but the remote system can never be synchronized with the local router or switch.
- Symmetric active mode—In this mode, the local router or switch and the remote system can synchronize with each other. You use this mode in a network in which either the local router or switch or the remote system might be a better source of time.

> NOTE: Symmetric active mode can be initiated by either the local or the remote system. Only one system needs to be configured to do so. This means that the local system can synchronize with any system that offers symmetric active mode without any configuration whatsoever. However, we strongly encourage you to configure authentication to ensure that the local system synchronizes only with known time servers.

- Broadcast mode—In this mode, the local router or switch sends periodic broadcast messages to a client population at the specified broadcast or multicast address. Normally, you include this statement only when the local router or switch is operating as a transmitter.
- Server mode—In this mode, the local router or switch operates as an NTP server.

> NOTE: In NTP server mode, the Junos OS supports authentication as follows:
>
> - If the NTP request from the client comes with an authentication key (such as a key ID and message digest sent with the packet), the request is processed and answered based on the authentication key match.
> - If the NTP request from the client comes without any authentication key, the request is processed and answered without authentication.

Related Documentation

- Configuring the NTP Time Server and Time Services on page 143
- Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization on page 177

Overview of CoS Upgrade Requirements (Junos OS Release 11.1 or 11.2 to a Later Release)

Before you upgrade to Junos OS Release 11.3, you must deactivate the CoS configuration if the CoS configuration includes any of the following features:

- **excess-rate** option
- **strict-high** or **high** priority queues
- Any of the Junos OS Release 11.1 or 11.2 default multidestination forwarding classes

CAUTION: **If your CoS configuration contains any of the features listed above and you attempt to upgrade from Junos OS Release 11.1 or 11.2 to a later version without first editing the configuration, the Junos OS might not restart.**

Junos OS Release 11.3 and later for QFX Series no longer supports the **excess-rate** statement, the **strict** priority option, or the default multidestination forwarding classes used in Junos OS Release 11.1 and 11.2. In addition, Junos OS Release 11.3 introduces new restrictions on how to configure and use **strict-high** priority queues.

This topic does not describe how to perform the software upgrade procedure. It describes how to deactivate your CoS configuration, edit your CoS configuration, and reactivate your CoS configuration at the appropriate times.

Use the following procedure to upgrade safely from Junos OS Release 11.1 or 11.2 to a later release:

1. Deactivate the CoS configuration *before* you upgrade the software:

   `user@switch#` **deactivate class-of-service**
2. Follow the upgrade procedure to Junos OS Release 11.3 or later software.
3. Make the following changes to the CoS configuration while the CoS configuration is still deactivated:
   - Remove the **excess-rate** statement from the CoS configuration if you have used it at the **[edit class-of-service schedulers]** or **[edit class-of-service traffic-control-profiles]** hierarchy level.
   - Remove the **strict-high** and **strict** priority queue configurations if you have used them at the **[edit class-of-service schedulers]** hierarchy level.
   - Remove the default multidestination forwarding classes (**mcast-be**, **mcast-af**, **mcast-ef**, and **mcast-nc**) if you have used them at the **[edit class-of-service schedulers]**, **[edit class-of-service rewrite-rules]**, **[edit class-of-service classifiers]**, **[edit class-of-service scheduler-maps]**, or **[edit class-of-service forwarding-class-sets]** hierarchy level. Alternatively, you can change the mapping of the multidestination traffic to use the new default multidestination forwarding class (**mcast**).
4. If desired, configure **strict-high** priority queues in accordance with the Junos OS Release 11.3 or later configuration rules, and map multidestination traffic to the default multidestination forwarding class (**mcast**).

5. Activate the CoS configuration:

   `user@switch#` **activate class-of-service**

6. Commit the CoS configuration:

   `user@switch#` **commit**

NOTE: If you configured the **transmit-rate** option for any queues under the **[edit class-of-service schedulers]** hierarchy level, if the rate is configured as an exact rate in Mbps, we recommend that you reconfigure the **transmit-rate** option as a percentage. This is because the scheduler converts exact rates to percentages, and when the exact rate is below 1 Gbps, some granularity may be lost in the conversion. You can avoid this potential issue by specifying the **transmit-rate** option as a percentage.

Related Documentation

- Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches on page 121
- Understanding CoS Classifiers on page 5334
- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Traffic Control Profiles on page 5381
- Overview of CoS Upgrade Requirements to Junos OS Release 12.2 on page 5291
- Overview of CoS Upgrade Requirements to Junos OS Release 12.3 (QFX3500 and QFX3600 Switches) or to Junos OS Release 13.1 (QFabric Systems) on page 5293
- Example: Configuring Unicast Classifiers on page 5495
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519

Understanding Autoinstallation of Configuration Files

Autoinstallation is the automatic configuration of a device over the network from a preexisting configuration file that you create and store on a configuration server—typically a Trivial File Transfer Protocol (TFTP) server. You can use autoinstallation to configure new devices automatically and to deploy multiple devices from a central location in the network.

You enable autoinstallation so that the switches in your network implement autoinstallation when they are powered on. To configure autoinstallation, you specify a configuration server, an autoinstallation interface, and a protocol for IP address acquisition.

This topic describes:

Typical Uses for Autoinstallation

Typical uses for autoinstallation of the software include:

- To deploy and update multiple devices from a central location in the network.
- To update a device—Autoinstallation occurs when a device that has been manually configured for autoinstallation is powered on.

Autoinstallation Configuration Files and IP Addresses

For the autoinstallation process to work, you must store one or more host-specific or default configuration files on a configuration server in the network and have a service available—typically Dynamic Host Configuration Protocol (DHCP)—to assign an IP address to the switch.

You can set up the following configuration files for autoinstallation on the switch:

- **network.conf**—Default configuration file for autoinstallation, in which you specify IP addresses and associated hostnames for devices on the network.
- **switch.conf**—Default configuration file for autoinstallation with a minimum configuration sufficient for you to telnet to the device and configure it manually.
- ***hostname*.conf**—Host-specific configuration file for autoinstallation on a device that contains all the configuration information necessary for the switch. In the filename, ***hostname*** is replaced with the hostname assigned to the switch.

If the server with the autoinstallation configuration file is not on the same LAN segment as the new device, or if a specific device is required by the network, you must configure an intermediate device directly attached to the new switch, through which the new switch can send TFTP, Boot Protocol (BOOTP), and Domain Name System (DNS) requests. In this case, you specify the IP address of the intermediate device as the location to receive TFTP requests for autoinstallation.

Typical Autoinstallation Process on a New Switch

When the switch configured for autoinstallation is powered on, it performs the following autoinstallation tasks:

1. The switch sends out DHCP or BOOTP requests on each connected interface simultaneously to obtain an IP address.

   If a DHCP server responds to these requests, it provides the switch with some or all of the following information:

   - An IP address and subnet mask for the autoinstallation interface.
   - The location of the (typically) TFTP server, Hypertext Transfer Protocol (HTTP) server, or FTP server on which the configuration file is stored.
   - The name of the configuration file to be requested from the TFTP server.
   - The IP address or hostname of the TFTP server.

If the DHCP server provides the server's hostname, a DNS server must be available on the network to resolve the name to an IP address.

- The IP address of an intermediate device if the configuration server is on a different LAN segment from the switch.

2. After the switch acquires an IP address, the autoinstallation process on the switch attempts to download a configuration file in the following ways:

   a. If the DHCP server specifies the host-specific configuration file ***hostname*****.conf**, the switch uses that filename in the TFTP server request. The autoinstallation process on the new switch makes three unicast TFTP requests for ***hostname*****.conf**. If these attempts fail, the switch broadcasts three requests to any available TFTP server for the file.

   b. If the switch does not locate a ***hostname*****.conf** file, the autoinstallation process sends three unicast TFTP requests for a **network.conf** file that contains the switch's hostname-to-IP-address mapping information. If these attempts fail, the switch broadcasts three requests to any available TFTP server for the file.

   c. If the switch fails to find a **network.conf** file that contains a hostname entry for the switch, the autoinstallation process sends out a DNS request and attempts to resolve the switch's IP address to a hostname.

   d. If the switch determines its hostname, it sends a TFTP request for the ***hostname*****.conf** file.

   e. If the switch is unable to map its IP address to a hostname, it sends TFTP requests for the default configuration file **switch.conf**. The TFTP request procedure is the same as for the **network.conf** file.

3. After the switch locates a configuration file on a TFTP server, the autoinstallation process downloads the file, installs the file on the switch, and commits the configuration.

Related Documentation

- Configuring Autoinstallation of Configuration Files (CLI Procedure) on page 130
- *Connecting and Configuring an EX Series Switch (CLI Procedure)*
- *Connecting and Configuring an EX Series Switch (J-Web Procedure)*
- *Configuration Files Terms*

Understanding DHCP Services for Switches

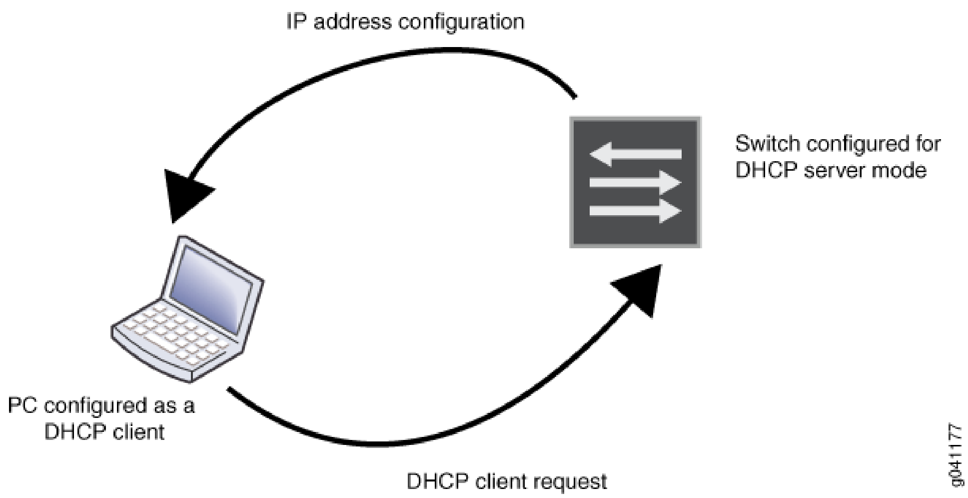
A Dynamic Host Configuration Protocol (DHCP) server on a Juniper Networks EX Series Ethernet Switch can provide many valuable TCP/IP network services. For example, DHCP can dynamically allocate the four required IP parameters to each computer on the LAN: IP address, network mask, router or switch address, and name server address. Additionally, DHCP on the switch can automatically upgrade software on client systems.

This topic describes:

DHCP Client/Server Model

DHCP IP address allocation works on a client/server model in which the server, in this case a switch, assigns the client reusable IP information from an address pool. A DHCP client might receive offer messages from multiple DHCP servers and can accept any one of the offers; however, the client usually accepts the first offer it receives. See Figure 5 on page 36.

Figure 5: DHCP Client/Server Model



Using DHCP

DHCP automates network-parameter assignment to network devices. Even in small networks, DHCP is useful because it makes it easy to add new machines to the network.

DHCP access service minimizes the overhead required to add clients to the network by providing a centralized, server-based setup, which means that you do not have to manually create and maintain IP address assignments for clients. In addition, when you use DHCP to manage a pool of IP addresses among hosts, you reduce the number of IP addresses needed on the network. DHCP does this by leasing an IP address to a host for a limited period of time, allowing the DHCP server to share a limited number of IP addresses. DHCP also provides a central database of devices that are connected to the network and eliminates duplicate resource assignments. In addition to IP addresses for clients, DHCP provides other configuration information, particularly the IP addresses of local caching Domain Name System (DNS) resolvers, network boot servers, or other service hosts.

Another valuable DHCP feature is automatic software download for installation of software packages on switches. DHCP clients configured for automatic software download receive messages as part of the DHCP message exchange process—when the software package name in the DHCP server message is different from that of the software package that booted the DHCP client switch, the new software is downloaded and installed. See "Upgrading Software Using Automatic Software Download" on page 127.

DHCP Relay Servers and DHCP Servers

You can configure a switch either as a DHCP server or as a DHCP relay server, but not both. Whereas a DHCP server replies to a client with an IP address, a DHCP relay server relays DHCP messages to and from the configured DHCP server, even if the client and server are on different IP networks.

Configure a switch to be a DHCP relay agent if you have locally attached hosts and a remote DHCP server. For directions on configuring a DHCP relay server, see *DHCP/BOOTP Relay for Switches Overview*.

Legacy DHCP and Extended DHCP for Server Versions

Two versions of both DHCP server and DHCP relay agent are available on EX Series switches and on the QFX Series. The original legacy DHCP server and legacy DHCP relay agent can be used in the same network as the extended DHCP servers and extended DHCP relay agent—extended DHCP is also referred to as virtual router (VR) aware DHCP.

You cannot configure legacy DHCP and extended DHCP versions on the same switch. Because the newer extended DHCP server version has more features, we recommend that you configure the extended DHCP server if it is supported by the switch. See *EX Series Switch Software Features Overview* for a list of switches that support the extended DHCP server.

The extended DHCP server version has the following added features:

- Graceful Routing Engine switchover (GRES), which provides mirroring support for clients. For details, see *High Availability Features for EX Series Switches Overview*.
- Virtual routing and forwarding (VRF), which allows multiple instances of a routing table to simultaneously coexist on the same switch. For details, see *Understanding Virtual Routing Instances on EX Series Switches* .

NOTE: Legacy DHCP supports the circuit ID and the remote ID fields for the relay agent option (option 82). Extended DHCP for the relay agent option supports only circuit ID. See *EX Series Switch Software Features Overview* for a list of switches that support extended DHCP (VR-aware DHCP).

Legacy DHCP and extended DHCP servers can be configured at the hierarchy levels shown in Table 33 on page 38:

Table 33: Legacy DHCP and Extended DHCP Server Hierarchy Levels

DHCP Service	Hierarchy
Extended DHCP server	**edit system services dhcp-local-server**
Extended DHCP address pool	**edit access address-assignment pool**
Legacy DHCP server	**edit system services dhcp**
Legacy DHCP relay	**edit forwarding-options helpers bootp**
Extended DHCP relay	**edit forwarding-options dhcp-relay**
Legacy DHCP address pool	**edit system services dhcp pool**

DHCP clients on a switch are always configured at the hierarchy level **[edit interfaces *interface-name* family dhcp]**.

Configuring DHCP on a Switch

A DHCP configuration consists of two parts: the configuration for a DHCP server and the configuration for DHCP clients. The DHCP server configuration is simple if you accept the default configurations.

When you configure a legacy DHCP server, you only need to define the DHCP server name and the interface on the switch. You can use the default configuration for the rest of the settings. When you configure an extended DHCP server, you need to only define a DHCP pool, indicate IP addresses for the pool, and create a server group. You can use the default configuration for the rest of the settings.

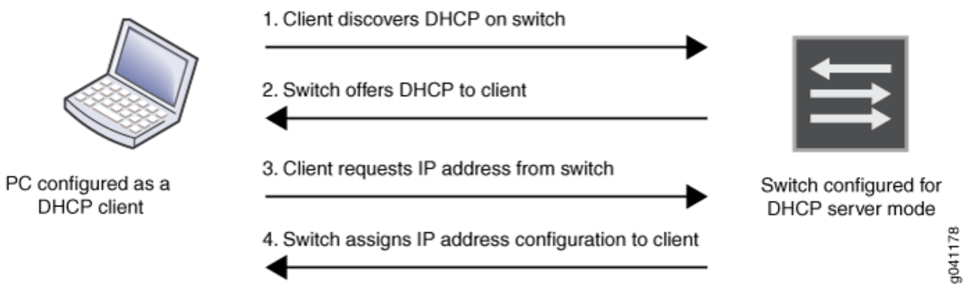
For directions for configuring either a legacy DHCP server or an extended DHCP server, see "Configuring a DHCP Server on Switches (CLI Procedure)" on page 133.

To configure a DHCP client, set the client's DHCP interface address in the **[edit interfaces interface-name unit 0 family inet dhcp]** hierarchy. For directions for configuring a DHCP client on a switch, see "Configuring a DHCP Client (CLI Procedure)" on page 132.

How DHCP Works

DHCP consists of a four-step transfer process beginning with a broadcast DHCP discovery message from the client. As the second step, the client receives a DHCP offer message from the server. This message includes the IP address and mask, and some other specific parameters. The client then sends a DHCP request message to accept the IP address and other parameters that it received from the server in the previous step. The DHCP server sends a DHCP response message and removes the now-allocated address from the DHCP address pool. See Figure 6 on page 39.

Figure 6: DHCP Four-Step Transfer



NOTE: Because the DHCP discovery message from the client is a broadcast message and because broadcast messages cross other segments only when they are explicitly routed, you might have to configure a DHCP relay agent on the switch interface so that all DHCP discovery messages from the clients are forwarded to one DHCP server.

Related Documentation

- Configuring a DHCP Client (CLI Procedure) on page 132
- Configuring a DHCP Server on Switches (CLI Procedure) on page 133
- *Configuring an Extended DHCP Relay Server on EX Series Switches (CLI Procedure)*
- *Configuring a DHCP SIP Server (CLI Procedure)*
- Upgrading Software Using Automatic Software Download on page 127
- *Monitoring DHCP Services*

Understanding In-Service Software Upgrade (ISSU)

An in-service software upgrade (ISSU) enables you to upgrade between two different Junos OS releases with minimal disruption on the control plane and with minimal disruption of traffic. During an ISSU, the Junos OS runs in two separate virtual machines (VMs)—one VM is in the master role acting as the master Routing Engine, and the other VM is in the backup role acting as the backup Routing Engine. The Junos OS is upgraded on the backup VM. After a successful software upgrade, the backup VM then becomes the master VM, and the original master VM is no longer needed and is shut down.

NOTE: **ISSU is supported in Junos OS Release 13.2X51-D15 and later.**

ISSU provides the following benefits:

- Eliminates network downtime during software image upgrades
- Reduces operating costs, while delivering higher service levels
- Allows fast implementation of new features

- In-Service Software Upgrade Process on page 40

In-Service Software Upgrade Process

When you request an ISSU on a standalone QFX5100 switch:

1. The management process (mgd) verifies that non-stop routing (NSR), graceful Routing Engine switchover (GRES), and non-stop bridging (NSB) are enabled.
2. The switch downloads and validates the software package.
3. The ISSU state machine spawns the backup Routing Engine (RE) with the newer software.
4. The ISSU state machine checks to see if the backup RE has synchronized all of the data with the master RE.
5. The ISSU state machine moves the devices (for example, forwarding ASIC, FPGA, management port and serial console) from the master RE to the backup RE.
6. The mastership is switched between the REs, so the backup RE becomes the master RE.
7. The old master RE is shut down.

Related Documentation

- In-Service Software Upgrade (ISSU) System Requirements on page 27
- Performing an In-Service Software Upgrade (ISSU) on page 106

Understanding Nonstop Software Upgrade on QFX Series Switches

Nonstop software upgrade (NSSU) enables you to upgrade the software running on all member switches in a QFX Series Virtual Chassis with minimal network traffic disruption during the upgrade.

NSSU is supported on both QFX3500 and QFX3600 Virtual Chassis platforms.

Performing an NSSU provides these benefits:

- No disruption to the control plane—NSSU uses graceful Routing Engine switchover (GRES) to ensure no disruption to the control plane. During the upgrade process, interface, kernel, and routing protocol information is preserved.
- Minimal disruption to network traffic—An NSSU minimizes network traffic disruption by:
  - Upgrading line cards one at a time permits traffic to continue to flow through the line cards that are not being upgraded.
  - Upgrading member switches one at a time enables the master and backup to maintain their master and backup roles (although mastership will change) without disruption to traffic.

  To achieve minimal disruption to traffic, you must configure link aggregation groups (LAGs) such that the member links of each LAG reside on different line cards or Virtual Chassis members. When one member link of a LAG is down, the remaining links are up, and traffic continues to flow through the LAG.

NOTE: Because NSSU upgrades the software on each line card or on each Virtual Chassis member one at a time, an upgrade using NSSU can take longer than an upgrade using the **request system software add** command.

This topic covers:

Requirements for Performing an NSSU

The following requirements apply to Virtual Chassis:

- All Virtual Chassis members and all Routing Engines must be running the same Junos OS release.
- Graceful Routing Engine switchover (GRES) must be enabled.

- For minimal traffic disruption, you must define link aggregation groups (LAGs) such that the member links reside on different Virtual Chassis members or on different line cards.

The following are requirements for Virtual Chassis members:

- The Virtual Chassis members must be connected in a ring topology so that no member is isolated as a result of another member being rebooted. This topology prevents the Virtual Chassis from splitting during an NSSU.
- The Virtual Chassis master and backup must be adjacent to each other in the ring topology. Adjacency permits the master and backup to always be in sync, even when the switches in linecard roles are rebooting.
- The Virtual Chassis must be preprovisioned so that the linecard role has been explicitly assigned to member switches acting in a linecard role. During an NSSU, the Virtual Chassis members must maintain their roles—the master and backup must maintain their master and backup roles (although mastership will change), and the remaining switches must maintain their linecard roles.
- A two-member Virtual Chassis must have **no-split-detection** configured so that the Virtual Chassis does not split when an NSSU upgrades a member.

How an NSSU Works

This section describes what happens when you request an NSSU on these switches and Virtual Chassis:

QFX3500 and QFX3600 Virtual Chassis

When you request an NSSU on an a QFX3500 or QFX3600 Virtual Chassis:

1. The Virtual Chassis master verifies that:
   - The backup is online and running the same software version.
   - Graceful Routing Engine switchover (GRES) is enabled.
   - The Virtual Chassis has a preprovisioned configuration.
2. The master installs the new software image on the backup and reboots it.
3. The master resynchronizes the backup.
4. The master installs the new software image on member switches that are in the linecard role and reboots them, one at a time. The master waits for each member to become online and active before starting the software upgrade on the next member.
5. When all members that are in the linecard role have been upgraded, the master performs a graceful Routing Engine switchover, and the upgraded backup becomes the master.
6. The software on the original master is upgraded and the original master is automatically rebooted. After the original master has rejoined the Virtual Chassis, you can optionally return control to it by requesting a graceful Routing Engine switchover.

NSSU Limitations

You cannot use an NSSU to downgrade the software—that is, to install an earlier version of the software than is currently running on the switch. To install an earlier software version, use the **request system software add** command.

You cannot roll back to the previous software version after you perform an upgrade using NSSU. If you need to rollback to the previous software version, you can do so by rebooting from the alternate root partition if you have not already copied the new software version into the alternate root partition.

NSSU and Junos OS Release Support

A Virtual Chassis must be running a Junos OS release that supports NSSU before you can perform an NSSU. If a Virtual Chassis is running a software version that does not support NSSU, use the **request system software add** command.

Table 34 on page 43 lists the QFX Series switches and Virtual Chassis that support NSSU and the Junos OS release at which they began supporting it.

Table 34: Platform and Release Support for NSSU

Platform	Junos OS Release
QFX3500 Virtual Chassis	13.2X50-D15 or later
QFX3600 Virtual Chassis	13.2X50-D15 or later

Overview of NSSU Configuration and Operation

You must ensure that the configuration of the switch or Virtual Chassis meets the requirements described in "Requirements for Performing an NSSU" on page 41. NSSU requires no additional configuration.

You perform an NSSU by executing the **request system software nonstop-upgrade** command. For detailed instructions on how to perform an NSSU, see the topics in Related Documentation.

Related Documentation

- Upgrading Software on QFX3500 and QFX3600 Virtual Chassis Using Nonstop Software Upgrade on page 125
- Configuring Graceful Routing Engine Switchover in a Virtual Chassis (CLI Procedure) on page 1746

Understanding Software Infrastructure and Processes

The QFX Series products run the Juniper Networks Junos OS. Junos OS includes processes for Internet Protocol (IP) routing and for managing interfaces, networks, and the switch.

Junos OS runs on the Routing Engine. The Routing Engine kernel coordinates communication among the Junos OS processes and provides a link to the Packet Forwarding Engine.

Using the Junos OS command-line interface (CLI), you configure switching features and set the properties of network interfaces. After activating a software configuration, use either the Junos Space or CLI user interface to monitor, manage operations, and diagnose protocol and network connectivity problems.

- Routing Engine and Packet Forwarding Engine on page 44
- Junos OS Processes on page 44

Routing Engine and Packet Forwarding Engine

A switch has two primary software processing components:

- Packet Forwarding Engine—Processes packets; applies filters, routing policies, and other features; and forwards packets to the next hop along the route to their final destination.
- Routing Engine—Provides three main functions:
  - Creates the packet forwarding switch , which provides route lookup, filtering, and switching on incoming data packets, and then directs outbound packets to the appropriate interface for transmission to the network.
  - Maintains the routing tables used by the switch and controls the routing protocols that run on the switch.
  - Provides control and monitoring functions for the switch, including controlling power and monitoring system status.

Junos OS Processes

Junos OS running on the Routing Engine and Packet Forwarding Engine consists of multiple processes that are responsible for individual functions.

The separation of functions provides operational stability, because each process accesses its own protected memory space. In addition, because each process is a separate software package, you can selectively upgrade all or part of the Junos OS for added flexibility.

Table 35 on page 45 describes the primary Junos OS processes.

Table 35: Junos OS Processes

Process	Name	Description
Chassis process	chassisd	Detects hardware on the system that is used to configure network interfaces. Monitors the physical status of hardware components and field-replaceable units (FRUs), detecting when environment sensors such as temperature sensors are triggered. Relays signals and interrupts—for example, when devices are taken offline, so that the system can close sessions and shut down gracefully.
DNS Server process	named-service	Resolves hostnames into addresses.
Dynamic Host Configuration Protocol (DHCP) process	dhcp-service	Enables a DHCP server to allocate network IP addresses and deliver configuration settings to client hosts without user intervention.
Ethernet switching process	eswd	Handles Layer 2 switching functionality such as MAC address learning, Spanning Tree Protocol, and access port security. Manages Ethernet switching interfaces, VLANs, and VLAN interfaces.
Firewall management process	firewall	Manages the firewall configuration and helps accept or reject packets that are transiting an interface on a switch.
Forwarding process	pfem	Defines how routing protocols operate on the partition. The overall performance of the partition is largely determined by the effectiveness of the forwarding process.
Interface process	dcd	Configures and monitors network interfaces by defining physical characteristics such as link encapsulation, hold times, and keepalive timers.
Integrated Local Management Interface (ILMI) process	ilmi	Provides bidirectional exchange of management information between two ATM interfaces across a physical connection.
Link Management Protocol (LMP) process	link-management	Establishes and maintains LMP control channels.
Management process	mgd	Provides communication between the other processes and an interface to the configuration database. Populates the configuration database with configuration information and retrieves the information when queried by other processes to ensure that the system operates as configured. Interacts with the other processes when commands are issued through one of the user interfaces on the partition. If a process terminates or fails to start when called, the management process attempts to restart it a limited number of times to prevent thrashing and logs any failure information for further investigation.

Table 35: Junos OS Processes *(continued)*

Process	Name	Description
Multicast snooping process	multicast-snooping	Makes Layer 2 devices, such as VLAN switches, aware of Layer 3 information, such as the media access control (MAC) addresses of members of a multicast group.
Secure Neighbor Discovery (SEND) Protocol process	send	Protects Neighbor Discovery Protocol (NDP) messages.
Simple Network Management Protocol (SNMP) process	snmp	Enables the monitoring of network devices from a central location and provides the switch's SNMP master agent.
Tunnel OAM process	tunnel-oamd	Enables the Operations, Administration, and Maintenance of Layer 2 tunneled networks. Layer 2 protocol tunneling (L2PT) allows service providers to send Layer 2 protocol data units (PDUs) across the provider's cloud and deliver them to Juniper Networks EX Series Ethernet Switches that are not part of the local broadcast domain.
Virtual Router Redundancy Protocol (VRRP) process	vrrp	Enables hosts on a LAN to make use of redundant routing platforms on that LAN without requiring more than the static configuration of a single default route on the hosts.

Related Documentation

- *Junos OS Baseline Network Operations Guide*
- *Junos OS Administration Library for Routing Devices*

Understanding System Snapshot on QFX Series Switches

NOTE: **On QFX3500 and QFX3600 switches running Enhanced Layer 2 Software, all of the directories that reside in the "/" partition are read only.**

You can create copies of the software running on a QFX Series switch using the system snapshot feature. The system snapshot feature takes a "snapshot" of the files currently used to run the switch—the complete contents of the **/config** and **/var** directories, which include the running Junos OS, the active configuration, and the rescue configuration—and copies all of these files into an alternate (internal, meaning internal flash, or an external, meaning USB flash) memory source. You can then use this snapshot to boot the switch at the next boot up or as a backup boot option.

You can only use snapshots to move files to external memory if the switch was booted from internal memory, or to move files to internal memory if the switch was booted from external memory. You cannot create a snapshot in the memory source that booted the switch even if the snapshot is being created on a different partition in the same memory source.

Snapshots are particularly useful for moving files onto USB flash drives. You cannot use the **copy** command or any other file-moving technique to move files from an internal memory source to USB memory on the switch.

System snapshots on the QFX Series switch have the following limitations:

- You cannot use snapshots to move files to any destination outside of the switch other than an installed external USB flash drive.
- Snapshot commands are always executed on a local switch.

Related Documentation

- Creating a Snapshot and Using It to Boot a QFX Series Switch on page 154

Understanding Zero Touch Provisioning

Understanding Zero Touch Provisioning

NOTE: To see which platforms support Zero Touch Provisioning, in a browser, go to Feature Explorer. In the **Explore Features** section of the Feature Explorer page, select **All Features**. In the **Features Grouped by Feature Family** box, select Zero Touch Provisioning. You can also type the name of the feature in the **Search for Features** edit box. In previous Junos OS releases on EX Series switches, Zero Touch Provisioning was called EZ Touchless Provisioning.

Zero Touch Provisioning allows you to provision new Juniper Networks switches in your network automatically, without manual intervention. When you physically connect a switch to the network and boot it with a default factory configuration, it attempts to upgrade the Junos OS software automatically and autoinstall a configuration file from the network.

The switch uses information that you configure on a Dynamic Host Configuration Protocol (DHCP) server to locate the necessary software image and configuration files on the network. If the DHCP server does not respond or provide the software image and configuration files, the switch boots with the preinstalled software and default factory configuration. On switches running Enhanced Layer 2 Software, Junos Extended Dynamic Host Configuration Protocol (JDHCP) is used instead of legacy DHCP. JDHCP supports the same functionality as DHCP, and all configuration options remain the same. JDHCP is an enhanced version of legacy DHCP software.

NOTE: For detailed information regarding the DHCP and DHCP options, refer to RFC2131 (http://www.ietf.org/rfc/rfc2131.txt) and RFC2132 (www.ietf.org/rfc/rfc2132.txt). Also, this document refers to Internet Systems Consortium (ISC) DHCP version 4.2. For more information regarding this version, refer to http://www.isc.org/software/dhcp/documentation.

The Zero Touch Provisioning process will either upgrade or downgrade the Junos OS version. During a downgrade:

- On an EX Series switch, If you downgrade to a software version earlier than Junos OS Release 12.2, in which Zero Touch Provisioning is not supported, the configuration file autoinstall phase of the Zero Touch Provisioning process does not happen.
- On an EX Series switch, to downgrade to a software version that does not support resilient dual-root partitions (Junos OS Release 10.4R2 or earlier), you must perform some manual work on the switch. For more information, see *Understanding Resilient Dual-Root Partitions on Switches*.

NOTE: On QFX3500 and QFX3600 switches running the original CLI, you cannot use ZTP to upgrade from Junos OS Release 12.2 and later to Junos OS Release 13.2X51-D15.

Zero Touch Provisioning Process

When you boot a switch with the default factory configuration, the following process happens:

1. If DHCP option 43, suboption 00 (the name of the software image file on the FTP, HTTP, or TFTP server) is configured, the switch compares the version of the provided software image to the version of the software installed on the switch.

   NOTE: **When the DHCP server cannot use suboption 00, configure the image file using suboption 04. If both suboption 00 and suboption 4 are defined, suboption 04 is ignored.**

2. If DHCP option 43, suboption 02 (a symbolic link to the software image file on the FTP, HTTP, or TFTP server), the switch compares the version of the provided software image to the version of the software installed on the switch.
   - If the Junos OS versions are different, the switch downloads the software image from the FTP, HTTP, or TFTP server, installs the Junos OS, and reboots using the default factory configuration.
   - If the software versions are the same, the switch does not upgrade the software.
3. If DHCP option 43, suboption 01 (the name of the configuration file on the FTP, TFTP, or HTTP server) is configured:

   If DHCP option 43 suboption 01 is not specified, the switch uses the default factory configuration.

   If both DHCP option 43 suboption 01 and suboption 2 are specified, suboption 01 is processed before suboption 02. The Junos OS is upgraded, and then the configuration file is applied.
4. If DHCP option 43, suboption 03 (the transfer mode setting) is configured, the switch accesses the FTP, HTTP, or TFTP server using the specified transfer mode setting—for example, FTP.

   If DHCP option 43, suboption 03, is not configured, TFTP becomes the transfer mode automatically.
5. If DHCP option 43, suboption 04 (the name of the software image file on the FTP, HTTP, or TFTP server) is configured, the switch compares the version of the provided software image to the version of the software installed on the switch.

   NOTE: **When the DHCP server cannot use suboption 00, configure the image file using suboption 04. If both suboption 00 and suboption 4 are defined, suboption 04 is ignored.**

   NOTE: **DHCP option 43 suboptions 05 through 255 are reserved.**

6. If DHCP option 150 or option 66 is specified, the IP address of the FTP, HTTP, or TFTP server is configured.

NOTE: You must configure either option 150 or option 66. If you configure both option 150 and option 66, option 150 takes precedence, and option 66 is ignored. Also, make sure you specify an IP address, not a hostname, because name resolution is not supported.

7. (Optional) If DHCP option 7 is specified, you can configure one or more system log (syslog) servers.

8. (Optional) If DHCP option 42 is specified, you can configure one or more NTP servers.
9. (Optional) If DHCP option 12 is specified, you can configure the hostname of the switch.

Zero Touch Provisioning Restart Process Triggers

ZTP restarts when any of the following events occur:

- Request for configuration file or image file fails.
- Configuration file is incorrect, and commit fails.
- No configuration file and no image file is available.
- Image file is corrupted, and installation fails.
- No file server information is available.
- DHCP client does not have valid ZTP parameters configured.
- When none of the DHCP client interfaces goes to a bound state.
- ZTP transaction fails after six attempts to fetch configuration file or image file.

When any of these events occur, ZTP resets the DHCP client state machine on all of the DHCP client-configured interfaces (management and network) and then restarts the state machine. Restarting the state machine enables the DHCP client to get the latest DHCP server-configured parameters.

Before ZTP restarts, approximately 15 to 30 seconds must elapse to allow enough time to build a list of bound and unbound DHCP client interfaces.

The list of bound and unbound DHCP client interfaces can contain:

- No entries.
- Multiple DHCP client interfaces.

  Priority is given to the DHCP client interfaces that have received all ZTP parameters (software image file, configuration file, and file server information) from the DHCP server.

After the lists of bound and unbound client interfaces are created, and a DHCP client gets selected for ZTP activity, then any existing default route is deleted, and the DHCP client interface that was selected adds a new default route. In order to add a new default route, only one ZTP instance can be active.

After ZTP restarts, the DHCP client attempts fetching files from the DHCP server for up to six times, with ten to fifteen seconds elapsing between attempts. Every attempt, whether successful or not, is logged and can be seen on the console.

If there is a failure, or the number of attempts exceeds the limit, ZTP stops. ZTP then clears the DHCP client bindings and restarts state machine on the DHCP-configured interfaces.

The ZTP restart process continues until there is either a successful software upgrade, or an operator manually commits a user configuration and deletes the ZTP configuration.

Related Documentation

- Configuring Zero Touch Provisioning on page 98
- Monitoring Zero Touch Provisioning on page 310

User Interfaces

CLI User Interface Overview

CLI Overview

The command-line interface (CLI) is the software interface you use to access, monitor, configure, troubleshoot, and manage a device running Junos OS. You can access the CLI either from the console or through a network connection. The CLI is a Juniper Networks-specific command shell that runs on top of a FreeBSD UNIX-based operating system kernel.

The CLI provides a variety of UNIX utilities, such as Emacs-style keyboard sequences, which allows you to perform the following actions:

- Move around on a command line and scroll through recently executed commands.
- Match regular expressions to locate and replace values and identifiers in a configuration.
- Filter command output.
- Log file entries.
- Store and archive device files on a UNIX-based file system.

You can exit the CLI environment and create a UNIX C shell or Bourne shell to navigate the file system, manage processes, and perform other tasks.

CLI Key Features

The CLI commands and statements follow a hierarchical organization and have consistent syntax. The CLI provides the following features for ease of use:

- Consistent command names—Commands that provide the same type of function have the same name, regardless of the portion of the software on which they are operating.

For example, all **show** commands display software information and statistics, and all **clear** commands erase various types of system information.

- Lists and short descriptions of available commands—Information about available commands is provided at each level of the CLI command hierarchy. If you type a question mark (**?**) at any level, you see a list of the available commands along with a short description of each command. This means that if you already are familiar with the Junos OS, you can use many of the CLI commands without referring to the documentation.
- Command completion—Command completion for command names (keywords) and for command options is available at each level of the hierarchy. To complete a command or option that you have partially typed, press Tab or the Spacebar. If the partially typed letters begin a string that uniquely identifies a command, the complete command name appears. Otherwise, a beep indicates that you have entered an ambiguous command, and the possible completions are displayed. Completion also applies to other strings, such as filenames, interface names, usernames, and configuration statements.

CLI Command Modes

The CLI has two modes, operational mode and configuration mode.

- Operational mode—This mode displays the current status of the device. In operational mode, you enter commands to monitor and troubleshoot Junos OS and devices and network connectivity. Operational mode is indicated by the **>** prompt—for example, **user@switch> clear**
- Configuration mode—A Junos OS device configuration is stored as a hierarchy of statements. In configuration mode, you can define all properties of the Juniper Networks Junos OS, including interfaces, VLANs, Virtual Chassis information, user access, and several system hardware properties. To enter configuration mode, enter the **configure** command. Configuration mode is indicated by the **#** prompt and includes the current location in the configuration hierarchy—for example:

```
[edit interfaces ge-0/0/12]
user@switch#
```

In configuration mode, you are actually viewing and changing the candidate configuration file. The candidate configuration allows you to make configuration changes without causing operational changes to the current operating configuration, called the active configuration. When you commit the changes you added to the candidate configuration, the system updates the active configuration. Candidate configurations enable you to alter your configuration without causing potential damage to your current network operations.

To activate your configuration changes, enter the **commit** command.

When you commit the candidate configuration, you can require an explicit confirmation for the commit to become permanent by using the **commit confirmed** command. This is useful for verifying that a configuration change works correctly and does not prevent management access to the switch. After you issue the **commit confirmed** command, you must issue another **commit** command within the defined period of time (10 minutes by default), or the system reverts to the previous configuration.

You can also activate your configuration changes and exit configuration mode with a single command, **commit and-quit**. This command succeeds only if there are no mistakes or syntax errors in the configuration.

To return to operational mode, go to the top of the configuration hierarchy and then quit—for example:

```
[edit interfaces ge-0/0/12]
user@switch# top
[edit]
user@switch# exit
```

When you monitor and configure a device running Junos OS, you may need to switch between operational mode and configuration mode. When you change to configuration mode, the command prompt also changes. The operational mode prompt is a right angle bracket (**>**) and the configuration mode prompt is a pound sign (**#**).

When you log in to the switch and type the **cli** command, you are automatically in operational mode. To switch to configuration mode, type the **configure** command or the **edit** command.

The CLI prompt changes from **user@switch>** to **user@switch#**, and a banner appears to indicate the hierarchy level.

To return to operational mode as well as commit your changes, enter **command and-quit**. To return to operational mode without committing any of your changes, enter **exit**.

To display the output of an operational mode command, such as **show**, while in configuration mode, issue the **run** configuration mode command and then specify the operational mode command.

Related Documentation

- Configuring CLI Tips on page 56
- Overview of Navigating the CLI on page 75
- *CLI User Guide*
- Other Tools to Configure and Monitor Devices Running Junos OS on page 313

Configuring CLI Tips

The Junos OS CLI provides the option of configuring CLI tips for the user. By default, the **tip** command is not enabled when a user logs in.

- To enable tips, include the **login-tip** statement at the **[edit system login class *class-name*]** hierarchy level:

```
[edit system login class class-name]
login-tip;
```


Adding this statement enables the **tip** command for the class specified, provided the user logs in using the CLI.

Related Documentation

- CLI User Interface Overview on page 54
- *Defining Junos OS Login Classes*
- **login-tip on page 255**

Format for Specifying Filenames and URLs in Junos OS CLI Commands

In some command-line interface (CLI) commands and configuration statements—including **file copy**, **file archive**, **load**, **save**, **set system login user *username* authentication *load-key-file***, and **request system software add**—you can include a filename. On a routing matrix, you can include chassis information (for example, **lcc0**, **lcc0-re0**, or **lcc0-re1**) as part of the filename.

A *routing matrix* is a multichassis architecture composed of either one TX Matrix router and from one to four T640 routers connected to the TX Matrix router, or one TX Matrix Plus router and from one to four T1600 routers connected to the TX Matrix Plus router. From the perspective of the user interface, the routing matrix appears as a single router. On a routing matrix composed of the TX Matrix router and T640 routers, the TX Matrix router controls all the T640 routers. On a routing matrix composed of a TX Matrix Plus router and T1600 routers, the TX Matrix Plus router controls all the T1600 routers.

You can specify a filename or URL in one of the following ways:

- ***filename***—File in the user's current directory on the local CompactFlash card (not applicable on the QFX Series). You can use wildcards to specify multiple source files or a single destination file. Wildcards are not supported in Hypertext Transfer Protocol (HTTP) or FTP.

  NOTE: Wildcards are supported only by the **file (compare | copy | delete | list | rename | show)** commands. When you issue the **file show** command with a wildcard, it must resolve to one filename.

- ***path/filename***—File on the local flash disk.
- **/var/*filename*** or **/var/*path/filename***—File on the local hard disk. You can also specify a file on a local Routing Engine for a specific T640 router or a T1600 router in a routing matrix:

  `user@host>` **file delete lcc0-re0:/var/tmp/junk**

- **a:*filename*** or **a:*path/filename***—File on the local removable media. The default path is **/** (the root-level directory). The removable media can be in MS-DOS or UNIX (UFS) format.
- ***hostname*:/*path/filename***, ***hostname*:*filename***, ***hostname*:*path/filename***, or "**scp://*hostname/path/filename***"—File on an **scp/ssh** client. This form is not available in the worldwide version of the Junos OS. The default path is the user's home directory on the remote system. You can also specify ***hostname*** as ***username@hostname***.

- **ftp://*hostname/path/filename***—File on an FTP server. You can also specify ***hostname*** as ***username*@*hostname*** or ***username*:*password*@*hostname***. The default path is the user's home directory. To specify an absolute path, the path must start with **%2F**; for example, **ftp://*hostname*/%2F*path/filename***. To have the system prompt you for the password, specify **prompt** in place of the password. If a password is required and you do not specify the password or **prompt**, an error message is displayed:

```
user@host> file copy ftp://username@ftp.hostname.net/filename
file copy ftp.hostname.net: Not logged in.
```

```
user@host> file copy ftp://username:prompt@ftp.hostname.net/filename
Password for username@ftp.hostname.net:
```

- **re0:*/path/filename*** or **re1:*/path/filename***—File on a local Routing Engine. You can also specify a file on a local Routing Engine for a specific T640 router or a T1600 router in a routing matrix:

```
user@host> show log lcc0-re1:chassisd
```

NOTE: You cannot specify a URL for a file on a Hypertext Transfer Protocol (HTTP) server, because HTTP URLs are not writable.

Related Documentation

- Format for Specifying IP Addresses, Network Masks, and Prefixes in Junos OS Configuration Statements on page 27
- *Default Directories for Junos OS File Storage on the Router or Switch*

Getting Started with Enhanced Layer 2 Software

Understanding Enhanced Layer 2 Software Support

Enhanced Layer 2 software (ELS) is automatically supported if your device is running a Junos OS release that supports it. You do not need to take any action to enable ELS, and you cannot disable ELS.

ELS is available on the following EX Series switches and QFX Series devices.

Table 36: ELS Support

Device	Initial ELS Release
EX4300 switches	13.2X50-D10
EX9200 switches	12.3R2
QFX3500 switches	13.2X50-D15
QFX3600 switches	13.2X50-D15
QFX5100 switches	13.2X51-D10

ELS is supported on the EX4300 and EX9200 switches for all Junos OS releases, starting with the initial releases shown in Table 36 on page 59.

ELS support was introduced on QFX3500 and QFX3600 switches in Junos OS Release 13.2X50-D15. ELS is only supported on the software package that supports Virtual Chassis (the **jinstall-qfx-3-*** software package) for QFX3500 and QFX3600 switches.

For QFX5100 switches, ELS support was introduced in Junos OS Release 13.2X51-D10 and is supported on the **jinstall-qfx-5-*** software package.

NOTE: ELS is not supported on software packages that can be installed in a QFabric system.

Using the ELS Translator Tool

The ELS Translator is a web-based tool that converts Junos OS Layer 2 configurations to Enhanced Layer 2 Software (ELS) configurations. This conversion tool supports all Juniper Networks EX Series, MX Series, and QFX Series platforms with ELS installed. The ELS Translator is hosted on Juniper Networks Customer Support website for EX Series switches, MX Series Universal Edge routers, and QFX Series switches and is available to registered users, internal users, partners, and premium service contract customers. You need to login using your Juniper Networks user name and password to access the ELS Translator tool.

Click to access the ELS translator tool.

If you are upgrading from a version of Junos OS that does not support ELS to a version of Junos OS that supports ELS, we recommend updating your configuration with the ELS Translator Tool using the following procedure:

1. Log onto your device using the console port.

   NOTE: **Only perform this procedure from the console port. You will lose connectivity to your device if you perform this procedure from a management port or any other interface.**

2. Copy your entire existing configuration into another file. Save the file to a remote location. See “Saving a Configuration to a File” on page 1141.
3. Retain the portion of your existing configuration related to management network connectivity (such as **[edit system]**). Delete all other top-level configuration hierarchy levels (such as **[edit interfaces]**, **[edit protocols]**, and **[edit vlans]**). Issue a **commit** operation to remove the deleted configuration hierarchy levels.
4. Perform the software upgrade. Reboot your device to complete the upgrade. See “Software Installation Overview” on page 109

   NOTE: **Maintain your console port connection during the reboot.**

5. Click to access the ELS translator tool in a web browser. Follow the instructions on the page to update your configuration.
6. Return to your console port connection. When the switch has rebooted to complete the software upgrade, copy the configuration from the ELS Translator Tool onto your switch. See “Uploading a Configuration File” on page 1145.
7. Commit the new configuration.

NOTE: **It is possible a script might not translate correctly, so review translated scripts carefully before loading the converted configuration on your switch or other device.**

Configuring a VLAN

You can configure one or more VLANs to perform Layer 2 bridging. The Layer 2 bridging functions include integrated routing and bridging (IRB) for support for Layer 2 bridging and Layer 3 IP routing on the same interface. EX Series and QFX Series switches can function as Layer 2 switches, each with multiple bridging, or broadcast, domains that participate in the same Layer 2 network. You can also configure Layer 3 routing support for a VLAN.

To configure a VLAN:

1. Create the VLAN by setting the unique VLAN name and configuring the VLAN ID:

[edit]
user@host# **set vlans *vlan-name* vlan-id *vlan-id-number***

2. Assign at least one interface to the VLAN:

   [edit]
   user@host# **set interface *interface-name* family ethernet-switching vlan members *vlan-name***

Configuring the Native VLAN Identifier

EX Series and QFX Series switches support receiving and forwarding routed or bridged Ethernet frames with 802.1Q VLAN tags. Typically, trunk ports, which connect switches to each other, accept untagged control packets but do not accept untagged data packets. You can enable a trunk port to accept untagged data packets by configuring a native VLAN ID on the interface on which you want the untagged data packets to be received.

To configure the native VLAN ID:

1. On the interface on which you want untagged data packets to be received, set the interface mode to trunk, which specifies that the interface is in multiple VLANs and can multiplex traffic between different VLANs.

   [edit interfaces]
   user@host# **set *interface-name* unit *logical-unit-number* family ethernet-switching interface-mode trunk**

2. Configure the native VLAN ID:

   [edit interfaces]
   user@host# **set *interface-name* native-vlan-id *number***

3. Assign the interface to the native VLAN ID:

   [edit interfaces]
   user@host# **set *interface-name* unit *logical-unit-number* family ethernet-switching vlan members *native-vlan-id-number***

Configuring Layer 2 Interfaces

To ensure that your high-traffic network is tuned for optimal performance, explicitly configure some settings on the switch's network interfaces.

To configure a Gigabit Ethernet interface or 10-Gigabit Ethernet interface for trunk interface mode:

[edit]
user@host# **set interfaces *interface-name* unit *logical-unit-number* family ethernet-switching interface-mode trunk**

To configure a Gigabit Ethernet interface or 10-Gigabit Ethernet interface for access interface mode:

[edit]
user@host# **set interfaces *interface-name* unit *logical-unit-number* family ethernet-switching interface-mode access**

Configuring Layer 3 Interfaces

To configure a Layer 3 interface, you must assign an IP address to the interface. You assign an address to an interface by specifying the address when configuring the protocol family. For the inet or inet6 family, configure the interface IP address.

You can configure interfaces with a 32-bit IP version 4 (IPv4) address and optionally with a destination prefix, sometimes called a subnet mask. An IPv4 address utilizes a 4-octet dotted decimal address syntax (for example, 192.16.1.1). An IPv4 address with destination prefix utilizes a 4-octet dotted decimal address syntax with a destination prefix appended (for example, 192.16.1.1/30).

To specify an IP address for the logical unit using IPv4:

```
[edit]
user@host# set interfaces interface-name unit logical-unit-number family inet address ip-address
```

You represent IP version 6 (IPv6) addresses in hexadecimal notation using a colon-separated list of 16-bit values. You assign a 128-bit IPv6 address to an interface.

To specify an IP address for the logical unit using IPv6:

```
[edit]
user@host# set interfaces interface-name unit logical-unit-number family inet6 address ip-address
```

Configuring an IRB Interface

Integrated routing and bridging (IRB) provides support for Layer 2 bridging and Layer 3 IP routing on the same interface. IRB enables you to route packets to another routed interface or to another VLAN that has a Layer 3 protocol configured. IRBs allow the device to recognize packets that are being sent to local addresses so that they are bridged (switched) whenever possible and are routed only when necessary. Whenever packets can be switched instead of routed, several layers of processing are eliminated. An interface named irb functions as a logical router on which you can configure a Layer 3 logical interface for VLAN. For redundancy, you can combine an IRB interface with implementations of the Virtual Router Redundancy Protocol (VRRP) in both bridging and virtual private LAN service (VPLS) environments.

To configure an IRB interface:

1. Create a Layer 2 VLAN by assigning it a name and a VLAN ID:

   ```
   [edit]
   user@host# set vlans vlan-name vlan-id vlan-id
   ```

2. Create an IRB logical interface:

   ```
   [edit]
   user@host# set interface irb unit logical-unit-number family inet address ip-address
   ```

3. Associate the IRB interface with the VLAN:

   ```
   [edit]
   user@host# set vlans vlan-name l3-interface irb.logical-unit-number
   ```

Configuring an Aggregated Ethernet Interface and Configuring LACP on That Interface

Use the link aggregation feature to aggregate one or more links to form a virtual link or link aggregation group (LAG). The MAC client can treat this virtual link as if it were a single link to increase bandwidth, provide graceful degradation as failure occurs, and increase availability.

To configure an aggregated Ethernet interface:

1. Specify the number of aggregated Ethernet interfaces to be created:

   ```
   [edit chassis]
   user@host# set aggregated-devices ethernet device-count number
   ```
2. Specify the name of the link aggregation group interface:

   ```
   [edit interfaces]
   user@host# set interfaces aex
   ```
3. Specify the minimum number of links for the aggregated Ethernet interface (aex), that is, the defined bundle, to be labeled “up”:

   ```
   [edit interfaces]
   user@host# set aex aggregated-ether-options minimum-links number
   ```
4. Specify the link speed for the aggregated Ethernet bundle:

   ```
   [edit interfaces]
   user@host# set aex aggregated-ether-options link-speed link-speed
   ```
5. Specify the members to be included within the aggregated Ethernet bundle:

   ```
   [edit interfaces]
   user@host# set interface-name ether-options 802.3ad aex
   user@host# set interface-name ether-options 802.3ad aex
   ```
6. Specify an interface family for the aggregated Ethernet bundle:

   ```
   [edit interfaces]
   user@host# set aex unit 0 family inet address ip-address
   ```

For aggregated Ethernet interfaces on the device, you can configure the Link Aggregation Control Protocol (LACP). LACP bundles several physical interfaces to form one logical interface. You can configure aggregated Ethernet with or without LACP enabled.

When LACP is enabled, the local and remote sides of the aggregated Ethernet links exchange protocol data units (PDUs), containing information about the state of the link. You can configure Ethernet links to actively transmit PDUs, or you can configure the links to passively transmit them, sending out LACP PDUs only when they receive them from another link. One side of the link must be configured as active for the link to be up.

To configure LACP:

1. Enable one side of the aggregated Ethernet link as active:

   ```
   [edit interfaces]
   user@host# set aex aggregated-ether-options lacp active
   ```
2. Specify the interval at which the interfaces send LACP packets:

   ```
   [edit interfaces]
   user@host# set aex aggregated-ether-options lacp periodic interval
   ```

Enhanced Layer 2 CLI Configuration Statement and Command Changes

The enhanced Layer 2 Command Line Interface (CLI) feature is introduced in Junos OS Release 12.3R2. The enhanced Layer 2 CLI feature changes the CLI for some Layer 2 features on EX Series switches. This enhanced CLI will be used to configure Layer 2 features on future EX Series hardware platforms, and also to configure Layer 2 features on other Juniper Networks products.

The following tables provide a list of existing commands that were moved to new hierarchies or changed on EX Series switches as part of this CLI enhancement effort. The table is provided as a high-level reference only. For detailed information about these commands, use the links to the configuration statements provided in the table or see the technical documentation.

Table 37: Enhanced Layer 2 CLI Changes

Original Hierarchy	Changed Hierarchy	Change Description

ethernet-switching-options {
  analyzer {
    name {
      ...
    }
  }
}
	forwarding-options {
	  analyzer {
	    name {
	      ...
	    }
	  }
	}
		Statements moved to different hierarchy.

ethernet-switching-options {
  authentication-whitelist {
    ...
  }
}
	switch-options {
	  ...
	  authentication-whitelist {
	    ...
	  }
	}
		Hierarchy renamed.

ethernet-switching-options {
  bpdu-block {
    ...
  }
}
	protocols {
	  layer2-control {
	    bpdu-block {
	      ...
	    }
	  }
	}
		Statement moved to different hierarchy.

ethernet-switching-options {
  dot1q-tunneling {
    ether-type (0x8100 | 0x88a8 | 0x9100);
      ...
  }
}
	interfaces *interface-name* {
	  ether-options {
	    ethernet-switch-profile {
	      tag-protocol-id [*tpids*];
	    }
	  }
	}
	
	interfaces *interface-name* {
	  aggregated-ether-options {
	    ethernet-switch-profile {
	      tag-protocol-id [*tpids*];
	    }
	  }
	}
		Statement replaced with new statement and moved to different hierarchy.

ethernet-switching-options {
  interfaces *interface-name* {
    no-mac-learning;
    ...
  }
}
	switch-options {
	  interfaces *interface-name* {
	    no-mac-learning;
	    ...
	  }
	}
		Hierarchy renamed.

Table 37: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

ethernet-switching-options {
  mac-notification {
    notification-interval *seconds*;
    ...
  }
}
	—	Statements deleted.

ethernet-switching-options {
  mac-table-aging-time *seconds*;
  ...
}
	protocols {
	  l2-learning {
	    global-mac-table-aging-time *seconds*;
	    ...
	  }
	}
		Statement replaced with new statement and moved to different hierarchy.

ethernet-switching-options {
  nonstop-bridging;
}
	protocols {
	  layer2-control {
	    nonstop-bridging {
	    }
	  }
	}
		Statement moved to different hierarchy.

ethernet-switching-options {
  port-error-disable {
    disable-timeout *timeout*;
    ...
  }
}
	interfaces *interface-name* family
	  ethernet-switching {
	  recovery-timeout *seconds*;
	}
		Statement replaced with a new statement.

ethernet-switching-options {
  redundant-trunk-group {
    group *name* {
      description;
      interface *interface-name* {
        primary;
      }
      preempt-cutover-timer *seconds*;
      ...
    }
  }
}
	switch-options {
	  redundant-trunk-group {
	    group *name* {
	      description;
	      interface *interface-name* {
	        primary;
	      }
	      preempt-cutover-timer *seconds*;
	      ...
	    }
	  }
	}
		Hierarchy renamed.

Table 37: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

ethernet-switching-options {
secure-access-port {
interface (all | *interface-name*) {
(dhcp-trusted | no-dhcp-trusted);
static-ip *ip-address* {
mac *mac-address*;
vlan *vlan-name*;
}
}
vlan (all | *vlan-name*) {
(arp-inspection | no-arp-inspection);
dhcp-option82 {
disable;
circuit-id {
prefix *hostname*;
use-interface-description;
use-vlan-id;
}
remote-id {
prefix (*hostname* | mac | none);
use-interface-description;
use-string *string*;
}
vendor-id [*string*];
}
(examine-dhcp | no-examine-dhcp);
}
(ip-source-guard | no-ip-source-guard);
}
}
	vlans *vlan-name* forwarding-options{
	dhcp-security {
	arp-inspection;
	group *group-name* {
	interface*interface-name* {
	static-ip *ip-address* {
	mac *mac-address*;
	}
	}
	overrides {
	no-option-82;
	trusted;
	}
	}
	ip-source-guard;
	no-dhcp-snooping;
	option-82 {
	circuit-id {
	prefix {
	host-name;
	routing-instance-name;
	}
	use-interface-description (device |
	logical);
	use-vlan-id;
	}
	remote-id {
	host-name;
	use-interface-description (device |
	logical);
	use-string *string*;
	}
	vendor-id {
	use-string *string*;
	}
	}
	}
		Statements moved to different hierarchy.
		
		NOTE: The statement **examine-dhcp** does not exist in the changed hierarchy. Instead, DHCP snooping is enabled automatically when other DHCP security features are enabled on a VLAN. See *Configuring Port Security (CLI Procedure)* for additional information.

ethernet-switching-options {
secure-access-port {
dhcp-snooping-file {
location *local_pathname* | *remote_URL*;
timeout *seconds*;
write-interval *seconds*;
}
	system [
	processes [
	dhcp-service
	dhcp-snooping-file *local_pathname* |
	remote_URL;
	write-interval *interval*;
	}
	}
		Statement moved to different hierarchy.

ethernet-switching-options {
secure-access-port vlan (all | *vlan-name*{
mac-move-limit
}
	vlans *vlan-name* switch-options {
	mac-move-limit
	}
		Statement moved to different hierarchy.

Table 37: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

ethernet-switching-options {
static {
vlan *vlan-id* {
mac *mac-address* next-hop
interface-name;
...
}
}
}
	vlans {
	vlan-name {
	switch-options {
	interface *interface-name* {
	static-mac *mac-address*;
	...
	}
	}
	}
	}
		Statement replaced with new statement and moved to different hierarchy.

ethernet-switching-options {
storm-control {
(...)
}
}
	forwarding-options {
	storm-control-profiles *profile-name* {
	(...)
	}
	}
	
	interfaces *interface-name* unit *number* family
	ethernet-switching {
	storm-control *storm-control-profile*;
	}
		Storm control configuration is done in two steps. The first step is to create a storm control profile at the [edit forwarding-options] hierarchy, and the second step is to bind the profile to a logical interface at the [edit interfaces] hierarchy. See *Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches* for additional information.

ethernet-switching-options {
traceoptions {
file *filename* <files *number*> <no-stamp>
<replace> <size *size*> <world-readable
| no-world-readable>;
flag *flag* <disable>;
...
}
}
	—	Statements removed.

ethernet-switching-options {
unknown-unicast-forwarding {
(...)
}
}
	switch-options {
	unknown-unicast-forwarding {
	(...)
	}
	}
		Hierarchy renamed.

ethernet-switching-options {
voip {
interface (all | [*interface-name* |
access-ports]) {
forwarding-class (assured-forwarding
| best-effort | expedited-forwarding
| network-control);
vlan *vlan-name*;
...
}
}
}
	switch-options {
	voip {
	interface (all | [*interface-name* |
	access-ports]) {
	forwarding-class (assured-forwarding
	| best-effort | expedited-forwarding
	| network-control);
	vlan *vlan-name*;
	...
	}
	}
	}
		Hierarchy renamed.

Table 37: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

interfaces *interface-name* {
  ether-options {
    link-mode *mode*;
    speed (auto-negotiation | *speed*)
  }
}
	interfaces *interface-name* {
	  link-mode *mode*;
	  speed *speed*)
	}
		Statements moved to different hierarchy.

interfaces *interface-name* {
  unit *logical-unit-number* {
    family ethernet-switching {
      native-vlan-id *vlan-id*
    }
  }
}
	interfaces *interface-name* {
	  native-vlan-id *vlan-id*
	}
		Statement moved to different hierarchy.

interfaces *interface-name* {
  unit *logical-unit-number* {
    family ethernet-switching {
      port-mode *mode*
    }
  }
}
	interfaces *interface-name* {
	  unit *logical-unit-number* {
	    family ethernet-switching {
	      interface-mode *mode*
	    }
	  }
	}
		Statement replaced with a new statement.

interfaces vlan	**interfaces irb**	Statement replaced with a new statement.

Table 37: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

protocols {
igmp-snooping {
traceoptions {
file *filename* <files *number*>
<no-stamp> <replace>
<size *maximum-file-size*>
<world-readable |
no-world-readable>;
flag *flag* <*flag-modifier*> <disable>;
}
vlan (all | *vlan-identifier*) {
disable;
data-forwarding {
receiver {
install;
source-vlans *vlan-name*;
}
source {
groups *ip-address*;
}
}
immediate-leave;
interface (all | *interface-name*) {
multicast-router-interface;
static {
group *multicast-ip-address*;
}
}
proxy {
source-address *ip-address*;
}
robust-count *number*;
}
}
}
	protocols {
	igmp-snooping {
	vlan *vlan-name* {
	immediate-leave;
	interface *interface-name* {
	group-limit <1..65535>
	host-only-interface
	multicast-router-interface;
	immediate-leave;
	static {
	group *multicast-ip-address* {
	source < >
	}
	}
	}
	}
	l2-querier {
	source-address *ip-address*;
	}
	proxy {
	source-address *ip-address*;
	}
	query-interval *number*;
	query-last-member-interval *number*;
	query-response-interval *number*;
	robust-count *number*;
	traceoptions {
	file *filename* <files *number*>
	<no-stamp> <replace>
	<size *maximum-file-size*>
	<world-readable |
	no-world-readable>;
	flag *flag* <*flag-modifier*>;
	}
	}
	}
	}
		IGMP snooping is configured on a VLAN.

vlans {
vlan-name {
dot1q-tunneling {
customer-vlans (*id* | native | *range*);
layer2-protocol-tunneling all |
protocol-name {
drop-threshold *number*;
shutdown-threshold *number*;
...
}
}
}
}
	interface *interface-name* {
	encapsulation extended-vlan-bridge;
	flexible-vlan-tagging;
	native-vlan-id *number*;
	unit *logical-unit-number* {
	input-vlan-map *action*;
	output-vlan-map *action*;
	vlan-id *number*;
	vlan-id-list [*vlan-id vlan-id–vlan-id*];
	}
	}
		Statements replaced with new statements and moved to different hierarchy

Table 37: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

vlans {
  vlan-name {
    filter{
      input *filter-name*
      output *filter-name*;
      ...
    }
  }
}
	vlans {
	  vlan-name {
	    forwarding-options {
	      filter{
	        input *filter-name*
	        output *filter-name*;
	        ...
	      }
	    }
	  }
	}
		Statements moved to different hierarchy.

vlans {
  vlan-name {
    interface *interface-name* {
      egress;
      ingress;
      mapping (native (push | swap) | policy
        | *tag* (push | swap));
      pvlan-trunk;
      ...
    }
  }
}
	—	Statements removed. You can assign interfaces to a VLAN using the [edit interfaces *interface-name* unit *logical-unit-number* family ethernet-switching vlan members *vlan-name*] hierarchy.

vlans {
  vlan-name {
    isolation-id *id-number*;
      ...
  }
}
	—	Statement removed.

vlans {
  vlan-name {
    l3-interface **vlan**.*logical-interface-number*;
      ...
  }
}
	vlans {
	  vlan-name {
	    l3-interface **irb**.*logical-interface-number*;
	      ...
	  }
	}
		Syntax changed.

vlans {
  vlan-name {
    l3-interface-ingress-counting
      layer-3-interface-name;
      ...
  }
}
	—	Statement removed. Ingress traffic is automatically tracked.

Table 37: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

vlans {
vlan-name {
mac-limit *limit* **action** *action*;
...
}
}
	vlans {
	vlan-name {
	switch-options {
	interface-mac-limit *limit* {
	packet-action *action*;
	...
	}
	}
	}
	}
	
	vlans {
	vlan-name {
	switch-options {
	interface *interface-name* {
	interface-mac-limit *limit* {
	packet-action *action*;
	...
	}
	}
	}
	}
	}
		Statements moved to different hierarchies and renamed.

vlans {
vlan-name {
mac-table-aging-time *seconds*;
...
}
}
	protocols {
	l2-learning {
	global-mac-table-aging-time *seconds*;
	...
	}
	}
		Statement moved to different hierarchy and renamed.

vlans {
vlan-name {
no-local-switching;
...
}
}
	—	Statement removed.

vlans {
vlan-name {
no-mac-learning;
...
}
}
	vlans {
	vlan-name {
	switch-options {
	no-mac-learning *limit*
	...
	}
	}
	}
		Statement moved to different hierarchy.

vlans {
vlan-name {
primary-vlan *vlan-name*;
...
}
}
	—	Statement removed.

Table 37: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

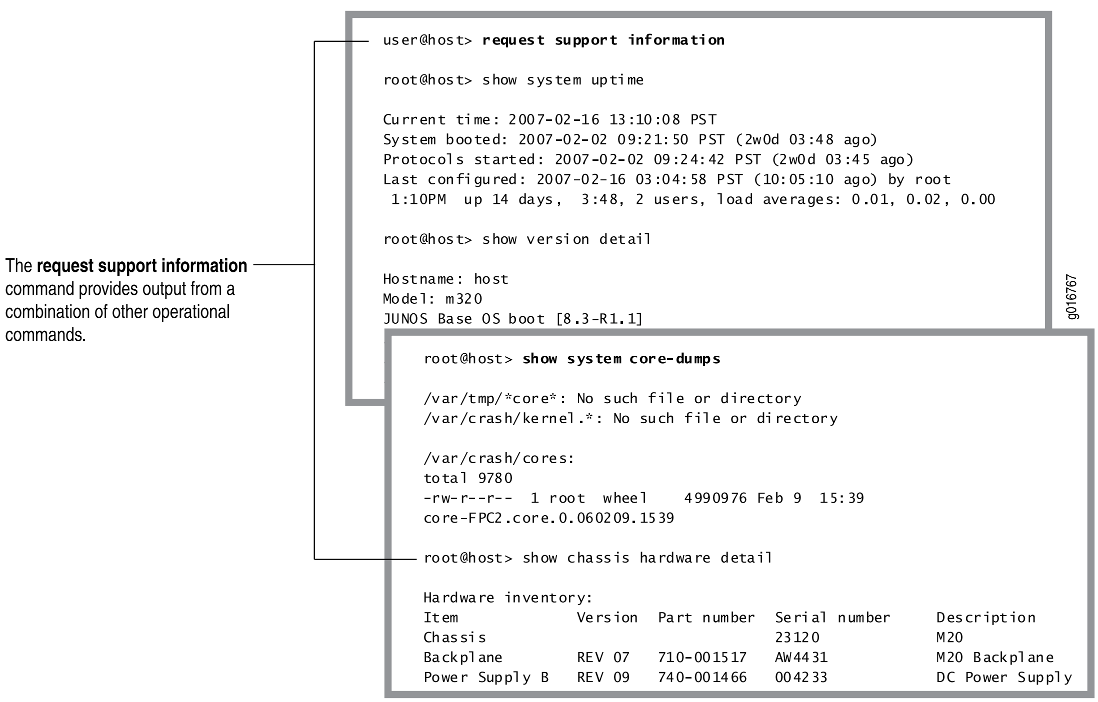
vlans {
  vlan-name {
    vlan-prune;
    ...
  }
}
	—	Statement removed.

vlans {
  vlan-name {
    vlan-range *vlan-id-low-vlan-id-high*;
    ...
  }
}
	vlans {
	  vlan-name {
	    vlan-id-list [*vlan-id-numbers*];
	    ...
	  }
	}
		Statement replaced with new statement.

Junos OS Operational Mode Commands That Combine Other Commands

In some cases, some Junos OS operational commands are created from a combination of other operational commands. These commands can be useful shortcuts for collecting information about the device, as shown in Figure 7 on page 72.

Figure 7: Commands That Combine Other Commands



Related Documentation

- Overview of Junos OS CLI Operational Mode Commands on page 73
- Understanding the Brief, Detail, Extensive, and Terse Options of Junos OS Operational Commands on page 77

Overview of Junos OS CLI Operational Mode Commands

This topic provides an overview of Junos OS CLI operational mode commands and contains the following sections:

CLI Command Categories

When you log in to a device running Junos OS and the CLI starts, there are several broad groups of CLI commands:

- Commands for controlling the CLI environment—Some set commands in the **set** hierarchy configure the CLI display screen. For information about these commands, see *Understanding the Junos OS CLI Modes, Commands, and Statement Hierarchies*.
- Commands for monitoring and troubleshooting—The following commands display information and statistics about the software and test network connectivity. Detailed command descriptions are provided in the *Junos OS Interfaces Command Reference*.
  - **clear**—Clear statistics and protocol database information.
  - **mtrace**—Trace mtrace packets from source to receiver.
  - **monitor**—Perform real-time debugging of various software components, including the routing protocols and interfaces.
  - **ping**—Determine the reachability of a remote network host.
  - **show**—Display the current configuration and information about interfaces, routing protocols, routing tables, routing policy filters, system alarms, and the chassis.
  - **test**—Test the configuration and application of policy filters and autonomous system (AS) path regular expressions.
  - **traceroute**—Trace the route to a remote network host.
- Commands for connecting to other network systems—The **ssh** command opens Secure Shell connections, and the **telnet** command opens telnet sessions to other hosts on the network. For information about these commands, see the CLI Explorer.
- Commands for copying files—The **copy** command copies files from one location on the router or switch to another, from the router or switch to a remote system, or from a remote system to the router or switch. For information about these commands, see the CLI Explorer.
- Commands for restarting software processes—The commands in the **restart** hierarchy restart the various Junos OS processes, including the routing protocol, interface, and SNMP. For information about these commands, see the CLI Explorer.
- A command—**request**—for performing system-level operations, including stopping and rebooting the router or switch and loading Junos OS images. For information about this command, see the CLI Explorer.

- A command—**start**—to exit the CLI and start a UNIX shell. For information about this command, see the CLI Explorer.
- A command—**configure**—for entering configuration mode, which provides a series of commands that configure Junos OS, including the routing protocols, interfaces, network management, and user access. For information about the CLI configuration commands, see "Understanding Junos OS CLI Configuration Mode" on page 78.
- A command—**quit**—to exit the CLI. For information about this command, see the CLI Explorer.
- For more information about the CLI operational mode commands, see the CLI Explorer and the CLI Explorer.

Commonly Used Operational Mode Commands

Table 38 on page 74 lists some operational commands you may find useful for monitoring router or switch operation. For a complete description of operational commands, see the Junos OS command references.

NOTE: The QFX3500 switch does not support the IS-IS, OSPF, BGP, MPLS, and RSVP protocols.

Table 38: Commonly Used Operational Mode Commands

Items to Check	Description	Command
Software version	Versions of software running on the router or switch	**show version**
Log files	Contents of the log files	**monitor**
	Log files and their contents and recent user logins	**show log**
Remote systems	Host reachability and network connectivity	**ping**
	Route to a network system	**traceroute**
Configuration	Current system configuration	**show configuration**
Manipulate files	List of files and directories on the router or switch	**file list**
	Contents of a file	**file show**
Interface information	Detailed information about interfaces	**show interfaces**

Table 38: Commonly Used Operational Mode Commands *(continued)*

Items to Check	Description	Command
Chassis	Chassis alarm status	**show chassis alarms**
	Information currently on craft display	**show chassis craft-interface**
	Router or switch environment information	**show chassis environment**
	Hardware inventory	**show chassis hardware**
Routing table information	Information about entries in the routing tables	**show route**
Forwarding table information	Information about data in the kernel's forwarding table	**show route forwarding-table**
IS-IS	Adjacent routers or switches	**show isis adjacency**
OSPF	Display standard information about OSPF neighbors	**show ospf neighbor**
BGP	Display information about BGP neighbors	**show bgp neighbor**
MPLS	Status of interfaces on which MPLS is running	**show mpls interface**
	Configured LSPs on the router or switch, as well as all ingress, transit, and egress LSPs	**show mpls lsp**
	Routes that form a label-switched path	**show route label-switched-path**
RSVP	Status of interfaces on which RSVP is running	**show rsvp interface**
	Currently active RSVP sessions	**show rsvp session**
	RSVP packet and error counters	**show rsvp statistics**

Related Documentation

- Junos OS Operational Mode Commands That Combine Other Commands on page 72
- Understanding the Brief, Detail, Extensive, and Terse Options of Junos OS Operational Commands on page 77

Overview of Navigating the CLI

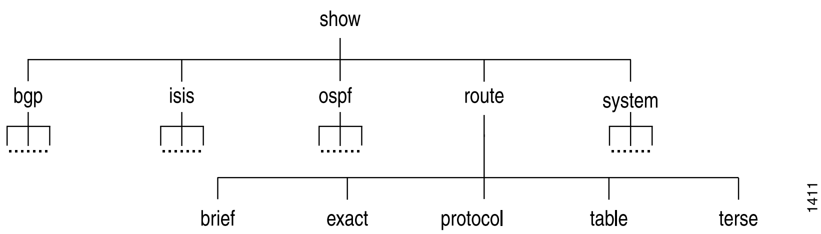
This topic describes how to navigate the CLI.

- CLI Command Hierarchy on page 76
- CLI Configuration Statements on page 76
- Moving Among Hierarchy Levels on page 76

CLI Command Hierarchy

CLI commands are organized in a hierarchy. Commands that perform a similar function are grouped together under the same level of the hierarchy. For example, all commands that display information about the system and the system software are grouped under the **show system** command, and all commands that display information about the routing table are grouped under the **show route** command. Figure 8 on page 76 illustrates a portion of the **show** command hierarchy.

Figure 8: CLI Command Hierarchy



To execute a command, you enter the full command name, starting at the top level of the hierarchy. For example, to display a brief view of your Ethernet switching options for your interfaces, use the command **show ethernet-switching-options interfaces**.

CLI Configuration Statements

The configuration statement hierarchy has two types of statements: *container statements*, which are statements that contain other statements, and *leaf statements*, which do not contain other statements. All of the container and leaf statements together form the *configuration hierarchy*.

The **protocols** statement is a top-level statement at the trunk of the configuration tree. The **ospf**, **area**, and **interface** statements are all subordinate container statements of a higher statement (they are branches of the hierarchy tree), and the **hello-interval** statement is a leaf on the tree.

Moving Among Hierarchy Levels

You can use the CLI commands to navigate the levels of the configuration statement hierarchy:

- edit— Moves to an existing configuration statement hierarchy or creates a hierarchy and moves to that level.
- exit—Moves up the hierarchy to the previous level where you were working. This command is, in effect, the opposite of the **edit** command. Alternatively, you can use the **quit** command. The **exit** and **quit** commands are interchangeable.
- up—Moves up the hierarchy one level at a time.
- top—Moves directly to the top level of the hierarchy.

Related Documentation

- CLI User Interface Overview on page 54
- *CLI User Guide*

Understanding the Brief, Detail, Extensive, and Terse Options of Junos OS Operational Commands

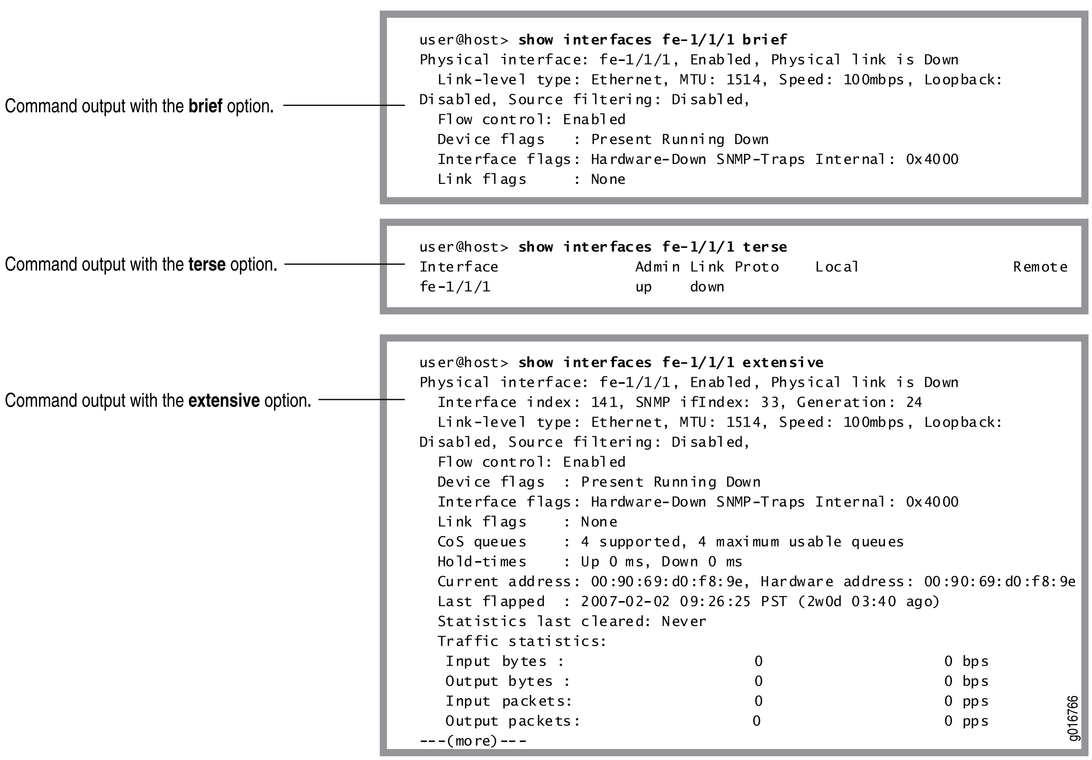
The Junos OS operational mode commands can include **brief**, **detail**, **extensive**, or **terse** options. You can use these options to control the amount of information you want to view.

1. Use the ? prompt to list options available for the command. For example:

```
user@host> show interfaces fe-1/1/1 ?
Possible completions:
<[Enter]>            Execute this command
  brief              Display brief output
  descriptions       Display interface description strings
  detail             Display detailed output
  extensive          Display extensive output
  media              Display media information
  snmp-index         SNMP index of interface
  statistics         Display statistics and detailed output
  terse              Display terse output
  |                  Pipe through a command
```

2. Choose the option you wish to use with the command. (See Figure 9 on page 77.)

Figure 9: Command Output Options



Related Documentation

- Overview of Junos OS CLI Operational Mode Commands on page 73
- *Controlling the Scope of an Operational Mode Command*

Understanding Junos OS CLI Configuration Mode

You can configure all properties of Junos OS, including interfaces, general routing information, routing protocols, and user access, as well as several system hardware properties.

As described in *Understanding the Junos OS CLI Modes, Commands, and Statement Hierarchies*, a router configuration is stored as a hierarchy of statements. In configuration mode, you create the specific hierarchy of configuration statements that you want to use. When you have finished entering the configuration statements, you commit them, which activates the configuration on the router.

You can create the hierarchy interactively or you can create an ASCII text file that is loaded onto the router or switch and then committed.

This topic covers:

Configuration Mode Commands

Table 39 on page 79 summarizes each CLI configuration mode command. The commands are organized alphabetically.

Table 39: Summary of Configuration Mode Commands

Command	Description
activate	Remove the **inactive:** tag from a statement, effectively reading the statement or identifier to the configuration. Statements or identifiers that have been activated take effect when you next issue the **commit** command.
annotate	Add comments to a configuration. You can add comments only at the current hierarchy level.
commit	Commit the set of changes to the database and cause the changes to take operational effect.
copy	Make a copy of an existing statement in the configuration.
deactivate	Add the **inactive:** tag to a statement, effectively commenting out the statement or identifier from the configuration. Statements or identifiers marked as inactive do not take effect when you issue the **commit** command.
delete	Delete a statement or identifier. All subordinate statements and identifiers contained within the specified statement path are deleted with it.
edit	Move inside the specified statement hierarchy. If the statement does not exist, it is created.
exit	Exit the current level of the statement hierarchy, returning to the level prior to the last edit command, or exit from configuration mode. The **quit** and **exit** commands are synonyms.
extension	Manage configurations that are contributed by SDK application packages. Either display or delete user-defined configuration contributed by the named SDK application package. A configuration defined in any native Junos OS package is never deleted by the extension command.
help	Display help about available configuration statements.
insert	Insert an identifier into an existing hierarchy.
load	Load a configuration from an ASCII configuration file or from terminal input. Your current location in the configuration hierarchy is ignored when the load operation occurs.

Table 39: Summary of Configuration Mode Commands *(continued)*

Command	Description
quit	Exit the current level of the statement hierarchy, returning to the level prior to the last edit command, or exit from configuration mode. The **quit** and **exit** commands are synonyms.
rename	Rename an existing configuration statement or identifier.
replace	Replace identifiers or values in a configuration.
rollback	Return to a previously committed configuration. The software saves the last 10 committed configurations, including the rollback number, date, time, and name of the user who issued the **commit configuration** command.
run	Run a top-level CLI command without exiting from configuration mode.
save	Save the configuration to an ASCII file. The contents of the current level of the statement hierarchy (and below) are saved, along with the statement hierarchy containing it. This allows a section of the configuration to be saved, while fully specifying the statement hierarchy.
set	Create a statement hierarchy and set identifier values. This is similar to **edit** except that your current level in the hierarchy does not change.
show	Display the current configuration.
status	Display the users currently editing the configuration.
top	Return to the top level of configuration command mode, which is indicated by the **[edit]** banner.
up	Move up one level in the statement hierarchy.
update	Update a private database.
wildcard	Delete a statement or identifier. All subordinate statements and identifiers contained within the specified statement path are deleted with it. You can use regular expressions to specify a pattern. Based on this pattern, you search for items that contain these patterns and delete them.

Configuration Statements and Identifiers

You can configure router or switch properties by including the corresponding statements in the configuration. Typically, a statement consists of a keyword, which is fixed text, and, optionally, an identifier. An identifier is an identifying name that you can define, such as the name of an interface or a username, which enables you and the CLI to differentiate among a collection of statements.

Table 40 on page 81 describes top-level CLI configuration mode statements.

NOTE: **The QFX3500 switch does not support the IS-IS, OSPF, BGP, LDP, MPLS, and RSVP protocols.**

Table 40: Configuration Mode Top-Level Statements

Statement	Description
access	Configure the Challenge Handshake Authentication Protocol (CHAP). For information about the statements in this hierarchy, see the *Junos OS Administration Library for Routing Devices*.
accounting-options	Configure accounting statistics data collection for interfaces and firewall filters. For information about the statements in this hierarchy, see the *Network Management Administration Guide for Routing Devices*.
chassis	Configure properties of the router chassis, including conditions that activate alarms and SONET/SDH framing and concatenation properties. For information about the statements in this hierarchy, see the *Junos OS Administration Library for Routing Devices*.
class-of-service	Configure class-of-service parameters. For information about the statements in this hierarchy, see the *Junos OS Class of Service Library for Routing Devices*.
firewall	Define filters that select packets based on their contents. For information about the statements in this hierarchy, see the *Routing Policy Feature Guide for Routing Devices*.
forwarding-options	Define forwarding options, including traffic sampling options. For information about the statements in this hierarchy, see the *Junos OS Network Interfaces Library for Routing Devices*.
groups	Configure configuration groups. For information about statements in this hierarchy, see the *Junos OS Administration Library for Routing Devices*.
interfaces	Configure interface information, such as encapsulation, interfaces, virtual channel identifiers (VCIs), and data-link connection identifiers (DLCIs). For information about the statements in this hierarchy, see the *Junos OS Network Interfaces Library for Routing Devices*.
policy-options	Define routing policies, which allow you to filter and set properties in incoming and outgoing routes. For information about the statements in this hierarchy, see the *Routing Policy Feature Guide for Routing Devices*.
protocols	Configure routing protocols, including BGP, IS-IS, LDP, MPLS, OSPF, RIP, and RSVP. For information about the statements in this hierarchy, see the chapters that discuss how to configure the individual routing protocols in the *Junos OS Routing Protocols Library for Routing Devices* and the *Junos OS MPLS Applications Library for Routing Devices*.

Table 40: Configuration Mode Top-Level Statements *(continued)*

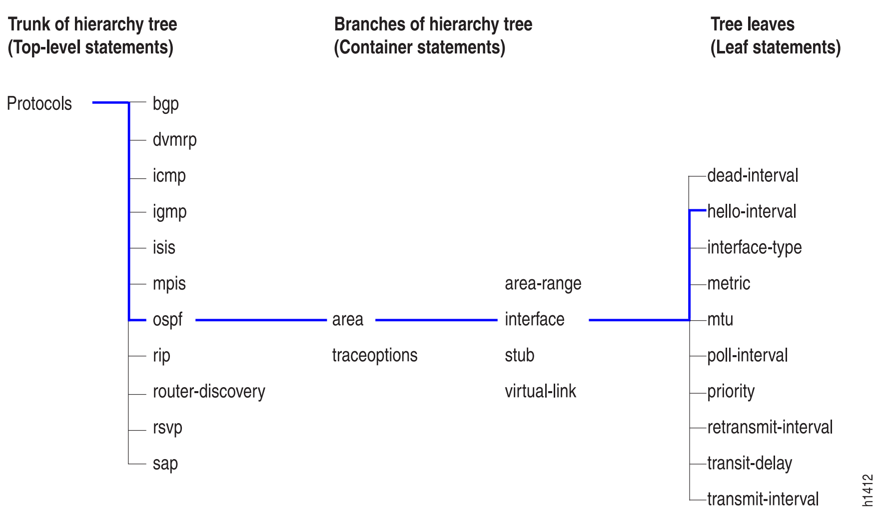
Statement	Description
routing-instances	Configure multiple routing instances. For information about the statements in this hierarchy, see the *Junos OS Routing Protocols Library for Routing Devices*.
routing-options	Configure protocol-independent routing options, such as static routes, autonomous system numbers, confederation members, and global tracing (debugging) operations to log. For information about the statements in this hierarchy, see the *Junos OS Routing Protocols Library for Routing Devices*.
security	Configure IP Security (IPsec) services. For information about the statements in this hierarchy see the *Junos OS Administration Library for Routing Devices*.
snmp	Configure SNMP community strings, interfaces, traps, and notifications. For information about the statements in this hierarchy, see the *Network Management Administration Guide for Routing Devices*.
system	Configure systemwide properties, including the hostname, domain name, Domain Name System (DNS) server, user logins and permissions, mappings between hostnames and addresses, and software processes. For information about the statements in this hierarchy, see the *Junos OS Administration Library for Routing Devices*.

For specific information on configuration statements, see the Junos OS configuration guides.

Configuration Statement Hierarchy

The Junos OS configuration consists of a hierarchy of *statements*. There are two types of statements: *container statements*, which are statements that contain other statements, and *leaf statements*, which do not contain other statements (see Figure 10 on page 82). All of the container and leaf statements together form the *configuration hierarchy*.

Figure 10: Configuration Mode Hierarchy of Statements



Each statement at the top level of the configuration hierarchy resides at the trunk (or root level) of a hierarchy tree. The top-level statements are container statements, containing other statements that form the tree branches. The leaf statements are the leaves of the hierarchy tree. An individual hierarchy of statements, which starts at the trunk of the hierarchy tree, is called a *statement path*. Figure 10 on page 82 illustrates the hierarchy tree, showing a statement path for the portion of the protocol configuration hierarchy that configures the hello interval on an interface in an OSPF area.

The **protocols** statement is a top-level statement at the trunk of the configuration tree. The **ospf**, **area**, and **interface** statements are all subordinate container statements of a higher statement (they are branches of the hierarchy tree); and the **hello-interval** statement is a leaf on the tree which in this case contains a data value: the length of the hello interval, in seconds.

The CLI represents the statement path shown in Figure 10 on page 82 as **[edit protocols ospf area *area-number* interface *interface-name*]** and displays the configuration as follows:

```
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/0 {
        hello-interval 5;
      }
      interface so-0/0/1 {
        hello-interval 5;
      }
    }
  }
}
```

The CLI indents each level in the hierarchy to indicate each statement's relative position in the hierarchy and generally sets off each level with braces, using an open brace at the beginning of each hierarchy level and a closing brace at the end. If the statement at a hierarchy level is empty, the braces are not printed.

Each leaf statement ends with a semicolon. If the hierarchy does not extend as far as a leaf statement, the last statement in the hierarchy ends with a semicolon.

The configuration hierarchy can also contain "oneliners" at the last level in the hierarchy. Oneliners remove one level of braces in the syntax and display the container statement, its identifiers, the child or leaf statement and its attributes all on one line. For example, in the following sample configuration hierarchy, the line **level 1 metric *10*** is a oneliner because the **level** container statement with identifier ***1***, its child statement **metric**, and its corresponding attribute ***10*** all appear on a single line in the hierarchy:

```
[edit protocols]
  isis {
    interface ge-0/0/0.0 {
      level 1 metric 10;
    }
  }
}
```


Likewise, in the following example, **dynamic-profile** ***dynamic-profile-name*** **aggregate-clients;** is a oneliner because the **dynamic-profile** statement, its identifier ***dynamic-profile-name***, and leaf statement **aggregate-clients** all appear on one line when you run the **show** command in the configuration mode:

```
[edit forwarding-options]
user@host# show
dhcp-relay {
  dynamic-profile dynamic-profile-name aggregate-clients;
}
```

Related Documentation

- *Entering and Exiting the Junos OS CLI Configuration Mode*

Licenses

Junos OS Feature Licenses

Some Junos OS software features require a license to activate the feature. To enable a licensed feature, you need to purchase, install, manage, and verify a license key that corresponds to each licensed feature. To conform to Junos OS feature licensing requirements, you must purchase one license per feature per device. The presence of the appropriate software license key on your device determines whether you are eligible to configure and use the licensed feature.

To speed deployment of licensed features, Junos OS software implements an honor-based licensing structure and provides you with a 30-day grace period to use a licensed feature without a license key installed. The grace period begins when you configure the feature and your device uses the licensed feature for the first time, but not necessarily when you install the license. After the grace period expires, the system generates system log messages saying that the feature requires a license. To clear the error message and use the licensed feature properly, you must install and verify the required license.

For information about how to purchase software licenses, contact your Juniper Networks sales representative.

Related Documentation

- *License Enforcement*
- Junos OS Feature License Keys on page 86
- *Software Feature Licenses*

- Verifying Junos OS License Installation on page 94

Software Features That Require Licenses on the QFX Series

The following Junos OS features require an Advanced Feature License (AFL) on QFX Series devices:

NOTE: If you try to configure a feature that is not licensed, you will receive syslog messages saying that you are using a feature that is licensable and that you do not possess a license for the feature. If you try to commit configuration changes for a feature that is not licensed, you will receive a commit warning saying that you have exceeded the allowed license limit for the feature.

- Border Gateway Protocol (BGP)
- Intermediate System-to-Intermediate System (IS-IS)
- Multiprotocol Label Switching (MPLS)
- Fibre Channel support

Table 41 on page 85 lists the licenses you can purchase for each QFX Series software feature.

For information about how to purchase a software license, contact your Juniper Networks sales representative.

Table 41: Junos OS Feature Licenses and Model Numbers for QFX Series Devices

Licensed Software Feature	Supported Devices	Number of Licenses Required	Model Number
QFX Series advanced feature license for Border Gateway Protocol (BGP), Intermediate System-to-Intermediate System (IS-IS), and Multi-protocol Label Switching (MPLS)	QFX3500, QFX3600, QFX5100-48S, and QFX5100-48T switches.	One per switch	QFX-JSL-EDGE-ADV1
QFX Series advanced feature license for Border Gateway Protocol (BGP), Intermediate System-to-Intermediate System (IS-IS), and Multi-protocol Label Switching (MPLS)	QFX5100-24Q and QFX5100-96S switches.	One per switch	QFX5100-HDNSE-LIC
QFX Series advanced feature license for Border Gateway Protocol (BGP)	QFX3100 Director device	One per Node device in a network Node group	QFX-JSL-DRCTR-ADV1

Table 41: Junos OS Feature Licenses and Model Numbers for QFX Series Devices *(continued)*

Licensed Software Feature	Supported Devices	Number of Licenses Required	Model Number
QFX Series advanced feature license for Fibre Channel	QFX3500 switch	One per switch on which fibre channel ports are configured	QFX-JSL-EDGE-FC
QFX Series advanced feature license for Fibre Channel	QFX3100 Director device	One per QFX3500 Node device on which fibre channel ports are configured	QFX-JSL-DRCTR-FC
QFX Series advanced feature license for Fibre Channel - Capacity 16	QFX3100 Director device	One for up to 16 QFX3500 Node devices on which fibre channel ports are configured	QFX-JSL-DRCTR-FC-C16
QFX Series feature license for enabling fabric mode	QFX3500 and QFX3600 device	One per device	QFX3000-JSL-EDGE-FAB
QFX Series feature license for base software for QFX3000-G QFabric system	QFX3100 Director device	One per QFX3000-G QFabric system	QFX3008-JSL-DRCTR-FAB
QFX Series feature license for base software for QFX3000-M QFabric system	QFX3100 Director device	One per QFX3000-M QFabric system	QFX3000M-JSL-DRCTR-FAB

Related Documentation

- Junos OS Feature Licenses on page 84
- Junos OS Feature License Keys on page 86
- Generating the License Keys for a Standalone QFX Series Device on page 89
- *Generating the License Keys for a QFabric System*
- Adding New Licenses (CLI Procedure) on page 91
- Deleting a License (CLI Procedure) on page 92
- Saving License Keys on page 93
- Verifying Junos OS License Installation on page 94

Junos OS Feature License Keys

Some Junos OS software features require a license to be activated. To enable each licensed feature, you must purchase, install, manage, and verify a license key that corresponds to the licensed feature.

Release-Tied License Keys and Upgrade Licenses on MX Series Routers

The Junos OS licensing infrastructure currently associates a license feature with attributes such as date, platform, and validity. In addition to these attributes, for MX Series routers running Junos OS Release 12.2 and later, a licensed feature can be associated with a release number at the time of generating the license key. This type of release-tied license key is used to validate a particular licensed feature while attempting a software upgrade. The upgrade process aborts if the release number in the license key is earlier than the Junos OS release number to which the system is being upgraded.

Additionally, an upgrade license key can be generated for a release-tied licensed feature. An upgrade license key is used for carrying forward a capacity license to the upgrade release. Although an upgrade license might be an acceptable license on the current release, it does not add to the existing capacity limit. The capacity added in the upgrade license key is valid for the upgrade software release only.

The release number embedded in the license key indicates the maximum release number up to which Junos OS can be upgraded.

As an example, assume that your system is running Junos OS Release 12.2 and is using the **scale-subscriber** licensed feature with a later release-tied upgrade license key installed. If you request a software upgrade to the later release of Junos OS, the software upgrade operation fails and the following error message is displayed:

```
mgd: error: No valid upgrade license found for feature 'scale-subscriber'.
Aborting Software upgrade.
Validation failed
```

In this example, to successfully upgrade to the later release of Junos OS, the release number included in the upgrade license key should be greater than or equal to the later release number. Also, you can perform software upgrades up to the previous release without any additional license keys to retain the existing scale limit.

NOTE:
When you install a release-tied license, the following apply:

- You can purchase an upgrade capacity license only if a base capacity license for the same scale-tier has already been generated or purchased.
- You cannot install an upgrade license if the capacity does not match any of the existing base capacity licenses on the system.
- The license installation fails when you install a lower release number license key on a higher software release number.
- A release-tied license can be installed on a Junos OS release number that is lower than or equal to the release number included in the license key. For example, a 12.2 license key is valid on Junos OS Release 12.1.
- An upgrade license is valid only on the target release number specified in the license key, but can be installed on an earlier Junos OS release. For example, a 4 K scale-tier upgrade license for Junos OS Release 12.2 can be installed on an earlier release, and the installed count of licenses remains unaltered.
- Release-tied licenses of the previous release are not deleted on upgrading Junos OS to a newer release version.

Licensable Ports on MX5, MX10, and MX40 Routers

Starting with Junos OS Release 12.2, license keys are available to enhance the port capacity on MX5, MX10, and MX40 routers up to the port capacity of an MX80 router. The MX5, MX10, and MX40 routers are derived from the modular MX80 chassis with similar slot and port assignments, and provide all functionality available on an MX80 router, but at a lower capacity. Restricting port capacity is achieved by making a set of MIC slots and ports licensable. MICs without a license are locked, and are unlocked or made usable by installing appropriate upgrade licenses.

The base capacity of a router is identified by the Ideeprom assembly ID (I2C ID), which defines the board type. However, the Junos OS licensing infrastructure allows the use of restricted ports without a license for a grace period of 30 days. After the grace period expires, the router reverts back to the base capacity if no upgrade license is purchased and installed for the locked ports. The I2C ID along with an upgrade license determine the final capacity of an MX5, MX10, or MX40 router.

The MX5, MX10, MX40, and MX80 routers support the following types of MICs:

- A built-in 10-Gigabit Ethernet MIC with four 10-Gigabit Ethernet ports
- Two front-pluggable MICs

A feature ID is assigned to every license upgrade for enhancing port capacity. Table 42 on page 88 displays the chassis types and their associated port capacity, I2C ID, base capacity, feature ID, feature name, and the final capacity after a license upgrade.

Table 42: Upgrade Licenses for Enhancing Port Capacity

Chassis Type	Port Capacity	I2C ID	Base Capacity	Feature ID and Feature Name	Upgrade Capacity
MX5	20G	0x556	Slot 1 • 1/MIC0	f1—MX5 to MX10 upgrade	Slot 1 and 2 • 1/MIC0 • 1/MIC1
MX10	40G	0x555	Slot 1 and 2 • 1/MIC0 • 1/MIC1	f2—MX10 to MX40 upgrade	Slot 2 and first 2 ports on Slot 0 • 1/MIC1 • First 2 ports on 0/MIC0
MX40	60G	0x554	Slot 1, SLot 2 and first 2 ports on Slot 0 • 1/MIC0 • 1/MIC1 • First 2 ports on 0/MIC0	f3—MX40 to MX80 upgrade	Slot 2 and all ports on Slot 0 • 1/MIC1 • All 4 ports on 0/MIC0

When installing an upgrade license for enhancing port capacity on MX5, MX10 and MX40 routers, consider the following:

- To upgrade an MX5 router to MX80 router capacity, licenses for all three features (f1, f2, f3) must be installed. All three features can be provided in a single license key.
- To upgrade an MX10 router to MX40 router capacity, installing a license key with f2 feature is sufficient.
- Non-applicable feature IDs in a license key reject the upgrade license. For example:
  - An f1 feature ID on an MX10 upgrade license key rejects the license.
  - Feature IDs f1 and f2 on an MX40 upgrade license key reject the entire license.

Related Documentation

- Junos OS Feature Licenses on page 84
- *License Enforcement*
- *Software Feature Licenses*
- Verifying Junos OS License Installation on page 94

Generating the License Keys for a Standalone QFX Series Device

When you purchase a Junos OS software feature license for a QFX Series device, you receive an e-mail containing an authorization code for the feature license from Juniper Networks. You can use the authorization code to generate a unique license key (a combination of the authorization code and the device's serial number) for the device, and then add the license key on the device.

Before generating the license keys for a device:

- Purchase the required licenses for the device. See "Software Features That Require Licenses on the QFX Series" on page 85.
- Note down the authorization code in the e-mail you received from Juniper Networks when you purchased the license.
- Determine the serial number of the device. For instructions, see *Locating the Serial Number on a QFX3500 Device or Component*.

To generate the license keys for a device:

1. In a browser, log in to the Juniper Networks License Management System at https://www.juniper.net/lcrs/license.do.

   The Manage Product Licenses page appears.

   NOTE: **To access the licensing site, you must have a service contract with Juniper Networks and an access account. If you need help obtaining an account, complete the registration form at the Juniper Networks website** https://www.juniper.net/registration/Register.jsp **.**

2. On the Generate Licenses tab, select **QFX Series Product** from the drop-down list, and click **Go**.

   The Generate Licenses - QFX Series Product page appears.

3. Select the **QFX Series Product Device** option button, and click **Continue**.

   The Generate Licenses - QFX Series Product Devices page appears.

4. In the **Device Serial Number** field, enter the serial number for the device.

5. In the **Authorization Code** field, enter the authorization code in the e-mail you received from Juniper Networks when you purchased the license.

6. (Optional) If you want to enter another authorization code for the same device, click **Enter More Authorization Codes** to display a new authorization code field. Enter the authorization code in this field.

7. Click **Confirm**.

   The Confirm License Information page appears, displaying a summary of the information you submitted to the License Management System.

8. Review the information to ensure everything is correct and then click **Generate License**.

   The Generate Licenses - QFX Series Product Devices page appears, displaying a summary of your license keys, including a link that displays the details of your new license keys.

9. Select the file format in which you want to obtain your new license keys.

10. Select the delivery method you want to use to obtain your new license keys.

    To download the license keys:

    - Select the **Download to this computer** option button, and click **OK**.

    To e-mail the license keys:

    - Select the **Send e-mail to *e-mail ID*** option button, and click **OK**.

Related Documentation

- Software Features That Require Licenses on the QFX Series on page 85
- Adding New Licenses (CLI Procedure) on page 91

- *Locating the Serial Number on a QFX3500 Device or Component*

Adding New Licenses (CLI Procedure)

Before adding new licenses, complete the following tasks:

- Purchase the required licenses.
- Establish basic network connectivity with the router or switch. For instructions on establishing basic connectivity, see the *Getting Started Guide* or *Quick Start Guide* for your device.

NOTE: On QFabric systems, install your licenses in the default partition of the QFabric system and not on the individual components (Node devices and Interconnect devices).

To add a new license key to the device using the CLI:

1. From the CLI operational mode, enter one of the following CLI commands:
   - To add a license key from a file or URL, enter the following command, specifying the filename or the URL where the key is located:

     user@host> **request system license add** ***filename*** **|** ***url***

   - To add a license key from the terminal, enter the following command:

     user@host> **request system license add terminal**

2. When prompted, enter the license key, separating multiple license keys with a blank line.

   If the license key you enter is invalid, an error appears in the CLI output when you press Ctrl+d to exit license entry mode.

3. Go on to "Verifying Junos OS License Installation" on page 94.

On routers that have Graceful Routing Engine switchover (GRES) enabled, after successfully adding the new license on the master Routing Engine, the license keys are automatically synchronized on the backup Routing Engine as well. However, in case GRES is not enabled, the new license is added on each Routing Engine separately. This ensures that the license key is enabled on the backup Routing Engine during changeover of mastership between the Routing Engines.

To add a new license key to a router with dual Routing Engines without GRES:

1. After adding the new license key on the master Routing Engine, use the **request chassis routing-engine master switch** command to have the backup Routing Engine become the master Routing Engine.
2. Log in to the active Routing Engine and add the new license key, repeating the same process.

NOTE: Adding a license key to the router or switch might be delayed if a kernel resynchronization operation is in progress at that time. The following message is displayed on the CLI when the license-adding operation is about to be delayed:

A kernel re-sync operation is in progress. License update may take several minutes to complete.

Related Documentation

- Deleting a License (CLI Procedure) on page 92
- Junos OS Feature Licenses on page 84
- Verifying Junos OS License Installation on page 94
- request system license add on page 379

Deleting a License (CLI Procedure)

Before deleting a license, establish basic network connectivity with the router or switch. For instructions on establishing basic connectivity, see the *Getting Started Guide* or *Quick Start Guide* for your router or switch.

You have the options to delete a single license, delete all licenses, or delete a list of licenses enclosed in brackets.

1. Display the licenses available to be deleted.

```
user@host> request system license delete license-identifier-list ?
Possible completions:
  E00468XXX4            License key identifier
  JUNOS10XXX1           License key identifier
  JUNOS10XXX2           License key identifier
  JUNOS10XXX3           License key identifier
  JUNOS10XXX4           License key identifier
  [                     Open a set of values
```

2. To delete a license key or keys from a device using the CLI operational mode, select one of the following methods:

   - Delete a single license by specifying the license ID. Using this option, you can delete only one license at a time.

     user@host> **request system license delete *license-identifier***

   - Delete all license keys from the current device.

     user@host> **request system license delete all**

   - Delete multiple license keys from the current device. Specify the license identifier for each key and enclose the list of identifiers in brackets.

     user@host> **request system license delete license-identifier-list [*JUNOS10XXX1 JUNOS10XXX3 JUNOS10XXX4 ...*]**

   ```
   Delete license(s) ?
    [yes,no] (no) yes
   ```


3. Go on to "Verifying Junos OS License Installation" on page 94.

NOTE: Deleting a license key from the router or switch might be delayed if a kernel resynchronization operation is in progress at that time. The following message is displayed on the CLI when the license-deleting operation is about to be delayed:
A kernel re-sync operation is in progress. License update may take several minutes to complete.

Related Documentation

- Adding New Licenses (CLI Procedure) on page 91
- Saving License Keys on page 93
- Junos OS Feature Licenses on page 84
- Verifying Junos OS License Installation on page 94
- **request system license delete on page 380**

Saving License Keys

Before saving a license, establish basic network connectivity with the router or switch. For instructions on establishing basic connectivity, see the *Getting Started Guide* or *Quick Start Guide* for your router or switch.

To save the licenses installed on a device to a file using the CLI:

1. From the CLI operational mode, enter one of the following CLI commands:
   - To save the installed license keys to a file or URL, enter the following command:

     user@host> **request system license save *filename* | *url***

     For example, the following command saves the installed license keys to a file named **license.config**:
   - To save a license key from the terminal, enter the following command:

     user@host> **request system license save ftp://user@host/license.config**
2. Go on to "Verifying Junos OS License Installation" on page 94.

Related Documentation

- Adding New Licenses (CLI Procedure) on page 91
- Deleting a License (CLI Procedure) on page 92
- Junos OS Feature Licenses on page 84
- Verifying Junos OS License Installation on page 94

Verifying Junos OS License Installation

To verify Junos OS license management, perform the following tasks:

- Displaying Installed Licenses on page 94
- Displaying License Usage on page 95

Displaying Installed Licenses

Purpose Verify that the expected licenses are installed and active on the router or switch.

Action From the CLI, enter the **show system license** command.

Sample Output

```
user@host> show system license
License usage:
                          Licenses     Licenses    Licenses    Expiry
  Feature name                used    installed      needed
  subscriber-acct                0            1           0    permanent
  subscriber-auth                0            1           0    permanent
  subscriber-addr                0            1           0    permanent
  subscriber-vlan                0            1           0    permanent
  subscriber-ip                  0            1           0    permanent
  scale-subscriber               0         1000           0    permanent
  scale-l2tp                     0         1000           0    permanent
  scale-mobile-ip                0         1000           0    permanent

Licenses installed:
  License identifier: E000185416
  License version: 2
  Features:
    subscriber-acct  - Per Subscriber Radius Accounting
      permanent
    subscriber-auth  - Per Subscriber Radius Authentication
      permanent
    subscriber-addr  - Address Pool Assignment
      permanent
    subscriber-vlan  - Dynamic Auto-sensed Vlan
      permanent
    subscriber-ip    - Dynamic and Static IP
      permanent
```

Meaning The output shows a list of the license usage and a list of the licenses installed on the router or switch. Verify the following information:

- Each license is present. Licenses are listed in ascending alphanumeric order by license ID.
- The state of each license is **permanent**.

NOTE: A state of invalid indicates that the license key is not a valid license key. Either it was entered incorrectly or it is not valid for the specific device.

- The feature for each license is the expected feature. The features enabled are listed by license. An all-inclusive license has all features listed.
- All configured features have the required licenses installed. The Licenses needed column must show that no licenses are required.

Displaying License Usage

Purpose Verify that the licenses fully cover the feature configuration on the router or switch.

Action From the CLI, enter the **show system license usage** command.

Sample Output

```
user@host> show system license usage
             Licenses      Licenses     Licenses     Expiry
  Feature name          used     installed      needed
  subscriber-addr          1             0           1     29 days
  scale-subscriber         0          1000           0     permanent
  scale-l2tp               0          1000           0     permanent
  scale-mobile-ip          0          1000           0     permanent
```

Meaning The output shows any licenses installed on the router or switch and how they are used. Verify the following information:

- Any configured licenses appear in the output. The output lists features in ascending alphabetical order by license name. The number of licenses appears in the third column. Verify that you have installed the appropriate number of licenses.
- The number of licenses used matches the number of configured features. If a licensed feature is configured, the feature is considered used. The sample output shows that the subscriber address pooling feature is configured.
- A license is installed on the router or switch for each configured feature. For every feature configured that does not have a license, one license is needed.

  For example, the sample output shows that the subscriber address feature is configured but that the license for the feature has not yet been installed. The license must be installed within the remaining grace period to be in compliance.

CHAPTER 4

Installation

Software Installation

Configuring Zero Touch Provisioning

NOTE: To see which platforms support Zero Touch Provisioning (ZTP), in a browser, go to Feature Explorer. In the **Explore Features** section of the Feature Explorer page, select **All Features**. In the **Features Grouped by Feature Family** box, select Zero Touch Provisioning. You can also type the name of the feature in the **Search for Features** edit box. In previous Junos OS releases on EX Series switches, Zero Touch Provisioning was called EZ Touchless Provisioning.

Zero Touch Provisioning allows you to provision new switches in your network automatically, without manual intervention. When you physically connect a switch to the network and boot it with a default configuration, it attempts to upgrade the Junos OS software automatically and autoinstall a configuration file from the network.

The switch uses information that you configure on a Dynamic Host Configuration Protocol (DHCP) server to locate the necessary software image and configuration files on the network. If the DHCP server does not respond or provide the software image and configuration files, the switch continues using the preinstalled Junos OS software and default factory configuration. On switches running Enhanced Layer 2 Software, Junos Extended Dynamic Host Configuration Protocol (JDHCP) is used instead of legacy DHCP. JDHCP supports the same functionality as DHCP, and all configuration options remain the same. JDHCP is an enhanced version of legacy DHCP software.

NOTE: If the ZTP configuration is enabled, the switch broadcasts DHCP DISCOVER packets on its interfaces. If the DHCP server on the network responds with DHCP vendor options set with the necessary values to initiate ZTP, then ZTP proceeds. To disable broadcasting the DHCP DISCOVER packets without performing the ZTP process, manually delete the **auto-image-upgrade** statement located at the **[edit chassis]** hierarchy. If ZTP completes without errors, the **auto-image-upgrade** statement is automatically deleted.

Before you begin:

- Ensure that the switch has access to the following network resources:
  - A DHCP server to lease IP addresses and information on software images and configuration files on the network.

    Refer to your DHCP server documentation for configuration instructions.
  - The File Transfer Protocol (anonymous FTP), Hypertext Transfer Protocol (HTTP), Trivial File Transfer Protocol (TFTP) server on which the software image and configuration files are stored

    NOTE: Although TFTP is supported, we recommend that you use FTP or HTTP instead, because these transport protocols are more reliable.

- A Domain Name System (DNS) server to perform reverse DNS lookup
- (Optional) An NTP server to perform time synchronization on the network
- (Optional) A system log (syslog) server to manage system log messages and alerts

- Locate and record the MAC address printed on the switch chassis.

CAUTION: **We recommend that you do not commit a user configuration while the switch is performing ZTP activity—for example, updating the software image or applying a configuration file.**

Perform the following steps to configure ZTP:

1. Boot the switch.

   The switch continues to use the preinstalled Junos OS software and default factory configuration.

2. Issue the **request system zeroize** command on the switch.

3. Download the software image file and the configuration file to the FTP, HTTP, TFTP, server that the switch will download these files from.

   You can download either one or both of these files.

4. Configure the DHCP server to provide the necessary information to the switch.

   Configure IP address assignment.

   You can configure dynamic or static IP address assignment for the switch's management address. To determine the switch's management MAC address for static IP address mapping, add 1 to the last byte of the switch's MAC address, which you noted before you began this procedure.

5. Define the format of the vendor-specific information for DHCP option 43 in the dhcpd.conf file.

   Here is an example of an ISC DHCP 4.2 server dhcpd.conf file:

   ```
   option space NEW_OP; option;
     option NEW_OP.config-file-name code 1 = text;
     option NEW_OP.image-file-type code 2 = text;
     option NEW_OP.transfer-mode code 3 = text;
     option NEW_OP.alt-image-file-name code 4= text;
     option NEW_OP-encapsulation code 43 = encapsulate NEW_OP;
   ```

6. Configure the following DHCP option 43 suboptions:

   - Suboption 00: The name of the software image file to install

     NOTE: **When the DHCP server cannot use suboption 00, configure the image file using suboption 04. If both suboption 00 and suboption 4 are defined, suboption 04 is ignored.**

option NEW_OP.image-file-name "/dist/images/jinstall-ex-4300-13.2R1.1-domestic-signed.tgz";

- Suboption 01: The name of the configuration file to install

  option NEW_OP.config-file-name "/dist/config/jn-switch35.config";

- Suboption 02: The symbolic link to the software image file to install

  option NEW_OP.image-file-type "symlink";

  NOTE: If you do not specify suboption 2, the Zero Touch Provisioning process handles the software image as a filename, not a symbolic link.

- Suboption 03: The transfer mode that the switch uses to access the TFTP/FTP/HTTP server

  option NEW_OP.transfer-mode "ftp";

  NOTE: If suboption 03 is not configured, TFTP becomes the transfer mode by default.

- Suboption 04: The name of the software image file to install

  NOTE: When the DHCP server cannot use suboption 00, configure the image file using suboption 04. If both suboption 00 and suboption 4 are defined, suboption 04 is ignored.

  NOTE: DHCP option 43 suboptions 05 through 255 are reserved.

  option NEW_OP.alt-image-file-name "/dist/images/jinstall-ex-4300-13.2R1.1-domestic-signed.tgz";

7. NOTE: You must configure either option 150 or option 66. If you configure both option 150 and option 66, option 150 takes precedence, and option 66 is ignored. Also, make sure you specify an IP address, not a hostname, because name resolution is not supported.

   Configure DHCP option 150 to specify the IP address of the FTP, HTTP, or TFTP server.

   option option-150 code 150 "10.100.31.71";

8. Configure DHCP option 66 to specify the IP address of the FTP, HTTP, or TFTP server.

   option tftp-server-name "10.100.31.71";

9. (Optional) Configure DHCP option 7 to specify one or more system log (syslog) servers.

   option log-servers 10.100.31.72;

10. (Optional) Configure DHCP option 42 to specify one or more NTP servers.

    option ntp-servers 10.100.31.73;

11. (Optional) Configure DHCP option 12 to specify the hostname of the switch.

    option hostname "jn-switch35";

    The following sample configuration shows the DHCP options you just configured:

```
host jn-switch35 {
   hardware ethernet ac:4b:c8:29:5d:02;
   fixed-address 10.100.31.36;
   option tftp-server-name "10.100.31.71";
   option host-name "jn-switch35";
   option log-servers 10.100.31.72;
   option ntp-servers 10.100.31.73;
   option NEW_OP.image-file-name
      "/dist/images/jinstall-ex-4300-13.2R1.1-domestic-signed.tgz";
   option NEW_OP.transfer-mode "ftp";
   option NEW_OP.config-file-name "/dist/config/jn-switch35.config";
}
```

    Based on the DHCP options you just configured, the following statements are appended to the Junos OS configuration file (for example, **jn-switch35.config**):

```
system {
   host-name jn-switch35;
   syslog {
      host 10.100.31.72 {
         any any;
      }
   }
   ntp {
      server 10.100.31.73;
   }
}
```

12. Connect the switch to the network that includes the DHCP server and the FTP, HTTP, or TFTP server.

13. Boot the switch with the default configuration.

14. Monitor the ZTP process by looking at the following log files.

    NOTE: When SLAX (live operating system based on Linux) scripts are issued, the **op-script.log** and **event-script.log** files are produced.

    - /var/log/dhcp_logfile
    - /var/log/image_load_log
    - /var/log/op-script.log
    - /var/log/event-script.log

You can also monitor the ZTP process by looking at error messages and issuing operational commands. See "Monitoring Zero Touch Provisioning" on page 310 for more information.

Related Documentation

- Understanding Zero Touch Provisioning on page 47
- NTP Time Server and Time Services Overview on page 31
- *Op Script Overview*
- Monitoring Zero Touch Provisioning on page 310
- Understanding DHCP Services for Switches on page 36
- Reverting to the Default Factory Configuration by Using the request system zeroize Command on page 164

Junos OS Package Names

You upgrade the Juniper Networks Junos OS on the QFX Series by copying a software package to your switch or another system on your local network and then installing the new software package on the switch.

A software package name is in the following format:

NOTE: **A signed domestic package is used as an example only. Other types of software packages might be available in future releases.**

***package-name-m.nZx.y*-domestic-signed.tgz**

where:

- ***package-name*** is the name of the package—for example, **jinstall-qfx**.
- ***m.n*** is the software release, with ***m*** representing the major release number and ***n*** representing the minor release number—for example, **11.1**.
- ***Z*** indicates the type of software release, where **R** indicates released software and **B** indicates beta-level software.
- ***x.y*** represents the maintenance software release, with ***x*** representing the maintenance software release number and ***y*** representing the maintenance software spin number—for example, **1.5**.

A sample switch software package name is:

```
jinstall-qfx-11.1R1.5-domestic-signed.tgz
```

Related Documentation

- Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches on page 121
- *Upgrading Software on a QFabric System*
- Software Installation Overview on page 109

Performing a Recovery Installation on a QFX Series Device

If Junos OS on your device is damaged in some way that prevents the software from loading correctly, you may need to perform a recovery installation using an emergency boot device (for example, a USB flash drive) to restore the default factory installation. Once you have recovered the software, you need to restore the device configuration. You can either create a new configuration as you did when the device was shipped from the factory, or if you saved the previous configuration, you can simply restore that file to the device.

If at all possible, you should try to perform the following steps before you perform the recovery installation:

1. Ensure that you have an emergency boot device to use during the installation. See "Creating an Emergency Boot Device for a QFX Series Device" on page 153 for information on how to create an emergency boot device.
2. Copy the existing configuration in the file **/config/juniper.conf.gz** from the device to a remote system, such as a server, or to an emergency boot device. For extra safety, you can also copy the backup configurations (the files named **/config/juniper.conf.*n***, where *n* is a number from 0 through 9) to a remote system or to an emergency boot device.

   WARNING: **The recovery installation process completely overwrites the entire contents of the internal flash storage.**

3. Copy any other stored files to a remote system as desired.

To reinstall Junos OS:

1. Insert the emergency boot device into the QFX Series device.
2. Reboot the QFX Series device.

   NOTE: **Do not power off the device if it is already on.**

   [edit system]
   user@device> **request system reboot**

   If you do not have access to the CLI, power cycle the QFX Series device.

   The emergency boot device (external USB install media) is detected. At this time, you can load the Junos OS from the emergency boot device onto the internal flash storage.

3. The software prompts you with the following options:

```
External USB install media detected.
You can load Junos from this media onto an internal drive.
Press 'y' to proceed, 'f' to format and install, or 'n' to abort.
Do you wish to continue ([y]/f/n)? f
```

4. Type **f** to format the internal flash storage and install the Junos OS on the emergency boot device onto the internal flash storage.

   If you do no want to format the internal flash storage, type **y**.

   The following messages are displayed:

```
Installing packages from external USB drive da1
Packages will be installed to da0, media size: 8G

Processing format options
Fri September  4 01:18:44 UTC 2012

-- IMPORTANT INFORMATION --
Installer has detected settings to format system boot media.
This operation will erase all data from your system.

Formatting installation disk .. this will take a while, please wait
Disabling platform watchdog - threshold 12 mins

Determining installation slice
Fri September  4 01:27:07 UTC 2012
```

5. The device copies the software from the emergency boot device, occasionally displaying status messages. Copying the software can take up to 12 minutes.

   When the device is finished copying the software, you are presented with the following prompt:

```
*** Fri September  4 01:19:00 UTC 2012***
Installation successful..
Please select one of the following options:
Reboot to installed Junos after removing install media (default) ... 1
Reboot to installed Junos by disabling install media .............. 2
Exit to installer debug shell ..................................... 3
Install Junos to alternate slice .................................. 4
Your choice: 4
NOTE: System installer will now install Junos to alternate slice
Do not power off or remove the external installer media or
interrupt the installation mechanism.
```

6. Select **4** to install Junos OS to the alternate slice of the partition, and then press Enter.
7. Remove the emergency boot device when prompted and then press Enter. The device then reboots from the internal flash storage on which the software was just installed. When the reboot is complete, the device displays the login prompt.
8. Create a new configuration as you did when the device was shipped from the factory, or restore the previously saved configuration file to the device.

Related Documentation

• Creating an Emergency Boot Device for a QFX Series Device on page 153

Performing a Recovery Installation on a QFX5100 Switch

If Junos OS on your switch is damaged in some way that prevents the software from loading correctly, you may need to perform a recovery installation using an emergency boot device (for example, a USB flash drive) to restore the default factory installation. Once you have recovered the software, you need to restore the device configuration. You can either create a new configuration as you did when the device was shipped from the factory, or if you saved the previous configuration, you can simply restore that file to the switch.

If at all possible, you should try to perform the following steps before you perform the recovery installation:

1. Ensure that you have an emergency boot device to use during the installation. See “Creating an Emergency Boot Device for a QFX Series Device” on page 153 for information on how to create an emergency boot device.
2. Copy the existing configuration in the file **/config/juniper.conf.gz** from the switch to a remote system, such as a server, or to an emergency boot device. For extra safety, you can also copy the backup configurations (the files named **/config/juniper.conf.*n***, where *n* is a number from 0 through 9) to a remote system or to an emergency boot device.

   WARNING: **The recovery installation process completely overwrites the entire contents of the internal flash storage.**

3. Copy any other stored files to a remote system as desired.

To reinstall Junos OS:

1. Insert the emergency boot device into the QFX Series device.
2. Power cycle the QFX Series device.

   The emergency boot device (external USB install media) is detected. At this time, you can load the Junos OS from the emergency boot device onto the internal flash storage.

3. The software prompts you with the following options:

   ```
   Junos Snapshot Installer - (c) Juniper Networks 2013
   Reboot
   Install Junos Snapshot
   [13.2-20131115_x_132_x51_vjunos.0Boot to host shell [debug]
   ```

4. Select **Install Junos** to format the internal flash storage and install the Junos OS on the emergency boot device onto the internal flash storage.
5. The switch copies the software from the emergency boot device, occasionally displaying status messages. Copying the software can take up to 12 minutes.

   When the software is finished being copied from the emergency device to the QFX5100 switch, the QFX5100 switch the reboots from the internal flash storage on which the software was just installed. When the reboot is complete, the switch displays the Junos OS login prompt:

```
root@switch#
```

6. Create a new configuration as you did when the switch was shipped from the factory, or restore the previously saved configuration file to the switch.
7. Remove the emergency boot device.

Related Documentation

- Creating an Emergency Boot Device for a QFX Series Device on page 153

Performing an In-Service Software Upgrade (ISSU)

You can use an in-service software upgrade to upgrade the software running on the switch with minimal traffic disruption during the upgrade.

NOTE: **ISSU is supported in Junos OS Release 13.2X51-D15 and later.**

This topic covers:

Preparing the Switch for Software Installation

Before you begin software installation using ISSU:

- Ensure that nonstop active routing (NSR), nonstop bridging (NSB), and graceful Routing Engine switchover (GRES) are enabled. NSB and GRES enable NSB-supported Layer 2 protocols to synchronize protocol information between the master and backup Routing Engines.

  To verify that nonstop active routing is enabled:

  NOTE: **If nonstop active routing is enabled, then graceful Routing Engine switchover is enabled.**

  ```
  user@switch> show task replication
          Stateful Replication: Enabled
          RE mode: Master
  ```

  If nonstop active routing is not enabled (**Stateful Replication** is **Disabled**), see *Configuring Nonstop Active Routing*for information on how to enable it.

- Enable nonstop bridging (NSB). See *Configuring Nonstop Bridging* for information on how to enable it.
- (Optional) Back up the system software—Junos OS, the active configuration, and log files—on the switch to an external storage device with the **request system snapshot** command.

Upgrading the Software Using ISSU

This procedure describes how to upgrade the software running on a standalone switch:

To upgrade the switch using ISSU:

1. Download the software package by following the procedure in the Downloading Software Files with a Browser section in “Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches” on page 121.
2. Copy the software package or packages to the switch. We recommend that you copy the file to the **/var/tmp** directory.
3. Log in to the console connection. Using a console connection allows you to monitor the progress of the upgrade.
4. Start the ISSU:
   - On the switch, enter:

     user@switch> **request system software in-service-upgrade /var/tmp/*package-name*.tgz**

   where ***package-name*.tgz** is, for example, **jinstall-132_x51_vjunos.domestic.tgz**.

   NOTE: During the upgrade, you will not be able to access the Junos OS CLI.

   The switch displays status messages similar to the following messages as the upgrade executes:

```
jinstall-132_x51_vjunos.domestic.tgz reboot
ISSU: Validating Image
Prepare for ISSU
spawn the backup VM
ISSU: Preparing Backup RE
Backup upgrade done
ISSU: Backup RE Prepare Done
waiting for backup RE switchover ready
GRES operational
Initiating Chassis In-Service-Upgrade
Chassis ISSU Started
ISSU: Preparing Daemons
ISSU: Daemons Ready for ISSU
ISSU: Starting Upgrade for FRUs
ISSU: FPC Warm Booting
ISSU: FPC Warm Booted
ISSU: Preparing for Switchover
ISSU: Ready for Switchover
Checking In-Service-Upgrade status
  Item           Status                  Reason
  FPC 0          Online (ISSU)
send ISSU done to chassisd on backup VM
Chassis ISSU Completed
ISSU: IDLE
mgd_package_issu: Initiate em0 device handoff
```

NOTE: An ISSU might stop instead of abort if the FPC is at the warm boot stage. Also, any links that go down and up will not be detected during a warm boot of the Packet Forwarding Engine (PFE).

NOTE: If the ISSU process stops, you can look at the log files to diagnose the problem. The log files are located at */var/log/vjunos-log.tgz*.

5. Log in after the reboot of the switch completes. To verify that the software has been upgraded, enter the following command:

   user@switch> **show version**

6. To ensure that the resilient dual-root partitions feature operates correctly, copy the new Junos OS image into the alternate root partitions of all of the switch:

   user@switch> **request system snapshot slice alternate**

   Resilient dual-root partitions allow the switch to boot transparently from the alternate root partition if the system fails to boot from the primary root partition.

Related Documentation

- Understanding In-Service Software Upgrade (ISSU) on page 40
- **request system software in-service-upgrade on page 406**

Recovering from a Failed Software Installation

Problem If the Junos OS appears to have been installed but the CLI does not work, or if the switch has no software installed, you can use this recovery installation procedure to install the Junos OS.

Solution If a Junos OS image already exists on the switch, you can either install the new Junos OS package in a separate partition, in which case both Junos OS images remain on the switch, or you can remove the existing Junos OS image before you start the new installation process.

To perform a recovery installation:

1. Power on the switch. The loader script starts.
2. After the message **Loading /boot/defaults/loader.conf** appears, you are prompted with the following message:

   Hit [Enter] to boot immediately, or space bar for command prompt.

   Press the Spacebar to enter the manual loader. The **loader>** prompt appears.
3. Enter the following command:

   `loader>` **install [– –format] [– –external]** ***source*** where:

- **format**—Enables you to erase the installation media before installing the installation package. If you do not include this option, the system installs the new Junos OS in a different partition from that of the most recently installed Junos OS.
- **external**—Installs the installation package onto external media (a USB stick, for example).
- ***source***—Represents the name and location of the Junos OS package, either on a server on the network or as a file on an external media, as shown in the following two examples:
  - Network address of the server and the path on the server; for example, **tftp://192.17.1.28/junos/jinstall-qfx-11.1R1.5-domestic-signed.tgz**
  - Junos OS package on a USB device (commonly stored in the root drive as the only file), for example, **file:///jinstall-qfx-11.1R1.5-domestic-signed.tgz**).

The installation now proceeds normally and ends with a login prompt.

Software Installation Overview

A QFX Series product is delivered with the Junos OS preinstalled. As new features and software fixes become available, you can upgrade your software to use them.

When you power on the switch, it starts (boots) using the installed software.

You upgrade the Junos OS on a switch by copying a software package to a switch or other system on your local network and then using the CLI to install the new software on the switch. You then reboot the switch, which boots from the upgraded software. After a successful upgrade, you should back up the new current configuration to a secondary device.

During a successful upgrade, the installation package removes all files from the **/var/tmp** directory of the switch and completely reinstalls the existing software. It retains configuration files, and similar information, such as secure shell and host keys, from the previous version. The previous software package is preserved in a separate disk partition, and you can manually revert to it if necessary. If the software installation fails for any reason, such as loss of power during the installation process, the system returns to the originally active installation when you reboot.

If you encounter any difficulties during software installation or an upgrade, you can use the recovery installation procedure to install the Junos OS on the switch.

Related Documentation

- Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches on page 121
- *Upgrading Software on a QFabric System*
- Recovering from a Failed Software Installation on page 108
- *Performing a Nonstop Software Upgrade on the QFabric System*
- Performing a QFabric System Recovery Installation on the Director Group on page 6471

- Performing a Recovery Installation on a QFX Series Device on page 103

Upgrading Jloader Software on QFX Series Devices

Jloader software contains a boot loader (Uboot), which is used to bring up QFX Series devices and load the Junos OS from the flash memory of these devices. You can upgrade Jloader software on QFX3500 switches, QFX3500 and QFX3600 Node devices, and QFX3600-I and QFX3008-I Interconnect devices.

NOTE: Before you upgrade the Jloader software, see Table 43 on page 110, Table 44 on page 110, and Table 45 on page 111 to make sure that you are upgrading to the right version of Jloader software for the Junos OS software release running on your QFX3500 switches, or Node devices and Interconnect devices in your QFabric system.

See Table 46 on page 111 to see which Uboot software versions are available and the filenames of the Jloader software packages.

Table 43: Junos OS and Jloader Software Compatibility Matrix for the QFX3500 Switch and QFX3500 Node Device

Junos OS Software Version	1.1.2	1.1.4	1.1.5	1.1.8
11.3R1 and later (QFX3500 switch)	Supported	Supported	Not supported	Supported and recommended
11.3X30.6 and later (QFX3500 Node device)	Supported	Supported	Not supported	Supported and recommended
12.1X49-D1 and later (QFX3500 switch)	Supported	Supported	Not supported	Supported and recommended
12.2X50-D1 and later (QFX3500 switch and QFX3500 Node device)	Supported	Supported	Not supported	Supported and recommended

NOTE: An en dash means that the item is not applicable.

Table 44: Junos OS and Jloader Software Compatibility Matrix for the QFX3008-I Interconnect Device

Junos OS Software Version	1.1.2	1.1.4	1.1.5	1.1.8
11.3X30.9 and later (QFX3008-I Interconnect device)	Supported	Supported	Not supported	Supported and recommended

Table 44: Junos OS and Jloader Software Compatibility Matrix for the QFX3008-I Interconnect Device *(continued)*

Junos OS Software Version	1.1.2	1.1.4	1.1.5	1.1.8
11.3X30.6 and later (QFX3008-I Interconnect device)	Supported	Supported	Not supported	Supported and recommended
12.2X50-D10.3 and later (QFX3008-I Interconnect device)	Supported	Supported	Not supported	Supported and recommended

NOTE: An en dash means that the item is not applicable.

Table 45: Junos OS and Jloader Software Compatibility Matrix for the QFX3600-I Interconnect Device and QFX3600 Node Device

Junos OS Software Version	1.1.2	1.1.4	1.1.5	1.1.8
12.2X50-D10.3 and later (QFX3600-I Interconnect Device and QFX3600 Node Device)	-	-	Supported	Supported and recommended
12.2X50-D20 and later (QFX3600 switch)	-	-	Supported	Supported and recommended

Table 46: Uboot Software Release and Jloader Software Compatibility Matrix

Uboot Software Release Number	Jloader Software Package Name
1.1.2	jloader-qfx-11.3X30.9-signed.tgz
1.1.4 (11.3R3 and 11.3R2 releases only. Not supported on 11.3R1)	jloader-qfx-11.3I20120127_0733_dc-builder-signed.tgz
1.1.4 (12.1R1 release and later)	jloader-qfx-12.1-20120125_pr.0-signed.tgz
1.1.5 (12.2X50-D10.3 and later)	jloader-qfx-12.2X50.D10.3-signed.tgz
1.1.8 (13.1X50-D15.1 and later)	jloader-qfx-13.3-20130831_pr_branch_qfd.0.tgz

Jloader Software Version 1.1.4 Guidelines

Jloader Release 1.1.4 is compatible with Junos OS Release 11.3R3 and 11.3R2, and Junos OS Release 12.1R1 and later. Jloader Release 1.1.4 is not compatible with Junos OS Release 11.3R1. The Jloader software package names are different for versions 1.1.4 (Junos OS 11.3R3 and 11.3R2) and 1.1.4 (Junos OS 12.2R1 release and later), but the binaries are the same. Because the binaries are the same, you can upgrade or downgrade to any Junos OS release.

- If you have Junos OS Release 11.3 installed and want to upgrade the Jloader software from version 1.1.2 to version 1.1.4, you need to upgrade using the **jloader-qfx-11.3I20120127_0733_dc-builder-signed.tgz** software package.
- If you have Junos OS Release 11.3R2 installed and want to upgrade to Junos OS Release 12.1, you do not need to upgrade the Jloader Release and can continue to use Jloader Release 1.1.2.
- If you have Junos OS Release 12.1 installed and want to upgrade the Jloader software from version 1.1.2 to version 1.1.4, you need to upgrade using the **jloader-qfx-12.1-20120125_pr.0-signed.tgz** software package.
- If you upgrade to Junos OS Release 12.1, you can upgrade to Jloader Release 1.1.4 using the **jloader-qfx-12.1-20120125_pr.0-signed.tgz** software package.

Upgrading Jloader Software on a QFX3500 Switch

The Jloader software for a QFX3500 switch resides in two flash memory banks. At any time, one bank acts as the primary bank, and the QFX3500 switch boots from it. The other bank is the backup bank—if the QFX3500 switch cannot boot from the primary bank, it boots from the backup bank. When you upgrade the Jloader software, the upgraded software is installed in the backup bank, which then becomes the new primary bank. Thus the primary and backup banks alternate each time you upgrade the Jloader software, with the primary bank containing the most recently installed version of the software, and the backup bank containing the previous version. To upgrade the Jloader software on a QFX3500 switch, you must perform the upgrade twice: once for each bank. Each upgrade requires that you to reboot the QFX3500 switch.

NOTE: If you are running Junos OS Release 11.3R1 or Junos OS Release 11.3R2, you must use the **no-validate** option when you issue the **request system software add** command to upgrade the Jloader software. Otherwise, the installation will fail and you receive a configuration error. The **no-validate** option is not required for Junos OS Release 11.3R3 and later.

NOTE: After you upgrade the Jloader software on the first bank, the software package is deleted after you reboot. Make sure that you have either downloaded the Jloader software package to either a remote site or in a local directory on the switch, such as the **/var/tmp** directory on the QFX3500 device.

1. In a browser, go to http://www.juniper.net/support/downloads/junos.html .

   The Junos Platforms Download Software page appears.
2. In the QFX Series section of the Junos Platforms Download Software download page, select the QFX Series platform software you want to download.
3. Select the number of the software version that you want to download in the Release: pull-down window to the right of the tabs on the Download Software page.

4. Select the Software tab and then select the install package you want to download in the Install Package section.
5. In the pop-up Alert box, click the link to the Product Support Notification (PSN) document.
6. Enter your name and password and press **Enter**.
7. Read the End User License Agreement, click the **I agree** radio button, and then click **Proceed**.
8. Open or save the **jloader-qfx-*version*-signed.tgz** file either to a local system or to a remote location. If you are saving the installation package to a remote system, make sure that you can access it using HTTP, TFTP, FTP, or scp.
9. Log in to the QFX3500 switch and enter the shell. We recommend using a console connection.
10. Determine the version of the Jloader software package installed on the switch.

    For example:

    ```
    root@switch% ls
    gres-tp krt_gencfg_filter.txt
    jloader-qfx-11.3-20110510.0-signed.tgz
    ```
11. Determine the version of the Uboot software that is running in the bank:

    For example:

    ```
    root@switch% kenv | grep boot.version
    boot.version="1.0.7"
    ```
12. Enter the CLI and install the Jloader software package.

    - To install a Jloader software package that is located in the **/var/tmp** directory, issue the **request system software add /var/tmp/jloader-qfx-version.tgz no-validate** command:

      For example:

      ```
      user@switch> request system software add
      /var/tmp/jloader-qfx-11.3-20110510.0-signed.tgz no-validate
      ```

      You see the following messages during the installation:

      ```
      Verified jloader-qfx-11.3-20110510.0.tgz signed by PackageProduction_11_3_0
      Adding jloader-qfx...
      Installation in progress, please wait...
      Mounted jloader-qfx package on /dev/md8...
      Verified manifest signed by PackageProduction_11_3_0
      Verified jloader-qfx-11.3-20110510.0 signed by PackageProduction_11_3_0
      Registering jloader-qfx as unsupported

      Installation finished successfully.
      Please reboot to activate the package
      Saving package file in /var/sw/pkg/jloader-qfx-11.3-20110510.0-signed.tgz
      ...
      Saving state for rollback ...

      juniper@qfx3500>
      ```
    - To install a Jloader software package located on a remote server using FTP, issue the **request system software add**

/ftp://hostname/pathname/jloader-qfx-version-signed.tgz no-validate command.

For example:

```
user@switch> request system software add
/ftp://hostname/pathname/jloader-qfx-11.3-20110510.0-signed.tgz no-validate
```

- To install a Jloader software package located on a remote server using HTTP, issue the **request system software add /http://hostname/pathname/jloader-qfx-*version*-signed.tgz no-validate** command.

  For example:

```
user@switch> request system software add
/http://hostname/pathname/jloader-qfx-11.3-20110510.0-signed.tgz no-validate
```

13. When prompted, reboot the Control Board by issuing the **request system reboot** command.

    For example:

```
user@switch> request system reboot
Reboot the system ? [yes,no] (no) yes
```

14. Enter the shell and verify that the version of the Uboot software in the primary bank is the version you just installed.

    For example:

```
root@switch% kenv | grep boot.version
boot.version="1.1.1"
```

15. To install the Jloader software package on the current backup bank, repeat Step 10 through Step 14.

Upgrading Jloader Software on a QFabric System

This procedure explains how to upgrade the Jloader software on your Node devices and Interconnect devices. The example shows how to upgrade the Jloader Release 1.1.1 to 1.1.2 on a Node device with the serial number BBAK1186.

NOTE: Before you upgrade the Jloader software, make sure you have the serial numbers of the Node devices, Interconnect devices, and Control Boards in the Interconnect devices you want to upgrade.

1. Issue the **show chassis hardware node-device ?** command to view the serial numbers of the Node devices.

   For example:

   ```
   user@qfabric> show chassis hardware node-device ?
     <node-device>          Node device identifier
     BBAK1186               Node device
     BBAK3149               Node device
     BBAK3177               Node device
     BBAK8063               Node device
     BBAK8799               Node device
     P2443-C                Node device
     P2515-C                Node device
     P3708-C                Node device
     P3885-C                Node device
     P3916-C                Node device
     node0                  Node device
     node1                  Node device
     node2                  Node device
     node3                  Node device
     node4                  Node device
     node5                  Node device
     node6                  Node device
     node7                  Node device
     node8                  Node device
   ```

   An example of a Node device serial number is BBAK1186.

2. Issue the **show chassis hardware interconnect-device ?** command to view the serial numbers of the Interconnect devices.

   For example:

   ```
   user@qfabric> show chassis hardware interconnect-device ?
   Possible completions:
     interconnect-device  Interconnect device identifier
     IC-F1052             Interconnect device
     IC-F3947             Interconnect device
   ```

   The Interconnect device serial numbers are IC-F1052 and IC-F3947.

3. Issue the **show chassis hardware interconnect-device *name*** command to view the serial numbers of the Control Boards in the Interconnect device.

   For example:

   ```
   user@qfabric> show chassis hardware interconnect-device IC-F3947
   ```

```
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis          REV 10                F3947             QFXC08-3008
Midplane         REV 10   750-035835   F3947-C           QFX Midplane
CB 0             REV 14   750-035855   ZJ9432            QFX Chassis Control
Board
  Routing Engine 0        BUILTIN      BUILTIN           QFX Routing Engine
CB 1             REV 14   750-035855   ZJ9404            QFX Chassis Control
Board
```

The Control Board serial numbers are ZJ9432 and ZJ9404.

4. Issue the **show chassis firmware node-device *name*** command to see which version of Uboot software you have installed on your Node device.

   For example:

   `user@qfabric>` **show chassis firmware node-device BBAK1186**

   ```
   Part                      Type       Version
   node4                     U-Boot     1.1.6 (May 10 2011 - 04:52:59) 1.1.1

                             loader     FreeBSD/MIPS U-Boot bootstrap loader 0.1
   ```

   The Uboot software version is 1.1.1. The loader software version appears after the timestamp for U-Boot 1.1.6.

5. Issue the **show chassis firmware interconnect-device *name*** command to see which version of Uboot software you have installed on the Routing Engines located on the Control Boards of the Interconnect device.

   For example:

   `user@qfabric>` **show chassis firmware interconnect-device IC-F3947**

   ```
   Part                      Type       Version
   Routing Engine 0         U-Boot     U-Boot 1.1.6 (Jan 27 2012 - 03:24:34) 1.1.4

                             loader     FreeBSD/MIPS U-Boot bootstrap loader 0.1

   Routing Engine 1         U-Boot     U-Boot 1.1.6 (Jan 27 2012 - 03:24:34) 1.1.4

                             loader     FreeBSD/MIPS U-Boot bootstrap loader 0.1
   ```

   The Uboot software version is 1.1.4. The loader software version appears after the timestamp for U-Boot 1.1.6.

6. In a browser, go to http://www.juniper.net/support/downloads/junos.html .

   The Junos Platforms Download Software page appears.

7. In the QFX Series section of the Junos Platforms Download Software download page, select the QFX Series platform software you want to download.

8. Select the number of the software version that you want to download in the Release: pull-down window to the right of the tabs on the Download Software page.

9. Select the **Software** tab and then select the install package you want to download in the Install Package section.

10. In the pop-up Alert box, click the link to the Product Support Notification (PSN) document.
11. Enter your username and password, and press **Enter**.
12. Read the End User License Agreement, click the **I agree** radio button, and then click **Proceed**.
13. Open or save the **jloader-qfx-*version*-signed.tgz** file either to a local system or to a remote location. If you are saving the installation package to a remote system, make sure that you can access it using HTTP, TFTP, FTP, or scp.
14. Retrieve the software from the location in which you downloaded it. To do this, issue the **request system software download */path/package-name*** command.

    For example:

    ```
    user@qfabric> request system software download
    ftp://server/files/jloader-qfx-11.3X30.9-signed.tgz
    ```
15. Log in to the Director device as root and enter the shell to verify that you have downloaded the Jloader software package. We recommend using a console connection. The software package is copied from where you downloaded it and is placed locally on the QFabric system in the **/pbdata/packages** directory.

    For example:

    ```
    [root@dg0] # pwd
    /pbdata/packages

    [root@dg0] # ls
    jloader-qfx-11.3X30.9-signed.tgz
    ```
16. Before you copy over the Jloader software package to the Node device or Interconnect device, determine the directory that matches the serial number of the Node device or Interconnect device that you want to upgrade. View the remote logs and the Node device and Interconnect device serial numbers by issuing the **ls /pbdata/export/rlogs** command at the command line of the Director device before you copy the software package over to the device.

    NOTE: The **/pbdata/export/rlogs/*node-device-serial-ID*** and **/pbdata/export/rlogs/*interconnect-device-serial-ID*** directories on the Director device are NFS mounted as the **/tftpboot/logfiles** directories on the Node device and Interconnect device. These directories are created for all Node devices and Interconnect devices in a QFabric system. The Jloader files are stored in the **/tftpboot/logfiles** directories for each Node device and Interconnect device.

    For example:

    ```
    [root@dg0 tmp] # ls /pbdata/export/rlogs
    02de4930-828b-11e1-a319-00e081c57938  c9898afe-828b-11e1-956c-00e081c57938
    04103b2a-29d5-e011-bf8a-0e6bdf3aa1e6  eeba4aac-828b-11e1-85e2-00e081c57938
    1e2739e0-828b-11e1-bf74-00e081c57938  F1052
    8d8a978c-828b-11e1-a833-00e081c57938  F3947
    ad55b89e-828b-11e1-b70e-00e081c57938  P2443-C
    BBAK1186                              P2515-C
    ```

```
BBAK3149                                   P3708-C
BBAK3177                                   P3885-C
BBAK8063                                   P3916-C
BBAK8799
```

BBAK1186 is the serial number of the Node device that needs to be upgraded.

17. Copy the Jloader software package from the **/var/tmp** directory to the **/pbdata/export/rlogs/BBAK1186** directory.

    For example:

    ```
    [root@dg0 tmp] # cp jloader-qfx-11.3X30.9-signed.tgz /pbdata/export/rlogs/BBAK1186
    ```

18. Confirm that the Jloader software package you copied over is in the **/pbdata/export/rlogs/BBAK1186** directory.

    For example:

    ```
    [root@dg0 tmp] # ls /pbdata/export/rlogs/BBAK1186
    jloader-qfx-11.3X30.9-signed.tgz
    ```

19. Issue the **/root/dns.dump** command to find out the internal IP addresses of the Node device or Interconnect device.

    ```
    [root@dg0 tmp] # /root/dns.dump
    ; <<>> DiG 9.3.6-P1-RedHat-9.3.6-4.P1.el5 <<>> -t axfr pkg.dcbg.juniper.net
    @169.254.0.1
    ;; global options:  printcmd
    pkg.dcbg.juniper.net.   600     IN      SOA     ns.pkg.dcbg.juniper.net.
    mail.pkg.dcbg.juniper.net. 152 3600 600 7200 3600
    pkg.dcbg.juniper.net.   600     IN      NS      ns.pkg.dcbg.juniper.net.
    pkg.dcbg.juniper.net.   600     IN      A       169.254.0.1
    pkg.dcbg.juniper.net.   600     IN      MX      1 mail.pkg.dcbg.juniper.net.
    dcfnode---DCF-ROOT.pkg.dcbg.juniper.net. 45 IN A 169.254.192.17
    dcfnode---DRE-0.pkg.dcbg.juniper.net. 45 IN A   169.254.3.3
    dcfnode-8d8a978c-828b-11e1-a833-00e081c57938.pkg.dcbg.juniper.net. 45 IN A
    169.254.128.19
    dcfnode-ad55b89e-828b-11e1-b70e-00e081c57938.pkg.dcbg.juniper.net. 45 IN A
    169.254.128.20
    dcfnode-BBAK1186.pkg.dcbg.juniper.net. 45 IN A  169.254.128.14
    ```

    The internal IP address for BBAK1186 is 169.254.128.14.

20. Upgrade the Jloader software on the Node device or Interconnect device.

    Before you can upgrade the Jloader software, you need to use SSH to log in to the Node device or Interconnect device and verify that the software is in the **/tftpboot/logfiles** directory.

    a. Use SSH to log in to the Node device or Interconnect device.

       For example:

       ```
       [root@dg0 tmp] # ssh 160.254.128.14
       root@169.254.128.14's password:
       --- JUNOS 11.3X30.10 built 2012-03-11 22:55:43 UTC
       At least one package installed on this device has limited support.
       Run 'file show /etc/notices/unsupported.txt' for details.
       root@sng3%
       ```

    b. Verify that the Jloader software package is in the **tftpboot/logfiles** directory of the Node device or Interconnect device.

For example:

```
root@sng3% ls /tftpboot/logfiles
.index                                  jloader-qfx-11.3X30.9-signed.tgz
```

c. Copy the Jloader software package from the **/tftpboot/logfiles** directory to the **/var/tmp** directory of the Node device or Interconnect device.

   For example:

```
root@sng3% cp /tftpboot/logfiles/jloader-qfx-11.3X30.9-signed.tgz /var/tmp
```

d. Verify that the Jloader software package is in the **/var/tmp** directory of the Node device or Interconnect device.

   For example:

```
root@sng3% ls /var/tmp
.snap                                   jloader-qfx-11.3X30.9-signed.tgz
      tmp
gres-tp                                 krt_gencfg_filter.txt
      vc-autoupgrade
if-rtsdb                                rtsdb
```

e. Enter CLI mode and issue the **request system software add /var/tmp/jloader-qfx-*version*-signed.tgz** command.

   For example:

```
root@sng3% cli
root@sng3> request system software add /var/tmp/jloader-qfx-11.3X30.9-signed.tgz
Validating on fpc0
Checking compatibility with configuration
Initializing...
Using jbase-11.3X30.10
Verified manifest signed by PackageProduction_11_3_0
Verified jbase-11.3X30.10 signed by PackageProduction_11_3_0
Using /var/tmp/jloader-qfx-11.3X30.9-signed.tgz
Verified jloader-qfx-11.3X30.9.tgz signed by PackageProduction_11_3_0
Using jloader-qfx-11.3X30.9.tgz
Checking jloader-qfx requirements on /
Verified manifest signed by PackageProduction_11_3_0
Verified jloader-qfx-11.3X30.9 signed by PackageProduction_11_3_0
Using jkernel-qfx-11.3X30.10
Verified manifest signed by PackageProduction_11_3_0
Verified jkernel-qfx-11.3X30.10 signed by PackageProduction_11_3_0
Using jroute-qfx-11.3X30.10
Verified manifest signed by PackageProduction_11_3_0
Verified jroute-qfx-11.3X30.10 signed by PackageProduction_11_3_0
Using jcrypto-qfx-11.3X30.10
Verified manifest signed by PackageProduction_11_3_0
Verified jcrypto-qfx-11.3X30.10 signed by PackageProduction_11_3_0
Using jweb-qfx-11.3X30.10
Verified manifest signed by PackageProduction_11_3_0
Verified jweb-qfx-11.3X30.10 signed by PackageProduction_11_3_0
Using jswitch-qfx-11.3X30.10
Verified manifest signed by PackageProduction_11_3_0
Verified jswitch-qfx-11.3X30.10 signed by PackageProduction_11_3_0
Hardware Database regeneration succeeded
Validating against /config/juniper.conf.gz
mgd: commit complete
Validation succeeded
```

```
Done with validate on all chassis

fpc0:
Verified jloader-qfx-11.3X30.9.tgz signed by PackageProduction_11_3_0
Adding jloader-qfx...
Installation in progress, please wait...
Mounted jloader-qfx package on /dev/md10...
Verified manifest signed by PackageProduction_11_3_0
Verified jloader-qfx-11.3X30.9 signed by PackageProduction_11_3_0
#######################################
##########################################################################################################
Installation finished successfully.
Please reboot to activate the package
Saving package file in /var/sw/pkg/jloader-qfx-11.3X30.9-signed.tgz ...
Saving state for rollback ...


Upgrade has completed successfully.
Reboot is now required.
```

f. Reboot both the Node device and Interconnect device twice, because they each contain two partitions.

   For example:

```
root@sng3> request system reboot
Reboot the system ? [yes,no] (no) yes
Shutdown NOW!
[pid 37663]

root@sng3>

*** FINAL System shutdown message from root@sng3 ***

System going down IMMEDIATELY
```

g. Verify that the Uboot software on the Node device or Interconnect device has been upgraded to the new Uboot software by logging in to the QFabric CLI and issuing either the **show chassis firmware node-device *name*** command or the **show chassis firmware interconnect-device *name*** command.

   For example:

```
user@qfabric> show chassis firmware node-device BBAK1186
Part                      Type       Version
node4                     U-Boot     1.1.6 (Nov 19 2011 - 11:42:07) 1.1.2

                          loader     FreeBSD/MIPS U-Boot bootstrap loader
0.1
```

   The Uboot software version is now 1.1.2. The loader software version appears after the timestamp for U-Boot 1.1.6.

Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches

To upgrade Junos OS, you need to install the appropriate upgrade package on the QFX Series. Upgrading involves these tasks:

Downloading Software Files with a Browser

To download the software package from the Juniper Networks Support website, go to http://www.juniper.net/support/ .

NOTE: **To access the download site, you must have a service contract with Juniper Networks and an access account. If you need help obtaining an account, complete the registration form at the Juniper Networks website** https://www.juniper.net/registration/Register.jsp **.**

1. Using a Web browser, navigate to the http://www.juniper.net/support .
2. Click **Download Software**.
3. In the **Switching** box, click **Junos OS Platforms**.
4. In the **QFX Series** section, click the name of the platform for which you want to download software.
5. Click the **Software** tab and select the release number from the **Release** drop-down list.
6. In the **Install Package** section of the **Software** tab, select the **Install Package** for the release.

   A login screen appears.
7. Enter your name and password and press **Enter**.
8. Read the End User License Agreement, click the **I agree** radio button, and then click **Proceed**.
9. Save the **jinstall-qfx-<*version*>-domestic-signed.tgz** file on your computer.
10. Open or save the installation package either to the local system in the **var/tmp** directory or to a remote location. If you are saving the installation package to a remote system, make sure that you can access it using HTTP, TFTP, FTP, or scp.

Accessing Software Downloaded to a Remote Location

To access the installation package if you downloaded it to a remote location (for example, any system other than the switch):

1. From the command line, make sure you are in the **/var/tmp** directory of the switch.
2. Start the shell interface:

   `user@switch>` **start shell**
3. Initiate an FTP, TFTP, or scp session.

   In this example, FTP is used.

   >**ftp**
4. Use FTP to access the remote location where the installation package resides.

   ftp ftp://*<hostname>*/*<pathname>*/*<package-name-m.mZx-distribution>*.tgz.

   where *<package-name-m.mZx-distribution>*.tgz is jinstall-qfx-11.1R1.5-domestic-signed.tgz
5. When prompted, enter your username and password.
6. Use the **get** command to transfer the installation package from the remote location to your **/var/tmp** directory on your switch.

   get *<package-name-m.mZx-distribution>*.tgz
7. Close the FTP session:

   bye

Connecting to the Console Port

We recommend that you connect to the console port while installing the installation package so you can respond to any required user input and detect any errors that may occur.

Backing Up the Current Configuration Files

Before you install the new installation package, we strongly recommend that you back up your current configuration files because the upgrade process removes all of the stored files on the switch.

To back up your current configuration files, enter the **save** command:

`user@switch>` **save *filename***

Executing this command saves a copy of your configuration files to a remote location such as an external USB device.

Installing a Standard Software Package

NOTE: Before you install the software, back up any critical files in **/var/home**. For more information regarding how to back up critical files, contact Customer Support at http://www.juniper.net/support.

NOTE: **If you are upgrading from a standard software package to an ELS-based package, see the *Upgrading to an ELS-Based Software Package* section.**

Install the software in one of two ways:

If the installation package resides locally on the switch, execute the **request system software add validate** *<pathname><source>* **reboot** command.

For example:

`user@switch>` **request system software add validate /var/tmp/jinstall-qfx-11.1R1.5-domestic-signed.tgz reboot**

If the Install Package resides remotely, execute the **request system software add validate** *<pathname><source>* **reboot** command.

For example:

`user@switch#` **request system software add validate ftp://ftpserver/directory/jinstall-qfx-11.1R1.5-domestic-signed.tgz reboot**

After the reboot has finished, verify that the new version of software has been properly installed by executing the **show version** command.

`user@switch>` **show version**

Upgrading to an ELS-Based Software Package

To upgrade your switch from a version of Junos OS that does not support Enhanced Layer 2 Software (ELS) to a version of Junos OS that supports ELS, we recommend performing the following procedure.

NOTE: **Because this procedure can cause service outages, we recommend that you avoid performing this procedure on switches carrying traffic in a production network.**

1. Log in to your device using the console port.

   NOTE: **Only perform this procedure from the console port. You can lose connectivity to your device if you perform this procedure from a management port or any other interface.**

2. Set your device to standalone mode by issuing the **request chassis device-mode standalone** command. Do not reboot your system at this time.

   NOTE: **This step is only required for new devices shipped from the factory or QFabric system Node devices that you plan to redeploy in a QFX Series Virtual Chassis.**

3. Choose whether you wish to reuse your previous configuration or not.

   - To reuse your previous configuration as part of the software upgrade, you must convert the configuration from the original style Junos OS CLI to the ELS CLI format using the following steps:

     NOTE: We recommend this procedure for customers currently using a QFX3500 or QFX3600 switch as a standalone device.

     a. Copy your entire existing configuration into a text file. Save the file to a remote location or USB drive.
     b. Retain the portion of your existing configuration related to management network connectivity (such as **[edit system]** and management interfaces). Delete all other configuration elements (such as the **[edit protocols]** and **[edit vlans]** hierarchy levels, non-management interfaces, and so on). Issue a **commit** operation to remove the deleted configuration.
     c. Perform the software upgrade with the **validate** option and reboot your device to complete the upgrade by issuing the **request system software add validate reboot** command. Maintain your console port connection during the reboot.
     d. Using a web browser, navigate to the ELS Translator Tool. Follow the instructions on the page to convert your saved configuration file to the new ELS CLI format.
     e. Return to your console port connection. When the switch has rebooted to complete the software upgrade, copy the configuration from the ELS Translator Tool and load it in to your switch.
     f. Issue a **commit** operation to activate the translated configuration.

   - To delete your current configuration and upgrade the software, follow these steps:

     NOTE: We recommend this procedure for customers with new QFX3500 or QFX3600 devices shipped from the factory or QFabric system Node devices that will be redeployed in a QFX Series Virtual Chassis.

     a. Perform a software upgrade with the **no-validate** option by issuing the **request system software add no-validate** command.
     b. Delete the configuration and set the device to factory defaults by issuing the **request system zeroize** command. The device automatically reboots and reverts to a factory default configuration.
     c. Configure your device using the ELS CLI format.

Related Documentation

- Overview of CoS Upgrade Requirements (Junos OS Release 11.1 or 11.2 to a Later Release) on page 32
- Software Installation Overview on page 109
- Recovering from a Failed Software Installation on page 108

- Upgrading Jloader Software on QFX Series Devices on page 110
- **request system software add on page 392**
- *Installation and Upgrade Guide*

Upgrading Software on QFX3500 and QFX3600 Virtual Chassis Using Nonstop Software Upgrade

You can use nonstop software upgrade (NSSU) to upgrade the software running on all member switches with minimal traffic disruption during the upgrade.

NSSU is supported on the following Virtual Chassis platforms:

- QFX3500 Virtual Chassis
- QFX3600 Virtual Chassis

This topic covers:

Preparing the Switch for Software Installation

Before you begin software installation using NSSU:

- Ensure that the Virtual Chassis is configured correctly to support NSSU. Verify that:
  - The Virtual Chassis members are connected in a ring topology. A ring topology prevents the Virtual Chassis from splitting during an NSSU.
  - The Virtual Chassis master and backup are adjacent to each other in the ring topology. Adjacency permits the master and backup to always be in sync, even when the switches in linecard roles are rebooting.
  - The Virtual Chassis is preprovisioned so that the linecard role has been explicitly assigned to member switches acting in the linecard role. During an NSSU, the Virtual Chassis members must maintain their roles—the master and backup must maintain their master and backup roles (although mastership will change), and the other member switches must maintain their linecard roles.
  - A two-member Virtual Chassis has **no-split-detection** configured so that the Virtual Chassis does not split when an NSSU upgrades a member.
- Verify that the members are running the same version of the software:

  ```
  user@switch> show version
  ```

  If the Virtual Chassis members are not running the same version of the software, use the **request system software add** command to upgrade the software on the inconsistent members.

- Ensure that graceful Routing Engine switchover (GRES) is enabled.
- (Optional) Back up the system software—Junos OS, the active configuration, and log files—on each member to an external storage device with the request system snapshot command.

Upgrading the Software Using NSSU

This procedure describes how to upgrade the software running on all Virtual Chassis members using NSSU. When the upgrade completes, all members are running the new version of the software. Because a graceful Routing Engine switchover occurs during the upgrade, the original Virtual Chassis backup is the new master.

To upgrade all members using NSSU:

1. Download the software package by following the procedure in the Downloading Software Files with a Browser section in "Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches" on page 121.
2. Copy the software package or packages to the Virtual Chassis. We recommend that you copy the file to the **/var/tmp** directory on the master.
3. Log in to the Virtual Chassis using the console connection or the virtual management Ethernet (VME) interface. Using a console connection allows you to monitor the progress of the master switch reboot.
4. Start the NSSU:
   - On a QFX3500 or QFX3600 Virtual Chassis, enter:

     user@switch> **request system software nonstop-upgrade /var/tmp/*package-name*.tgz**

     where ***package-name*.tgz** is, for example, **jinstall-qfx-3-13.2X50-D15.3-domestic-signed.tgz**.

   The switch displays status messages similar to the following messages as the upgrade executes:

```
Chassis ISSU Check Done
ISSU: Validating Image
ISSU: Preparing Backup RE
Installing image on other FPC's along with the backup

Checking pending install on fpc1
Pushing bundle to fpc1
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Completed install on fpc1

Checking pending install on fpc2
Pushing bundle to fpc2
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Completed install on fpc2

Rebooting fpc1
```

```
ISSU: Backup RE Prepare Done
Waiting for Backup RE reboot
GRES operational
Initiating Chassis In-Service-Upgrade
Chassis ISSU Started
ISSU: Preparing Daemons
ISSU: Daemons Ready for ISSU
ISSU: Starting Upgrade for FRUs
ISSU: Preparing for Switchover
ISSU: Ready for Switchover
Checking In-Service-Upgrade status
  Item           Status                  Reason
  FPC 0          Online
  FPC 1          Online
  FPC 2          Online (ISSU)
Going to install image on master
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
relinquish mastership
ISSU: IDLE

*** FINAL System shutdown message from user@switch ***

System going down IMMEDIATELY


Shutdown NOW!
[pid 9336]
```

5. Log in after the reboot of the original master switch completes. To verify that the software on all Routing Engines in the Virtual Chassis members has been upgraded, enter the following command:

   user@switch> **show version**

6. To ensure that the resilient dual-root partitions feature operates correctly, copy the new Junos OS image into the alternate root partitions of all members:

   user@switch> **request system snapshot slice alternate all-members**

   Resilient dual-root partitions allow the switch to boot transparently from the alternate root partition if the system fails to boot from the primary root partition.

Related Documentation

- Understanding Nonstop Software Upgrade on QFX Series Switches on page 41
- *Understanding Resilient Dual-Root Partitions on Switches*

Upgrading Software Using Automatic Software Download

The automatic software download feature uses the DHCP message exchange process to download and install software packages. You configure the automatic software download feature on switches acting as DHCP clients. You must enable automatic software download on the switch before the software upgrade can occur.

You configure a path to a software package file on the DHCP server. The server communicates the path to the software package file through DHCP server messages.

If you enable automatic software download, the DHCP client switch compares the software package name in the DHCP server message to the name of the software package that booted the switch. If the software packages are different, the DHCP client switch downloads and installs the software package specified in the DHCP server message.

Before you upgrade software using automatic software download, ensure that you have configured DHCP services for the switch, including configuring a path to a boot server and a boot file. See "Configuring a DHCP Server on Switches (CLI Procedure)" on page 133 for information about using the CLI to configure DHCP services and settings. See *Configuring DHCP Services (J-Web Procedure)* for information about using the J-Web interface to configure DHCP services and settings.

To enable automatic software download on an EX Series switch acting as a DHCP client:

```
[edit chassis]
user@switch# set auto-image-upgrade
```

After automatic software download is enabled on your DHCP client switch and after DHCP services are enabled on your network, an automatic software download can occur at any time as part of the DHCP message exchange process.

If an automatic software download occurs, you see the following message on the switch:

```
Auto-image upgrade started
On successful installation system will reboot automatically
```

The switch reboots automatically to complete the upgrade.

Related Documentation

- Verifying That Automatic Software Download Is Working Correctly on page 315
- *Understanding Software Installation on EX Series Switches*
- Understanding DHCP Services for Switches on page 36

CHAPTER 5

Configuration

Initial Configuration

Configuring Autoinstallation of Configuration Files (CLI Procedure)

Autoinstallation is the automatic configuration of a device over the network from a pre-existing configuration file that you create and store on a configuration server—typically a Trivial File Transfer Protocol (TFTP) server. You can use autoinstallation to automatically deploy multiple devices from a central location in the network.

To specify autoinstallation to run when you power on a switch already installed in your network, you can enable it by specifying one or more interfaces, protocols, and configuration servers to be used for autoinstallation.

Before you explicitly enable and configure autoinstallation on the switch, perform these tasks as needed for your network's configuration:

- Have a service available—typically Dynamic Host Configuration Protocol (DHCP)—to assign an IP address to the switch
- Configure a DHCP server on your network to meet your network requirements. You can configure a switch to operate as a DHCP server. For more information, see "Configuring a DHCP Server on Switches (CLI Procedure)" on page 133.
- Create one of the following configuration files, and store it on a TFTP server (or HTTP server or FTP server) in the network:
  - A host-specific file with the name ***hostname*.conf** for each switch undergoing autoinstallation. Replace ***hostname*** with the name of a switch. The ***hostname*.conf** file typically contains all the configuration information necessary for the switch with this hostname.
  - A default configuration file named **switch.conf** with the minimum configuration necessary to enable you to telnet into the new switch for further configuration.
- Physically attach the switch to the network using a Gigabit Ethernet port.
- If you configure the DHCP server to provide only the TFTP server hostname, add an IP address-to-hostname mapping entry for the TFTP server to the DNS database file on the Domain Name System (DNS) server in the network.
- If the switch is not on the same network segment as the DHCP server (or other device providing IP address resolution), configure an existing device as an intermediate device to receive TFTP and DNS requests and forward them to the TFTP server and the DNS server. You must configure the LAN or serial interface on the intermediate device with the IP addresses of the hosts providing TFTP and DNS services. Connect this interface to the switch.
- If you are using ***hostname*.conf** files for autoinstallation, you must also complete the following tasks:
  - Configure the DHCP server to provide a ***hostname*.conf** filename to each switch. Each switch uses its ***hostname*.conf** filename to request a configuration file from the TFTP server. Copy the necessary ***hostname*.conf** configuration files to the TFTP server.
  - Create a default configuration file named **network.conf**, and copy it to the TFTP server. This file contains IP-address-to-hostname mapping entries. If the DHCP server does not send a ***hostname*.conf** filename to a new switch, the switch uses **network.conf** to resolve its hostname based on its IP address.

    Alternatively, you can add the IP-address-to-hostname mapping entry for the switch to a DNS database file.

    The switch uses the hostname to request a ***hostname*.conf** file from the TFTP server.

To configure autoinstallation:

1. Specify the URL address of one or more servers from which to obtain configuration files.

   ```
   [edit system]
   user@switch# set autoinstallation configuration-servers tftp://tftpconfig.sp.com
   ```


NOTE: You can also use an FTP address, for example, ftp://*user*:*password*@sftpconfig.sp.com.

2. Configure one or more Ethernet interfaces to perform autoinstallation and one or two procurement protocols for each interface. The switch uses the protocols to send a request for an IP address for the interface:

```
[edit system]
user@switch# set autoinstallation interfaces ge-0/0/0 bootp
```

Related Documentation

- Verifying Autoinstallation Status on page 314
- Understanding Autoinstallation of Configuration Files on page 33
- Understanding DHCP Services for Switches on page 36

Configuring a DHCP Client (CLI Procedure)

A Dynamic Host Configuration Protocol (DHCP) server can provide many valuable TCP/IP network services. DHCP can dynamically allocate IP parameters, such as an IP address, to clients, and it can also deliver software upgrades to clients.

DHCP configuration consists of two components, configuration of DHCP clients and configuration of a DHCP server. Client configuration determines how clients send a message requesting an IP address, whereas a DHCP server configuration enables the server to send an IP address configuration back to the client. This topic describes configuring a DHCP client. For directions for configuring a DHCP server, see "Configuring a DHCP Server on Switches (CLI Procedure)" on page 133.

You can change DHCP client configurations from the switch, using client identifiers to indicate which clients you want to configure.

To configure a DHCP client, you configure an interface to belong to the DHCP family and specify additional attributes, as desired:

[edit]
user@switch# set interfaces *interface-name* unit *number* family inet dhcp *configuration-statement*

The options that you can configure are listed in Table 47 on page 132. Replace the variable *configuration-statement* with one or more of the statements listed in this table. If you do not explicitly configure these options, the switch uses default values for them.

Table 47: DHCP Client Settings

Configuration Statement	Description
client-identifier	Unique client ID—By default this consists of the hardware type (01 for Ethernet) and the MAC address (a.b.c.d). For this example, the value would be 01abcd.
lease-time	Ttime in seconds that a client holds the lease for an IP address assigned by a DHCP server. If a client does not request a specific lease time, then the server sends the default lease time. The default lease time on a Junos OS DHCP server is 1 day.

Table 47: DHCP Client Settings *(continued)*

Configuration Statement	Description
retransmission-attempt	Number of times the client attempts to retransmit a DHCP packet.
retransmission-interval	Time between transmission attempts.
server-address	IP address of the server that the client queries for an IP address.
update-server	TCP/IP settings learned from an external DHCP server to the DHCP server running on the switch are propagated.
vendor-option	Vendor class ID (CPU's manufacturer ID string) for the DHCP client.

Related Documentation

- Configuring a DHCP Server on Switches (CLI Procedure) on page 133
- Understanding DHCP Services for Switches on page 36

Configuring a DHCP Server on Switches (CLI Procedure)

A Dynamic Host Configuration Protocol (DHCP) server can provide two valuable TCP/IP network services. DHCP can dynamically allocate IP parameters, such as an IP address, to clients and it can also deliver software upgrades to clients.

DHCP configuration consists of two components, optional reconfiguration of default settings on DHCP clients and configuration of a DHCP server. This topic covers configuration of the DHCP server. For directions for reconfiguring a DHCP client, see "Configuring a DHCP Client (CLI Procedure)" on page 132.

You can configure either of two versions of a DHCP server on a switch—either the extended server version or the legacy server version. We recommend that you use the extended server configuration unless you need to keep your DHCP server configuration backward-compatible with the legacy server version.

This topic includes the following tasks:

1. Configuring an Extended DHCP Server on a Switch on page 133
2. Configuring a Legacy DHCP Server on a Switch (CLI Procedure) on page 134

Configuring an Extended DHCP Server on a Switch

To configure an extended DHCP server, you must configure a DHCP pool, indicate IP addresses for the pool, and create a server group. Additional configurations are optional.

Do not assign addresses that are already in use in the network to address pools. The extended DHCP server does not check whether addresses are already in use before assigning them to clients.

1. Create an address pool for DHCP IP addresses:

```
[edit]
```

user@switch# **set access address-pool** *address-pool*

2. Configure addresses for DHCP dynamic assignment:

   [edit access address-assignment]
   user@switch# **set pool** ***address-pool-name***

3. Create a server group on the switch, providing a group name and an interface for DHCP:

   [edit system services dhcp-local-server]
   user@switch# **set group** ***group-name*** **interface** ***interface-name***

4. Optionally, process the information protocol data units (PDUs):

   [edit system services dhcp-local-server]
   user@switch# **set overrides process-inform**

5. Optionally, redefine the order of attribute matching for pool selection:

   [edit system services dhcp-local-server]
   user@switch# **set pool-match-order ip-address-first**

6. Optionally, enable dynamic reconfiguration triggered by the DHCP extended server of all DHCP clients or only the DHCP clients serviced by the specified group of interfaces:

   [edit system services dhcp-local-server]
   user@switch# **set reconfigure**

   [edit system services dhcp-local-server group *group-name*]
   user@switch# **set reconfigure**

Configuring a Legacy DHCP Server on a Switch (CLI Procedure)

To configure a legacy DHCP server, you must configure a pool of IP addresses for dynamic assignment. You only need to supply a series of network addresses. Additional configurations are optional.

1. Configure a pool of IP addresses for dynamic assignment:

   [edit system services dhcp]
   user@switch# **set pool (Legacy DHCP)** ***network-range***

   NOTE: Step 2 through step 15 assign global values at the [edit system services dhcp] hierarchy level. You can also assign the same values to a specific pool using those same commands at the [edit system services dhcp pool *network-range*] hierarchy level.

2. Optionally, change the domain search list used to resolve hostnames:

   [edit system services dhcp]
   user@switch# **set domain-search [** ***domain-list*** **]**

3. Optionally, change the domain name server (DNS) name that the DHCP server advertises to clients:

   [edit system services dhcp]

user@switch# **set name-server** ***address***

4. Optionally, change the DHCP options:

   [edit system services dhcp]
   user@switch# **set option** ***id-number***

5. Optionally, change the devices advertised to clients:

   [edit system services dhcp]
   user@switch# **set router** ***address***

6. Optionally, change the SIP server:

   [edit system services dhcp]
   user@switch# **set sip-server** ***addresses-or-names***

   For more information, see *Configuring a DHCP SIP Server (CLI Procedure)*.

7. Optionally, change the DHCP client's hardware address:

   [edit system services dhcp]
   user@switch# **set static-binding** ***mac-address***

8. Optionally, change the NetBIOs name server:

   [edit system services dhcp]
   user@switch# **set wins-server** ***address***

Related Documentation

- Configuring a DHCP Client (CLI Procedure) on page 132
- *Configuring a DHCP SIP Server (CLI Procedure)*
- Understanding DHCP Services for Switches on page 36

Configuring a DNS Name Server for Resolving a Hostname into Addresses

To have the router or switch resolve hostnames into addresses, you must configure one or more Domain Name System (DNS) name servers by including the **name-server** statement at the **[edit system]** hierarchy level:

```
[edit system]
name-server {
  address;
}
```

The following example shows how to configure two DNS name servers:

```
[edit]
user@switch# set system name-server 192.168.1.253
[edit]
user@switch# set system name-server 192.168.1.254
[edit]
user@switch# show
system {
  name server {
    192.168.1.253;
    192.168.1.254;
  }
}
```

Related Documentation

- name-server on page 263

Configuring the Domain Name for the Router or Switch

For each router or switch, you should configure the name of the domain in which the router or switch is located. This is the default domain name that is appended to hostnames that are not fully qualified.

To configure the domain name, include the **domain-name** statement at the **[edit system]** hierarchy level:

```
[edit system]
domain-name domain-name;
```

The following example shows how to configure the domain name:

```
[edit]
user@host# set system domain-name company.net
[edit]
user@host# show
system {
  domain-name company.net;
}
```

Related Documentation

- *domain-name*
- domain-name on page 246
- Example: Configuring the Domain Name for the Router or Switch on page 174

Configuring the Domains to Search When a Router or Switch Is Included in Multiple Domains

If your router or switch is included in several different domains, you can configure those domain names to be searched.

To configure more than one domain to be searched, include the **domain-search** statement at the **[edit system]** hierarchy level:

```
[edit system]
domain-search [ domain-list ];
```

The domain list can contain up to six domain names, with a total of up to 256 characters.

The following example shows how to configure two domains to be searched:

```
[edit system]
domain-search [ domainone.net domainonealternate.com ]
```

Related Documentation

- Example: Configuring the Domain Name for the Router or Switch on page 174
- *Reaching a Domain Name System Server*

  Configuring a DNS Name Server for Resolving a Hostname into Addresses on page 135

Configuring the Hostname of the Router or Switch

The hostname of the device provides its identification for many purposes. Junos OS uses the configured hostname as part of the command prompt, to prepend log files and other accounting information, as well as in other places where knowing the device identity is useful. We recommend that the hostname be descriptive and memorable.

Optionally, instead of configuring the hostname at the **[edit system]** hierarchy level, you can use a configuration group, as shown in this procedure. This is a recommended best practice for configuring the hostname, especially if the device has dual Routing Engines. This procedure uses groups called **re0** and **re1** as an example.

To set the hostname:

1. Include the **host-name** statement in the configuration.

   The name value must be less than 256 characters.

   [edit groups *group-name* system]
   host-name *hostname*;

   For example:

   [edit groups re0 system]
   root@# **set host-name san-jose-router**

   [edit groups re1 system]
   root@# **set host-name san-jose-router1**

2. If you used one or more configuration groups, apply the configuration groups, substituting the appropriate group names.

   For example:

   [edit]
   user@host# **set apply-groups [re0 re1]**

3. Commit the changes.

   [edit]
   root@# **commit**

   The hostname subsequently appears in the device CLI prompt.

   san-jose-router@#

Related Documentation

- *Understanding Hostnames*
- *Example: Configuring the Name of the Router, IP Address, and System ID*
- Example: Configuring the Name of the Switch, IP Address, and System ID on page 174
- Mapping the Hostname of the Switch to IP Addresses on page 158

Configuring the Junos OS to Determine Conditions That Trigger Alarms on Different Interface Types

For the different types of PICs, you can configure which conditions trigger alarms and whether they trigger a red or yellow alarm. Red alarm conditions light the **RED ALARM** LED and trigger an audible alarm if one is connected. Yellow alarm conditions light the **YELLOW ALARM** LED and trigger an audible alarm if one is connected.

NOTE: By default, any failure condition on the integrated-services interface (Adaptive Services PIC) triggers a red alarm.

To configure conditions that trigger alarms and that can occur on any interface of the specified type, include the **alarm** statement at the **[edit chassis]** hierarchy level.

```
[edit chassis]
alarm {
  interface-type {
    alarm-name (red | yellow | ignore);
  }
}
```

alarm-name is the name of an alarm.

Related Documentation

- *System-Wide Alarms and Alarms for Each Interface Type*
- *Chassis Conditions That Trigger Alarms*
- *Silencing External Devices Connected to Alarm Relay Contacts*

Configuring the Junos OS to Disable Protocol Redirect Messages on the Router or Switch

By default, the router or switch sends protocol redirect messages. To disable the sending of redirect messages by the router or switch, include the **no-redirects** statement at the **[edit system]** hierarchy level:

```
[edit system]
no-redirects;
```

To reenable the sending of redirect messages on the router or switch, delete the **no-redirects** statement from the configuration.

To disable the sending of redirect messages on a per-interface basis, include the **no-redirects** statement at the **[edit interfaces *interface-name* unit *logical-unit-number* family *family*]** hierarchy level.

Related Documentation

- *Configuring the Junos OS to Ignore ICMP Source Quench Messages*
- Configuring the Junos OS to Select a Fixed Source Address for Locally Generated TCP/IP Packets on page 141
- *Junos OS Network Interfaces Library for Routing Devices*

Configuring the Junos OS to Disable the Reporting of IP Address and Timestamps in Ping Responses

When you issue the **ping** command with the **record-route** option, the Routing Engine displays the path of the ICMP echo request packets and timestamps in the ICMP echo responses by default.

You can configure the Routing Engine to disable the setting of the **record-route** option in the IP header of the ping request packets. Disabling the **record-route** option prevents the Routing Engine from recording and displaying the path of the ICMP echo request packets in the response.

- To configure the Routing Engine to disable the setting of the **record route** option, include the **no-ping-record-route** statement at the **[edit system]** hierarchy level:

```
[edit system]
no-ping-record-route;
```

- To disable the reporting of timestamps in the ICMP echo responses, include the **no-ping-time-stamp** option at the **[edit system]** hierarchy level:

```
[edit system]
no-ping-time-stamp;
```

By configuring the **no-ping-record-route** and **no-ping-timestamp** options, you can prevent unauthorized persons from discovering information about the provider edge (PE) router or switch and its loopback address.

Related Documentation

- *Configuring the Junos OS to Disable the Routing Engine Response to Multicast Ping Packets*

Configuring the Junos OS to Display a System Login Announcement

By default, no login announcement is displayed. To configure a system login announcement, include the **announcement** statement at the **[edit system login]** hierarchy level:

```
[edit system login]
announcement text;
```

If the announcement text contains any spaces, enclose the text in quotation marks.

A system login *announcement* appears after the user logs in. A system login *message* appears before the user logs in.

TIP: You can use the same special characters described to format your system login announcement.

Related Documentation

- *Defining Junos OS Login Classes*
- *Configuring the Junos OS to Display a System Login Message*

Configuring the Junos OS to Display a System Login Message

By default, no login message is displayed on the router or switch. To configure a system login message, include the **message** statement at the **[edit system login]** hierarchy level:

[edit system login]
message *text*;

If the message text contains any spaces, enclose it in quotation marks.

You can format the message using the following special characters:

- \n—New line
- \t—Horizontal tab
- \'—Single quotation mark
- \"—Double quotation mark
- \\—Backslash

The following is a sample login message configuration:

```
[edit]
system {
    login {
        message "\n\n\n\tUNAUTHORIZED USE OF THIS SYSTEM\n
                 \tIS STRICTLY PROHIBITED!\n\n\tPlease contact
                 \'company-noc@company.com\' to gain\naccess
                 to this equipment if you need authorization.\n\n\n";
        }
    }
}
```

The preceding login message configuration example produces a login message similar to the following:

```
server% telnet router1
Trying 1.1.1.1...
Connected to router1.
Escape character is '^]'.



          UNAUTHORIZED USE OF THIS SYSTEM
          IS STRICTLY PROHIBITED!

          Please contact 'company-noc@company.com' to gain
          access to this equipment if you need authorization.



router1 (ttyp0)

login:
```

A system login message appears before the user logs in. A system login announcement appears after the user logs in.

Related Documentation

- *Defining Junos OS Login Classes*
- message on page 257

Configuring the Junos OS to Extend the Default Port Address Range

By default, the upper range of a port address is 5000. You can increase the range from which the port number can be selected to decrease the probability that someone can determine your port number.

- To configure the Junos OS to extend the default port address range, include the **source-port** statement at the **[edit system internet-options]** hierarchy level:

```
[edit system internet-options]
source-port upper-limit upper-limit;
```

upper-limit ***upper-limit*** is the upper limit of a source port address and can be a value from 5000 through 65,355.

Related Documentation

- *Configuring the Junos OS to Disable TCP RFC 1323 Extensions*
- *Configuring the Junos OS ARP Learning and Aging Options for Mapping IPv4 Network Addresses to MAC Addresses*
- source-port on page 283

Configuring the Junos OS ICMPv4 Rate Limit for ICMPv4 Routing Engine Messages

To limit the rate at which ICMPv4 messages can be generated and received by the Routing Engine, include the **icmpv4-rate-limit** statement at the **[edit system internet-options]** hierarchy level:

```
icmpv4-rate-limit bucket-size bucket-size packet-rate packet-rate;
```

The bucket size is the number of seconds in the rate-limiting bucket. The packet rate is the rate-limiting packets earned per second. Specify a **bucket-size** from 0 through 4294967295 seconds. The default value is 5 seconds. Specify a **packet-rate** from 0 through 4,294,967,295. The default value is 1000.

Related Documentation

- icmpv4-rate-limit on page 249

Configuring the Junos OS to Select a Fixed Source Address for Locally Generated TCP/IP Packets

By default, the source address included in locally generated Transmission Control Protocol/IP (TCP/IP) packets, such as FTP traffic, and in User Datagram Protocol (UDP) and IP packets, such as Network Time Protocol (NTP) requests, is chosen as the local address for the interface on which the traffic is transmitted. This means that the local address chosen for packets to a particular destination might change from connection to connection based on the interface that the routing protocol has chosen to reach the destination when the connection is established. If multiple equal-cost next hops are present for a destination, locally generated packets use the **lo0** address as a source.

- To configure the software to select a fixed address to use as the source for locally generated IP packets, include the **default-address-selection** statement at the **[edit system]** hierarchy level:

```
[edit system]
default-address-selection;
```

If you include the **default-address-selection** statement in the configuration, the Junos OS chooses the system default address as the source for most locally generated IP packets. The default address is usually an address configured on the **lo0** loopback interface. For example, if you specified that SSH and telnet use a particular address, but you also have **default-address selection** configured, the system default address is used.

Related Documentation

- Configuring the Junos OS to Disable Protocol Redirect Messages on the Router or Switch on page 138
- **default-address-selection on page 241**

Configuring NTP Authentication Keys

Time synchronization can be authenticated to ensure that the switch obtains its time services only from known sources. By default, network time synchronization is unauthenticated. The switch will synchronize to whatever system appears to have the most accurate time. We strongly encourage you to configure authentication of network time services.

To authenticate other time servers, include the **trusted-key** statement at the **[edit system ntp]** hierarchy level. Only time servers that transmit network time packets containing one of the specified key numbers are eligible to be synchronized. Additionally, the key needs to match the value configured for that key number. Other systems can synchronize to the local switch without being authenticated.

```
[edit system ntp]
trusted-key [ key-numbers ];
```

Each key can be any 32-bit unsigned integer except 0. Include the **key** option in the **peer**, **server**, or **broadcast** statements to transmit the specified authentication key when transmitting packets. The key is necessary if the remote system has authentication enabled so that it can synchronize to the local system.

To define the authentication keys, include the **authentication-key** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
authentication-key key-number type type value password;
```

number is the key number, ***type*** is the authentication type (only Message Digest 5 [MD5] is supported), and ***password*** is the password for this key. The key number, type, and password must match on all systems using that particular key for authentication.

Related Documentation

- NTP Time Server and Time Services Overview on page 31
- Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization on page 177

- trusted-key on page 305
- *authentication-key*

Configuring the NTP Time Server and Time Services

When you use NTP, configure the router or switch to operate in one of the following modes:

- Client mode
- Symmetric active mode
- Broadcast mode
- Server mode

The following topics describe how to configure these modes of operation:

Configuring the Router or Switch to Operate in Client Mode

To configure the local router or switch to operate in client mode, include the **server** statement and other optional statements at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
server address <key key-number> <version value> <prefer>;
authentication-key key-number type type value password;
boot-server address;
trusted-key [ key-numbers ];
```

Specify the address of the system acting as the time server. You must specify an address, not a hostname.

To include an authentication key in all messages sent to the time server, include the **key** option. The key corresponds to the key number you specify in the **authentication-key** statement, as described in .

By default, the router or switch sends NTP version 4 packets to the time server. To set the NTP version level to 1, 2, or 3, include the **version** option.

If you configure more than one time server, you can mark one server preferred by including the **prefer** option.

The following example shows how to configure the router or switch to operate in client mode:

```
[edit system ntp]
authentication-key 1 type md5 value "$9$EgfcrvX7VY4ZEcwgoHjkP5Q3CuREyv87";
boot-server 10.1.1.1;
```

```
server 10.1.1.1 key 1 prefer;
trusted-key 1;
```

Configuring the Router or Switch to Operate in Symmetric Active Mode

To configure the local router or switch to operate in symmetric active mode, include the **peer** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
peer address <key key-number> <version value> <prefer>;
```

Specify the address of the remote system. You must specify an address, not a hostname.

To include an authentication key in all messages sent to the remote system, include the **key** option. The key corresponds to the key number you specify in the **authentication-key** statement.

By default, the router or switch sends NTP version 4 packets to the remote system. To set the NTP version level to 1, 2 or 3, include the **version** option.

If you configure more than one remote system, you can mark one system preferred by including the **prefer** option:

```
peer address <key key-number> <version value> prefer;
```

Configuring the Router or Switch to Operate in Broadcast Mode

To configure the local router or switch to operate in broadcast mode, include the **broadcast** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
broadcast address <key key-number> <version value> <ttl value>;
```

Specify the broadcast address on one of the local networks or a multicast address assigned to NTP. You must specify an address, not a hostname. If the multicast address is used, it must be **224.0.1.1**.

To include an authentication key in all messages sent to the remote system, include the **key** option. The key corresponds to the key number you specify in the **authentication-key** statement.

By default, the router or switch sends NTP version 4 packets to the remote system. To set the NTP version level to 1, 2, or 3, include the **version** option.

Configuring the Router or Switch to Operate in Server Mode

In server mode, the router or switch acts as an NTP server for clients when the clients are configured appropriately. The only prerequisite for " server mode" is that the router or switch must be receiving time from another NTP peer or server. No other configuration is necessary on the router or switch.

To configure the local router or switch to operate as an NTP server, include the following statements at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
authentication-key key-number type type value password;
```



```
server address <key key-number> <version value> <prefer>;
trusted-key [ key-numbers ];
```

Specify the address of the system acting as the time server. You must specify an address, not a hostname.

To include an authentication key in all messages sent to the time server, include the **key** option. The key corresponds to the key number you specify in the **authentication-key** statement.

By default, the router or switch sends NTP version 4 packets to the time server. To set the NTP version level to 1,or 2, or 3, include the **version** option.

If you configure more than one time server, you can mark one server preferred by including the **prefer** option.

The following example shows how to configure the router or switch to operate in server mode:

```
[edit system ntp]
authentication-key 1 type md5 value "$9$txERuBEreWx-wtuLNdboaUjH.T3AtOESe";
server 172.17.27.46 prefer;
trusted-key 1;
```

Related Documentation

- NTP Time Server and Time Services Overview on page 31
- Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization on page 177

Specifying the Physical Location of the Switch

To specify the physical location of the switch, specify the following options for the **location** statement at the **[edit system]** hierarchy level:

- **altitude *feet***—Number of feet above sea level.
- **building *name***—Name of the building, 1 to 28 characters in length. If the string contains spaces, enclose it in quotation marks (" ").
- **country-code *code***—Two-letter country code.
- **floor *number***—Floor in the building.
- **hcoord *horizontal-coordinate***—Bellcore Horizontal Coordinate.
- **lata *service-area***—Long-distance service area.
- **latitude *degrees***—Latitude in degree format.
- **longitude *degrees***—Longitude in degree format.
- **npa-nxx *number***—First six digits of the phone number (area code and exchange).
- **postal-code *postal-code***—Postal code.
- **rack *number***—Rack number.
- **vcoord *vertical-coordinate***—Bellcore Vertical Coordinate.

The following example shows how to specify the physical location of the switch:

```
[edit system]
location {
    altitude feet;
    building name;
    country-code code;
    floor number;
    hcoord horizontal-coordinate;
    lata service-area;
    latitude degrees;
    longitude degrees;
    npa-nxx number;
    postal-code postal-code;
    rack number;
    vcoord vertical-coordinate;
}
```

Related Documentation

- Example: Configuring the Name of the Switch, IP Address, and System ID on page 174

Configuring the Root Password

The Junos OS is preinstalled on the router or switch. When the router or switch is powered on, it is ready to be configured. Initially, you log in as the user “root” with no password.

NOTE: If you configure a blank password using the **encrypted-password** statement at the **[edit system root-authentication]** hierarchy level for root authentication, you can commit a configuration, but you are *not* able to log in as superuser and gain root level access to the router or switch.

After you log in, you should configure the root (superuser) password by including the **root-authentication** statement at the **[edit system]** hierarchy level and configuring one of the password options:

```
[edit system]
root-authentication {
    (encrypted-password "password"| plain-text-password);
    load-key-file URL filename;
    ssh-dsa “public-key” <from hostname>;
    ssh-ecdsa “public-key” <from hostname>;
    ssh-rsa “public-key” <from hostname>;
}
```

If you configure the **plain-text-password** option, you are prompted to enter and confirm the password:

```
[edit system]
user@host# set root-authentication plain-text-password
New password: type password here
Retype new password: retype password here
```

The default requirements for plain-text passwords are:

- The password must be between 6 and 128 characters long
  - You can include most character classes in a password (uppercase letters, lowercase letters, numbers, punctuation marks, and other special characters). Control characters are not recommended.
  - Valid passwords must contain at least one change of case or character class.

You can use the **load-key-file** *URL filename* statement to load an SSH key file that was previously generated using **ssh-keygen**. The *URL filename* is the path to the file's location and name. When using this option, the contents of the key file are copied into the configuration immediately after entering the **load-key-file** *URL* statement. This command loads RSA (SSH version 1 and SSH version 2) and DSA (SSH version 2) public keys.

Optionally, you can use the **ssh-dsa**, **ssh-ecdsa**, or **ssh-rsa** statements to directly configure SSH RSA, DSA, or ECDSA keys to authenticate root logins. You can configure more than one public key for SSH authentication of root logins as well as for user accounts. When a user logs in as root, the public keys are referenced to determine whether the private key matches any of them.

To view the SSH keys entries, use the configuration mode **show** command. For example:

```
[edit system]
user@host# set root-authentication load-key-file my-host:.ssh/id_dsa.pub
.file.19692 | 0 KB | 0.3 kB/s | ETA: 00:00:00 | 100%
[edit system]
user@host# show
root-authentication {
  ssh-rsa "1024 35 97276382040842510554682267572498642416303222
    20740496252839038203869014158453496417001961060835872296
    15634757491827360336127644187426594689320773910834481012
    68312595772262546166799927831612350043866091586628382248
    97467326056611921489539813965561563786211940327687806538
    16960202749164163735913269396344008443 boojum@juniper.net"; #
    SECRET-DATA
}
```

Junos-FIPS software has special password requirements. FIPS passwords must be between 10 and 20 characters in length. Passwords must use at least three of the five defined character sets (uppercase letters, lowercase letters, digits, punctuation marks, and other special characters). If Junos-FIPS is installed on the router or switch, you cannot configure passwords unless they meet this standard. If you use the **encrypted-password** option, then a null-password (empty) is not permitted.

You cannot configure a blank password for **encrypted-password** using blank quotation marks (" "). You must configure a password whose number of characters range from 1 through 128 characters and enclose the password in quotation marks.

Related Documentation

- *Configuring the Root Password*
- Example: Configuring a Plain-Text Password for Root Logins on page 1264
- Example: Configuring SSH Authentication for Root Logins on page 1266
- Example: Changing the Requirements for Junos OS Plain-Text Passwords on page 172

- *Recovering the Root Password*

Configuring the Router or Switch to Listen for Broadcast Messages Using NTP

When you are using NTP, you can configure the local router or switch to listen for broadcast messages on the local network to discover other servers on the same subnet by including the **broadcast-client** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
broadcast-client;
```

When the router or switch detects a broadcast message for the first time, it measures the nominal network delay using a brief client-server exchange with the remote server. It then enters *broadcast client* mode, in which it listens for, and synchronizes to, succeeding broadcast messages.

To avoid accidental or malicious disruption in this mode, both the local and remote systems must use authentication and the same trusted key and key identifier.

Related Documentation

- Configuring the Router or Switch to Listen for Multicast Messages Using NTP on page 148
- Configuring the NTP Time Server and Time Services on page 143
- Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization on page 177

Configuring the Router or Switch to Listen for Multicast Messages Using NTP

When you are using NTP, you can configure the local router or switch to listen for multicast messages on the local network to discover other servers on the same subnet by including the **multicast-client** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
multicast-client <address>;
```

When the router or switch receives a multicast message for the first time, it measures the nominal network delay using a brief client-server exchange with the remote server. It then enters *multicast client* mode, in which it listens for, and synchronizes to, succeeding multicast messages.

You can specify one or more IP addresses. (You must specify an address, not a hostname.) If you do, the router or switch joins those multicast groups. If you do not specify any addresses, the software uses **224.0.1.1**.

To avoid accidental or malicious disruption in this mode, both the local and remote systems must use authentication and the same trusted key and key identifier.

Related Documentation

- Configuring the Router or Switch to Listen for Broadcast Messages Using NTP on page 148
- Configuring the NTP Time Server and Time Services on page 143
- Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization on page 177

Configuring System Alarms to Appear Automatically Upon Login

You can configure Juniper Networks routers and switches to run the **show system alarms** command whenever a user with the login class **admin** logs in to the router or switch. To do so, include the **login-alarms** statement at the **[edit system login class admin]** hierarchy level.

```
[edit system login class admin]
login-alarms;
```

For more information on the **show system alarms** command, see the CLI Explorer.

Related Documentation

- *System Alarms on J Series Routers*
- show system alarms on page 872

Configuring Time-Based User Access

The Junos OS enables you to configure time-based restrictions for user access to log in to a device. This is useful for restricting the time and duration of user logins for all users belonging to a login class. You can specify the days of the week when users can log in, the access start time, and the access end time.

- To configure user access on specific days of the week, without any restrictions on the duration of login, include the **allowed-days** statement only.

  ```
  [edit system]
  login {
    class class-name {
      allowed-days [ days-of-the-week ];
    }
  ```

- To configure user access on all the days of the week for a specific duration, include the **access-start** and **access-end** statements only.

  ```
  [edit system]
  login {
    class class-name {
      access-start HH:MM;
      access-end HH:MM;
    }
  }
  ```

- To configure user access on specific days of the week for a specified duration, include the **allowed-days**, **access-start**, and **access-end** statements.

```
[edit system]
login {
  class class-name {
    allowed-days [ days-of-the-week ];
    access-start HH:MM;
    access-end HH:MM;
  }
}
```


Specify the start time and end time in ***HH*:*MM*** (24-hour) format, where ***HH*** represents the hours and ***MM*** represents the minutes.

NOTE: Access start time and end time that spans across 12:00 AM on a specified day results in the user having access until the next day, even if the access day is not explicitly configured. For instance, the following configuration results in the user having access until 6:00 AM on Tuesday and Thursday, although the **allowed-days** statement specifies access only on Monday and Wednesday:

```
[edit system]
login {
  class operator-night-shift {
    allowed-days [ monday wednesday ];
    access-start 2000;
    access-end 0600;
  }
}
```

Related Documentation

- *Examples: Configuring Time-Based User Access*
- *Defining Junos OS Login Classes*
- *access-end*
- *access-start*
- *allowed-days*
- access-end on page 220
- access-start on page 221
- allowed-days on page 224

Configuring the Timeout Value for Idle Login Sessions

An idle login session is one in which the CLI operational mode prompt is displayed but there is no input from the keyboard. By default, a login session remains established until a user logs out of the router or switch, even if that session is idle. To close idle sessions automatically, you must configure a time limit for each login class. If a session established by a user in that class remains idle for the configured time limit, the session automatically closes.

To define the timeout value for idle login sessions, include the **idle-timeout** statement at the **[edit system login class *class-name*]** hierarchy level:

```
[edit system login class class-name]
idle-timeout minutes;
```

Specify the number of minutes that a session can be idle before it is automatically closed.

If you have configured a timeout value, the CLI displays messages similar to the following when timing out an idle user. It starts displaying these messages 5 minutes before timing out the user.

```
user@host# Session will be closed in 5 minutes if there is no activity.
Warning: session will be closed in 1 minute if there is no activity
Warning: session will be closed in 10 seconds if there is no activity
Idle timeout exceeded: closing session
```

If you configure a timeout value, the session closes after the specified time has elapsed, unless the user is running telnet or monitoring interfaces using the **monitor interface** or **monitor traffic** command.

Related Documentation

- *Defining Junos OS Login Classes*
- *idle-timeout*
- idle-timeout on page 250

Configuring a QFX3500 Device as a Standalone Switch

If you are using the QFX3500 device as a standalone switch, you must perform the initial configuration of the QFX3500 device through the console port using the command-line interface (CLI). If you are using the QFX3500 as a Node device in a QFX3000 QFabric system, you instead perform the initial setup of a QFabric system on a QFX3100 Director device (see *Performing the QFabric System Initial Setup on a QFX3100 Director Group*).

Before you begin connecting and configuring a QFX3500 device, set the following parameter values on the console server or PC:

- Baud Rate—9600
- Flow Control—None
- Data—8
- Parity—None
- Stop Bits—1
- DCD State—Disregard

To connect and configure the device from the console:

1. Connect the console port to a laptop or PC using the supplied RJ-45 cable and RJ-45 to DB-9 adapter. The console (**CON**) port is located on the front panel of the device.
2. Log in as **root**. There is no password. If the software booted before you connected to the console port, you might need to press the Enter key for the prompt to appear.

   ```
   login: root
   ```
3. Start the CLI.

   ```
   root@% cli
   ```
4. Enter configuration mode.

   ```
   root> configure
   ```

5. Add a password to the root administration user account.

   ```
   [edit]
   root@# set system root-authentication plain-text-password
   New password: password
   Retype new password: password
   ```

6. (Optional) Configure the name of the device. If the name includes spaces, enclose the name in quotation marks (“ ”).

   ```
   [edit]
   root@# set system host-name host-name
   ```

7. Configure the default gateway.

   ```
   [edit]
   root@# set routing-options static route default next-hop address
   ```

8. Configure the IP address and prefix length for the device management interface.

   ```
   [edit]
   root@# set interfaces me0 unit 0 family inet address address/prefix-length
   ```

   CAUTION: Configuring the two management Ethernet interfaces within the same subnet is not supported.

   NOTE: The management ports are on the front panel of the QFX3500 device. They are labeled C0 and C1 on the front panel. In the CLI they are referred to as me0 and me1.

9. (Optional) Configure the static routes to remote prefixes with access to the management port.

   ```
   [edit]
   root@# set routing-options static route remote-prefix next-hop destination-ip retain
   no-readvertise
   ```

10. Enable telnet service.

    ```
    [edit]
    root@# set system services telnet
    ```

    NOTE: When Telnet is enabled, you cannot log in to a QFX3500 device through Telnet using root credentials. Root login is allowed only for SSH access.

11. Commit the configuration to activate it on the device.

    ```
    [edit]
    root@# commit
    ```

Related Documentation

- *Installing and Connecting a QFX3500 Device*
- *QFX3000-G QFabric System Installation Overview*
- *Understanding QFX3000-G QFabric System Hardware Configurations*

Creating an Emergency Boot Device for a QFX Series Device

If Junos OS on the QFX Series is damaged in some way that prevents the software from loading properly, you can use an emergency boot device to repartition the primary disk and load a fresh installation of Junos OS. Use the following procedure to create an emergency boot device.

Before you begin, you need to download the installation media image for your device and Junos OS release from http://www.juniper.net/customers/support/ .

NOTE: **In the following procedure, we assume that you are creating the emergency boot device on a QFX device. You can create the emergency boot device on another Juniper Networks switch or router, or any PC or laptop that supports Linux. The steps you take to create the emergency boot device vary, depending on the device.**

To create an emergency boot device from a QFX device:

1. Use FTP to copy the installation media image into the **/var/tmp** directory on the QFX device.
2. Insert a USB device into the USB port.
3. From the Junos OS command-line interface (CLI), start the shell:

```
user@device> start shell
%
```

4. Switch to the root account using the **su** command:

```
% su
Password: password
```

NOTE: **The password is the root password for the QFX device. If you logged in to the device as root, you do not need to perform this step.**

5. Enter the following command on the QFX3500, QFX3600, and QFX3600-I devices:

```
root@device% dd if=/var/tmp/filename of=/dev/da1 bs=16k
```

The device writes the installation media image to the USB device:

```
root@device% dd if=/var/tmp/install-media-qfx3500.junos_11.1 of=/dev/da1 bs=16k
11006+1 records in
11006+1 records out
180332544 bytes transferred in 71.764266 secs (2512846 bytes/sec)
```

6. Enter the following command on the QFX5100 device:

```
root@device% dd if=/var/tmp/filename of=/dev/da0 bs=1048576
```

The device writes the installation media image to the USB device:

```
root@device% dd if=/var/tmp/jinstall-vjunos-usb-13.2.img of=/dev/da0 bs=1048576
11006+1 records in
```

```
11006+1 records out
180332544 bytes transferred in 71.764266 secs (2512846 bytes/sec)
```

7. Log out of the shell:

```
root@device% exit
% exit
user@device>
```

Related Documentation

- *USB Port Specifications for the QFX Series*
- Performing a Recovery Installation on a QFX Series Device on page 103
- Performing a QFabric System Recovery Installation on the Director Group on page 6471
- Performing a Recovery Installation on a QFX5100 Switch on page 105

Creating a Snapshot and Using It to Boot a QFX Series Switch

The system snapshot feature takes a “snapshot” of the files currently used to run the QFX Series switch—the complete contents of the **/config** and **/var** directories, which include the running Juniper Networks Junos OS, the active configuration, and the rescue configuration—and copies all of these files into an alternate (internal, meaning internal flash, or an external, meaning USB flash) memory source. You can then use these snapshots to boot the switch at the next bootup or as a backup boot option.

This topic includes the following tasks:

Creating a Snapshot on a USB Flash Drive and Using It to Boot the Switch

A snapshot can be created on USB flash memory after a switch is booted using files stored in internal memory.

Ensure that you have the following tools and parts available before creating a snapshot on a USB Flash drive:

- A USB flash drive that meets the QFX Series switch USB port specifications. See *USB Port Specifications for the QFX Series*.

To create a snapshot on USB flash memory and use it to boot the switch:

1. Place the snapshot into USB flash memory:

   user@switch> request system snapshot **partition**

NOTE: This example uses the **partition** option. If you have already created a partition for the snapshot, you don’t need to use the **partition** option.

2. (Optional) Perform this step if you want to boot the switch now using the snapshot stored on the external USB flash drive. If you created the snapshot as a backup, do not perform this step.
   - To reboot the switch using the most recently created snapshot:

     user@switch> **request system reboot**

   - To reboot the switch using a snapshot in a specific partition on the USB flash drive:

     user@switch> **request system reboot slice 1**

Creating a Snapshot on an Internal Flash Drive and Using it to Boot the Switch

A snapshot can be created on internal memory after a switch is booted using files stored in external memory.

To create a snapshot in internal memory and use it to boot the switch:

1. Place the snapshot files in internal memory:

   user@switch> **request system snapshot partition**

   NOTE: This example uses the **partition** option. If you have already created a partition for the snapshot, you don't need to use the **partition** option.

2. (Optional) Perform this step if you want to boot the switch now using the newly created snapshot. If you created the snapshot as a backup, do not perform this step.
   - To reboot the switch using the most recently created snapshot:

     user@switch> **request system reboot**

   - To reboot the switch using a snapshot in a specific partition in internal memory:

     user@switch> **request system reboot slice 1**

Creating a Snapshot on the Alternate Slice of the Boot Media

The alternate slice of the boot media contains a backup software image that the switch can boot from if it is unable to boot from the primary slice. When you upgrade software, the new software image gets copied only to the primary slice of the boot media.

To create a snapshot of the currently booted software image on the backup slice of the boot media:

user@switch> **request system reboot slice alternate**

After the system boots up, you will see the following message before the login prompt:

WARNING: THIS DEVICE HAS BOOTED FROM THE BACKUP JUNOS IMAGE

It is possible that the primary copy of JUNOS failed to boot up properly, and so this device has booted up from the backup copy.

Please re-install JUNOS to recover the primary copy in case it has been corrupted.

The system will generate an alarm indicating that the switch has booted from the backup slice.

Related Documentation

- *Verifying That a System Snapshot Was Created on a QFX Series Switch*
- Understanding System Snapshot on QFX Series Switches on page 46

Creating a Snapshot and Using It to Boot a QFX5100 Switch

The system snapshot feature takes a “snapshot” of the files currently used to run the QFX Series switch—the complete contents of the **/config** directories, which include the running Juniper Networks Junos OS, the active configuration, and the rescue configuration, as well as the host OS—and copies all of these files into an external USB flash drive. You can use the snapshot to boot the switch at the next bootup or as a backup boot option.

This topic includes the following tasks:

- Creating a Snapshot on an External USB Flash Drive and Using It to Boot the Switch on page 156

Creating a Snapshot on an External USB Flash Drive and Using It to Boot the Switch

A snapshot can be created on an external USB flash drive after a switch is booted using files stored in internal memory.

Ensure that you have the following tools and parts available before creating a snapshot on an external USB flash drive:

- An external USB flash drive that meets the QFX Series switch USB port specifications. See *USB Port Specifications for the QFX Series*.

To create a snapshot on the external USB flash drive and use it to boot the switch:

1. Insert the external USB flash drive.
2. Issue the **request system snapshot** command.

   user@switch> **request system snapshot**

3. (Optional) Perform this step if you want to boot the switch now using the snapshot stored on the external USB flash drive. If you created the snapshot as a backup, do not perform this step.

   - Insert the external USB flash drive.
   - Power cycle the device.

     The external USB flash drive is detected.

   - The software prompts you with the following options:

     ```
     Junos Snapshot Installer - (c) Juniper Networks 2013
     Reboot
     Install Junos Snapshot [13.2-20131115_x_132_x51_vjunos.0
     Boot to host shell [debug]
     ```


- Select **Install Junos Snapshot** to install the snapshot located on the external USB flash drive to the switch.

  The switch copies the software from the external USB flash drive, occasionally displaying status messages. When the software is finished being copied from the external USB flash drive to the QFX5100 switch, the QFX5100 switch then reboots from the internal flash storage on which the software was just installed. When the reboot is complete, the switch displays the Junos OS login prompt:

  ```
  root@switch#
  ```

Related Documentation

- *Verifying That a System Snapshot Was Created on a QFX Series Switch*
- Understanding System Snapshot on QFX Series Switches on page 46

Including the Year or Millisecond in Timestamps

By default, the timestamp recorded in a standard-format system log message specifies the month, date, hour, minute, and second when the message was logged, as in the following example:

Aug 21 12:36:30

To include the year, the millisecond, or both in the timestamp, include the **time-format** statement at the **[edit system syslog]** hierarchy level:

[edit system syslog]
time-format (year | millisecond | year millisecond);

However, the timestamp for traceoption messages is specified in milliseconds by default, and is independent of the **[edit system syslog time-format]** statement.

The modified timestamp is used in messages directed to each destination configured by a **file**, **console**, or **user** statement at the **[edit system syslog]** hierarchy level, but not to destinations configured by a **host** statement.

The following example illustrates the format for a timestamp that includes both the millisecond (401) and the year (2006):

Aug 21 12:36:30.401 2006

NOTE: Messages logged in structured-data format include the year and millisecond by default. If you include the structured-data statement at the **[edit system syslog file *filename*]** hierarchy level along with the **time-format** statement, the **time-format** statement is ignored and messages are logged in structured-data format.

For information about the **structured-data** statement, see *Logging Messages in Structured-Data Format*. For information about the contents of a structured-data message, see the *Junos OS System Log Messages Reference*.

Related Documentation

- *Single-Chassis System Logging Configuration Overview*
- *Examples: Configuring System Logging*

Mapping the Hostname of the Switch to IP Addresses

To map a hostname of a switch to one or more IP addresses, include the **inet** statement at the **[edit system static-host-mapping *hostname*]** hierarchy level:

```
[edit system]
static-host-mapping {
  hostname {
    inet [ addresses ];
    alias [ aliases ];
  }
}
```

hostname is the name specified by the **host-name** statement at the **[edit system]** hierarchy level.

For each host, you can specify one or more aliases.

Related Documentation

- *Configuring Basic Router or Switch Properties*
- Configuring the Domain Name for the Router or Switch on page 136
- *Example: Configuring the Name of the Router, IP Address, and System ID*
- **static-host-mapping on page 285**

Methods for Configuring Junos OS

You can use any of the methods shown in Table 48 on page 159 to configure Junos OS:

Table 48: Methods for Configuring Junos OS

Method	Description
Command-line interface (CLI)	Create the configuration for the device using the CLI. You can enter commands from a single command line, and scroll through recently executed commands.
ASCII file	Load an ASCII file containing a configuration that you created earlier, either on this system or on another system. You can then activate and run the configuration file, or you can edit it using the CLI and then activate it.
J-Web graphical user interface (GUI)	Use the J-Web graphical user interface (GUI) to configure the device. J-Web enables you to monitor, configure, troubleshoot, and manage the router on a client by means of a Web browser. The J-Web GUI is preinstalled on J Series Services Routers and is an optional software package that can be installed on M Series and T Series routers. J-Web is not available for the QFX Series.
Junos XML management protocol (API)	Use Junos XML protocol Perl client modules to develop custom applications for configuring information on devices that run Junos OS. Client applications use the Junos XML management protocol to request and change configuration information on Juniper Networks J Series, M Series, and T Series routers. The Junos XML management protocol is customized for Junos OS, and operations in the API are equivalent to those in the Junos OS CLI.
NETCONF application programming interface (API)	Use NETCONF Perl client modules to develop custom applications for configuring information on devices that run Junos OS. Client applications use the NETCONF XML management protocol to request and change configuration information on Juniper Networks J Series, M Series, and T Series routers. The NETCONF XML management protocol includes features that accommodate the configuration data models of multiple vendors.
Configuration commit scripts	Create scripts that run at commit time to enforce custom configuration rules. Commit scripts are written in Extensible Stylesheet Language Transformations (XSLT). Commit scripts are not available for the QFX Series.

The following sections contain complete descriptions of the methods you can use to configure Junos OS:

- Junos OS Command-Line Interface (CLI) on page 160
- ASCII File on page 160
- J-Web Package on page 160
- Junos XML Management Protocol Software on page 161

- NETCONF XML Management Protocol Software on page 161
- Configuration Commit Scripts on page 161

Junos OS Command-Line Interface (CLI)

The Junos OS CLI is a straightforward command interface. You use Emacs-style keyboard sequences to move around on a command line and scroll through a buffer that contains recently executed commands. You type commands on a single line, and the commands are executed when you press the Enter key. The CLI also provides command help and command completion. For more information about the CLI, see the *CLI User Guide* and CLI Explorer.

ASCII File

You can load an ASCII file containing a configuration that you created earlier, either on this system or another system. You can then activate and run the configuration file as is, or you can edit it using the CLI and then activate it.

J-Web Package

As an alternative to entering CLI commands, the Junos OS supports the J-Web graphical user interface (GUI). The J-Web user interface enables you to monitor, configure, troubleshoot, and manage the router on a client by means of a Web browser with Hypertext Transfer Protocol (HTTP) or HTTP over Secure Sockets Layer (HTTPS) enabled.

The J-Web user interface is preinstalled on J Series Services Routers. It is provided as an optional, licensed software package (jweb package) on M Series and T Series routers. The jweb package is not included in jinstall and jbundle software bundles. It must be installed separately. To install the package on M Series and T Series routers, follow the procedure described in the *Installation and Upgrade Guide*.

J-Web supports weak (56-bit) encryption by default. This enables international customers to install J-Web and use HTTPS connections for J-Web access. Domestic customers can also install the jcrypto strong encryption package. This package automatically overrides the weak encryption. For more information about the J-Web GUI, see the *J-Web Interface User Guide*.

NOTE: Because the J-Web package is bundled separately from other packages, it is possible to have a version mismatch between J-Web and other Junos OS packages you have installed.

To check for a version mismatch, use the **show system alarms** CLI command. If the version number does not match exactly, a system alarm appears. For example, if you install the 7.4R1.2 jroute package and the 7.4R1.1 jweb package, an alarm is activated. For more information on the **show system alarms** command, see the CLI Explorer.

Junos XML Management Protocol Software

The Junos XML management protocol is an Extensible Markup Language (XML) application that client applications use to request and change configuration information on Juniper Networks J Series, M Series, MX Series, and T Series routers. This API is customized for Junos OS, and operations in the API are equivalent to Junos OS CLI configuration mode commands. The Junos XML management protocol includes a set of Perl modules that enable client applications to communicate with a Junos XML protocol server on the router. The Perl modules are used to develop custom applications for configuring and monitoring Junos OS.

For a complete description of how to use Junos XML and Junos XML management protocol software, see the *Junos XML Management Protocol Developer Guide*.

NETCONF XML Management Protocol Software

The NETCONF XML management protocol is an Extensible Markup Language (XML) application that client applications can use to request and change configuration information on Juniper Networks J Series, M Series, MX Series, and T Series routers. This API is customized for Junos OS, and includes features that accommodate the configuration data models of multiple vendors. The NETCONF XML management protocol includes a set of Perl modules that enable client applications to communicate with a NETCONF server on the router. The Perl modules are used to develop custom applications for configuring and monitoring Junos OS.

For a complete description of how to use Junos XML and NETCONF XML management protocol software, see the *NETCONF XML Management Protocol Developer Guide*.

Configuration Commit Scripts

You can create and use scripts that run at commit time to enforce custom configuration rules. If a configuration breaks the custom rules, the script can generate actions that the Junos OS performs. These actions include:

- Generating custom error messages
- Generating custom warning messages
- Generating custom system log messages
- Making changes to the configuration

Configuration commit scripts also enable you to create macros, which expand simplified custom aliases for frequently used configuration statements into standard Junos configuration statements. Commit scripts are written in Extensible Stylesheet Language Transformations (XSLT). For more information, see the *Junos OS Automation Library*.

Related Documentation

- *Junos OS Configuration from External Devices*

Modifying the Default Time Zone for a Router or Switch Running Junos OS

The default local time zone on the router or switch is UTC (Coordinated Universal Time, formerly known as Greenwich Mean Time, or GMT).

- To modify the local time zone, include the **time-zone** statement at the **[edit system]** hierarchy level:

```
[edit system]
time-zone (GMT hour-offset | time-zone);
```

You can use the **GMT *hour-offset*** option to set the time zone relative to UTC (GMT) time. By default, ***hour-offset*** is **0**. You can configure this to be a value from **–14** to **+12**.

You can also specify the ***time-zone*** value as a string such as PDT (Pacific Daylight Time) or WET (Western European Time), or specify the continent and major city.

NOTE: Junos OS complies with the POSIX time-zone standard, which is counter-intuitive to the way time zones are generally indicated relative to UTC. A time zone ahead of UTC (east of the Greenwich meridian) is commonly indicated as GMT +*n*; for example, the Central European Time (CET) zone is indicated as GMT +1. However, this is not true for POSIX time zone designations. POSIX indicates CET as GMT-1. If you include the **set system time-zone GMT+1** statement for a router in the CET zone, your router time will be set to one hour behind GMT, or two hours behind the actual CET time. For this reason, you might find it easier to use the POSIX time-zone strings, which you can list by entering **set system time-zone ?**.

For the time zone change to take effect for all processes running on the router or switch, you must reboot the router or switch.

The following example shows how to change the current time zone to **America/New_York**:

```
[edit]
user@host# set system time-zone America/New_York
[edit]
user@host# show
system {
  time-zone America/New_York;
}
```

Related Documentation

- NTP Time Server and Time Services Overview on page 31
- Setting a Custom Time Zone on Routers or Switches Running Junos OS on page 165

Rebooting and Halting a QFX Series Product

To reboot the switch, issue the **request system reboot** command.

```
user@switch> request system reboot ?
Possible completions:
  <[Enter]>            Execute this command
```



```
  at                     Time at which to perform the operation
  in                     Number of minutes to delay before operation
  media                  Boot media for next boot
  message                Message to display to all users
  |                      Pipe through a command
```

```
user@switch> request system reboot
Reboot the system ? [yes,no] (no) yes
Rebooting switch
```

Similarly, to halt the switch, issue the **request system halt** command.

CAUTION: Before entering this command, you must have access to the switch's console port in order to bring up the Routing Engine.

```
user@switch> request system halt ?
Possible completions:
  <[Enter]>              Execute this command
  at                     Time at which to perform the operation
  in                     Number of minutes to delay before operation
  media                  Boot media for next boot
  message                Message to display to all users
  |                      Pipe through a command
```

NOTE: When you issue this command on an individual component in a QFabric system, you will receive a warning that says "Hardware-based members will halt, Virtual Junos Routing Engines will reboot." If you want to halt only one member, use the **member** option. You cannot issue this command from the QFabric CLI.

Issuing the **request system halt** command on the switch halts the Routing Engine. To reboot a Routing Engine that has been halted, you must connect through the console.

Related Documentation

- clear system reboot on page 329
- request system reboot on page 387
- request system halt on page 373
- request system power-off on page 383

- *Connecting a QFX Series Device to a Management Console*

Reverting to the Default Factory Configuration

If for any reason the current active configuration fails, you can revert to the default factory configuration. The default factory configuration contains the basic configuration settings. This is the first configuration of the switch, and it is loaded when the switch is first installed and powered on.

The **load factory default** command is a standard Junos OS configuration command. This configuration command replaces the current active configuration with the default factory configuration.

To revert the switch to the rescue configuration:

1. [edit]
   user@switch# **load factory-default**
   [edit]
   user@switch# **delete system commit factory-settings**
   [edit]
   user@switch# **commit**

Related Documentation

- Understanding Configuration Files on page 1126
- Loading a Previous Configuration File on page 1136
- Reverting to the Rescue Configuration on page 165

Reverting to the Default Factory Configuration by Using the request system zeroize Command

The **request system zeroize** command is a standard Junos OS operational mode command that removes all configuration information and resets all key values. The operation unlinks all user-created data files, including customized configuration and log files, from their directories. The switch then reboots and reverts to the factory-default configuration.

To completely erase user-created data so that it is unrecoverable, use the **request system zeroize media** command.

CAUTION: Before issuing **request system zeroize**, use the **request system snapshot** command to back up the files currently used to run the switch to a secondary device.

To revert to the factory-default configuration by using the **request system zeroize** command:

1. `user@switch>` **request system zeroize**
   ```
   warning: System will be rebooted and may not boot without configuration
   Erase all data, including configuration and log files? [yes,no] (yes)
   ```
2. Type **yes** to remove configuration and log files and revert to the factory default configuration.
3. Complete the initial configuration of the switch. See or "Configuring a QFX3500 Device as a Standalone Switch" on page 151

Related Documentation

- **request system zeroize on page 445**

Reverting to the Rescue Configuration

If someone inadvertently commits a configuration that denies management access to a QFX Series product and the console port is not accessible, you can overwrite the invalid configuration and replace it with the rescue configuration. The rescue configuration is a previously committed, valid configuration.

To revert the switch to the rescue configuration:

1. Enter the **load override** command.

   [edit]
   user@switch# **load override** *filename*

2. Commit your changes.

   [edit]
   user@switch# **commit** *filename*

Related Documentation

- Setting or Deleting the Rescue Configuration on page 1145
- Reverting to the Default Factory Configuration on page 163
- Configuration File Terms on page 26

Saving Core Files Generated by Junos OS Processes

By default, when an internal Junos OS process generates a core file, the file and associated context information are saved for debugging purposes in a compressed tar file named **/var/tmp/*process-name*.core.*core-number*.tgz**. The contextual information includes the configuration and system log message files.

- To disable the saving of core files and associated context information:

  [edit system]
  no-saved-core-context;

- To save the core files only:

  [edit system]
  saved-core-files *number*;

  Where ***number*** is the number of core files to save and can be a value from 1 through 10.

- To save the core files along with the contextual information:

  [edit system]
  saved-core-context;

Related Documentation

- Viewing Core Files from Junos OS Processes on page 171

Setting a Custom Time Zone on Routers or Switches Running Junos OS

You can update the time zone database information on routers or switches running Junos OS. This feature simplifies time zone management in devices running Junos OS by allowing for future unforeseen time zone database adjustments. You can configure your router or switch to use a custom time zone database file that you create to meet your requirements by editing an existing time zone database file.

Tasks for setting a custom time zone are:

Importing and Installing Time Zone Files

To import and install time zone files, follow these steps:

1. Download the time zone files archive and untar them to a temporary directory such as **/var/tmp**:

```
# mkdir -p /var/tmp/tz && cd /var/tmp/tz && rm *
# wget 'ftp://ftp.iana.org/tz/tzdata-latest.tar.gz'
# tar xvzf tzdata*.gz
africa
antarctica
asia
australasia
europe
northamerica
southamerica
pacificnew
etcetera
factory
backward
systemv
solar87
solar88
solar89
iso3166.tab
zone.tab
leapseconds
yearistype.sh
```

NOTE: If needed, you can edit the above untarred files to create or modify time zones.

2. Select the names of time zone files to compile and feed them to the following script. For example, to generate **northamerica** and **asia** tz files:

```
# /usr/libexec/ui/compile-tz northamerica asia
```

3. Enable the use of the generated tz files using the CLI:

```
[edit]
# set system use-imported-time-zones
[edit]
# set system time-zone ?
```

This should show the newly generated tz files in **/var/db/zoneinfo/**.

4. Set the time zone and commit the configuration:

   [edit]
   # set system time-zone <your-time-zone>
   # commit

5. Verify that the time zone change has taken effect:

   [edit]
   # run show system uptime

Configuring a Custom Time Zone

To use a custom time zone, follow these steps:

1. Download a time zones archive (from a known or designated source) to the router or switch. Compile the time zone archive using the *zic* time zone compiler, which generates *tz* files.

2. Using the CLI, configure the router or switch to enable the use of the generated tz files as follows:

   [edit]
   user@host# **set system use-imported-time-zones**

3. Display the imported time zones (saved in the directory **/var/db/zoneinfo/**):

   [edit]
   user@host# **set system time-zone ?**

   If you do not configure the router to use imported time zones, the Junos OS default time zones are shown (saved in the directory **/usr/share/zoneinfo/**).

Related Documentation

- *Modifying the Default Time Zone for a Router or Switch Running Junos OS*
- *NTP Overview*
- NTP Time Server and Time Services Overview on page 31
- Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization on page 177
- *use-imported-time-zones*

Setting the Date and Time

1. Enter operational mode in the CLI.

2. Enter the following command:

   user@switch> **set date *YYYYMMDDHHMM.ss source-address***

   For example, the following command sets the date and time.

   user@switch# **set date 201102151010.55**

3. To set the date and time from an NTP server, enter the following command:

   user@switch# **set date ntp *servers***

For example, the following command sets the date and time from an NTP server:

user@switch# **set date ntp 200.40.40.1**

4. To set the date and time from more than one NTP server, enter the same command:

   user@switch# **set date ntp *servers***

   For example, the following command sets the date and time from more than one NTP server:

   user@switch# **set date ntp 200.40.40.1 200.40.40.2**

Related Documentation

- *set date*

Specifying Access Privileges for Junos OS Operational Mode Commands

You can specify extended regular expressions by using the **allow-commands** and **deny-commands** statements to define a user's access privileges to individual operational mode commands. Doing so takes precedence over a login class permissions bit set for a user. You can include one **deny-commands** and one **allow-commands** statement in each login class.

To explicitly provide use of an individual operational mode command that would otherwise be denied, include the **allow-commands** statement at the **[edit system login class *class-name*]** hierarchy level:

[edit system login class *class-name*]
allow-commands "*regular-expression*";

To explicitly deny access to an individual operational mode command that would otherwise be supported, include the **deny-commands** statement at the **[edit system login class *class-name*]** hierarchy level:

[edit system login class *class-name*]
deny-commands "*regular-expression*";

If the regular expression contains any spaces, operators, or wildcard characters, enclose the expression in quotation marks. Regular expressions are not case-sensitive.

allow-commands "show interfaces";

NOTE: Modifiers are not supported within the regular expression string to be matched. If a modifier is used, then nothing is matched.

For example, the deny command **set protocols** does not match anything, whereas **protocols** matches *protocols*.

Explicitly providing access to operational mode commands using the **allow-commands** statement adds to the regular permissions set using the **permissions** statement. Likewise, explicitly denying access to operational mode commands using the **deny-commands** statement removes permissions for the specified commands from the default permissions provided by the **permissions** statement.

For example, if a login class has the permission **view** and the **allow-commands** statement includes the **request system software add** command, the specified login class user can install software, in addition to the permissions specified by the **view** permissions flag. Likewise, if a login class has the permission **all** and the **deny-commands** statement includes the **request system software add** command, the specified login class user can perform all operations allowed by the **all** permissions flag, except installing software using the **request system software add** command.

If you allow and deny the same commands, the **allow-commands** permissions take precedence over the permissions specified by **deny-commands**. For example, if you include **allow-commands "request system software add"** and **deny-commands "request system software add"**, the login class user is allowed to install software using the **request system software add** command.

If you specify a regular expression for **allow-commands** and **deny-commands** with two different variants of a command, the longest match is always executed.

For example, if you specify a regular expression for **allow-commands** with the **commit-synchronize** command and a regular expression for **deny-commands** with the **commit** command, users assigned to such a login class would be able to issue the **commit synchronize** command, but not the **commit** command. This is because **commit-synchronize** is the longest match between **commit** and **commit-synchronize**, and it is specified for **allow-commands**.

Likewise, if you specify a regular expression for **allow-commands** with the **commit** command and a regular expression for **deny-commands** with the **commit-synchronize** command, users assigned to such a login class would be able to issue the **commit** command, but not the **commit-synchronize** command. This is because **commit-synchronize** is the longest match between **commit** and **commit-synchronize**, and it is specified for **deny-commands**.

Anchors are required when specifying complex regular expressions with **allow-commands** or **deny-commands** statements. For example, when specifying multiple commands using the pipe (|) symbol for **allow-commands**, the following syntax is incorrect: **allow-commands = "(monitor.*)|(ping.*)|(show.*)|(exit)"** . Instead, you must specify the expression using the following syntax: **allow-commands** = **"(^monitor) | (^ping) | (^show) | (^exit)"** OR **allow-commands ="^(monitor | ping | show | exit)"**

Related Documentation

- Example: Configuring Access Privileges for Operational Mode Commands on page 1263
- Regular Expressions for Allowing and Denying Junos OS Operational Mode Commands on page 1220
- *allow-commands*
- *deny-commands*

Synchronizing and Coordinating Time Distribution Using NTP

Using NTP to synchronize and coordinate time distribution in a large network involves these tasks:

1. Configuring NTP on page 170
2. Configuring the NTP Boot Server on page 170
3. Specifying a Source Address for an NTP Server on page 170

Configuring NTP

- To configure NTP on the router or switch, include the **ntp** statement at the **[edit system]** hierarchy level:

```
[edit system]
ntp {
   authentication-key number type type value password;
   boot-server (address | hostname);
   broadcast <address> <key key-number> <version value> <ttl value>;
   broadcast-client;
   multicast-client <address>;
   peer address <key key-number> <version value> <prefer>;
   server address <key key-number> <version value> <prefer>;
   source-address source-address;
   trusted-key [ key-numbers ];
}
```

Configuring the NTP Boot Server

When you boot the router or switch, it issues an **ntpdate** request, which polls a network server to determine the local date and time. You need to configure a server that the router or switch uses to determine the time when the router or switch boots. Otherwise, NTP will not be able to synchronize to a time server if the server's time appears to be very far off of the local router's or switch's time.

- To configure the NTP boot server, include the **boot-server** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
boot-server (address | hostname);
```

Specify either the IP address or the hostname of the network server.

Specifying a Source Address for an NTP Server

For IP version 4 (IPv4), you can specify that if the NTP server configured at the **[edit system ntp]** hierarchy level is contacted on one of the loopback interface addresses, the reply always uses a specific source address. This is useful for controlling which source address NTP uses to access your network when it is either responding to or sending an NTP client request from your network.

To configure the specific source address that the reply will always use, and the source address that requests initiated by NTP server will use, include the **source-address** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
source-address source-address;
```

source-address is a valid IP address configured on one of the router or switch interfaces.

NOTE: If a firewall filter is applied on the loopback interface, ensure that the source address specified for the NTP server at the **[edit system ntp]** hierarchy level is explicitly included as one of the match criteria in the firewall filter. This enables the Junos OS to accept traffic on the loopback interface from the specified source address.

The following example shows a firewall filter with the source address **10.0.10.100** specified in the **from** statement included at the **[edit firewall filter *firewall-filter-name*]** hierarchy:

```
[edit firewall filter Loopback-Interface-Firewall-Filter]
term Allow-NTP {
  from {
    source-address {
      172.17.27.46/32; // IP address of the NTP server
      10.0.10.100/32; // Source address specified for the NTP server
      }
    then accept;
  }
}
```

If no source address is configured for the NTP server, include the primary address of the loopback interface in the firewall filter.

Related Documentation

- NTP Time Server and Time Services Overview on page 31
- Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization on page 177

Viewing Core Files from Junos OS Processes

When an internal Junos process generates a core file, the output found at **/var/crash/** and **/var/tmp/** can now be viewed. This provides a quick method of finding core issues across large networks.

Use the CLI command **show system core-dumps** to view core files.

```
root@host> show system core-dumps
-rw-------  1 root  wheel  268369920 Jun 18 17:59 /var/crash/vmcore.0
-rw-rw----  1 root  field    3371008 Jun 18 17:53 /var/tmp/rpd.core.0
-rw-r--r--  1 root  wheel   27775914 Jun 18 17:59 /var/crash/kernel.0
```

Related Documentation

- *Saving Core Files from Junos OS Processes*
- Saving Core Files Generated by Junos OS Processes on page 165

Configuration Examples

Example: Changing the Requirements for Junos OS Plain-Text Passwords

This example shows how to set various maximum and minimum requirements for plain-text passwords to increase password strength.

Requirements

This example requires a device running Junos 12.2 or greater. The **minimum-length** and **maximum-length** password requirements statements are available in earlier releases, however, you must have Junos OS Release 12.2 or greater to configure **minimum-lower-cases**, **minimum-numerics**, **minimum-punctuations**, or **minimum-upper-cases**.

Overview

You can use a variety of requirements to strengthen plain-text passwords for greater security. Junos OS provides a number of possible configurations at the **[edit system login password]** hierarchy level that allow you to require users to create plain-text passwords that conform to a particular set of requirements that may include such things as length, number of changes, type of characters, numbers, or letter case.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

set system login password minimum-length 12

set system login password maximum-length 22

set system login password minimum-numerics 1

set system login password minimum-upper-cases 1

set system login password minimum-lower-cases 1

set system login password minimum-punctuations 1

Configuring Requirements for Plain-Text Passwords

Step-by-Step Procedure

This example configures password requirements that require the user to creat a password that has a minimum length of 12 characters, a maximum length of 22 characters, and that includes at least one lower-case letter, at least one upper-case letter, at least one punctuation character, and at least one numeric character.

1. Navigate to configuration mode in the [system login password] hierarchy level.

```
user@host> edit
[edit]
user@host# edit system login password
```

2. Set a minimum length requirement of 12 characters and a maximum length requirement of 22 characters for user passwords.

```
[edit system login password]
user@host# set minimum-length 12
[edit system login password]
user@host# set maximum-length 22
```

3. Require users to set a password that has at least one lower-case letter and at least one upper-case letter.

```
[edit system login password]
user@host# set minimum-lower-cases 1
[edit system login password]
user@host# set minimum-upper-cases 1
```

4. Require users to set a password that has at least one punctuation-class character and at least one number.

```
[edit system login password]
user@host# set minimum-punctuations 1
[edit system login password]
user@host# set minimum-numerics 1
```

Results

From configuration mode, confirm your configuration by entering the show command at the edit system login password hierarchy level. if the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit system login password]
user@host# show
minimum-length 12;
maximum-length 22;
minimum-numerics 1;
minimum-upper-cases 1;
minimum-lower-cases 1;
```


Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221
- *password (Login)*

Example: Configuring the Domain Name for the Router or Switch

The following example shows how to configure the router or switch domain name:

```
[edit]
user@host# set system domain-name company.net
[edit]
user@host# show
system {
  domain-name company.net;
}
```

Related Documentation

- domain-name on page 246
- Configuring the Domain Name for the Router or Switch on page 136

Example: Configuring the Name of the Switch, IP Address, and System ID

The following example shows how to configure the switch name, map the name to an IP address and alias, and configure a system identifier:

```
[edit]
user@switcht# set system host-nameswitch-sj1
[edit]
user@switch# set system static-host-mapping switch-sj1 inet 192.168.1.77
[edit]
user@switcht# set system static-host-mapping switch-sj1 alias sj1
[edit]
user@switch# set system static-host-mapping switch-sj1 sysid 1921.6800.1077
[edit]
user@switcht# show
system {
  host-name switch-sj1;
  static-host-mapping {
    switch-sj1 {
      inet 192.168.1.77;
      alias sj1;
      sysid 1921.6800.1077;
    }
  }
}
```

Related Documentation

- *Configuring Basic Router or Switch Properties*

Example: Configuring NTP

The Network Time Protocol (NTP) provides the mechanisms to synchronize time and coordinate time distribution in a large, diverse network. NTP uses a returnable-time design in which a distributed subnet of time servers operating in a self-organizing, hierarchical primary-secondary configuration synchronizes local clocks within the subnet and to national time standards by means of wire or radio. The servers also can redistribute reference time using local routing algorithms and time daemons.

This example shows how to configure NTP:

Requirements

This example uses the following software and hardware components:

- Junos OS Release 11.1 or later
- A switch connected to a network on which an NTP boot server and NTP server reside

Overview

Debugging and troubleshooting are much easier when the timestamps in the log files of all switches are synchronized, because events that span a network can be correlated with synchronous entries in multiple logs. We recommend using the Network Time Protocol (NTP) to synchronize the system clocks of your switch and other network equipment.

In this example, an administrator wants to synchronize the time in a switch to a single time source. We recommend using authentication to make sure that the NTP peer is trusted. The **boot-server** statement identifies the server from which the initial time of day and date are obtained when the router or switch boots. The **server** statement identifies the NTP server used for periodic time synchronization. The **authentication-key** statement specifies that an HMAC-Message Digest 5 (MD5) scheme is used to hash the key value for authentication, which prevents the switch from synchronizing with an attacker's host that is posing as the time server.

Configuration

To configure NTP:

CLI Quick Configuration

To quickly configure NTP, copy the following commands and paste them into the switch's terminal window:

```
[edit system]
set ntp boot-server 10.1.4.1
set ntp server 10.1.4.2
set ntp authentication-key 2 type md5 value "$9$aH1j8"
```

Step-by-Step Procedure

To configure NTP :

1. Specify the boot server:

   ```
   [edit system]
   user@switch# set ntp boot-server 10.1.4.1
   ```
2. Specify the NTP server:


```
[edit system]
user@switch# set ntp server 10.1.4.2
```

3. Specify the key number, authentication type (MD5), and key for authentication:

```
[edit system]
user@switch# set ntp authentication-key 2 type md5 value "$9$aH1j8"
```

Results Check the results:

```
[edit system]
user@switch# show
ntp {
  boot-server 10.1.4.1;
  authentication-key 2 type md5 value "$9$aH1j8"; ## SECRET-DATA
  server 10.1.4.2;
}
```

Verification

To confirm that the configuration is correct, perform these tasks:

- Checking the Time on page 176
- Displaying the NTP Peers on page 176
- Displaying the NTP Status on page 177

Checking the Time

Purpose Check the time that has been set on the switch.

Action Enter the **show system uptime** operational mode command to display the time.

```
user@switch> show system uptime
fpc0:
--------------------------------------------------------------------------
Current time: 2009-06-12 12:49:03 PDT
System booted: 2009-05-15 06:24:43 PDT (4w0d 06:24 ago)
Protocols started: 2009-05-15 06:27:08 PDT (4w0d 06:21 ago)
Last configured: 2009-05-27 14:57:03 PDT (2w1d 21:52 ago) by admin1
12:49PM  up 28 days,  6:24, 1 user, load averages: 0.05, 0.06, 0.01
```

Meaning The output shows that the current date and time are June 12, 2009 and 12:49:03 PDT. The switch booted 4 weeks, 6 hours, and 24 minutes ago, and its protocols were started approximately 3 minutes before it booted. The switch was last configured by user **admin1** on May 27, 2009, and there is currently one user logged in to the switch.

The output also shows that the load average is 0.05 seconds for the last minute, 0.06 seconds for the last 5 minutes, and 0.01 seconds for the last 15 minutes.

Displaying the NTP Peers

Purpose Verify that the time has been obtained from an NTP server.

Action Enter the **show ntp associations** operational mode command to display the NTP server from switch obtained its time.

```
user@switch> show ntp associations
     remote           refid      st t when poll reach   delay   offset  jitter
==============================================================================
*ntp5.domain1.ne .GPS.            1 u  414 1024  377    3.435    4.002   0.765
```

Meaning The asterisk (*) in front of the NTP server name, or peer, indicates that the time is synchronized and obtained from this server. The delay, offset, and jitter are displayed in milliseconds.

Displaying the NTP Status

Purpose View the configuration of the NTP server and the status of the system.

Action Enter the **show ntp status** operational mode command to view the status of the NTP.

```
user@switch> show ntp status
status=0644 leap_none, sync_ntp, 4 events, event_peer/strat_chg,
version="ntpd 4.2.0-a Mon Apr 13 19:09:05 UTC 2009 (1)",
processor="powerpc", system="JUNOS9.5R1.8", leap=00, stratum=2,
precision=-18, rootdelay=2.805, rootdispersion=42.018, peer=48172,
refid=172.17.28.5,
reftime=cddd397a.60e6d7bf  Fri, Jun 12 2009 13:30:50.378, poll=10,
clock=cddd3b1b.ec5a2bb4  Fri, Jun 12 2009 13:37:47.923, state=4,
offset=3.706, frequency=-23.018, jitter=1.818, stability=0.303
```

Meaning The output shows status information about the switch and the NTP.

Related Documentation

- NTP Time Server and Time Services Overview on page 31
- **ntp on page 268**
- Configuring the NTP Time Server and Time Services on page 143
- CLI Explorer
- *Junos OS Baseline Network Operations Guide*

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization

Debugging and troubleshooting are much easier when the timestamps in the log files of all the routers or switches are synchronized, because events that span the network can be correlated with synchronous entries in multiple logs. We strongly recommend using the Network Time Protocol (NTP) to synchronize the system clocks of routers, switches, and other network equipment.

By default, NTP operates in an entirely unauthenticated manner. If a malicious attempt to influence the accuracy of a router or switch's clock succeeds, it could have negative effects on system logging, make troubleshooting and intrusion detection more difficult, and impede other management functions.

The following sample configuration synchronizes all the routers or switches in the network to a single time source. We recommend using authentication to make sure that the NTP peer is trusted. The **boot-server** statement identifies the server from which the initial time of day and date is obtained when the router boots. The **server** statement identifies the NTP server used for periodic time synchronization. The **authentication-key** statement specifies that an HMAC-Message Digest 5 (MD5) scheme should be used to hash the key value for authentication, which prevents the router or switch from synchronizing with an attacker's host posing as the time server.

```
[edit]
system {
  ntp {
    authentication-key 2 type md5 value "$9$aH1j8gqQ1gjyjgjhgjgiiiii"; # SECRET-DATA
    boot-server 10.1.4.1;
    server 10.1.4.2;
  }
}
```

Related Documentation

- *NTP Overview*
- NTP Time Server and Time Services Overview on page 31
- *authentication-key*
- **boot-server on page 232**
- **server on page 280**
- **show ntp associations on page 849**
- **show ntp status on page 851**

Configuration Statements

- syslog (System) on page 287
- system on page 289
- tacplus on page 294
- tacplus-server on page 295
- timeout on page 296
- time-format on page 297
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- traceoptions (Commit Scripts) on page 300
- traceoptions (Layer 2 Learning) on page 302
- tracing on page 304
- trusted-key on page 305
- uid on page 305
- use-imported-time-zones on page 306
- user (Access) on page 306

QFX Series CLI Hierarchy

This topic contains the full command-line interface (CLI) statement hierarchy for the QFX Series.

- [edit access] Hierarchy on page 181
- [edit accounting-options] Hierarchy on page 182
- [edit chassis] Hierarchy on page 183
- [edit class-of-service] Hierarchy on page 185
- [edit ethernet-switching-options] Hierarchy on page 187
- [edit fabric] Hierarchy on page 189
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- [edit fc-options] Hierarchy on page 191
- [edit firewall] Hierarchy on page 191
- [edit groups] Hierarchy on page 192
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- [edit protocols] Hierarchy on page 198
- [edit security] Hierarchy on page 211
- [edit snmp] Hierarchy on page 211
- [edit system] Hierarchy on page 215
- [edit vlans] Hierarchy on page 220

[edit access] Hierarchy

```
access {
```

```
        address-assignment
        pool pool-name
        address-poolpool-name
        profile profile-name {
          accounting {
            accounting-stop-on-access-deny;
            accounting-stop-on-failure;
            (authentication-order (ldap radius | none);
            order (radius | none);
          }
          radius {
            accounting-server [server-addresses];
            authentication-server [server-addresses];
          }
        }
      }
```

[edit accounting-options] Hierarchy

```
accounting-options {
  class-usage-profile profile-name {
    destination-classes {
      destination-class-name;
    }
    file filename;
    interval minutes;
    source-classes {
      source-class-name;
    }
  }
  file filename {
    archive-sites {
      site-name;
    }
    files number;
    nonpersistent;
    size bytes;
    start-time time;
    transfer-interval minutes;
  }
  filter-profile profile-name {
    counters {
      counter-name;
    }
    file filename;
    interval minutes;
  }
  interface-profile profile-name {
    fields {
      input-bytes;
      input-errors;
      input-multicast;
      input-packets;
      input-unicast;
      output-bytes;
      output-errors;
```



```
            output-multicast;
            output-packets;
            output-unicast;
            rpf-check-bytes;
            rpf-check-packets;
            rpf-check6-bytes;
            rpf-check6-packets;
            unsupported-protocol;
        }
        file filename;
        interval minutes;
    }
    mib-profile profile-name {
        file filename;
        interval minutes;
        object-names {
            mib-object-name;
        }
        operation (get | get-next | walk);
    }
    policy-decision-statistics-profile profile-name {
        application-aware-access-list-fields {
            address;
            application;
            application-group;
            input-bytes;
            input-interface;
            input-packets;
            mask;
            output-bytes;
            output-packets;
            subscriber-name;
            timestamp;
            vrf-name;
        }
        file filename;
    }
    routing-engine-profile profile-name {
        fields {
            field-name;
        }
        file filename;
        interval minutes;
    }
}
```

[edit chassis] Hierarchy

```
interconnect-device {
    alarm {
        interface-type {
            link-down (red | yellow | ignore);
        }
    }
    container-devices {
        device-count number;
```



```
      }
      craft-lockout {
        alarm {
          interface-type {
            link-down (red | yellow | ignore);
          }
        }
        container-devices {
          device-count number;
        }
        fpc slot {
          power (on | off);
        }
        routing-engine {
          on-disk-failure {
            disk-failure-action (halt | reboot);
          }
        }
      }
      fpc slot {
        power (on | off);
      }
      routing-engine {
        on-disk-failure {
          disk-failure-action (halt | reboot);
        }
      }
    }
    chassis {
      routing-engine {
      redundancy {
        failover {
          on-disk-failure {
          disk-failure-action (halt | reboot);
          }
          on-loss-of-keepalives;
        }
        graceful-switchover;
      }
      aggregated-devices {
        ethernet {
          device-count number;
        }
        alarm {
          interface-type {
            alarm-name (red | yellow | ignore);
          }
        }
      }
      forwarding-options profile-name {
        num-65-127-prefix value
      }
      fpc slot {
        auto-speed-detection disable
          pic pic-number{
          port port-number{
```

```
            tunnel-port port-number tunnel-services;
            channel-speed speed;
          }
          port-range port-range-low port-range-high {
            channel-speed speed;
          }
        }
      }
      maximum-ecmp next-hops;
    }
```

[edit class-of-service] Hierarchy

```
class-of-service {
  classifiers {
    (dscp | dscp-ipv6 | ieee-802.1 | exp) classifier-name {
      import (classifier-name | default);
      forwarding-class class-name {
        loss-priority level {
          code-points [ aliases ] [ bit-patterns ];
        }
      }
    }
  }
  code-point-aliases {
    (dscp| dscp-ipv6 | ieee-802.1) {
      alias-name bits;
    }
  }
  congestion-notification-profile profile-name {
    input {
      ieee-802.1 {
        code-point [code-point-bits] {
          pfc {
            mru mru-value;
          }
        }
      }
      cable-length cable-length-value;
    }
    output {
      ieee-802.1 {
        code-point [code-point-bits] {
          flow-control-queue [queue | list-of-queues];
        }
      }
    }
  }
  drop-profiles {
    profile-name {
      interpolate {
        fill-level low-value fill-level high-value drop-probability 0 drop-probability
          high-value;
      }
    }
  }
```



```
forwarding-class class-name {
  loss-priority level {
    code-points [ aliases ] [ bit-patterns ];
  }
}
forwarding-class class-name {
  scheduler scheduler-name;
}
forwarding-class-sets forwarding-class-set-name {
  class class-name;
}
forwarding-classes {
  class {
    class-name {
      queue-num queue-number <no-loss>;
    }
  }
}
host-outbound-traffic{
  forwarding-class class-name;
  dscp-code-point code-point;
}
interfaces {
  interface-name  {
    congestion-notification-profile profile-name {
    }
    forwarding-class lossless-forwarding-class-name;
    forwarding-class-set forwarding-class-set-name {
      output-traffic-control-profile profile-name;
    }
    rewrite-value {
      input {
        ieee-802.1{
          code-point code-point-bits;
        }
      }
    }
    unit logical-unit-number {
      classifiers {
        (dscp | dscp-ipv6 | ieee-802.1 exp) (classifier-name | default);
      }
      forwarding-class class-name;
      rewrite-rules {
        (dscp | dscp-ipv6 | ieee-802.1) (classifier-name | default);
      }
    }
  }
}
multi-destination {
  classifiers {
    (dscp | ieee-802.1) classifier-name;
  }
}
rewrite-rules {
  (dscp | dscp-ipv6 | ieee-802.1 | exp) classifier-name {
    import (rewrite-name | default);
```



```
        forwarding-class class-name {
          loss-priority priority code-point (alias | bits);
        }
      }
    }
    scheduler-maps {
      map-name {
        forwarding-class class-name scheduler scheduler-name;
      }
    }
    schedulers {
      scheduler-name  {
        buffer-size (percent percentage | remainder);
        drop-profile-map loss-priority (low | medium-high | high) protocol protocol
          drop-profile drop-profile-name;
        priority priority;
        shaping-rate (rate | percent percentage);
        transmit-rate (percent percentage);
      }
    }
    shared-buffer {
      egress {
        percent percent;
        buffer-partition (lossless | lossy | multicast) {
          percent percent
        }
      }
      ingress {
        percent percent;
        buffer-partition (lossless | lossless-headroom | lossy) {
          percent percent
        }
      }
    }
    system-defaults {
      classifiers exp classifier-name;
    }
    traffic-control-profiles profile-name {
      guaranteed-rate(rate| percent percentage);
      scheduler-map map-name;
      shaping-rate (rate| percent percentage);
    }
  }
```

[edit ethernet-switching-options] Hierarchy

```
  ethernet-switching-options {
    analyzer {
      name {
        input {
          egress {
            interface (all | interface-name);
          }
          ingress {
            interface (all | interface-name);
            vlan (vlan-id | vlan-name);
```

```
                }
            output {
                interface interface-name;
                ip-address ip-address;
                vlan (vlan-id | vlan-name);
            }
        }
    }
    bpdu-block {
        interface (all | [interface-name]);
        disable-timeout timeout;
    }
    dot1q-tunneling {
        ether-type (0x8100 | 0x88a8 | 0x9100)
    }
    interfaces interface-name {
        no-mac-learning;
    }
    mac-table-aging-time seconds {
    }
    port-error-disable {
        disable-timeout timeout;
    }
    secure-access-port {
        dhcp-snooping-file {
            location local_pathname | remote_URL;
            timeout seconds;
            write-interval seconds;
        }
        interface (all | interface-name) {
            allowed-mac {
                mac-address-list;
            }
            (dhcp-trusted | no-dhcp-trusted);
            fcoe-trusted;
            mac-limit limit action action;
            no-allowed-mac-log;
        }
        vlan (all | vlan-name) {
            (arp-inspection | no-arp-inspection) [
                forwarding-class (for DHCP Snooping or DAI Packets) class-name;
            }
            dhcp-option82 {
                circuit-id {
                    prefix (Circuit ID for Option 82) hostname;
                    use-interface-description;
                    use-vlan-id;
                }
                remote-id {
                    prefix (Remote ID for Option 82) hostname | mac | none;
                    use-interface-description;
                    use-string string;
                }
                vendor-id <string>;
            }
            (examine-dhcp | no-examine-dhcp) {
```

```
        forwarding-class (for DHCP Snooping or DAI Packets) class-name;
      }
      examine-fip {
        examine-vn2vn {
          beacon-period milliseconds;
        }
        fc-map fc-map-value;
      }
      mac-move-limit limit <fabric-limit limit action action;
    }
  }
  static {
    vlan vlan-id {
      mac mac-address next-hop interface-name;
    }
  }
  storm-control {
    interface (all | interface-name) {
      bandwidth bandwidth;
      no-broadcast;
      no-multicast;
      no-unknown-unicast;
    }
  }
  traceoptions {
    file filename <files number> <no-stamp> <replace> <size size> <world-readable |
      no-world-readable>;
    flag flag <disable>;
  }
  unknown-unicast-forwarding {
    vlan (all | vlan-name) {
      interface interface-name;
    }
  }
}
```

[edit fabric] Hierarchy

```
fabric
  aliases {
    director-device director-device-name {
      assigned-director-device-name;
    }
    interconnect-device interconnect-device-name {
      assigned-interconnect-device-name;
    }
    node-device node-device-name {
      assigned-node-device-name;
    }
  }
  resources {
    node-group node-group-name {
      node-device node-device-name;
      network-domain;
    }
  }
```



```
}
```

[edit fc-fabrics] Hierarchy

```
fc-fabrics {
  fc-fabric-name {
    description
    fabric-id fc-fabric-id;
    fabric-type proxy;
    interface {
      interface-name {
        max-login-sessions max-login-sessions;
      }
      interface-name {
        max-login-sessions max-login-sessions;
      }
      <...>;
        max-login-sessions max-login-sessions;
      }
      vlan.interface-name;
    }
    fc2 {
      traceoptions {
        file filename <replace> <size size> <files number> <no-stamp>;
        <world-readable | no-world-readable>;
        flag flag <flag-modifier>;
      }
    }
    max-login-sessions max-login-sessions;
    protocols {
      fip {
        fcoe-trusted;
        fc-map fc-map-value;
        fka-adv-period milliseconds;
        interface {
          interface-name {
            fka-adv-period milliseconds;
            priority priority;
          }
        }
        max-sessions-per-enode max-sessions-per-enode;
        priority priority;
        traceoptions {
          file filename <replace> <size size> <files number> <no-stamp>;
          <world-readable | no-world-readable>;
          flag flag <flag-modifier> <disable>;
        }
      }
    }
    proxy {
      auto-load-rebalance
      load-balance-algorithm (simple | enode-based | flogi-based);
      no-fabric-wwn-verify;
      traceoptions {
        file filename <replace> <size size> <files number> <no-stamp>;
        <world-readable | no-world-readable>;
```



```
            flag flag <flag-modifier> <disable>;
          }
        }
      }
    }
```

[edit fc-options] Hierarchy

```
fc-options
  max-login-sessions-per-node max-login-sessions-per-node;
  traceoptions {
    file filename <replace> <size size> <files number> <no-stamp>;
    <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
```

[edit firewall] Hierarchy

```
firewall {
  family family-name {
    filter filter-name {
      interface-specific;
      term term-name {
        from {
          match-conditions;
        }
        then {
          action;
          action-modifiers;
        }
      }
    }
  }
  policer policer-name {
    filter-specific;
    if-exceeding {
      bandwidth-limit bps;
      burst-size-limit bytes;
    }
    then {
      policer-action;
    }
  }
  three-color-policer policer-name {
    action {
      loss-priority high then discard;
    }
    single-rate {
      (color-aware | color-blind);
      committed-information-rate bps;
      committed-burst-size bytes;
      excess-burst-size bytes;
    }
    two-rate {
      (color-aware | color-blind);
      committed-information-rate bps;
```

```
          committed-burst-size bytes;
          peak-information-rate bps;
          peak-burst-size bytes;
        }
      }
    }
```

[edit groups] Hierarchy

```
groups {
  group-name {
    configuration-data;
  }
  global {
    configuration-data
  }
  if-config {
    configuration-data
  }
  re1 {
    configuration-data
  }
}
```

[edit interfaces] Hierarchy

```
interfaces {
  aex {
    disable;
      aggregated-ether-options {
      configured-flow-control {
        rx-buffers (on | off);
        tx-buffers (on | off);
      }
      (flow-control | no-flow-control);
      lacp mode {
        admin-key key;
        periodic interval;
        system-id mac-address;
      }
      link-speed speed;
      loopback;
      no-loopback;
      minimum-links number;
    }
      mc-ae {
        chassis-id chassis-id;
        mc-ae-id mc-ae-id;
        mode (active-active);
        status-control (active | standby);
      }
    description text;
    gratuitous-arp-reply | no-gratuitous-arp-reply)
    hold-time down milliseconds up milliseconds;
    mtu bytes;
    no-gratuitous-arp-request;
```



```
    traceoptions;
    (traps | no traps);
    unit logical-unit-number {
      disable;
      description text;
      family {
        ethernet-switching {
          filter input filter-name;
          filter output filter-name;
          native-vlan-id vlan-id;
          port-mode mode;
          reflective-relay;
          vlan {
            members [ (all | names | vlan-ids) ];
          }
        }
        inet {
          address address {
            primary;
          }
          filter input filter-name;
          filter output filter-name;
          primary;
          targeted-broadcast;
        }
      (traps | no traps);
      vlan-id vlan-id-number;
    }
    vlan-tagging;
  }
  interface-range interface-range-name {
    disable;
    description text;
    ether-options {
      802.3ad aex {
        lacp {
          force-up;
        }
      }
      (auto-negotiation| no-auto-negotiation);
      configured-flow-control {
        rx-buffers (on | off);
        tx-buffers (on | off);
      }
      (flow-control | no-flow-control);
      link-mode mode;
      speed (auto-negotiation | speed);
    }
    hold-time milliseconds down milliseconds;
    member interface-name;
    member-range starting-interface-name to  ending-interface-name;
    mtu bytes;
    unit logical-unit-number {
      disable;
      description text;
      family family-name {...}
```

```
        (traps | no traps);
        vlan-id vlan-id-number;
      }
    }
    lo0 {
      disable;
      description text;
      hold-time milliseconds down milliseconds;
      traceoptions;
      (traps | no traps);
      unit logical-unit-number {
        disable;
        description text;
        family {
          inet {
            address address {
              primary;
            }
            filter input filter-name;
            filter output filter-name;
            primary;
            targeted-broadcast;
          }
        (traps | no traps);
      }
    }
    mex {
      disable;
      description text;
      hold-time milliseconds down milliseconds;
      (gratuitous-arp-reply | no-gratuitous-arp-reply);
      no-gratuitous-arp-request;
      traceoptions;
      traps;
      unit logical-unit-number {
        disable;
      description text;
        family {
          ethernet-switching {
            filter input filter-name;
            filter output filter-name;
            native-vlan-id vlan-id;
            port-mode mode;
            reflective-relay;
            vlan {
              members [ (all | names | vlan-ids) ];
            }
          }
          inet {
            address address {
            primary;
            filter input filter-name;
            filter output filter-name;
            primary;
            targeted-broadcast;
            }
```



```
        }
    traps;
    vlan-id vlan-id-number;
    }
  vlan-tagging;
  vlan {
    disable;
    description  text;
    (gratuitous-arp-reply| no-gratuitous-arp-reply);
    hold-time milliseconds down milliseconds;
    mtu bytes;
    no-gratuitous-arp-request;
    traceoptions;
    (traps | no traps);
    unit logical-unit-number {
      description text;
      disable;
      family {
        inet {
          address address {
            primary;
          }
          filter input filter-name;
          filter output filter-name;
          primary;
          targeted-broadcast;
        }
      (traps | no traps);
    }
  }
  fc-0/0/port {
    fibrechannel-options {
      bb-sc-n;
      (loopback | no-loopback);
      speed (auto-negotiation | 2g | 4g | 8g);
    }
    unit logical-unit-number {
      disable;
      description text;
      family {
        fibre-channel {
          port-mode np-port;
        }
      (traps | no traps);
    }
  ge-0/0/port {
    disable;
    description text;
    ether-options {
      802.3ad aex {
        lacp {
          force-up;
          primary;
        }
      }
      (auto-negotiation | no-auto-negotiation);
```



```
        configured-flow-control {
          rx-buffers (on | off);
          tx-buffers (on | off);
        }
        (flow-control | no-flow-control);
        link-mode mode;
        loopback;
        no-loopback;
        speed (auto-negotiation | speed);
      }
      gratuitous-arp-reply| no-gratuitous-arp-reply);
      hold-time milliseconds down milliseconds;
      mtu bytes;
      no-gratuitous-arp-request;
      traceoptions;
      (traps | no traps);
      unit logical-unit-number {
        description text;
        disable;
        family {
          ethernet-switching {
            filter input filter-name;
            filter output filter-name;
            native-vlan-id vlan-id;
            port-mode mode;
            reflective-relay;
            vlan {
              members [ (all | names | vlan-ids) ];
            }
          }
          inet {
            address address {
              primary;
            }
            filter input filter-name;
            filter output filter-name;
            primary;
            targeted-broadcast;
          }
        (traps | no traps);
        vlan-id vlan-id-number;
      }
      vlan-tagging;
    }
    vrrp-group group-id {
      (accept-data | no-accept-data);
      advertise-interval seconds;
      authentication-key key;
      authentication-type authentication;
      fast-interval milliseconds;
      (preempt | no-preempt) {
        hold-time seconds;
      }
      priority number;
      track {
        interface interface-name {
```

```
            bandwidth-threshold bits-per-second priority-cost priority;
            priority-cost priority;
          }
          priority-hold-time seconds;
          route prefix/prefix-length routing-instance instance-name priority-cost priority;
          }
        }
        virtual-address [ addresses ];
      }
      xe-0/0/port {
        disable;
        description text;
        ether-options {
          802.3ad aex {
            lacp {
              force-up;
              (primary | backup);
            }
          }
          configured-flow-control {
            rx-buffers (on | off);
            tx-buffers (on | off);
          }
          (flow-control | no-flow-control);
          loopback;
          no-loopback;
        }
        (gratuitous-arp-reply| no-gratuitous-arp-reply
        hold-time milliseconds down milliseconds;
        mtu bytes;
        no-gratuitous-arp-request;
        traceoptions;
        (traps | no traps);
        unit logical-unit-number {
          disable;
          description text;
          family {
            ethernet-switching {
              filter input filter-name;
              filter output filter-name;
              native-vlan-id vlan-id;
              port-mode mode;
              reflective-relay;
              vlan {
                members [ (all | names | vlan-ids) ];
              }
            }
            fibre-channel {
              port-mode (f-port | np-port);
            }
            inet {
              address address {
                primary;
              }
              filter input filter-name;
              filter output filter-name;
```

```
                primary;
                targeted-broadcast;
            }
        (traps | no traps);
        vlan-id vlan-id-number;
        }
        vlan-tagging;
    }
}
```

[edit policy-options] Hierarchy

```
policy-options
  application-maps application-map-name {
    application application-name {
      code-points [ aliases ] [ bit-patterns ];
    }
  }
  policy-statement policy-name {
    term term-name {
      from {
        family family-name;
        match-conditions;
        policy subroutine-policy-name;
        prefix-list prefix-list-name;
        prefix-list-filter prefix-list-name match-type <actions>;
        route-filter destination-prefix match-type <actions>;
        source-address-filter source-prefix match-type <actions>;
      }
      to {
        match-conditions;
        policy subroutine-policy-name;
      }
      then actions;
    }
  }
```

[edit protocols] Hierarchy

```
protocols {
  bgp {
    disable;
    accept-remote-nexthop;
    advertise-external <conditional>;
    advertise-inactive;
    (advertise-peer-as | no-advertise-peer-as);
    authentication-algorithm (aes-128-cmac-96 | hmac-sha-1-96 | md5);
    authentication-key key;
    authentication-key-chain key-chain;
    bfd-liveness-detection {
      authentication {
        algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
          meticulous-keyed-sha-1 | simple-password);
        key-chain key-chain-name;
        loose-check;
      }
```



```
  detection-time {
    threshold milliseconds;
  }
  hold-down-interval milliseconds;
  minimum-interval milliseconds;
  minimum-receive-interval milliseconds;
  multiplier number;
  no-adaptation;
  session-mode (automatic | multihop | single-hop);
  transmit-interval {
    minimum-interval milliseconds;
    threshold milliseconds;
  }
  version (1 | automatic);
}
cluster cluster-identifier;
damping;
description text-description;
export [ policy-names ];
family family-name {
  ... the family subhierarchies appear after the main [edit protocols bgp] hierarchy ...
}
graceful-restart {
  disable;
  restart-time seconds;
  stale-routes-time seconds;
}
group group-name {
  ... the group subhierarchy appears after the main [edit protocols bgp] hierarchy ...
}
hold-time seconds;
import [ policy-names ];
include-mp-next-hop;
keep (all | none);
local-address address;
local-as autonomous-system <loops number> < alias> <private>;
local-preference local-preference;
log-updown;
metric-out (metric | igp (delay-med-update | offset) | minimum-igp offset);
mtu-discovery;
multihop {
  no-nexthop-change;
  ttl ttl-value;
}
no-aggregator-id;
no-client-reflect;
out-delay seconds;
outbound-route-filter {
  bgp-orf-cisco-mode;
  prefix-based {
    accept {
      inet;
      inet6;
    }
  }
}
```

```
      passive;
      path-selection {
        always-compare-med;
        as-path-ignore;
        cisco-non-deterministic;
        external-router-id;
        med-plus-igp {
          igp-multiplier number;
          med-multiplier number;
        }
      }
      peer-as autonomous-system;
      preference preference;
      remove-private;
      tcp-mss segment-size;
      traceoptions {
        file filename <files number> <size maximum-file-size> <world-readable |
          no-world-readable>;
        flag flag <flag-modifier> <disable>;
      }
    }
    dcbx {
      disable;
      interface (interface-name | all) {
        disable;
        application-map application-map-name;
        applications {
          no-auto-negotiation;
        }
        enhanced-transmission-selection {
          no-auto-negotiation;
          no-recommendation-tlv;
          recommendation-tlv {
            no-auto-negotiation;
          }
        }
        dcbx-version (auto-negotiate | ieee-dcbx | dcbx-version-1.01);
        priority-flow-control {
          no-auto-negotiation;
        }
      }
    }
    iccp {
      authentication-key string;
      local-ip-addr local-ip-addr;
      peer ip-address{
        authentication-key string;
        backup-liveness-detection {
          backup-peer-ip ip-address;
        }
        liveness-detection {
          detection-time {
            threshold milliseconds;
          }
          minimum-intervalmilliseconds;
          minimum-receive-interval milliseconds;
```



```
            multiplier number;
            no-adaptation;
            transmit-interval {
               minimum-interval milliseconds;
               threshold milliseconds;
            }
            version (Liveness Detection) (1 | automatic);
         }
         local-ip-addr ipv4-address;
         session-establishment-hold-time seconds;
      }
      session-establishment-hold-time seconds;
      traceoptions {
         file <filename> <files number> <match regular-expression> <microsecond-stamp>
            <size size> <world-readable | no-world-readable>;
         flag flag;
         no-remote-trace;
      }
   }
   igmp-snooping {
      traceoptions {
         file filename <files number> <size size> <world-readable | no-world-readable>
            <match regex>;
         flag flag (detail | disable | receive | send);
      }
      vlan vlan-name {
         disable;
         }
         interface interface-name {
            group-limit limit;
            multicast-router-interface;
            static {
               group ip-address;
            }
         }
         robust-count number;
      }
   }
   isis {
      disable;
      export [ policy-names ];
      ignore-attached-bit;
      interface interface-name {
         bfd-liveness-detection {
            authentication {
               algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
                  meticulous-keyed-sha-1 | simple-password);
               key-chain key-chain-name;
               loose-check;
            }
            detection-time {
               threshold milliseconds;
            }
            minimum-interval milliseconds;
            minimum-receive-interval milliseconds;
            multiplier number;
```

```
        no-adaptation;
        transmit-interval {
            minimum-interval milliseconds;
            threshold milliseconds;
        }
        version (1 | automatic);
    }
    checksum;
    csnp-interval (seconds | disable);
    disable;
    hello-padding (adaptive | loose | strict);
    level (1 | 2) {
        disable;
        hello-authentication-key key;
        hello-authentication-type authentication;
        hello-interval seconds;
        hold-time seconds;
        ipv4-multicast-metric number;
        metric metric;
        passive;
        priority number;
    }
    lsp-interval milliseconds;
    mesh-group (value | blocked);
    no-ipv4-multicast;
    no-unicast-topology;
    passive;
    point-to-point;
}
level (1 | 2) {
    disable;
    authentication-key key;
    authentication-type authentication;
    external-preference preference;
    no-csnp-authentication;
    no-hello-authentication;
    no-psnp-authentication;
    preference preference;
    prefix-export-limit number;
    wide-metrics-only;
}
loose-authentication-check;
lsp-lifetime seconds;
max-areas number;
no-adjacency-holddown;
no-authentication-check;
no-ipv4-routing;
overload {
    advertise-high-metrics;
    timeout seconds;
}
reference-bandwidth reference-bandwidth;
rib-group {
    inet group-name;
}
topologies {
```



```
      ipv4-multicast;
    }
    traceoptions {
      file filename <files number> <size maximum-file-size> <world-readable |
        no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
    traffic-engineering {
      disable;
      family inet {
        shortcuts {
          multicast-rpf-routes:
        }
      }
    }
  }
  lldp {
    disable;
    advertisement-interval seconds;
    hold-multiplier number;
    interface (LLDP) (all | interface-name) {
      disable;
    }
    traceoptions {
      file filename <files number> <size size> <world-readable | no-world-readable>
        <match regex>;
      flag flag (detail | disable | receive | send);
    }
  }
  mstp {
    disable;
    bpdu-timeout-action;
    bridge-priority priority;
    configuration-name (MSTP) name;
    forward-delay seconds;
    hello-time seconds;
    interface (all | interface-name) {
      disable;
      bpdu-timeout-action {
        block;
        alarm;
      }
      cost  cost;
      edge;
      mode mode;
      no-root-port;
      priority priority;
    }
    max-age seconds;
    max-hops hops;
    msti msti-id {
      vlan (vlan-id | vlan-name);
      interface interface-name {
        disable;
        cost  cost;
        edge;
```

```
        mode mode;
        priority priority;
      }
    }
    revision-level revision-level;
    traceoptions {
      file filename <files number > <size size> <no-stamp | world-readable |
        no-world-readable>;
      flag flag;
    }
  }
  ospf {
    disable;
    area area-id {
      area-range ip-prefix</prefix-length> <exact> <override-metric metric> <restrict>;
      context-identifier identifier
      interface interface-name {
        disable;
        authentication {
          md5 key-id key key-string <start-time YYYY-MM-DD.hh:mm>;
          simple-password key-string;
        }
        bandwidth-based-metrics {
          bandwidth value metric number;
        }
        bfd-liveness-detection {
          authentication {
            algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
              meticulous-keyed-sha-1 | simple-password);
            key-chain key-chain-name;
            loose-check;
          }
          detection-time {
            threshold milliseconds;
          }
          full-neighbors-only;
          minimum-interval milliseconds;
          minimum-receive-interval milliseconds;
          multiplier number;
          no-adaptation;
          transmit-interval {
            minimum-interval milliseconds;
            threshold milliseconds;
          }
          version (1 | automatic);
        }
        dead-interval seconds;
        dynamic-neighbors;
        flood-reduction;
        hello-interval seconds;
        interface-type (nbma | p2mp | p2p);
        metric metric;
        neighbor address <eligible>;
        no-eligible-backup;
        no-interface-state-traps;
        no-neighbor-down-notification;
```

```
        passive {
          traffic-engineering {
            remote-node-id address;
          }
        }
        poll-interval seconds;
        priority number;
        retransmit-interval seconds;
        secondary;
        te-metric metric;
        topology (name | default | ipv4-multicast) {
          disable;
          bandwidth-based-metrics {
            bandwidth value;
            metric number;
          }
          metric metric;
        }
        transit-delay seconds;
      }
      network-summary-export [ policy-names ];
      network-summary-import [ policy-names ];
      nssa {
        area-range ip-prefix</prefix-length> <exact> <override-metric metric> <restrict>;
        default-lsa {
          default-metric metric;
          metric-type type;
          type-7;
        }
        (summaries | no-summaries);
      }
      stub <default-metric metric> <summaries | no-summaries>;
      virtual-link neighbor-id router-id transit-area area-id {
        disable;
        authentication {
          md5 key-id key key-string <start-time YYYY-MM-DD.hh:mm>;
          simple-password key-string;
        }
        dead-interval seconds;
        demand-circuit;
        flood-reduction;
        hello-interval seconds;
        ipsec-sa sa-name;
        no-neighbor-down-notification;
        retransmit-interval seconds;
        topology (name | default | ipv4-multicast) {
          disable;
          metric metric;
        }
        transit-delay seconds;
      }
    }
    database-protection {
      ignore-count number;
      ignore-time seconds;
      maximum-lsa number;
```

```
        reset-time seconds;
        warning-only;
        warning-threshold percent;
      }
      export [ policy-names ];
      external-preference preference;
      graceful-restart {
        disable;
        helper-disable <both | restart-signaling | standard>;
        no-strict-lsa-checking;
        notify-duration seconds;
        restart-duration seconds;
      }
      import [ policy-names ];
      no-nssa-abr;
      no-rfc-1583;
      overload <timeout seconds>;
      preference preference;
      prefix-export-limit number;
      reference-bandwidth reference-bandwidth;
      rib-group group-name;
      topology (default | ipv4-multicast | name) {
        overload;
        prefix-export-limit number;
        topology-id number;
      }
      traceoptions {
        file filename <files number> <size maximum-file-size> <world-readable |
          no-world-readable>;
        flag flag <flag-modifier> <disable>;
      }
      traffic-engineering {
        advertise-unnumbered-interfaces;
        credibiliity-protocol-preference;
        ignore-lsp-metrics;
        multicast-rpf-routes;
        no-topology;
        shortcuts <lsp-metric-into-summary>;
      }
    }
    pim {
      disable;
      assert-timeout seconds;
      dense-groups {
        addresses;
      }
      dr-election-on-p2p;
      export;
      family (inet | inet6) {
        disable;
      }
      graceful-restart {
        disable;
        restart-duration seconds;
      }
      import [ policy-names ];
```



```
interface interface-name {
  accept-remote-source;
  disable;
  family (inet | inet6) {
    disable;
  }
  hello-interval seconds;
  mode (dense | sparse | sparse-dense);
  neighbor-policy [ policy-names ];
  override-interval milliseconds;
  priority number;
  propagation-delay milliseconds;
  reset-tracking-bit;
  version version;
}
join-load-balance;
join-prune-timeout;
nonstop-routing;
override-interval milliseconds;
propagation-delay milliseconds;
reset-tracking-bit;
rib-group group-name;
rp {
  auto-rp {
    (announce | discovery | mapping);
    (mapping-agent-election | no-mapping-agent-election);
  }
  bootstrap {
    family (inet | inet6) {
      export [ policy-names ];
      import [ policy-names ];
      priority number;
    }
  }
  bootstrap-import [ policy-names ];
  bootstrap-export [ policy-names ];
  bootstrap-priority number;
  dr-register-policy [ policy-names ];
  embedded-rp {
    group-ranges {
      destination-ip-prefix</prefix-length>;
    }
    maximum-rps limit;
  }
  local {
    family (inet | inet6) {
      address address;
      anycast-pim {
        disable;
          rp-set {
          address address <forward-msdp-sa>;
        }
        local-address address;
      }
      group-ranges {
        destination-ip-prefix</prefix-length>;
```

```
                }
                hold-time seconds;
                priority number;
            }
        }
        rp-register-policy [ policy-names ];
        spt-threshold {
            infinity [ policy-names ];
        }
        static {
            address address {
                group-ranges {
                version version;
                destination-ip-prefix</prefix-length>;
                }
            }
        }
    }
    rpf-selection {
        group group-address{
            source source-address{
                next-hop next-hop-address;
            }
            wildcard-source {
                next-hop next-hop-address;
            }
        }
        prefix-list prefix-list-addresses {
            source source-address {
                next-hop next-hop-address;
            }
            wildcard-source {
                next-hop next-hop-address;
            }
        }
    traceoptions {
        file filename <files number> <size size> <world-readable | no-world-readable>;
        flag flag <flag-modifier> <disable>;
    }
    tunnel-devices [ mt-fpc/pic/port ];
}
rip {
    authentication-key password;
    authentication-type type;
    (check-zero | no-check-zero);
    group group-name {
        bfd-liveness-detection {
            authentication {
                algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
                    meticulous-keyed-sha-1 | simple-password);
                key-chain key-chain-name;
                loose-check;
            }
            detection-time {
                threshold milliseconds;
            }
```



```
            minimum-interval milliseconds;
            minimum-receive-interval milliseconds;
            multiplier number;
            no-adaptation;
            transmit-interval {
               minimum-interval milliseconds;
               threshold milliseconds;
            }
            version (1 | automatic);
         }
         export [ policy-names ];
         import [ policy-names ];
         metric-out metric;
            neighbor neighbor-name {
               any-sender;
               authentication-key password;
               authentication-type type;
               bfd-liveness-detection {
                  ... same statements as at the [edit protocols rip group group-name
                     bfd-liveness-detection] hierarchy level ...
               }
               (check-zero | no-check-zero);
               import [ policy-names ];
               message-size number;
               metric-in metric;
               receive (both | none | version-1 | version-2);
               route-timeout seconds;
               send (broadcast | multicast | none | version-1);
               update-interval seconds;
            }
         preference preference;
         route-timeout seconds;
         update-interval seconds;
      }
      holddown seconds;
      import [ policy-names ];
      message-size number;
      metric-in metric;
      receive (both | none | version-1 | version-2);
      rib-group group-name;
      route-timeout seconds;
      send (broadcast | multicast | none | version-1);
      traceoptions {
         file filename <files number> <size maximum-file-size> <world-readable |
            no-world-readable>;
         flag flag <flag-modifier> <disable>;
      }
      update-interval seconds;
   }
   rstp {
      disable;
      bpdu-block-on-edge;
      bridge-priority priority;
      forward-delay seconds;
      hello-time seconds;
      interface (all | interface-name) {
```

```
        disable;
        bpdu-timeout-action {
          alarm;
          block;
        }
        cost  cost;
        edge;
        mode mode;
        no-root-port;
        priority priority;
      }
      max-age seconds;
    }
    traceoptions {
      file filename <files number > <size size> <no-stamp> <world-readable |
        no-world-readable>;
      flag flag;
    }
  }
  stp {
    disable;
    bridge-priority priority;
    forward-delay seconds;
    hello-time seconds;
    interface (all | interface-name) {
      disable;
      bpdu-timeout-action {
        alarm;
        block;
      }
      cost  cost;
      edge;
      mode mode;
      no-root-port;
      priority priority;
    }
    max-age seconds;
  }
    traceoptions {
      file filename <files number > <size size> <no-stamp | world-readable |
        no-world-readable>;
      flag flag;
    }
  uplink-failure-detection {
    group group-name {
      link-to-monitor interface-name;
      link-to-disable interface-name;
    }
  }
  vstp {
    bpdu-block-on-edge;
    disable (Spanning Trees);
    force-version (Spanning Trees) stp;
    vlan (Spanning Trees) vlan-id {
      bridge-priority (Spanning Trees) priority;
      forward-delay (Spanning Trees) seconds;
```



```
          hello-time (Spanning Trees) seconds;
          interface (Spanning Trees) (all | interface-name) {
            bpdu-timeout-action (Spanning Trees) {
              block (Spanning Trees);
              log (Spanning Trees);
            }
            cost (Spanning Trees)  cost;
            disable (Spanning Trees);
            edge (Spanning Trees);
            mode (Spanning Trees) mode;
            no-root-port (Spanning Trees);
            priority (Spanning Trees) priority;
          }
          max-age (Spanning Trees) seconds;
          traceoptions (Spanning Trees) {
            file filename <files number > <size size> <no-stamp | world-readable |
              no-world-readable>;
            flag flag;
          }
        }
      }
    }
```

[edit security] Hierarchy

```
security {
  certificates
  pki
  ssh-known-hosts
  traceoptions
}
```

[edit snmp] Hierarchy

```
snmp {
  client-list client-list-name {
    ip-addresses;
  }
  community community-name {
    authorization authorization;
    client-list-name client-list-name;
    clients {
      address restrict;
    }
    logical-system logical-system-name {
      routing-instance routing-instance-name {
        clients {
        addresses;
        }
      }
    }
    routing-instance routing-instance-name {
      clients {
      addresses;
      }
    }
```

```
    view view-name;
}
contact contact;
description description;
filter-duplicates;
filter-interfaces;
health-monitor {
    falling-threshold integer;
    interval seconds;
    rising-threshold integer;
}
interface [ interface-names ];
location location;
name name;
nonvolatile {
    commit-delay seconds;
}
rmon {
    alarm index {
        description description;
        falling-event-index index;
        falling-threshold integer;
        falling-threshold-interval seconds;
        interval seconds;
        request-type;
        rising-event-index index;
        rising-threshold integer;
        sample-type (absolute-value | delta-value);
        startup-alarm (falling-alarm | rising-alarm | rising-or-falling alarm);
        syslog-subtag syslog-subtag;
        variable oid-variable;
    }
    event index {
        community community-name;
        description description;
        type type;
    }
    history history-index {
        bucket-size number;
        interface interface-name;
        interval seconds;
        owner owner-name;
    }
}
traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable> <match
        regular-expression>;
    flag flag;
}
trap-group group-name {
    categories {
        category;
    }
    destination-port port-number;
    routing-instance routing-instance-name;
    targets {
```



```
        address;
      }
      version (all | v1 | v2);
    }
    trap-options {
      agent-address outgoing-interface;
      source-address address;
    }
    v3 {
      notify name {
        tag tag-name;
        type trap;
      }
      notify-filter profile-name {
        oid object-identifier (include | exclude);
      }
      snmp-community community-index {
        community-name community-name;
        security-name security-name;
        tag tag-name;
      }
      target-address target-address-name {
        address address;
        address-mask address-mask;
        logical-system logical-system;
        port port-number;
        retry-count number;
        routing-instance routing-instance-name;
        tag-list tag-list;
        target-parameters target-parameters-name;
        timeout seconds;
      }
      target-parameters target-parameters-name {
        notify-filter profile-name;
        parameters {
          message-processing-model (v1 | v2c | V3);
          security-level (authentication | none | privacy);
          security-model (usm | v1 | v2c);
          security-name security-name;
        }
      }
      usm {
        local-engine {
          user username {
            authentication-sha {
              authentication-password authentication-password;
            }
            authentication-md5 {
              authentication-password authentication-password;
            }
            authentication-none;
            privacy-aes128 {
              privacy-password privacy-password;
            }
            privacy-des {
              privacy-password privacy-password;
```

```
                }
                privacy-3des {
                    privacy-password privacy-password;
                }
                privacy-none;
            }
        }
        remote-engine engine-id {
            user username {
                authentication-sha {
                    authentication-password authentication-password;
                }
                authentication-md5 {
                    authentication-password authentication-password;
                }
                authentication-none;
                privacy-aes128 {
                    privacy-password privacy-password;
                }
                privacy-des {
                    privacy-password privacy-password;
                }
                privacy-3des {
                    privacy-password privacy-password;
                }
                privacy-none {
                    privacy-password privacy-password;
                }
            }
        }
    }
    vacm {
        access {
            group group-name {
                (default-context-prefix | context-prefix context-prefix) {
                    security-model (any | usm | v1 | v2c) {
                        security-level (authentication | none | privacy) {
                            notify-view view-name;
                            read-view view-name;
                            write-view view-name;
                        }
                    }
                }
            }
        }
        security-to-group {
            security-model (usm | v1 | v2c) {
                security-name security-name {
                    group group-name;
                }
            }
        }
    }
}
view view-name {
    oid object-identifier (include | exclude);
```



```
  }
}
```

[edit system] Hierarchy

```
system {
  accounting {
    events [ login change-log interactive-commands ];
    destination {
      radius {
        server {
          server-address {
            accounting-port port-number;
            retry number;
            secret password;
            source-address address;
            timeout seconds;
          }
        }
      }
      tacplus {
        server {
          server-address {
            port port-number;
            secret password;
            single-connection;
            timeout seconds;
          }
        }
      }
    }
  }
  archival {
    configuration {
      archive-sites {
        ftp://<username>:<password>@<host>:<port>/<url-path>;
        ftp://<username>:<password>@<host>:<port>/<url-path>;
      }
      transfer-interval interval;
      transfer-on-commit;
    }
  }
  arp {
    aging-timer minutes;
    interfaces;
  }
  authentication-order [ authentication-methods ];
  (compress-configuration-files | no-compress-configuration-files);
  default-address-selection;
  domain-name domain-name;
  domain-search [ domain-list ];
  host-name hostname;
  internet-options {
    icmpv4-rate-limitbucket-size bucket-size packet-rate packet-rate;
    source-port upper-limit <upper-limit>;
  }
```



```
location {
  altitude feet;
  building name;
  country-code code;
  floor number;
  hcoord horizontal-coordinate;
  lata service-area;
  latitude degrees;
  longitude degrees;
  npa-nxx number;
  postal-code postal-code;
  rack number;
  vcoord vertical-coordinate;
}
login {
  announcementtext;
  class class-name {
    access-end;
    access-start;
    allow-configuration "regular-expression";
    allowed-days "regular-expression";
    deny-commands "regular-expression";
    deny-configuration "regular-expression";
    idle-timeout minutes;
    login-tip;
    permissions [ permissions ];
  }
  message text;
  password {
    change-type (set-transitions | character-set);
    format (md5 | sha1 | des);
    maximum-length length;
    minimum-changes number;
    minimum-length length;
  }
  retry-options {
    backoff-factor seconds;
    backoff-threshold number;
    minimum-time seconds;
    tries-before-disconnect number;
  }
  user username {
    authentication {
      (encrypted-password "password" | plain-text-password);
      load-key-file URL;
      remote-debug-permission (qfabric-admin | qfabric-operator |qfabric-user);
      ssh-rsa "public-key";
      ssh-dsa "public-key";
    }
    uid uid-value;
    class class-name;
    full-name complete-name;
  }
}
name-server {
  address;
```



```
}
no-multicast-echo;
no-redirects;
no-ping-record-route;
no-ping-time-stamp;
ntp {
  authentication-key number type type value password;
  serveraddress <key key-number> <version value> <prefer>;
}
ports {
  auxiliary {
    disable;
    insecure;
    type terminal-type;
  }
  console {
    disable;
    insecure;
    log-out-on-disconnect;
    type terminal-type;
  }
}
radius-server server-address {
  accounting-port port-number;
  port number;
  retry number;
  secret password;
  source-address source-address;
  timeout seconds;
  }
}
radius-options {
  password-protocol mschap-v2;
  }
  attributes {
    nas-ip-address ip-address;
root-authentication {
  (encrypted-password "password" | plain-text-password);
  ssh-rsa "public-key";
  ssh-dsa "public-key";
}
(saved-core-context | no-saved-core-context);
saved-core-files saved-core-files;
services {
  finger {
    connection-limit limit;
    rate-limit limit;
  }
  flow-tap-dtcp {
    ssh {
      connection-limit limit;
      rate-limit limit;
    }
  }
  ftp {
    connection-limit limit;
```

```
            rate-limit limit;
        }
        service-deployment {
            servers server-address {
                port port-number;
            }
            source-address source-address;
        }
        ssh {
            root-login (allow | deny | deny-password);
            protocol-version [v1 v2];
            connection-limit limit;
            rate-limit limit;
        }
        telnet {
            connection-limit limit;
            rate-limit limit;
        }
        web-management {
            http {
                interfaces [ interface-names ];
                port port;
            }
            https {
                interfaces [ interface-names ];
                local-certificate name;
                port port;
            }
            session {
                idle-timeout [ minutes ];
                session-limit [ session-limit ];
            }
        }
        xnm-clear-text {
            connection-limit limit;
            rate-limit limit;
        }
        xnm-ssl {
            connection-limit limit;
            local-certificate name;
            rate-limit limit;
        }
    }
    static-host-mapping {
        hostname {
            alias [ alias ];
            inet [ address ];
            sysid system-identifier;
        }
    }
    syslog {
        archive {
            files number;
            size maximum-file-size;
            start-time "YYYY-MM-DD.hh:mm";
            transfer-interval minutes;
```



```
        (world-readable | no-world-readable);
      }
      console {
        facility severity;
      }
      file filename {
        archive {
          files number;
          size maximum-file-size;
          start-time "YYYY-MM-DD.hh:mm";
          transfer-interval minutes;
          (world-readable | no-world-readable);
        }
        explicit-priority;
        facility severity;
        match "regular-expression";
        structured-data {
          brief;
        }
      }
      host (hostname | other-routing-engine | scc-master) {
        explicit-priority;
        facility-override facility;
        facility severity;
        log-prefix string;
        match "regular-expression";
      }
      source-address source-address;
      time-format (millisecond | year | year millisecond);
      user (username | *) {
        facility severity;
        match "regular-expression";
      }
    }
    tacplus-options {
      service-name service-name;
      (no-cmd-attribute-value | exclude-cmd-attribute);
    }
    tacplus-server server-address {
      port
      secret password;
      single-connection;
      source-address source-address;
      timeout seconds;
    }
    time-zone (GMThour-offset | time-zone);
    }
    tracing {
      destination-override {
      syslog host;
      }
    }
    use-imported-time-zones;
  }
```


[edit vlans] Hierarchy

```
vlans {
  vlan-name {
    description text-description;
    dot1q-tunneling {
      customer-vlans (id | range);
    }
    filter input filter-name;
    filter output filter-name;
    interface interface-name {
      isolated;
      mapping (policy | tag push | native push);
      promiscuous;
    }
    isolation-vlan-id;
    l3-interface vlan.logical-interface-number;
    mac-limit number;
    mac-table-aging-time seconds;
    no-local-switching;
    no-mac-learning;
    primary-vlan vlan-name;
    pvlan extend-secondary-vlan-id vlan-id;
    vlan-id number;
    vlan-range vlan-id-low-vlan-id-high;
  }
}
```

access-end

Syntax access-end *HH:MM*;

Hierarchy Level [edit system login class]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the end time for login access.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring Time-Based User Access on page 149

access-start

Syntax access-start *HH*:*MM*;

Hierarchy Level [edit system login class]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the start time for login access.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring Time-Based User Access on page 149

accounting

Syntax

```
accounting {
  destination {
    radius {
      server {
        server-address {
          accounting-port port-number;
          secret password;
          source-address address;
          retry number;
          timeout seconds;
        }
      }
    }
    tacplus {
      server {
        server-address {
          port port-number;
          secret password;
          single-connection;
          timeout seconds;
        }
      }
    }
  }
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure audit of TACACS+ or RADIUS authentication events, configuration changes, and interactive commands.

Options The remaining statements are explained separately.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring RADIUS Accounting*
- Configuring TACACS+ System Accounting on page 1248

accounting-port

Syntax accounting-port *port-number*;

Hierarchy Level [edit system accounting destination radius server *server-address*],
[edit system radius server *server-address*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the accounting port number on which to contact the RADIUS server.

Options *number*—Port number on which to contact the RADIUS server.

Default: 1813

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring RADIUS Accounting*

allow-commands

Syntax allow-commands "*regular-expression*";

Hierarchy Level [edit system login class *class-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the operational mode commands that members of a login class can use.

Default If you omit this statement and the **deny-commands** statement, users can issue only those commands for which they have access privileges through the **permissions** statement.

Options *regular-expression*—Extended (modern) regular expression as defined in POSIX 1003.2. If the regular expression contains any spaces, operators, or wildcard characters, enclose it in quotation marks.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Specifying Access Privileges for Junos OS Operational Mode Commands on page 168
- **deny-commands on page 242**
- **user on page 306**

allow-configuration

Syntax allow-configuration "*regular-expression*";

Hierarchy Level [edit system login class *class-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Explicitly allow configuration access to the specified levels in the hierarchy even if the permissions set with the **permissions** statement do not grant such access by default.

Default If you omit this statement and the **deny-configuration** statement, users can edit only those commands for which they have access privileges through the **permissions** statement.

Options *regular-expression*—Extended (modern) regular expression as defined in POSIX 1003.2. If the regular expression contains any spaces, operators, or wildcard characters, enclose it in quotation marks.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Specifying Access Privileges for Junos OS Configuration Mode Hierarchies on page 1253
- Regular Expressions for Allowing and Denying Junos OS Configuration Mode Hierarchies on page 1219
- deny-configuration on page 243
- user on page 306

allowed-days

Syntax allowed-days [*days-of-the-week*];

Hierarchy Level [edit system login class *class-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the days of the week when users can log in.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring Time-Based User Access on page 149

allow-transients

Syntax allow-transients;

Hierarchy Level [edit systems scripts commit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, enable transient configuration changes to be committed.

Default Transient changes are disabled by default. If you do not include the **allow-transients** statement, and an enabled script generates transient changes, the command-line interface (CLI) generates an error message and the commit operation fails.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Generating a Persistent or Transient Change*
- *Creating a Macro to Read the Custom Syntax and Generate Related Configuration Statements*

announcement

Syntax announcement *text*;

Hierarchy Level [edit system login]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a system login announcement. This announcement appears after a user logs in.

Options ***text***—Text of the announcement. If the text contains any spaces, enclose it in quotation marks.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration

Related Documentation

- *Configuring the Junos OS to Display a System Login Announcement*
- Configuring the Junos OS to Display a System Login Message on page 140
- **message on page 257**

archival

Syntax

```
archival {
  configuration {
    archive-sites {
      file://<path>/<filename>;
      ftp://username@host:<port>url-path password password;
      http://username@host:<port>url-path password password;
      pasvftp://username@host:<port>url-path password password;
      scp://username@host:<port>url-path password password;
    }
    transfer-interval interval;
    transfer-on-commit;
  }
}
```

Hierarchy Level [edit system]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure copying of the currently active configuration to an archive site. An archive site can be a file, or an FTP or SCP location.

NOTE: **The edit system archival hierarchy is not available on QFabric systems.**

Options The remaining statements are explained separately.

NOTE: **The [edit system archival] hierarchy is not available on QFabric systems.**

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Using Junos OS to Configure a Router or Switch to Transfer Its Configuration to an Archive Site on page 1147

arp (System)

Syntax

```
arp {
  aging-timer minutes;
  gratuitous-arp-delayseconds;
  gratuitous-arp-on-ifup;
  interfaces {
    interface-name {
      aging-timer minutes;
    }
  }
  passive-learning;
  purging;
}
```

For EX-Series switches:

```
arp {
  aging-timer minutes;
}
```

Hierarchy Level [edit system]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify ARP options. You can enable backup VRRP routers to learn ARP requests for VRRP-IP to VRRP-MAC address translation. You can also set the time interval between ARP updates.

For EX-Series switches, set only the time interval between ARP updates.

Options **aging-timer**—Time interval in minutes between ARP updates. In environments where the number of ARP entries to update is high (for example, on routers only, metro Ethernet environments), increasing the time between updates can improve system performance.

passive-learning (QFX-Series only)—Configure switches to learn the ARP mappings (IP-to-MAC address) for hosts sending the requests.

Default: 20 minutes

Range: 1 to 240 minutes

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Junos OS ARP Learning and Aging Options for Mapping IPv4 Network Addresses to MAC Addresses*
- *Junos OS Network Interfaces Library for Routing Devices*

- For more information about ARP updates, see the *Junos OS System Basics Configuration Guide* .

authentication (Login)

Syntax

```
authentication {
  encrypted-password password;
  load-key-file URL;
  plain-text-password password;
  remote-debug-permission (qfabric-admin | qfabric-operator |qfabric-user);
  ssh-dsa "public-key";
  ssh-rsa "public-key";
}
```

Hierarchy Level [edit system login user *username*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Authentication methods that a user can use to log in to the switch. You can assign multiple authentication methods to a single user.

Options

encrypted-password "*password*"—Message Digest 5 (MD5) or other encrypted authentication. Specify the MD5 or other password. You can specify only one encrypted password for each user.

You cannot configure a blank password for **encrypted-password** using blank quotation marks (" "). You must configure a password of 1 through 128 characters and enclose the password in quotation marks.

load-key-file—Load RSA (SSH version 1 and SSH version 2) and DSA (SSH version 2) public keys from a file. The file is a URL containing one or more SSH keys.

plain-text-password—Plain-text password. The command-line interface (CLI) prompts you for the password and then encrypts it.

remote-debug-permission (QFabric systems only)—QFabric component authentication. Specifies permission levels for users to access individual components in a QFabric system.

ssh-dsa "*public-key*"—SSH version 2 authentication. Specify the SSH public key. You can specify one or more public keys for each user.

ssh-rsa "*public-key*"—SSH version 1 and SSH version 2 authentication. Specify the SSH public key. You can specify one or more public keys for each user.

Required Privilege Level

admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring Junos OS User Accounts on page 1226
- root-authentication on page 277

authentication-key

Syntax authentication-key *key-number* type *type* value *password*;

Hierarchy Level [edit system ntp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Network Time Protocol (NTP) authentication keys so that the router or switch can send authenticated packets. If you configure the router or switch to operate in authenticated mode, you must configure a key.

Both the keys and the authentication scheme (MD5) must be identical between a set of peers sharing the same key number.

Options ***key-number***—An integer in the range of 1 to 65533.

type *type*—Authentication type. It can only be **md5**.

value *password*—Key itself, consisting of 1 through 8 ASCII characters. If the key contains spaces, enclose it in quotation marks.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring NTP Authentication Keys (QFabric System)*
- *NTP Time Server and Time Services Overview (QFabric System)*

authentication-order

Syntax authentication-order [*authentication-methods*];

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the order in which the software tries different user authentication methods when attempting to authenticate a user. For each login attempt, the software tries the authentication methods in order, starting with the first one, until the password matches.

Default If you do not include the **authentication-order** statement, users are verified based on their configured passwords.

Options *authentication-methods*—One or more authentication methods, listed in the order in which they should be tried. The method can be one or more of the following:

- **password**—Use the password configured for the user with the **authentication** statement at the **[edit system login user]** hierarchy level.
- **radius**—Use RADIUS authentication services.
- **tacplus**—Use TACACS+ authentication services.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Junos OS Authentication Order for RADIUS, TACACS+, and Local Password Authentication on page 1228
- authentication on page 228

auxiliary

Syntax

```
auxiliary {
  disable;
  insecure;
  type terminal-type;
}
```

Hierarchy Level [edit system ports]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the characteristics of the auxiliary port.

Default The auxiliary port is disabled.

Options **disable**—Disable the port.

insecure—Disable superuser access or root logins to establish a terminal connection.

type *terminal-type*—Type of terminal that is connected to the port.

Range: **ansi**, **vt100**, **small-xterm**, **xterm**

Default: The terminal type is unknown, and the user is prompted for the terminal type.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring Console and Auxiliary Port Properties on page 6101

boot-server (NTP)

Syntax boot-server (*address* | *hostname*);

Hierarchy Level [edit system ntp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the server that NTP queries when the router or switch boots to determine the local date and time.

When you boot the router or switch, it issues an **ntpdate** request, which polls a network server to determine the local date and time. You need to configure a server that the router or switch uses to determine the time when the router or switch boots. Otherwise, NTP cannot synchronize to a time server if the server time significantly differs from the local router's or switch's time. You can configure either an IP address or a hostname for the boot server. If you configure a hostname instead of an IP address, the **ntpdate** request resolves the hostname to an IP address when the router or switch boots up.

Options

- ***address***—IP address of an NTP boot server.
- ***hostname***—Hostname of an NTP boot server.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Synchronizing and Coordinating Time Distribution Using NTP on page 170

broadcast

Syntax broadcast *address* <key *key-number*> <version *value*> <ttl *value*>;

Hierarchy Level [edit system ntp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the local router or switch to operate in broadcast mode with the remote system at the specified address to send periodic broadcast messages to a client population. Normally, you include this statement only when the local router or switch is operating as a transmitter.

Options *address*—Broadcast address on one of the local networks or a multicast address assigned to NTP. You must specify an address, not a hostname. If the multicast address is used, it must be **224.0.1.1**.

key ***key-number***—(Optional) All packets sent to the address include authentication fields that are encrypted using the specified key number (any unsigned 32-bit integer).

ttl ***value***—(Optional) Time-to-live (TTL) value to use.

Range: 1 through 255

Default: 1

version ***value***—(Optional) Specify the version number to be used in outgoing NTP packets.

Range: 1 through 4

Default: 4

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the NTP Time Server and Time Services on page 143

broadcast-client

Syntax broadcast-client;

Hierarchy Level [edit system ntp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the local router or switch to listen for broadcast messages on the local network to discover other servers on the same subnet.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Router or Switch to Listen for Broadcast Messages Using NTP on page 148

change-type

Syntax change-type (character-sets | set-transitions);

Hierarchy Level [edit system login password]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set requirements for using character sets in plain-text passwords. When you combine this statement with the **minimum-changes** statement, you can check for the total number of character sets included in the password or for the total number of character-set changes in the password. Newly created passwords must meet these requirements.

Options Specify one of the following:

- **character-sets**—Number of character sets in the password. Valid character sets include uppercase letters, lowercase letters, numbers, punctuation, and other special characters.
- **set-transitions**—Number of transitions between character sets.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221
- **minimum-changes on page 257**

checksum

Syntax checksum (md5 | sha-256 | sha1) *hash*;

Hierarchy Level [edit event-options event-script file*filename*],
[edit system scripts commit file *filename*],

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos commit scripts and op scripts, specify the MD5, SHA-1, or SHA-256 checksum hash. When it executes a local event or commit script, the Junos OS verifies the authenticity of the script by using the configured checksum hash.

Options **md5** ***hash***—MD5 checksum of this script.

sha-256 ***hash***—SHA-256 checksum of this script.

sha1 ***hash***—SHA-1 checksum of this script.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Configuring Checksum Hashes for a Commit Script*
- *Configuring Checksum Hashes for an Event Script*
- *Configuring Checksum Hashes for an Op Script*
- file checksum md5 on page 336
- file checksum sha-256 on page 338
- file checksum sha1 on page 337

class (Defining Login Classes)

Syntax

```
class class-name {
  access-end;
  access-start;
  allow-commands "regular-expression";
  allow-configuration "regular-expression";
  deny-commands "regular-expression";
  deny-configuration "regular-expression";
  idle-timeout minutes;
  login-tip;
  permissions [ permissions ];
}
```

Hierarchy Level [edit system login]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define a login class.

Options *class-name*—A name you choose for the login class.

The remaining statements are explained separately.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Defining Junos OS Login Classes on page 1250
- user on page 306

class (Assigning a Class to an Individual User)

Syntax

```
class class-name {
   operator;
   read-only;
   super-user;
   unauthorized;
}
```

Hierarchy Level [edit system login user *username*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a user's login class. You must configure one class for each user.

Options *class-name*—One of the classes defined at the **[edit system login class]** hierarchy level.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring Junos OS User Accounts on page 1226

commit

Syntax

```
commit {
  allow-transients;
  direct-access;
  file filename {
    checksum (md5 | sha-256 | sha1) hash;
    optional;
    refresh;
    refresh-from url;
    sourceurl;
  }
  refresh;
  refresh-from url;
  traceoptions {
    file <filename> <files number> <size size> <world-readable | no-world-readable>;
    flag flag;
    no-remote-trace;
  }
}
```

Hierarchy Level [edit system scripts]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, configure the commit-time scripting mechanism.

Options The statements are explained separately.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

compress-configuration-files (System)

Syntax (compress-configuration-files | no-compress-configuration-files);

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Compress the current operational configuration file. The file is stored in the file **juniper.conf**, in the **/config** file system, along with the last three committed versions of the configuration. However, with large networks, the current configuration file might exceed the available space in the **/config** file system. Compressing the current configuration file allows the file to fit in the file system, typically reducing the size of the file by 90 percent. The current configuration file is compressed on the second commit of the configuration after the first commit is made to include the **compress-configuration-files** statement.

NOTE: We recommend that you enable compression of the configuration files to minimize the amount of disk space that they require.

Default The current operational configuration file is uncompressed.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Compressing the Current Configuration File on page 1131

console (Physical Port)

Syntax

```
console {
  disable;
  insecure;
  log-out-on-disconnect;
  type terminal-type;
}
```

Hierarchy Level [edit system ports]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the characteristics of the console port.

Default The console port is enabled and its speed is 9600 baud.

Options

disable—Disable console login connections.

insecure—Disable root login connections to the console and auxiliary ports. Configuring the console port as insecure also prevents superusers and anyone with a user identifier (UID) of 0 from establishing terminal connections in multiuser mode. This option can be used to prevent a user from attempting password recovery by booting into single-user mode, if the user does not know the root password.

log-out-on-disconnect—Log out the session when the data carrier on the console port is lost.

type *terminal-type*—Type of terminal that is connected to the port: **ansi**, **vt100**, **small-xterm**, or **xterm**.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring Console and Auxiliary Port Properties on page 6101

default-address-selection

Syntax default-address-selection;

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Use the loopback interface, **lo0**, as the source address for all locally generated IP packets when the packet is sent through a routed interface, but not when the packet is sent through a local interface such as **fxp0**. The **lo0** interface is the interface to the switch's Routing Engine.

Default The default address is used as the source address for all locally generated IP packets on outgoing interfaces that are unnumbered. If an outgoing interface is numbered, the default address is chosen using the following sequence:

- The primary address on the loopback interface **lo0** that is *not* **127.0.0.1** is used.
- The primary address for the primary interface or the preferred address (if configured) for the primary interface is used.

  By default, the primary address on an interface is selected as the numerically lowest local address configured on the interface.

  An interface's *primary address* is used by default as the local address for broadcast and multicast packets sourced locally and sent out through the interface. An interface's *preferred address* is the default local address used for packets sourced by the local switch to destinations on the subnet. By default, the numerically lowest local address configured for the interface is chosen as the preferred address on the subnet.

  To configure a different primary address or preferred address, include the **primary** or **preferred** statement at the **[edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address*]** or **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* address *address*]** hierarchy levels.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Junos OS to Select a Fixed Source Address for Locally Generated TCP/IP Packets on page 141
- *Junos OS Network Interfaces Library for Routing Devices*

deny-commands

Syntax deny-commands "*regular-expression*";

Hierarchy Level [edit system login class]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the operational mode commands that the user is denied permission to issue even though the permissions set with the **permissions** statement would allow their use.

Default If you omit this statement and the **allow-commands** statement, users can issue only those commands for which they have access privileges through the **permissions** statement.

Options *regular-expression*—Extended (modern) regular expression as defined in POSIX 1003.2. If the regular expression contains any spaces, operators, or wildcard characters, enclose it in quotation marks.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Specifying Access Privileges for Junos OS Operational Mode Commands on page 168
- allow-commands on page 223
- user on page 306

deny-configuration

Syntax deny-configuration "*regular-expression*";

Hierarchy Level [edit system login class]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Explicitly deny configuration access to the specified levels in the hierarchy even if the permissions set with the **permissions** statement grant such access by default.

Default If you omit this statement and the **allow-configuration** statement, users can edit those levels in the configuration hierarchy for which they have access privileges through the **permissions** statement.

Options *regular-expression*—Extended (modern) regular expression as defined in POSIX 1003.2. If the regular expression contains any spaces, operators, or wildcard characters, enclose it in quotation marks.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Specifying Access Privileges Using allow/deny-configuration Statements*
- allow-configuration on page 224
- user on page 306

destination (Accounting)

Syntax

```
destination {
  radius {
    server {
      server-address {
        accounting-port port-number;
        secret password;
        source-address address;
        retry number;
        timeout seconds;
      }
    }
  }
  tacplus {
    server {
      server-address {
        port port-number;
        secret password;
        single-connection;
        timeout seconds;
      }
    }
  }
}
```

Hierarchy Level [edit system accounting]

Release Information Statement introduced before Junos OS Release 7.4.
radius statement added in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the authentication server.

Options The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring RADIUS System Accounting on page 1231
- *Configuring TACACS+ System Accounting*

destination-override

Syntax

```
destination-override {
  syslog host ip-address;
}
```

Hierarchy Level [edit system tracing]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Override the system-wide configuration of the switch at the **[edit system tracing]** hierarchy level. This statement has no effect if system tracing is not configured.

Options **syslog**—System process log files to send to the remote tracing host.

- **syslog**—System process log files to send to the remote tracing host.
- **host *ip-address***—IP address to which to send tracing information.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Understanding Tracing and Logging Operations on page 5979
- **tracing on page 304**

direct-access

Syntax direct-access;

Hierarchy Level [edit system scripts commit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify that commit scripts read input configurations directly from the database when inspecting these scripts for errors.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *commit*
- **scripts on page 6171**
- How Commit Scripts Work on page 5984
- Controlling the Execution of Commit Scripts on page 6105

domain-name

Syntax domain-name *domain-name*;

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the name of the domain in which the switch is located. This is the default domain name that is appended to hostnames that are not fully qualified.

Options ***domain-name***—Name of the domain.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Domain Name for the Router or Switch on page 136
- Example: Configuring the Domain Name for the Router or Switch on page 174

domain-search

Syntax domain-search *domain-list*;

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a list of domains to be searched.

Options ***domain-list***—List of domain names to search. The list can contain up to 6 domain names, with a total of up to 256 characters.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Domains to Search When a Router or Switch Is Included in Multiple Domains on page 136

explicit-priority

Syntax

```
explicit-priority {
  archive <files number> <size size <start-timetime> <transfer-interval
    interval><world-readable | no-world-readable>;
  archive-sites {
    file://<path>/<filename>;
    ftp://username@host:<port>url-path password password;
    scp://username@host:<port>url-path password password;
  }
structured-data {
  brief;
  }
}
```

Hierarchy Level

[edit system syslog file *filename*],
[edit system syslog host]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Record the priority (facility and severity level) in each standard-format system log message directed to a file or remote destination.

When the **structured-data** statement is also included at the **[edit system syslog file *filename*]** hierarchy level, this statement is ignored for the file.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Including Priority Information in System Log Messages on page 6132

events

Syntax events [*events*];

Hierarchy Level [edit system accounting]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the types of events to track and log.

Options *events*—Event types; can be one or more of the following:

- **change-log**—Audit configuration changes.
- **interactive-commands**—Audit interactive commands (any command-line input).
- **login**—Audit logins.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring TACACS+ System Accounting on page 1248

format

Syntax format (des | md5 | sha1);

Hierarchy Level [edit system login password]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the authentication algorithm for plain-text passwords.

Default For Junos OS, the default encryption format is **md5**. For Junos OS-FIPS software, the default encryption format is **sha1**.

Options The hash algorithm that authenticates the password can be one of three algorithms:

- **des**—Has a block size of 8 bytes; its key size is 48 bits long.
- **md5**—Produces a 128-bit digest.
- **sha1**—Produces a 160-bit digest.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221

host-name

Syntax

host-name *hostname*;

Hierarchy Level

[edit system]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Set the hostname of the switch.

Options

hostname—Name of the switch.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Hostname of the Router or Switch on page 137

icmpv4-rate-limit

Syntax

```
icmpv4-rate-limit {
   bucket-size seconds;
   packet-rate pps;
}
```

Hierarchy Level

[edit system internet-options]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure rate-limiting parameters for ICMPv4 messages sent.

Options

bucket-size *seconds*—Number of seconds in the rate-limiting bucket.
Range: 0 through 4294967295 seconds
Default: 5

packet-rate *pps*—Rate-limiting packets earned per second.
Range: 0 through 4294967295 pps
Default: 1000

Required Privilege Level

admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *ping*
- *Configuring the Junos OS ICMPv4 Rate Limit for ICMPv4 Routing Engine Messages*
- *Configuring the Junos OS ICMPv6 Rate Limit for ICMPv6 Routing Engine Messages*

idle-timeout

Syntax idle-timeout *minutes*;

Hierarchy Level [edit system login class *class-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For a login class, configure the maximum time that a session can be idle before the user is logged off the switch. The session times out after remaining at the CLI operational mode prompt for the specified time.

Default If you omit this statement, a user is never forced off the system after extended idle times.

Options *minutes*—Maximum idle time.

Range: 0 through 4294967295 minutes

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring the Timeout Value for Idle Login Sessions on page 150

internet-options

Syntax

```
internet-options {
  icmpv4-rate-limit bucket-size bucket-size packet-rate packet-rate;
  source-port upper-limit upper-limit;
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure system IP options to protect against certain types of denial-of-service (DoS) attacks.

The remaining statements are explained separately.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring the Junos OS ICMPv4 Rate Limit for ICMPv4 Routing Engine Messages on page 141
- Configuring the Junos OS to Extend the Default Port Address Range on page 141

l2-learning

Syntax

```
l2-learning {
  global-mac-limit limit;
  global-mac-statistics;
  global-mac-table-aging-time seconds;
  global-no-mac-learning;
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 8.4.

Description (MX Series routers, and EX Series switches, and QFX Series switches only) Configure Layer 2 address learning and forwarding properties globally.

The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Layer 2 Learning and Forwarding Overview*

load-key-file

Syntax load-key-file *URL filename*;

Hierarchy Level [edit system root-authentication],
[edit system login user *username* authentication]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

NOTE: **ECDSA is not supported on the QFabric system.**

Load RSA (SSH version 1 and SSH version 2) and DSA or ECDSA (SSH version 2) public keys from a previously-generated named file at a specified URL location or local path. The file contains one or more SSH keys that are copied into the configuration when the command is issued.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring the Root Password on page 146
- Configuring the Root Password on page 1236

- *Configuring Junos OS User Accounts*

- Configuring Junos OS User Accounts on page 1226

location

Syntax

```
location {
  altitude feet;
  building name;
  country-code code;
  floor number;
  hcoord horizontal-coordinate;
  lata service-area;
  latitude degrees;
  longitude degrees;
  npa-nxx number;
  postal-code postal-code;
  rack number;
  vcoord vertical-coordinate;
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the system location.

Options

altitude *feet*—Number of feet above sea level.

building *name*—Name of the building. The name of the building can be 1 to 28 characters in length. If the string contains spaces, enclose it in quotation marks (" ").

country-code *code*—Two-letter country code.

floor *number*—Floor in the building.

hcoord *horizontal-coordinate*—Bellcore Horizontal Coordinate.

lata *service-area*—Long-distance service area.

latitude *degrees*—Latitude in degree format.

longitude *degrees*—Longitude in degree format.

npa-nxx *number*—First six digits of the phone number (area code and exchange).

postal-code *postal-code*—Postal code.

rack *number*—Rack number.

vcoord *vertical-coordinate*—Bellcore Vertical Coordinate.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Specifying the Physical Location of the Switch on page 145

login

Syntax

```
login {
  announcementtext;
  class class-name {
    access-end "regular-expression";
    access-start "regular-expression";
    allow-commands "regular-expression";
    allow-configuration "regular-expression";
    deny-commands "regular-expression";
    deny-configuration "regular-expression";
    idle-timeout minutes;
    login-tip;
    permissions [ permissions ];
  }
  message text;
  password {
    change-type (set-transitions | character-set);
    format (md5 | sha1 | des);
    maximum-length length;
    minimum-changes number;
    minimum-length length;
  }
  retry-options {
    backoff-factor seconds;
    backoff-threshold number;
    minimum-time seconds;
    tries-before-disconnect number;
  }
  user username {
    authentication authentication;
      (encrypted-password "password" | plain-text-password);
      load-key-file URL;
      remote-debug-permission (qfabric-admin | qfabric-operator |qfabric-user);
      ssh-dsa "public-key";
      ssh-rsa "public-key";
    }
    class class-name;
    full-name complete-name;
    uid uid-value;
  }
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure user access to the switch.

Options The remaining statements are explained separately.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Defining Junos OS Login Classes on page 1250

login-alarms

Syntax login-alarms;

Hierarchy Level [edit system login class *class-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Show system alarms automatically when an **admin** user logs in to the router or switch.

Options *class-name*—Login class name.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring System Alarms to Appear Automatically Upon Login on page 149

login-tip

Syntax login-tip;

Hierarchy Level [edit system login class *class-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Enable CLI tips at login.

Default Disabled.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring CLI Tips on page 56

max-configurations-on-flash

Syntax max-configurations-on-flash *number*;

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the number of configurations stored on the internal fixed media storage (for example, USB device).

Options *number*—The number of configurations stored on the CompactFlash card.

Range: 0 through 49. The most recently saved configuration is number 0, and the oldest saved configuration is number 49.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Saving a Configuration to a File on page 1141
- Setting or Deleting the Rescue Configuration on page 1145
- Uploading a Configuration File on page 1145
- *Uploading a Configuration File*

maximum-length

Syntax maximum-length *length*;

Hierarchy Level [edit system login passwords]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the maximum number of characters allowed in plain-text passwords. Newly created passwords must meet this requirement.

Default For Junos OS-FIPS software, the maximum number of characters for plain-text passwords is **20**. For Junos OS, no maximum is set.

Options **length**—Maximum number of characters the password can include.

Range: 1 to 64 characters

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221
- **minimum-length on page 258**

message

Syntax message *text*;

Hierarchy Level [edit system login]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a system login message. This message appears before a user logs in.

Options *text*—Text of the message.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration

Related Documentation

- Configuring the Junos OS to Display a System Login Message on page 140
- **announcement on page 225**

minimum-changes

Syntax minimum-changes *number*;

Hierarchy Level [edit system login passwords]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the minimum number of character sets (or character set changes) required in plain-text passwords. Newly created passwords must meet this requirement.

This statement is used in combination with the **change-type** statement. If the change type is **character-sets**, then the number of character sets included in the password is checked against the specified minimum. If the change type is **set-transitions**, then the number of character set changes in the password is checked against the specified minimum.

Default For Junos OS, the minimum number of changes is 1. For Junos-FIPS software, the minimum number of changes is 3.

Options *number*—Minimum number of character sets (or character set changes) required for the password.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221
- **change-type on page 234**

minimum-length

Syntax minimum-length *length*;

Hierarchy Level [edit system login password]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the minimum number of characters required in plain-text passwords. Newly created passwords must meet this requirement.

Default For Junos OS, the minimum number of characters for plain-text passwords is six. For Junos-FIPS software, the minimum number of characters for plain-text passwords is 10.

Options **length**—Minimum number of characters the password must include.

Range: 6 to 20 characters

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221
- **maximum-length on page 256**

minimum-lower-cases

Syntax minimum-lower-cases *number*;

Hierarchy Level [edit system login password]

Release Information Statement introduced in Junos OS Release 12.1.

Description Specify the minimum number of lower-case letters required in plain-text passwords. Newly created passwords must meet this requirement.

This statement can be used in combination with all of the other requirement options for plain-text passwords, such as **minimum-length**, **minimum-punctuations**, **minimum-upper-cases,** and so on.

Using several password minimum requirement options will cause the **minimum-length** to be reset if the total sum of the required minimums exceeds the **minimum-length** setting.

Options *number*—The minimum number of lower-case letters required for the password.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221
- Example: Changing the Requirements for Junos OS Plain-Text Passwords on page 172
- *password (Login)*

minimum-numerics

Syntax minimum-numerics *number*;

Hierarchy Level [edit system login password]

Release Information Statement introduced in Junos OS Release 12.1.

Description Specify the minimum number of numeric class characters required in plain-text passwords. Newly created passwords must meet this requirement.

This statement can be used in combination with all of the other requirement options for plain-text passwords, such as **minimum-length**, **minimum-punctuations**, **minimum-lower-cases,** and so on.

Using several password minimum requirement options will cause the **minimum-length** to be reset if the total sum of the required minimums exceeds the **minimum-length** setting.

Options *number*—The minimum number of numeric class characters required for the password.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221
- Example: Changing the Requirements for Junos OS Plain-Text Passwords on page 172
- *password (Login)*

minimum-punctuations

Syntax minimum-punctuations *number*;

Hierarchy Level [edit system login password]

Release Information Statement introduced in Junos OS Release 12.1.

Description Specify the minimum number of punctuation class characters required in plain-text passwords. Newly created passwords must meet this requirement.

This statement can be used in combination with all of the other requirement options for plain-text passwords, such as **minimum-length**, **minimum-upper-cases**, **minimum-lower-cases,** and so on.

Using several password minimum requirement options will cause the **minimum-length** to be reset if the total sum of the required minimums exceeds the **minimum-length** setting.

Options *number*—The minimum number of punctuation class characters required for the password.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221
- Example: Changing the Requirements for Junos OS Plain-Text Passwords on page 172
- *password (Login)*

minimum-upper-cases

Syntax minimum-upper-cases *number*;

Hierarchy Level [edit system login password]

Release Information Statement introduced in Junos OS Release 12.1.

Description Specify the minimum number of upper-case letters required in plain-text passwords. Newly created passwords must meet this requirement.

This statement can be used in combination with all of the other requirement options for plain-text passwords, such as **minimum-length**, **minimum-punctuations**, **minimum-lower-cases,** and so on.

Using several password minimum requirement options will cause the **minimum-length** to be reset if the total sum of the required minimums exceeds the **minimum-length** setting.

Options *number*—The minimum number of upper-case letters required for the password.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221
- Example: Changing the Requirements for Junos OS Plain-Text Passwords on page 172
- *password (Login)*

multicast-client

Syntax multicast-client <*address*>;

Hierarchy Level [edit system ntp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Network Time Protocol (NTP), configure the local router or switch to listen for multicast messages on the local network to discover other servers on the same subnet.

Options *address*—(Optional) One or more IP addresses. If you specify addresses, the router or switch joins those multicast groups.

Default: 224.0.1.1.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Router or Switch to Listen for Multicast Messages Using NTP on page 148

name-server

Syntax

```
name-server {
  address;
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure one or more Domain Name System (DNS) name servers.

Options ***address***—Address of the name server. To configure multiple name servers, include multiple ***address*** options.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring a DNS Name Server for Resolving a Hostname into Addresses on page 135

no-multicast-echo

Syntax

```
no-multicast-echo {
  arp {
    aging-timer minutes;
    gratuitous-arp-delayseconds;
    gratuitious-arp-on-ifup;
    interfaces {
      interface-name {
        aging-timer minutes;
      }
    }
    passive-learning;
    purging;
    }
    host-name hostname;
    location{
      altitude feet;
      building name;
      country-code code;
      floor number;
      hcoord horizontal-coordinate;
      lata service-area;
      latitude degrees;
      longitude degrees;
      npa-nxx number;
      postal-code postal-code;
      rack number;
      vcoord vertical-coordinate;
      }
    }
    license {
      autoupdate URL;
        }
        renew before-expiration (number | interval number)
      }
    }
  }
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Disable the Routing Engine from responding to ICMP echo requests sent to multicast group addresses.

Default The Routing Engine responds to ICMP echo requests sent to multicast group addresses.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Junos OS to Disable the Routing Engine Response to Multicast Ping Packets*

no-ping-record-route

Syntax no-ping-record-route;

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 9.4.
Statement introduced in Junos OS Release 9.4 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the Junos OS to disable the reporting of the IP address in ping responses.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Junos OS to Disable the Reporting of IP Address and Timestamps in Ping Responses on page 139

no-ping-time-stamp

Syntax no-ping-time-stamp;

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 9.4.
Statement introduced in Junos OS Release 9.4 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the Junos OS to disable the recording of timestamps in ping responses.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Junos OS to Disable the Reporting of IP Address and Timestamps in Ping Responses on page 139

no-redirects (IPv4 Traffic)

Syntax

no-redirects;

Hierarchy Level

[edit system],
[edit interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for EX Series switches.

Description

Stop protocol redirect messages for IPv4 traffic from being sent on the entire switch or on an interface on the router or switch.

To disable the sending of protocol redirect messages for the entire router or switch, include the **no-redirects** statement at the **[edit system]** hierarchy level.

To disable the sending of protocol redirect messages on a specific interface, include the **no-redirects** statement at the **[edit interfaces *interface-name* unit *logical-unit-number* family *family*]** hierarchy level.

Default

The router or switch sends redirect messages.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Junos OS to Disable Protocol Redirect Messages on the Router or Switch on page 138
- *Understanding the Protocol Redirect Mechanism on EX Series Switches*
- *Configuring Junos OS to Disable Sending Protocol Redirect Messages on EX Series Switches (CLI Procedure)*
- *Junos OS Network Interfaces Library for Routing Devices*

no-split-detection

Syntax no-split-detection;

Hierarchy Level [edit virtual-chassis]

Release Information Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Disable the split and merge feature in a Virtual Chassis or VCF configuration.

We recommend using this statement to disable the split and merge feature when configuring a two-member Virtual Chassis. Enabling this statement on a two-member Virtual Chassis ensures that both switches remain in the correct Virtual Chassis roles in the event of a Virtual Chassis split.

Default The split and merge feature is enabled.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Example: Assigning the Virtual Chassis ID to Determine Precedence During an EX4200 Virtual Chassis Merge*
- *Disabling Split and Merge in a Virtual Chassis (CLI Procedure)*
- *Assigning the Virtual Chassis ID to Determine Precedence During a Virtual Chassis Merge (CLI Procedure)*
- *Understanding Split and Merge in a Virtual Chassis*

ntp

Syntax

ntp {
  authentication-key *number* type *type* value *password*;
  boot-server *address*;
  broadcast <*address*> <key *key-number*> <version *value*> <ttl *value*>;
  broadcast-client;
  multicast-client <*address*>;
  peer *address* <key *key-number*> <version *value*> <prefer>;
  server *address* <key *key-number*> <version *value*> <prefer>;
  source-address *source-address*;
  trusted-key [*key-numbers*];
}

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Network Time Protocol (NTP) on the switch.

The remaining statements are explained separately.

Required Privilege Level
system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation
- Synchronizing and Coordinating Time Distribution Using NTP on page 170

optional

Syntax optional;

Hierarchy Level [edit system scripts commit file *filename*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, allow a commit operation to succeed even if the script specified in the **file** statement is missing from the **/var/db/scripts/commit** directory on the router.

Required Privilege Level
maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation
- *Controlling Execution of Commit Scripts During Commit Operations*

password (Login)

Syntax

```
password {
  change-type (set-transitions | character-set);
  format (md5 | sha1 | des);
  maximum-length length;
  minimum-changes number;
  minimum-length length;
}
```

Hierarchy Level [edit system login]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure special requirements such as character length and encryption format for plain-text passwords. Newly created passwords must meet these requirements.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221

peer

Syntax peer *address* <key *key-number*> <version *value*> <prefer>;

Hierarchy Level [edit system ntp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For NTP, configure the local router or switch to operate in symmetric active mode with the remote system at the specified address. In this mode, the local router or switch and the remote system can synchronize with each other. This configuration is useful in a network in which either the local router or switch or the remote system might be a better source of time.

Options ***address***—Address of the remote system. You must specify an address, not a hostname.

key *key-number*—(Optional) All packets sent to the address include authentication fields that are encrypted using the specified key number.

Range: Any unsigned 32-bit integer

prefer—(Optional) Mark the remote system as the preferred host, which means that if all other factors are equal, this remote system is chosen for synchronization among a set of correctly operating systems.

version *value*—(Optional) Specify the NTP version number to be used in outgoing NTP packets.

Range: 1 through 4

Default: 4

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the NTP Time Server and Time Services on page 143

permissions

Syntax

```
permissions {
  storage;
  storage-control;
}
```

Hierarchy Level [edit system login class]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the login access privileges to be provided on the switch.

Options *permissions*—Privilege type.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring Access Privilege Levels on page 1226
- Table 103 on page 1207
- **user on page 306**

port (TACACS+ Server)

Syntax port *port-number*;

Hierarchy Level [edit system accounting destination tacplus server *server-address*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the port number on which to contact the TACACS+ server.

Options *number*—Port number on which to contact the TACACS+ server.

Default: 49

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring TACACS+ System Accounting on page 1248

ports

Syntax

```
ports {
  auxiliary {
    disable;
    insecure;
    type terminal-type;
  }
  console {
    disable;
    insecure;
    log-out-on-disconnect;
    type terminal-type;
  }
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the properties of the console and auxiliary ports. The ports are located on the craft interface.

See the switch hardware documentation for port locations.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring Console and Auxiliary Port Properties on page 6101

radius (System)

Syntax

```
radius {
  server {
    server-address {
      accounting-port port-number;
      secret password;
      source-address address;
      retry number;
      timeout seconds;
    }
  }
}
```

Hierarchy Level [edit system accounting destination]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the RADIUS accounting server.

Options *server-address*—Address of the RADIUS accounting server.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring RADIUS System Accounting on page 1231

refresh (Commit Scripts)

Syntax refresh;

Hierarchy Level [edit system scripts commit],
[edit system scripts file *filename*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, overwrite the local copy of all enabled commit scripts or a single enabled script located in the **/var/db/scripts/commit** directory with the copy located at the source URL, as specified in the **source** statement at the same hierarchy level.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- refresh-from on page 274
- source on page 282

refresh-from (Commit Scripts)

Syntax refresh-from *url*;

Hierarchy Level [edit system scripts commit],
[edit system scripts commit file *filename*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, overwrite the local copy of all enabled commit scripts or a single enabled script located in the **/var/db/scripts/commit** directory with the copy located at a URL other than the URL specified in the **source** statement.

Options *url*—The source specified as a Hypertext Transfer Protocol (HTTP) URL, FTP URL, or secure copy (scp)-style remote file specification.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- refresh on page 274
- source on page 282

retry

Syntax retry *number*;

Hierarchy Level [edit system radius server *server-address*],
[edit system accounting destination radius server *server-address*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Number of times the router or switch is allowed to try to contact a RADIUS authentication or accounting server.

Options *number*—Number of retries allowed for contacting a RADIUS server.

Range: 1 through **10**

Default: 3

NOTE: The **[edit system accounting]** hierarchy is not available on QFabric systems.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring RADIUS Authentication on page 1233
- *Configuring RADIUS Accounting*
- timeout on page 296

retry-options

Syntax

```
retry-options {
  backoff-threshold number;
  backoff-factor seconds;
  maximum-time seconds;
  minimum-time seconds;
  tries-before-disconnect number;
}
```

Hierarchy Level [edit system login]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Maximum number of times a user can attempt to enter a password while logging in through SSH or Telnet before being disconnected.

Options

backoff-threshold *number*—Threshold for the number of failed login attempts before the user experiences a delay when attempting to reenter a password. Use the **backoff-factor** option to specify the length of delay, in seconds.

Range: 1 through 3

Default: 2

backoff-factor *seconds*—Length of delay after each failed login attempt. The length of delay increases by this value for each subsequent login attempt after the value specified in the **backoff-threshold** option.

Range: 5 through 10

Default: 5

maximum-time *seconds*—Maximum length of time that the connection remains open for the user to enter a username and password to log in. If the user remains idle and does not enter a username and password within the configured **maximum-time**, the connection is closed.

Range: 20 through 300

Default: 120

minimum-time *seconds*—Minimum length of time that the connection remains open while the user is attempting to enter a password to log in.

Range: 20 through 60

Default: 20

tries-before-disconnect *number*—Maximum number of times a user is allowed to attempt to enter a password to log in through SSH or Telnet.

Range: 1 through 10

Default: 10

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Limiting the Number of User Login Attempts for SSH and Telnet Sessions on page 1250

root-authentication

Syntax

```
root-authentication {
  (encrypted-password "password" | load-key-password URL | plain-text-password);
  ssh-dsa "public-key";
  ssh-rsa "public-key";
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the authentication methods for the root-level user, whose username is **root**.

Options

encrypted-password "*password*"— Specify the MD5 or other encrypted authentication password. You can specify only one encrypted password.

You cannot configure a blank password for the **encrypted-password** option using blank quotation marks (" "). You must configure a password of 1 through 128 characters and enclose the password in quotation marks.

plain-text-password—Plain-text password. The CLI prompts you for the password and then encrypts it. The CLI displays the encrypted version, and the software places the encrypted version in its user database. You can specify only one plain-text password.

ssh-dsa "*public-key*"—SSH version 2 authentication. Specify the DSA (SSH version 2) public key. You can specify one or more public keys.

ssh-rsa "*public-key*"—SSH version 1 authentication. Specify the RSA (SSH version 1 and SSH version 2) public key. You can specify one or more public keys.

Required Privilege Level

admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring the Root Password on page 1236
- **authentication on page 228**

saved-core-context

Syntax (saved-core-context | no-saved-core-context);

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure whether the switch saves core files generated by internal Junos OS processes, along with contextual information (system log files and a copy of the current configuration):

- **saved-core-context**—The switch saves each core file and its associated context in a compressed tar file named **/var/tmp/*process-name*.core.*core-number*.tgz**.
- **no-saved-core-context**—The switch does not save core files and their associated context.

Default The switch saves core files.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Saving Core Files from Junos OS Processes*
- saved-core-files on page 278

saved-core-files

Syntax saved-core-files *number*;

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Save core files generated by internal Junos OS processes, but not the associated contextual information (configuration and system log files).

Options ***number***—Maximum number of core files to save.

Range: 1 through **10**

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Saving Core Files from Junos OS Processes*
- saved-core-context on page 278

secret

Syntax secret *password*;

Hierarchy Level [edit system accounting destination radius server *server-address*],
[edit system accounting destination tacplus server *server-address*],
[edit system radius-server *server-address*],
[edit system tacplus-server *server-address*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the password to use with the RADIUS or TACACS+ server. The secret password used by the local switch must match that used by the server.

Options *password*—Password to use; can include spaces included in quotation marks.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring RADIUS Accounting*
- Configuring RADIUS Authentication on page 1233
- Configuring TACACS+ Authentication on page 1245
- Configuring TACACS+ System Accounting on page 1248

server (TACACS+ Accounting)

Syntax

```
server {
  server-address {
    port port-number;
    secret password;
    single-connection;
    timeout seconds;
  }
}
```

Hierarchy Level [edit system accounting destination tacplus]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure TACACS+ logging.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring TACACS+ System Accounting on page 1248

server (NTP)

Syntax server *address* <key *key-number*> <version *value*> <prefer>;

Hierarchy Level [edit system ntp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For NTP, configure the switch to operate in client mode with the remote system at the specified server address. In this mode, the local switch can be synchronized with the remote system, but the remote system can never be synchronized with the local switch.

Options ***address***—Address of the remote system. You must specify an address, not a hostname.

key *key-number*—(Optional) Use the specified key number to encrypt authentication fields in all packets sent to the specified address.

Range: Any unsigned 32-bit integer

prefer—(Optional) Mark the remote system as preferred host, which means that if all other things are equal, this remote system is chosen for synchronization among a set of correctly operating systems.

version *value*—(Optional) Specify the version number to be used in outgoing NTP packets.

Range: 1 through 4

Default: 4

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation
- *ntp*

server (RADIUS Accounting)

Syntax

```
server {
  server-address {
    accounting-port port-number;
    retry number
    secret password;
    source-address address;
    timeout seconds;
  }
}
```

Hierarchy Level [edit system accounting destination radius]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure RADIUS logging.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring RADIUS System Accounting on page 1231

single-connection

Syntax single-connection;

Hierarchy Level [edit system accounting destination tacplus server *server-address*],
[edit system tacplus *server-address*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Optimize attempts to connect to a TACACS+ server. The software maintains one open TCP connection to the server for multiple requests rather than opening a connection for each connection attempt.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring TACACS+ Authentication on page 1245
- Configuring TACACS+ System Accounting on page 1248

source (Commit Scripts)

Syntax source *url*;

Hierarchy Level [edit system scripts commit file *filename*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series .

Description For Junos OS commit scripts, specify the location of the source file for an enabled script located in the **/var/db/scripts/commit** directory. When you include the **refresh** statement at the same hierarchy level and commit the configuration, the local copy is overwritten by the version stored at the specified URL.

Options *url*—The source specified as an HTTP URL, FTP URL, or scp-style remote file specification.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

source-address (NTP, RADIUS, System Logging, or TACACS+)

Syntax source-address *source-address*;

Hierarchy Level [edit system accounting destination radius server *server-address*],
[edit system accounting destination tacplus server *server-address*],
[edit system ntp],
[edit system radius-server *server-address*],
[edit system syslog],
[edit system tacplus-server *server-address*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify a source address for each configured TACACS+ server, RADIUS server, NTP server, or the source address to record in system log messages that are directed to a remote machine.

Options ***source-address***—Valid IP address configured on one of the switch interfaces. For system logging, the address is recorded as the message source in messages sent to the remote machines specified in all **host *hostname*** statements at the **[edit system syslog]** hierarchy level.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring RADIUS Authentication on page 1233
- Synchronizing and Coordinating Time Distribution Using NTP on page 170
- *Specifying an Alternative Source Address for System Log Messages*

source-port (Port Addresses)

Syntax source-port upper-limit <*upper-limit*>;

Hierarchy Level [edit system internet-options]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the range of port addresses.

Options **upper-limit *upper-limit***—(Optional) The range of port addresses and can be a value from 5000 through 65,355.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Junos OS to Extend the Default Port Address Range on page 141

ssh-dsa

Syntax ssh-dsa "*public-key*";

Hierarchy Level [edit system root-authentication]
[edit system login user authentication]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the DSA (SSH version 2) public key. You can specify one or more public keys.

Options **ssh-dsa "*public-key*"**—SSH version 2 authentication.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring the Root Password on page 146
- **authentication on page 228**
- *root-authentication*

ssh-rsa

Syntax ssh-dsa "*public-key*";

Hierarchy Level [edit system root-authentication]
[edit system login user authentication]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the RSA (SSH version 1) public key. You can specify one or more public keys.

Options **ssh-rsa "*public-key*"**—SSH version 1 authentication. Specify the RSA (SSH version 1 and SSH version 2) public key. You can specify one or more public keys.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring the Root Password on page 1236
- **authentication on page 228**

- *root-authentication*

static-host-mapping

Syntax

```
static-host-mapping {
  hostname {
    alias [ alias ];
    inet [ address ];
    sysid system-identifier;
  }
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Map a hostname to one or more IP addresses and aliases, and configure an International Organization for Standardization (ISO) system identifier (system ID).

Options

alias ***alias***—Alias for the hostname.

hostname—Fully qualified hostname.

inet ***address***—IP address. You can specify one or more IP addresses for the host.

sysid ***system-identifier***—ISO system identifier (system ID). This is the 6-byte portion of the Intermediate System-to-Intermediate System (IS-IS) network service access point (NSAP). We recommend that you use the host's IP address represented in binary-coded decimal (BCD) format. For example, the IP address **208.197.169.18** is **2081.9716.9018** in BCD.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Hostname of the Router or Switch on page 137

structured-data

Syntax

```
structured-data {
  brief;
}
```

Hierarchy Level [edit system syslog file *filename*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Write system log messages to the log file in structured-data format, which complies with Internet draft draft-ietf-syslog-protocol-23, *The syslog Protocol* (http://tools.ietf.org/html/draft-ietf-syslog-protocol-23).

NOTE: When this statement is included, other statements that specify the format for messages written to the file are ignored (the **explicit-priority** statement at the **[edit system syslog file *filename*]** hierarchy level and the **time-format** statement at the **[edit system syslog]** hierarchy level).

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Logging Messages in Structured-Data Format*
- explicit-priority on page 247
- time-format on page 297

syslog (System)

Syntax

```
syslog {
  archive {
    (binary-data| no-binary-data);
    files number;
    size maximum-file-size;
    start-time "YYYY-MM-DD.hh:mm";
    transfer-interval minutes;
    (world-readable | no-world-readable);
  }
  console {
    facility severity;
  }
  file filename {
    facility severity;
    explicit-priority;
    match "regular-expression";
    archive {
      (binary-data| no-binary-data);
      files number;
      size maximum-file-size;
      start-time "YYYY-MM-DD.hh:mm";
      transfer-interval minutes;
      (world-readable | no-world-readable);
    }
    structured-data {
      brief;
    }
  }
  host (hostname | other-routing-engine | scc-master) {
    facility severity;
    explicit-priority;
    facility-override facility;
    log-prefix string;
    match "regular-expression";
    source-address source-address;
    structured-data {
      brief;
    }
    port port number;
  }
  log-rotate-frequency frequency;
  server server name;
  source-address source-address;
  time-format(millisecond | year | year millisecond);
  user (username | *) {
    facility severity;
    match "regular-expression";
  }
}
```

Hierarchy Level [edit logical-systems *logical-system-name* system],
[edit system]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Support at the **[edit logical-systems *logical-system-name* system]** hierarchy level introduced in Junos OS Release 11.4.

Description

Configure the types of system log messages to send to files, to a remote destination, to user terminals, or to the system console.

The remaining statements are explained separately.

Options

archive—Define parameters for archiving log messages.

console—Send log messages of a specified class and severity to the console.

file—Send log messages to a named file.

host —Remote location to be notified of specific log messages.

log-rotate-frequency—Configure the interval for checking logfile size and archiving messages.

server—Name of the system log server in the inet.0 routing instance.

source-address—Include a specified address as the source address for log messages.

time-format—Additional information to include in the system log time stamp.

user—Notify a specific user of the log event.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Junos OS System Log Configuration Overview*
- *Junos OS System Log Messages Reference*
- Overview of Single-Chassis System Logging Configuration on page 6069

system

Syntax

```
system {
  accounting {
    events [ login change-log interactive-commands ];
    destination {
      radius {
        server {
          server-address {
            accounting-port port-number;
            retry number;
            secret password;
            source-address address;
            timeout seconds;
          }
        }
      }
      tacplus {
        server {
          server-address {
            port port-number;
            secret password;
            single-connection;
            timeout seconds;
          }
        }
      }
    }
  }
  archival {
    configuration {
      archive-sites {
        ftp://<username>:<password>@<host>:<port>/<url-path>;
        ftp://<username>:<password>@<host>:<port>/<url-path>;
      }
      transfer-interval interval;
      transfer-on-commit;
    }
  }
  arp {
    aging-timer minutes;
    interfaces;
  }
  authentication-order [ authentication-methods ];
  (compress-configuration-files | no-compress-configuration-files);
  default-address-selection;
  domain-name domain-name;
  domain-search [ domain-list ];
  host-name hostname;
  internet-options {
    icmpv4-rate-limitbucket-size bucket-size packet-rate packet-rate;
    source-port upper-limit <upper-limit>;
  }
  location {
```



```
    altitude feet;
    building name;
    country-code code;
    floor number;
    hcoord horizontal-coordinate;
    lata service-area;
    latitude degrees;
    longitude degrees;
    npa-nxx number;
    postal-code postal-code;
    rack number;
    vcoord vertical-coordinate;
  }
  login {
    announcementtext;
    class class-name {
      access-end;
      access-start;
      allow-configuration "regular-expression";
      allowed-days "regular-expression";
      deny-commands "regular-expression";
      deny-configuration "regular-expression";
      idle-timeout minutes;
      login-tip;
      permissions [ permissions ];
    }
    message text;
    password {
      change-type (set-transitions | character-set);
      format (md5 | sha1 | des);
      maximum-length length;
      minimum-changes number;
      minimum-length length;
    }
    retry-options {
      backoff-factor seconds;
      backoff-threshold number;
      minimum-time seconds;
      tries-before-disconnect number;
    }
    user username {
      authentication {
        (encrypted-password "password" | plain-text-password);
        load-key-file URL;
        remote-debug-permission (qfabric-admin | qfabric-operator |qfabric-user);
        ssh-rsa "public-key";
        ssh-dsa "public-key";
      }
      uid uid-value;
      class class-name;
      full-name complete-name;
    }
  }
  name-server {
    address;
  }
```



```
no-multicast-echo;
no-redirects;
no-ping-record-route;
no-ping-time-stamp;
ntp {
  authentication-key number type type value password;
  serveraddress <key key-number> <version value> <prefer>;
}
ports {
  auxiliary {
    disable;
    insecure;
    type terminal-type;
  }
  console {
    disable;
    insecure;
    log-out-on-disconnect;
    type terminal-type;
  }
}
radius-server server-address {
  accounting-port port-number;
  port number;
  retry number;
  secret password;
  source-address source-address;
  timeout seconds;
  }
}
radius-options {
  password-protocol mschap-v2;
  }
  attributes {
    nas-ip-address ip-address;
root-authentication {
  (encrypted-password "password" | plain-text-password);
  ssh-rsa "public-key";
  ssh-dsa "public-key";
}
(saved-core-context | no-saved-core-context);
saved-core-files saved-core-files;
services {
  finger {
    connection-limit limit;
    rate-limit limit;
  }
  flow-tap-dtcp {
    ssh {
      connection-limit limit;
      rate-limit limit;
    }
  }
  ftp {
    connection-limit limit;
    rate-limit limit;
```

```
    }
    service-deployment {
      servers server-address {
        port port-number;
      }
      source-address source-address;
    }
    ssh {
      root-login (allow | deny | deny-password);
      protocol-version [v1 v2];
      connection-limit limit;
      rate-limit limit;
    }
    telnet {
      connection-limit limit;
      rate-limit limit;
    }
    web-management {
      http {
        interfaces [ interface-names ];
        port port;
      }
      https {
        interfaces [ interface-names ];
        local-certificate name;
        port port;
      }
      session {
        idle-timeout [ minutes ];
        session-limit [ session-limit ];
      }
    }
    xnm-clear-text {
      connection-limit limit;
      rate-limit limit;
    }
    xnm-ssl {
      connection-limit limit;
      local-certificate name;
      rate-limit limit;
    }
  }
  static-host-mapping {
    hostname {
      alias [ alias ];
      inet [ address ];
      sysid system-identifier;
    }
  }
  syslog {
    archive {
      files number;
      size maximum-file-size;
      start-time "YYYY-MM-DD.hh:mm";
      transfer-interval minutes;
      (world-readable | no-world-readable);
```



```
        }
        console {
          facility severity;
        }
        file filename {
          archive {
            files number;
            size maximum-file-size;
            start-time "YYYY-MM-DD.hh:mm";
            transfer-interval minutes;
            (world-readable | no-world-readable);
          }
          explicit-priority;
          facility severity;
          match "regular-expression";
          structured-data {
            brief;
          }
        }
        host (hostname | other-routing-engine | scc-master) {
          explicit-priority;
          facility-override facility;
          facility severity;
          log-prefix string;
          match "regular-expression";
        }
        source-address source-address;
        time-format (millisecond | year | year millisecond);
        user (username | *) {
          facility severity;
          match "regular-expression";
        }
      }
      tacplus-options {
        service-name service-name;
        (no-cmd-attribute-value | exclude-cmd-attribute);
      }
      tacplus-server server-address {
        port
        secret password;
        single-connection;
        source-address source-address;
        timeout seconds;
      }
      time-zone (GMThour-offset | time-zone);
      }
      tracing {
        destination-override {
        syslog host;
        }
      }
      use-imported-time-zones;
    }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure system management properties.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

tacplus

Syntax

```
tacplus {
  server {
    server-address {
      port port-number;
      secret password;
      single-connection;
      timeout seconds;
    }
  }
}
```

Hierarchy Level [edit system accounting destination]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure TACACS+.

Options *server-address*—Address of the TACACS+ authentication server.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring TACACS+ System Accounting on page 1248

tacplus-server

Syntax

```
tacplus-server server-address {
  port
  secret password;
  single-connection;
  source-address source-address;
  timeout seconds;
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the TACACS+ server.

Options *server-address*—Address of the TACACS+ authentication server.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring TACACS+ Authentication on page 1245

timeout

Syntax timeout *seconds*;

Hierarchy Level [edit system radius-server *server-address*],
[edit system tacplus-server *server-address*],
[edit system accounting destination radius server server-address],
[edit system accounting destination tacplus server server-address]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the length of time that the local router or switch waits to receive a response from a RADIUS or TACACS+ server.

Options ***seconds***—Length of time to wait.

Range: 1 through 90 seconds

Default: 3 seconds

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring RADIUS Accounting*
- Configuring TACACS+ System Accounting on page 1248
- **retry on page 275**

time-format

Syntax time-format (year | millisecond | year millisecond);

Hierarchy Level [edit system syslog]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Include the year, the millisecond, or both, in the timestamp on every standard-format system log message. The additional information is included for messages directed to each destination configured by a **file**, **console**, or **user** statement at the **[edit system syslog]** hierarchy level, but not to destinations configured by a **host** statement.

Default The timestamp specifies the month, date, hour, minute, and second when the message was logged—for example, **Aug 21 12:36:30**.

NOTE: When the **structured-data** statement is included at the **[edit system syslog file *filename*]** hierarchy level, this statement is ignored for the file.

Options **millisecond**—Include the millisecond in the timestamp.

year—Include the year in the timestamp.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Including the Year or Millisecond in Timestamps on page 157
- **structured-data on page 286**

time-zone

Syntax time-zone (GMT *hour-offset* | *time-zone*);

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the local time zone. To have the time zone change take effect for all processes running on the switch, you must reboot the switch.

Default UTC

Options **GMT *hour-offset***—Set the time zone relative to UTC time.

Range: –14 through +12

Default: 0

time-zone—Specify the time zone as **UTC**, which is the default time zone, or as a string such as PDT (Pacific Daylight Time), or use one of the following continents and major cities:

Africa/Abidjan, Africa/Accra, Africa/Addis_Ababa, Africa/Algiers, Africa/Asmera, Africa/Bamako, Africa/Bangui, Africa/Banjul, Africa/Bissau, Africa/Blantyre, Africa/Brazzaville, Africa/Bujumbura, Africa/Cairo, Africa/Casablanca, Africa/Ceuta, Africa/Conakry, Africa/Dakar, Africa/Dar_es_Salaam, Africa/Djibouti, Africa/Douala, Africa/El_Aaiun, Africa/Freetown, Africa/Gaborone, Africa/Harare, Africa/Johannesburg, Africa/Kampala, Africa/Khartoum, Africa/Kigali, Africa/Kinshasa, Africa/Lagos, Africa/Libreville, Africa/Lome, Africa/Luanda, Africa/Lubumbashi, Africa/Lusaka, Africa/Malabo, Africa/Maputo, Africa/Maseru, Africa/Mbabane, Africa/Mogadishu, Africa/Monrovia, Africa/Nairobi, Africa/Ndjamena, Africa/Niamey, Africa/Nouakchott, Africa/Ouagadougou, Africa/Porto-Novo, Africa/Sao_Tome, Africa/Timbuktu, Africa/Tripoli, Africa/Tunis, Africa/Windhoek

America/Adak, America/Anchorage, America/Anguilla, America/Antigua, America/Aruba, America/Asuncion, America/Barbados, America/Belize, America/Bogota, America/Boise, America/Buenos_Aires, America/Caracas, America/Catamarca, America/Cayenne, America/Cayman, America/Chicago, America/Cordoba, America/Costa_Rica, America/Cuiaba, America/Curacao, America/Dawson, America/Dawson_Creek, America/Denver, America/Detroit, America/Dominica, America/Edmonton, America/El_Salvador, America/Ensenada, America/Fortaleza, America/Glace_Bay, America/Godthab, America/Goose_Bay, America/Grand_Turk, America/Grenada, America/Guadeloupe, America/Guatemala, America/Guayaquil, America/Guyana, America/Halifax, America/Havana, America/Indiana/Knox, America/Indiana/Marengo, America/Indiana/Vevay, America/Indianapolis, America/Inuvik, America/Iqaluit, America/Jamaica, America/Jujuy, America/Juneau, America/La_Paz, America/Lima, America/Los_Angeles, America/Louisville, America/Maceio, America/Managua, America/Manaus, America/Martinique, America/Mazatlan, America/Mendoza, America/Menominee, America/Mexico_City, America/Miquelon, America/Montevideo, America/Montreal, America/Montserrat, America/Nassau, America/New_York, America/Nipigon, America/Nome, America/Noronha, America/Panama, America/Pangnirtung, America/Paramaribo, America/Phoenix, America/Port-au-Prince, America/Port_of_Spain, America/Porto_Acre, America/Puerto_Rico, America/Rainy_River, America/Rankin_Inlet, America/Regina, America/Rosario, America/Santiago, America/Santo_Domingo, America/Sao_Paulo, America/Scoresbysund, America/Shiprock, America/St_Johns, America/St_Kitts, America/St_Lucia, America/St_Thomas, America/St_Vincent, America/Swift_Current, America/Tegucigalpa, America/Thule, America/Thunder_Bay, America/Tijuana, America/Tortola, America/Vancouver, America/Whitehorse, America/Winnipeg, America/Yakutat, America/Yellowknife

Antarctica/Casey, Antarctica/DumontDUrville, Antarctica/Mawson, Antarctica/McMurdo, Antarctica/Palmer, Antarctica/South_Pole

Arctic/Longyearbyen

Asia/Aden, Asia/Alma-Ata, Asia/Amman, Asia/Anadyr, Asia/Aqtau, Asia/Aqtobe, Asia/Ashkhabad, Asia/Baghdad, Asia/Bahrain, Asia/Baku, Asia/Bangkok, Asia/Beirut, Asia/Bishkek, Asia/Brunei, Asia/Calcutta, Asia/Chungking, Asia/Colombo, Asia/Dacca, Asia/Damascus, Asia/Dubai, Asia/Dushanbe, Asia/Gaza, Asia/Harbin, Asia/Hong_Kong, Asia/Irkutsk, Asia/Ishigaki, Asia/Jakarta, Asia/Jayapura, Asia/Jerusalem, Asia/Kabul, Asia/Kamchatka, Asia/Karachi, Asia/Kashgar, Asia/Katmandu, Asia/Krasnoyarsk, Asia/Kuala_Lumpur, Asia/Kuching, Asia/Kuwait, Asia/Macao, Asia/Magadan, Asia/Manila, Asia/Muscat, Asia/Nicosia, Asia/Novosibirsk, Asia/Omsk, Asia/Phnom_Penh, Asia/Pyongyang, Asia/Qatar, Asia/Rangoon, Asia/Riyadh, Asia/Saigon, Asia/Seoul, Asia/Shanghai, Asia/Singapore, Asia/Taipei, Asia/Tashkent, Asia/Tbilisi, Asia/Tehran, Asia/Thimbu, Asia/Tokyo, Asia/Ujung_Pandang, Asia/Ulan_Bator, Asia/Urumqi, Asia/Vientiane, Asia/Vladivostok, Asia/Yakutsk, Asia/Yekaterinburg, Asia/Yerevan

Atlantic/Azores, Atlantic/Bermuda, Atlantic/Canary, Atlantic/Cape_Verde, Atlantic/Faeroe, Atlantic/Jan_Mayen, Atlantic/Madeira, Atlantic/Reykjavik, Atlantic/South_Georgia, Atlantic/St_Helena, Atlantic/Stanley

Australia/Adelaide, Australia/Brisbane, Australia/Broken_Hill, Australia/Darwin, Australia/Hobart, Australia/Lindeman, Australia/Lord_Howe, Australia/Melbourne, Australia/Perth, Australia/Sydney

Europe/Amsterdam, Europe/Andorra, Europe/Athens, Europe/Belfast, Europe/Belgrade, Europe/Berlin, Europe/Bratislava, Europe/Brussels, Europe/Bucharest, Europe/Budapest, Europe/Chisinau, Europe/Copenhagen, Europe/Dublin, Europe/Gibraltar, Europe/Helsinki, Europe/Istanbul, Europe/Kaliningrad, Europe/Kiev, Europe/Lisbon, Europe/Ljubljana, Europe/London, Europe/Luxembourg, Europe/Madrid, Europe/Malta, Europe/Minsk, Europe/Monaco, Europe/Moscow, Europe/Oslo, Europe/Paris, Europe/Prague, Europe/Riga, Europe/Rome, Europe/Samara, Europe/San_Marino, Europe/Sarajevo, Europe/Simferopol, Europe/Skopje, Europe/Sofia, Europe/Stockholm, Europe/Tallinn, Europe/Tirane, Europe/Vaduz, Europe/Vatican, Europe/Vienna, Europe/Vilnius, Europe/Warsaw, Europe/Zagreb, Europe/Zurich

Indian/Antananarivo, Indian/Chagos, Indian/Christmas, Indian/Cocos, Indian/Comoro, Indian/Kerguelen, Indian/Mahe, Indian/Maldives, Indian/Mauritius, Indian/Mayotte, Indian/Reunion

Pacific/Apia, Pacific/Auckland, Pacific/Chatham, Pacific/Easter, Pacific/Efate, Pacific/Enderbury, Pacific/Fakaofo, Pacific/Fiji, Pacific/Funafuti, Pacific/Galapagos, Pacific/Gambier, Pacific/Guadalcanal, Pacific/Guam, Pacific/Honolulu, Pacific/Johnston, Pacific/Kiritimati, Pacific/Kosrae, Pacific/Kwajalein, Pacific/Majuro, Pacific/Marquesas, Pacific/Midway, Pacific/Nauru, Pacific/Niue, Pacific/Norfolk, Pacific/Noumea, Pacific/Pago_Pago, Pacific/Palau, Pacific/Pitcairn, Pacific/Ponape, Pacific/Port_Moresby, Pacific/Rarotonga, Pacific/Saipan, Pacific/Tahiti, Pacific/Tarawa, Pacific/Tongatapu, Pacific/Truk, Pacific/Wake, Pacific/Wallis, Pacific/Yap

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Modifying the Default Time Zone for a Router or Switch Running Junos OS on page 162

traceoptions (Commit Scripts)

Syntax

```
traceoptions {
  file <filename> <files number> <size size> <world-readable | no-world-readable>;
  flag flag;
  no-remote-trace;
}
```

Hierarchy Level [edit system scripts commit],

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define tracing operations for commit or op scripts.

Default If you do not include this statement, no script-specific tracing operations are performed.

Options *filename*—Name of the file to receive the output of the tracing operation. All files are placed in the directory **/var/log**. By default, commit script process tracing output is placed in the file **cscript.log** and op script process tracing is placed in the file **op-script.log**. If you include the **file** statement, you must specify a filename. To retain the default, you can specify **cscript.log** or **op-script.log** as the filename.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed and compressed to ***trace-file*.0.gz**. When ***trace-file*** again reaches its maximum size, ***trace-file*.0.gz** is renamed ***trace-file*.1.gz** and ***trace-file*** is renamed and compressed to ***trace-file*.0.gz**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum number of files, you also must specify a maximum file size with the **size** option and a filename.

Range: 2 through 1000

Default: 10 files

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements. You can include the following flags:

- **all**—Log all operations
- **events**—Log important events
- **input**—Log script input data
- **offline**—Generate data for offline development
- **output**—Log script output data
- **rpc**—Log script RPCs
- **xslt**—Log the XSLT library

no-world-readable—Restrict file access to owner. This is the default.

size ***size***—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed and compressed to ***trace-file*.0.gz**. When ***trace-file*** again reaches its maximum size, ***trace-file*.0.gz** is renamed ***trace-file*.1.gz** and ***trace-file*** is renamed and compressed to ***trace-file*.0.gz**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option and a filename.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through 1 GB

Default: 128 KB

world-readable—Enable unrestricted file access.

Required Privilege Level

maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Tracing Commit Script Processing*

traceoptions (Layer 2 Learning)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag (detail | disable | receive | send);
  in-memory-debug;
  level;
  no-remote-trace;
}
```

Hierarchy Level [edit protocols l2-learning]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Define tracing operations for Layer 2 learning.

Default The **traceoptions** feature is disabled by default.

Options **file *filename***—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**.

You can specify the following options:

- **no-world-readable**—(Optional) Restrict file access to the user who created the file.
- **size *size*** —(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**, then **trace-file.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten. If you specify a maximum number of files, you also must specify a maximum file size with the **files** option. Use ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify gigabytes.
- **world-readable**—(Optional) Enable unrestricted file access.

flag *flag* —Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. You can include the following flags:

- **all**—All tracing operations.
- **bmac-next-hop**—Trace backbone MAC next hop operations.
- **bridge-bmac-next-hop**—Trace backbone MAC next hop bridge operations.
- **bridging-interface**—Trace interface bridge operations.
- **bridging-domain**—Trace bridging domain operations.
- **configuration**—Trace configuration operations.
- **flood-next-hop**—Trace flood next hop operations.
- **initialization**—Trace initialization operations.
- **interface-device**—Trace interface device operations.
- **interface-family**—Trace interface family operations.

- **interface-logical**—Trace logical interface operations.
- **ipc**—Trace inter-process communications operations.
- **irb**—Trace integrated routing and bridging operations.
- **isid**—Trace i-tagged service ID operations.
- **kack**—Trace kernel-acknowledgment.
- **learning-domain**—Trace learning domain operations.
- **logical-system**—Trace logical system operations.
- **mac-learning**—Trace MAC address learning.
- **mc-ae**—Trace multichassis aggregated Ethernet interface operations.
- **redundant-trunk-group**—Trace redundant trunk group operations.
- **routing-instance**—Trace routing instance operations.
- **routing-socket**—Trace routing socket operations.
- **storm-control**—Trace storm control operations.
- **unknown-unicast-forwarding**—Trace unknown unicast forwarding events.
- **vpls-ping**—Trace Virtual Private VLAN Service (VPLS) ping operations.

in-memory-debug—Enable trace parameters in the memory.

level—Specify level of debugging output.

no-remote-trace—Disable remote tracing.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

tracing

Syntax

```
tracing {
  destination-override syslog host ip-address;
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the switch to enable remote tracing to a specified host IP address.

NOTE: **The tracing statement is not supported on the QFX3000 QFabric system.**

The following processes are supported:

- **chassisd**—Chassis-control process
- **eventd**—Event-processing process
- **cosd**—Class-of-service process

If you enabled remote tracing but wish to disable it for specific processes on the switch, use the **no-remote-trace** statement at the **[edit system *process-name* traceoptions]** hierarchy level.

Default Remote tracing is disabled by default.

Options **destination-override syslog host *ip-address***—Overrides the global configuration for system tracing and has no effect if the **tracing** statement is not configured.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Understanding Tracing and Logging Operations on page 5979
- destination-override on page 245

trusted-key

Syntax trusted-key [*key-numbers*];

Hierarchy Level [edit system ntp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For NTP, configure the keys to use when you configure the switch to synchronize its time with other systems on the network.

Options *key-numbers*—One or more key numbers. Each key can be any 32-bit unsigned integer except 0.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring NTP Authentication Keys on page 142
- *authentication-key*
- server on page 280

uid

Syntax uid *uid-value*;

Hierarchy Level [edit system login user]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a user identifier for a login account.

Options *uid-value*—Number associated with the login account. This value must be unique on the router or switch.

Range: **100** through **64000**

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring Junos OS User Accounts on page 1226

use-imported-time-zones

Syntax use-imported-time-zones;

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a custom time zone from a locally generated time zone database.

Required Privilege Level
admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation
- Setting a Custom Time Zone on Routers or Switches Running Junos OS on page 165

user (Access)

Syntax

```
user username {
  authentication {
    (encrypted-password "password" | plain-text-password);
    load-key-file URL;
    remote-debug-permission (qfabric-admin | qfabric-operator |qfabric-user);
    ssh-dsa "public-key" <from hostname>;
    ssh-rsa "public-key" <from hostname>;
  }
  class class-name;
  full-name "complete-name";
  uid uid-value;
}
```

Hierarchy Level [edit system login]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure access permission for individual users.

Options The remaining statements are explained separately.

Required Privilege Level
admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation
- Configuring Junos OS User Accounts on page 1226
- class on page 236

CHAPTER 6

Administration

Routine Monitoring

Monitoring System Process Information

Purpose View the processes running on the QFX Series.

Action To view the software processes running on the QFX Series:

[edit system]

user@switch> **show system processes**

Meaning Table 49 on page 307 summarizes the output fields in the system process information display.

The display includes the total CPU load and total memory utilization.

Table 49: Summary of System Process Information Output Fields

Field	Values
PID	Identifier of the process.
Name	Owner of the process.

Table 49: Summary of System Process Information Output Fields *(continued)*

Field	Values
State	Current state of the process.
CPU Load	Percentage of the CPU that is being used by the process.
Memory Utilization	Amount of memory that is being used by the process.
Start Time	Time of day when the process started.

Related Documentation

- Monitoring System Properties on page 308
- show system uptime on page 1025

Monitoring System Properties

Purpose View system properties such as the name and IP address of a QFX Series product and resource usage.

Action To monitor system properties in the CLI, enter the following commands:

- show system uptime
- show system users
- show system storage

Meaning Table 50 on page 308 summarizes key output fields in the system properties display.

Table 50: Summary of Key System Properties Output Fields

Field	Values	Additional Information
General Information		
Serial Number	Serial number for a QFX Series product.	
Junos OS Version	Version of Junos OS active on the switch, including whether the software is for domestic or export use.	Export software is for use outside the USA and Canada.
Hostname	Name of the QFX Series product.	
IP Address	IP address of the QFX Series product.	
Loopback Address	Loopback address.	
Domain Name Server	Address of the domain name server.	

Table 50: Summary of Key System Properties Output Fields *(continued)*

Field	Values	Additional Information
Time Zone	Time zone on the QFX Series product.	
Time		
Current Time	Current system time, in Coordinated Universal Time (UTC).	
System Booted Time	Date and time when the QFX Series product was last booted and how long it has been running.	
Protocol Started Time	Date and time when the protocols were last started and how long they have been running.	
Last Configured Time	Date and time when a configuration was last committed. This field also shows the name of the user who issued the last **commit** command.	
Load Average	CPU load average for 1, 5, and 15 minutes.	
Storage Media		
Internal Flash Memory	Usage details of internal flash memory.	
External Flash Memory	Usage details of external USB flash memory.	
Logged in Users Details		
User	Username of any user logged in to the switch.	
Terminal	Terminal through which the user is logged in.	
From	System from which the user has logged in. A hyphen indicates that the user is logged in through the console.	
Login Time	Time when the user logged in.	This is the **user@switch** field in **show system users** command output.
Idle Time	How long the user has been idle.	

Related Documentation

- Monitoring System Process Information on page 307
- **show system processes on page 941**

Monitoring Interface Status and Traffic

Purpose View interface status to monitor interface bandwidth utilization and traffic statistics on the QFX Series product.

Action

- To view interface status for all the interfaces, enter **show interfaces xe**.
- To view status and statistics for a specific interface, enter **show interfaces xe** ***interface-name***.
- To view status and traffic statistics for all interfaces, enter either **show interfaces xe detail** or **show interfaces xe extensive**.

Meaning For details about output from the CLI commands, see **show interfaces xe**.

Monitoring Zero Touch Provisioning

You can use the console and operational commands to monitor Zero Touch Provisioning.

Using the Console to Monitor Zero Touch Provisioning

The following Zero Touch Provisioning (ZTP) activities are displayed on the console during the ZTP process:

- Starting and ending times of ZTP process.
- Lists of bound and unbound DHCP client interfaces.
- DHCP options that DHCP servers send to DHCP clients.
- Logs indicating which interfaces are used for ZTP.
- ZTP parameters that DHCP clients obtain from DHCP servers.
- File names of configuration and image files, names of file servers, protocols used to fetch files, and times when DHCP servers fetch configuration and image files.
- Failure states caused by files not being on servers, or unreachable servers, and time outs.
- Number of attempts made, and number of attempts remaining, for retry in current ZTP cycle.
- Completion of file transfers.
- Installation, reboot, and state of ZTP process.
- Internal state errors and termination of ZTP process.
- Logs for when default routes were added or deleted.

Using System Log Alerts to Monitor Zero Touch Provisioning

Purpose In this example, the system log alert alerts you that the auto-image upgrade will start.

Action Use the following system log alert to monitor the auto-image upgrade process.

```
“ALERT:Auto-image upgrade will start. This can terminate config CLI session(s).
Modified configuration will be lost. To stop Auto-image, in CLI do the
following: 'edit; delete chassis auto-image-upgrade; commit'.”

“Checking whether image upgrade is already invoked”
```

Meaning This system log alert indicates that the auto-image upgrade will start, and provides information on how to stop the auto-image upgrade process.

Using Error Messages to Monitor Zero Touch Provisioning

Purpose Error messages provide information on which DHCP options are not configured.

Action Use the information in the following error message to find out which DHCP options are not configured.

```
“DHCP Log Server Option”
“DHCP Host Name Option”
“DHCP NTP Server Option”
```

Meaning The error message indicates that the DHCP log server, hostname, and NTP server options are not configured.

Using System Log Files to Monitor Zero Touch Provisioning

Purpose System log files provide information on the state of the auto-upgrade process, lists of bound and unbound DHCP client interfaces, IP addresses of file servers, names and locations of image and configuration files, and successful and failed attempts at fetching configuration and image files.

Action Use the information in the following system log files to monitor the auto-upgrade process.

```
Auto Image Upgrade: Start fetching config-file file from server 1.1.1.1 through
irb using ftp


Auto Image Upgrade: Tried [2] attempts to fetch config-file file from server
1.1.1.1 through irb. Summary: "Retrieving /config-file
:: Failed to open file.". To retry [4] times.


Auto Image Upgrade: Tried [4] attempts to fetch config-file file from server
1.1.1.1 through irb. Summary: "Retrieving /config-fileconfig-file
:: Failed to open file.". To retry [2] times.

Auto Image Upgrade: Tried [6] attempts to fetch config-file file from server
1.1.1.1 through irb. Summary: "Retrieving /config-file
:: Failed to open file.". To retry [0] times.
```



```
Auto Image Upgrade: All [6] attempts to fetch config-file file from server 1.1.1.1
 through irb FAILED. Start retry again in few minutes.
```

Meaning These system log files indicate that there were six failed attempts to fetch the configuration file from the file server, the IP address of the file server, the DHCP client interface name, and the number of times the retry process occurred.

Using the show dhcp client binding Command

Purpose Issue the **show dhcp client binding** command to display DHCP client binding information

Action Issue the **show dhcp client binding** command to display the IP address of the DHCP client, the hardware address of the DHCP client, number of seconds in which the DHCP client's IP address lease expires, state of the DHCP client IP address in the binding table, and the name of the interface that has active client bindings.

show dhcp client binding

```
user@switch# show dhcp client binding
IP address        Hardware address   Expires     State      Interface
0.0.0.0           00:22:83:2a:db:dc  0           SELECTING  irb.0
6.6.6.13          00:22:83:2a:db:dd  49201       BOUND      vme.0
0.0.0.0           00:22:83:2a:db:df  0           SELECTING  xe-0/0/0.0
0.0.0.0           00:22:83:2a:db:e0  0           SELECTING  xe-0/0/1.0
```

Meaning The output of this command shows that there is one client interface that is bound, and that there are three interfaces that are receiving DHCP offers from the DHCP server.

Using the show dhcp client statistics Command

Purpose Issue the **show dhcp client statistics** command to display DHCP client statistics.

Action Issue the **show dhcp client statistics** command to display DHCP client statistics, such as the number of packets dropped, and the number DHCP and BOOTP messages sent and received.

show dhcp client statistics

```
user@switch# show dhcp client statistics
Packets dropped:
    Total                      14
    Send error                 14
Messages received:
    BOOTREPLY                  5
    DHCPOFFER                  1
    DHCPACK                    4
    DHCPNAK                    0
    DHCPFORCERENEW             0
Messages sent:
    BOOTREQUEST                6751
    DHCPDECLINE                0
    DHCPDISCOVER               6747
    DHCPREQUEST                4
    DHCPINFORM                 0
    DHCPRELEASE                0
```



```
DHCPRENEW                    0
DHCPREBIND                   0
```

Meaning The output of this command displays how many packets were dropped with errors, the number of BOOTREPLY and DHCPOFFER messages that were received, and the number of BOOTREQUEST and DHCPREQUEST messages that were sent.

Related Documentation

- Understanding Zero Touch Provisioning on page 47
- Configuring Zero Touch Provisioning on page 98

Other Tools to Configure and Monitor Devices Running Junos OS

Apart from the command-line interface, Junos OS also supports the following applications, scripts, and utilities that enable you to configure and monitor devices running Junos OS:

- Junos XML Management Protocol Application Programming Interface (API)—Application programmers can use the Junos XML Management Protocol API to monitor and configure Juniper Networks QFX Series products. Juniper Networks provides a Perl module with the API to help you more quickly and easily develop custom Perl scripts for configuring and monitoring the QFX Series.
- NETCONF Application Programming Interface (API)—Application programmers can also use the NETCONF API to monitor and configure Juniper Networks QFX Series products.
- Junos OS commit scripts—You can define scripts to enforce custom configuration tasks, enforce consistency, prevent common mistakes, and more. Every time you commit a new candidate configuration, the active commit scripts are called to inspect the new candidate configuration. If a configuration violates your custom rules, the script can instruct the Junos OS to perform various actions, including making changes to the configuration and generating custom, warning, and system log messages.
- Junos OS Op scripts—You can add your own commands to the operation-mode CLI. You can use these scripts to automate troubleshooting of known network problems and correct them.
- Junos OS event scripts—You can use event scripts to diagnose and fix issues, monitor the overall status of the system, and examine errors periodically. Event scripts are similar to op scripts except that certain events on the switch will trigger these scripts.
- Junos Space—The Junos Space application design allows multiple users concurrent access to its user interface. It also includes applications for network infrastructure automation.

Related Documentation

- CLI User Interface Overview on page 54
- *QFX Series Software Features Overview*
- *NETCONF XML Management Protocol Developer Guide*
- Understanding Device and Network Management Features on page 5975

Verifying a Unified In-Service Software Upgrade (ISSU)

Purpose Verify the status of FPCs and their corresponding PICs after the most recent unified ISSU.

Action Issue the **show chassis in-service-upgrade** command on the master Routing Engine:

```
user@host> show chassis in-service-upgrade
  Item           Status                  Reason
  FPC 0          Online
  FPC 1          Online
  FPC 2          Online
    PIC 0        Online
    PIC 1        Online
  FPC 3          Offline                 Offlined by CLI command
  FPC 4          Online
    PIC 1        Online
  FPC 5          Online
    PIC 0        Online
  FPC 6          Online
    PIC 3        Online
  FPC 7          Online
```

Meaning See show chassis in-service-upgrade for more information.

Related Documentation

- *Performing a Unified ISSU*
- *Troubleshooting Unified ISSU Problems*
- Understanding In-Service Software Upgrade (ISSU) on page 40
- Performing an In-Service Software Upgrade (ISSU) on page 106
- *Managing and Tracing BFD Sessions During Unified ISSU Procedures*

Verifying Autoinstallation Status

Purpose Display the status of the autoinstallation feature.

Action From the CLI, enter the **show system autoinstallation status** command.

Sample Output

```
user@switch> show system autoinstallation status
Autoinstallation status:
Master state: Active
Last committed file: None
Configuration server of last committed file: 10.25.100.1
Interface:
  Name: ge-0/0/0
  State: Configuration Acquisition
  Acquired:
    Address: 192.168.124.75
    Hostname: host-ge-000
    Hostname source: DNS
    Configuration filename: switch-ge-000.conf
    Configuration filename server: 10.25.100.3
  Address acquisition:
```



```
    Protocol: DHCP Client
    Acquired address: None
    Protocol: RARP Client
    Acquired address: None
Interface:
  Name: ge-0/0/1
  State: None
  Address acquisition:
    Protocol: DHCP Client
    Acquired address: None
    Protocol: RARP Client
    Acquired address: None
```

Meaning The output shows the settings configured for autoinstallation. Verify that the values displayed are correct for the switch when it is deployed on the network.

Related Documentation

- Configuring Autoinstallation of Configuration Files (CLI Procedure) on page 130

Verifying That Automatic Software Download Is Working Correctly

Purpose Verify that the automatic software download feature is working correctly.

Action Use the **show system services dhcp client *interface-name*** command to verify that the automatic software download feature has been used to install a software package.

```
user@switch> show system services dhcp client ge-0/0/1.0
 Logical Interface Name       ge-0/0/1.0
  Hardware address          00:0a:12:00:12:12
  Client Status             bound
  Vendor Identifier         ether
  Server Address            10.1.1.1
  Address obtained          10.1.1.89
  Lease Obtained at         2009-08-20 18:13:04 PST
  Lease Expires at          2009-08-22 18:13:04 PST

DHCP Options :
  Name: name-server, Value: [ 10.209.194.131, 2.2.2.2, 3.3.3.3 ]
  Name: server-identifier, Value: 10.1.1.1
  Name: router, Value: [ 10.1.1.80 ]
  Name: boot-image,
  Value: jinstall-ex-4200-9.6R1.5-domestic-signed.tgz
  Name: boot-image-location,
  Value: 10.1.1.25:/bootfiles/
```

Meaning The output from this command shows the name and location of the software package under DHCP options when automatic software download was last used to install a software package. The sample output in DHCP options shows that the last DHCP server message to arrive on the DHCP client had a boot server address of 192.168.1.165 and a boot file named jinstall-ex-4200-9.6R1.5-domestic-signed.tgz. If automatic software download was enabled on this client switch during the last DHCP message exchange, these values were used by the switch to upgrade the software.

Related Documentation

- Upgrading Software Using Automatic Software Download on page 127
- Understanding DHCP Services for Switches on page 36

Operational Commands

- commit
- clear log
- clear chassis display message
- clear system commit
- clear system reboot
- file
- file archive
- file checksum md5
- file checksum sha1
- file checksum sha-256
- file compare
- file delete
- file list
- file rename
- file show
- load
- ping
- request chassis beacon
- request chassis fpc
- request chassis pic
- request chassis routing-engine master
- request message
- request system configuration rescue delete
- request system configuration rescue save
- request system halt
- request system license add
- request system license delete
- request system license save
- request system logout
- request system power-off
- request system reboot
- request system snapshot

- request system software add
- request system software delete
- request system software download
- request system software in-service-upgrade
- request system software nonstop-upgrade
- request system software rollback
- request system software validate
- request system storage cleanup
- request system zeroize
- restart
- rollback
- save
- show app-engine info
- show chassis alarms
- show chassis beacon
- show chassis environment
- show chassis environment fpc
- show chassis environment pem
- show chassis environment routing-engine
- show chassis fan
- show chassis firmware
- show chassis fpc
- show chassis hardware
- show chassis in-service-upgrade
- show chassis lcd
- show chassis led
- show chassis location
- show chassis mac-addresses
- show chassis pic
- show chassis routing-engine
- show chassis zones
- show cli
- show cli authorization
- show cli directory
- show cli history
- show host
- show interfaces diagnostics optics

- show log
- show ntp associations
- show ntp status
- show subscribers
- show system alarms
- show system audit
- show system boot-messages
- show system buffers
- show system certificate
- show system commit
- show system configuration archival
- show system configuration rescue
- show system connections
- show system core-dumps
- show system directory-usage
- show system license
- show system processes
- show system reboot
- show system resource-cleanup processes
- show system rollback
- show system services service-deployment
- show system software
- show system statistics
- show system storage
- show system uptime
- show system users
- show system virtual-memory
- show version
- start shell
- test configuration
- traceroute
- traceroute monitor

commit

Syntax commit <<*at* <"string">> <and-quit> <check> <comment <"*comment-string*">>
<confirmed> <display detail> <**fast-synchronize**> <*minutes*>
<synchronize <force> <scripts>>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Option **fast-synchronize** added in Junos OS Release 12.2.
Option **synchronize scripts** introduced in Junos OS Release 13.2.

Description Commit the set of changes to the database and cause the changes to take operational effect.

Options **at <"string">**—(Optional) Save software configuration changes and activate the configuration at a future time, or upon reboot.

string is **reboot** or the future time to activate the configuration changes. Enclose the ***string*** value (including **reboot**) in quotation marks (" "). You can specify time in two formats:

- A time value in the form ***hh*:*mm***[**:*ss***] (hours, minutes, and optionally seconds)— Commit the configuration at the specified time, which must be in the future but before 11:59:59 PM on the day the **commit at** configuration command is issued. Use 24-hour time for the ***hh*** value; for example, **04:30:00** is 4:30:00 AM, and **20:00** is 8:00 PM. The time is interpreted with respect to the clock and time zone settings on the router.

- A date and time value in the form ***yyyy-mm-dd hh*:*mm***[**:*ss***] (year, month, date, hours, minutes, and, optionally, seconds)—Commit the configuration at the specified day and time, which must be after the **commit at** command is issued. Use 24-hour time for the ***hh*** value. For example, **2003-08-21 12:30:00** is 12:30 PM on August 21, 2003. The time is interpreted with respect to the clock and time zone settings on the router.

For example, **commit at "18:00:00"**. For date and time, include both values in the same set of quotation marks. For example, **commit at "2005-03-10 14:00:00"**.

A *commit check* is performed when you issue the **commit at** configuration mode command. If the result of the check is successful, then the current user is logged out of configuration mode, and the configuration data is left in a read-only state. No other commit can be performed until the scheduled commit is completed.

NOTE: If Junos OS fails before the configuration changes become active, all configuration changes are lost.

You cannot enter the **commit at** configuration command when there is a pending reboot.

You cannot enter the **request system reboot** command once you schedule a commit operation for a specific time in the future.

You cannot commit a configuration when a scheduled commit is pending. For information about how to use the **clear** command to cancel a scheduled configuration, see the CLI Explorer.

and-quit—(Optional) Commit the configuration and, if the configuration contains no errors and the commit succeeds, exit from configuration mode.

check—(Optional) Verify the syntax of the configuration, but do not activate it.

comment <"***comment-string***">—(Optional) Add a comment that describes the committed configuration. The comment can be as long as 512 bytes and must be typed on a single line. You cannot include a comment with the **commit check** command. Enclose ***comment-string*** in quotation marks (" "). For example, **commit comment "Includes changes recommended by SW Lab".**

confirmed <*minutes*>—(Optional) Require that the commit be confirmed within the specified amount of time. To confirm a commit, enter either a **commit** or **commit check** command. If the commit is not confirmed within the time limit, the configuration rolls back automatically to the precommit configuration and a broadcast message is sent to all logged-in users. To show when a rollback is scheduled, enter the **show system commit** command. The allowed range is **1** through **65,535** minutes, and the default is **10** minutes.

In Junos OS Release 11.4 and later, you can also use the **commit confirmed** command in the **[edit private]** configuration mode.

display detail—(Optional) Monitors the commit process.

NOTE: In Junos OS Release 10.4 and later, if the number of commit details or messages exceeds a page when used with the **| display detail** pipe option, the **more** pagination option on the screen is no longer available. Instead, the messages roll up on the screen by default, just like using the **commit** command with the **| no more** pipe option.

fast-synchronize—(Optional) Configure the commits to run in parallel on both the master and backup Routing Engines to reduce the time taken for commit synchronization.

NOTE: The **fast-synchronize** statement is not supported on QFX Series devices when used in a Virtual Chassis.

synchronize <force> <scripts>—(Optional) If your router has two Routing Engines, you can manually direct one Routing Engine to synchronize its configuration with the other by issuing the **commit synchronize** command. The Routing Engine on which you execute this command (request Routing Engine) copies and loads its candidate configuration to the other (responding Routing Engine). Both Routing Engines then perform a syntax check on the candidate configuration file being committed. If no errors are found, the configuration is activated and becomes the current operational configuration on both Routing Engines. The **commit synchronize** command does not work if the responding Routing Engine has uncommitted configuration changes. However, you can enforce commit synchronization on the Routing Engines by using the **force** option. When you issue the **commit synchronize** command with the **force** option from one Routing Engine, the configuration sessions on the other Routing Engine are terminated and its configuration synchronized with that on the Routing Engine from which you issued the command.

When you issue the **commit synchronize** command with the **scripts** option, the device synchronizes all commit, event, lib, and op scripts from the requesting Routing Engine to the responding Routing Engine and also commits and synchronizes the configuration. If the commit check operation fails for the requesting Routing Engine, the process stops, and the scripts are not copied to the responding Routing Engine. If the commit check or commit operation fails for the responding Routing Engine, the scripts are still synchronized, since the synchronization occurs prior to the commit check operation on the responding Routing Engine.

If the **load-scripts-from-flash** statement is configured for the requesting Routing Engine, the device synchronizes the scripts from flash memory on the requesting Routing Engine to flash memory on the responding Routing Engine. Otherwise, the device synchronizes the scripts from the hard disk on the requesting Routing Engine to the hard disk on the responding Routing Engine. The device synchronizes all scripts regardless of whether they are enabled in the configuration or have been updated since the last synchronization.

NOTE: When you issue the **commit synchronize** command, you must use the **apply-groups re0** and **re1** commands. For information about how to use groups, see *Disabling Inheritance of a Junos OS Configuration Group*.

The responding Routing Engine must use Junos OS Release 5.0 or later.

Required Privilege Level

configure—To enter configuration mode.

NOTE: If you are using Junos OS in a Common Criteria environment, system log messages are created whenever a secret attribute is changed (for example, password changes or changes to the RADIUS shared secret). These changes are logged during the following configuration load operations:

```
load merge
load replace
load override
load update
```

For more information, see the *Secure Configuration Guide for Common Criteria and Junos-FIPS*

Related Documentation

- *Verifying a Junos Configuration, Committing a Junos OS Configuration*
- *Scheduling a Junos Commit Operation*
- *Deactivating and Reactivating Statements and Identifiers in a Junos Configuration*
- *Monitoring the Junos Commit Process*
- *Adding a Comment to Describe the Committed Configuration*

Sample Output

commit | display detail

```
user@host> commit | display detail
--------------
2011-08-24 01:08:08.00691 PDT: begin creating snapshots
2011-08-24 01:08:09.00210 PDT: end creating snapshots
2011-08-24 01:08:09.00211 PDT: begin preparing metadata
2011-08-24 01:08:09.00228 PDT: end preparing metadata
2011-08-24 01:08:09.00229 PDT: begin computing dcf root changes
2011-08-24 01:08:09.00236 PDT: end computing dcf root changes
2011-08-24 01:08:09.00244 PDT: begin computing additions
2011-08-24 01:08:09.00251 PDT: end computing additions
2011-08-24 01:08:09.00251 PDT: begin local object validation
2011-08-24 01:08:09.00251 PDT: end local object validation
2011-08-24 01:08:09.00252 PDT: begin update instances
2011-08-24 01:08:09.00252 PDT: end update instances
2011-08-24 01:08:09.00252 PDT: begin adjust metadata
2011-08-24 01:08:09.00252 PDT: end adjust metadata
2011-08-24 01:08:09.00253 PDT: begin validate metadata
2011-08-24 01:08:09.00253 PDT: end validate metadata
2011-08-24 01:08:09.00253 PDT: begin adjust allocations
2011-08-24 01:08:09.00254 PDT: end adjust allocations
2011-08-24 01:08:09.00254 PDT: begin adjust dependencies
2011-08-24 01:08:09.00254 PDT: end adjust dependencies
2011-08-24 01:08:09.00255 PDT: begin instance validation
2011-08-24 01:08:09.00255 PDT: end instance validation
2011-08-24 01:08:09.00255 PDT: begin opening all sessions eagerly
2011-08-24 01:08:09.00277 PDT: begin request #1 [login]
2011-08-24 01:08:09.00278 PDT: end request #1 [login]
2011-08-24 01:08:09.00325 PDT: begin processing globals
2011-08-24 01:08:09.00330 PDT: begin waiting for stamp check
```

```
(qfabric-default---node0)
2011-08-24 01:08:09.00334 PDT: end reply #1 [login]
2011-08-24 01:08:09.00351 PDT: end reply #1 [login]
2011-08-24 01:08:09.00451 PDT: begin request #2 [open]
2011-08-24 01:08:09.00451 PDT: end request #2 [open]
2011-08-24 01:08:09.00451 PDT: begin request #3 [get commit history]
2011-08-24 01:08:09.00452 PDT: end request #3 [get commit history]
2011-08-24 01:08:09.00452 PDT: begin request #4 [load]
2011-08-24 01:08:09.00453 PDT: end request #4 [load]
2011-08-24 01:08:09.00453 PDT: begin request #5 [load]
2011-08-24 01:08:09.00454 PDT: begin reply #2 [open]
2011-08-24 01:08:09.00456 PDT: end reply #2 [open]
2011-08-24 01:08:09.00457 PDT: begin reply #3 [get commit history]
2011-08-24 01:08:09.00475 PDT: end reply #3 [get commit history]
2011-08-24 01:08:09.00476 PDT: begin reply #4 [load]
2011-08-24 01:08:09.00499 PDT: begin reply #5 [load]
2011-08-24 01:08:09.00501 PDT: end waiting for stamp check
(qfabric-default---node0)
2011-08-24 01:08:09.00501 PDT: begin waiting for open (qfabric-default---node0)
2011-08-24 01:08:09.00502 PDT: end waiting for open (qfabric-default---node0)
2011-08-24 01:08:09.00504 PDT: end processing globals
2011-08-24 01:08:09.00617 PDT: end request #5 [load]
2011-08-24 01:08:09.00617 PDT: begin request #6 [check]
2011-08-24 01:08:09.00617 PDT: end request #6 [check]
2011-08-24 01:08:09.00619 PDT: end reply #5 [load]
2011-08-24 01:08:09.00619 PDT: begin reply #6 [check]
2011-08-24 01:08:09.00730 PDT: end session
2011-08-24 01:08:09.00752 PDT: end request #5 [load]
2011-08-24 01:08:09.00754 PDT: begin request #6 [check]
2011-08-24 01:08:09.00755 PDT: end request #6 [check]
2011-08-24 01:08:09.00881 PDT: end request #5 [load]
2011-08-24 01:08:09.00961 PDT: begin commit to devices
2011-08-24 01:08:10.00668 PDT: begin request #8 [get commit history]
2011-08-24 01:08:10.00669 PDT: end request #8 [get commit history]
2011-08-24 01:08:10.00721 PDT: end session
2011-08-24 01:08:10.00727 PDT: end commit to devices
2011-08-24 01:08:10.00733 PDT: begin committing metadata
2011-08-24 01:08:10.00772 PDT: end committing metadata
2011-08-24 01:08:10.00772 PDT: begin calling commit callbacks
2011-08-24 01:08:10.00773 PDT: end calling commit callbacks
commit complete
```

clear log

Syntax

clear log *filename*
<all>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Remove contents of a log file.

Options

filename—Name of the specific log file to delete.

all—(Optional) Delete the specified log file and all archived versions of it.

Required Privilege Level

clear

Related Documentation

- show log on page 846

List of Sample Output

clear log on page 324

Output Fields

See file list for an explanation of output fields.

Sample Output

clear log

The following sample commands list log file information, clear the contents of a log file, and then display the updated log file information:

```
user@host> file list lcc0-re0:/var/log/sampled detail
lcc0-re0:
--------------------------------------------------------------------------
-rw-r-----  1 root  wheel      26450 Jun 23 18:47 /var/log/sampled
total 1

user@host> clear log lcc0-re0:sampled
lcc0-re0:
--------------------------------------------------------------------------

user@host> file list lcc0-re0:/var/log/sampled detail
lcc0-re0:
--------------------------------------------------------------------------
-rw-r-----  1 root  wheel         57 Sep 15 03:44 /var/log/sampled
total 1
```

clear chassis display message

Syntax
clear chassis display message

Syntax (TX Matrix Router)
clear chassis display message
<lcc *number* | scc>

Syntax (TX Matrix Plus Router)
clear chassis display message
<lcc *number* | sfc *number*>

Syntax (QFabric Systems)
clear chassis display message
<node-device *name* | interconnect-device *name*>

Release Information
Command introduced in Junos OS Release 7.5.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option for the TX Matrix Plus routers introduced in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description
(M40e, M160, M320, T Series routers, EX Series, and QFabric systems only) Clear or stop a text message on the craft interface display, which is on the front of the router or switch or on the LCD panel display on the router or switch. The craft interface alternates the display of text messages with standard craft interface messages, switching between messages every 2 seconds. By default, on both the router and the switch, the text message is displayed for 5 minutes. The craft interface display has four 20-character lines. The LCD panel display has two 16-character lines, and text messages appear only on the second line.

Options
none—Clear or stop a text message on the craft interface display.

interconnect-device *name*—(QFabric systems only) (Optional) On a QFabric system, clear or stop a text message on the LCD panel display on the specified Interconnect device.

lcc *number*—(TX Matrix router and TX Matrix Plus router only) (Optional) Line-card chassis number.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

node-device *name*—(QFabric systems only) (Optional) On a QFabric system, clear or stop a text message on the LCD panel display on the specified Node device in a Node group.

scc—(TX Matrix routers only) (Optional) Clear or stop a text message on the craft interface on the TX Matrix router (switch-card chassis).

sfc *number*—(TX Matrix Plus routers only) (Optional) Clear or stop a text message on the craft interface on the TX Matrix Plus router (or switch-fabric chassis). Replace ***number*** with 0.

Required Privilege Level clear

Related Documentation

- *Configuring the LCD Panel on EX Series Switches (CLI Procedure)*
- *set chassis display message*
- *show chassis craft-interface*

List of Sample Output clear chassis display message on page 326

Output Fields See *show chassis craft-interface* for an explanation of output fields.

Sample Output

clear chassis display message

The following example displays and then clears the text message on the craft interface display:

```
user@host> show chassis craft-interface
Red alarm:     LED off, relay off
Yellow alarm:  LED off, relay off
Host OK LED:   On
Host fail LED: Off
FPCs     0  1  2  3  4  5  6  7
-------------------------------
Green  ..  *..  *  *.
Red    ........
LCD screen:
     +--------------------+
     |NOC contact Dusty   |
     |(888) 526-1234      |
     +--------------------+
```

```
user@host> clear chassis display message
```

```
user@host> show chassis craft-interface
Red alarm:     LED off, relay off
Yellow alarm:  LED off, relay off
Host OK LED:   On
Host fail LED: Off
FPCs     0  1  2  3  4  5  6  7
-------------------------------
Green  ..  *..  *  *.
Red    ........
LCD screen:
```



```
+--------------------+
|host                |
|Up: 0+17:05:47      |
|                    |
|Temperature OK      |
+--------------------+
```

clear system commit

Syntax clear system commit

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear any pending commit operation.

Options This command has no options.

Required Privilege Level maintenance (or the actual user who scheduled the commit)

Related Documentation

- show system commit on page 898

List of Sample Output

clear system commit on page 328
clear system commit (None Pending) on page 328
clear system commit (User Does Not Have Required Privilege Level) on page 328

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear system commit

```
user@host> clear system commit
Pending commit cleared.
```

clear system commit (None Pending)

```
user@host> clear system commit
No commit scheduled.
```

clear system commit (User Does Not Have Required Privilege Level)

```
user@host> clear system commit
error: Permission denied
```


clear system reboot

Syntax

clear system reboot
<both-routing-engines>

Syntax (EX Series Switches)

clear system reboot
<all-members>
<both-routing-engines>
<local>
<member *member-id*>

Syntax (TX Matrix Router)

clear system reboot
<both-routing-engines>
<all-chassis | all-lcc | lcc *number* | scc>

Syntax (TX Matrix Plus Router)

clear system reboot
<both-routing-engines>
<all-chassis | all-lcc | lcc *number* | sfc *number*>

Syntax (QFX Series)

clear system reboot
<infrastructure *name*>
<interconnect-device *name*>
<node-group *name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Clear any pending system software reboots or halts. When issued on a TX Matrix router without any options, the default behavior clears all pending system software reboots or halts on all T640 routers connected to the TX Matrix router. When issued on a TX Matrix Plus router without any options, the default behavior clears all pending system software reboots or halts on all T1600 or T4000 routers connected to the TX Matrix Plus router.

Options

none—Clear all pending system software reboots or halts.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Clear all halt or reboot requests for all the Routing Engines in the chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, clear all halt or reboot requests for all T640 routers (or line-card chassis) connected to the TX Matrix router. On a TX Matrix Plus router, clear all halt or reboot requests on the l connected T1600 or T4000 LCCs.

all-members—(EX4200 switches only) (Optional) Clear all halt or reboot requests on all members of the Virtual Chassis configuration.

both-routing-engines—(Systems with multiple Routing Engines) (Optional) Clear all halt or reboot requests on both Routing Engines. On a TX Matrix router, clear both Routing Engines on all chassis connected to the TX Matrix router. Likewise, on a TX Matrix

Plus router, clear both Routing Engines on all chassis connected to the TX Matrix Plus router.

infrastructure ***name***—(QFabric systems) (Optional) Clear all halt or reboot requests on the fabric control Routing Engines or fabric manager Routing Engines.

interconnect-device ***name***—(QFabric systems) (Optional) Clear all halt or reboot requests on the Interconnect device.

lcc ***number***—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, clear all halt or reboot requests for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, clear all halt or reboot requests for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches only) (Optional) Clear all halt or reboot requests on the local Virtual Chassis member.

member ***member-id***—(EX4200 switches only) (Optional) Clear all halt or reboot requests on the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value from 0 through 9.

node-group ***name***—(QFabric systems) (Optional) Clear all halt or reboot requests on the Node group.

scc—(TX Matrix routers only) (Optional) Clear all halt or reboot requests for the TX Matrix router (or switch-card chassis).

sfc ***number***—(TX Matrix Plus routers only) (Optional) Clear all halt or reboot requests for the TX Matrix Plus router. Replace ***number*** with 0.

Required Privilege Level

maintenance

Related Documentation

- *request system reboot*
- **request system reboot on page 387**
- Rebooting and Halting a QFX Series Product on page 162
- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

clear system reboot on page 332
clear system reboot (TX Matrix Router) on page 332
clear system reboot (QFX Series) on page 332

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear system reboot

```
user@host> clear system reboot
reboot requested by root at Sat Dec 12 19:37:34 1998
[process id 17855]
Terminating...
```

clear system reboot (TX Matrix Router)

```
user@host> clear system reboot
scc-re0:
--------------------------------------------------------------------------
No shutdown/reboot scheduled.
lcc0-re0:
--------------------------------------------------------------------------
No shutdown/reboot scheduled.
lcc2-re0:
--------------------------------------------------------------------------
No shutdown/reboot scheduled.
```

clear system reboot (QFX Series)

```
user@switch> clear system reboot node-group node1
No shutdown/reboot scheduled.
```


file

Syntax file <**archive |checksum |compare | copy | delete | list | rename | show | source address |archive**>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Archive files from the device, copy files to and from the router or switch, calculate the file checksum, compare files, delete a file from the device, list files on the device, rename a file, show file contents, or show the local address to initiate a connection.

Options **archive (Optional)** —Archive, and optionally compress, one or multiple local system files as a single file, locally or at a remote location.

checksum (Optional) —Calculate the Message Digest 5 (MD5) checksum of a file.

compare (Optional) —Compare two local files and describe the differences between them in default, context, or unified output styles.

copy (Optional) —Copy files from one place to another on the local switch or between the local switch and a remote system.

delete (Optional) —Delete a file on the local switch.

list (Optional) —Display a list of files on the local switch.

rename (Optional) —Rename a file on the local switch.

show (Optional) —Display the contents of a file.

source address (Optional) —Specify the source address of the local file.

Required Privilege Level maintenance

Related Documentation

- *Viewing Files and Directories on a Device Running Junos OS*
- CLI Explorer

file archive

Syntax

file archive destination *destination* source *source*
<compress>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Archive, and optionally compress, one or multiple local system files as a single file, locally or at a remote location.

Options

destination ***destination***—Destination of the archived file or files. Specify the destination as a URL or filename. The Junos OS adds one of the following suffixes if the destination filename does not already have it:

- For archived files—The suffix **.tar**
- For archived and compressed files—The suffix **.tgz**

source ***source***—Source of the original file or files. Specify the source as a URL or filename.

compress—(Optional) Compress the archived file with the GNU zip (gzip) compression utility. The compressed files have the suffix **.tgz**.

Required Privilege Level

maintenance

Related Documentation

- Format for Specifying Filenames and URLs in Junos OS CLI Commands on page 57

List of Sample Output

file archive (Multiple Files) on page 334
file archive (Single File) on page 334
file archive (with Compression) on page 335

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

file archive (Multiple Files)

The following sample command archives all message files in the local directory **/var/log/messages** as the single file **messages-archive.tar**.

```
user@host> file archive source /var/log/messages* destination /var/log/messages-archive.tar
/usr/bin/tar: Removing leading / from absolute path names in the archive.

user@host>
```

file archive (Single File)

The following sample command archives one message file in the local directory **/var/log/messages** as the single file **messages-archive.tar**.


```
user@host> file archive source /var/log/messages destination /var/log/messages-archive.tar
/usr/bin/tar: Removing leading / from absolute path names in the archive.
user@host
```

file archive (with Compression)

The following sample command archives and compresses all message files in the local directory **/var/log/messages** as the single file **messages-archive.tgz**.

```
user@host> file archive compress source /var/log/messages* destination
/var/log/messages-archive.tgz
/usr/bin/tar: Removing leading / from absolute path names in the archive.
```

file checksum md5

Syntax file checksum md5 <*pathname*> *filename*

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Calculate the Message Digest 5 (MD5) checksum of a file.

Options ***pathname***—(Optional) Path to a filename.

filename—Name of a local file for which to calculate the MD5 checksum.

Required Privilege Level maintenance

Related Documentation

- *Configuring Checksum Hashes for a Commit Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Event Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Op Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Executing an Op Script from a Remote Site* in the *Junos OS Configuration and Operations Automation Guide*
- file checksum sha-256 on page 338
- file checksum sha1 on page 337
- *op*

List of Sample Output file checksum md5 on page 336

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

file checksum md5

```
user@host> file checksum md5 jbundle-5.3R2.4-export-signed.tgz
MD5 (jbundle-5.3R2.4-export-signed.tgz) = 2a3b69e43f9bd4893729cc16f505a0f5
```


file checksum sha1

Syntax file checksum sha1 <*pathname*> *filename*

Release Information Command introduced in Junos OS Release 9.5.
Command introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Calculate the Secure Hash Algorithm (SHA-1) checksum of a file.

Options ***pathname***—(Optional) Path to a filename.

filename—Name of a local file for which to calculate the SHA-1 checksum.

Required Privilege Level maintenance

Related Documentation

- *Configuring Checksum Hashes for a Commit Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Event Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Op Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Executing an Op Script from a Remote Site* in the *Junos OS Configuration and Operations Automation Guide*
- file checksum md5 on page 336
- file checksum sha-256 on page 338
- *op*

List of Sample Output file checksum sha1 on page 337

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

file checksum sha1

```
user@host> file checksum sha1 /var/db/scripts/opscript.slax

SHA1 (/var/db/scripts/commitscript.slax) = ba9e47120c7ce55cff29afd73eacd370e162c676
```

file checksum sha-256

Syntax file checksum sha-256 <*pathname*> *filename*

Release Information Command introduced in Junos OS Release 9.5.
Command introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Calculate the Secure Hash Algorithm 2 family (SHA-256) checksum of a file.

Options ***pathname***—(Optional) Path to a filename.

filename—Name of a local file for which to calculate the SHA-256 checksum.

Required Privilege Level maintenance

Related Documentation

- *Configuring Checksum Hashes for a Commit Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Event Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Op Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Executing an Op Script from a Remote Site* in the *Junos OS Configuration and Operations Automation Guide*
- file checksum md5 on page 336
- file checksum sha1 on page 337
- *op*

List of Sample Output file checksum sha-256 on page 338

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

file checksum sha-256

```
user@host> file checksum sha-256 /var/db/scripts/commitscript.slax

SHA256 (/var/db/scripts/commitscript.slax) =
94c2b061fb55399e15babd2529453815601a602b5c98e5c12ed929c9d343dd71
```


file compare

Syntax

file compare (files *filename filename*)
<context | unified>
<ignore-white-space>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Compare two local files and describe the differences between them in default, context, or unified output styles:

- **Default**—In the first line of output, **c** means lines were changed between the two files, **d** means lines were deleted between the two files, and **a** means lines were added between the two files. The numbers preceding this alphabetical marker represent the first file, and the lines after the alphabetical marker represent the second file. A left angle bracket (**<**) in front of output lines refers to the first file. A right angle bracket (**>**) in front of output lines refers to the second file.
- **Context**—The display is divided into two parts. The first part is the first file; the second part is the second file. Output lines preceded by an exclamation point (**!**) have changed. Additions are marked with a plus sign (**+**), and deletions are marked with a minus sign (**-**).
- **Unified**—The display is preceded by the line number from the first and the second file (*xx,xxx,x*). Before the line number, additions to the file are marked with a plus sign (**+**), and deletions to the file are marked with a minus sign (**-**). The body of the output contains the affected lines. Changes are viewed as additions plus deletions.

Options

files *filename*—Names of two local files to compare.

context—(Optional) Display output in context format.

ignore-white-space—(Optional) Ignore changes in the amount of white space.

unified—(Optional) Display output in unified format.

Required Privilege Level

none

Related Documentation

- Format for Specifying Filenames and URLs in Junos OS CLI Commands on page 57
- Viewing Core Files from Junos OS Processes on page 171

List of Sample Output

file compare files on page 340
file compare files context on page 340
file compare files unified on page 340
file compare files unified ignore-white-space on page 340

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

file compare files

```
user@host> file compare files /tmp/one /tmp/two
100c100
<              full-name "File 1";
---
>              full-name "File 2";
102c102
<              class foo; # 'foo' is not defined
---
>              class super-user;
```

file compare files context

```
user@host> file compare files /tmp/one /tmp/two context
*** /tmp/one    Wed Dec  3 17:12:50 2003
--- /tmp/two    Wed Dec  3 09:13:14 2003
***************
*** 97,104 ****
              }
          }
          user bill {
!             full-name "Bill Smith";
!             class foo; # 'foo' is not defined
              authentication {
                  encrypted-password SECRET;
              }
--- 97,105 ----
              }
          }
          user bill {
!             full-name "Bill Smith";
!             uid 1089;
!             class super-user;
              authentication {
                  encrypted-password SECRET;
              }
```

file compare files unified

```
user@host> file compare files /tmp/one /tmp/two unified
--- /tmp/one    Wed Dec  3 17:12:50 2003
+++ /tmp/two    Wed Dec  3 09:13:14 2003
@@ -97,8 +97,9 @@
             }
         }
         user bill {
-            full-name "Bill Smith";
-            class foo; # 'foo' is not defined
+            full-name "Bill Smith";
+            uid 1089;
+            class super-user;
             authentication {
                 encrypted-passwordSECRET;
             }
```

file compare files unified ignore-white-space

```
user@host> file compare files /tmp/one /tmp/two unified ignore-white-space
```



```
--- /tmp/one    Wed Dec  3 09:13:10 2003
+++ /tmp/two    Wed Dec  3 09:13:14 2003
@@ -99,7 +99,7 @@
         user bill {
             full-name "Bill Smith";
             uid 1089;
-            class foo; # 'foo' is not defined
+            class super-user;
             authentication {
                  encrypted-password <SECRET>; # SECRET-DATA
             }
```

file delete

Syntax file delete *filename*
<purge>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Delete a file on the local router or switch.

Options ***filename***—Name of the file to delete. For a routing matrix, include chassis information in the filename if the file to be deleted is not local to the Routing Engine from which the command is issued.

purge—(Optional) Overwrite regular files before deleting them.

Required Privilege Level maintenance

List of Sample Output file delete on page 342
file delete (Routing Matrix) on page 342

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

file delete

```
user@host> file list /var/tmp
dcd.core
rpd.core
snmpd.core

user@host> file delete /var/tmp/snmpd.core
user@host> file list /var/tmp
dcd.core
rpd.core
```

file delete (Routing Matrix)

```
user@host> file list lcc0-re0:/var/tmp
dcd.core
rpd.core
snmpd.core

user@host> file delete lcc0-re0:/var/tmp/snmpd.core
user@host> file list /var/tmp
dcd.core
rpd.core
```


file list

Syntax

file list
<detail | recursive>
<*filename*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display a list of files on the local router or switch.

Options

none—Display a list of all files for the current directory.

detail | recursive—(Optional) Display detailed output or descend recursively through the directory hierarchy, respectively.

filename—(Optional) Display a list of files. For a routing matrix, the filename must include the chassis information.

Additional Information

The default directory is the home directory of the user logged in to the router or switch. To view available directories, enter a space and then a backslash (/) after the **file list** command. To view files within a specific directory, include a backslash followed by the directory and, optionally, subdirectory name after the **file list** command.

Required Privilege Level

maintenance

List of Sample Output

file list on page 343
file list (Routing Matrix) on page 343

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

file list

```
user@host> file list /var/tmp
dcd.core
rpd.core
snmpd.core
```

file list (Routing Matrix)

```
user@host> file list lcc0-re0:var/tmp
lcc0-re0:
--------------------------------------------------------------------------
/var/tmp/:
.gdbinit
.pccardd
Test/
chassisd*
chassisd.nathan*
check_time*
```

```
cores/
diagTestPrep*
diagtest*
diagtest.regress*
do_switchovers*
dump_test*
err.manoj.log
esw_clearstats*
esw_counter*
esw_debug*
esw_debug_ge*
esw_filt_test*
esw_filter_tnp_addr*
esw_getstats*
esw_phy*
esw_stats*
```


file rename

Syntax file rename *source destination*

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Rename a file on the local router or switch.

Options ***destination***—New name for the file.

source—Original name of the file. For a routing matrix, the filename must include the chassis information.

Required Privilege Level maintenance

List of Sample Output file rename on page 345
file rename (Routing Matrix) on page 345

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

file rename

The following example lists the files in **/var/tmp**, renames one of the files, and then displays the list of files again to reveal the newly named file.

```
user@host> file list /var/tmp
dcd.core
rpd.core
snmpd.core

user@host> file rename /var/tmp/dcd.core /var/tmp/dcd.core.990413
user@host> file list /var/tmp
dcd.core.990413
rpd.core
snmpd.core
```

file rename (Routing Matrix)

The following example lists the files in **/var/tmp**, renames one of the files, and then displays the list of files again to reveal the newly named file.

```
user@host> file list lcc0-re1:/var/tmp
lcc0-re1:
--------------------------------------------------------------------------

/var/tmp:
.pccardd
sartre.conf
snmpd
syslogd.core-tarball.0.tgz
```

```
user@host> file rename lcc0-re0:/var/tmp/snmpd /var/tmp/snmpd.rr
user@host> file list lcc0-re1:/var/tmp
lcc0-re1:
--------------------------------------------------------------------------

/var/tmp:
.pccardd
sartre.conf
snmpd.rr
syslogd.core-tarball.0.tgz
```

file show

Syntax file show *filename*
<encoding (base64 | raw)>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the contents of a file.

Options ***filename***—Name of a file. For a routing matrix, the filename must include the chassis information.

encoding (base64 | raw)—(Optional) Encode file contents with base64 encoding or show raw text.

Required Privilege Level maintenance

List of Sample Output file show on page 347
file show (Routing Matrix) on page 347

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

file show

```
user@host> file show /var/log/messages
Apr 13 21:00:08 romney /kernel: so-1/1/2: loopback suspected; going to standby.
Apr 13 21:00:40 romney /kernel: so-1/1/2: loopback suspected; going to standby.
Apr 13 21:02:48 romney last message repeated 4 times
Apr 13 21:07:04 romney last message repeated 8 times
Apr 13 21:07:13 romney /kernel: so-1/1/0: Clearing SONET alarm(s) RDI-P
Apr 13 21:07:29 romney /kernel: so-1/1/0: Asserting SONET alarm(s) RDI-P
...
```

file show (Routing Matrix)

```
user@host> file show lcc0-re0:/var/tmp/.gdbinit
lcc0-re0:
--------------------------------------------------------------------------
####################################################################
# Settings
####################################################################

set print pretty

####################################################################
# Basic stuff
####################################################################

define msgbuf
        printf "%s", msgbufp->msg_ptr
end
```

```
# hex dump of a block of memory
# usage: dump address length
define dump
   p $arg0, $arg1
   set $ch = $arg0
   set $j = 0
   set $n = $arg1
   while ($j < $n)
        #printf "%x %x ",&$ch[$j],$ch[$j]
        printf "%x ",$ch[$j]
        set $j = $j + 1
        if (!($j % 16))
                printf "\n"
        end
   end
end
```

load

Syntax

load (factory-default | merge | override | patch | replace | set | update)
load (*filename* | terminal) <relative>

QFX Series

load (dhcp-snooping *filename*)

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Load a configuration from an ASCII configuration file, from terminal input, or from the factory default. Your current location in the configuration hierarchy is ignored when the load operation occurs.

Options

dhcp-snooping—(QFX Series switches) Loads DHCP snooping entries.

factory-default—Loads the factory configuration. The factory configuration contains the manufacturer's suggested configuration settings. The factory configuration is the router or switch's first configuration and is loaded when the router or switch is first installed and powered on.

On J Series Services Routers, pressing and holding down the Config button on the router for 15 seconds causes the factory configuration to be loaded and committed. However, this operation deletes all other configurations on the router; using the **load factory-default** command does not.

filename—Name of the file to load. For information about specifying the filename, see *Viewing Files and Directories on a Device Running Junos OS*.

merge—Combine the configuration that is currently shown in the CLI with the configuration.

override—Discard the entire configuration that is currently shown in the CLI and load the entire configuration. Marks every object as changed.

patch—Change part of the configuration and mark only those parts as changed.

replace—Look for a **replace** tag in ***filename***, delete the existing statement of the same name, and replace it with the configuration.

set—Merge a set of commands with an existing configuration. This option executes the configuration instructions line by line as they are stored in a file or from a terminal. The instructions can contain any configuration mode command, such as **set**, **edit**, **exit**, and **top**.

relative—(Optional) Use the **merge** or **replace** option without specifying the full hierarchy level.

terminal—Use the text you type at the terminal as input to the configuration. Type Ctrl+d to end terminal input.

update—Discard the entire configuration that is currently shown in the CLI, and load the entire configuration. Marks changed objects only.

NOTE: If you are using Junos OS in a Common Criteria environment, system log messages are created whenever a secret attribute is changed (for example, password changes or changes to the RADIUS shared secret). These changes are logged during the following configuration load operations:

```
load merge
load replace
load override
load update
```

For more information, see the *Secure Configuration Guide for Common Criteria and Junos-FIPS* .

Required Privilege Level configure—To enter configuration mode, but other required privilege levels depend on where the statement is located in the configuration hierarchy.

Related Documentation

- Loading a Configuration from a File on page 1133

ping

Syntax

ping *host*
<bypass-routing>
<count *requests*>
<detail>
<do-not-fragment>
<inet | inet6>
<interface *source-interface*>
<interval *seconds*>
<logical-system *logical-system-name*>
<loose-source *value*>
<mac-address *mac-address*>
<no-resolve>
<pattern *string*>
<rapid>
<record-route>
<routing-instance *routing-instance-name*>
<size *bytes*>
<source *source-address*>
<strict >
<strict-source *value*.>
<tos *type-of-service*>
<ttl *value*>
<verbose>
<vpls *instance-name*>
<wait *seconds*>

Syntax (QFX Series)

ping *host*
<bypass-routing>
<count *requests*>
<detail>
<do-not-fragment>
<inet>
<interface *source-interface*>
<interval *seconds*>
<logical-system *logical-system-name*>
<loose-source *value*>
<mac-address *mac-address*>
<no-resolve>
<pattern *string*>
<rapid>
<record-route>
<routing-instance *routing-instance-name*>
<size *bytes*>
<source *source-address*>
<strict>
< strict-source *value*>
<tos *type-of-service*>
<ttl *value*>
<verbose>
<wait *seconds*>

Release Information Command introduced before Junos OS Release 7.4.

Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Check host reachability and network connectivity. The **ping** command sends Internet Control Message Protocol (ICMP) ECHO_REQUEST messages to elicit ICMP ECHO_RESPONSE messages from the specified host. Press Ctrl+c to interrupt a ping command.

Options ***host***—IP address or hostname of the remote system to ping.

bypass-routing—(Optional) Bypass the normal routing tables and send ping requests directly to a system on an attached network. If the system is not on a directly attached network, an error is returned. Use this option to ping a local system through an interface that has no route through it.

count *requests*—(Optional) Number of ping requests to send. The range of values is **1** through **2,000,000,000**. The default value is an unlimited number of requests.

detail—(Optional) Include in the output the interface on which the ping reply was received.

do-not-fragment—(Optional) Set the do-not-fragment (DF) flag in the IP header of the ping packets. For IPv6 packets, this option disables fragmentation.

> NOTE: In Junos OS Release 11.1 and later, when issuing the **ping** command for an IPv6 route with the **do-not-fragment** option, the maximum ping packet size is calculated by subtracting 48 bytes (40 bytes for the IPV6 header and 8 bytes for the ICMP header) from the MTU. Therefore, if the ping packet size (including the 48-byte header) is greater than the MTU, the ping operation might fail.

inet—(Optional) Ping Packet Forwarding Engine IPv4 routes.

inet6—(Optional) Ping Packet Forwarding Engine IPv6 routes.

interface *source-interface*—(Optional) Interface to use to send the ping requests.

interval *seconds*—(Optional) How often to send ping requests. The range of values, in seconds, is **1** through infinity. The default value is **1**.

logical-system *logical-system-name*—(Optional) Name of logical system from which to send the ping requests.

Alternatively, enter the **set cli logical-system *logical-system-name*** command and then run the **ping** command. To return to the main router or switch, enter the **clear cli logical-system** command.

loose-source *value*—(Optional) Intermediate loose source route entry (IPv4). Open a set of values.

mac-address ***mac-address***—(Optional) Ping the physical or hardware address of the remote system you are trying to reach.

no-resolve—(Optional) Do not attempt to determine the hostname that corresponds to the IP address.

pattern ***string***—(Optional) Specify a hexadecimal fill pattern to include in the ping packet.

rapid—(Optional) Send ping requests rapidly. The results are reported in a single message, not in individual messages for each ping request. By default, five ping requests are sent before the results are reported. To change the number of requests, include the **count** option.

record-route—(Optional) Record and report the packet's path (IPv4).

routing-instance ***routing-instance-name***—(Optional) Name of the routing instance for the ping attempt.

size ***bytes***—(Optional) Size of ping request packets. The range of values, in bytes, is **0** through **65,468**. The default value is **56**, which is effectively 64 bytes because 8 bytes of ICMP header data are added to the packet.

source ***source-address***—(Optional) IP address of the outgoing interface. This address is sent in the IP source address field of the ping request. If this option is not specified, the default address is usually the loopback interface (**lo.0**).

strict—(Optional) Use the strict source route option (IPv4).

strict-source ***value***—(Optional) Intermediate strict source route entry (IPv4). Open a set of values.

tos ***type-of-service***—(Optional) Set the type-of-service (ToS) field in the IP header of the ping packets. The range of values is **0** through **255**.

If the device configuration includes the **dscp-code-point** ***value*** statement at the **[edit class-of-service host-outbound-traffic]** hierarchy level, the configured DSCP value overrides the value specified in this command option. In this case, the ToS field of ICMP echo request packets sent on behalf of this command carries the DSCP value specified in the **dscp-code-point** configuration statement instead of the value you specify in this command option.

ttl ***value***—(Optional) Time-to-live (TTL) value to include in the ping request (IPv6). The range of values is **0** through **255**.

verbose—(Optional) Display detailed output.

vpls ***instance-name***—(Optional) Ping the instance to which this VPLS belongs.

wait ***seconds***—(Optional) Maximum wait time, in seconds, after the final packet is sent. If this option is not specified, the default delay is **10** seconds. If this option is used without the count option, a default count of **5** packets is used.

Required Privilege Level

network

Related Documentation

- *Configuring the Junos OS ICMPv4 Rate Limit for ICMPv4 Routing Engine Messages*

List of Sample Output

ping hostname on page 354
ping hostname rapid on page 354
ping hostname size count on page 354

Output Fields

When you enter this command, you are provided feedback on the status of your request. An exclamation point (**!**) indicates that an echo reply was received. A period (**.**) indicates that an echo reply was not received within the timeout period. An **x** indicates that an echo reply was received with an error code. These packets are not counted in the received packets count. They are accounted for separately.

Sample Output

ping hostname

```
user@host> ping skye
PING skye.net (192.168.169.254): 56 data bytes
64 bytes from 192.168.169.254: icmp_seq=0 ttl=253 time=1.028 ms
64 bytes from 192.168.169.254: icmp_seq=1 ttl=253 time=1.053 ms
64 bytes from 192.168.169.254: icmp_seq=2 ttl=253 time=1.025 ms
64 bytes from 192.168.169.254: icmp_seq=3 ttl=253 time=1.098 ms
64 bytes from 192.168.169.254: icmp_seq=4 ttl=253 time=1.032 ms
64 bytes from 192.168.169.254: icmp_seq=5 ttl=253 time=1.044 ms
^C [abort]
```

ping hostname rapid

```
user@host> ping skye rapid
PING skye.net (192.168.169.254): 56 data bytes
!!!!!
--- skye.net ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.956/0.974/1.025/0.026 ms
```

ping hostname size count

```
user@host> ping skye size 200 count 5
PING skye.net (192.168.169.254): 200 data bytes
208 bytes from 192.168.169.254: icmp_seq=0 ttl=253 time=1.759 ms
208 bytes from 192.168.169.254: icmp_seq=1 ttl=253 time=2.075 ms
208 bytes from 192.168.169.254: icmp_seq=2 ttl=253 time=1.843 ms
208 bytes from 192.168.169.254: icmp_seq=3 ttl=253 time=1.803 ms
208 bytes from 192.168.169.254: icmp_seq=4 ttl=253 time=17.898 ms

--- skye.net ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 1.759/5.075/17.898 ms
```

request chassis beacon

Syntax (QFX Series)

request chassis beacon
<all (off | on)>
<fpc *slot-number* (off | on)>
<interconnect-device *name* (cb *slot-number* | fpc *slot-number* | (off | on)>
<node-device *name* (off | on)>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

(QFX Series only) Enable or disable the beacon LED on a QFX Series device.

Options

all—Turn the beacon LED either **on** or **off** on all QFabric system Interconnect and Node devices.

cb ***slot-number***—Turn the beacon LED either **on** or **off** on the Control Board of the QFX3008-I Interconnect device.

fpc ***slot-number***—Turn the beacon LED either **on** or **off** on the Flexible PIC Concentrator on the standalone QFX3500 switch or the Interconnect device.

interconnect-device ***name***—Turn the beacon LED either **on** or **off** on the Interconnect device.

node-device ***name***—Turn the beacon LED either **on** or **off** on the Node device.

off—Turn the beacon LED **off**.

on—Turn the beacon LED **on**.

Required Privilege Level

maintenance

Related Documentation

- show chassis beacon on page 478

List of Sample Output

request chassis beacon fpc 0 on (QFX Series) on page 355
request chassis beacon node-device (QFabric System) on page 355
request chassis beacon on interconnect-device fpc (QFabric System) on page 356

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request chassis beacon fpc 0 on (QFX Series)

```
user@switch> request chassis beacon fpc 0 on

Beacon set to ON
```

request chassis beacon node-device (QFabric System)

```
user@switch> request chassis beacon node-device node1 on
```

```
node1                    ON
```

request chassis beacon on interconnect-device fpc (QFabric System)

user@switch> **request chassis beacon on interconnect-device fpc 2**

```
FPC 2                    ON
```

request chassis fpc

Syntax

request chassis fpc (offline | online | restart) slot *slot-number*

Syntax (TX Matrix and TX Matrix Plus Routers)

request chassis fpc (offline | online | restart) slot *slot-number*
<lcc *number*>

Syntax (MX Series Routers)

request chassis fpc (offline | online | restart) slot *slot-number*
<all-members>
<local>
<member *member-id*>

Syntax (MX2020 3D Universal Edge Routers)

request chassis fpc (offline | online | restart) slot *slot-number*

Syntax (MX2010 3D Universal Edge Routers)

request chassis fpc (offline | online | restart) slot *slot-number*

Syntax (QFabric System)

request chassis fpc
<interconnect-device *name* slot *slot-number* (offline | online)>
<(offline | online) interconnect-device *name* slot *slot-number*>
<slot *slot-number* interconnect-device *name* (offline | online)>

Syntax (PTX Series Packet Transport Routers)

request chassis fpc (offline | online | restart) slot *slot-number*

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS 11.3 for QFX Series.
Command introduced in Junos OS 12.1x48 for PTX Series Packet Transport Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.

Description

(M20, M40, M40e, M120, M160, M320, MX Series, and T Series routers, QFabric systems, EX Series switches, and PTX Series Packet Transport Routers only) Control the operation of the Flexible PIC Concentrator (FPC). For information about the meaning of “FPCs” on the switches, see *EX Series Switches Hardware and CLI Terminology Mapping*.

Options

offline—Take the FPC offline.

online—Bring the FPC online.

interconnect-device ***name***—(QFabric systems only) Bring the Flexible Port Concentrator (FPC) on the QFX3008-I Interconnect device either offline or online:

- (QFabric System) On a QFabric system, specify the name of the QFX3008-I Interconnect device containing the Flexible Port Concentrator (FPC) you want to bring either offline or online.

restart—Restart the FPC.

slot ***slot-number***—FPC slot number:

- M20 router—0 through 3.
- M120 router—0 through 5.
- MX240 router—0 through 2. On the MX240 router, slot-number corresponds to the Dense Port Concentrator (DPC) slot number. If an MPC is installed, slot-number corresponds to the MPC slot number.
- MX480 router—0 through 5. On the MX480 router, slot-number corresponds to the Dense Port Concentrator (DPC) slot number. If an MPC is installed, slot-number corresponds to the MPC slot number.
- MX960 router—0 through 11. On the MX960 router, slot-number corresponds to the Dense Port Concentrator (DPC) slot number. If an MPC is installed, slot-number corresponds to the MPC slot number.
- MX2020 router—0 through 19.
- MX2010 router—0 through 9.
- TX Matrix and TX Matrix Plus routers only—On the TX Matrix router, if you specify the number of the T640 router by using the **lcc** ***number*** option (the recommended method), replace ***slot-number*** with a value from 0 through 7. Otherwise, replace ***slot-number*** with a value from 0 through 31.

  Likewise, on a TX Matrix Plus router, if you specify the number of the T1600 or T4000 router by using the **lcc** ***number*** option (the recommended method), replace ***slot-number*** with a value from 0 through 7. Otherwise, replace ***slot-number*** with a value from 0 through 31. In case of TX Matrix Plus router with 3D SIBs, replace *slot-number* with a value from **0** through **63**. For example, the following commands have the same result:

  ```
  user@host> request chassis fpc lcc 1 slot 1 offline
  user@host> request chassis fpc slot 9 offline
  ```

- Other routers—0 through 7.
- QFabric System—Replace ***slot-number*** with a value from 0 through 2.
- EX Series switches:
  - EX4200 switches in a Virtual Chassis configuration—Replace ***slot-number*** with a value from 0 through 9.
  - EX6210 switches—Replace ***slot-number*** with a value from 0 through 9.

NOTE: These commands are not supported for slots 4 and 5 when a Switch Fabric and Routing Engine (SRE) module is installed in those slots. These commands are supported for slots 4 and 5 only if a line card is installed in them.

  - EX8208 switches—Replace ***slot-number*** with a value from 0 through 7.
  - EX8216 switches—Replace ***slot-number*** with a value from 0 through 15.

- PTX5000 Packet Transport Router—Replace ***slot-number*** with a value from 0 through 7.

all-members—(MX Series routers only) (Optional) Change FPC status of all members of the Virtual Chassis configuration.

local—(MX Series routers only) (Optional) Change FPC status of the local Virtual Chassis member.

member *member-id*—(MX Series routers only) (Optional) Change FPC status of the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value of 0 or 1.

lcc *number*—(TX Matrix router and TX Matrix Plus router only) (Optional) Line-card chassis number.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

Required Privilege Level

maintenance

Related Documentation

- show chassis fpc on page 597
- *show chassis fpc-feb-connectivity*
- *show chassis fabric fpcs*
- *Configuring the Junos OS to Make a Flexible PIC Concentrator Stay Offline*
- *Configuring the Junos OS to Resynchronize FPC Sequence Numbers with Active FPCs when an FPC Comes Online*

- *MX960 Flexible PIC Concentrator Description*

List of Sample Output

request chassis fpc on page 360
request chassis fpc (MX Series Routers with Media Services Blade [MSB]) on page 360
request chassis fpc (MX2020 Router) on page 360
request chassis fpc (MX2010 Router) on page 360

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

request chassis fpc

```
user@host> request chassis fpc online slot 0
FPC 0 already online
```

request chassis fpc (MX Series Routers with Media Services Blade [MSB])

```
user@host> request chassis fpc slot 0
Possible completions:
  offline              Take FPC offline
  online               Bring FPC online
  restart              Restart FPC
```

request chassis fpc (MX2020 Router)

```
user@host >request chassis fpc online slot 2
FPC 2 already online
```

request chassis fpc (MX2010 Router)

```
user@host >request chassis fpc offline slot 5
Offline initiated, use "show chassis fpc" to verify
```


request chassis pic

Syntax request chassis pic (offline | online) fpc-slot *slot-number* pic-slot *slot-number*

Syntax (ACX4000 Series Routers) request chassis pic (offline | online) fpc-slot *slot-number* pic-slot *slot-number*

Syntax (TX Matrix and TX Matrix Plus Routers) request chassis pic (offline | online) fpc-slot *slot-number* pic-slot *slot-number* <lcc *number*>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.3 for ACX4000 Routers.
Command introduced in Junos OS Release 13.2 for the QFX Series.

Description Control the operation of the PIC.

NOTE: The **request chassis pic (offline | online) fpc-slot *slot number* pic-slot *slot-number*** command is not supported for built-in PICs on MX Series routers.

To view a list of built-in PICs on the router or switch chassis, use the **show chassis hardware** command.

NOTE: T1600 routers and TX Matrix Plus routers with 100-Gigabit Ethernet PICs require two adjacent PIC slots, 0 and 1, for each PIC. Therefore, only **online** and **offline** command options to PIC slot 0 are allowed. Use of the **online** and **offline** command options for PIC slot 1 with the described router and PIC combination is not allowed.

NOTE: In T Series routers, when the PIC state is set from **offline** to **online** or vice-versa before the processing is complete for the previous command, you are provided feedback on the status of your request. The following sample messages are displayed if you try to set a PIC **offline** or **online**:

```
user@switch> request chassis pic fpc-slot 1 pic-slot 0 online
fpc 1 pic 0 online initiated, use "show chassis fpc pic-status" to verify
```

```
user@switch> request chassis pic fpc-slot 1 pic-slot 0 online
FPC 1 PIC 0 already transitioning to online
```

When the same PIC is set to a different state while the transition is in progress, you are provided feedback on the status of your request.

```
user@switch> request chassis pic fpc-slot 1 pic-slot 0 offline
FPC 1, PIC 0 already transitioning to online.  Please retry later.
```


Options **offline**—Take the PIC offline.

online—Bring the PIC online.

fpc-slot ***slot-number***—Flexible PIC Concentrator (FPC) slot number. Replace ***slot-number*** with a value appropriate for your router or switch:

- ACX4000 routers—1 or 2.
- EX Series switches:
  - EX3200 switches and EX4200 standalone switches—0.
  - EX4200 switches in a Virtual Chassis configuration—0 through 9 (switch's member ID).
  - EX8208 switches—0 through 7 (line card).
  - EX8216 switches—0 through 15 (line card).
- M5, M7i, M10, and M10i routers—0 or 1.
- M20 routers—0 through 3.
- M40 and M40e routers—0 through 7.
- M120 routers—0 through 5.
- M160 routers—0 through 7.
- M320 routers—0 through 7.
- MX 5, MX10, and MX40 routers—0 or 1.
- MX80 routers—0 or 1.
- MX240 routers—0 through 2
- MX480 routers—0 through 5
- MX2020 routers—0 through 19.
- MX2010 routers—0 through 9.
- MX960 routers—0 through 11.
- PTX5000 routers—0 or 1.
- T Series routers—0 through 7.
- TX Matrix and TX Matrix Plus routers only—On a TX Matrix router, if you specify the number of the T640 router by using the **lcc** ***number*** option (the recommended method), replace ***slot-number*** with a value from 0 through 7. Otherwise, replace ***slot-number*** with a value from 0 through 31.

  Likewise, on a TX Matrix Plus router, if you specify the ***number*** of the T1600 or T4000 router by using the lcc number option (the recommended method), replace ***slot-number*** with a value from 0 through 7. Otherwise, for the FPC slot number, replace ***slot-number*** with a value from 0 through 31. On a TX Matrix Plus router with 3D SIBs to assign the FPC slot number, replace *slot-number* with a value from **0** through **63**. For example, the following commands have the same result:


```
user@host> request chassis pic fpc-slot 1 lcc 1 pic-slot 0 offline
user@host> request chassis pic fpc-slot 9 pic-slot 0 offline
```

- QFX5100 standalone switches—0.

pic-slot ***slot-number***—PIC slot number.

- EX3200 and EX4200 switches—0 for built-in network interfaces and 1 for interfaces on uplink modules.
- EX8208 and EX8216 switches—0.
- M Series routers—0, 1, 2, or 3
- MX960 router—***slot-number*** corresponds to the slot number of the Packet Forwarding Engine.
- PTX5000 routers—0 or 1.
- T320 router—0 or 1.
- T640 router—0, 1, 2, or 3.
- T1600 router —0, 1, 2, or 3.
- T4000 router—0, 1, 2, or 3.
- QFX5100 standalone switches—0, 1, or 2. PIC 0 is used for all interfaces that are not configured on expansion modules, and PIC 1 and PIC 2 are used for interfaces configured on expansion modules.

lcc ***number***—(TX Matrix router and TX Matrix Plus router only) (Optional) Line-card chassis number.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

Required Privilege Level

maintenance

Related Documentation

- show chassis hardware on page 628
- show chassis pic on page 790
- *Configuring the PIC Type*

List of Sample Output

request chassis pic on page 364

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

request chassis pic

```
user@host> request chassis pic pic-slot 0 online fpc-slot 0
FPC 0, PIC 0 is already online
```


request chassis routing-engine master

Syntax

request chassis routing-engine master (acquire | release | switch)
<force>
<no-confirm>

Syntax (TX Matrix Routers)

request chassis routing-engine master (acquire | release | switch) (lcc *number* | scc | all-chassis)
<force>
<no-confirm>

Syntax (TX Matrix Plus Routers)

request chassis routing-engine master (acquire | release | switch) (lcc *number* | sfc | all-chassis | all-lcc)
<force>
<no-confirm>

Syntax (MX Series Routers)

request chassis routing-engine master (acquire | release | switch)
<all-members>
<force>
<local>
<member *member-id*>
<no-confirm>

Syntax (MX104 3D Universal Edge Routers)

request chassis routing-engine master (acquire | release | switch)
<no-confirm>

Syntax (MX2010 and MX2020 3D Universal Edge Routers)

request chassis routing-engine master (acquire | release | switch <check>)
<no-confirm>

Syntax (QFX Series)

request chassis routing-engine master (release | switch)
<check>
<interconnect-device *name*>
<node-group *name*>
<no-confirm>

Release Information

Command introduced before Junos OS Release 7.4.
all-chassis option added in Junos OS Release 8.0.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.3 for QFX Series.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.

Description

For routers or switches with multiple Routing Engines, control which Routing Engine is the master.

CAUTION: (Routing matrix based on the TX Matrix or TX Matrix Plus routers only) Within the routing matrix, we recommend that all Routing Engines run the same Junos OS Release. If you run different releases on the Routing Engines and a change in mastership occurs on any backup Routing Engine in the routing matrix, one or all routers (in a routing matrix based on the TX Matrix router or in a routing matrix based on a TX Matrix Plus router) might become logically disconnected from the TX Matrix router and cause data loss. For more information, see the *TX Matrix Router Hardware Guide* or the *Junos OS High Availability Library for Routing Devices*.

NOTE: Successive graceful Routing Engine switchover events must be a minimum of 240 seconds (4 minutes) apart after both Routing Engines have come up.

If the router or switch displays a warning message similar to “Standby Routing Engine is not ready for graceful switchover. Packet Forwarding Engines that are not ready for graceful switchover might be reset,” do not attempt switchover. If you choose to proceed with switchover, only the Packet Forwarding Engines that were not ready for graceful switchover are reset. None of the Flexible PIC concentrators (FPCs) should spontaneously restart. We recommend that you wait until the warning no longer appears and then proceed with the switchover.

You will receive an error message stating “Command aborted. Not ready for mastership switch, try after n seconds” when this command is re-entered before 240 seconds have elapsed on EX Series switches.

NOTE: On a QFabric system, to avoid traffic loss on the network Node group, switch mastership of the routing engine to the backup routing engine, and then reboot.

Options

acquire—Attempt to become the master Routing Engine.

release—Request that the other Routing Engine become the master.

switch—Toggle mastership between Routing Engines.

The **acquire**, **release**, and **switch** options have the following suboptions:

all-chassis—(TX Matrix and TX Matrix Plus routers only) On a routing matrix composed of a TX Matrix router and the attached T640 routers, switch mastership on all the Routing Engines in the routing matrix. Likewise, on a routing matrix composed of a TX Matrix Plus router and the attached T1600 or T4000 routers, switch mastership on all the Routing Engines in the routing matrix.

all-lcc—(TX Matrix Plus routers only) Request to acquire mastership for all line-card chassis (LCC).

all-members—(MX Series routers only) (Optional) Control Routing Engine mastership on the Routing Engines in all member routers of the Virtual Chassis configuration.

check—(QFabric systems, MX240, MX480, MX960, MX2010, and MX2020 routers only) (Optional) Available only with the **switch** option. Check graceful switchover status of the standby Routing Engine before toggling mastership between Routing Engines.

interconnect-device *name*—(QFabric systems only) (Optional) Control Routing Engine mastership on the Routing Engines on an Interconnect device.

lcc *number*—(TX Matrix router and TX Matrix Plus router only) (Optional) Line-card chassis number.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Control Routing Engine mastership on the Routing Engines in the local Virtual Chassis member.

member *member-id*—(MX Series routers only) (Optional) Control Routing Engine mastership on the Routing Engines of the specified member in the Virtual Chassis Configuration. Replace ***member-id*** with a value of 0 or 1.

no-confirm—(Optional) Do not request confirmation for the switch.

node-group *name*—(QFabric systems only) (Optional) Control Routing Engine mastership on the Routing Engines on a Node group.

scc—(TX Matrix routers only) TX Matrix (switch-card chassis).

sfc—(TX Matrix Plus routers only) TX Matrix Plus router (or switch-fabric chassis).

force—(Optional) Available only with the acquire option. Force the change to a new master Routing Engine.

NOTE: The force option is not supported on the MX104 router.

Additional Information

Because both Routing Engines are always running, the transition from one to the other as the master Routing Engine is immediate. However, the changeover interrupts communication to the System and Switch Board (SSB). The SSB takes several seconds to reinitialize the Flexible PIC Concentrators (FPCs) and restart the PICs. Interior gateway protocol (IGP) and BGP convergence times depend on the specific network environment.

By default, the Routing Engine in slot 0 (**RE0**) is the master and the Routing Engine in slot 1 (**RE1**) is the backup. To change the default master Routing Engine, include the **routing-engine** statement at the [**edit chassis redundancy**] hierarchy level in the configuration. For more information, see the *Junos OS Administration Library for Routing Devices*

To have the backup Routing Engine become the master Routing Engine, use the **request chassis routing-engine master switch** command. If you use this command to change the master and then restart the chassis software for any reason, the master reverts to the default setting.

NOTE: Although the configurations on the two Routing Engines do not have to be the same and are not automatically synchronized, we recommend making both configurations the same.

Required Privilege Level

maintenance

Related Documentation

- show chassis routing-engine on page 804
- *Configuring Routing Engine Redundancy*
- *Switching the Global Master and Backup Roles in a Virtual Chassis Configuration*

List of Sample Output

request chassis routing-engine master acquire on page 368
request chassis routing-engine master switch on page 368

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request chassis routing-engine master acquire

```
user@host> request chassis routing-engine master acquire

warning: Traffic will be interrupted while the PFE is re-initialized

warning: The other routing engine's file system could be corrupted

Reset other routing engine and become master ? [yes,no] (no)
```

request chassis routing-engine master switch

```
user@host> request chassis routing-engine master switch

warning: Traffic will be interrupted while the PFE is re-initialized
```

```
Toggle mastership between Routing Engines ? [yes,no] (no) yes

Resolving mastership...
Complete. The other Routing Engine becomes the master.
```

Switch mastership back to the local Routing Engine:

user@host> **request chassis routing-engine master switch**

```
warning: Traffic will be interrupted while the PFE is re-initialized
Toggle mastership between routing engines ? [yes,no] (no) yes

Resolving mastership...
Complete. The local routing engine becomes the master.
```


request message

Syntax

request message all message "*text*"
request message message "*text*" (terminal *terminal-name* | user *user-name*)

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display a message on the screens of all users who are logged in to the router or switch or on specific screens.

Options

all—Display a message on the terminal of all users who are currently logged in.

message "*text*"—Message to display.

terminal *terminal-name*—Name of the terminal on which to display the message.

user *user-name*—Name of the user to whom to direct the message.

Required Privilege Level

maintenance

List of Sample Output

request message message on page 370

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request message message

```
user@host> request message message "Maintenance window in 10 minutes" user maria
Message from user@host on ttyp0 at 20:27 ...
Maintenance window in 10 minutes
EOF
```

request system configuration rescue delete

Syntax request system configuration rescue delete

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Delete an existing rescue configuration.

NOTE: The **[edit system configuration]** hierarchy is not available on QFabric systems.

Options This command has no options.

Required Privilege Level maintenance

Related Documentation

- request system configuration rescue save on page 372
- request system software rollback on page 428
- show system commit on page 898

List of Sample Output request system configuration rescue delete on page 371

Output Fields This command produces no output.

Sample Output

request system configuration rescue delete

```
user@host> request system configuration rescue delete
```

request system configuration rescue save

Syntax request system configuration rescue save

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Save the most recently committed configuration as the rescue configuration so that you can return to it at any time by using the **rollback** command.

NOTE: The **[edit system configuration]** hierarchy is not available on QFabric systems.

Options This command has no options.

Required Privilege Level maintenance

Related Documentation

- request system software delete on page 400
- request system software rollback on page 428
- show system commit on page 898

List of Sample Output request system configuration rescue save on page 372

Output Fields This command produces no output.

Sample Output

request system configuration rescue save

```
user@host> request system configuration rescue save
```


request system halt

Syntax

request system halt
<at *time*>
<backup-routing-engine>
<both-routing-engines>
<other-routing-engine>
<in *minutes*>
<media (compact-flash | disk | removable-compact-flash | usb)>
<message "*text*">

Syntax (EX Series Switches)

request system halt
<all-members>
<at *time*>
<backup-routing-engine>
<both-routing-engines>
<in *minutes*>
<local>
<media (external | internal)>
<member *member-id*>
<message "*text*">
<other-routing-engine>
<slice *slice*>

Syntax (PTX Series)

request system halt
<at *time*>
<backup-routing-engine>
<both-routing-engines>
<other-routing-engine>
<in *minutes*>
<media (compact-flash | disk)>
<message "*text*">

Syntax (TX Matrix Router)

request system halt
<all-lcc | lcc *number* | scc>
<at *time*>
<backup-routing-engine>
<both-routing-engines>
<other-routing-engine>
<in *minutes*>
<media (compact-flash | disk)>
<message "*text*">

Syntax (TX Matrix Plus Router)

request system halt
<all-chassis | all-lcc | lcc *number* | sfc *number*>
<at *time*>
<backup-routing-engine>
<both-routing-engines>
<other-routing-engine>
<in *minutes*>
<media (compact-flash | disk)>
<message "*text*">

Syntax (MX Series Router)

```
request system halt
<all-members>
<at time>
<backup-routing-engine>
<both-routing-engines>
<in minutes>
<local>
<media (external | internal)>
<member member-id>
<message "text">
<other-routing-engine>
```

Syntax (QFX Series)

```
request system halt
<all-members>
<at time>
<both-routing-engines>
<director-device director-device-id>
<in minutes>
<local>
<media >
<member member-id>
<message "text">
<other-routing-engine>
<slice slice>
```

Release Information

Command introduced before Junos OS Release 7.4.
other-routing-engine option introduced in Junos OS Release 8.0.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.
director-device option introduced for QFabric systems in Junos OS Release 12.2.
backup-routing-engine option introduced in Junos OS Release 13.1.

Description

Stop the router or switch software.

NOTE: When you issue this command on an individual component in a QFabric system, you will receive a warning that says "Hardware-based members will halt, Virtual Junos Routing Engines will reboot." If you want to halt only one member of a Node group, use the **member** option from the Node group CLI. You cannot issue this command from the QFabric CLI.

When you issue this command on a QFX5100 switch, you are not prompted to reboot. You must power cycle the switch to reboot.

Options

none—Stop the router or switch software immediately.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Halt all chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, halt all T640 routers (or line-card chassis) connected to the TX Matrix router.

On a TX Matrix Plus router, halt all T1600 or T4000 routers connected to the TX Matrix Plus router.

all-members—(EX4200 switches and MX Series routers only) (Optional) Halt all members of the Virtual Chassis configuration.

at *time* —(Optional) Time at which to stop the software, specified in one of the following ways:

- **now**—Stop the software immediately. This is the default.
- ***+minutes***—Number of minutes from now to stop the software.
- ***yymmddhhmm***—Absolute time at which to stop the software, specified as year, month, day, hour, and minute.
- ***hh:mm***—Absolute time on the current day at which to stop the software.

backup-routing-engine—(Optional) Halt the backup Routing Engine. This command halts the backup Routing Engine, regardless from which Routing Engine the command is executed. For example, if you issue the command from the master Routing Engine, the backup Routing Engine is halted. If you issue the command from the backup Routing Engine, the backup Routing Engine is halted.

both-routing-engines—(Optional) Halt both Routing Engines at the same time.

director-device *director-device-id*—(QFabric systems only) Halt a specific Director device.

lcc *number*—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, halt a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, halt a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Halt the local Virtual Chassis member.

in *minutes*—(Optional) Number of minutes from now to stop the software. This option is an alias for the at +*minutes* option.

media (compact-flash | disk | removable-compact-flash | usb)—(Optional) Boot medium for the next boot. (The options **removable-compact-flash** and **usb** pertain to J Series routers only.)

media (external | internal)—(EX Series and QFX Series switches and MX Series routers only) (Optional) Halt the boot media:

- **external**—Halt the external mass storage device.
- **internal**—Halt the internal flash device.

member ***member-id***—(EX4200 switches and MX Series routers only) (Optional) Halt the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

message "*text*"—(Optional) Message to display to all system users before stopping the software.

other-routing-engine—(Optional) Halt the other Routing Engine from which the command is issued. For example, if you issue the command from the master Routing Engine, the backup Routing Engine is halted. Similarly, if you issue the command from the backup Routing Engine, the master Routing Engine is halted.

scc—(TX Matrix routers only) (Optional) Halt the TX Matrix router (or switch-card chassis).

sfc ***number***—(TX Matrix Plus routers only) (Optional) Halt the TX Matrix Plus router (or switch-fabric chassis). Replace *number* with 0.

slice ***slice***—(EX Series and QFX Series switches only) (Optional) Halt a partition on the boot media. This option has the following suboptions:

- 1—Halt partition 1.
- 2—Halt partition 2.
- **alternate**—Reboot from the alternate partition.

Additional Information

On the M7i router, the **request system halt** command does not immediately power down the Packet Forwarding Engine. The power-down process can take as long as 5 minutes.

On a TX Matrix router and TX Matrix Plus router if you issue the **request system halt** command on the master Routing Engine, all the master Routing Engines connected to the routing matrix are halted. If you issue this command on the backup Routing Engine, all the backup Routing Engines connected to the routing matrix are halted.

NOTE: If you have a router or switch with two Routing Engines and you want to shut the power off to the router or switch or remove a Routing Engine, you must first halt the backup Routing Engine (if it has been upgraded), and then halt the master Routing Engine. To halt a Routing Engine, issue the **request system halt** command. You can also halt both Routing Engines at the same time by issuing the **request system halt both-routing-engines** command.

Required Privilege Level maintenance

Related Documentation

- clear system reboot on page 329
- request system power-off on page 383
- Rebooting and Halting a QFX Series Product on page 162
- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

request system halt on page 378
request system halt (In 2 Hours) on page 378
request system halt (Immediately) on page 378
request system halt (At 1:20 AM) on page 378

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system halt

```
user@host> request system halt
Halt the system ? [yes,no] (no) yes

*** FINAL System shutdown message from root@section2 ***
System going down IMMEDIATELY
Terminated
...
syncing disks... 11 8 done
The operating system has halted.
Please press any key to reboot.
```

request system halt (In 2 Hours)

The following example, which assumes that the time is 5 PM (1700), illustrates three different ways to request that the system stop 2 hours from now:

```
user@host> request system halt at +120
user@host> request system halt in 120
user@host> request system halt at 19:00
```

request system halt (Immediately)

```
user@host> request system halt at now
```

request system halt (At 1:20 AM)

To stop the system at 1:20 AM, enter the following command. Because 1:20 AM is the next day, you must specify the absolute time.

```
user@host> request system halt at yymmdd120
request system halt at 120
Halt the system at 120? [yes,no] (no) yes
```


request system license add

Syntax request system license add (*filename* | terminal)

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Add a license key.

Options ***filename***—License key from a file or URL. Specify the filename or the URL where the key is located.

terminal—License key from the terminal.

Required Privilege Level maintenance

Related Documentation

- Adding New Licenses (CLI Procedure) on page 91

List of Sample Output request system license add on page 379

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system license add

`user@host>` **request system license add terminal**

request system license delete

Syntax

request system license delete (*license-identifier* | license-identifier-list [*licenseid001 licenseid002 licenseid003*]| all)

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Option **license-identifier-list** introduced in Junos OS Release 13.1.

Description

Delete a license key. You can choose to delete one license at a time, all licenses at once, or a list of license identifiers enclosed in brackets.

Options

license-identifier—Text string that uniquely identifies a license key.

license-identifier-list [*licenseid001 licenseid002 licenseid003*....]—Delete multiple license identifiers as a list enclosed in brackets.

all—Delete all licenses on the device.

Required Privilege Level

maintenance

Related Documentation

- Deleting a License (CLI Procedure) on page 92

request system license save

Syntax request system license save (*filename* | terminal)

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Save installed license keys to a file or URL.

Options ***filename***—License key from a file or URL. Specify the filename or the URL where the key is located.

terminal—License key from the terminal.

Required Privilege Level maintenance

Related Documentation

- Saving License Keys on page 93

List of Sample Output request system license save on page 381

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system license save

```
user@host> request system license save ftp://user@host/license.conf
```

request system logout

Syntax request system logout (pid *pid* | terminal *terminal* | user *username*)
<all>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Log out users from the router or switch and the configuration database. If a user held the **configure exclusive** lock, this command clears the exclusive lock.

Options **all**—(Optional) Log out all sessions owned by a particular PID, terminal session, or user. (On a TX Matrix or TX Matrix Plus router, this command is broadcast to all chassis.)

pid ***pid***—Log out the user session using the specified management process identifier (PID). The PID type must be management process.

terminal ***terminal***—Log out the user for the specified terminal session.

user ***username***—Log out the specified user.

Required Privilege Level configure

Related Documentation
- *Junos OS Administration Library for Routing Devices*

List of Sample Output request system logout on page 382

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system logout

```
user@host> request system logout user tammy all
Connection closed by foreign host.
```


request system power-off

Syntax

request system power-off
<both-routing-engines>
<other-routing-engine>
<at *time*>
<in *minutes*>
<media (compact-flash | disk | removable-compact-flash | usb)>
<message "*text*">

Syntax (EX Series Switches)

request system power-off
<all-members>
<at *time*>
<both-routing-engines>
<in *minutes*>
<local>
<media (external | internal)>
<member *member-id*>
<message "*text*">
<other-routing-engine>
<slice *slice*>

Syntax (TX Matrix Router)

request system power-off
<all-chassis | all-lcc | lcc *number* | scc>
<both-routing-engines>
<other-routing-engine>
<at *time*>
<in *minutes*>
<media (compact-flash | disk)>
<message "*text*">

Syntax (TX Matrix Plus Router)

request system power-off
<all-chassis | all-lcc | lcc *number* | sfc *number*>
<both-routing-engines>
<other-routing-engine>
<at *time*>
<in *minutes*>
<media (compact-flash | disk)>
<message "*text*">

Syntax (MX Series Router)

request system power-off
<all-members>
<at *time*>
<both-routing-engines>
<in *minutes*>
<local>
<media (external | internal)>
<member *member-id*>
<message "*text*">
<other-routing-engine>

Syntax (QFX Series)

request system power-off
<at *time*>

<in *minutes*>
<media (external | internal)>
<message "*text*">
<slice *slice*>

Release Information

Command introduced in Junos OS Release 8.0.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Power off the software.

NOTE: When you issue this command on an individual component in a QFabric system, you will receive a warning that says "Hardware-based members will halt, Virtual Junos Routing Engines will reboot." If you want to halt only one member, use the **member** option. You cannot issue this command from the QFabric CLI.

Options

none—Power off the router or switch software immediately.

all-chassis—(Optional) (TX Matrix and TX Matrix Plus router only) Power off all Routing Engines in the chassis.

all-lcc—(Optional) (TX Matrix and TX Matrix Plus router only) On a TX Matrix router, power off all T640 routers (or line-card chassis) connected to the TX Matrix router. On a TX Matrix Plus router, power off all T1600 routers (or line-card chassis) connected to the TX Matrix Plus router.

all-members—(EX4200 switches and MX Series routers only) (Optional) Power off all members of the Virtual Chassis configuration.

at *time*—(Optional) Time at which to power off the software, specified in one of the following ways:

- **now**—Power off the software immediately. This is the default.
- ***+minutes***—Number of minutes from now to power off the software.
- ***yymmddhhmm***—Absolute time at which to power off the software, specified as year, month, day, hour, and minute.
- ***hh:mm***—Absolute time on the current day at which to power off the software.

both-routing-engines—(Optional) Power off both Routing Engines at the same time.

in *minutes*—(Optional) Number of minutes from now to power off the software. This option is an alias for the **at *+minutes*** option.

lcc *number*—(Optional) (TX Matrix and TX Matrix Plus router only) On a TX Matrix router, power off a T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, power off a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Power off the local Virtual Chassis member.

media (compact-flash | disk | removable-compact-flash | usb)—(Optional) Boot medium for the next boot. (The options **removable-compact-flash** and **usb** pertain to the J Series routers only.)

media (external | internal)—(EX Series and QFX Series switches and MX Series routers only) (Optional) Power off the boot media:

- **external**—Power off the external mass storage device.
- **internal**—Power off the internal flash device.

member *member-id*—(EX4200 switches and MX Series routers only) (Optional) Power off the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

message "*text*"—(Optional) Message to display to all system users before powering off the software.

other-routing-engine—(Optional) Power off the other Routing Engine from which the command is issued. For example, if you issue the command from the master Routing Engine, the backup Routing Engine is halted. Similarly, if you issue the command from the backup Routing Engine, the master Routing Engine is halted.

scc—(Optional) (TX Matrix router only) Power off only the master Routing Engine or the backup Routing Engine on the TX Matrix router (or switch-card chassis). If you issue the command from the master Routing Engine, the master SCC is powered off. If you issue the command from the backup Routing Engine, the backup SCC is powered off.

sfc *number*—(Optional) (TX Matrix Plus router only) Power off only the master Routing Engine or the backup Routing Engine on the TX Matrix Plus router (or switch-fabric chassis). If you issue the command from the master Routing Engine, the master SFC is powered off. If you issue the command from the backup Routing Engine, the backup SFC is powered off. Replace *number* with zero.

slice ***slice***—(EX Series and QFX Series switches only) (Optional) Power off a partition on the boot media. This option has the following suboptions:

- **1**—Power off partition 1.
- **2**—Power off partition 2.
- **alternate**—Reboot from the alternate partition.

Additional Information

On a routing matrix composed of a TX Matrix router and T640 routers, if you issue the **request system power-off** command on the TX Matrix master Routing Engine, all the master Routing Engines connected to the routing matrix are powered off. If you issue this command on the backup Routing Engine, all the backup Routing Engines connected to the routing matrix are powered off.

Likewise, on a routing matrix composed of a TX Matrix Plus router and T1600 routers, if you issue the **request system power-off** command on the TX Matrix Plus master Routing Engine, all the master Routing Engines connected to the routing matrix are powered off. If you issue this command on the backup Routing Engine, all the backup Routing Engines connected to the routing matrix are powered off.

If you issue the **request system power-off both-routing-engines** command on the TX Matrix or TX Matrix Plus router, all the Routing Engines on the routing matrix are powered off.

Required Privilege Level

maintenance

List of Sample Output

request system power-off on page 386

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system power-off

```
user@host> request system power-off message “This router will be powered off in 30 minutes. Please save your data and log out immediately.”
warning: This command will not halt the other routing-engine.
If planning to switch off power, use the both-routing-engines option.
Power Off the system ? [yes,no] (no) yes

*** FINAL System shutdown message from remote@nutmeg ***
System going down IMMEDIATELY

This router will be powered off in 30 minutes. Please save your data and log out
immediately.

Shutdown NOW!
[pid 5177]
```

request system reboot

Syntax (QFX Series)

request system reboot
<all <graceful>>
<at **time**>
<director-device *name*>
<director-group <graceful>>
<fabric <graceful>>
<in **minutes**>
<media >
<message “**text**”>
<node-group *name*>
<slice (1 | 2 | alternate)>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Reboot the Junos OS.

NOTE: **On a QFabric system, to avoid traffic loss on the network Node group, switch mastership of the Routing Engine to the backup Routing Engine, and then reboot.**

Reboot requests are recorded in the system log files, which you can view with the **show log messages** command. You can view the process names with the **show system processes** command.

Options

none—Reboots the software immediately.

all—(QFabric systems only) (Optional) Reboots the software on the Director group, fabric control Routing Engines, fabric manager Routing Engines, Interconnect devices, and network and server Node groups.

at time—(Optional) Time at which to reboot the software, specified in one of the following ways:

- ***+minutes***—Number of minutes from now to reboot the software.
- ***hh:mm***—Absolute time on the current day at which to reboot the software, specified in 24-hour time.
- **now**—Stop or reboot the software immediately. This is the default.
- ***yymmddhhmm***—Absolute time at which to reboot the software, specified as year, month, day, hour, and minute.

director-device *name*—(QFabric systems only) (Optional) Reboots the software on the Director device and the default partition (QFabric CLI).

director-group—(QFabric systems only) (Optional) Reboots the software on the Director group and the default partition (QFabric CLI).

fabric—(QFabric systems only) (Optional) Reboots the fabric control Routing Engines and the Interconnect devices.

graceful—(QFabric systems only) (Optional) Allows the QFabric component to reboot with minimal impact to network traffic. This option is only available for the **all**, **fabric**, and **director-group** options.

in minutes—(Optional) Number of minutes from now to reboot the software. This option is an alias for the **at +*minutes*** option.

media (external | internal)—(Optional) Boot medium for the next boot. The external option reboots the switch using a software package stored on an external boot source, such as a USB flash drive. The internal option reboots the switch using a software package stored in an internal memory source.

message "text"—(Optional) Message to display to all system users before rebooting the software.

node-group *name*—(QFabric systems only) (Optional) Reboots the software on a server Node group or a network Node group.

routing-engine—(Optional) Reboot the Routing Engine.

slice (1 | 2 | alternate)—(Optional) Reboot using the specified partition on the boot media. This option has the following suboptions:

NOTE: The slice option is not supported on the QFX5100 switch, because there is no alternate slice when Junos OS boots as a Virtual Machine (VM). To switch to previous version of Junos OS, issue the **request system software rollback** command.

- **1**—Reboot from partition 1.
- **2**—Reboot from partition 2.
- **alternate**—Reboot from the alternate partition, which is the partition that did not boot the switch at the last bootup.

Required Privilege Level

maintenance

Related Documentation

- clear system reboot on page 329
- Rebooting and Halting a QFX Series Product on page 162

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system reboot

```
user@switch> request system reboot
Reboot the system ? [yes,no] (no)
```

request system reboot (At 2300)

```
user@switch> request system reboot at 2300 message ?Maintenance time!?
Reboot the system ? [yes,no] (no) yes

shutdown: [pid 186]
*** System shutdown message from root@berry.network.net ***
System going down at 23:00
```

request system reboot (In 2 Hours)

The following example, which assumes that the time is 5 PM (1700), illustrates three different ways to request the system to reboot in 2 hours:

```
user@switch> request system reboot at +120
user@switch> request system reboot in 120
user@switch> request system reboot at 19:00
```

request system reboot (Immediately)

```
user@switch> request system reboot at now
```

request system reboot (At 1:20 AM)

To reboot the system at 1:20 AM, enter the following command. Because 1:20 AM is the next day, you must specify the absolute time.

```
user@switch> request system reboot at 06060120
request system reboot at 120
Reboot the system at 120? [yes,no] (no) yes
```

request system reboot director-device

```
user@switch> request system reboot director-device Node1
Issuing this command may interrupt traffic forwarding.
Continue? [yes,no] (no)
```

request system reboot director-group

```
user@switch> request system reboot director-group
Issuing this command may interrupt traffic forwarding.
Continue? [yes,no] (no)
```

request system reboot director-group graceful

```
user@switch> request system reboot director-group graceful
Issuing this command may interrupt traffic forwarding.
Continue? [yes,no] (no)
```

request system snapshot

Syntax

request system snapshot
<config-partition>
<media>
<partition>
<root-partition>
slice alternate

Release Information

Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Copy the currently running Junos OS and configuration to alternate media. This command takes a snapshot of the contents of the **/** (root), and **/var** partitions on the media used to boot the switch and then copies the snapshot to alternate media. If the switch was booted from internal flash memory, the snapshot is copied to an external USB flash drive. If the switch was booted from an external USB flash drive, the snapshot is copied to internal flash memory.

Options

none—Create a snapshot on the alternate media—that is, the external media if you booted the switch using software stored on internal media or internal media if you booted the switch using software stored on external media.

config-partition—(Optional) Create a snapshot of the configuration partition only and store it onto the default /altconfig on the hard disk device or an /altconfig on a USB device.

media *type*—(Optional) Specify the boot device the software is copied to:

- compact-flash—Copy software to the primary compact flash drive.
- external—Copy software to an external mass storage device, such as a USB flash drive. If a USB drive is not connected, the switch displays an error message.
- internal—Copy software to an internal flash drive.
- removable-compact-flash—Copy software to the removable compact flash drive.

partition—(Optional) Partition the destination media before copying over the snapshot.

root-partition—(Optional) Create a snapshot of the root partition only and store it onto the default /altroot on the hard disk device or an /altroot on a USB device.

slice alternate—(Optional) Take a snapshot of the active root partition and copy it to the alternate slice on the boot media.

Required Privilege Level

view

Related Documentation

- *show system snapshot*
- Creating a Snapshot and Using It to Boot a QFX Series Switch on page 154
- *Verifying That a System Snapshot Was Created on a QFX Series Switch*

List of Sample Output request system snapshot partition on page 391

Sample Output

request system snapshot partition

```
user@switch> request system snapshot partition
Clearing current label...
Partitioning external media (da1) ...
Verifying compatibility of destination media partitions...
Running newfs (334MB) on external media  / partition ...
Running newfs (404MB) on external media  /config partition ...
Running newfs (222MB) on external media  /var partition ...
Copying '/dev/da0s2a' to '/dev/da1s1a' .. (this may take a few minutes)
Copying '/dev/da0s3e' to '/dev/da1s3e' .. (this may take a few minutes)
Copying '/dev/da0s2f' to '/dev/da1s1f' .. (this may take a few minutes)
The following filesystems were archived: / /config /var
```

request system software add

Syntax

request system software add *package-name*
<best-effort-load>
<delay-restart>
<force>
<no-copy>
<no-validate>
<re0 | re1>
<reboot>
<set [*package-name package-name*]>
<unlink>
<upgrade-with-config>
<upgrade-with-config-format *format*>
<validate>

Syntax (EX Series Switches)

request system software add *package-name*
<best-effort-load>
<delay-restart>
<force>
<no-copy>
<no-validate>
<re0 | re1>
<reboot>
<set [*package-name package-name*]>
<upgrade-with-config>
<upgrade-with-config-format *format*>
<validate>

Syntax (TX Matrix Router)

request system software add *package-name*
<best-effort-load>
<delay-restart>
<force>
<lcc *number* | scc>
<no-copy>
<no-validate>
<re0 | re1>
<reboot>
<set [*package-name package-name*]>
<unlink>
<upgrade-with-config>
<upgrade-with-config-format *format*>
<validate>

Syntax (TX Matrix Plus Router)

request system software add *package-name*
<best-effort-load>
<delay-restart>
<force>
<lcc *number* | sfc *number*>
<no-copy>
<no-validate>
<re0 | re1>
<reboot>
<set [*package-name package-name*]>

<unlink>
<upgrade-with-config>
<upgrade-with-config-format *format*>
<validate>

Syntax (MX Series Router)

request system software add *package-name*
<best-effort-load>
<delay-restart>
<force>
<member *member-id*>
<no-copy>
<no-validate>
<re0 | re1>
<reboot>
<set [*package-name package-name*]>
<unlink>
<upgrade-with-config>
<upgrade-with-config-format *format*>
<validate>

Syntax (QFX Series)

request system software add *package-name*
<best-effort-load>
<component all>
<delay-restart>
<force>
<no-copy>
<no-validate>
<partition>
<reboot>
<unlink>
<upgrade-with-config>
<upgrade-with-config-format *format*>
<validate>

Release Information

Command introduced before Junos OS Release 7.4.
best-effort-load and **unlink** options added in Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.
set [*package-name package-name*] option added in Junos OS Release 11.1 for EX Series switches.
set [*package-name package-name*] option added in Junos OS Release 12.2 for M Series, MX Series, T Series routers, and Branch SRX Series Services Gateways.

NOTE: On EX Series switches, the **set [*package-name package-name*]** option allows you to install only two software packages on a mixed EX4200 and EX4500 Virtual Chassis, whereas, on M Series, MX Series, T Series routers, and Branch SRX Series Services Gateways, the **set [*package-name package-name*]** option allows you to install multiple software packages and software add-on packages at the same time.

upgrade-with-config and **upgrade-with-config-format** ***format*** options added in Junos OS Release 12.3 for M Series routers, MX Series routers, T Series routers, EX Series Ethernet switches, and QFX Series devices.

Description

NOTE: We recommend that you always download the software image to **/var/tmp** only. On EX Series and QFX Series switches, you must use the **/var/tmp** directory. Other directories are not supported.

Install a software package or bundle on the router or switch.

Options

package-name—Location from which the software package or bundle is to be installed. For example:

- **/var/tmp/*package-name***—For a software package or bundle that is being installed from a local directory on the router or switch.
- ***protocol*://*hostname/pathname/package-name***—For a software package or bundle that is to be downloaded and installed from a remote location. Replace ***protocol*** with one of the following:
  - **ftp**—File Transfer Protocol.
    Use **ftp://*hostname/pathname/package-name***. To specify authentication credentials, use **ftp://<*username*>:<*password*>@*hostname/pathname/package-name***. To have the system prompt you for the password, specify **prompt** in place of the password. If a password is required, and you do not specify the password or **prompt**, an error message is displayed.
  - **http**—Hypertext Transfer Protocol.
    Use **http://*hostname/pathname/package-name***. To specify authentication credentials, use **http://<*username*>:<*password*>@*hostname/pathname/package-name***. If a password is required and you omit it, you are prompted for it.
  - **scp**—Secure copy (available only for Canada and U.S. version).
    Use **scp://*hostname/pathname/package-name***. To specify authentication credentials, use **scp://<*username*>:<*password*>@*hostname/pathname/package-name***.

NOTE:

- The *pathname* in the protocol is the relative path to the user's home directory on the remote system and not the root directory.
- Do not use the **scp** protocol in the **request system software add** command to download and install a software package or bundle from a remote location. The previous statement does not apply to the QFabric switch. The software upgrade is handled by the MGD process which does not support scp.
  Use the **file copy** command to copy the software package or bundle from the remote location to the */var/tmp* directory on the hard disk:
  file copy scp://*source/package-name* /var/tmp
  Then install the software package or bundle using the **request system software add** command:
  request system software add /var/tmp/*package-name*
- On a J Series Services Router, when you install the software from a remote location, the package is removed at the earliest opportunity in order to make room for the installation to be completed. If you copy the software to a local directory on the router and then install the new package, use the **unlink** option to achieve the same effect and allow the installation to be completed.

best-effort-load—(Optional) Activate a partial load and treat parsing errors as warnings instead of errors.

component all—(QFabric systems only) (Optional) Install software package on all of the QFabric components.

delay-restart—(Optional) Install a software package or bundle, but do not restart software processes.

force—(Optional) Force the addition of the software package or bundle (ignore warnings).

lcc *number* —(TX Matrix routers and TX Matrix Plus routers only) (Optional) In a routing matrix based on the TX Matrix router, install a software package or bundle on a T640 router that is connected to the TX Matrix router. In a routing matrix based on the TX Matrix Plus router, install a software package or bundle on a router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.

- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

member ***member-id***—(MX Series routers only) (Optional) Install a software package on the specified Virtual Chassis member. Replace ***member-id*** with a value of 0 or 1.

partition—(QFX3500 switches only) (Optional) Format and repartition the media before installation.

scc—(TX Matrix routers only) (Optional) Install a software package or bundle on a Routing Engine on a TX Matrix router (or switch-card chassis).

sfc ***number***—(TX Matrix Plus routers only) (Optional) Install a software package or bundle on a Routing Engine on a TX Matrix Plus router. Replace *number* with 0.

no-copy—(Optional) Install a software package or bundle, but do not save copies of the package or bundle files.

no-validate—(Optional) When loading a software package or bundle with a different release, suppress the default behavior of the **validate** option.

re0 | re1—(Optional) On routers or switches that support dual or redundant Routing Engines, load a software package or bundle on the Routing Engine in slot 0 (re0) or the Routing Engine in slot 1 (re1).

reboot—(Optional) After adding the software package or bundle, reboot the system. On a QFabric switch, the software installation is not complete until you reboot the component for which you have installed the software.

set [*package-name package-name*]—(Mixed EX4200 and EX4500 Virtual Chassis only) (Optional) Install two software packages—a package for an EX4200 switch and the same release of the package for an EX4500 switch—to upgrade all member switches in a mixed EX4200 and EX4500 Virtual Chassis.

set [*package-name package-name*]—(M Series, MX Series, T Series routers, and Branch SRX Series Services Gateways only) (Optional) Install multiple software packages and software add-on packages at the same time.

unlink—(Optional) On J Series Services Routers, this option ensures that the software package is removed at the earliest opportunity in order to make room for the installation to be completed. On M Series, T Series, and MX Series routers, use the **unlink** option to remove the software package from this directory after a successful upgrade is completed.

upgrade-with-config—(Optional) Install one or more configuration files.

upgrade-with-config-format ***format***—(Optional) Specify the configuration file fomat, **text** or **xml**. The default format is **text**.

NOTE: The **upgrade-with-config** and **upgrade-with-config-format** options are only available locally on the router or switch. In a routing matrix, the configuration is applied only to the local router and is not propagated to other routers.

The options are validated during the validation process and applied to the router or switch during the upgrade process. If the upgrade process is successful, the options are removed from the configuration. If the upgrade process fails, the configuration file is renamed with the .failed suffix.

validate—(Optional) Validate the software package or bundle against the current configuration as a prerequisite to adding the software package or bundle. This is the default behavior when the software package or bundle being added is a different release.

NOTE: The **validate** option only works on systems that do not have **graceful-switchover** (GRES) enabled. To use the **validate** option on a system with GRES, either disable GRES for the duration of the installation, or install using the command request system software in-service-upgrade, which requires nonstop active routing (NSR) to be enabled when using GRES.

Additional Information

Before upgrading the software on the router or switch, when you have a known stable system, issue the **request system snapshot** command to back up the software, including the configuration, to the **/altroot** and **/altconfig** file systems. After you have upgraded the software on the router or switch and are satisfied that the new package or bundle is successfully installed and running, issue the **request system snapshot** command again to back up the new software to the **/altroot** and **/altconfig** file systems.

NOTE: The **request system snapshot** command is currently not supported on the QFabric system. Also, you cannot add or install multiple packages on a QFabric system.

After you run the **request system snapshot** command, you cannot return to the previous version of the software, because the running and backup copies of the software are identical.

If you are upgrading more than one package at the same time, delete the operating system package, jkernel, last. Add the operating system package, jkernel, first and the routing software package, jroute, last. If you are upgrading all packages at once, delete and add them in the following order:

user@host> **request system software add /var/tmp/jbase**
user@host> **request system software add /var/tmp/jkernel**
user@host> **request system software add /var/tmp/jpfe**
user@host> **request system software add /var/tmp/jdocs**
user@host> **request system software add /var/tmp/jroute**
user@host> **request system software add /var/tmp/jcrypto**

By default, when you issue the **request system software add** ***package-name*** command on a TX Matrix master Routing Engine, all the T640 master Routing Engines that are connected to it are upgraded to the same version of software. If you issue the same command on the TX Matrix backup Routing Engine, all the T640 backup Routing Engines that are connected to it are upgraded to the same version of software.

Likewise, when you issue the **request system software add** ***package-name*** command on a TX Matrix Plus master Routing Engine, all the T1600 or T4000 master Routing Engines that are connected to it are upgraded to the same version of software. If you issue the same command on the TX Matrix Plus backup Routing Engine, all the T1600 or T4000 backup Routing Engines that are connected to it are upgraded to the same version of software.

Required Privilege Level
maintenance

Related Documentation

- request system software delete on page 400
- request system software rollback on page 428
- request system storage cleanup on page 435
- Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches on page 121
- *Upgrading Software on a QFabric System*
- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output
request system software add validate on page 398
request system software add (Mixed EX4200 and EX4500 Virtual Chassis) on page 399
request system software add component all (QFabric Systems) on page 399

Output Fields
When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system software add validate

```
user@host> request system software add validate /var/tmp/ jinstall-7.2R1.7-domestic-signed.tgz
Checking compatibility with configuration
Initializing...
Using jbase-7.1R2.2
Using /var/tmp/jinstall-7.2R1.7-domestic-signed.tgz
Verified jinstall-7.2R1.7-domestic.tgz signed by PackageProduction_7_2_0
Using /var/validate/tmp/jinstall-signed/jinstall-7.2R1.7-domestic.tgz
Using /var/validate/tmp/jinstall/jbundle-7.2R1.7-domestic.tgz
Checking jbundle requirements on /
Using /var/validate/tmp/jbundle/jbase-7.2R1.7.tgz
Using /var/validate/tmp/jbundle/jkernel-7.2R1.7.tgz
```

```
Using /var/validate/tmp/jbundle/jcrypto-7.2R1.7.tgz
Using /var/validate/tmp/jbundle/jpfe-7.2R1.7.tgz
Using /var/validate/tmp/jbundle/jdocs-7.2R1.7.tgz
Using /var/validate/tmp/jbundle/jroute-7.2R1.7.tgz
Validating against /config/juniper.conf.gz
mgd: commit complete
Validation succeeded
Validating against /config/rescue.conf.gz
mgd: commit complete
Validation succeeded
Installing package '/var/tmp/jinstall-7.2R1.7-domestic-signed.tgz' ...
Verified jinstall-7.2R1.7-domestic.tgz signed by PackageProduction_7_2_0
Adding jinstall...

WARNING:     This package will load JUNOS 7.2R1.7 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-7.2R1.7-domestic-signed.tgz ...
Saving state for rollback ...
```

Sample Output

request system software add (Mixed EX4200 and EX4500 Virtual Chassis)

user@switch> **request system software add set [/var/tmp/jinstall-ex-4200-11.1R1.1-domestic-signed.tgz /var/tmp/jinstall-ex-4500-11.1R1.1-domestic-signed.tgz]**
...

request system software add component all (QFabric Systems)

user@switch> **request system software add /pbdata/packages/jinstall-qfabric-12.2X50-D1.3.rpm component all**
...

request system software delete

Syntax

request system software delete *software-package*
<force>
<reboot>
<set [*package-name package-name*]>

Syntax (TX Matrix Router)

request system software delete *software-package*
<force>
<lcc *number* | scc>
<reboot>
<set [*package-name package-name*]>

Syntax (TX Matrix Plus Router)

request system software delete *software-package*
<force>
<lcc *number* | sfc *number*>
<reboot>
<set [*package-name package-name*]>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Option **sfc** introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Option **set [*package-name package-name*]** added in Junos OS Release 12.2 for M Series, MX Series, T Series routers, and Branch SRX Services Gateways.
Option reboot introduced in Junos OS Release 12.3.

Description

Remove a software package or bundle from the router or switch.

CAUTION: Before removing a software package or bundle, make sure that you have already placed the new software package or bundle that you intend to load onto the router or switch.

Options

software-package—Software package or bundle name. You can delete any or all of the following software bundles or packages:

- **jbase**—(Optional) Junos base software suite
- **jcrypto**—(Optional, in domestic version only) Junos security software
- **jdocs**—(Optional) Junos online documentation file
- **jkernel**—(Optional) Junos kernel software suite
- **jpfe**—(Optional) Junos Packet Forwarding Engine support
- **jroute**—(Optional) Junos routing software suite
- **junos**—(Optional) Junos base software

NOTE: On EX Series switches, some of the package names are different than those listed. To see the list of packages that you can delete on an EX Series switch, enter the command **show system software**.

force—(Optional) Ignore warnings and force removal of the software.

lcc *number*—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, remove an extension or upgrade package from a specific T640 router (line-card chassis) that is connected to the TX Matrix router. On a TX Matrix Plus router, remove an extension or upgrade package from a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

reboot—As of Junos OS 12.3 and greater, automatically reboot upon completing the **request system software delete** command.

scc—(TX Matrix routers only) (Optional) Remove an extension or upgrade package from the TX Matrix router (or switch-card chassis).

set [*package-name package-name*]—(M Series, MX Series, T Series routers, and Branch SRX Series Services Gateways only) (Optional) Install multiple software packages or software add-on packages at the same time.

sfc *number*—(TX Matrix Plus routers only) (Optional) Remove an extension or upgrade package from the TX Matrix Plus router. Replace *number* with 0.

Additional Information

Before upgrading the software on the router or switch, when you have a known stable system, issue the **request system snapshot** command to back up the software, including the configuration, to the /altroot and /altconfig file systems (on routers) or the /, /altroot, /config, /var, and /var/tmp file systems (on switches). After you have upgraded the software on the router or switch and are satisfied that the new packages are successfully installed and running, issue the **request system snapshot** command again to back up the new software to the /altroot and /altconfig file systems (on routers) or the /, /altroot, /config, /var, and /var/tmp file systems (on switches). After you run the **request system snapshot** command, you cannot return to the previous version of the software, because the running and backup copies of the software are identical.

Required Privilege Level maintenance

Related Documentation

- request system software add on page 392
- request system software rollback on page 428
- request system software validate on page 432
- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output request system software delete jdocs on page 402

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system software delete jdocs

The following example displays the system software packages before and after the **jdocs** package is deleted through the **request system software delete** command:

```
user@host> show system software
Information for jbase:

Comment:
JUNOS Base OS Software Suite [7.2R1.7]


Information for jcrypto:

Comment:
JUNOS Crypto Software Suite [7.2R1.7]


Information for jdocs:

Comment:
JUNOS Online Documentation [7.2R1.7]


Information for jkernel:

Comment:
JUNOS Kernel Software Suite [7.2R1.7]

...


user@host> request system software delete jdocs
Removing package 'jdocs' ...


user@host> show system software
Information for jbase:

Comment:
JUNOS Base OS Software Suite [7.2R1.7]
```



```
Information for jcrypto:

Comment:
JUNOS Crypto Software Suite [7.2R1.7]


Information for jkernel:

Comment:
JUNOS Kernel Software Suite [7.2R1.7]

...
```

request system software download

Syntax (QFabric System)

request system software download *path package-name*

Release Information

Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Download a software package from a location on the Director device, mounted external USB flash drive, remote FTP or SCP location, or other location.

Options

path—Location where the software package is located. For example:

- */pbdata/packages/package-name*—For a software package that is being installed from a local directory on the switch.
- *protocol://hostname/pathname/package-name*—For a software package or bundle that is to be downloaded and installed from a remote location. Replace ***protocol*** with one of the following:
  - **ftp**—File Transfer Protocol.
    Use **ftp:*//hostname/pathname/package-name***. To specify authentication credentials, use
    ftp://*<username>*:*<password>*@*hostname/pathname/package-name*. To have the system prompt you for the password, specify **prompt** in place of the password. If a password is required, and you do not specify the password or **prompt**, an error message is displayed.
  - **scp**—Secure copy (available only for Canada and U.S. version).
    Use **scp:*//hostname/pathname/package-name***. To specify authentication credentials, use
    scp://*<username>*:*<password>*@*hostname/pathname/package-name*.

Required Privilege Level

maintenance

Related Documentation

- request system software add on page 392
- request system software delete on page 400
- request system software rollback on page 428
- request system storage cleanup on page 435
- Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches on page 121
- *Upgrading Software on a QFabric System*

List of Sample Output

request system software download on page 405

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system software download

```
user@switch> request system software download
ftp://ftp.install-directory/jinstall-qfabric-11.3X30.6.rpm
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  186M  100  186M    0     0  18.4M      0  0:00:10  0:00:10 --:--:-- 18.6M
```


request system software in-service-upgrade

Syntax

request system software in-service-upgrade *package-name*
<no-old-master-upgrade>
<reboot>

Syntax (QFX5100 Switches)

request system software in-service-upgrade *package-name*

Release Information

Command introduced in Junos OS Release 9.0.
Command introduced in Junos OS Release 12.3R2, 13.1R2, and 13.2R1 for TX Matrix Plus routers.
Command introduced in Junos OS Release 13.2 for PTX5000 routers.
Command introduced in Junos OS Release 13.2 X51-D15 for the QFX Series.

Description

Perform a unified in-service software upgrade (ISSU). A unified ISSU enables you to upgrade from one Junos OS Release to another with no disruption on the control plane and with minimal disruption of traffic. In addition, graceful Routing Engine switchover (GRES) and nonstop active routing (NSR) must be enabled. On QFX5100 switches, nonstop bridging (NSB) must be enabled if you are using the Layer 2 Control Protocol process (l2cpd) to transmit Layer 2 spanning tree protocols in a Layer 2 bridge environment.

Options

package-name—Location from which the software package or bundle is to be installed. For example:

- ***/var/tmp/package-name***— For a software package or bundle that is being installed from a local directory on the router.
- ***protocol://hostname/pathname/package-name***—For a software package or bundle that is to be downloaded and installed from a remote location. Replace ***protocol*** with one of the following:
  - **ftp**—File Transfer Protocol
  - **http**—Hypertext Transfer Protocol
  - **scp**—Secure copy (available only for Canada and U.S. version)

no-old-master-upgrade—(Optional) When the **no-old-master-upgrade** option is included, after the backup Routing Engine is rebooted with the new software package and a switchover occurs to make it the new master Routing Engine, the former master (new backup) Routing Engine will not be upgraded to the new software. In this case, you must manually upgrade the former master (new backup) Routing Engine. If you do not include the **no-old-master-upgrade** option, the system will automatically upgrade the former master Routing Engine.

reboot—(Optional) When the **reboot** option is included, the former master (new backup) Routing Engine is automatically rebooted after being upgraded to the new software. When the **reboot** option is not included, you must manually reboot the former master (new backup) Routing Engine using the **request system reboot** command.

Additional Information

The following conditions apply to unified ISSUs:

- Unified ISSU is not supported on every platform. For a list of supported platforms, see *Unified ISSU System Requirements*.
- Unsupported PICs are restarted during a unified ISSU on certain routing devices. For information about supported PICs, see the *Junos OS High Availability Library for Routing Devices*.
- Unsupported protocols will experience packet loss during a unified ISSU. For information about supported protocols, see the *Junos OS High Availability Library for Routing Devices*.
- During a unified ISSU, you cannot bring any PICs online or offline on certain routing devices.

For more information, see the *Junos OS High Availability Library for Routing Devices*.

Required Privilege Level

view

Related Documentation

- *request system software abort*
- show chassis in-service-upgrade on page 754
- *Unified ISSU Concepts*
- *Performing a Unified ISSU*

List of Sample Output

request system software-in-service upgrade reboot on page 407
request system software-in-service upgrade reboot (TX Matrix Plus Router) on page 409
request system software-in-service upgrade (QFX5100 Switch) on page 417

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system software-in-service upgrade reboot

```
{master}

user@host> request system software in-service-upgrade
/var/tmp/jinstall-9.0-20080114.2-domestic-signed.tgz reboot
ISSU: Validating Image
PIC 0/3 will be offlined (In-Service-Upgrade not supported)
Do you want to continue with these actions being taken ? [yes,no] (no) yes

ISSU: Preparing Backup RE
Pushing bundle to re1
Checking compatibility with configuration
Initializing...
Using jbase-9.0-20080114.2
Verified manifest signed by PackageProduction_9_0_0
Using /var/tmp/jinstall-9.0-20080114.2-domestic-signed.tgz
Verified jinstall-9.0-20080114.2-domestic.tgz signed by PackageProduction_9_0_0
Using jinstall-9.0-20080114.2-domestic.tgz
Using jbundle-9.0-20080114.2-domestic.tgz
Checking jbundle requirements on /
Using jbase-9.0-20080114.2.tgz
```

```
Verified manifest signed by PackageProduction_9_0_0
Using jkernel-9.0-20080114.2.tgz
Verified manifest signed by PackageProduction_9_0_0
Using jcrypto-9.0-20080114.2.tgz
Verified manifest signed by PackageProduction_9_0_0
Using jpfe-9.0-20080114.2.tgz
Using jdocs-9.0-20080114.2.tgz
Verified manifest signed by PackageProduction_9_0_0
Using jroute-9.0-20080114.2.tgz
Verified manifest signed by PackageProduction_9_0_0
Hardware Database regeneration succeeded
Validating against /config/juniper.conf.gz
mgd: commit complete
Validation succeeded
Installing package '/var/tmp/jinstall-9.0-20080114.2-domestic-signed.tgz' ...
Verified jinstall-9.0-20080114.2-domestic.tgz signed by PackageProduction_9_0_0
Adding jinstall...
Verified manifest signed by PackageProduction_9_0_0

WARNING:     This package will load JUNOS 9.0-20080114.2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-9.0-20080114.2-domestic-signed.tgz
...
Saving state for rollback ...
Backup upgrade done
Rebooting Backup RE

Rebooting re1
ISSU: Backup RE Prepare Done
Waiting for Backup RE reboot
GRES operational
Initiating Chassis In-Service-Upgrade
Chassis ISSU started
ISSU: Backup RE Prepare Done
ISSU: Preparing Daemons
ISSU: Daemons Ready for ISSU
ISSU: Starting Upgrade for FRUs
ISSU: Preparing for Switchover
ISSU: Ready for Switchover
Checking In-Service-Upgrade status
  Item           Status                  Reason
  FPC 0          Online (ISSU)
  FPC 1          Online (ISSU)
  FPC 2          Online (ISSU)
```



```
  FPC 6          Online (ISSU)
  FPC 7          Online (ISSU)
Resolving mastership...
Complete. The other routing engine becomes the master.
ISSU: RE switchover Done
ISSU: Upgrading Old Master RE
Installing package '/var/tmp/paKEuy' ...
Verified jinstall-9.0-20080114.2-domestic.tgz signed by PackageProduction_9_0_0
Adding jinstall...
Verified manifest signed by PackageProduction_9_0_0

WARNING:     This package will load JUNOS 9.0-20080114.2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-9.0-20080114.2-domestic-signed.tgz
...
cp: /var/tmp/paKEuy is a directory (not copied).
Saving state for rollback ...
ISSU: Old Master Upgrade Done
ISSU: IDLE
Shutdown NOW!
Reboot consistency check bypassed - jinstall 9.0-20080114.2 will complete
installation upon reboot
[pid 30227]

*** FINAL System shutdown message from root@host ***

System going down IMMEDIATELY

Connection to host closed.
```

request system software-in-service upgrade reboot (TX Matrix Plus Router)

```
{master}

user@host> request system software in-service-upgrade
/var/tmp/jinstall-12.3R2-domestic-signed.tgz
Chassis ISSU Check Done
ISSU: Validating Image
PIC 8/1 will be offlined (In-Service-Upgrade not supported)
PIC 19/2 will be offlined (In-Service-Upgrade not supported)
PIC 15/3 will be offlined (In-Service-Upgrade not supported)
Do you want to continue with these actions being taken ? [yes,no] (no) yes

Checking compatibility with configuration
Initializing...
```

```
Using jbase-12.3R2
Verified manifest signed by PackageProduction_12_3_0
Using /var/tmp/jinstall-12.3R2-domestic-signed.tgz
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Using jinstall-12.3R2-domestic.tgz
Using jbundle-12.3R2-domestic.tgz
Checking jbundle requirements on /
Using jbase-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jbase-12.3R2 signed by PackageProduction_12_3_0
Using /var/validate/chroot/tmp/jbundle/jboot-12.3R2.tgz
Using jcrypto-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jcrypto-12.3R2 signed by PackageProduction_12_3_0
Using jdocs-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jdocs-12.3R2 signed by PackageProduction_12_3_0
Using jkernel-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jkernel-12.3R2 signed by PackageProduction_12_3_0
Using jpfe-12.3R2.tgz
WARNING: jpfe-12.3R2.tgz: not a signed package
WARNING: jpfe-common-12.3R2.tgz: not a signed package
Verified jpfe-common-12.3R2 signed by PackageProduction_12_3_0
WARNING: jpfe-T-12.3R2.tgz: not a signed package
Verified jpfe-T-12.3R2 signed by PackageProduction_12_3_0
Using jplatform-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jplatform-12.3R2 signed by PackageProduction_12_3_0
Using jroute-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jroute-12.3R2 signed by PackageProduction_12_3_0
Using jruntime-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jruntime-12.3R2 signed by PackageProduction_12_3_0
Using jservices-12.3R2.tgz
Using jservices-crypto-12.3R2.tgz
Hardware Database regeneration succeeded
Validating against /config/juniper.conf.gz
mgd: commit complete
Validation succeeded
ISSU: Preparing LCC Backup REs
Pushing bundle to lcc0-re1
Pushing bundle to lcc1-re1
Pushing bundle to lcc2-re1
Pushing bundle to lcc3-re1
Pushing bundle to sfc0-re1
Installing package '/var/tmp/jinstall-12.3R2-domestic-signed.tgz' ...
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Adding jinstall...
Verified manifest signed by PackageProduction_12_3_0

WARNING:     This package will load JUNOS 12.3R2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
```



```
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-12.3R2-domestic-signed.tgz ...
Saving state for rollback ...
Installing package '/var/tmp/jinstall-12.3R2-domestic-signed.tgz' ...
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Adding jinstall...
Verified manifest signed by PackageProduction_12_3_0

WARNING:     This package will load JUNOS 12.3R2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-12.3R2-domestic-signed.tgz ...
Saving state for rollback ...
Installing package '/var/tmp/jinstall-12.3R2-domestic-signed.tgz' ...
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Adding jinstall...
Verified manifest signed by PackageProduction_12_3_0

WARNING:     This package will load JUNOS 12.3R2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.
```

```
Saving package file in /var/sw/pkg/jinstall-12.3R2-domestic-signed.tgz ...
Saving state for rollback ...
Installing package '/var/tmp/jinstall-12.3R2-domestic-signed.tgz' ...
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Adding jinstall...
Verified manifest signed by PackageProduction_12_3_0

WARNING:     This package will load JUNOS 12.3R2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-12.3R2-domestic-signed.tgz ...
Saving state for rollback ...
ISSU: Preparing SFC Backup RE
NOTICE: Validating configuration against jinstall-12.3R2-domestic-signed.tgz.
NOTICE: Use the 'no-validate' option to skip this if desired.
Checking compatibility with configuration
Initializing...
Using jbase-12.3R2
Verified manifest signed by PackageProduction_12_3_0
Using /var/tmp/jinstall-12.3R2-domestic-signed.tgz
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Using jinstall-12.3R2-domestic.tgz
Using jbundle-12.3R2-domestic.tgz
Checking jbundle requirements on /
Using jbase-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jbase-12.3R2 signed by PackageProduction_12_3_0
Using /var/validate/chroot/tmp/jbundle/jboot-12.3R2.tgz
Using jcrypto-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jcrypto-12.3R2 signed by PackageProduction_12_3_0
Using jdocs-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jdocs-12.3R2 signed by PackageProduction_12_3_0
Using jkernel-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jkernel-12.3R2 signed by PackageProduction_12_3_0
Using jpfe-12.3R2.tgz
WARNING: jpfe-12.3R2.tgz: not a signed package
WARNING: jpfe-common-12.3R2.tgz: not a signed package
Verified jpfe-common-12.3R2 signed by PackageProduction_12_3_0
WARNING: jpfe-T-12.3R2.tgz: not a signed package
Verified jpfe-T-12.3R2 signed by PackageProduction_12_3_0
Using jplatform-12.3R2.tgz
```



```
Verified manifest signed by PackageProduction_12_3_0
Verified jplatform-12.3R2 signed by PackageProduction_12_3_0
Using jroute-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jroute-12.3R2 signed by PackageProduction_12_3_0
Using jruntime-12.3R2.tgz
Verified manifest signed by PackageProduction_12_3_0
Verified jruntime-12.3R2 signed by PackageProduction_12_3_0
Using jservices-12.3R2.tgz
Using jservices-crypto-12.3R2.tgz
Hardware Database regeneration succeeded
Validating against /config/juniper.conf.gz
mgd: commit complete
Validation succeeded
Installing package '/var/tmp/jinstall-12.3R2-domestic-signed.tgz' ...
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Adding jinstall...
Verified manifest signed by PackageProduction_12_3_0

WARNING:     This package will load JUNOS 12.3R2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-12.3R2-domestic-signed.tgz ...
Saving state for rollback ...
SFC Backup upgrade done
Rebooting SFC Backup RE

Rebooting sfc0-re1
ISSU: SFC Backup RE Prepare Done
Waiting for SFC Backup RE reboot

Rebooting lcc0-re1
Rebooting LCC [lcc0-re1]

Rebooting lcc1-re1
Rebooting LCC [lcc1-re1]

Rebooting lcc2-re1
Rebooting LCC [lcc2-re1]

Rebooting lcc3-re1
Rebooting LCC [lcc3-re1]
LCC Backup REs have rebooted
Waiting for LCC Backup REs come back online
ISSU: LCC Backup REs Prepare Done
```

```
GRES operational
Initiating Chassis In-Service-Upgrade
Chassis ISSU Started
ISSU: Preparing Daemons
ISSU: Daemons Ready for ISSU
ISSU: Starting Upgrade for FRUs
ISSU: Preparing for Switchover
ISSU: Ready for Switchover
Checking In-Service-Upgrade status
lcc0-re0:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 1          Online (ISSU)
    PIC 0        Online (ISSU)
  FPC 2          Online (ISSU)
  FPC 3          Online (ISSU)
    PIC 1        Online (ISSU)
  FPC 4          Online (ISSU)
  FPC 6          Online (ISSU)
  FPC 7          Online (ISSU)

lcc1-re0:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 0          Online (ISSU)
    PIC 3        Online (ISSU)
  FPC 1          Online (ISSU)
  FPC 2          Online (ISSU)
  FPC 4          Online (ISSU)
  FPC 6          Online (ISSU)
  FPC 7          Online (ISSU)

lcc2-re0:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 0          Online (ISSU)
  FPC 2          Online (ISSU)
  FPC 3          Online (ISSU)
    PIC 0        Online (ISSU)
  FPC 4          Online (ISSU)
  FPC 6          Online (ISSU)
  FPC 7          Online (ISSU)
    PIC 1        Online (ISSU)

lcc3-re0:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 0          Online (ISSU)
    PIC 0        Online (ISSU)
  FPC 1          Online (ISSU)
  FPC 2          Online (ISSU)
  FPC 3          Online (ISSU)
    PIC 2        Online (ISSU)
  FPC 4          Online (ISSU)
  FPC 5          Online (ISSU)
  FPC 6          Online (ISSU)
  FPC 7          Online (ISSU)
    PIC 1        Online (ISSU)

lcc0-re0:
--------------------------------------------------------------------------
```

```
Resolving mastership...
Complete. The other routing engine becomes the master.

lcc1-re0:
--------------------------------------------------------------------------
Resolving mastership...
Complete. The other routing engine becomes the master.

lcc2-re0:
--------------------------------------------------------------------------
Resolving mastership...
Complete. The other routing engine becomes the master.

lcc3-re0:
--------------------------------------------------------------------------
Resolving mastership...
Complete. The other routing engine becomes the master.
Resolving mastership...
Complete. The other routing engine becomes the master.
ISSU: RE switchover Done
ISSU: Upgrading SFC Old Master RE

lcc0-re0:
Installing package '/var/tmp/jinstall-12.3R2-domestic-signed.tgz' ...
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Adding jinstall...
Verified manifest signed by PackageProduction_12_3_0

WARNING:     This package will load JUNOS 12.3R2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-12.3R2-domestic-signed.tgz ...
Saving state for rollback ...

lcc1-re0:
Installing package '/var/tmp/jinstall-12.3R2-domestic-signed.tgz' ...
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Adding jinstall...
Verified manifest signed by PackageProduction_12_3_0

WARNING:     This package will load JUNOS 12.3R2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
```

```
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-12.3R2-domestic-signed.tgz ...
Saving state for rollback ...

lcc2-re0:
Installing package '/var/tmp/jinstall-12.3R2-domestic-signed.tgz' ...
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Adding jinstall...
Verified manifest signed by PackageProduction_12_3_0

WARNING:     This package will load JUNOS 12.3R2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-12.3R2-domestic-signed.tgz ...
Saving state for rollback ...

lcc3-re0:
Installing package '/var/tmp/jinstall-12.3R2-domestic-signed.tgz' ...
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Adding jinstall...
Verified manifest signed by PackageProduction_12_3_0

WARNING:     This package will load JUNOS 12.3R2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
NOTICE: uncommitted changes have been saved in
```



```
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-12.3R2-domestic-signed.tgz ...
Saving state for rollback ...
Installing package '/var/tmp/paBWTg' ...
Verified jinstall-12.3R2-domestic.tgz signed by PackageProduction_12_3_0
Adding jinstall...
Verified manifest signed by PackageProduction_12_3_0

WARNING:     This package will load JUNOS 12.3R2 software.
WARNING:     It will save JUNOS configuration files, and SSH keys
WARNING:     (if configured), but erase all other files and information
WARNING:     stored on this machine.  It will attempt to preserve dumps
WARNING:     and log files, but this can not be guaranteed.  This is the
WARNING:     pre-installation stage and all the software is loaded when
WARNING:     you reboot the system.

Saving the config files ...
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Installing the bootstrap installer ...

WARNING:     A REBOOT IS REQUIRED TO LOAD THIS SOFTWARE CORRECTLY. Use the
WARNING:     'request system reboot' command when software installation is
WARNING:     complete. To abort the installation, do not reboot your system,
WARNING:     instead use the 'request system software delete jinstall'
WARNING:     command as soon as this operation completes.

Saving package file in /var/sw/pkg/jinstall-12.3R2-domestic-signed ...
cp: /var/tmp/paBWTg is a directory (not copied).
Saving state for rollback ...
ISSU: SFC Old Master Upgrade Done
ISSU: IDLE
```

request system software-in-service upgrade (QFX5100 Switch)

```
{master}

user@switch> request system software in-service-upgrade
/var/tmp/jinstall-qfx-132_x51_vjunos.0-domestic.tgz
ISSU: Validating Image
Prepare for ISSU
spawn the backup VM
ISSU: Preparing Backup RE
Backup upgrade done
ISSU: Backup RE Prepare Done
waiting for backup RE switchover ready
GRES operational
Initiating Chassis In-Service-Upgrade
Chassis ISSU Started
ISSU: Preparing Daemons
ISSU: Daemons Ready for ISSU
ISSU: Starting Upgrade for FRUs
ISSU: FPC Warm Booting
ISSU: FPC Warm Booted
```

```
ISSU: Preparing for Switchover
ISSU: Ready for Switchover
Checking In-Service-Upgrade status
  Item           Status                  Reason
  FPC 0          Online (ISSU)
send ISSU done to chassisd on backup VM
Chassis ISSU Completed
ISSU: IDLE
mgd_package_opus_issu: Initiate em0 device handoff
```


request system software nonstop-upgrade

Syntax

request system software nonstop-upgrade (*package-name* | set [*package-name* *package-name*])
<no-copy>
<no-old-master-upgrade>
<reboot >
<unlink>

Release Information

Command introduced in Junos OS Release 10.4 for EX Series switches.
Option **set [*package-name package-name*]** added in Junos OS Release 12.1 for EX Series switches.
Command introduced in Junos OS Release 13.2X50-D15 for the QFX Series.

Description

Perform a nonstop software upgrade (NSSU) on a switch with redundant Routing Engines or on a Virtual Chassis. The behavior of this command depends on which switch or Virtual Chassis it is executed on:

- When you execute this command on an EX3300, EX4200, EX4300, EX4500, or EX4550 Virtual Chassis or QFX3500 and QFX3600 Virtual Chassis, or a mixed Virtual Chassis composed of any combination of EX4200, EX4500, and EX4550 switches, all Virtual Chassis members are upgraded. The original Virtual Chassis backup becomes the master. The original master is automatically upgraded and rebooted and rejoins the Virtual Chassis as the backup after the upgrade completes.
- When you execute this command on an EX6200 or EX8200 switch, both the backup and master Routing Engines are upgraded, with the original backup Routing Engine becoming the new master at the end of the upgrade.

  The original master Routing Engine is automatically rebooted on an EX6200 switch.

  The original master Routing Engine is not automatically rebooted on an EX8200 switch unless you specify the **reboot** option.
- When you execute this command on an EX8200 Virtual Chassis, all master and backup Routing Engines are upgraded in the Virtual Chassis, including the external Routing Engines. The original backup Routing Engines become the new master Routing Engines. The original master Routing Engines are not automatically rebooted, unless you specify the **reboot** option.

This command has the following requirements:

- All Virtual Chassis members and all Routing Engines must be running the same Junos OS release.
- Graceful Routing Engine switchover (GRES) must be enabled.
- Nonstop active routing (NSR) must be enabled.

NOTE: Although nonstop bridging (NSB) does not have to be enabled for you to use this command, we recommend that you enable NSB. Enabling NSB ensures that all NSB-supported Layer 2 protocols operate seamlessly during the Routing Engine switchover that is part of the NSSU. See *Configuring Nonstop Bridging on EX Series Switches (CLI Procedure)*.

NOTE: Nonstop active routing (NSR) and nonstop bridging (NSB) are not supported on QFX3500 and QFX3600 Virtual Chassis.

- The command must be executed from the master Routing Engine on a standalone switch or from the master on a Virtual Chassis.
- For minimal traffic disruption, you must define link aggregation groups (LAGs) such that the member links reside on different Virtual Chassis members (for EX3300, EX4200, EX4300, EX4500, EX4550, QFX3500 and QFX3600 Virtual Chassis, and mixed Virtual Chassis) or on different line cards (for EX6200 and EX8200 switches, and for EX8200 Virtual Chassis).
- For EX3300, EX4200, EX4300, EX4500, EX4550, QFX3500 and QFX3600 Virtual Chassis, and mixed Virtual Chassis:
  - The Virtual Chassis members must be connected in a ring topology. A ring topology prevents the Virtual Chassis from splitting during an NSSU.
  - The Virtual Chassis master and backup must be adjacent to each other in the ring topology. Adjacency permits the master and backup to always be in sync, even when the switches in linecard roles are rebooting.
  - The Virtual Chassis must be preprovisioned so that the linecard role has been explicitly assigned to member switches acting in a linecard role. During an NSSU, the Virtual Chassis members must maintain their roles—the master and backup must maintain their Routing Engine roles (although mastership will change), and the remaining switches must maintain their linecard roles.
  - A two-member Virtual Chassis must have **no-split-detection** configured so that the Virtual Chassis does not split when an NSSU upgrades a member.

Options ***package-name***—Location from which the software package or bundle is to be installed. For example:

- ***/var/tmp/package-name***—For a software package or bundle that is being installed from a local directory on the switch.
- ***protocol://hostname/pathname/package-name***—For a software package or bundle that is to be downloaded and installed from a remote location. Replace ***protocol*** with one of the following:
  - **ftp**—File Transfer Protocol.

Use **ftp://*hostname/pathname/package-name***. To specify authentication credentials, use **ftp://<*username*>:<*password*>@*hostname/pathname/package-name***. To have the system prompt you for the password, specify **prompt** in place of the password. If a password is required, and you do not specify the password or **prompt**, an error message is displayed.

- **http**—Hypertext Transfer Protocol.
  Use **http://*hostname/pathname/package-name***. To specify authentication credentials, use **http://<*username*>:<*password*>@*hostname/pathname/package-name***. If a password is required and you omit it, you are prompted for it.
- **scp**—Secure copy (available only for Canada and U.S. version).
  Use **scp://*hostname/pathname/package-name***. To specify authentication credentials, use **scp://<*username*>:<*password*>@*hostname/pathname/package-name***.

NOTE: The ***pathname*** in the protocol is the relative path to the user home directory on the remote system and not the root directory.

set [*package-name package-name*]—(Mixed Virtual Chassis only) Locations of the EX4200 and the EX4500 installation packages. These packages must be for the same Junos OS release. See the description of the ***package-name*** option for information about how to specify the location of the installation packages.

no-copy—(Optional) Install a software package or bundle, but do not save copies of package or bundle files.

no-old-master-upgrade—(Optional) (EX8200 switches only) Upgrade the backup Routing Engine only. After the upgrade completes, the original master Routing Engine becomes the backup Routing Engine and continues running the previous software version.

reboot—(Optional) (EX8200 switches and EX8200 Virtual Chassis only) When the **reboot** option is included, the original master (new backup) Routing Engines are automatically rebooted after being upgraded to the new software. When the **reboot** option is not included, you must manually reboot the original master (new backup) Routing Engines using the **request system reboot** command.

NOTE: If you do not use the **reboot** option on an EX8200 Virtual Chassis, you must establish a connection to the console port on the Switch Fabric and Routing Engine (SRE) module or Routing Engine (RE) module to perform the manual reboot of the backup Routing Engines.

unlink—(Optional) Remove the software package after a successful upgrade is completed.

Required Privilege Level

maintenance

Related Documentation

- *show chassis nonstop-upgrade*
- *Upgrading Software on an EX3300 Virtual Chassis, EX4200 Virtual Chassis, EX4300 Virtual Chassis, EX4500 Virtual Chassis, EX4550 Virtual Chassis, or Mixed Virtual Chassis Using Nonstop Software Upgrade (CLI Procedure)*
- *Upgrading Software on an EX6200 or EX8200 Standalone Switch Using Nonstop Software Upgrade (CLI Procedure)*
- *Upgrading Software on an EX8200 Virtual Chassis Using Nonstop Software Upgrade (CLI Procedure)*
- Upgrading Software on QFX3500 and QFX3600 Virtual Chassis Using Nonstop Software Upgrade on page 125

List of Sample Output

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system software nonstop-upgrade (EX4200 Virtual Chassis)

```
user@switch> request system software nonstop-upgrade
/var/tmp/jinstall-ex-4200—12.1R5.5—domestic-signed.tgz
Chassis ISSU Check Done
ISSU: Validating Image
ISSU: Preparing Backup RE
Installing image on other FPC's along with the backup

Checking pending install on fpc1
Pushing bundle to fpc1
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Completed install on fpc1

Checking pending install on fpc2
Pushing bundle to fpc2
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Completed install on fpc2

Checking pending install on fpc3
Pushing bundle to fpc3
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Completed install on fpc3

Checking pending install on fpc4
```

```
Pushing bundle to fpc4
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Completed install on fpc4

Checking pending install on fpc5
Pushing bundle to fpc5
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Completed install on fpc5

Checking pending install on fpc6
Pushing bundle to fpc6
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Completed install on fpc6

Checking pending install on fpc7
Pushing bundle to fpc7
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Completed install on fpc7
Backup upgrade done
Rebooting Backup RE

Rebooting fpc1
ISSU: Backup RE Prepare Done
Waiting for Backup RE reboot
GRES operational
Initiating Chassis In-Service-Upgrade
Chassis ISSU Started
ISSU: Preparing Daemons
ISSU: Daemons Ready for ISSU
ISSU: Starting Upgrade for FRUs
ISSU: Preparing for Switchover
ISSU: Ready for Switchover
Checking In-Service-Upgrade status
  Item           Status                  Reason
  FPC 0          Online
  FPC 1          Online
  FPC 2          Online (ISSU)
  FPC 3          Online (ISSU)
  FPC 4          Online (ISSU)
  FPC 5          Online (ISSU)
  FPC 6          Online (ISSU)
  FPC 7          Online (ISSU)
Going to install image on master
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
relinquish mastership
ISSU: IDLE

*** FINAL System shutdown message from root@switch ***

System going down IMMEDIATELY


Shutdown NOW!
[pid 9336]
```

request system software nonstop-upgrade (EX6200 Switch)

```
{master}
user@switch> request system software nonstop-upgrade
/var/tmp/jinstall-ex-6200–12.2R5.5–domestic-signed.tgz
Chassis ISSU Check Done
ISSU: Validating Image
ISSU: Preparing Backup RE
Pushing bundle to re0
NOTICE: Validating configuration against
jinstall-ex-6200-12.2R5.5-domestic-signed.tgz.
NOTICE: Use the 'no-validate' option to skip this if desired.
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Backup upgrade done
Rebooting Backup RE

Rebooting re0
ISSU: Backup RE Prepare Done
Waiting for Backup RE reboot
GRES operational
Initiating Chassis In-Service-Upgrade
Chassis ISSU Started
ISSU: Preparing Daemons
ISSU: Daemons Ready for ISSU
ISSU: Starting Upgrade for FRUs
ISSU: Preparing for Switchover
ISSU: Ready for Switchover
Checking In-Service-Upgrade status
  Item           Status                  Reason
  FPC 0          Online (ISSU)
  FPC 1          Online (ISSU)
  FPC 2          Online (ISSU)
  FPC 3          Online (ISSU)
  FPC 4          Online
  FPC 5          Online
  FPC 6          Online (ISSU)
  FPC 7          Online (ISSU)
  FPC 8          Online (ISSU)
  FPC 9          Online (ISSU)
Going to install image on master
NOTICE: Validating configuration against
jinstall-ex-6200-12.2R5.5-domestic-signed.tgz.
NOTICE: Use the 'no-validate' option to skip this if desired.
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
relinquish mastership
ISSU: IDLE
Trying to relinquish mastership before rebooting...
Resolving mastership...
Complete. The other routing engine becomes the master.

*** FINAL System shutdown message from user@switch ***

System going down IMMEDIATELY
```

request system software nonstop-upgrade reboot (EX8200 Switch)

```
{master}
user@switch> request system software nonstop-upgrade reboot
```



```
/var/tmp/jinstall-ex-8200-10.4R1.5-domestic-signed.tgz
Chassis ISSU Check Done
ISSU: Validating Image
ISSU: Preparing Backup RE
Pushing bundle to re1
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Backup upgrade done
Rebooting Backup RE

Rebooting re1
ISSU: Backup RE Prepare Done
Waiting for Backup RE reboot
GRES operational
Initiating Chassis In-Service-Upgrade
Chassis ISSU Started
ISSU: Preparing Daemons
ISSU: Daemons Ready for ISSU
ISSU: Starting Upgrade for FRUs
ISSU: Preparing for Switchover
ISSU: Ready for Switchover
Checking In-Service-Upgrade status
  Item           Status                  Reason
  FPC 0          Online (ISSU)
  FPC 2          Offline                 Offlined by CLI command
  FPC 3          Online (ISSU)
Resolving mastership...
Complete. The other routing engine becomes the master.
ISSU: RE switchover Done
ISSU: Upgrading Old Master RE
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
ISSU: Old Master Upgrade Done
ISSU: IDLE
Shutdown NOW!
[pid 2635]


*** FINAL System shutdown message from user@switch ***
System going down IMMEDIATELY
```

request system software nonstop-upgrade no-old-master-upgrade (EX8200 Switch)

```
{master}
user@switch> request system software nonstop-upgrade no-old-master-upgrade
/var/tmp/jinstall-ex-8200-10.4R1.5-domestic-signed.tgz
Chassis ISSU Check Done
ISSU: Validating Image
ISSU: Preparing Backup RE
Pushing bundle to re1
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Backup upgrade done
Rebooting Backup RE

Rebooting re1
ISSU: Backup RE Prepare Done
Waiting for Backup RE reboot
GRES operational
Initiating Chassis In-Service-Upgrade
Chassis ISSU Started
```



```
ISSU: Preparing Daemons
ISSU: Daemons Ready for ISSU
ISSU: Starting Upgrade for FRUs
ISSU: Preparing for Switchover
ISSU: Ready for Switchover
Checking In-Service-Upgrade status
  Item           Status                  Reason
  FPC 0          Online (ISSU)
  FPC 1          Online (ISSU)
  FPC 2          Online (ISSU)
  FPC 3          Offline                 Offlined by CLI command
  FPC 4          Online (ISSU)
  FPC 5          Online (ISSU)
  FPC 6          Online (ISSU)
  FPC 7          Online (ISSU)
Resolving mastership...
Complete. The other routing engine becomes the master.
ISSU: RE switchover Done
Skipping Old Master Upgrade
ISSU: IDLE
```

request system software nonstop-upgrade reboot (EX8200 Virtual Chassis)

```
{master:9}
user@external-routing-engine> request system software nonstop-upgrade reboot
/var/tmp/jinstall-ex-xre200-11.1-20101130.0-domestic-signed.tgz
Chassis ISSU Check Done
ISSU: Validating Image
ISSU: Preparing LCC Backup REs
ISSU: Preparing Backup RE
Pushing bundle /var/tmp/jinstall-ex-xre200-11.1-20101130.0-domestic-signed.tgz
to member8
--------------------------------------------------------------------------
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
VC Backup upgrade done
Rebooting VC Backup RE

Rebooting member8
ISSU: Backup RE Prepare Done
Waiting for VC Backup RE reboot
Pushing bundle to member0-backup
Pushing bundle to member1-backup
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately

Rebooting member0-backup
Rebooting LCC [member0-backup]

Rebooting member1-backup
Rebooting LCC [member1-backup]
ISSU: LCC Backup REs Prepare Done
GRES operational
Initiating Chassis Nonstop-Software-Upgrade
Chassis ISSU Started
ISSU: Preparing Daemons
ISSU: Daemons Ready for ISSU
ISSU: Starting Upgrade for FRUs
ISSU: Preparing for Switchover
```



```
ISSU: Ready for Switchover
Checking Nonstop-Upgrade status
member0:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 0          Online (ISSU)
  FPC 1          Online (ISSU)
  FPC 2          Online (ISSU)
  FPC 5          Online (ISSU)

member1:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 0          Online (ISSU)
  FPC 1          Offline                 Offlined due to config
  FPC 2          Online (ISSU)
  FPC 3          Online (ISSU)
  FPC 4          Online (ISSU)
  FPC 5          Online (ISSU)
  FPC 7          Online (ISSU)

member0:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 0          Online (ISSU)
  FPC 1          Online (ISSU)
  FPC 2          Online (ISSU)
  FPC 5          Online (ISSU)

member1:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 0          Online (ISSU)
  FPC 1          Offline                 Offlined due to config
  FPC 2          Online (ISSU)
  FPC 3          Online (ISSU)
  FPC 4          Online (ISSU)
  FPC 5          Online (ISSU)
  FPC 7          Online (ISSU)
ISSU: Upgrading Old Master RE
Pushing bundle /var/tmp/incoming-package-8200.tgz to member0-master
Pushing bundle /var/tmp/incoming-package-8200.tgz to member1-master

ISSU: RE switchover Done
WARNING: A reboot is required to install the software
WARNING:     Use the 'request system reboot' command immediately
Rebooting ...
shutdown: [pid 2188]
Shutdown NOW!
ISSU: Old Master Upgrade Done
ISSU: IDLE
Shutdown NOW!

*** FINAL System shutdown message from root@ ***
System going down IMMEDIATELY
```

request system software rollback

Syntax

request system software rollback

Syntax (EX Series Switches)

request system software rollback
<all-members>
<local>
<member *member-id*>
<reboot>

Syntax (TX Matrix Router)

request system software rollback
<lcc *number* | scc>
<reboot>

Syntax (TX Matrix Plus Router)

request system software rollback
<lcc *number* | sfc *number*>
<reboot>

Syntax (MX Series Router)

request system software rollback
<all-members>
<local>
<member *member-id*>
<reboot>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Option **sfc** introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Command behavior changed in Junos OS Release 12.1.
Option **reboot** introduced in Junos OS Release 12.3.

Description

For all versions of Junos OS up to and including Junos OS 11.4, revert to the software that was loaded at the last successful **request system software add** command.

As of Junos OS 12.1 and greater, revert to the last known good state before the most recent **request system software (add | delete)** command. For example, using rollback in Junos OS 12.1 after using **request system software add** restores the system to a known good state prior to using the **add** command. Similarly, using rollback in Junos OS 12.1 after using **request system software delete** restores the system to a known good state prior to using the **delete** command.

A software rollback fails if any required package (or a **jbundle** package containing the required package) cannot be found in */var/sw/pkg*.

Additional Information

- On M Series and T Series routers, if **request system software add <jinstall> reboot** was used for the previous installation, then **request system software rollback** has o effect. In this case, use **jinstall** to reinstall the required package.

- On M Series and T Series routers, if **request system software add <sdk1>** was used for the previous installation, then **request system software rollback** removes the last installed SDK package (**sdk1** in this example).
- On SRX Series devices with dual root systems, when **request system software rollback** is run, the system switches to the alternate root. Each root can have a different version of Junos OS. Rollback takes each root back to the previously installed image.

Options **all-members**—(EX4200 switches and MX Series routers only) (Optional) Attempt to roll back to the previous set of packages on all members of the Virtual Chassis configuration.

lcc ***number***—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, attempt to roll back to the previous set of packages on a T640 router connected to the TX Matrix router. On a TX Matrix Plus router, attempt to roll back to the previous set of packages on a connected router connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Attempt to roll back to the previous set of packages on the local Virtual Chassis member.

member ***member-id***—(EX4200 switches and MX Series routers only) (Optional) Attempt to roll back to the previous set of packages on the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace *member-id* with a value of 0 or 1.

none—For all versions of Junos OS up to and including Junos OS 11.4, revert to the set of software as of the last successful **request system software add**. As of Junos OS 12.1 and greater, revert to the last known good state before the most recent **request system software (add | delete)** command.

reboot—As of Junos OS 12.3 and greater, automatically reboot upon completing the **request system software rollback** command.

scc—(TX Matrix routers only) (Optional) Attempt to roll back to the previous set of packages on the TX Matrix router (or switch-card chassis).

sfc ***number***—(TX Matrix Plus routers only) (Optional) Attempt to roll back to the previous set of packages on the TX Matrix Plus router. Replace *number* with 0.

Required Privilege Level

maintenance

Related Documentation

- *request system software abort*
- request system software add on page 392
- request system software delete on page 400
- request system software validate on page 432
- request system configuration rescue delete on page 371
- request system configuration rescue save on page 372
- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

request system software rollback on page 431

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system software rollback

```
user@host> request system software rollback
Verified SHA1 checksum of ./jbase-7.2R1.7.tgz
Verified SHA1 checksum of ./jdocs-7.2R1.7.tgz
Verified SHA1 checksum of ./jroute-7.2R1.7.tgz
Installing package './jbase-7.2R1.7.tgz' ...
Available space: 35495 require: 7335
Installing package './jdocs-7.2R1.7.tgz' ...
Available space: 35339 require: 3497
Installing package './jroute-7.2R1.7.tgz' ...
Available space: 35238 require: 6976
NOTICE: uncommitted changes have been saved in
/var/db/config/juniper.conf.pre-install
Reloading /config/juniper.conf.gz ...
Activating /config/juniper.conf.gz ...
mgd: commit complete
Restarting mgd ...
Restarting aprobed ...
Restarting apsd ...
Restarting cosd ...
Restarting fsad ...
Restarting fud ...
Restarting gcdrd ...
Restarting ilmid ...
Restarting irsd ...
Restarting l2tpd ...
Restarting mib2d ...
Restarting nasd ...
Restarting pppoed ...
Restarting rdd ...
Restarting rmopd ...
Restarting rtspd ...
Restarting sampled ...
Restarting serviced ...
Restarting snmpd ...
Restarting spd ...
Restarting vrrpd ...

WARNING: cli has been replaced by an updated version:
CLI release 7.2R1.7 built by builder on 2005-04-22 02:03:44 UTC
Restart cli using the new version ? [yes,no] (yes) yes

Restarting cli ...
user@host
```


request system software validate

Syntax

request system software validate *package-name*
<set [*package-name package-name*]>
<upgrade-with-config>
<upgrade-with-config-format *format*>

Syntax (TX Matrix Router)

request system software validate *package-name*
<lcc *number* | scc>
<set [*package-name package-name*]>
<upgrade-with-config>
<upgrade-with-config-format *format*>

Syntax (TX Matrix Plus Router)

request system software validate *package-name*
<lcc *number* | sfc *number*>
<set [*package-name package-name*]>
<upgrade-with-config>
<upgrade-with-config-format *format*>

Syntax (MX Series Router)

request system software validate *package-name*
<member *member-id*>
<set [*package-name package-name*]>
<upgrade-with-config>
<upgrade-with-config-format *format*>

Release Information

Command introduced before Junos OS Release 7.4.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.
set [*package-name package-name*] option added in Junos OS Release 12.2 for M Series, MX Series, T Series routers, and Branch SRX Series Services Gateways.
upgrade-with-config and **upgrade-with-config-format *format*** options added in Junos OS Release 12.3 for M Series routers, MX Series routers, and T Series routers.

Description

Validate candidate software against the current configuration of the router.

Options

lcc *number*—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, validate the software bundle or package on a specific T640 router (or line-card chassis) that is connected to the TX Matrix router. On a TX Matrix Plus router, validate the software bundle or package for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.

- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

member *member-id*—(MX Series routers only) (Optional) Validate the software bundle or package on the specified member of the Virtual Chassis configuration. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

package-name—Name of the software bundle or package to test.

scc—(TX Matrix routers only) (Optional) Validate the software bundle or package for the TX Matrix router (or switch-card chassis).

set [*package-name package-name*]—(M Series, MX Series, T Series routers, and Branch SRX Series Services Gateways only) (Optional) Install multiple software packages or software add-on packages at the same time.

sfc *number*—(TX Matrix Plus routers only) (Optional) Validate the software bundle or package for the TX Matrix Plus router.

upgrade-with-config—(Optional) Install one or more configuration files.

upgrade-with-config-format *format*—(Optional) Specify the configuration file fomat, **text** or **xml**. The default format is **text**.

NOTE: The **upgrade-with-config** and **upgrade-with-config-format** options are only available locally on the router or switch. In a routing matrix, the configuration is applied only to the local router and is not propagated to other routers.

The options are validated during the validation process and applied to the router or switch during the upgrade process. If the upgrade process is successful, the options are removed from the configuration. If the upgrade process fails, the configuration file is renamed with the .failed suffix.

Additional Information

By default, when you issue the **request system software validate** command on a TX Matrix master Routing Engine, all the T640 master Routing Engines that are connected to it are validated. If you issue the same command on the TX Matrix backup Routing Engine, all the T640 backup Routing Engines that are connected to it are upgraded to the same version of software.

Likewise, if you issue the **request system software validate** command on a TX Matrix Plus master Routing Engine, all the T1600 or T4000 master Routing Engines that are connected to it are validated. If you issue the same command on a TX Matrix Plus backup Routing Engine, all the T1600 or T4000 backup Routing Engines that are connected to it are upgraded to the same version of software.

Required Privilege Level maintenance

Related Documentation

- *request system software abort*
- request system software add on page 392
- request system software delete on page 400
- request system software rollback on page 428
- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

request system software validate (Successful Case) on page 434
request system software validate (Failure Case) on page 434

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

request system software validate (Successful Case)

```
user@host> request system software validate /var/sw/pkg/jbundle-5.3I20020124_0520_sjg.tgz
Checking compatibility with configuration
Initializing...
Using /packages/jbase-5.3I20020122_1901_sjg
Using /var/sw/pkg/jbundle-5.3I20020124_0520_sjg.tgz
Using /var/chroot/var/tmp/jbundle/jbase-5.3I20020124_0520_sjg.tgz
Using /var/chroot/var/tmp/jbundle/jkernel-5.3I20020124_0520_sjg.tgz
Using /var/chroot/var/tmp/jbundle/jcrypto-5.3I20020124_0520_sjg.tgz
Using /var/chroot/var/tmp/jbundle/jpfe-5.3I20020124_0520_sjg.tgz
Using /var/chroot/var/tmp/jbundle/jdocs-5.3I20020124_0520_sjg.tgz
Using /var/chroot/var/tmp/jbundle/jroute-5.3I20020124_0520_sjg.tgz
Validating against /config/juniper.conf.gz
mgd: commit complete

WARNING: cli has been replaced by an updated version:
CLI release 5.3I0 built by sjg on 2002-01-24 05:23:53 UTC
Restart cli using the new version ? [yes,no] (yes)
```

request system software validate (Failure Case)

```
user@host> request system software validate 6.3/
Pushing bundle to lcc0-re0
error: Failed to transfer package to lcc0-re0


user@host> request system software validate test
Pushing bundle to lcc0-re0
Pushing bundle to lcc2-re0

lcc0-re0:
gzip: stdin: not in gzip format
tar: child returned status 1
ERROR: Not a valid package: /var/tmp/test
```


request system storage cleanup

Syntax

request system storage cleanup <dry-run>

Syntax (EX Series Switches)

request system storage cleanup
<all-members>
<dry-run>
<local>
<member *member-id*>

Syntax (MX Series Router)

request system storage cleanup
<all-members>
<dry-run>
<local>
<member *member-id*>

Syntax (QFX Series)

request system storage cleanup
<component (*serial number* | *UUID* | all)>
<director-group *name*>
<dry-run>
<infrastructure *name*>
<interconnect-device *name*>
<name-tag *name-tag*>
<node-group *name*>
<prune>
<qfabric (component *name*) | dry-run | name-tag | repository)>
<repository (core | log)>

Release Information

Command introduced in Junos OS Release 7.4.
dry-run option introduced in Junos OS Release 7.6.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Free storage space on the router or switch by rotating log files and proposing a list of files for deletion. User input is required for file deletion. On a QFabric system, you can delete debug files located on individual devices or on the entire QFabric system.

Options

all-members—(EX4200 switches and MX Series routers only) (Optional) Delete files on the Virtual Chassis master Routing Engine only.

NOTE: To delete files on the other members of the Virtual Chassis configuration, log in to each backup Routing Engine and delete the files using the **request system storage cleanup local** command.

component (*UUID* | *serial number* | all)—(QFabric systems only) (Optional) Delete files located on individual QFabric system devices or on the entire QFabric system.

director-group *name*—(QFabric systems only) (Optional) Delete files on the Director group.

dry-run—(Optional) List files proposed for deletion (without deleting them).

infrastructure ***name***—(QFabric systems only) (Optional) Delete files on the fabric control Routing Engine and fabric manager Routing Engine.

interconnect-device ***name***—(QFabric systems only) Optional) Delete files on the Interconnect device.

local—(EX4200 switches and MX Series routers only) (Optional) Delete files on the local Virtual Chassis member.

member ***member-id***—(EX4200 switches and MX Series routers only) (Optional) Delete files on the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

name-tag ***name-tag***—(QFabric systems only) (Optional) Delete debug files that match a specific regular expression.

node-group ***name***—(QFabric systems only) (Optional) Delete files on the Node group.

prune—(QFabric systems only) (Optional) Delete debug files located in either the core or log debug repositories of a QFabric system device.

qfabric component ***name***—(QFabric systems only) (Optional) Delete debug files located in the debug repositories of a QFabric system device.

repository (core | log)—(QFabric systems only) (Optional) Specify the repository on the QFabric system device for which you want to delete debug files.

Additional Information

If logging is configured and being used, the **dry-run** option rotates the log files. In that case, the output displays the message “Currently rotating log files, please wait.” If no logging is currently under way, the output displays only a list of files to delete.

Required Privilege Level

maintenance

List of Sample Output

request system storage cleanup dry-run on page 437
request system storage cleanup on page 438
request system storage cleanup director-group (QFabric Systems) on page 438
request system storage cleanup infrastructure device-name (QFabric Systems) on page 440
request system storage cleanup interconnect-device device-name (QFabric Systems) on page 441
request system storage cleanup node-group group-name (QFabric Systems) on page 442
request system storage cleanup qfabric component device-name (QFabric Systems) on page 443
request system storage cleanup qfabric component device-name repository core (QFabric Systems) on page 443
request system storage cleanup qfabric component all (QFabric Systems) on page 443

Output Fields

Table 51 on page 437 describes the output fields for the **request system storage cleanup** command. Output fields are listed in the approximate order in which they appear.

Table 51: request system storage cleanup Output Fields

Field Name	Field Description
List of files to delete:	Shows list of files available for deletion.
Size	Size of the core-dump file.
Date	Last core-dump file modification date and time.
Name	Name of the core-dump file.
Directory to delete:	Shows list of directories available for deletion.
Repository scope:	Repository where core-dump files and log files are stored. The core-dump files are located in the **core** repository, and the log files are located in the **log** repository. The default **Repository scope** is shared since both the **core** and **log** repositories are shared by all of the QFabric system devices.
Repository head:	Name of the top-level repository location.
Repository name:	Name of the repository: **core** or **log**.
Creating list of debug artifacts to be removed under:	Shows location of files available for deletion.
List of debug artifacts to be removed under:	Shows list of files available for deletion.

Sample Output

request system storage cleanup dry-run

```
user@host> request system storage cleanup dry-run
Currently rotating log files, please wait.
This operation can take up to a minute.

List of files to delete:

         Size Date         Name
  11.4K Mar  8 15:00 /var/log/messages.1.gz
  7245B Feb  5 15:00 /var/log/messages.3.gz
  11.8K Feb 22 13:00 /var/log/messages.2.gz
  3926B Mar 16 13:57 /var/log/messages.0.gz
  3962B Feb 22 12:47 /var/log/sampled.1.gz
  4146B Mar  8 12:20 /var/log/sampled.0.gz
  4708B Dec 21 11:39 /var/log/sampled.2.gz
  7068B Jan 16 18:00 /var/log/messages.4.gz
  13.7K Dec 27 22:00 /var/log/messages.5.gz
   890B Feb 22 17:22 /var/tmp/sampled.pkts
```



```
  65.8M Oct 26 09:10 /var/sw/pkg/jinstall-7.4R1.7-export-signed.tgz
  63.1M Oct 26 09:13 /var/sw/pkg/jbundle-7.4R1.7.tgz
```

request system storage cleanup

```
user@host> request system storage cleanup
Currently rotating log files, please wait.
This operation can take up to a minute.

List of files to delete:

         Size Date         Name
  11.4K Mar  8 15:00 /var/log/messages.1.gz
  7245B Feb  5 15:00 /var/log/messages.3.gz
  11.8K Feb 22 13:00 /var/log/messages.2.gz
  3926B Mar 16 13:57 /var/log/messages.0.gz
  11.6K Mar  8 15:00 /var/log/messages.5.gz
  7254B Feb  5 15:00 /var/log/messages.6.gz
  12.9K Feb 22 13:00 /var/log/messages.8.gz
  3726B Mar 16 13:57 /var/log/messages.7.gz
  3962B Feb 22 12:47 /var/log/sampled.1.gz
  4146B Mar  8 12:20 /var/log/sampled.0.gz
  4708B Dec 21 11:39 /var/log/sampled.2.gz
  7068B Jan 16 18:00 /var/log/messages.4.gz
  13.7K Dec 27 22:00 /var/log/messages.5.gz
   890B Feb 22 17:22 /var/tmp/sampled.pkts
  65.8M Oct 26 09:10 /var/sw/pkg/jinstall-7.4R1.7-export-signed.tgz
  63.1M Oct 26 09:13 /var/sw/pkg/jbundle-7.4R1.7.tgz

Delete these files ? [yes,no] (yes)
```

request system storage cleanup director-group (QFabric Systems)

```
user@switch> request system storage cleanup director-group
List of files to delete:

         Size Date         Name
4.0K   2011-11-07 05:16:29  /tmp/2064.sfcauth
4.0K   2011-11-07 05:07:34  /tmp/30804.sfcauth
4.0K   2011-11-07 04:13:41  /tmp/26792.sfcauth
4.0K   2011-11-07 04:13:39  /tmp/26432.sfcauth
0      2011-11-07 07:45:40  /tmp/cluster_cleanup.log
1.3M   2011-11-07 07:39:11  /tmp/cn_monitor.20111107-052401.log
4.0K   2011-11-07 07:36:29  /tmp/clustat.28019.log
4.0K   2011-11-07 07:36:29  /tmp/clustat_x.28019.log
9.6M   2011-11-07 05:30:24  /tmp/sfc.2.log
4.0K   2011-11-07 05:28:11  /tmp/mgd-init.1320672491.log
248K   2011-11-07 05:19:24  /tmp/cn_monitor.20111107-045111.log
4.0K   2011-11-07 05:17:18  /tmp/clustat.3401.log
4.0K   2011-11-07 05:17:18  /tmp/clustat_x.3401.log
8.0K   2011-11-07 04:58:25  /tmp/mgd-init.1320670633.log
0      2011-11-07 04:54:01  /tmp/mysql_db_install_5.1.37.log
4.0K   2011-11-07 04:52:08  /tmp/cn_send.log
0      2011-11-07 04:52:00  /tmp/init_eth0.log
4.0K   2011-11-07 04:49:35  /tmp/install_interfaces.sh.log
4.0K   2011-11-07 04:48:15  /tmp/bootstrap.sh.log
160K   2011-11-07 04:47:43  /tmp/bootstrap_cleanup.log
38M    2011-11-07 04:42:42  /tmp/cn_monitor.20111104-110308.log
4.0K   2011-11-07 04:38:47  /tmp/clustat.30913.log
4.0K   2011-11-07 04:38:47  /tmp/clustat_x.30913.log
4.0K   2011-11-07 04:38:03  /tmp/dcf_upgrade.sh.remove.log
```



```
4.0K   2011-11-07 04:38:03  /tmp/peer_update.log
4.0K   2011-11-07 04:38:02  /tmp/dcf_upgrade.log
4.0K   2011-11-07 04:38:02  /tmp/perl_mark_upgrade.log
8.0K   2011-11-07 04:13:42  /tmp/install_dcf_rpm.log
4.0K   2011-11-07 04:13:06  /tmp/00_cleanup.sh.1320667986.log
0      2011-11-07 04:13:06  /tmp/ccif_patch_4410_4450.sh.1320667986.log
4.0K   2011-11-07 04:13:06  /tmp/dcf-tools.sh.1320667986.log
0      2011-11-07 04:13:06  /tmp/initial.sh.1320667986.log
0      2011-11-07 04:13:06  /tmp/inventory.sh.1320667986.log
4.0K   2011-11-07 04:13:06  /tmp/qf-db.sh.1320667986.log
4.0K   2011-11-07 04:13:06  /tmp/sfc.sh.1320667986.log
8.0K   2011-11-07 04:13:05  /tmp/jinstall-qfabric.log
8.0K   2011-11-04 11:10:24  /tmp/mgd-init.1320430192.log
4.0K   2011-11-04 11:07:03  /tmp/mysql_dcf_db_install.log
8.0K   2011-11-04 10:55:07  /tmp/ccif_patch_4410_4450.sh.1320429307.log
8.0K   2011-11-04 10:55:07  /tmp/initial.sh.1320429307.log
4.0K   2011-11-04 10:55:07  /tmp/inventory.sh.1320429307.log
8.0K   2011-11-04 10:55:07  /tmp/sfc.sh.1320429307.log
4.0K   2011-11-04 10:54:09  /tmp/ks-script-Ax0tz5.log
4.0K   2011-11-07 04:13:06  /tmp//sfc.sh.1320667986.log
8.0K   2011-11-04 10:55:07  /tmp//sfc.sh.1320429307.log

Directory to delete:
45M    2011-11-08 10:57:43  /tmp/sfc-captures

List of files to delete:

         Size Date         Name
4.0K   2011-11-08 05:47:47  /tmp/5713.sfcauth
4.0K   2011-11-08 05:14:32  /tmp/14494.sfcauth
4.0K   2011-11-08 05:11:47  /tmp/9978.sfcauth
4.0K   2011-11-08 05:09:37  /tmp/6128.sfcauth
4.0K   2011-11-08 05:04:28  /tmp/29703.sfcauth
4.0K   2011-11-07 11:59:10  /tmp/7811.sfcauth
4.0K   2011-11-07 11:36:08  /tmp/32415.sfcauth
4.0K   2011-11-07 11:30:30  /tmp/22406.sfcauth
4.0K   2011-11-07 11:24:37  /tmp/12131.sfcauth
4.0K   2011-11-07 10:48:42  /tmp/12687.sfcauth
4.0K   2011-11-07 09:27:20  /tmp/31082.sfcauth
4.0K   2011-11-07 07:33:58  /tmp/14633.sfcauth
4.0K   2011-11-07 05:08:25  /tmp/15447.sfcauth
4.0K   2011-11-07 04:12:29  /tmp/26874.sfcauth
4.0K   2011-11-07 04:12:27  /tmp/26713.sfcauth
4.0K   2011-11-07 03:49:17  /tmp/17691.sfcauth
4.0K   2011-11-05 01:32:23  /tmp/5716.sfcauth
4.0K   2011-11-07 08:00:17  /tmp/sfcsnmpd.log
4.0K   2011-11-07 07:57:50  /tmp/cluster_cleanup.log
824K   2011-11-07 07:38:37  /tmp/cn_monitor.20111107-053643.log
4.0K   2011-11-07 07:36:30  /tmp/clustat.18399.log
4.0K   2011-11-07 07:36:30  /tmp/clustat_x.18399.log
4.0K   2011-11-07 07:35:47  /tmp/command_lock.log
4.0K   2011-11-07 05:39:54  /tmp/mgd-init.1320673194.log
92K    2011-11-07 05:19:25  /tmp/cn_monitor.20111107-050412.log
4.0K   2011-11-07 05:17:20  /tmp/clustat.30115.log
4.0K   2011-11-07 05:17:20  /tmp/clustat_x.30115.log
8.0K   2011-11-07 05:08:07  /tmp/mgd-init.1320671241.log
4.0K   2011-11-07 05:04:57  /tmp/cn_send.log
0      2011-11-07 05:04:52  /tmp/init_eth0.log
4.0K   2011-11-07 05:02:38  /tmp/install_interfaces.sh.log
4.0K   2011-11-07 05:01:19  /tmp/bootstrap.sh.log
160K   2011-11-07 05:00:47  /tmp/bootstrap_cleanup.log
```

```
28M     2011-11-07 04:42:27  /tmp/cn_monitor.20111104-112954.log
4.0K    2011-11-07 04:38:49  /tmp/clustat.6780.log
4.0K    2011-11-07 04:38:49  /tmp/clustat_x.6780.log
4.0K    2011-11-07 04:38:05  /tmp/issue_event.log
4.0K    2011-11-07 04:38:05  /tmp/peer_upgrade_reboot.log
12K     2011-11-07 04:38:05  /tmp/primary_update.log
4.0K    2011-11-07 04:38:04  /tmp/dcf_upgrade.sh.remove.log
4.0K    2011-11-07 04:38:04  /tmp/peer_rexec_upgrade.log
4.0K    2011-11-07 04:13:42  /tmp/peer_install_dcf_rpm.log
4.0K    2011-11-07 04:11:57  /tmp/dcf-tools.sh.1320667917.log
0       2011-11-07 04:11:57  /tmp/initial.sh.1320667917.log
0       2011-11-07 04:11:57  /tmp/inventory.sh.1320667917.log
4.0K    2011-11-07 04:11:57  /tmp/qf-db.sh.1320667917.log
4.0K    2011-11-07 04:11:57  /tmp/sfc.sh.1320667917.log
4.0K    2011-11-07 04:11:56  /tmp/00_cleanup.sh.1320667916.log
0       2011-11-07 04:11:56  /tmp/ccif_patch_4410_4450.sh.1320667916.log
8.0K    2011-11-07 04:11:56  /tmp/jinstall-qfabric.log
4.0K    2011-11-07 04:11:33  /tmp/dcf_upgrade.log
8.0K    2011-11-04 11:53:12  /tmp/mgd-init.1320432782.log
8.0K    2011-11-04 11:06:17  /tmp/ccif_patch_4410_4450.sh.1320429977.log
8.0K    2011-11-04 11:06:17  /tmp/initial.sh.1320429977.log
4.0K    2011-11-04 11:06:17  /tmp/inventory.sh.1320429977.log
8.0K    2011-11-04 11:06:17  /tmp/sfc.sh.1320429977.log
4.0K    2011-11-04 11:05:19  /tmp/ks-script-_tnWeb.log
4.0K    2011-11-07 04:11:57  /tmp//sfc.sh.1320667917.log
8.0K    2011-11-04 11:06:17  /tmp//sfc.sh.1320429977.log

Directory to delete:
49M     2011-11-08 10:45:20  /tmp/sfc-captures
```

request system storage cleanup infrastructure device-name (QFabric Systems)

```
user@switch> request system storage cleanup infrastructure FC-0
re0:
--------------------------------------------------------------------------

List of files to delete:

         Size Date         Name
   139B Nov  8 19:03 /var/log/default-log-messages.0.gz
  5602B Nov  8 19:03 /var/log/messages.0.gz
  28.4K Nov  8 10:15 /var/log/messages.1.gz
  35.2K Nov  7 13:45 /var/log/messages.2.gz
   207B Nov  7 16:02 /var/log/wtmp.0.gz
    27B Nov  7 12:14 /var/log/wtmp.1.gz
 184.4M Nov  7 12:16
/var/sw/pkg/jinstall-dc-re-11.3I20111104_1216_dc-builder-domestic-signed.tgz
 124.0K Nov  7 15:59 /var/tmp/gres-tp/env.dat
     0B Nov  7 12:57 /var/tmp/gres-tp/lock
   155B Nov  7 16:02 /var/tmp/krt_gencfg_filter.txt
     0B Nov  7 12:35 /var/tmp/last_ccif_update
  1217B Nov  7 12:15 /var/tmp/loader.conf.preinstall
 184.4M Nov  6 07:11 /var/tmp/mchassis-install.tgz
  10.8M Nov  7 12:16
/var/tmp/preinstall/bootstrap-install-11.3I20111104_1216_dc-builder.tar
  57.4K Nov  7 12:16 /var/tmp/preinstall/configs-11.3I20111104_1216_dc-builder.tgz

   259B Nov  7 12:16 /var/tmp/preinstall/install.conf
 734.3K Nov  4 13:46
/var/tmp/preinstall/jboot-dc-re-11.3I20111104_1216_dc-builder.tgz
 177.8M Nov  7 12:16
```



```
/var/tmp/preinstall/jbundle-dc-re-11.3I20111104_1216_dc-builder-domestic.tgz
   124B Nov  7 12:15 /var/tmp/preinstall/metatags
  1217B Nov  7 12:16 /var/tmp/preinstall_boot_loader.conf
     0B Nov  7 16:02 /var/tmp/rtsdb/if-rtsdb
```

request system storage cleanup interconnect-device device-name (QFabric Systems)

```
user@switch> request system storage cleanup interconnect IC-WS001
re1:
--------------------------------------------------------------------------

List of files to delete:

         Size Date         Name
    11B Nov  7 15:55 /var/jail/tmp/alarmd.ts
   128B Nov  8 19:06 /var/log/default-log-messages.0.gz
  9965B Nov  8 19:06 /var/log/messages.0.gz
  15.8K Nov  8 12:30 /var/log/messages.1.gz
  15.8K Nov  8 11:00 /var/log/messages.2.gz
  15.7K Nov  8 07:30 /var/log/messages.3.gz
  15.8K Nov  8 04:00 /var/log/messages.4.gz
  15.7K Nov  8 00:30 /var/log/messages.5.gz
  18.7K Nov  7 21:00 /var/log/messages.6.gz
  17.6K Nov  7 19:00 /var/log/messages.7.gz
  58.3K Nov  7 16:00 /var/log/messages.8.gz
  20.3K Nov  7 15:15 /var/log/messages.9.gz
    90B Nov  7 15:41 /var/log/wtmp.0.gz
    57B Nov  7 12:41 /var/log/wtmp.1.gz
 124.0K Nov  7 15:42 /var/tmp/gres-tp/env.dat
     0B Nov  7 12:40 /var/tmp/gres-tp/lock
     0B Nov  7 12:41 /var/tmp/if-rtsdb/env.lck
  12.0K Nov  7 15:41 /var/tmp/if-rtsdb/env.mem
 132.0K Nov  7 15:55 /var/tmp/if-rtsdb/shm_usr1.mem
2688.0K Nov  7 15:41 /var/tmp/if-rtsdb/shm_usr2.mem
2048.0K Nov  7 15:41 /var/tmp/if-rtsdb/trace.mem
   730B Nov  7 19:57 /var/tmp/juniper.conf+.gz
   155B Nov  7 15:53 /var/tmp/krt_gencfg_filter.txt
     0B Nov  7 15:41 /var/tmp/rtsdb/if-rtsdb

re0:
--------------------------------------------------------------------------

List of files to delete:

         Size Date         Name
    11B Nov  7 15:55 /var/jail/tmp/alarmd.ts
   121B Nov  8 19:06 /var/log/default-log-messages.0.gz
  16.7K Nov  8 19:06 /var/log/messages.0.gz
  22.2K Nov  8 17:45 /var/log/messages.1.gz
  18.4K Nov  8 17:00 /var/log/messages.2.gz
  21.6K Nov  8 16:00 /var/log/messages.3.gz
  17.9K Nov  8 14:30 /var/log/messages.4.gz
  19.4K Nov  8 13:30 /var/log/messages.5.gz
  18.2K Nov  8 12:30 /var/log/messages.6.gz
  20.4K Nov  8 11:30 /var/log/messages.7.gz
  21.4K Nov  8 10:15 /var/log/messages.8.gz
  21.0K Nov  8 09:00 /var/log/messages.9.gz
  19.9K Nov  8 08:13 /var/log/snmp-traps.0.gz
   203B Nov  8 15:36 /var/log/wtmp.0.gz
    57B Nov  7 12:41 /var/log/wtmp.1.gz
 124.0K Nov  7 15:42 /var/tmp/gres-tp/env.dat
```

```
      0B Nov  7 12:40 /var/tmp/gres-tp/lock
      0B Nov  7 12:41 /var/tmp/if-rtsdb/env.lck
   12.0K Nov  7 15:41 /var/tmp/if-rtsdb/env.mem
  132.0K Nov  7 15:55 /var/tmp/if-rtsdb/shm_usr1.mem
 2688.0K Nov  7 15:41 /var/tmp/if-rtsdb/shm_usr2.mem
 2048.0K Nov  7 15:41 /var/tmp/if-rtsdb/trace.mem
    727B Nov  7 15:54 /var/tmp/juniper.conf+.gz
    155B Nov  7 15:55 /var/tmp/krt_gencfg_filter.txt
      0B Nov  7 15:41 /var/tmp/rtsdb/if-rtsdb
```

request system storage cleanup node-group group-name (QFabric Systems)

```
user@switch> request system storage cleanup node-group NW-NG-0
BBAK0372:
--------------------------------------------------------------------------

List of files to delete:

         Size Date         Name
    126B Nov  8 19:07 /var/log/default-log-messages.0.gz
    179B Nov  7 13:32 /var/log/install.0.gz
   22.9K Nov  8 19:07 /var/log/messages.0.gz
   26.5K Nov  8 17:30 /var/log/messages.1.gz
   20.5K Nov  8 13:15 /var/log/messages.2.gz
   33.2K Nov  7 17:45 /var/log/messages.3.gz
   35.5K Nov  7 15:45 /var/log/messages.4.gz
    339B Nov  8 17:10 /var/log/wtmp.0.gz
     58B Nov  7 12:40 /var/log/wtmp.1.gz
  124.0K Nov  8 17:08 /var/tmp/gres-tp/env.dat
      0B Nov  7 12:39 /var/tmp/gres-tp/lock
      0B Nov  7 12:59 /var/tmp/if-rtsdb/env.lck
   12.0K Nov  8 17:09 /var/tmp/if-rtsdb/env.mem
 2688.0K Nov  8 17:09 /var/tmp/if-rtsdb/shm_usr1.mem
  132.0K Nov  8 17:09 /var/tmp/if-rtsdb/shm_usr2.mem
 2048.0K Nov  8 17:09 /var/tmp/if-rtsdb/trace.mem
   1082B Nov  8 17:09 /var/tmp/juniper.conf+.gz
    155B Nov  7 17:39 /var/tmp/krt_gencfg_filter.txt
      0B Nov  8 17:09 /var/tmp/rtsdb/if-rtsdb

EE3093:
--------------------------------------------------------------------------

List of files to delete:

         Size Date         Name
     11B Nov  8 17:33 /var/jail/tmp/alarmd.ts
    119B Nov  8 19:08 /var/log/default-log-messages.0.gz
    180B Nov  7 17:41 /var/log/install.0.gz
    178B Nov  7 13:32 /var/log/install.1.gz
   2739B Nov  8 19:08 /var/log/messages.0.gz
   29.8K Nov  8 18:45 /var/log/messages.1.gz
   31.8K Nov  8 17:15 /var/log/messages.2.gz
   20.6K Nov  8 16:00 /var/log/messages.3.gz
   15.4K Nov  8 10:15 /var/log/messages.4.gz
   15.4K Nov  8 02:15 /var/log/messages.5.gz
   25.5K Nov  7 20:45 /var/log/messages.6.gz
   48.0K Nov  7 17:45 /var/log/messages.7.gz
   32.8K Nov  7 13:45 /var/log/messages.8.gz
    684B Nov  8 17:02 /var/log/wtmp.0.gz
     58B Nov  7 12:40 /var/log/wtmp.1.gz
  124.0K Nov  7 17:34 /var/tmp/gres-tp/env.dat
```



```
      0B Nov  7 12:40 /var/tmp/gres-tp/lock
      0B Nov  7 12:59 /var/tmp/if-rtsdb/env.lck
   12.0K Nov  7 17:39 /var/tmp/if-rtsdb/env.mem
 2688.0K Nov  7 17:39 /var/tmp/if-rtsdb/shm_usr1.mem
  132.0K Nov  7 17:40 /var/tmp/if-rtsdb/shm_usr2.mem
 2048.0K Nov  7 17:39 /var/tmp/if-rtsdb/trace.mem
    155B Nov  7 17:40 /var/tmp/krt_gencfg_filter.txt
      0B Nov  7 17:39 /var/tmp/rtsdb/if-rtsdb
```

request system storage cleanup qfabric component device-name (QFabric Systems)

```
user@switch> request system storage cleanup qfabric component A0001/YA0197
Repository type: regular
Repository head: /pbstorage
Creating list of debug artifacts to be removed under:
/pbstorage/rdumps/A0001/YA0197
Removing debug artifacts ... (press control C to abort)
Removing /pbstorage/rdumps/A0001/YA0197/cosd.core.0.0.05162011123308.gz ... done
Removing /pbstorage/rdumps/A0001/YA0197/cosd.core.1.0.05162011123614.gz ... done
Removing /pbstorage/rdumps/A0001/YA0197/cosd.core.2.0.05162011123920.gz ... done
Removing /pbstorage/rdumps/A0001/YA0197/livekcore.05132011163930.gz ... done
Removing /pbstorage/rdumps/A0001/YA0197/tnetd.core.0.1057.05162011124500.gz ...
done
Removing /pbstorage/rdumps/A0001/YA0197/vmcore.05132011120528.gz ... done
Removing /pbstorage/rdumps/A0001/YA0197/vmcore.kz ... done
Creating list of debug artifacts to be removed under: /pbstorage/rlogs/A0001/YA0197
Removing debug artifacts ... (press control C to abort)
Removing /pbstorage/rlogs/A0001/YA0197/kdumpinfo.05132011120528 ... done
Removing /pbstorage/rlogs/A0001/YA0197/kernel.tarball.0.1039.05122011234415.tgz
... done
Removing /pbstorage/rlogs/A0001/YA0197/kernel.tarball.1.1039.05132011175544.tgz
... done
Removing /pbstorage/rlogs/A0001/YA0197/tnetd.tarball.0.1057.05162011175453.tgz
... done
```

request system storage cleanup qfabric component device-name repository core (QFabric Systems)

```
user@switch> request system storage cleanup qfabric component EE3093 repository core
Repository scope: shared
Repository head: /pbdata/export
Repository name: core
Creating list of debug artifacts to be removed under: /pbdata/export/rdumps/EE3093
NOTE: core repository under /pbdata/export/rdumps/EE3093 empty
```

request system storage cleanup qfabric component all (QFabric Systems)

```
user@switch> request system storage cleanup qfabric component all
Repository scope: shared
Repository head: /pbdata/export
Creating list of debug artifacts to be removed under: /pbdata/export/rdumps
NOTE: core repository under /pbdata/export/rdumps/all empty
Creating list of debug artifacts to be removed under: /pbdata/export/rlogs
List of debug artifacts to clean up ... (press control C to abort)
/pbdata/export/rlogs/73747cd8-0710-11e1-b6a4-00e081c5297e/install-11072011125819.log
/pbdata/export/rlogs/77116f18-0710-11e1-a2a0-00e081c5297e/install-11072011125819.log
/pbdata/export/rlogs/BBAK0372/install-11072011121538.log
/pbdata/export/rlogs/BBAK0394/install-11072011121532.log
/pbdata/export/rlogs/EE3093/install-11072011121536.log
/pbdata/export/rlogs/WS001/YN5999/install-11072011121644.log
/pbdata/export/rlogs/WS001/YW3803/install-11072011122429.log
/pbdata/export/rlogs/cd78871a-0710-11e1-878e-00e081c5297e/install-11072011125932.log
/pbdata/export/rlogs/d0afda1e-0710-11e1-a1d0-00e081c5297e/install-11072011125930.log
```

```
/pbdata/export/rlogs/d0afda1e-0710-11e1-a1d0-00e081c5297e/install-11072011133211.log
/pbdata/export/rlogs/d0afda1e-0710-11e1-a1d0-00e081c5297e/install-11072011155302.log
/pbdata/export/rlogs/d31ab7a6-0710-11e1-ad1b-00e081c5297e/install-11072011125931.log
/pbdata/export/rlogs/d4d0f254-0710-11e1-90c3-00e081c5297e/install-11072011125932.log
```


request system zeroize

Syntax

request system zeroize
<media>

Release Information

Command introduced before Junos OS Release 9.0.
Command introduced in Junos OS Release 11.2 for EX Series switches.
Option **media** added in Junos OS Release 11.4 for EX Series switches.
Command introduced in Junos OS Release 12.2 for MX Series devices.
Command introduced in Junos OS Release 12.3 for the QFX Series.

Description

NOTE: **The media option is not available on the QFX Series.**

Remove all configuration information on the Routing Engines and reset all key values. If the device has dual Routing Engines, the command is broadcast to all Routing Engines on the device. The command removes all data files, including customized configuration and log files, by unlinking the files from their directories. The command removes all user-created files from the system including all plain-text passwords, secrets, and private keys for SSH, local encryption, local authentication, IPsec, RADIUS, TACACS+, and SNMP.

This command reboots the device and sets it to the factory default configuration. After the reboot, you cannot access the device through the management Ethernet interface. Log in through the console as **root** and start the Junos OS command-line interface (CLI) by typing **cli** at the prompt.

To completely erase user-created data so that it is unrecoverable, use the **media** option.

Options

media—(Optional) In addition to removing all configuration and log files, the **media** option causes memory and the media to be scrubbed, removing all traces of any user-created files. Every storage device attached to the system is scrubbed, including disks, flash drives, removable USBs, and the like. The duration of the scrubbing process is dependent on the size of the media being erased. As a result, the **request system zeroize media** operation can take considerably more time than the **request system zeroize** operation. However, the critical security parameters are all removed at the beginning of the process.

Required Privilege Level

maintenance

Related Documentation

- *request system snapshot*
- request system snapshot on page 390
- *Reverting to the Default Factory Configuration for the EX Series Switch*
- *Reverting to the Rescue Configuration for the EX Series Switch*
- Reverting to the Default Factory Configuration on page 163

- Reverting to the Rescue Configuration on page 165
- Reverting to the Default Factory Configuration by Using the request system zeroize Command on page 164

List of Sample Output

Sample Output

request system zeroize

```
user@host> request system zeroize
warning: System will be rebooted and may not boot without configuration
Erase all data, including configuration and log files? [yes,no] (no) yes

0 1 1 0 0 0 done

syncing disks... All buffers synced.
Uptime: 5d19h20m26s
recorded reboot as normal shutdown
Rebooting...

U-Boot 1.1.6 (Mar 11 2011 - 04:39:06)

Board: EX4200-24T 2.11
EPLD:  Version 6.0 (0x85)
DRAM:  Initializing (1024 MB)
FLASH: 8 MB

Firmware Version: --- 01.00.00 ---
USB:   scanning bus for devices... 2 USB Device(s) found
       scanning bus for storage devices... 1 Storage Device(s) found

ELF file is 32 bit
Consoles: U-Boot console

FreeBSD/PowerPC U-Boot bootstrap loader, Revision 2.4
(user@juniper.net, Fri Mar 11 03:03:36 UTC 2011)
Memory: 1024MB
bootsequencing is enabled
bootsuccess is set
new boot device = disk0s1:
Loading /boot/defaults/loader.conf
/kernel data=0x915c84+0xa1260 syms=[0x4+0x7cbd0+0x4+0xb1c19]


Hit [Enter] to boot immediately, or space bar for command prompt.
Booting [/kernel]...
Kernel entry at 0x800000e0 ...
GDB: no debug ports present
KDB: debugger backends: ddb
KDB: current backend: ddb
Copyright (c) 1996-2011, Juniper Networks, Inc.
All rights reserved.
Copyright (c) 1992-2006 The FreeBSD Project.
Copyright (c) 1979, 1980, 1983, 1986, 1988, 1989, 1991, 1992, 1993, 1994
        The Regents of the University of California. All rights reserved.
JUNOS 11.1R1.8 #0: 2011-03-09 20:14:25 UTC
```

```
user@juniper.net:/volume/build/junos/11.1/release/11.1R1.8/obj-powerpc/bsd/kernels/
  JUNIPER-EX/kernel
Timecounter "decrementer" frequency 50000000 Hz quality 0
cpu0: Freescale e500v2 core revision 2.2
cpu0: HID0 80004080
...
```

request system zeroize media

```
user@host> request system zeroize media
warning: System will be rebooted and may not boot without configuration
Erase all data, including configuration and log files? [yes,no] (no) yes

warning: ipsec-key-management subsystem not running - not needed by configuration.
warning: zeroizing fpc0

{master:0}
root> Waiting (max 60 seconds) for system process `vnlru' to stop...done
. . .
Syncing disks, vnodes remaining...2 4 2 4 3 2 1 1 0 0 0 done

syncing disks... All buffers synced.
Uptime: 14m50s
recorded reboot as normal shutdown
Rebooting...

U-Boot 1.1.6 (Apr 21 2011 - 13:58:42)

Board: EX4200-48PX 1.1
EPLD:  Version 8.0 (0x82)
DRAM:  Initializing (512 MB)
FLASH: 8 MB
NAND:  No NAND device found!!!
0 MiB

Firmware Version: --- 01.00.00 ---
USB:   scanning bus for devices... 2 USB Device(s) found
       scanning bus for storage devices... 1 Storage Device(s) found

ELF file is 32 bit
Consoles: U-Boot console

FreeBSD/PowerPC U-Boot bootstrap loader, Revision 2.2
(vtseng@svl-junos-pool27.juniper.net, Fri Feb 26 17:48:51 PST 2010)
Memory: 512MB
Loading /boot/defaults/loader.conf
/kernel data=0x9abfdc+0xb06e4 syms=[0x4+0x83b30+0x4+0xbd7c6]

Hit [Enter] to boot immediately, or space bar for command prompt.
Booting [/kernel] in 1 second... Booting [/kernel]...
Kernel entry at 0x800000e0 ...
GDB: no debug ports present
KDB: debugger backends: ddb
KDB: current backend: ddb
Copyright (c) 1996-2011, Juniper Networks, Inc.
All rights reserved.
Copyright (c) 1992-2006 The FreeBSD Project.
Copyright (c) 1979, 1980, 1983, 1986, 1988, 1989, 1991, 1992, 1993, 1994
 The Regents of the University of California. All rights reserved.
JUNOS 11.4R1.2 #0: 2011-10-27 18:05:39 UTC
```

```
    user@juniper.net:/volume/build/junos/11.4/release/11.4R1.2/obj-powerpc/
bsd/kernels/JUNIPER-EX/kernel
can't re-use a leaf (all_slot_serialid)!
Timecounter "decrementer" frequency 50000000 Hz quality 0
cpu0: Freescale e500v2 core revision 2.2
cpu0: HID0 80004080<EMCP,TBEN,EN_MAS7_UPDATE>
real memory  = 511705088 (488 MB)
avail memory = 500260864 (477 MB)
ETHERNET SOCKET BRIDGE initialising
Initializing EXSERIES platform properties ...
. . .
Automatic reboot in progress...
Media check on da0 on ex platforms
** /dev/da0s2a
FILE SYSTEM CLEAN; SKIPPING CHECKS
clean, 20055 free (31 frags, 2503 blocks, 0.0% fragmentation)
zeroizing /dev/da0s1a ...
. . .
zeroizing /dev/da0s3d ...
. . .
zeroizing /dev/da0s3e ...
. . .
zeroizing /dev/da0s4d ...
. . .
zeroizing /dev/da0s4e ...
. . .

syncing disks... All buffers synced.
Uptime: 3m40s
Rebooting...

U-Boot 1.1.6 (Apr 21 2011 - 13:58:42)

Board: EX4200-48PX 1.1
EPLD:  Version 8.0 (0x82)
DRAM:  Initializing (512 MB)
FLASH: 8 MB
NAND:  No NAND device found!!!
0 MiB

Firmware Version: --- 01.00.00 ---
USB:   scanning bus for devices... 2 USB Device(s) found
       scanning bus for storage devices... 1 Storage Device(s) found

ELF file is 32 bit
Consoles: U-Boot console

FreeBSD/PowerPC U-Boot bootstrap loader, Revision 2.2
(vtseng@svl-junos-pool27.juniper.net, Fri Feb 26 17:48:51 PST 2010)
Memory: 512MB
Loading /boot/defaults/loader.conf
/kernel data=0x9abfdc+0xb06e4 syms=[0x4+0x83b30+0x4+0xbd7c6]

Hit [Enter] to boot immediately, or space bar for command prompt.
Booting [/kernel] in 1 second... Booting [/kernel]...
Kernel entry at 0x800000e0 ...
GDB: no debug ports present
KDB: debugger backends: ddb
KDB: current backend: ddb
Copyright (c) 1996-2011, Juniper Networks, Inc.
All rights reserved.
```



```
Copyright (c) 1992-2006 The FreeBSD Project.
Copyright (c) 1979, 1980, 1983, 1986, 1988, 1989, 1991, 1992, 1993, 1994
 The Regents of the University of California. All rights reserved.
JUNOS 11.4R1.2 #0: 2011-10-27 18:05:39 UTC
    user@juniper.net:/volume/build/junos/11.4/release/11.4R1.2/obj-powerpc/
bsd/kernels/JUNIPER-EX/kernel
can't re-use a leaf (all_slot_serialid)!
Timecounter "decrementer" frequency 50000000 Hz quality 0
cpu0: Freescale e500v2 core revision 2.2
cpu0: HID0 80004080 <EMCP,TBEN,EN_MAS7_UPDATE>
real memory  = 511705088 (488 MB)
avail memory = 500260864 (477 MB)
ETHERNET SOCKET BRIDGE initialising
Initializing EXSERIES platform properties ...
. . .
Automatic reboot in progress...
Media check on da0 on ex platforms
** /dev/da0s1a
FILE SYSTEM CLEAN; SKIPPING CHECKS
clean, 20064 free (48 frags, 2502 blocks, 0.1% fragmentation)
zeroizing /dev/da0s2a ...
. . .
Creating initial configuration...mgd: error: Cannot open configuration file:
/config/juniper.conf
mgd: warning: activating factory configuration
mgd: commit complete
mgd: ---------------------------------------------------------
mgd: Please login as 'root'. No password is required.
mgd: To start Initial Setup, type 'ezsetup' at the JUNOS prompt.
mgd: To start JUNOS CLI, type 'cli' at the JUNOS prompt.
mgd: ---------------------------------------------------------
Setting initial options:  debugger_on_panic=NO debugger_on_break=NO.
Starting optional daemons: .
Doing initial network setup:
. . .

Amnesiac (ttyu0)
```

restart

Syntax

restart
<adaptive-services |ancpd-service | application-identification |audit-process | auto-configuration |captive-portal-content-delivery |ce-l2tp-service |chassis-control | class-of-service |clksyncd-service |database-replication|datapath-trace-service |dhcp-service | diameter-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging | ethernet-connectivity-fault-management |ethernet-link-fault-management |event-processing | firewall |general-authentication-service | gracefully | iccp-service |idp-policy | immediately |interface-control | ipsec-key-management | kernel-replication | l2-learning | l2cpd-service | l2tp-service | l2tp-universal-edge | lacp | license-service |link-management |local-policy-decision-function |mac-validation |mib-process | mobile-ip | mountd-service |mpls-traceroute |mspd | multicast-snooping |named-service | nfsd-service | packet-triggered-subscribers |peer-selection-service |pgcp-service | pgm | pic-services-logging | pki-service |ppp | ppp-service |pppoe | protected-system-domain-service | redundancy-interface-process | remote-operations | root-system-domain-service | routing <logical-system *logical-system-name*> | sampling | sbc-configuration-process | sdk-service |service-deployment | services | services pgcp gateway *gateway-name* | snmp |soft |static-subscribers |statistics-service| subscriber-management | subscriber-management-helper | tunnel-oamd |usb-control| vrrp |web-management>
<gracefully | immediately | soft>

Syntax (ACX Series Routers)

restart
<adaptive-services |audit-process | auto-configuration | autoinstallation |chassis-control | class-of-service |clksyncd-service |database-replication| dhcp-service | diameter-service | disk-monitoring | dynamic-flow-capture | ethernet-connectivity-fault-management |ethernet-link-fault-management |event-processing | firewall |general-authentication-service | gracefully | immediately |interface-control | ipsec-key-management | l2-learning | lacp |link-management |mib-process | mobile-ip | mountd-service |mpls-traceroute |mspd | named-service | nfsd-service | pgm | pki-service |ppp | pppoe | redundancy-interface-process | remote-operations | routing | sampling | sdk-service |secure-neighbor-discovery | service-deployment | services | snmp |soft |statistics-service| subscriber-management | subscriber-management-helper | tunnel-oamd | vrrp>

Syntax (EX Series Switches)

restart
<autoinstallation | chassis-control | class-of-service | database-replication | dhcp | dhcp-service | diameter-service | dot1x-protocol | ethernet-link-fault-management | ethernet-switching | event-processing | firewall | general-authentication-service | interface-control | kernel-replication | l2-learning | lacp | license-service | link-management | lldpd-service | mib-process | mountd-service | multicast-snooping | pgm | redundancy-interface-process | remote-operations | routing | secure-neighbor-discovery | service-deployment | sflow-service | snmp | vrrp | web-management>

Syntax (Routing Matrix)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging | event-processing | firewall | interface-control | ipsec-key-management | kernel-replication | l2-learning | l2tp-service | lacp | link-management | mib-process | pgm | pic-services-logging | ppp | pppoe | redundancy-interface-process | remote-operations | routing <logical-system *logical-system-name*> | sampling | service-deployment | snmp>
<all | all-lcc | lcc *number*>

<gracefully | immediately | soft>

Syntax (J Series Routing Platform)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | dhcp | dialer-services | dlsw | event-processing | firewall | interface-control | ipsec-key-management | isdn-signaling | l2-learning | l2tp-service | mib-process | network-access-service | pgm | ppp | pppoe | remote-operations | routing <logical-system *logical-system-name*> | sampling | service-deployment | snmp | usb-control | web-management>
<gracefully | immediately | soft>

Syntax (TX Matrix Routers)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | dhcp-service | diameter-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging | event-processing | firewall | interface-control | ipsec-key-management | kernel-replication | l2-learning | l2tp-service | lacp | link-management | mib-process |pgm | pic-services-logging | ppp | pppoe | redundancy-interface-process | remote-operations | routing <logical-system *logical-system-name*> | sampling | service-deployment | snmp| statistics-service>
<all-chassis | all-lcc | lcc *number* | scc>
<gracefully | immediately | soft>

Syntax (TX Matrix Plus Routers)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | dhcp-service | diameter-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging | event-processing | firewall | interface-control | ipsec-key-management | kernel-replication | l2-learning | l2tp-service | lacp | link-management | mib-process | pgm | pic-services-logging | ppp | pppoe | redundancy-interface-process | remote-operations | routing <logical-system *logical-system-name*> | sampling | service-deployment | snmp| statistics-service>
<all-chassis | all-lcc | all-sfc | lcc *number* | sfc *number*>
<gracefully | immediately | soft>

Syntax (MX Series Routers)

restart
<adaptive-services | ancpd-service |application-identification|audit-process | auto-configuration |captive-portal-content-delivery |ce-l2tp-service |chassis-control | class-of-service |clksyncd-service |database-replication| datapath-trace-service |dhcp-service | diameter-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging | ethernet-connectivity-fault-management |ethernet-link-fault-management |event-processing | firewall | general-authentication-service | gracefully |iccp-service |idp-policy |immediately |interface-control | ipsec-key-management | kernel-replication | l2-learning |l2cpd-service |l2tp-service | l2tp-universal-edge | lacp | license-service |link-management |local-policy-decision-function |mac-validation |mib-process | mobile-ip |mountd-service |mpls-traceroute |mspd | multicast-snooping |named-service | nfsd-service | packet-triggered-subscribers |peer-selection-service | pgcp-service | pgm | pic-services-logging | pki-service |ppp | ppp-service |pppoe | protected-system-domain-service | redundancy-interface-process | remote-operations |root-system-domain-service | routing |routing <logical-system *logical-system-name*> | sampling | sbc-configuration-process | sdk-service |service-deployment |services | services pgcp gateway *gateway-name* |snmp |soft |static-subscribers |statistics-service| subscriber-management | subscriber-management-helper | tunnel-oamd | usb-control| vrrp |web-management>
<all-members>
<gracefully | immediately | soft>
<local>
<member *member-id*>

Syntax (J Series Routers)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | dhcp | dhcp-service | dialer-services | diameter-service | dlsw | event-processing | firewall | interface-control | ipsec-key-management | isdn-signaling | l2ald | l2-learning | l2tp-service | mib-process | network-access-service | pgm | ppp | pppoe | remote-operations | routing <logical-system *logical-system-name*> | sampling | service-deployment | snmp | usb-control | web-management>
<gracefully | immediately | soft>

Syntax (QFX Series)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | dialer-services | diameter-service | dlsw | ethernet-connectivity | event-processing | fibre-channel | firewall | general-authentication-service | igmp-host-services | interface-control | ipsec-key-management | isdn-signaling | l2ald | l2-learning | l2tp-service | mib-process | named-service | network-access-service | nstrace-process | pgm | ppp | pppoe | redundancy-interface-process | remote-operations |*logical-system-name*> | routing | sampling |secure-neighbor-discovery | service-deployment | snmp | usb-control | web-management>
<gracefully | immediately | soft>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 12.2 for ACX Series routers.
Options added:

- **dynamic-flow-capture** in Junos OS Release 7.4.
- **dlsw** in Junos OS Release 7.5.
- **event-processing** in Junos OS Release 7.5.
- **ppp** in Junos OS Release 7.5.
- **l2ald** in Junos OS Release 8.0.
- **link-management** in Release 8.0.
- **pgcp-service** in Junos OS Release 8.4.
- **sbc-configuration-process** in Junos OS Release 9.5.
- **services pgcp gateway** in Junos OS Release 9.6.
- **sfc** and **all-sfc** for the TX Matrix Router in Junos OS Release 9.6.

Description

Restart a Junos OS process.

CAUTION: Never restart a software process unless instructed to do so by a customer support engineer. A restart might cause the router or switch to drop calls and interrupt transmission, resulting in possible loss of data.

Options

none—Same as **gracefully**.

adaptive-services—(Optional) Restart the configuration management process that manages the configuration for stateful firewall, Network Address Translation (NAT), intrusion detection services (IDS), and IP Security (IPsec) services on the Adaptive Services PIC.

all-chassis—(TX Matrix and TX Matrix Plus routers only) (Optional) Restart the software process on all chassis.

all-lcc—(TX Matrix and TX Matrix Plus routers only) (Optional) For a TX Matrix router, restart the software process on all T640 routers connected to the TX Matrix router. For a TX Matrix Plus router, restart the software process on all T1600 routers connected to the TX Matrix Plus router.

all-members—(MX Series routers only) (Optional) Restart the software process for all members of the Virtual Chassis configuration.

all-sfc—(TX Matrix Plus routers only) (Optional) For a TX Matrix Plus router, restart the software processes for the TX Matrix Plus router (or switch-fabric chassis).

ancpd-service—(Optional) Restart the Access Node Control Protocol (ANCP) process, which works with a special Internet Group Management Protocol (IGMP) session to collect outgoing interface mapping events in a scalable manner.

application-identification—(Optional) Restart the process that identifies an application using intrusion detection and prevention (IDP) to allow or deny traffic based on applications running on standard or nonstandard ports.

audit-process—(Optional) Restart the RADIUS accounting process that gathers statistical data that can be used for general network monitoring, analyzing, and tracking usage patterns, for billing a user based on the amount of time or type of services accessed.

auto-configuration—(Optional) Restart the Interface Auto-Configuration process.

autoinstallation—(EX Series switches only) (Optional) Restart the autoinstallation process.

captive-portal-content-delivery—(Optional) Restart the HTTP redirect service by specifying the location to which a subscriber's initial Web browser session is redirected, enabling initial provisioning and service selection for the subscriber.

ce-l2tp-service—(M10, M10i, M7i, and MX Series routers only) (Optional) Restart the Universal Edge Layer 2 Tunneling Protocol (L2TP) process, which establishes L2TP tunnels and Point-to-Point Protocol (PPP) sessions through L2TP tunnels.

chassis-control—(Optional) Restart the chassis management process.

class-of-service—(Optional) Restart the class-of-service (CoS) process, which controls the router's or switch’s CoS configuration.

clksyncd-service—(Optional) Restart the external clock synchronization process, which uses synchronous Ethernet (SyncE).

database-replication—(EX Series switches and MX Series routers only) (Optional) Restart the database replication process.

datapath-trace-service—(Optional) Restart the packet path tracing process.

dhcp—(J Series routers and EX Series switches only) (Optional) Restart the software process for a Dynamic Host Configuration Protocol (DHCP) server. A DHCP server allocates network IP addresses and delivers configuration settings to client hosts without user intervention.

dhcp-service—(Optional) Restart the Dynamic Host Configuration Protocol process.

dialer-services—(J Series routers and EX Series switches only) (Optional) Restart the ISDN dial-out process.

diameter-service—(Optional) Restart the diameter process.

disk-monitoring—(Optional) Restart disk monitoring, which checks the health of the hard disk drive on the Routing Engine.

dlsw—(J Series routers and QFX Series only) (Optional) Restart the data link switching (DLSw) service.

dot1x-protocol—(EX Series switches only) (Optional) Restart the port-based network access control process.

dynamic-flow-capture—(Optional) Restart the dynamic flow capture (DFC) process, which controls DFC configurations on Monitoring Services III PICs.

ecc-error-logging—(Optional) Restart the error checking and correction (ECC) process, which logs ECC parity errors in memory on the Routing Engine.

ethernet-connectivity-fault-management—(Optional) Restart the process that provides IEEE 802.1ag Operation, Administration, and Management (OAM) connectivity fault management (CFM) database information for CFM maintenance association end points (MEPs) in a CFM session.

ethernet-link-fault-management—(EX Series switches and MX Series routers only) (Optional) Restart the process that provides the OAM link fault management (LFM) information for Ethernet interfaces.

ethernet-switching—(EX Series switches only) (Optional) Restart the Ethernet switching process.

event-processing—(Optional) Restart the event process (eventd).

fibre-channel—(QFX Series only) (Optional) Restart the Fibre Channel process.

firewall—(Optional) Restart the firewall management process, which manages the firewall configuration and enables accepting or rejecting packets that are transiting an interface on a router or switch.

general-authentication-service—(EX Series switches and MX Series routers only) (Optional) Restart the general authentication process.

gracefully—(Optional) Restart the software process.

iccp-service—(Optional) Restart the Inter-Chassis Communication Protocol (ICCP) process.

idp-policy—(Optional) Restart the intrusion detection and prevention (IDP) protocol process.

immediately—(Optional) Immediately restart the software process.

interface-control—(Optional) Restart the interface process, which controls the router's or switch's physical interface devices and logical interfaces.

ipsec-key-management—(Optional) Restart the IPsec key management process.

isdn-signaling—(J Series routers and QFX Series only) (Optional) Restart the ISDN signaling process, which initiates ISDN connections.

kernel-replication—(Optional) Restart the kernel replication process, which replicates the state of the backup Routing Engine when graceful Routing Engine switchover (GRES) is configured.

l2-learning—(Optional) Restart the Layer 2 address flooding and learning process.

l2cpd-service—(Optional) Restart the Layer 2 Control Protocol process, which enables features such as Layer 2 protocol tunneling and nonstop bridging.

l2tp-service— (M10, M10i, M7i, and MX Series routers only) (Optional) Restart the Layer 2 Tunneling Protocol (L2TP) process, which sets up client services for establishing Point-to-Point Protocol (PPP) tunnels across a network and negotiating Multilink PPP if it is implemented.

l2tp-universal-edge—(MX Series routers only) (Optional) Restart the L2TP process, which establishes L2TP tunnels and PPP sessions through L2TP tunnels.

lacp—(Optional) Restart the Link Aggregation Control Protocol (LACP) process. LACP provides a standardized means for exchanging information between partner systems on a link to allow their link aggregation control instances to reach agreement on the identity of the LAG to which the link belongs, and then to move the link to that LAG, and to enable the transmission and reception processes for the link to function in an orderly manner.

lcc *number*—(TX Matrix and TX Matrix Plus routers only) (Optional) For a TX Matrix router, restart the software process for a specific T640 router that is connected to the TX Matrix router. For a TX Matrix Plus router, restart the software process for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

license-service—(EX Series switches only) (Optional) Restart the feature license management process.

link-management— (TX Matrix and TX Matrix Plus routers and EX Series switches only) (Optional) Restart the Link Management Protocol (LMP) process, which establishes and maintains LMP control channels.

lldpd-service—(EX Series switches only) (Optional) Restart the Link Layer Discovery Protocol (LLDP) process.

local—(MX Series routers only) (Optional) Restart the software process for the local Virtual Chassis member.

local-policy-decision-function— (Optional) Restart the process for the Local Policy Decision Function, which regulates collection of statistics related to applications and application groups and tracking of information about dynamic subscribers and static interfaces.

mac-validation— (Optional) Restart the Media Access Control (MAC) validation process, which configures MAC address validation for subscriber interfaces created on demux interfaces in dynamic profiles on MX Series routers.

member *member-id*—(MX Series routers only) (Optional) Restart the software process for a specific member of the Virtual Chassis configuration. Replace ***member-id*** with a value of **0** or **1**.

mib-process—(Optional) Restart the Management Information Base (MIB) version II process, which provides the router's MIB II agent.

mobile-ip—(Optional) Restart the Mobile IP process, which configures Junos OS Mobile IP features.

mountd-service—(EX Series switches and MX Series routers only) (Optional) Restart the service for NFS mount requests.

mpls-traceroute—(Optional) Restart the MPLS Periodic Traceroute process.

mspd—(Optional) Restart the Multiservice process.

multicast-snooping—(EX Series switches and MX Series routers only) (Optional) Restart the multicast snooping process, which makes Layer 2 devices, such as VLAN switches, aware of Layer 3 information, such as the media access control (MAC) addresses of members of a multicast group.

named-service—(Optional) Restart the DNS Server process, which is used by a router or a switch to resolve hostnames into addresses.

network-access-service—(J Series routers and QFX Series only) (Optional) Restart the network access process, which provides the router's Challenge Handshake Authentication Protocol (CHAP) authentication service.

nfsd-service—(Optional) Restart the Remote NFS Server process, which provides remote file access for applications that need NFS-based transport.

packet-triggered-subscribers—(Optional) Restart the packet-triggered subscribers and policy control (PTSP) process, which allows the application of policies to dynamic subscribers that are controlled by a subscriber termination device.

peer-selection-service—(Optional) Restart the Peer Selection Service process.

pgcp-service—(Optional) Restart the pgcpd service process running on the Routing Engine. This option does not restart pgcpd processes running on mobile station PICs. To restart pgcpd processes running on mobile station PICs, use the **services pgcp gateway** option.

pgm—(Optional) Restart the process that implements the Pragmatic General Multicast (PGM) protocol for assisting in the reliable delivery of multicast packets.

pic-services-logging—(Optional) Restart the logging process for some PICs. With this process, also known as fsad (the file system access daemon), PICs send special logging information to the Routing Engine for archiving on the hard disk.

pki-service—(Optional) Restart the PKI Service process.

ppp—(Optional) Restart the Point-to-Point Protocol (PPP) process, which is the encapsulation protocol process for transporting IP traffic across point-to-point links.

ppp-service—(Optional) Restart the Universal Edge PPP process, which is the encapsulation protocol process for transporting IP traffic across Universal Edge routers.

pppoe—(Optional) Restart the Point-to-Point Protocol over Ethernet (PPPoE) process, which combines PPP that typically runs over broadband connections with the Ethernet link-layer protocol that allows users to connect to a network of hosts over a bridge or access concentrator.

protected-system-domain-service—(Optional) Restart the Protected System Domain (PSD) process.

redundancy-interface-process—(Optional) Restart the ASP redundancy process.

remote-operations—(Optional) Restart the remote operations process, which provides the ping and traceroute MIBs.

root-system-domain-service—(Optional) Restart the Root System Domain (RSD) service.

routing—(ACX Series routers, QFX Series, EX Series switches, and MX Series routers only) (Optional) Restart the routing protocol process.

routing <logical-system *logical-system-name*>—(Optional) Restart the routing protocol process, which controls the routing protocols that run on the router or switch and maintains the routing tables. Optionally, restart the routing protocol process for the specified logical system only.

sampling—(Optional) Restart the sampling process, which performs packet sampling based on particular input interfaces and various fields in the packet header.

sbc-configuration-process—(Optional) Restart the session border controller (SBC) process of the border signaling gateway (BSG).

scc—(TX Matrix routers only) (Optional) Restart the software process on the TX Matrix router (or switch-card chassis).

sdk-service—(Optional) Restart the SDK Service process, which runs on the Routing Engine and is responsible for communications between the SDK application and Junos OS. Although the SDK Service process is present on the router, it is turned off by default.

secure-neighbor-discovery—(QFX Series, EX Series switches, and MX Series routers only) (Optional) Restart the secure Neighbor Discovery Protocol (NDP) process, which provides support for protecting NDP messages.

sfc *number*—(TX Matrix Plus routers only) (Optional) Restart the software process on the TX Matrix Plus router (or switch-fabric chassis). Replace ***number*** with **0**.

service-deployment—(Optional) Restart the service deployment process, which enables Junos OS to work with the Session and Resource Control (SRC) software.

services—(Optional) Restart a service.

services pgcp gateway *gateway-name*—(Optional) Restart the pgcpd process for a specific border gateway function (BGF) running on an MS-PIC. This option does not restart the pgcpd process running on the Routing Engine. To restart the pgcpd process on the Routing Engine, use the **pgcp-service** option.

sflow-service—(EX Series switches only) (Optional) Restart the flow sampling (sFlow technology) process.

snmp—(Optional) Restart the SNMP process, which enables the monitoring of network devices from a central location and provides the router's or switch's SNMP master agent.

soft—(Optional) Reread and reactivate the configuration without completely restarting the software processes. For example, BGP peers stay up and the routing table stays constant. Omitting this option results in a graceful restart of the software process.

static-subscribers—(Optional) Restart the static subscribers process, which associates subscribers with statically configured interfaces and provides dynamic service activation and activation for these subscribers.

statistics-service—(Optional) Restart the process that manages the Packet Forwarding Engine statistics.

subscriber-management—(Optional) Restart the Subscriber Management process.

subscriber-management-helper—(Optional) Restart the Subscriber Management Helper process.

tunnel-oamd—(Optional) Restart the Tunnel OAM process, which enables the Operations, Administration, and Maintenance of Layer 2 tunneled networks. Layer 2 protocol tunneling (L2PT) allows service providers to send Layer 2 PDUs across the provider's cloud and deliver them to Juniper Networks EX Series Ethernet Switches that are not part of the local broadcast domain.

usb-control—(J Series routers and MX Series routers only) (Optional) Restart the USB control process.

vrrp—(ACX Series routers, EX Series switches, and MX Series routers only) (Optional) Restart the Virtual Router Redundancy Protocol (VRRP) process, which enables hosts on a LAN to make use of redundant routing platforms on that LAN without requiring more than the static configuration of a single default route on the hosts.

web-management—(J Series routers, QFX Series, EX Series switches, and MX Series routers only) (Optional) Restart the Web management process.

Required Privilege Level reset

Related Documentation

- Overview of Junos OS CLI Operational Mode Commands on page 73

List of Sample Output restart interfaces on page 459

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

restart interfaces

```
user@host> restart interfaces
interfaces process terminated
interfaces process restarted
```

rollback

Syntax rollback <*number* | rescue>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Return to a previously committed configuration. The software saves the last 50 committed configurations, including the rollback number, date, time, and name of the user who issued the **commit** configuration command.

The currently operational Junos OS configuration is stored in the file **juniper.conf**, and the last three committed configurations are stored in the files **juniper.conf.1**, **juniper.conf.2**, and **juniper.conf.3**. These four files are located in the directory **/config**, which is on the router's flash drive. The remaining 46 previous committed configurations, the files **juniper.conf.4** through **juniper.conf.49**, are stored in the directory **/var/db/config**, which is on the router's hard disk.

During rollback, the configuration you specify is loaded from the associated file. Only objects in the rollback configuration that differ from the previously loaded configuration are marked as changed (equivalent to **load update**).

Options none (Optional)—Return to the most recently saved configuration.

number—(Optional) Configuration to return to. The range of values is from **0** through **49**. The most recently saved configuration is number 0, and the oldest saved configuration is number 49. The default is **0**.

rescue—(Optional) Return to the rescue configuration.

Required Privilege Level rollback—To roll back to configurations other than the one most recently committed.

Related Documentation

- Returning to a Previously Committed Junos OS Configuration on page 1137
- Creating and Returning to a Rescue Configuration on page 1132

save

Syntax save *filename*

QFX Series save (dhcp-snooping *filename*)

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Save the configuration to an ASCII file. The contents of the current level of the statement hierarchy (and below) are saved, along with the statement hierarchy containing it. This allows a section of the configuration to be saved, while fully specifying the statement hierarchy.

When saving a file to a remote system, the software uses the **scp/ssh** protocol.

Options *filename*—Name of the saved file. You can specify a filename in one of the following ways:

- *filename*—File in the user's home directory (the current directory) on the local flash drive.
- *path/filename*—File on the local flash drive.
- **/var/***filename* or **/var/***path/filename*—File on the local hard disk.
- **a:***filename* or **a:***path/filename*—File on the local drive. The default path is **/** (the root-level directory). The removable media can be in MS-DOS or UNIX (UFS) format.
- *hostname:/path/filename, hostname:filename, hostname:path/filename,* or **scp://***hostname/path/filename*—File on an **scp/ssh** client. This form is not available in the worldwide version of Junos OS. The default path is the user's home directory on the remote system. You can also specify ***hostname*** as ***username@hostname***.
- **ftp://***hostname/path/filename*—File on an FTP server. You can also specify ***hostname*** as ***username* @*hostname*** or ***username*:*password* @*hostname***. The default path is the user's home directory. To specify an absolute path, the path must start with the string **%2F**; for example, **ftp://***hostname***/%2F***path/filename*. To have the system prompt you for the password, specify **prompt** in place of the password. If a password is required, and you do not specify the password or **prompt**, an error message is displayed:

  ```
  user@host> file copy ftp://username@ftp.hostname.net//filename
  file copy ftp.hostname.net: Not logged in.
  user@host> file copy ftp://username:prompt@ftphostname.net//filename
  ```

Password for *username*@ftp.*hostname*.net:

- **http://***hostname/path/filename*—File on a Hypertext Transfer Protocol (HTTP) server. You can also specify ***hostname*** as ***username@hostname*** or ***username*:*password*@*hostname***. If a password is required and you omit it, you are prompted for it.
- **re0:***/path/filename* or **re1:***/path/filename*—File on a local Routing Engine.

Required Privilege Level configure—To enter configuration mode.

Related Documentation

- *Deactivating and Reactivating Statements and Identifiers in a Junos Configuration*

show app-engine info

Syntax

show app-engine info
<compute-cluster *compute-cluster-name*>
<compute-cluster *compute-cluster-name* compute-node *compute-node-name*>

Release Information

Command introduced Junos OS Release 12.3.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description

Show the basic information of a compute node.

Options

compute-cluster-name—(Optional) Name of the compute cluster.

compute-node-name—(Optional) Name of the compute node. Specifying a compute-node alone will not return any result. Always specify the compute-cluster with a compute node.

Additional Information

In the operational mode of the CLI when you type **?** for a name, for example a compute-node name, you would expect to get a list of available compute nodes plus the option to type in a name not listed. This is the auto-complete feature in the CLI. However, in JunosV App Engine, , if you specify compute cluster and compute node in the operational command, the auto-complete works only if the compute cluster is put before the compute node.

For commands with an optional **compute-cluster *compute-cluster-name*** option, if that option is omitted, the command will be executed on all compute nodes of all compute clusters. For commands with an optional **compute-node *compute-node-name*** option, if that option is omitted, the command will be executed on all compute nodes of the specified compute cluster.

Required Privilege Level

view

Related Documentation

- *show app-engine status*
- *show app-engine resource-usage*
- *show app-engine processes compute-cluster compute-node*

List of Sample Output

show app-engine info on page 464
show app-engine info compute-cluster compute-node on page 464
show app-engine info (Command failed) on page 464
show app-engine info (QFX5100 Switch) on page 465

Output Fields

For a description of the output fields, see Table 52 on page 464. Output fields are listed in the approximate order in which they appear.

Table 52: show app-engine info Output Fields

Field Name	Field Description
Compute cluster	Name of the compute cluster.
Compute node	Name of the compute node.
Model	Model name of the compute node.
Kernel release	Kernel release of the Linux which the compute node is running.
Machine	The machine architecture of the compute node.
Management IP	The management IP address of the compute node.

Sample Output

show app-engine info

In the following example, notice there are multiple compute clusters and multiple compute nodes shown because there was no compute cluster or compute node specified in the command.

```
user@host> show app-engine info
Compute cluster: cluster1
  Compute node       Model          Kernel release    Machine    Management IP
  cn2                VXE1001        2.6.18-238.el5    x86_64     192.168.1.29/24


Compute cluster: new-cluster
  Compute node       Model          Kernel release    Machine    Management IP
  new-node           --- Offline ---                             10.1.1.1/24
```

show app-engine info compute-cluster compute-node

The output when the optional **compute-cluster** and **compute-node** options are used is the same (both online and offline) as for the **show app-engine info** command except that basic information is displayed for only the compute node specified in the command.

```
user@host> show app-engine info compute-cluster cluster1 compute-node cn2
Compute cluster: cluster1
  Compute node       Model          Kernel release    Machine    Management IP
  cn2                VXE1001        2.6.18-238.el5    x86_64     192.168.1.29/24

user@host> show app-engine info compute-cluster new-cluster compute-node new-node
Compute cluster: new-cluster
  Compute node       Model          Kernel release    Machine    Management IP
  new-node           --- Offline ---                             10.1.1.1/24
```

show app-engine info (Command failed)

```
user@host> show app-engine info compute-cluster new-cluster compute-node new-node
```



```
Compute cluster: new-cluster
  Compute node      Model          Kernel release    Machine   Management IP
  new-node          --- Error getting information ---          10.1.1.1/24
```

show app-engine info (QFX5100 Switch)

```
user@switch> show app-engine info
Compute cluster: default-cluster
  Compute node      Model          Kernel release    Machine   Management IP
  default-node      QFX          2.6.32-279.22.1.el6.x86_64x86_64 192.168.1.1/24
```

show chassis alarms

Syntax

show chassis alarms

Syntax (TX Matrix Routers)

show chassis alarms
<lcc *number* | scc>

Syntax (TX Matrix Plus Routers)

show chassis alarms
<lcc *number* | sfc *number*>

Syntax (MX Series Routers)

show chassis alarms
<all-members>
<local>
<member *member-id*>

Syntax (MX104, MX2010, and MX2020 3D Universal Edge Routers)

show chassis alarms

Syntax (QFX Series)

show chassis alarms
<interconnect-device *name*>
<node-device *name*>

Syntax (PTX Series Packet Transport Routers)

show chassis alarms

Syntax (ACX Series Universal Access Routers)

show chassis alarms

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option for the TX Matrix Plus router introduced in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 12.1 for the PTX Series Packet Transport Routers.
Command introduced in Junos OS Release 12.2 for the ACX Series Universal Access Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.

Description

Display information about the conditions that have been configured to trigger alarms.

Options

none—Display information about the conditions that have been configured to trigger alarms.

all-members—(MX Series routers only) (Optional) Display information about alarm conditions for all the member routers of the Virtual Chassis configuration.

interconnect-device *name*—(QFabric systems only) (Optional) Display information about alarm conditions for the Interconnect device.

lcc *number*—(TX Matrix router and TX Matrix Plus router only) (Optional) Line-card chassis number.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Display information about alarm conditions for the local Virtual Chassis member.

member *member-id*—(MX Series routers only) (Optional) Display information about alarm conditions for the specified member of the Virtual Chassis configuration. Replace *member-id* variable with a value of 0 or 1.

node-device *name*—(QFabric systems only) (Optional) Display information about alarm conditions for the Node device.

scc—(TX Matrix router only) (Optional) Show information about the TX Matrix router (switch-card chassis).

sfc *number*—(TX Matrix Plus router only) (Optional) Show information about the respective TX Matrix Plus router, which is the switch-fabric chassis. Replace *number* variable with **0**.

Additional Information

You cannot clear the alarms for chassis components. Instead, you must remedy the cause of the alarm. When a chassis alarm LED is lit, it indicates that you are running the router or switch in a manner that we do not recommend.

On routers, you can manually silence external devices connected to the alarm relay contacts by pressing the alarm cutoff button, located on the craft interface. Silencing the device does not remove the alarm messages from the display (if present on the router) or extinguish the alarm LEDs. In addition, new alarms that occur after you silence an external device reactivate the external device.

In Junos OS release 11.1 and later, alarms for fans also show the slot number of the fans in the CLI output.

In Junos OS Release 11.2 and later, the command output on EX8200 switches shows the detailed location (**Plane/FPC/PFE**) for link errors in the chassis.

In Junos OS Release 10.2 and later, an alarm is shown on T Series routers for a standby sonic clock generator (SCG) that is offline or absent.

You may often see the following error messages, in which only the error code is shown and no other information is provided:

```
Apr 12 08:04:10 send: red alarm set, device FPC 6, reason FPC 6 Major Errors - Error code:
 257
Apr 12 08:04:19 send: red alarm set, device FPC 1, reason FPC 1 Major Errors - Error code:
 559
```

To understand what CM_ALARM error codes mean, you need to first identify the structure of the CM Alarm codes. A CM_ALARM code has the following structure:

Bits:	Error type:
1-31	Major (1)
0	Minor (0)

According to the table above, the LSB (bit 0) identifies the **Error Type** (major alarm, if the bit is set and minor alarm if the bit is unset). The rest of the bits (1 - 31) identify the actual error code.

Take an example of the following error code, which was logged on a T1600:

```
Apr 12 08:04:10 send: red alarm set, device FPC 1, reason FPC 1 Major Errors - Error code:
 559
```

First, you have to convert 559 to binary; that is **1000101111**. The LSB in this case is **1**, which means that this is a major alarm. After removing the LSB, you are left with **100010111**, which is equal to 279 in decimal. This is the actual error code, its meaning can be found from the following list:

Chip Type: L Chip	**Code**
CMALARM_LCHIP_LOUT_DESRD_PARITY_ERR	1
CMALARM_LCHIP_LOUT_DESRD_UNINIT_ERR	2
CMALARM_LCHIP_LOUT_DESRD_ILLEGALLINK_ERR	3
CMALARM_LCHIP_LOUT_DESRD_ILLEGALSIZE_ERR	4
CMALARM_LCHIP_LOUT_HDRF_TOERR_ERR	5
CMALARM_LCHIP_LOUT_HDRF_PARITY_ERR	6
CMALARM_LCHIP_LOUT_HDRF_UCERR_ERR	7
CMALARM_LCHIP_LOUT_NLIF_CRCDROP_ERR	8

CMALARM_LCHIP_LOUT_NLIF_CRCERR_ERR	9
CMALARM_LCHIP_UCODE_TIMEOUT_ERR	10
CMALARM_LCHIP_LIN_SRCTL_ACCT_DROP_ERR	11
CMALARM_LCHIP_LIN_SRCTL_ACCT_ADDR_SIZE_ERR	12
CMALARM_LCHIP_SRAM_PARITY_ERR	13
CMALARM_LCHIP_UCODE_OVFLW_ERR	14
CMALARM_LCHIP_LOUT_HDRF_MTU_ERR	15

Chip Type: M Chip	Code
CMALARM_MCHIP_ECC_UNCORRECT_ERR	128

Chip Type: N Chip	Code
CMALARM_NCHIP_RDDMA_JBUS_TIMEOUT_ERR	256
CMALARM_NCHIP_RDDMA_FIFO_OVFLW_ERR	257
CMALARM_NCHIP_RDDMA_FIFO_UNFLW_ERR	258
CMALARM_NCHIP_RDDMA_SIZE_ERR	259
CMALARM_NCHIP_RDDMA_JBUS_CRC_ERR	260
CMALARM_NCHIP_WRDMA_PKTR_ERR	261
CMALARM_NCHIP_WRDMA_PKT_CRC_ERR	262
CMALARM_NCHIP_WRDMA_JBUS_TIMEOUT_ERR	263
CMALARM_NCHIP_WRDMA_FIFO_OVFLW_ERR	264
CMALARM_NCHIP_WRDMA_FIFO_UNFLW_ERR	265
CMALARM_NCHIP_WRDMA_PKT_LEN_ERR	266
CMALARM_NCHIP_WRDMA_JBUS_CRC_ERR	267
CMALARM_NCHIP_PKTR_DMA_AGE_ERR	268
CMALARM_NCHIP_PKTR_ICELLSIG_ERR	269
CMALARM_NCHIP_PKTR_FTTL_ERR	270

CMALARM_NCHIP_RODR_OFFSET_OVFLW_ERR	271
CMALARM_NCHIP_PKTR_TMO_CELL_ERR	272
CMALARM_NCHIP_PKTR_TMO_OUTRANGE_ERR	273
CMALARM_NCHIP_PKTR_MD_REQUEST_Q_OVFLW_ERR	274
CMALARM_NCHIP_PKTR_DMA_BUFFER_OVFLW_ERR	275
CMALARM_NCHIP_PKTR_GRT_OVFLW_ERR	276
CMALARM_NCHIP_FRQ_ERR	277
CMALARM_NCHIP_RODR_IN_Q_OVFLW_ERR	278
CMALARM_NCHIP_DBUF_CRC_ERR	279

Chip Type: R Chip	Code
CMALARM_RCHIP_SRAM_PARITY_ERR	512

Chip Type: R Chip	Code
CMALARM_ICHIP_WO_DESRD_ID_ERR	601
CMALARM_ICHIP_WO_DESRD_DATA_ERR	602
CMALARM_ICHIP_WO_DESRD_OFLOW_ERR	603
CMALARM_ICHIP_WO_HDRF_UCERR_ERR	604
CMALARM_ICHIP_WO_HDRF_MTUERR_ERR	605
CMALARM_ICHIP_WO_HDRF_PARITY_ERR	606
CMALARM_ICHIP_WO_HDRF_TOERR_ERR	607
CMALARM_ICHIP_WO_IP_CRC_ERR	608
CMALARM_ICHIP_WO_IP_INTER_ERR	609
CMALARM_ICHIP_WI_WAN_TIMEOUT_ERR	625
CMALARM_ICHIP_WI_FAB_TIMEOUT_ERR	626
CMALARM_ICHIP_RLDRAM_BIST_ERR	630
CMALARM_ICHIP_SDRAM_BIST_ERR	631

CMALARM_ICHIP_RLDRAM_PARITY_ERR	632
CMALARM_ICHIP_SDRAM_UNCORRECT_ERR	633
CMALARM_ICHIP_SDRAM_CORRECT_ERR	634
CMALARM_ICHIP_FUSE_DONE_ERR	635

According to the table above, the **279** error code corresponds to **CMALARM_NCHIP_DBUF_CRC_ERR**; this means that new CRC errors were seen on the NCHIP of this particular FPC, which is FPC as per the logs.

If you do not want to convert decimal to binary and vice versa, you may use the following shortcut:

For major alarms, the **Actual Error Code = (Error Code - 1)/2**, where **Error Code** is the code that you get in the log message. For example, if you get the following log:

```
Apr 12 08:04:10 send: red alarm set, device FPC 6, reason FPC 6 Major Errors - Error
code: 257
```

Actual Error Code = (257-1)/2 = 128. Similarly, for minor alarms, Actual Error Code = (Error Code)/2

Required Privilege Level

view

Related Documentation

- *Configuring an Alarm Entry and Its Attributes*
- *Chassis Conditions That Trigger Alarms*

List of Sample Output

show chassis alarms node-device (Alarms Active on the QFabric System) on page 475
show chassis alarms (Alarms Active on the QFabric System) on page 476
show chassis alarms (Alarms Active on an EX8200 Switch) on page 476
show chassis alarms (Alarms Active on a PTX5000 Packet Transport Router) on page 476
show chassis alarms (Alarms Active on an ACX2000 Universal Access Router) on page 477

Output Fields Table 53 on page 472 lists the output fields for the **show chassis alarms** command. Output fields are listed in the approximate order in which they appear.

Table 53: show chassis alarms Output Fields

Field Name	Field Description
Alarm time	Date and time the alarm was first recorded.
Class	Severity class for this alarm: **Minor** or **Major**.
Description	Information about the alarm.

Sample Output

show chassis alarms (Alarms Active)

```
user@host> show chassis alarms
3 alarms are currently active
Alarm time              Class  Description
2000-02-07 10:12:22 UTC Major fxp0: ethernet link down
2000-02-07 10:11:54 UTC Minor YELLOW ALARM - PEM 1 Removed
2000-02-07 10:11:03 UTC Minor YELLOW ALARM - Lower Fan Tray Removed
```

show chassis alarms (No Alarms Active)

```
user@host> show chassis alarms
No alarms are currently active
```

show chassis alarms (Fan Tray)

```
user@host> show chassis alarms
4 alarms currently active
Alarm time              Class  Description
2010-11-11 20:27:38 UTC  Major  Side Fan Tray 7 Failure
2010-11-11 20:27:13 UTC  Minor  Side Fan Tray 7 Overspeed
2010-11-11 20:27:13 UTC  Major  Side Fan Tray 5 Failure
2010-11-11 20:27:13 UTC  Major  Side Fan Tray 0 Failure
```

show chassis alarms (MX104 Router)

```
user@host >show chassis alarms
1 alarms currently active
Alarm time              Class  Description
2013-06-05 14:43:31 IST  Minor  Backup RE Active
```

show chassis alarms (MX2010 Router)

```
user@host> show chassis alarms
```



```
7 alarms currently active
Alarm time              Class  Description
2012-08-07 00:46:06 PDT  Major  Fan Tray 2 Failure
2012-08-06 18:24:36 PDT  Minor  Redundant feed missing for PSM 6
2012-08-06 07:41:04 PDT  Minor  Redundant feed missing for PSM 8
2012-08-04 02:42:06 PDT  Minor  Redundant feed missing for PSM 5
2012-08-03 21:14:24 PDT  Minor  Loss of communication with Backup RE
2012-08-03 12:26:03 PDT  Minor  Redundant feed missing for PSM 4
2012-08-03 10:40:18 PDT  Minor  Redundant feed missing for PSM 7
```

show chassis alarms (MX2020 Router)

```
user@host> show chassis alarms
1 alarms currently active
Alarm time Class Description
2012-10-03 12:14:59 PDT Minor Plane 0 not online
```

show chassis alarms (T4000 Router)

```
user@host> show chassis alarms
9 alarms currently active
Alarm time              Class  Description
2007-06-02 01:41:10 UTC  Minor  RE 0 Not Supported
2007-06-02 01:41:10 UTC  Minor  CB 0 Not Supported
2007-06-02 01:41:10 UTC  Minor  Mixed Master and Backup RE types
2007-05-30 19:37:33 UTC  Major  SPMB 1 not online
2007-05-30 19:37:29 UTC  Minor  Front Bottom Fan Tray Absent
2007-05-30 19:37:13 UTC  Major  PEM 1 Input Failure
2007-05-30 19:37:13 UTC  Major  PEM 0 Not OK
2007-05-30 19:37:03 UTC  Major  PEM 0 Improper for Platform
2007-05-30 19:37:03 UTC  Minor  Backup RE Active
```

show chassis alarms (Unreachable Destinations Present on a T Series Router)

```
user@host> show chassis alarms
10 alarms currently active
Alarm time              Class  Description
2011-08-30 18:43:53 PDT  Major  FPC 7 has unreachable destinations
2011-08-30 18:43:53 PDT  Major  FPC 5 has unreachable destinations
2011-08-30 18:43:52 PDT  Major  FPC 3 has unreachable destinations
2011-08-30 18:43:52 PDT  Major  FPC 2 has unreachable destinations
2011-08-30 18:43:52 PDT  Minor  SIB 0 Not Online
2011-08-30 18:43:33 PDT  Minor  SIB 4 Not Online
2011-08-30 18:43:28 PDT  Minor  SIB 3 Not Online
2011-08-30 18:43:05 PDT  Minor  SIB 2 Not Online
2011-08-30 18:43:28 PDT  Minor  SIB 1 Not Online
2011-08-30 18:43:05 PDT  Major  PEM 1 Not Ok
```

show chassis alarms (FPC Offline Due to Unreachable Destinations on a T Series Router)

```
user@host> show chassis alarms
10 alarms currently active
Alarm time              Class  Description
2011-08-30 18:43:53 PDT  Major  FPC 7 offline due to unreachable destinations
2011-08-30 18:43:53 PDT  Major  FPC 5 offline due to unreachable destinations
2011-08-30 18:43:52 PDT  Major  FPC 3 offline due to unreachable destinations
2011-08-30 18:43:52 PDT  Major  FPC 2 offline due to unreachable destinations
2011-08-30 18:43:52 PDT  Minor  SIB 0 Not Online
2011-08-30 18:43:33 PDT  Minor  SIB 4 Not Online
2011-08-30 18:43:28 PDT  Minor  SIB 3 Not Online
2011-08-30 18:43:05 PDT  Minor  SIB 2 Not Online
```



```
2011-08-30 18:43:28 PDT  Minor  SIB 1 Not Online
2011-08-30 18:43:05 PDT  Major  PEM 1 Not Ok
```

show chassis alarms (SCG Absent on a T Series Router)

```
user@host> show chassis alarms
4 alarms currently active
Alarm time               Class  Description
2011-01-23 21:42:46 PST  Major  SCG 0 NO EXT CLK MEAS-BKUP SCG ABS
```

show chassis alarms (Alarms Active on a TX Matrix Router)

```
user@host> show chassis alarms
scc-re0:
--------------------------------------------------------------------------
8 alarms currently active
Alarm time               Class  Description
2004-08-05 18:43:53 PDT  Minor  LCC 0 Minor Errors
2004-08-05 18:43:53 PDT  Minor  SIB 3 Not Online
2004-08-05 18:43:52 PDT  Major  SIB 2 Absent
2004-08-05 18:43:52 PDT  Major  SIB 1 Absent
2004-08-05 18:43:52 PDT  Major  SIB 0 Absent
2004-08-05 18:43:33 PDT  Major  LCC 2 Major Errors
2004-08-05 18:43:28 PDT  Major  LCC 0 Major Errors
2004-08-05 18:43:05 PDT  Minor  LCC 2 Minor Errors
lcc0-re0:
--------------------------------------------------------------------------
5 alarms currently active
Alarm time               Class  Description
2004-08-05 18:43:53 PDT  Minor  SIB 3 Not Online
2004-08-05 18:43:49 PDT  Major  SIB 2 Absent
2004-08-05 18:43:49 PDT  Major  SIB 1 Absent
2004-08-05 18:43:49 PDT  Major  SIB 0 Absent
2004-08-05 18:43:28 PDT  Major  PEM 0 Not OK
lcc2-re0:
--------------------------------------------------------------------------
5 alarms currently active
Alarm time               Class  Description
2004-08-05 18:43:35 PDT  Minor  SIB 3 Not Online
2004-08-05 18:43:33 PDT  Major  SIB 2 Absent
2004-08-05 18:43:33 PDT  Major  SIB 1 Absent
2004-08-05 18:43:33 PDT  Major  SIB 0 Absent
2004-08-05 18:43:05 PDT  Minor  PEM 1 Absent
```

show chassis alarms (TX Matrix Plus router with 3D SIBs)

```
user@host> show chassis alarms
sfc0-re0:
--------------------------------------------------------------------------
Alarm time               Class  Description
2012-07-19 10:07:32 UTC  Minor  SIB F13 0 Temperature Warm
2012-07-19 10:07:07 UTC  Minor  SIB F2S 0/6 Temperature Warm
2012-07-19 10:07:07 UTC  Minor  SIB F2S 0/4 Temperature Warm
2012-07-19 10:07:07 UTC  Minor  SIB F2S 0/2 Temperature Warm
2012-07-19 10:07:07 UTC  Minor  SIB F2S 0/0 Temperature Warm
2012-07-19 10:07:07 UTC  Minor  SIB F13 6 Temperature Warm
2012-07-19 10:06:42 UTC  Minor  SIB F2S 2/6 Temperature Warm
2012-07-19 10:06:42 UTC  Minor  SIB F2S 2/4 Temperature Warm
2012-07-19 10:06:42 UTC  Minor  SIB F2S 2/2 Temperature Warm
2012-07-19 10:06:42 UTC  Minor  SIB F2S 2/0 Temperature Warm
2012-07-19 10:06:42 UTC  Minor  SIB F13 3 Temperature Warm
2012-07-19 10:06:17 UTC  Minor  Temperature Warm
```



```
2012-07-19 10:06:17 UTC  Minor  SIB F2S 1/6 Temperature Warm
2012-07-19 10:06:17 UTC  Minor  SIB F2S 1/4 Temperature Warm
2012-07-19 10:06:17 UTC  Minor  SIB F2S 1/2 Temperature Warm
2012-07-19 10:06:17 UTC  Minor  SIB F2S 1/0 Temperature Warm
lcc0-re0:
--------------------------------------------------------------------------
Alarm time               Class  Description
2012-07-19 10:04:13 UTC  Minor  Temperature Warm
2012-07-19 10:04:13 UTC  Minor  SIB 2 Temperature Warm
2012-07-19 10:04:13 UTC  Minor  SIB 1 Temperature Warm
2012-07-19 10:04:13 UTC  Minor  SIB 0 Temperature Warm

lcc2-re0:
--------------------------------------------------------------------------
Alarm time               Class  Description
2012-07-19 10:04:18 UTC  Minor  Temperature Warm
2012-07-19 10:04:18 UTC  Minor  SIB 2 Temperature Warm
2012-07-19 10:04:18 UTC  Minor  SIB 1 Temperature Warm
2012-07-19 10:04:18 UTC  Minor  SIB 0 Temperature Warm
```

show chassis alarms (Alarms on a T4000 Router After the enhanced-mode Statement is Enabled)

To enable improved virtual private LAN service (VPLS) MAC address learning on T4000 routers, you must include the **enhanced-mode** statement at the **[edit chassis network-services]** hierarchy level and reboot the router. When router reboots, only the T4000 Type 5 FPCs are required to be present on the router. If there are any other FPCs (apart from T4000 Type 5 FPCs) on the T4000 router, such FPCs become offline, and FPC misconfiguration alarms are generated. The **show chassis alarm** command output displays FPC misconfiguration (**FPC *fpc-slot* misconfig**) as the reason for the generation of the alarms.

```
user@host> show chassis alarms
2 alarms currently active
  Alarm time               Class  Description
  2011-10-22 10:10:47 PDT  Major  FPC 1 misconfig
  2011-10-22 10:10:46 PDT  Major  FPC 0 misconfig
```

show chassis alarms (Backup Routing Engine)

```
user@host> show chassis alarms
2 alarms are currently active
Alarm time               Class  Description
2005-04-07 10:12:22 PDT  Minor  Host 1 Boot from alternate media
2005-04-07 10:11:54 PDT  Major  Host 1 compact-flash missing in Boot List
```

show chassis alarms (Alarms Active on the QFX Series)

```
user@switch> show chassis alarms
1 alarms currently active
Alarm time               Class  Description
2012-03-05 2:10:24 UTC  Major  FPC 0 PEM 0 Airflow not matching Chassis Airflow
```

show chassis alarms node-device (Alarms Active on the QFabric System)

```
user@switch> show chassis alarms node-device ED3691
node-device ED3694
3 alarms currently active
Alarm time               Class  Description
2011-08-24 16:04:15 UTC  Major  ED3694:fte-0/1/2: Link down
```

```
2011-08-24 16:04:14 UTC  Major  ED3694:fte-0/1/0: Link down
2011-08-24 14:21:14 UTC  Major  ED3694 PEM 0 is not supported/powered
```

show chassis alarms (Alarms Active on the QFabric System)

```
user@switch> show chassis alarms
IC-A0001:
--------------------------------------------------------------------------
1 alarms currently active
Alarm time               Class  Description
2011-08-24 16:04:15 UTC  Minor  Backup RE Active

ED3694:
--------------------------------------------------------------------------
3 alarms currently active
Alarm time               Class  Description
2011-08-24 16:04:15 UTC  Major  ED3694:fte-0/1/2: Link down
2011-08-24 16:04:14 UTC  Major  ED3694:fte-0/1/0: Link down
2011-08-24 14:21:14 UTC  Major  ED3694 PEM 0 is not supported/powered

SNG-0:
--------------------------------------------------------------------------

NW-NG-0:
--------------------------------------------------------------------------
1 alarms currently active
Alarm time               Class  Description
2011-08-24 15:49:27 UTC  Major  ED3691 PEM 0 is not supported/powered
```

show chassis alarms (Alarms Active on an EX8200 Switch)

```
user@switch> show chassis alarms

6 alarms currently active
Alarm time               Class  Description
2010-12-02 19:15:22 UTC  Major  Fan Tray Failure
2010-12-02 19:15:22 UTC  Major  Fan Tray Failure
2010-12-02 19:15:14 UTC  Minor  Check CB 0 Fabric Chip 1 on Plane/FPC/PFE: 1/5/0,
 1/5/1, 1/5/2, 1/5/3, 1/7/0, 1/7/1, 1/7/2, 1/7/3, 2/5/0, 2/5/1, ...
2010-12-02 19:15:14 UTC  Minor  Check CB 0 Fabric Chip 0 on Plane/FPC/PFE: 1/5/0,
 1/5/1, 1/5/2, 1/5/3, 1/7/0, 1/7/1, 1/7/2, 1/7/3, 2/5/0, 2/5/1, ...
2010-12-02 19:14:18 UTC  Major  PSU 1 Output Failure
2010-12-02 19:14:18 UTC  Minor  Loss of communication with Backup RE
```

show chassis alarms (Alarms Active on a PTX5000 Packet Transport Router)

```
user@switch> show chassis alarms

23 alarms currently active
Alarm time               Class  Description
2011-07-12 16:22:05 PDT  Minor  No Redundant Power for Rear Chassis
2011-07-12 16:22:05 PDT  Major  PDU 0 PSM 1 Not OK
2011-07-12 16:21:57 PDT  Minor  No Redundant Power for Fan 0-2
2011-07-12 16:21:57 PDT  Major  PDU 0 PSM 0 Not OK
2011-07-12 15:56:06 PDT  Major  PDU 1 PSM 2 Not OK
2011-07-12 15:56:06 PDT  Minor  No Redundant Power for FPC 0-7
2011-07-12 15:56:06 PDT  Major  PDU 0 PSM 3 Not OK
2011-07-12 15:28:20 PDT  Major  PDU 0 PSM 2 Not OK
2011-07-12 15:19:14 PDT  Minor  Backup RE Active
```


show chassis alarms (Alarms Active on an ACX2000 Universal Access Router)

```
user@host> show chassis alarms
7 alarms currently active
Alarm time               Class  Description
2012-05-22 11:19:09 UTC  Major  xe-0/3/1: Link down
2012-05-22 11:19:09 UTC  Major  xe-0/3/0: Link down
2012-05-22 11:19:09 UTC  Major  ge-0/1/7: Link down
2012-05-22 11:19:09 UTC  Major  ge-0/1/6: Link down
2012-05-22 11:19:09 UTC  Major  ge-0/1/3: Link down
2012-05-22 11:19:09 UTC  Major  ge-0/1/2: Link down
2012-05-22 11:19:09 UTC  Major  ge-0/1/1: Link down
```

show chassis beacon

show chassis beacon (QFX Series)

show chassis beacon
<cb *slot-number*>
<fpc *slot-number*>
<interconnect-device *name* (cb *slot-number* | fpc *slot-number*)>
<node-device *name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the beacon LED status on a QFX3500 standalone switch, Node device, and an Interconnect device. You can also display the beacon LED status of the Control Boards and Flexible PIC Concentrators on the Interconnect device.

Options

cb *slot-number*— (QFabric systems only) (Optional) Display the status of the beacon LEDs for the Control Board on the Interconnect device.

fpc *slot-number* — (QFabric systems only) (Optional) Display the status of the beacon LEDs for the Flexible PIC Concentrator (FPC) on the Interconnect device. (QFX3500 switches only) (Optional) Display the status of the beacon LEDs for the Flexible PIC Concentrator on the standalone switch.

interconnect-device *name*— (QFabric systems only) (Optional) Display the status of the beacon LEDs for the Interconnect device.

node-device *name*— (QFabric systems only) (Optional) Display the status of the beacon LEDs for the Node device.

Required Privilege Level view

Related Documentation

- request chassis beacon on page 355

List of Sample Output

show chassis beacon (QFX Series) on page 479
show chassis beacon interconnect-device (QFabric System) on page 479
show chassis beacon interconnect-device fpc (QFabric System) on page 479
show chassis beacon node-device (QFabric System) on page 479
show chassis beacon node-device fpc (QFabric System) on page 479

Output Fields Table 54 on page 478 lists the output fields for the **show chassis beacon** command. Output fields are listed in the approximate order in which they appear.

Table 54: show chassis led Output Fields

Field Name	Field Description
Slot	FPC slot number of the device whose content is being displayed. On QFX3500 standalone switches, the number is always **0**.

Table 54: show chassis led Output Fields *(continued)*

Field Name	Field Description
Beacon State	Status of the beacon state: • Off—The beacon is **OFF**. • On—The beacon is **ON**.

Sample Output

show chassis beacon (QFX Series)

```
user@switch> show chassis beacon
Slot            Beacon State
   FPC     0           OFF
```

show chassis beacon interconnect-device (QFabric System)

```
user@switch> show chassis beacon interconnect-device interconnect1
Chassis                 OFF
CB 0                    OFF
CB 1                    OFF
FC 0 FPC 0              OFF
FC 1 FPC 1              OFF
RC 0 FPC 8              OFF
RC 1 FPC 9              OFF
```

show chassis beacon interconnect-device fpc (QFabric System)

```
user@switch> show chassis beacon interconnect-device interconnect1 fpc 0
FPC 0                   ON
```

show chassis beacon node-device (QFabric System)

```
user@switch> show chassis beacon node-device node1
node1                  ON
```

show chassis beacon node-device fpc (QFabric System)

```
user@switch> show chassis beacon node-device node1 fpc 0
FPC 0                 ON
```

show chassis environment

Syntax

show chassis environment

Syntax (T320, T640, T1600, and T4000 Routers)

show chassis environment
<cb *cb-slot-number*>
<fpc *fpc-slot-number*>
<fpm>
<pem *pem-slot-number*>
<routing-engine *re-slot-number*>
<scg *scg-slot-number*>
<sib *sib-slot-number*>

Syntax (TX Matrix Routers)

show chassis environment
<lcc *number* | scc>

Syntax (TX Matrix Plus Routers)

show chassis environment
<cb *cb-slot-number*>
<cip *cip-slot-number*>
<fpc *fpc-slot-number*>
<fpm>
<lcc *number*>
<pem *pem-slot-number*>
<routing-engine *re-slot-number*>
<scg *scg-slot-number*>
< sfc *number*>
<sib *sib-slot-number*>

Syntax (MX Series Routers)

show chassis environment
<all-members>
<local>
<member *member-id*>

Syntax (MX104 3D Universal Edge Routers)

show chassis environment
<cb>
<pem *pem-slot-number*>
<routing-engine *re-slot-number*>

Syntax (MX2010 and MX2020 3D Universal Edge Routers)

show chassis environment
<adc *adc-slot-number*>
<cb *cb-slot-number*>
<fpc *fpc-slot-number*>
<fpm>
<monitored>
<psm *psm-slot-number*>
<routing-engine *re-slot-number*>
<sfb *sfb-slot-number*>

Syntax (EX8200 Switches)

show chassis environment
<all-members>
<cb *cb-slot-number*>
<fpc *fpc-slot-number*>
<local>

<member *member-id*>
<psu *psu-slot-number*>
<routing-engine *re-slot-number*>

Syntax (EX Series Switches except EX8200)

show chassis environment
<all-members>
<fpc *fpc-slot-number*>
<local>
<member *member-id*>
<power-supply-unit>
<routing-engine>

Syntax (QFX Series)

show chassis environment
<cb *slot-number* <interconnect-device *name*>>
<fpc *slot-number* <interconnect-device *name*>>
<interconnect-device *name* <*slot-number*>
<node-device *name*>
<pem *slot-number* (interconnect-device *name slot-number*) | (node-device *name*)>
<routing-engine *name* <interconnect-device *name slot-number*>>

Syntax (PTX Series Packet Transport Routers)

show chassis environment
<cb *cb-slot-number*>
<ccg *ccg-slot-number* >
<fpc *fpc-slot-number*>
<fpm>
<monitored>
<pdu *pdu-slot-number*>
<routing-engine *re-slot-number*>
<sib *sib-slot-number*>

Syntax (ACX Series Universal Access Routers)

show chassis environment
<cb *cb-slot-number*>
<pem *pem-slot-number*>
<routing-engine *re-slot-number*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for QFX Series.
Command introduced in Junos OS Release 12.1x48 for PTX Series Packet Transport Routers.
monitored option added in Junos OS Release 12.1x48 for PTX Series Packet Transport Routers.
Command introduced in Junos OS Release 12.1 for T4000 Core Routers.
Command introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
pem option introduced in Junos OS Release 12.3 for ACX4000 Universal Access Routers.
Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.

Description

Display environmental information about the router or switch chassis, including the temperature and information about the fans, power supplies, and Routing Engine.

In addition, on ACX4000 routers, display temperature information about the different channels of a Modular Interface Card (MIC). The number of channels displayed depends on the type of MIC installed.

Options

none—Display environmental information about the router or switch chassis. On a TX Matrix router, display environmental information about the TX Matrix router and its attached T640 routers. On a TX Matrix Plus router, display environmental information about the TX Matrix Plus router and its attached routers.

all-members—(MX Series routers and EX Series switches only) (Optional) Display chassis environmental information for all the members of the Virtual Chassis configuration.

adc *adc-slot-number*—(MX2020 and MX2010 routers only) (Optional) Display chassis environmental information for the adapter cards. For MX2020 routers, replace ***adc-slot-number*** with a value from **0** through **19**. For MX2010 routers, replace ***adc-slot-number*** with a value from **0** through **9**.

cb *cb-slot-number*—(ACX Series Universal Access Routers, EX Series switches, M120, M320, and M40e routers, MX Series routers, MX2020 routers, MX2010 routers, PTX Series Packet Transport Routers, QFX Series, and T Series routers, and TX Matrix Plus routers only) (Optional) Display chassis environmental information for the Control Board. On devices other than EX Series switches, replace ***cb-slot*** with **0** or **1**. For the EX Series switches, see *EX Series Switches Hardware and CLI Terminology Mapping* for information on CB slot numbering.

cip *cip-slot-number*—(TX Matrix Plus routers only) (Optional) Display chassis environmental information for the Connection Interface Panel (CIP). Replace the ***cip-slot-number*** variable with a value of **0** or **1**.

cb interconnect-device *name*—(QFabric systems only) (Optional) Display chassis environmental information for the Control Board on an Interconnect device.

ccg *ccg-slot-number*—(PTX Series only) (Optional) Display chassis environmental information for the Centralized Clock Generator. Replace ***cb-slot*** with a value of **0** or **1**.

fpc *fpc-slot*—(EX Series switches, M120, M320, and M40e routers, MX Series routers, MX2010 routers, MX2020 routers, PTX Series Packet Transport Routers, QFX Series, QFX3500 switches, QFabric systems, T Series routers, and TX Matrix Plus routers) (Optional) Display chassis environmental information for a specified Flexible PIC Concentrator. For MX2010 routers, replace ***fpc-slot*** with a value from **0** through **9**. For MX2020 routers, replace ***fpc-slot*** with a value from **0** through **19**. For information about FPC numbering, see show chassis environment fpc. On a QFabric system, display chassis environmental information for a specified Flexible PIC Concentrator on an Interconnect device. On an EX Series switch, display chassis environmental information for a specified Flexible PIC Concentrator; see *EX Series Switches Hardware and CLI Terminology Mapping* for information on FPC numbering. On a TX Matrix Plus router with 3D SIBs replace *fpc-slot* with a value from **0** through **63**.

fpm—(M120, M320, and M40e routers, MX2010 routers, MX2020 routers, PTX Series, Packet Transport Routers, T Series routers, and TX Matrix Plus routers only) (Optional) Display chassis environmental information for the craft interface (FPM).

interconnect-device ***name***—(QFabric systems only) (Optional) Display chassis environmental information for the Interconnect device.

monitored—(MX2020 routers and PTX Series Packet Transport Routers only) (Optional) Display chassis environmental information for monitored temperatures only. Temperatures that are not included in temperature alarm computations are not displayed.

lcc ***number***—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Line-card chassis number.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers and EX Series switches) (Optional) Display chassis environmental information for the local Virtual Chassis member.

member ***member-id***—(MX Series routers and EX Series switches only) (Optional) Display chassis environmental information for the specified member of the Virtual Chassis configuration. On MX Series routers, replace *member-id* variable with a value of **0** or **1**. For EX Series switches, see *member* for member ID values.

node-device ***name***—(QFabric systems only) (Optional) Display chassis environmental information for the Node device.

pdu ***pdu-slot-number***—(PTX Series only) (Optional) Display chassis environmental information for the specified power distribution unit.

pem—(QFX3500 switches and QFabric systems only) (Optional) Display chassis environmental information for the Power Entry Module on the specified Interconnect device or Node device.

pem ***pem-slot-number***—(ACX Series Universal Access Routers, M120, M320, and M40e routers, MX Series routers, MX104 routers, QFX Series, and T Series routers only) (Optional) Display chassis environmental information for the Power Entry Module on the specified Power Entry Module. For information about the options, see show chassis environment pem.

psm ***psm-slot-number***—(MX2020 and MX2010 routers only) (Optional) Display chassis environmental information for the power supply module. For MX2020 routers, replace ***psm-slot-number*** with a value from **0** through **17**. For MX2010 routers, replace ***psm-slot-number*** with a value from **0** through **8**.

psu ***psu-slot-number***—(EX Series switches only) (Optional) Display chassis environmental information for a specified power supply. See *EX Series Switches Hardware and CLI Terminology Mapping* for detailed information.

routing-engine—(QFX3500 switches and QFabric systems only) (Optional) Display chassis environmental information for the Routing Engine on the specified Interconnect device.

routing-engine ***re-slot-number***—(Optional) Display chassis environmental information for the specified Routing Engine. For information about the options, see **show chassis environment routing-engine**.

scg—(T Series routers only) (Optional) Display chassis environmental information about the SONET Clock Generator.

scc—(TX Matrix routers only) (Optional) Display chassis environmental information about the TX Matrix router (switch-card chassis).

sfb ***sfb-slot-number***—(MX2020 and MX2010 routers only) (Optional) Display chassis environmental information for the power supply module. Replace ***sfb-slot-number*** with a value from **0** through **7**.

sfc ***number***—(TX Matrix Plus routers only) (Optional) Display chassis environmental information about the respective TX Matrix Plus router (switch-fabric chassis). Replace ***number*** variable with **0**.

sib ***sib-slot-number***—(M320 routers, PTX Series Packet Transport Routers, and T Series routers only) (Optional) Display chassis environmental information about the specified switch interface board. For information about the options, see *show chassis environment sib*.

Required Privilege Level view

Related Documentation

- *show chassis environment adc*
- *show chassis environment cb*
- *show chassis environment ccg*
- *show chassis environment cip*
- **show chassis environment fpc on page 534**
- *show chassis environment fpm*
- *show chassis environment lcc*
- *show chassis environment mcs*

- *show chassis environment monitored*
- *show chassis environment pcg*
- *show chassis environment pdu*
- show chassis environment pem on page 559
- *show chassis environment psm*
- *show chassis environment psu*
- show chassis environment routing-engine on page 568
- *show chassis environment scg*
- *show chassis environment sfb*
- *show chassis environment sib*
- *show chassis environment sfc*

List of Sample Output

show chassis environment interconnect-device (QFabric System) on page 527
show chassis environment node-device (QFabric System) on page 529
show chassis environment pem node-device (QFabric System) on page 529
show chassis environment (PTX5000 Packet Transport Router) on page 529
show chassis environment (ACX2000 Universal Access Router) on page 532
show chassis environment (ACX4000 Universal Access Router) on page 532

Output Fields Table 55 on page 486 lists the output fields for the **show chassis environment** command. Output fields are listed in the approximate order in which they appear.

Table 55: show chassis environment Output Fields

Field Name	Field Description

Class	Information about the category or class of chassis component:
	• **Power**: Power information:
	  ◦ (M5, M10, M20, and M40 routers and EX Series switches only) Power supply status: **OK**, **Testing**, (during initial power-on), **Failed**, or **Absent**.
	  ◦ (M7i, M10i, M40e, M120, M160, M320, and T Series routers and EX Series switches only) Power Entry Modules status: **OK**, **Testing**, (during initial power-on), **Check**, **Failed**, or **Absent**.
	  ◦ (PTX Series only) Power information is reported in PDU or PSM combinations. The status is: **OK**, **Testing**, (during initial power-on), **Check**, **Failed**, or **Absent**.
	• **Temp**: Temperature of air flowing through the chassis in degrees Celsius (C) and Fahrenheit (F).
	  ◦ On PTX Series Packet Transport Routers and MX2010 and MX2020 Routers, multiple cooling zones are supported. FRU temperatures in each zone are coordinated with the fan speed of fan trays in those zones.
	  ◦ EX2200 switches have a side-to-rear cooling system. The **Local Intake** temperature is measured by the sensor on the right side of the chassis, and the **Remote Intake** temperature is measured by the sensor on the left side of the chassis.
	• **Pic**: On ACX4000 Routers, multiple temperature channels on a MIC. The status is: **OK** and the **Measurement** is in degrees Celsius (C) and Fahrenheit (F).
	• **Fan**: Fan status: **OK**, **Testing** (during initial power-on), **Failed**, or **Absent**.
	On PTX Series Packet Transport Routers and MX2010 and MX2020 Routers, multiple fan trays are supported. Fan status is reported in Fan Tray or Fan combinations. **Measurement** indicates actual fan RPM (PTX and MX2010 and MX2020 Routers only).
	• **Misc**: Information about other components of the chassis.
	  ◦ On some routers, this field indicates the status of one or more additional components.
	  ◦ On the M40e, M160, and M320 router, **Misc** includes **CIP** (Connector Interface Panel). **OK** indicates that the CIP is present. **Absent** indicates that the CIP is not present.
	  ◦ On T Series routers, **Misc** includes **CIP** and **SPMB** (Switch Processor Mezzanine Board). **OK** indicates that the **CIP** or **SPMB** is present. **Absent** indicates that the **CIP** or **SPMB** is not present.
	  ◦ On PTX Series Packet Transport Routers, **Misc** includes the **SPMB** (Switch Processor Mezzanine Board). The SPMB is located on the control boards. **OK** indicates that the control board is present. **Absent** indicates that the control board is not present.

Table 55: show chassis environment Output Fields *(continued)*

Field Name	Field Description
Item	(MX2010 and MX2020 Routers) Information about the chassis component: Routing Engines, Controls Boards (CBs), Switch Fabric Boards (SFBs), PICs, Flexible PIC Concentrators (FPCs), and Adapter Cards (ADCs). (MX104 Routers) Information about the chassis components: Routing Engines, Control Board (CB), Power Entry Module (PEM), and Compact Forwarding Engine Board (AFEB). (QFabric Systems) Information about the chassis component: Control Boards, Routing Engines, Flexible PIC Concentrators (FPCs), and Power Entry Modules (PEMs), Node Devices, and Interconnect Devices. (QFX Series) Information about the chassis component: Flexible PIC Concentrators (FPCs), and Power Entry Modules (PEMs).
Status	(MX104, MX2010, and MX2020 Routers) Status of the specified chassis component. For example, if the Class is Fan, the fan status can be: • **OK**: The fans are operational. • **Testing**: The fans are being tested during initial power-on. • **Failed**: The fans have failed or the fans are not spinning. • **Absent**: The fan tray is not installed. If the Class is Power, the power supply status can be: • **OK**: The power component is operational. • **Testing**: The power component is being tested during initial power-on. • **Check**: There is insufficient power---that is, fewer than the minimum required feeds are connected. • **Failed**: The inputs leads have failed. • **Absent**: The power component is not installed.
Measurement	(MX104, MX2010, and MX2020 Routers) Dependant on the Class. For example, if the Class is Temp, indicates the temperature in degree Celsius and degrees Fahrenheit. If the Class is Fan, indicates actual fan RPM.

Sample Output

show chassis environment (J2300 Router)

```
user@host> show chassis environment
Class Item                  Status     Measurement
Temp  Routing Engine        OK         40 degrees C / 104 degrees F
Fan   Fan                   OK
```

show chassis environment (J4300 or J6300 Router)

```
user@host> show chassis environment
Class Item                  Status     Measurement
Temp  Routing Engine        OK         41 degrees C / 105 degrees F
Fan   Fan 0                 OK
      Fan 1                 OK
```


show chassis environment (M5 Router)

```
user@host> show chassis environment
Class Item                  Status     Measurement
Power Power Supply A        OK
      Power Supply B        Absent
Temp  FPC 0                 OK         30 degrees C / 86 degrees F
      FEB                   OK         33 degrees C / 91 degrees F
      PS Intake             OK         27 degrees C / 80 degrees F
      PS Exhaust            OK         27 degrees C / 80 degrees F
      Routing Engine        OK         34 degrees C / 93 degrees F
Fans  Left Fan 1            OK         Spinning at normal speed
      Left Fan 2            OK         Spinning at normal speed
      Left Fan 3            OK         Spinning at normal speed
      Left Fan 4            OK         Spinning at normal speed
Misc  Craft Interface       OK
```

show chassis environment (M7i Router)

```
user@host> show chassis environment
Class Item                  Status     Measurement
Power Power Supply 0        OK
      Power Supply 1        Absent
Temp  Intake                OK         22 degrees C / 71 degrees F
      FPC 0                 OK         23 degrees C / 73 degrees F
      Power Supplies        OK         23 degrees C / 73 degrees F
      CFEB Intake           OK         24 degrees C / 75 degrees F
      CFEB Exhaust          OK         29 degrees C / 84 degrees F
      Routing Engine        OK         26 degrees C / 78 degrees F
Fans  Fan 1                 OK         Spinning at normal speed
      Fan 2                 OK         Spinning at normal speed
      Fan 3                 OK         Spinning at normal speed
      Fan 4                 OK         Spinning at normal speed
```

show chassis environment (M10 Router)

```
user@host> show chassis environment
Class Item                  Status     Measurement
Power Power Supply A        OK
      Power Supply B        Failed
Temp  FPC 0                 OK         36 degrees C / 96 degrees F
      FPC 1                 OK         35 degrees C / 95 degrees F
      FEB                   OK         34 degrees C / 93 degrees F
      PS Intake             OK         31 degrees C / 87 degrees F
      PS Exhaust            OK         34 degrees C / 93 degrees F
      Routing Engine        OK         35 degrees C / 95 degrees F
Fans  Left Fan 1            OK         Spinning at normal speed
      Left Fan 2            OK         Spinning at normal speed
      Left Fan 3            OK         Spinning at normal speed
      Left Fan 4            OK         Spinning at normal speed
Misc  Craft Interface       OK
```

show chassis environment (M10i Router)

```
user@host> show chassis environment
Class Item                  Status     Measurement
Power Power Supply 0        OK
      Power Supply 1        OK
```



```
        Power Supply 2        Absent
        Power Supply 3        Absent
Temp    Intake                OK         26 degrees C / 78 degrees F
        FPC 0                 OK         27 degrees C / 80 degrees F
        FPC 1                 OK         28 degrees C / 82 degrees F
        Lower Power Supplies  OK         29 degrees C / 84 degrees F
        Upper Power Supplies  OK         28 degrees C / 82 degrees F
        CFEB Intake           OK         27 degrees C / 80 degrees F
        CFEB Exhaust          OK         36 degrees C / 96 degrees F
        Routing Engine 0      OK         31 degrees C / 87 degrees F
        Routing Engine 1      OK         27 degrees C / 80 degrees F
Fans    Fan Tray 0 Fan 1      OK         Spinning at normal speed
        Fan Tray 0 Fan 2      OK         Spinning at normal speed
        Fan Tray 0 Fan 3      OK         Spinning at normal speed
        Fan Tray 0 Fan 4      OK         Spinning at normal speed
        Fan Tray 0 Fan 5      OK         Spinning at normal speed
        Fan Tray 0 Fan 6      OK         Spinning at normal speed
        Fan Tray 0 Fan 7      OK         Spinning at normal speed
        Fan Tray 0 Fan 8      OK         Spinning at normal speed
        Fan Tray 1 Fan 1      Absent
        Fan Tray 1 Fan 2      Absent
        Fan Tray 1 Fan 3      Absent
        Fan Tray 1 Fan 4      Absent
        Fan Tray 1 Fan 5      Absent
        Fan Tray 1 Fan 6      Absent
        Fan Tray 1 Fan 7      Absent
        Fan Tray 1 Fan 8      Absent
```

show chassis environment (M20 Router)

```
user@host> show chassis environment
Class Item                    Status     Measurement
Power Power Supply A          OK
      Power Supply B          Absent
Temp  FPC 0                   OK         28 degrees C / 82 degrees F
      FPC 1                   OK         27 degrees C / 80 degrees F
      Power Supply A          OK         22 degrees C / 71 degrees F
      Power Supply B          Absent
      SSB 0                   OK         30 degrees C / 86 degrees F
      Backplane               OK         22 degrees C / 71 degrees F
      Routing Engine 0        OK         26 degrees C / 78 degrees F
      Routing Engine 1        Testing
Fans  Rear Fan                OK         Spinning at normal speed
      Front Upper Fan         OK         Spinning at normal speed
      Front Middle Fan        OK         Spinning at normal speed
      Front Bottom Fan        OK         Spinning at normal speed
Misc  Craft Interface         OK
```

show chassis environment (M40 Router)

```
user@host> show chassis environment
Class Item                    Status     Measurement
Power Power Supply A          OK
      Power Supply B          Absent
Temp  FPC 3                   OK         24 degrees C / 75 degrees F
      FPC 6                   OK         26 degrees C / 78 degrees F
      SCB                     OK         26 degrees C / 78 degrees F
      Backplane @ A1          OK         28 degrees C / 82 degrees F
      Backplane @ A2          OK         23 degrees C / 73 degrees F
```



```
      Routing Engine        OK          26 degrees C / 78 degrees F
Fans  Top Impeller          OK          Spinning at normal speed
      Bottom impeller       OK          Spinning at normal speed
      Rear Left Fan         OK          Spinning at normal speed
      Rear Center Fan       OK          Spinning at normal speed
      Rear Right Fan        OK          Spinning at normal speed
Misc  Craft Interface       OK
```

show chassis environment (M40e Router)

```
user@host> show chassis environment
Class Item                  Status      Measurement
Power PEM 0                 OK
      PEM 1                 Absent
Temp  PCG 0                 OK          44 degrees C / 111 degrees F
      PCG 1                 OK          47 degrees C / 116 degrees F
      Routing Engine 0      OK          40 degrees C / 104 degrees F
      Routing Engine 1      OK          37 degrees C / 98 degrees F
      MCS 0                 OK          45 degrees C / 113 degrees F
      MCS 1                 OK          42 degrees C / 107 degrees F
      SFM 0 SPP             OK          40 degrees C / 104 degrees F
      SFM 0 SPR             OK          44 degrees C / 111 degrees F
      SFM 1 SPP             OK          43 degrees C / 109 degrees F
      SFM 1 SPR             OK          45 degrees C / 113 degrees F
      FPC 0                 OK          38 degrees C / 100 degrees F
      FPC 1                 OK          40 degrees C / 104 degrees F
      FPC 2                 OK          38 degrees C / 100 degrees F
      FPC 4                 OK          34 degrees C / 93 degrees F
      FPC 5                 OK          43 degrees C / 109 degrees F
      FPC 6                 OK          41 degrees C / 105 degrees F
      FPC 7                 OK          43 degrees C / 109 degrees F
      FPM CMB               OK          28 degrees C / 82 degrees F
      FPM Display           OK          28 degrees C / 82 degrees F
Fans  Rear Bottom Blower    OK          Spinning at normal speed
      Rear Top Blower       OK          Spinning at normal speed
      Front Top Blower      OK          Spinning at normal speed
      Fan Tray Rear Left    OK          Spinning at normal speed
      Fan Tray Rear Right   OK          Spinning at normal speed
      Fan Tray Front Left   OK          Spinning at normal speed
      Fan Tray Front Right  OK          Spinning at normal speed
Misc  CIP                   OK
```

show chassis environment (M120 Router)

```
user@host> show chassis environment
Class Item                          Status      Measurement
Temp  PEM 0                         OK
      PEM 1                         OK
      Routing Engine 0              OK          43 degrees C / 109 degrees F
      Routing Engine 1              OK          44 degrees C / 111 degrees F
      CB 0 Intake                   OK          33 degrees C / 91 degrees F
      CB 0 Exhaust A                OK          36 degrees C / 96 degrees F
      CB 0 Exhaust B                OK          35 degrees C / 95 degrees F
      CB 1 Intake                   OK          34 degrees C / 93 degrees F
      CB 1 Exhaust A                OK          38 degrees C / 100 degrees F
      CB 1 Exhaust B                OK          35 degrees C / 95 degrees F
      FEB 3 Intake                  OK          35 degrees C / 95 degrees F
      FEB 3 Exhaust A               OK          37 degrees C / 98 degrees F
      FEB 3 Exhaust B               OK          39 degrees C / 102 degrees F
```



```
          FEB 4 Intake                OK          33 degrees C / 91 degrees F
          FEB 4 Exhaust A             OK          39 degrees C / 102 degrees F
          FEB 4 Exhaust B             OK          36 degrees C / 96 degrees F
          FPC 2 Exhaust A             OK          32 degrees C / 89 degrees F
          FPC 2 Exhaust B             OK          31 degrees C / 87 degrees F
          FPC 3 Exhaust A             OK          32 degrees C / 89 degrees F
          FPC 3 Exhaust B             OK          33 degrees C / 91 degrees F
          FPC 4 Exhaust A             OK          32 degrees C / 89 degrees F
          FPC 4 Exhaust B             OK          30 degrees C / 86 degrees F
    Fans  Front Top Tray Fan 1        OK          Spinning at normal speed
          Front Top Tray Fan 2        OK          Spinning at normal speed
          Front Top Tray Fan 3        OK          Spinning at normal speed
          Front Top Tray Fan 4        OK          Spinning at normal speed
          Front Top Tray Fan 5        OK          Spinning at normal speed
          Front Top Tray Fan 6        OK          Spinning at normal speed
          Front Top Tray Fan 7        OK          Spinning at normal speed
          Front Top Tray Fan 8        OK          Spinning at normal speed
          Front Bottom Tray Fan 1     OK          Spinning at normal speed
          Front Bottom Tray Fan 2     OK          Spinning at normal speed
          Front Bottom Tray Fan 3     OK          Spinning at normal speed
          Front Bottom Tray Fan 4     OK          Spinning at normal speed
          Front Bottom Tray Fan 5     OK          Spinning at normal speed
          Front Bottom Tray Fan 6     OK          Spinning at normal speed
          Front Bottom Tray Fan 7     OK          Spinning at normal speed
          Front Bottom Tray Fan 8     OK          Spinning at normal speed
          Rear Top Tray Fan 1         OK          Spinning at normal speed
          Rear Top Tray Fan 2         OK          Spinning at normal speed
          Rear Top Tray Fan 3         OK          Spinning at normal speed
          Rear Top Tray Fan 4         OK          Spinning at normal speed
          Rear Top Tray Fan 5         OK          Spinning at normal speed
          Rear Top Tray Fan 6         OK          Spinning at normal speed
          Rear Top Tray Fan 7         OK          Spinning at normal speed
          Rear Top Tray Fan 8         OK          Spinning at normal speed
          Rear Bottom Tray Fan 1      OK          Spinning at normal speed
          Rear Bottom Tray Fan 2      OK          Spinning at normal speed
          Rear Bottom Tray Fan 3      OK          Spinning at normal speed
          Rear Bottom Tray Fan 4      OK          Spinning at normal speed
          Rear Bottom Tray Fan 5      OK          Spinning at normal speed
          Rear Bottom Tray Fan 6      OK          Spinning at normal speed
          Rear Bottom Tray Fan 7      OK          Spinning at normal speed
          Rear Bottom Tray Fan 8      OK          Spinning at normal speed
```

show chassis environment (M160 Router)

```
user@host> show chassis environment
Class Item                   Status     Measurement
Power PEM 0                  OK           PEM 1                  Absent
Temp  PCG 0                  OK         45 degrees C / 113 degrees F
      PCG 1                  Absent
      Routing Engine 0       OK         35 degrees C / 95 degrees F
      Routing Engine 1       Absent
      MCS 0                  OK         50 degrees C / 122 degrees F
      SFM 0 SPP              OK         47 degrees C / 116 degrees F
      SFM 0 SPR              OK         49 degrees C / 120 degrees F
      SFM 1 SPP              OK         50 degrees C / 122 degrees F
      SFM 1 SPR              OK         50 degrees C / 122 degrees F
      SFM 2 SPP              OK         51 degrees C / 123 degrees F
      SFM 2 SPR              OK         52 degrees C / 125 degrees F
      SFM 3 SPP              OK         52 degrees C / 125 degrees F
      SFM 3 SPR              OK         48 degrees C / 118 degrees F
      FPC 0                  OK         45 degrees C / 113 degrees F
```

```
        FPC 6                 OK         43 degrees C / 109 degrees F
        FPM CMB               OK         31 degrees C / 87 degrees F
        FPM Display           OK         33 degrees C / 91 degrees F
Fans    Rear Bottom Blower    OK         Spinning at normal speed
        Rear Top Blower       OK         Spinning at normal speed
        Front Top Blower      OK         Spinning at normal speed
        Fan Tray Rear Left    OK         Spinning at normal speed
        Fan Tray Rear Right   OK         Spinning at normal speed
        Fan Tray Front Left   OK         Spinning at normal speed
        Fan Tray Front Right  OK         Spinning at normal speed
Misc    CIP                   OK
```

show chassis environment (M320 Router)

```
user@host> show chassis environment
Class Item                     Status     Measurement
Temp  PEM 0                    Absent
      PEM 1                    Absent
      PEM 2                    OK
      PEM 3                    OK
      Routing Engine 0         OK         33 degrees C / 91 degrees F
      Routing Engine 1         OK         32 degrees C / 89 degrees F
      CB 0                     OK         36 degrees C / 96 degrees F
      CB 1                     OK         36 degrees C / 96 degrees F
      SIB 0                    OK         38 degrees C / 100 degrees F
      SIB 1                    OK         29 degrees C / 84 degrees F
      SIB 2                    OK         38 degrees C / 100 degrees F
      SIB 3                    OK         41 degrees C / 105 degrees F
      FPC 0 Intake             OK         28 degrees C / 82 degrees F
      FPC 0 Exhaust            OK         40 degrees C / 104 degrees F
      FPC 1 Intake             OK         29 degrees C / 84 degrees F
      FPC 1 Exhaust            OK         39 degrees C / 102 degrees F
      FPC 2 Intake             OK         28 degrees C / 82 degrees F
      FPC 2 Exhaust            OK         38 degrees C / 100 degrees F
      FPC 3 Intake             OK         28 degrees C / 82 degrees F
      FPC 3 Exhaust            OK         39 degrees C / 102 degrees F
      FPC 6 Intake             OK         27 degrees C / 80 degrees F
      FPC 6 Exhaust            OK         39 degrees C / 102 degrees F
      FPC 7 Intake             OK         27 degrees C / 80 degrees F
      FPC 7 Exhaust            OK         42 degrees C / 107 degrees F
      FPM GBUS                 OK         30 degrees C / 86 degrees F
Fan   Top Left Front fan       OK         Spinning at normal speed
      Top Right Rear fan       OK         Spinning at normal speed
      Top Right Front fan      OK         Spinning at normal speed
      Top Left Rear fan        OK         Spinning at normal speed
      Bottom Left Front fan    OK         Spinning at normal speed
      Bottom Right Rear fan    OK         Spinning at normal speed
      Bottom Right Front fan   OK         Spinning at normal speed
      Bottom Left Rear fan     OK         Spinning at normal speed
      Rear Fan 1 (TOP)         OK         Spinning at normal speed
      Rear Fan 2               OK         Spinning at normal speed
      Rear Fan 3               OK         Spinning at normal speed
      Rear Fan 4               OK         Spinning at normal speed
      Rear Fan 5               OK         Spinning at normal speed
      Rear Fan 6               OK         Spinning at normal speed
      Rear Fan 7 (Bottom)      OK         Spinning at normal speed
Misc  CIP                      OK
```


show chassis environment (MX104 Router)

```
user@host> show chassis environment
Class Item                           Status     Measurement
Temp  PEM 0                          OK         34 degrees C / 93 degrees F
      PEM 1                          Absent
      ABB 0 Intake                   OK         33 degrees C / 91 degrees F
      ABB 0 Exhaust A                OK         42 degrees C / 107 degrees F
      ABB 0 Exhaust B                OK         43 degrees C / 109 degrees F
      ABB 1 Intake                   Absent
      ABB 1 Exhaust A                Absent
      ABB 1 Exhaust B                Absent
      Routing Engine 0               OK         34 degrees C / 93 degrees F
      Routing Engine 0 CPU           OK         46 degrees C / 114 degrees F
      Routing Engine 1               Absent
      Routing Engine 1 CPU           Absent
      AFEB 0 AFEB Processor          OK         33 degrees C / 91 degrees F
Fans  Fan 1                          OK         Spinning at normal speed
      Fan 2                          OK         Spinning at normal speed
      Fan 3                          OK         Spinning at normal speed
      Fan 4                          OK         Spinning at normal speed
      Fan 5                          OK         Spinning at normal speed
```

show chassis environment (MX240 Router)

```
user@host> show chassis environment
Class Item                           Status     Measurement
Temp  PEM 0                          OK         40 degrees C / 104 degrees F
      PEM 1                          OK         45 degrees C / 113 degrees F
      PEM 2                          Absent
      PEM 3                          Absent
      Routing Engine 0               OK         39 degrees C / 102 degrees F
      Routing Engine 1               OK         37 degrees C / 98 degrees F
      CB 0 Intake                    OK         36 degrees C / 96 degrees F
      CB 0 Exhaust A                 OK         34 degrees C / 93 degrees F
      CB 0 Exhaust B                 OK         38 degrees C / 100 degrees F
      CB 0 ACBC                      OK         37 degrees C / 98 degrees F
      CB 0 SF A                      OK         49 degrees C / 120 degrees F
      CB 0 SF B                      OK         41 degrees C / 105 degrees F
      CB 1 Intake                    OK         37 degrees C / 98 degrees F
      CB 1 Exhaust A                 OK         34 degrees C / 93 degrees F
      CB 1 Exhaust B                 OK         39 degrees C / 102 degrees F
      CB 1 ACBC                      OK         38 degrees C / 100 degrees F
      CB 1 SF A                      OK         47 degrees C / 116 degrees F
      CB 1 SF B                      OK         41 degrees C / 105 degrees F
      FPC 1 Intake                   OK         33 degrees C / 91 degrees F
      FPC 1 Exhaust A                OK         38 degrees C / 100 degrees F
      FPC 1 Exhaust B                OK         53 degrees C / 127 degrees F
      FPC 1 I3 0 TSensor             OK         50 degrees C / 122 degrees F
      FPC 1 I3 0 Chip                OK         53 degrees C / 127 degrees F
      FPC 1 I3 1 TSensor             OK         49 degrees C / 120 degrees F
      FPC 1 I3 1 Chip                OK         52 degrees C / 125 degrees F
      FPC 1 I3 2 TSensor             OK         47 degrees C / 116 degrees F
      FPC 1 I3 2 Chip                OK         49 degrees C / 120 degrees F
      FPC 1 I3 3 TSensor             OK         44 degrees C / 111 degrees F
      FPC 1 I3 3 Chip                OK         46 degrees C / 114 degrees F
      FPC 1 IA 0 TSensor             OK         45 degrees C / 113 degrees F
      FPC 1 IA 0 Chip                OK         44 degrees C / 111 degrees F
      FPC 1 IA 1 TSensor             OK         44 degrees C / 111 degrees F
      FPC 1 IA 1 Chip                OK         48 degrees C / 118 degrees F
      FPC 2 Intake                   OK         32 degrees C / 89 degrees F
```

```
          FPC 2 Exhaust A               OK          40 degrees C / 104 degrees F
          FPC 2 Exhaust B               OK          52 degrees C / 125 degrees F
          FPC 2 I3 0 TSensor            OK          52 degrees C / 125 degrees F
          FPC 2 I3 0 Chip               OK          56 degrees C / 132 degrees F
          FPC 2 I3 1 TSensor            OK          52 degrees C / 125 degrees F
          FPC 2 I3 1 Chip               OK          55 degrees C / 131 degrees F
          FPC 2 I3 2 TSensor            OK          49 degrees C / 120 degrees F
          FPC 2 I3 2 Chip               OK          52 degrees C / 125 degrees F
          FPC 2 I3 3 TSensor            OK          44 degrees C / 111 degrees F
          FPC 2 I3 3 Chip               OK          48 degrees C / 118 degrees F
          FPC 2 IA 0 TSensor            OK          50 degrees C / 122 degrees F
          FPC 2 IA 0 Chip               OK          48 degrees C / 118 degrees F
          FPC 2 IA 1 TSensor            OK          47 degrees C / 116 degrees F
          FPC 2 IA 1 Chip               OK          53 degrees C / 127 degrees F
Fans      Front Fan                     OK          Spinning at normal speed
          Middle Fan                    OK          Spinning at normal speed
          Rear Fan                      OK          Spinning at normal speed
```

show chassis environment (MX240 Router with Enhanced MX SCB)

```
user@host> show chassis environment
Class Item                              Status      Measurement
Temp      PEM 0                         OK          40 degrees C / 104 degrees F
          PEM 1                         OK          45 degrees C / 113 degrees F
          PEM 2                         Absent
          PEM 3                         Absent
          Routing Engine 0              OK          39 degrees C / 102 degrees F
          Routing Engine 1              OK          37 degrees C / 98 degrees F
          CB 0 Intake                   OK          36 degrees C / 96 degrees F
          CB 0 Exhaust A                OK          34 degrees C / 93 degrees F
          CB 0 Exhaust B                OK          38 degrees C / 100 degrees F
          CB 0 ACBC                     OK          37 degrees C / 98 degrees F
          CB 0 XF A                     OK          49 degrees C / 120 degrees F
          CB 0 XF B                     OK          41 degrees C / 105 degrees F
          CB 1 Intake                   OK          37 degrees C / 98 degrees F
          CB 1 Exhaust A                OK          34 degrees C / 93 degrees F
          CB 1 Exhaust B                OK          39 degrees C / 102 degrees F
          CB 1 ACBC                     OK          38 degrees C / 100 degrees F
          CB 1 XF A                     OK          47 degrees C / 116 degrees F
          CB 1 XF B                     OK          41 degrees C / 105 degrees F
          FPC 1 Intake                  OK          33 degrees C / 91 degrees F
          FPC 1 Exhaust A               OK          38 degrees C / 100 degrees F
          FPC 1 Exhaust B               OK          53 degrees C / 127 degrees F
          FPC 1 I3 0 TSensor            OK          50 degrees C / 122 degrees F
          FPC 1 I3 0 Chip               OK          53 degrees C / 127 degrees F
          FPC 1 I3 1 TSensor            OK          49 degrees C / 120 degrees F
          FPC 1 I3 1 Chip               OK          52 degrees C / 125 degrees F
          FPC 1 I3 2 TSensor            OK          47 degrees C / 116 degrees F
          FPC 1 I3 2 Chip               OK          49 degrees C / 120 degrees F
          FPC 1 I3 3 TSensor            OK          44 degrees C / 111 degrees F
          FPC 1 I3 3 Chip               OK          46 degrees C / 114 degrees F
          FPC 1 IA 0 TSensor            OK          45 degrees C / 113 degrees F
          FPC 1 IA 0 Chip               OK          44 degrees C / 111 degrees F
          FPC 1 IA 1 TSensor            OK          44 degrees C / 111 degrees F
          FPC 1 IA 1 Chip               OK          48 degrees C / 118 degrees F
          FPC 2 Intake                  OK          32 degrees C / 89 degrees F
          FPC 2 Exhaust A               OK          40 degrees C / 104 degrees F
          FPC 2 Exhaust B               OK          52 degrees C / 125 degrees F
          FPC 2 I3 0 TSensor            OK          52 degrees C / 125 degrees F
          FPC 2 I3 0 Chip               OK          56 degrees C / 132 degrees F
          FPC 2 I3 1 TSensor            OK          52 degrees C / 125 degrees F
```



```
          FPC 2 I3 1 Chip              OK          55 degrees C / 131 degrees F
          FPC 2 I3 2 TSensor           OK          49 degrees C / 120 degrees F
          FPC 2 I3 2 Chip              OK          52 degrees C / 125 degrees F
          FPC 2 I3 3 TSensor           OK          44 degrees C / 111 degrees F
          FPC 2 I3 3 Chip              OK          48 degrees C / 118 degrees F
          FPC 2 IA 0 TSensor           OK          50 degrees C / 122 degrees F
          FPC 2 IA 0 Chip              OK          48 degrees C / 118 degrees F
          FPC 2 IA 1 TSensor           OK          47 degrees C / 116 degrees F
          FPC 2 IA 1 Chip              OK          53 degrees C / 127 degrees F
Fans      Front Fan                    OK          Spinning at normal speed
          Middle Fan                   OK          Spinning at normal speed
          Rear Fan                     OK          Spinning at normal speed
```

show chassis environment (MX480 Router)

```
user@host> show chassis environment
Class Item                           Status      Measurement
Temp      PEM 0                        OK          35 degrees C / 95 degrees F
          PEM 1                        OK          40 degrees C / 104 degrees F
          PEM 2                        Absent
          PEM 3                        Absent
          Routing Engine 0             OK          44 degrees C / 111 degrees F
          Routing Engine 1             OK          45 degrees C / 113 degrees F
          CB 0 Intake                  OK          36 degrees C / 96 degrees F
          CB 0 Exhaust A               OK          38 degrees C / 100 degrees F
          CB 0 Exhaust B               OK          39 degrees C / 102 degrees F
          CB 0 ACBC                    OK          37 degrees C / 98 degrees F
          CB 0 SF A                    OK          51 degrees C / 123 degrees F
          CB 0 SF B                    OK          44 degrees C / 111 degrees F
          CB 1 Intake                  OK          36 degrees C / 96 degrees F
          CB 1 Exhaust A               OK          39 degrees C / 102 degrees F
          CB 1 Exhaust B               OK          40 degrees C / 104 degrees F
          CB 1 ACBC                    OK          37 degrees C / 98 degrees F
          CB 1 SF A                    OK          50 degrees C / 122 degrees F
          CB 1 SF B                    OK          43 degrees C / 109 degrees F
          FPC 0 Intake                 OK          36 degrees C / 96 degrees F
          FPC 0 Exhaust A              OK          39 degrees C / 102 degrees F
          FPC 0 Exhaust B              OK          51 degrees C / 123 degrees F
          FPC 0 I3 0 TSensor           OK          49 degrees C / 120 degrees F
          FPC 0 I3 0 Chip              OK          56 degrees C / 132 degrees F
          FPC 0 I3 1 TSensor           OK          47 degrees C / 116 degrees F
          FPC 0 I3 1 Chip              OK          52 degrees C / 125 degrees F
          FPC 0 I3 2 TSensor           OK          46 degrees C / 114 degrees F
          FPC 0 I3 2 Chip              OK          48 degrees C / 118 degrees F
          FPC 0 I3 3 TSensor           OK          42 degrees C / 107 degrees F
          FPC 0 I3 3 Chip              OK          45 degrees C / 113 degrees F
          FPC 0 IA 0 TSensor           OK          45 degrees C / 113 degrees F
          FPC 0 IA 0 Chip              OK          45 degrees C / 113 degrees F
          FPC 0 IA 1 TSensor           OK          44 degrees C / 111 degrees F
          FPC 0 IA 1 Chip              OK          48 degrees C / 118 degrees F
          FPC 1 Intake                 OK          37 degrees C / 98 degrees F
          FPC 1 Exhaust A              OK          41 degrees C / 105 degrees F
          FPC 1 Exhaust B              OK          52 degrees C / 125 degrees F
          FPC 1 I3 0 TSensor           OK          51 degrees C / 123 degrees F
          FPC 1 I3 0 Chip              OK          57 degrees C / 134 degrees F
          FPC 1 I3 1 TSensor           OK          48 degrees C / 118 degrees F
          FPC 1 I3 1 Chip              OK          52 degrees C / 125 degrees F
          FPC 1 I3 2 TSensor           OK          46 degrees C / 114 degrees F
          FPC 1 I3 2 Chip              OK          50 degrees C / 122 degrees F
          FPC 1 I3 3 TSensor           OK          42 degrees C / 107 degrees F
          FPC 1 I3 3 Chip              OK          46 degrees C / 114 degrees F
```



```
      FPC 1 IA 0 TSensor           OK          49 degrees C / 120 degrees F
      FPC 1 IA 0 Chip              OK          48 degrees C / 118 degrees F
      FPC 1 IA 1 TSensor           OK          46 degrees C / 114 degrees F
      FPC 1 IA 1 Chip              OK          50 degrees C / 122 degrees F
Fans  Top Rear Fan                 OK          Spinning at normal speed
      Bottom Rear Fan              OK          Spinning at normal speed
      Top Middle Fan               OK          Spinning at normal speed
      Bottom Middle Fan            OK          Spinning at normal speed
      Top Front Fan                OK          Spinning at normal speed
      Bottom Front Fan             OK          Spinning at normal speed
```

show chassis environment (MX480 Router with Enhanced MX SCB)

```
user@host> show chassis environment
Class Item                         Status      Measurement
Temp  PEM 0                        OK          35 degrees C / 95 degrees F
      PEM 1                        OK          40 degrees C / 104 degrees F
      PEM 2                        Absent
      PEM 3                        Absent
      Routing Engine 0             OK          44 degrees C / 111 degrees F
      Routing Engine 1             OK          45 degrees C / 113 degrees F
      CB 0 Intake                  OK          36 degrees C / 96 degrees F
      CB 0 Exhaust A               OK          38 degrees C / 100 degrees F
      CB 0 Exhaust B               OK          39 degrees C / 102 degrees F
      CB 0 ACBC                    OK          37 degrees C / 98 degrees F
      CB 0 XF A                    OK          51 degrees C / 123 degrees F
      CB 0 XF B                    OK          44 degrees C / 111 degrees F
      CB 1 Intake                  OK          36 degrees C / 96 degrees F
      CB 1 Exhaust A               OK          39 degrees C / 102 degrees F
      CB 1 Exhaust B               OK          40 degrees C / 104 degrees F
      CB 1 ACBC                    OK          37 degrees C / 98 degrees F
      CB 1 XF A                    OK          50 degrees C / 122 degrees F
      CB 1 XF B                    OK          43 degrees C / 109 degrees F
      FPC 0 Intake                 OK          36 degrees C / 96 degrees F
      FPC 0 Exhaust A              OK          39 degrees C / 102 degrees F
      FPC 0 Exhaust B              OK          51 degrees C / 123 degrees F
      FPC 0 I3 0 TSensor           OK          49 degrees C / 120 degrees F
      FPC 0 I3 0 Chip              OK          56 degrees C / 132 degrees F
      FPC 0 I3 1 TSensor           OK          47 degrees C / 116 degrees F
      FPC 0 I3 1 Chip              OK          52 degrees C / 125 degrees F
      FPC 0 I3 2 TSensor           OK          46 degrees C / 114 degrees F
      FPC 0 I3 2 Chip              OK          48 degrees C / 118 degrees F
      FPC 0 I3 3 TSensor           OK          42 degrees C / 107 degrees F
      FPC 0 I3 3 Chip              OK          45 degrees C / 113 degrees F
      FPC 0 IA 0 TSensor           OK          45 degrees C / 113 degrees F
      FPC 0 IA 0 Chip              OK          45 degrees C / 113 degrees F
      FPC 0 IA 1 TSensor           OK          44 degrees C / 111 degrees F
      FPC 0 IA 1 Chip              OK          48 degrees C / 118 degrees F
      FPC 1 Intake                 OK          37 degrees C / 98 degrees F
      FPC 1 Exhaust A              OK          41 degrees C / 105 degrees F
      FPC 1 Exhaust B              OK          52 degrees C / 125 degrees F
      FPC 1 I3 0 TSensor           OK          51 degrees C / 123 degrees F
      FPC 1 I3 0 Chip              OK          57 degrees C / 134 degrees F
      FPC 1 I3 1 TSensor           OK          48 degrees C / 118 degrees F
      FPC 1 I3 1 Chip              OK          52 degrees C / 125 degrees F
      FPC 1 I3 2 TSensor           OK          46 degrees C / 114 degrees F
      FPC 1 I3 2 Chip              OK          50 degrees C / 122 degrees F
      FPC 1 I3 3 TSensor           OK          42 degrees C / 107 degrees F
      FPC 1 I3 3 Chip              OK          46 degrees C / 114 degrees F
      FPC 1 IA 0 TSensor           OK          49 degrees C / 120 degrees F
      FPC 1 IA 0 Chip              OK          48 degrees C / 118 degrees F
```

```
        FPC 1 IA 1 TSensor            OK          46 degrees C / 114 degrees F
        FPC 1 IA 1 Chip               OK          50 degrees C / 122 degrees F
Fans    Top Rear Fan                  OK          Spinning at normal speed
        Bottom Rear Fan               OK          Spinning at normal speed
        Top Middle Fan                OK          Spinning at normal speed
        Bottom Middle Fan             OK          Spinning at normal speed
        Top Front Fan                 OK          Spinning at normal speed
        Bottom Front Fan              OK          Spinning at normal speed
```

show chassis environment (MX960 Router)

```
user@host> show chassis environment
Class Item                            Status      Measurement
Temp    PEM 0                         Absent
        PEM 1                         Absent
        PEM 2                         Check
        PEM 3                         OK          35 degrees C / 95 degrees F
        Routing Engine 0              OK          37 degrees C / 98 degrees F
        Routing Engine 1              Absent
        CB 0 Intake                   OK          24 degrees C / 75 degrees F
        CB 0 Exhaust A                OK          30 degrees C / 86 degrees F
        CB 0 Exhaust B                OK          27 degrees C / 80 degrees F
        CB 1 Intake                   Absent
        CB 1 Exhaust A                Absent
        CB 1 Exhaust B                Absent
        CB 1 ACBC                     Absent
        CB 1 SF A                     Absent
        CB 1 SF B                     Absent
        CB 2 Intake                   Absent
        CB 2 Exhaust A                Absent
        CB 2 Exhaust B                Absent
        CB 2 ACBC                     Absent
        CB 2 SF A                     Absent
        CB 2 SF B                     Absent
        FPC 4 Intake                  OK          24 degrees C / 75 degrees F
        FPC 4 Exhaust A               OK          36 degrees C / 96 degrees F
        FPC 4 Exhaust B               OK          38 degrees C / 100 degrees F
        FPC 7 Intake                  OK          24 degrees C / 75 degrees F
        FPC 7 Exhaust A               OK          36 degrees C / 96 degrees F
        FPC 7 Exhaust B               OK          42 degrees C / 107 degrees F
Fans    Top Fan Tray Temp             Failed
        Top Tray Fan 1                OK          Spinning at normal speed
        Top Tray Fan 2                OK          Spinning at normal speed
        Top Tray Fan 3                OK          Spinning at normal speed
        Top Tray Fan 4                OK          Spinning at normal speed
        Top Tray Fan 5                OK          Spinning at normal speed
        Top Tray Fan 6                OK          Spinning at normal speed
        Bottom Fan Tray Temp          Failed
        Bottom Tray Fan 1             OK          Spinning at normal speed
        Bottom Tray Fan 2             OK          Spinning at normal speed
        Bottom Tray Fan 3             OK          Spinning at normal speed
        Bottom Tray Fan 4             OK          Spinning at normal speed
        Bottom Tray Fan 5             OK          Spinning at normal speed
        Bottom Tray Fan 6             OK          Spinning at normal speed
```

show chassis environment (MX960 Router with Enhanced MX SCB)

```
user@host> show chassis environment
Class Item                            Status      Measurement
Temp    PEM 0                         Absent
        PEM 1                         OK          50 degrees C / 122 degrees F
```



```
PEM 2                         OK          50 degrees C / 122 degrees F
PEM 3                         OK          50 degrees C / 122 degrees F
Routing Engine 0              OK          42 degrees C / 107 degrees F
Routing Engine 0 CPU          OK          51 degrees C / 123 degrees F
Routing Engine 1              OK          39 degrees C / 102 degrees F
Routing Engine 1 CPU          OK          44 degrees C / 111 degrees F
CB 0 Intake                   OK          35 degrees C / 95 degrees F
CB 0 Exhaust A                OK          36 degrees C / 96 degrees F
CB 0 Exhaust B                OK          43 degrees C / 109 degrees F
CB 0 ACBC                     OK          38 degrees C / 100 degrees F
CB 0 XF A                     OK          53 degrees C / 127 degrees F
CB 0 XF B                     OK          47 degrees C / 116 degrees F
CB 1 Intake                   OK          35 degrees C / 95 degrees F
CB 1 Exhaust A                OK          35 degrees C / 95 degrees F
CB 1 Exhaust B                OK          41 degrees C / 105 degrees F
CB 1 ACBC                     OK          38 degrees C / 100 degrees F
CB 1 XF A                     OK          52 degrees C / 125 degrees F
CB 1 XF B                     OK          47 degrees C / 116 degrees F
CB 2 Intake                   OK          32 degrees C / 89 degrees F
CB 2 Exhaust A                OK          30 degrees C / 86 degrees F
CB 2 Exhaust B                OK          35 degrees C / 95 degrees F
CB 2 ACBC                     OK          33 degrees C / 91 degrees F
CB 2 XF A                     OK          51 degrees C / 123 degrees F
CB 2 XF B                     OK          50 degrees C / 122 degrees F
FPC 0 Intake                  OK          35 degrees C / 95 degrees F
FPC 0 Exhaust A               OK          39 degrees C / 102 degrees F
FPC 0 Exhaust B               OK          50 degrees C / 122 degrees F
FPC 0 I3 0 TSensor            OK          50 degrees C / 122 degrees F
FPC 0 I3 0 Chip               OK          56 degrees C / 132 degrees F
FPC 0 I3 1 TSensor            OK          47 degrees C / 116 degrees F
FPC 0 I3 1 Chip               OK          50 degrees C / 122 degrees F
FPC 0 I3 2 TSensor            OK          45 degrees C / 113 degrees F
FPC 0 I3 2 Chip               OK          48 degrees C / 118 degrees F
FPC 0 I3 3 TSensor            OK          41 degrees C / 105 degrees F
FPC 0 I3 3 Chip               OK          44 degrees C / 111 degrees F
FPC 0 IA 0 TSensor            OK          45 degrees C / 113 degrees F
FPC 0 IA 0 Chip               OK          45 degrees C / 113 degrees F
FPC 0 IA 1 TSensor            OK          44 degrees C / 111 degrees F
FPC 0 IA 1 Chip               OK          48 degrees C / 118 degrees F
FPC 1 Intake                  OK          36 degrees C / 96 degrees F
FPC 1 Exhaust A               OK          47 degrees C / 116 degrees F
FPC 1 Exhaust B               OK          43 degrees C / 109 degrees F
FPC 1 LU 0 TCAM TSensor       OK          53 degrees C / 127 degrees F
FPC 1 LU 0 TCAM Chip          OK          57 degrees C / 134 degrees F
FPC 1 LU 0 TSensor            OK          53 degrees C / 127 degrees F
FPC 1 LU 0 Chip               OK          60 degrees C / 140 degrees F
FPC 1 MQ 0 TSensor            OK          53 degrees C / 127 degrees F
FPC 1 MQ 0 Chip               OK          56 degrees C / 132 degrees F
FPC 1 LU 1 TCAM TSensor       OK          51 degrees C / 123 degrees F
FPC 1 LU 1 TCAM Chip          OK          52 degrees C / 125 degrees F
FPC 1 LU 1 TSensor            OK          51 degrees C / 123 degrees F
FPC 1 LU 1 Chip               OK          53 degrees C / 127 degrees F
FPC 1 MQ 1 TSensor            OK          51 degrees C / 123 degrees F
FPC 1 MQ 1 Chip               OK          58 degrees C / 136 degrees F
FPC 2 Intake                  OK          35 degrees C / 95 degrees F
FPC 2 Exhaust A               OK          39 degrees C / 102 degrees F
FPC 2 Exhaust B               OK          54 degrees C / 129 degrees F
FPC 2 I3 0 TSensor            OK          52 degrees C / 125 degrees F
FPC 2 I3 0 Chip               OK          59 degrees C / 138 degrees F
FPC 2 I3 1 TSensor            OK          48 degrees C / 118 degrees F
FPC 2 I3 1 Chip               OK          52 degrees C / 125 degrees F
```



```
FPC 2 I3 2 TSensor          OK          47 degrees C / 116 degrees F
FPC 2 I3 2 Chip             OK          49 degrees C / 120 degrees F
FPC 2 I3 3 TSensor          OK          41 degrees C / 105 degrees F
FPC 2 I3 3 Chip             OK          44 degrees C / 111 degrees F
FPC 2 IA 0 TSensor          OK          47 degrees C / 116 degrees F
FPC 2 IA 0 Chip             OK          46 degrees C / 114 degrees F
FPC 2 IA 1 TSensor          OK          45 degrees C / 113 degrees F
FPC 2 IA 1 Chip             OK          49 degrees C / 120 degrees F
FPC 3 Intake                OK          34 degrees C / 93 degrees F
FPC 3 Exhaust A             OK          34 degrees C / 93 degrees F
FPC 3 Exhaust B             OK          47 degrees C / 116 degrees F
FPC 3 I3 0 TSensor          OK          48 degrees C / 118 degrees F
FPC 3 I3 0 Chip             OK          52 degrees C / 125 degrees F
FPC 3 I3 1 TSensor          OK          46 degrees C / 114 degrees F
FPC 3 I3 1 Chip             OK          48 degrees C / 118 degrees F
FPC 3 IA 0 TSensor          OK          41 degrees C / 105 degrees F
FPC 3 IA 0 Chip             OK          40 degrees C / 104 degrees F
FPC 5 Intake                OK          42 degrees C / 107 degrees F
FPC 5 Exhaust A             OK          42 degrees C / 107 degrees F
FPC 5 Exhaust B             OK          53 degrees C / 127 degrees F
FPC 5 LU 0 TSensor          OK          53 degrees C / 127 degrees F
FPC 5 LU 0 Chip             OK          54 degrees C / 129 degrees F
FPC 5 LU 1 TSensor          OK          53 degrees C / 127 degrees F
FPC 5 LU 1 Chip             OK          61 degrees C / 141 degrees F
FPC 5 LU 2 TSensor          OK          53 degrees C / 127 degrees F
FPC 5 LU 2 Chip             OK          51 degrees C / 123 degrees F
FPC 5 LU 3 TSensor          OK          53 degrees C / 127 degrees F
FPC 5 LU 3 Chip             OK          53 degrees C / 127 degrees F
FPC 5 MQ 0 TSensor          OK          47 degrees C / 116 degrees F
FPC 5 MQ 0 Chip             OK          52 degrees C / 125 degrees F
FPC 5 MQ 1 TSensor          OK          47 degrees C / 116 degrees F
FPC 5 MQ 1 Chip             OK          52 degrees C / 125 degrees F
FPC 5 MQ 2 TSensor          OK          47 degrees C / 116 degrees F
FPC 5 MQ 2 Chip             OK          46 degrees C / 114 degrees F
FPC 5 MQ 3 TSensor          OK          47 degrees C / 116 degrees F
FPC 5 MQ 3 Chip             OK          45 degrees C / 113 degrees F
FPC 7 Intake                OK          36 degrees C / 96 degrees F
FPC 7 Exhaust A             OK          35 degrees C / 95 degrees F
FPC 7 Exhaust B             OK          33 degrees C / 91 degrees F
FPC 7 QX 0 TSensor          OK          42 degrees C / 107 degrees F
FPC 7 QX 0 Chip             OK          47 degrees C / 116 degrees F
FPC 7 LU 0 TCAM TSensor     OK          42 degrees C / 107 degrees F
FPC 7 LU 0 TCAM Chip        OK          44 degrees C / 111 degrees F
FPC 7 LU 0 TSensor          OK          42 degrees C / 107 degrees F
FPC 7 LU 0 Chip             OK          46 degrees C / 114 degrees F
FPC 7 MQ 0 TSensor          OK          42 degrees C / 107 degrees F
FPC 7 MQ 0 Chip             OK          45 degrees C / 113 degrees F
FPC 8 Intake                OK          33 degrees C / 91 degrees F
FPC 8 Exhaust A             OK          33 degrees C / 91 degrees F
FPC 8 Exhaust B             OK          36 degrees C / 96 degrees F
FPC 8 I3 0 TSensor          OK          38 degrees C / 100 degrees F
FPC 8 I3 0 Chip             OK          43 degrees C / 109 degrees F
FPC 8 BDS 0 TSensor         OK          37 degrees C / 98 degrees F
FPC 8 BDS 0 Chip            OK          36 degrees C / 96 degrees F
FPC 8 IA 0 TSensor          OK          37 degrees C / 98 degrees F
FPC 8 IA 0 Chip             OK          37 degrees C / 98 degrees F
FPC 10 Intake               OK          38 degrees C / 100 degrees F
FPC 10 Exhaust A            OK          36 degrees C / 96 degrees F
FPC 10 Exhaust B            OK          41 degrees C / 105 degrees F
FPC 10 I3 0 TSensor         OK          40 degrees C / 104 degrees F
FPC 10 I3 0 Chip            OK          42 degrees C / 107 degrees F
```

```
          FPC 10 I3 1 TSensor           OK         40 degrees C / 104 degrees F
          FPC 10 I3 1 Chip              OK         44 degrees C / 111 degrees F
          FPC 10 I3 2 TSensor           OK         42 degrees C / 107 degrees F
          FPC 10 I3 2 Chip              OK         43 degrees C / 109 degrees F
          FPC 10 I3 3 TSensor           OK         39 degrees C / 102 degrees F
          FPC 10 I3 3 Chip              OK         44 degrees C / 111 degrees F
          FPC 10 IA 0 TSensor           OK         36 degrees C / 96 degrees F
          FPC 10 IA 0 Chip              OK         36 degrees C / 96 degrees F
          FPC 10 IA 1 TSensor           OK         43 degrees C / 109 degrees F
          FPC 10 IA 1 Chip              OK         42 degrees C / 107 degrees F
    Fans  Top Fan Tray Temp             OK         37 degrees C / 98 degrees F
          Top Tray Fan 1                OK         Spinning at normal speed
          Top Tray Fan 2                OK         Spinning at normal speed
          Top Tray Fan 3                OK         Spinning at normal speed
          Top Tray Fan 4                OK         Spinning at normal speed
          Top Tray Fan 5                OK         Spinning at normal speed
          Top Tray Fan 6                OK         Spinning at normal speed
          Bottom Fan Tray Temp          OK         28 degrees C / 82 degrees F
          Bottom Tray Fan 1             OK         Spinning at normal speed
          Bottom Tray Fan 2             OK         Spinning at normal speed
          Bottom Tray Fan 3             OK         Spinning at normal speed
          Bottom Tray Fan 4             OK         Spinning at normal speed
          Bottom Tray Fan 5             OK         Spinning at normal speed
          Bottom Tray Fan 6             OK         Spinning at normal speed
```

show chassis environment (MX2020 Router)

```
user@host> show chassis environment
Class Item                           Status     Measurement
Temp  PSM 0                          Absent
      PSM 1                          Absent
      PSM 2                          OK         41 degrees C / 105 degrees F
      PSM 3                          OK         39 degrees C / 102 degrees F
      PSM 4                          OK         39 degrees C / 102 degrees F
      PSM 5                          OK         38 degrees C / 100 degrees F
      PSM 6                          OK         38 degrees C / 100 degrees F
      PSM 7                          OK         38 degrees C / 100 degrees F
      PSM 8                          OK         37 degrees C / 98 degrees F
      PSM 9                          Absent
      PSM 10                         Absent
      PSM 11                         OK         47 degrees C / 116 degrees F
      PSM 12                         OK         45 degrees C / 113 degrees F
      PSM 13                         OK         44 degrees C / 111 degrees F
      PSM 14                         OK         44 degrees C / 111 degrees F
      PSM 15                         OK         43 degrees C / 109 degrees F
      PSM 16                         OK         42 degrees C / 107 degrees F
      PSM 17                         OK         41 degrees C / 105 degrees F
      PDM 0                          OK
      PDM 1                          Absent
      PDM 2                          Absent
      PDM 3                          OK
      CB 0 IntakeA-Zone0             OK         45 degrees C / 113 degrees F
      CB 0 IntakeB-Zone1             OK         34 degrees C / 93 degrees F
      CB 0 IntakeC-Zone0             OK         48 degrees C / 118 degrees F
      CB 0 ExhaustA-Zone0            OK         45 degrees C / 113 degrees F
      CB 0 ExhaustB-Zone1            OK         37 degrees C / 98 degrees F
      CB 0 TCBC-Zone0                OK         41 degrees C / 105 degrees F
      CB 1 IntakeA-Zone0             OK         46 degrees C / 114 degrees F
      CB 1 IntakeB-Zone1             OK         42 degrees C / 107 degrees F
      CB 1 IntakeC-Zone0             OK         49 degrees C / 120 degrees F
      CB 1 ExhaustA-Zone0            OK         46 degrees C / 114 degrees F
```

```
CB 1 ExhaustB-Zone1          OK         41 degrees C / 105 degrees F
CB 1 TCBC-Zone0              OK         46 degrees C / 114 degrees F
SPMB 0 Intake                OK         33 degrees C / 91 degrees F
SPMB 1 Intake                OK         42 degrees C / 107 degrees F
Routing Engine 0             OK         35 degrees C / 95 degrees F
Routing Engine 0 CPU         OK         34 degrees C / 93 degrees F
Routing Engine 1             OK         44 degrees C / 111 degrees F
Routing Engine 1 CPU         OK         42 degrees C / 107 degrees F
SFB 0 Intake-Zone0           OK         55 degrees C / 131 degrees F
SFB 0 Exhaust-Zone1          OK         48 degrees C / 118 degrees F
SFB 0 IntakeA-Zone0          OK         50 degrees C / 122 degrees F
SFB 0 IntakeB-Zone1          OK         40 degrees C / 104 degrees F
SFB 0 Exhaust-Zone0          OK         52 degrees C / 125 degrees F
SFB 0 SFB-XF2-Zone1          OK         61 degrees C / 141 degrees F
SFB 0 SFB-XF1-Zone0          OK         69 degrees C / 156 degrees F
SFB 0 SFB-XF0-Zone0          OK         68 degrees C / 154 degrees F
SFB 1 Intake-Zone0           OK         56 degrees C / 132 degrees F
SFB 1 Exhaust-Zone1          OK         47 degrees C / 116 degrees F
SFB 1 IntakeA-Zone0          OK         51 degrees C / 123 degrees F
SFB 1 IntakeB-Zone1          OK         40 degrees C / 104 degrees F
SFB 1 Exhaust-Zone0          OK         51 degrees C / 123 degrees F
SFB 1 SFB-XF2-Zone1          OK         62 degrees C / 143 degrees F
SFB 1 SFB-XF1-Zone0          OK         67 degrees C / 152 degrees F
SFB 1 SFB-XF0-Zone0          OK         69 degrees C / 156 degrees F
SFB 2 Intake-Zone0           OK         56 degrees C / 132 degrees F
SFB 2 Exhaust-Zone1          OK         47 degrees C / 116 degrees F
SFB 2 IntakeA-Zone0          OK         51 degrees C / 123 degrees F
SFB 2 IntakeB-Zone1          OK         40 degrees C / 104 degrees F
SFB 2 Exhaust-Zone0          OK         53 degrees C / 127 degrees F
SFB 2 SFB-XF2-Zone1          OK         65 degrees C / 149 degrees F
SFB 2 SFB-XF1-Zone0          OK         69 degrees C / 156 degrees F
SFB 2 SFB-XF0-Zone0          OK         70 degrees C / 158 degrees F
SFB 3 Intake-Zone0           OK         57 degrees C / 134 degrees F
SFB 3 Exhaust-Zone1          OK         48 degrees C / 118 degrees F
SFB 3 IntakeA-Zone0          OK         52 degrees C / 125 degrees F
SFB 3 IntakeB-Zone1          OK         41 degrees C / 105 degrees F
SFB 3 Exhaust-Zone0          OK         53 degrees C / 127 degrees F
SFB 3 SFB-XF2-Zone1          OK         66 degrees C / 150 degrees F
SFB 3 SFB-XF1-Zone0          OK         69 degrees C / 156 degrees F
SFB 3 SFB-XF0-Zone0          OK         71 degrees C / 159 degrees F
SFB 4 Intake-Zone0           OK         58 degrees C / 136 degrees F
SFB 4 Exhaust-Zone1          OK         49 degrees C / 120 degrees F
SFB 4 IntakeA-Zone0          OK         54 degrees C / 129 degrees F
SFB 4 IntakeB-Zone1          OK         42 degrees C / 107 degrees F
SFB 4 Exhaust-Zone0          OK         53 degrees C / 127 degrees F
SFB 4 SFB-XF2-Zone1          OK         64 degrees C / 147 degrees F
SFB 4 SFB-XF1-Zone0          OK         68 degrees C / 154 degrees F
SFB 4 SFB-XF0-Zone0          OK         71 degrees C / 159 degrees F
SFB 5 Intake-Zone0           OK         58 degrees C / 136 degrees F
SFB 5 Exhaust-Zone1          OK         50 degrees C / 122 degrees F
SFB 5 IntakeA-Zone0          OK         53 degrees C / 127 degrees F
SFB 5 IntakeB-Zone1          OK         43 degrees C / 109 degrees F
SFB 5 Exhaust-Zone0          OK         54 degrees C / 129 degrees F
SFB 5 SFB-XF2-Zone1          OK         66 degrees C / 150 degrees F
SFB 5 SFB-XF1-Zone0          OK         69 degrees C / 156 degrees F
SFB 5 SFB-XF0-Zone0          OK         74 degrees C / 165 degrees F
SFB 6 Intake-Zone0           OK         58 degrees C / 136 degrees F
SFB 6 Exhaust-Zone1          OK         49 degrees C / 120 degrees F
SFB 6 IntakeA-Zone0          OK         53 degrees C / 127 degrees F
SFB 6 IntakeB-Zone1          OK         43 degrees C / 109 degrees F
SFB 6 Exhaust-Zone0          OK         53 degrees C / 127 degrees F
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SFB 6 SFB-XF2-Zone1            OK          65 degrees C / 149 degrees F
SFB 6 SFB-XF1-Zone0            OK          68 degrees C / 154 degrees F
SFB 6 SFB-XF0-Zone0            OK          72 degrees C / 161 degrees F
SFB 7 Intake-Zone0             OK          57 degrees C / 134 degrees F
SFB 7 Exhaust-Zone1            OK          50 degrees C / 122 degrees F
SFB 7 IntakeA-Zone0            OK          53 degrees C / 127 degrees F
SFB 7 IntakeB-Zone1            OK          43 degrees C / 109 degrees F
SFB 7 Exhaust-Zone0            OK          54 degrees C / 129 degrees F
SFB 7 SFB-XF2-Zone1            OK          68 degrees C / 154 degrees F
SFB 7 SFB-XF1-Zone0            OK          69 degrees C / 156 degrees F
SFB 7 SFB-XF0-Zone0            OK          73 degrees C / 163 degrees F
FPC 0 Intake                   OK          41 degrees C / 105 degrees F
FPC 0 Exhaust A                OK          48 degrees C / 118 degrees F
FPC 0 Exhaust B                OK          62 degrees C / 143 degrees F
FPC 0 LU 0 TSen                OK          59 degrees C / 138 degrees F
FPC 0 LU 0 Chip                OK          62 degrees C / 143 degrees F
FPC 0 LU 1 TSen                OK          59 degrees C / 138 degrees F
FPC 0 LU 1 Chip                OK          64 degrees C / 147 degrees F
FPC 0 LU 2 TSen                OK          59 degrees C / 138 degrees F
FPC 0 LU 2 Chip                OK          53 degrees C / 127 degrees F
FPC 0 LU 3 TSen                OK          59 degrees C / 138 degrees F
FPC 0 LU 3 Chip                OK          53 degrees C / 127 degrees F
FPC 0 MQ 0 TSen                OK          47 degrees C / 116 degrees F
FPC 0 MQ 0 Chip                OK          49 degrees C / 120 degrees F
FPC 0 MQ 1 TSen                OK          47 degrees C / 116 degrees F
FPC 0 MQ 1 Chip                OK          51 degrees C / 123 degrees F
FPC 0 MQ 2 TSen                OK          47 degrees C / 116 degrees F
FPC 0 MQ 2 Chip                OK          44 degrees C / 111 degrees F
FPC 0 MQ 3 TSen                OK          47 degrees C / 116 degrees F
FPC 0 MQ 3 Chip                OK          45 degrees C / 113 degrees F
FPC 1 Intake                   OK          40 degrees C / 104 degrees F
FPC 1 Exhaust A                OK          49 degrees C / 120 degrees F
FPC 1 Exhaust B                OK          58 degrees C / 136 degrees F
FPC 1 LU 0 TSen                OK          55 degrees C / 131 degrees F
FPC 1 LU 0 Chip                OK          56 degrees C / 132 degrees F
FPC 1 LU 1 TSen                OK          55 degrees C / 131 degrees F
FPC 1 LU 1 Chip                OK          58 degrees C / 136 degrees F
FPC 1 LU 2 TSen                OK          55 degrees C / 131 degrees F
FPC 1 LU 2 Chip                OK          49 degrees C / 120 degrees F
FPC 1 LU 3 TSen                OK          55 degrees C / 131 degrees F
FPC 1 LU 3 Chip                OK          51 degrees C / 123 degrees F
FPC 1 MQ 0 TSen                OK          47 degrees C / 116 degrees F
FPC 1 MQ 0 Chip                OK          48 degrees C / 118 degrees F
FPC 1 MQ 1 TSen                OK          47 degrees C / 116 degrees F
FPC 1 MQ 1 Chip                OK          50 degrees C / 122 degrees F
FPC 1 MQ 2 TSen                OK          47 degrees C / 116 degrees F
FPC 1 MQ 2 Chip                OK          44 degrees C / 111 degrees F
FPC 1 MQ 3 TSen                OK          47 degrees C / 116 degrees F
FPC 1 MQ 3 Chip                OK          44 degrees C / 111 degrees F
FPC 2 Intake                   OK          39 degrees C / 102 degrees F
FPC 2 Exhaust A                OK          49 degrees C / 120 degrees F
FPC 2 Exhaust B                OK          61 degrees C / 141 degrees F
FPC 2 LU 0 TSen                OK          58 degrees C / 136 degrees F
FPC 2 LU 0 Chip                OK          60 degrees C / 140 degrees F
FPC 2 LU 1 TSen                OK          58 degrees C / 136 degrees F
FPC 2 LU 1 Chip                OK          65 degrees C / 149 degrees F
FPC 2 LU 2 TSen                OK          58 degrees C / 136 degrees F
FPC 2 LU 2 Chip                OK          51 degrees C / 123 degrees F
FPC 2 LU 3 TSen                OK          58 degrees C / 136 degrees F
FPC 2 LU 3 Chip                OK          53 degrees C / 127 degrees F
FPC 2 MQ 0 TSen                OK          47 degrees C / 116 degrees F
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FPC 2 MQ 0 Chip                OK          50 degrees C / 122 degrees F
FPC 2 MQ 1 TSen                OK          47 degrees C / 116 degrees F
FPC 2 MQ 1 Chip                OK          52 degrees C / 125 degrees F
FPC 2 MQ 2 TSen                OK          47 degrees C / 116 degrees F
FPC 2 MQ 2 Chip                OK          45 degrees C / 113 degrees F
FPC 2 MQ 3 TSen                OK          47 degrees C / 116 degrees F
FPC 2 MQ 3 Chip                OK          46 degrees C / 114 degrees F
FPC 3 Intake                   OK          40 degrees C / 104 degrees F
FPC 3 Exhaust A                OK          49 degrees C / 120 degrees F
FPC 3 Exhaust B                OK          61 degrees C / 141 degrees F
FPC 3 LU 0 TSen                OK          58 degrees C / 136 degrees F
FPC 3 LU 0 Chip                OK          61 degrees C / 141 degrees F
FPC 3 LU 1 TSen                OK          58 degrees C / 136 degrees F
FPC 3 LU 1 Chip                OK          62 degrees C / 143 degrees F
FPC 3 LU 2 TSen                OK          58 degrees C / 136 degrees F
FPC 3 LU 2 Chip                OK          51 degrees C / 123 degrees F
FPC 3 LU 3 TSen                OK          58 degrees C / 136 degrees F
FPC 3 LU 3 Chip                OK          53 degrees C / 127 degrees F
FPC 3 MQ 0 TSen                OK          48 degrees C / 118 degrees F
FPC 3 MQ 0 Chip                OK          50 degrees C / 122 degrees F
FPC 3 MQ 1 TSen                OK          48 degrees C / 118 degrees F
FPC 3 MQ 1 Chip                OK          54 degrees C / 129 degrees F
FPC 3 MQ 2 TSen                OK          48 degrees C / 118 degrees F
FPC 3 MQ 2 Chip                OK          45 degrees C / 113 degrees F
FPC 3 MQ 3 TSen                OK          48 degrees C / 118 degrees F
FPC 3 MQ 3 Chip                OK          48 degrees C / 118 degrees F
FPC 4 Intake                   OK          40 degrees C / 104 degrees F
FPC 4 Exhaust A                OK          49 degrees C / 120 degrees F
FPC 4 Exhaust B                OK          62 degrees C / 143 degrees F
FPC 4 LU 0 TSen                OK          59 degrees C / 138 degrees F
FPC 4 LU 0 Chip                OK          62 degrees C / 143 degrees F
FPC 4 LU 1 TSen                OK          59 degrees C / 138 degrees F
FPC 4 LU 1 Chip                OK          65 degrees C / 149 degrees F
FPC 4 LU 2 TSen                OK          59 degrees C / 138 degrees F
FPC 4 LU 2 Chip                OK          51 degrees C / 123 degrees F
FPC 4 LU 3 TSen                OK          59 degrees C / 138 degrees F
FPC 4 LU 3 Chip                OK          53 degrees C / 127 degrees F
FPC 4 MQ 0 TSen                OK          48 degrees C / 118 degrees F
FPC 4 MQ 0 Chip                OK          52 degrees C / 125 degrees F
FPC 4 MQ 1 TSen                OK          48 degrees C / 118 degrees F
FPC 4 MQ 1 Chip                OK          53 degrees C / 127 degrees F
FPC 4 MQ 2 TSen                OK          48 degrees C / 118 degrees F
FPC 4 MQ 2 Chip                OK          46 degrees C / 114 degrees F
FPC 4 MQ 3 TSen                OK          48 degrees C / 118 degrees F
FPC 4 MQ 3 Chip                OK          47 degrees C / 116 degrees F
FPC 5 Intake                   OK          41 degrees C / 105 degrees F
FPC 5 Exhaust A                OK          50 degrees C / 122 degrees F
FPC 5 Exhaust B                OK          63 degrees C / 145 degrees F
FPC 5 LU 0 TSen                OK          60 degrees C / 140 degrees F
FPC 5 LU 0 Chip                OK          63 degrees C / 145 degrees F
FPC 5 LU 1 TSen                OK          60 degrees C / 140 degrees F
FPC 5 LU 1 Chip                OK          66 degrees C / 150 degrees F
FPC 5 LU 2 TSen                OK          60 degrees C / 140 degrees F
FPC 5 LU 2 Chip                OK          56 degrees C / 132 degrees F
FPC 5 LU 3 TSen                OK          60 degrees C / 140 degrees F
FPC 5 LU 3 Chip                OK          54 degrees C / 129 degrees F
FPC 5 MQ 0 TSen                OK          49 degrees C / 120 degrees F
FPC 5 MQ 0 Chip                OK          52 degrees C / 125 degrees F
FPC 5 MQ 1 TSen                OK          49 degrees C / 120 degrees F
FPC 5 MQ 1 Chip                OK          53 degrees C / 127 degrees F
FPC 5 MQ 2 TSen                OK          49 degrees C / 120 degrees F
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FPC 5 MQ 2 Chip           OK         48 degrees C / 118 degrees F
FPC 5 MQ 3 TSen           OK         49 degrees C / 120 degrees F
FPC 5 MQ 3 Chip           OK         47 degrees C / 116 degrees F
FPC 6 Intake              OK         42 degrees C / 107 degrees F
FPC 6 Exhaust A           OK         51 degrees C / 123 degrees F
FPC 6 Exhaust B           OK         63 degrees C / 145 degrees F
FPC 6 LU 0 TSen           OK         61 degrees C / 141 degrees F
FPC 6 LU 0 Chip           OK         64 degrees C / 147 degrees F
FPC 6 LU 1 TSen           OK         61 degrees C / 141 degrees F
FPC 6 LU 1 Chip           OK         66 degrees C / 150 degrees F
FPC 6 LU 2 TSen           OK         61 degrees C / 141 degrees F
FPC 6 LU 2 Chip           OK         56 degrees C / 132 degrees F
FPC 6 LU 3 TSen           OK         61 degrees C / 141 degrees F
FPC 6 LU 3 Chip           OK         56 degrees C / 132 degrees F
FPC 6 MQ 0 TSen           OK         50 degrees C / 122 degrees F
FPC 6 MQ 0 Chip           OK         56 degrees C / 132 degrees F
FPC 6 MQ 1 TSen           OK         50 degrees C / 122 degrees F
FPC 6 MQ 1 Chip           OK         59 degrees C / 138 degrees F
FPC 6 MQ 2 TSen           OK         50 degrees C / 122 degrees F
FPC 6 MQ 2 Chip           OK         49 degrees C / 120 degrees F
FPC 6 MQ 3 TSen           OK         50 degrees C / 122 degrees F
FPC 6 MQ 3 Chip           OK         49 degrees C / 120 degrees F
FPC 7 Intake              OK         41 degrees C / 105 degrees F
FPC 7 Exhaust A           OK         51 degrees C / 123 degrees F
FPC 7 Exhaust B           OK         63 degrees C / 145 degrees F
FPC 7 LU 0 TSen           OK         60 degrees C / 140 degrees F
FPC 7 LU 0 Chip           OK         61 degrees C / 141 degrees F
FPC 7 LU 1 TSen           OK         60 degrees C / 140 degrees F
FPC 7 LU 1 Chip           OK         65 degrees C / 149 degrees F
FPC 7 LU 2 TSen           OK         60 degrees C / 140 degrees F
FPC 7 LU 2 Chip           OK         54 degrees C / 129 degrees F
FPC 7 LU 3 TSen           OK         60 degrees C / 140 degrees F
FPC 7 LU 3 Chip           OK         53 degrees C / 127 degrees F
FPC 7 MQ 0 TSen           OK         50 degrees C / 122 degrees F
FPC 7 MQ 0 Chip           OK         53 degrees C / 127 degrees F
FPC 7 MQ 1 TSen           OK         50 degrees C / 122 degrees F
FPC 7 MQ 1 Chip           OK         54 degrees C / 129 degrees F
FPC 7 MQ 2 TSen           OK         50 degrees C / 122 degrees F
FPC 7 MQ 2 Chip           OK         47 degrees C / 116 degrees F
FPC 7 MQ 3 TSen           OK         50 degrees C / 122 degrees F
FPC 7 MQ 3 Chip           OK         47 degrees C / 116 degrees F
FPC 8 Intake              OK         41 degrees C / 105 degrees F
FPC 8 Exhaust A           OK         50 degrees C / 122 degrees F
FPC 8 Exhaust B           OK         62 degrees C / 143 degrees F
FPC 8 LU 0 TSen           OK         59 degrees C / 138 degrees F
FPC 8 LU 0 Chip           OK         62 degrees C / 143 degrees F
FPC 8 LU 1 TSen           OK         59 degrees C / 138 degrees F
FPC 8 LU 1 Chip           OK         64 degrees C / 147 degrees F
FPC 8 LU 2 TSen           OK         59 degrees C / 138 degrees F
FPC 8 LU 2 Chip           OK         55 degrees C / 131 degrees F
FPC 8 LU 3 TSen           OK         59 degrees C / 138 degrees F
FPC 8 LU 3 Chip           OK         54 degrees C / 129 degrees F
FPC 8 MQ 0 TSen           OK         49 degrees C / 120 degrees F
FPC 8 MQ 0 Chip           OK         51 degrees C / 123 degrees F
FPC 8 MQ 1 TSen           OK         49 degrees C / 120 degrees F
FPC 8 MQ 1 Chip           OK         52 degrees C / 125 degrees F
FPC 8 MQ 2 TSen           OK         49 degrees C / 120 degrees F
FPC 8 MQ 2 Chip           OK         46 degrees C / 114 degrees F
FPC 8 MQ 3 TSen           OK         49 degrees C / 120 degrees F
FPC 8 MQ 3 Chip           OK         47 degrees C / 116 degrees F
FPC 9 Intake              OK         42 degrees C / 107 degrees F
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FPC 9 Exhaust A               OK          51 degrees C / 123 degrees F
FPC 9 Exhaust B               OK          63 degrees C / 145 degrees F
FPC 9 LU 0 TSen               OK          60 degrees C / 140 degrees F
FPC 9 LU 0 Chip               OK          65 degrees C / 149 degrees F
FPC 9 LU 1 TSen               OK          60 degrees C / 140 degrees F
FPC 9 LU 1 Chip               OK          67 degrees C / 152 degrees F
FPC 9 LU 2 TSen               OK          60 degrees C / 140 degrees F
FPC 9 LU 2 Chip               OK          54 degrees C / 129 degrees F
FPC 9 LU 3 TSen               OK          60 degrees C / 140 degrees F
FPC 9 LU 3 Chip               OK          54 degrees C / 129 degrees F
FPC 9 MQ 0 TSen               OK          51 degrees C / 123 degrees F
FPC 9 MQ 0 Chip               OK          55 degrees C / 131 degrees F
FPC 9 MQ 1 TSen               OK          51 degrees C / 123 degrees F
FPC 9 MQ 1 Chip               OK          59 degrees C / 138 degrees F
FPC 9 MQ 2 TSen               OK          51 degrees C / 123 degrees F
FPC 9 MQ 2 Chip               OK          49 degrees C / 120 degrees F
FPC 9 MQ 3 TSen               OK          51 degrees C / 123 degrees F
FPC 9 MQ 3 Chip               OK          49 degrees C / 120 degrees F
FPC 10 Intake                 OK          44 degrees C / 111 degrees F
FPC 10 Exhaust A              OK          49 degrees C / 120 degrees F
FPC 10 Exhaust B              OK          55 degrees C / 131 degrees F
FPC 10 LU 0 TSen              OK          54 degrees C / 129 degrees F
FPC 10 LU 0 Chip              OK          55 degrees C / 131 degrees F
FPC 10 LU 1 TSen              OK          54 degrees C / 129 degrees F
FPC 10 LU 1 Chip              OK          59 degrees C / 138 degrees F
FPC 10 LU 2 TSen              OK          54 degrees C / 129 degrees F
FPC 10 LU 2 Chip              OK          52 degrees C / 125 degrees F
FPC 10 LU 3 TSen              OK          54 degrees C / 129 degrees F
FPC 10 LU 3 Chip              OK          51 degrees C / 123 degrees F
FPC 10 MQ 0 TSen              OK          48 degrees C / 118 degrees F
FPC 10 MQ 0 Chip              OK          49 degrees C / 120 degrees F
FPC 10 MQ 1 TSen              OK          48 degrees C / 118 degrees F
FPC 10 MQ 1 Chip              OK          52 degrees C / 125 degrees F
FPC 10 MQ 2 TSen              OK          48 degrees C / 118 degrees F
FPC 10 MQ 2 Chip              OK          47 degrees C / 116 degrees F
FPC 10 MQ 3 TSen              OK          48 degrees C / 118 degrees F
FPC 10 MQ 3 Chip              OK          47 degrees C / 116 degrees F
FPC 11 Intake                 OK          30 degrees C / 86 degrees F
FPC 11 Exhaust A              OK          35 degrees C / 95 degrees F
FPC 11 Exhaust B              OK          30 degrees C / 86 degrees F
FPC 11 LU 0 TSen              OK          57 degrees C / 134 degrees F
FPC 11 LU 0 Chip              OK          58 degrees C / 136 degrees F
FPC 11 LU 1 TSen              OK          57 degrees C / 134 degrees F
FPC 11 LU 1 Chip              OK          62 degrees C / 143 degrees F
FPC 11 LU 2 TSen              OK          57 degrees C / 134 degrees F
FPC 11 LU 2 Chip              OK          53 degrees C / 127 degrees F
FPC 11 LU 3 TSen              OK          57 degrees C / 134 degrees F
FPC 11 LU 3 Chip              OK          54 degrees C / 129 degrees F
FPC 11 MQ 0 TSen              OK          52 degrees C / 125 degrees F
FPC 11 MQ 0 Chip              OK          52 degrees C / 125 degrees F
FPC 11 MQ 1 TSen              OK          52 degrees C / 125 degrees F
FPC 11 MQ 1 Chip              OK          57 degrees C / 134 degrees F
FPC 11 MQ 2 TSen              OK          52 degrees C / 125 degrees F
FPC 11 MQ 2 Chip              OK          48 degrees C / 118 degrees F
FPC 11 MQ 3 TSen              OK          52 degrees C / 125 degrees F
FPC 11 MQ 3 Chip              OK          52 degrees C / 125 degrees F
FPC 12 Intake                 OK          40 degrees C / 104 degrees F
FPC 12 Exhaust A              OK          47 degrees C / 116 degrees F
FPC 12 Exhaust B              OK          52 degrees C / 125 degrees F
FPC 12 LU 0 TSen              OK          51 degrees C / 123 degrees F
FPC 12 LU 0 Chip              OK          52 degrees C / 125 degrees F
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FPC 12 LU 1 TSen              OK          51 degrees C / 123 degrees F
FPC 12 LU 1 Chip              OK          55 degrees C / 131 degrees F
FPC 12 LU 2 TSen              OK          51 degrees C / 123 degrees F
FPC 12 LU 2 Chip              OK          47 degrees C / 116 degrees F
FPC 12 LU 3 TSen              OK          51 degrees C / 123 degrees F
FPC 12 LU 3 Chip              OK          50 degrees C / 122 degrees F
FPC 12 MQ 0 TSen              OK          46 degrees C / 114 degrees F
FPC 12 MQ 0 Chip              OK          46 degrees C / 114 degrees F
FPC 12 MQ 1 TSen              OK          46 degrees C / 114 degrees F
FPC 12 MQ 1 Chip              OK          50 degrees C / 122 degrees F
FPC 12 MQ 2 TSen              OK          46 degrees C / 114 degrees F
FPC 12 MQ 2 Chip              OK          44 degrees C / 111 degrees F
FPC 12 MQ 3 TSen              OK          46 degrees C / 114 degrees F
FPC 12 MQ 3 Chip              OK          46 degrees C / 114 degrees F
FPC 13 Intake                 OK          40 degrees C / 104 degrees F
FPC 13 Exhaust A              OK          48 degrees C / 118 degrees F
FPC 13 Exhaust B              OK          52 degrees C / 125 degrees F
FPC 13 LU 0 TSen              OK          51 degrees C / 123 degrees F
FPC 13 LU 0 Chip              OK          52 degrees C / 125 degrees F
FPC 13 LU 1 TSen              OK          51 degrees C / 123 degrees F
FPC 13 LU 1 Chip              OK          55 degrees C / 131 degrees F
FPC 13 LU 2 TSen              OK          51 degrees C / 123 degrees F
FPC 13 LU 2 Chip              OK          48 degrees C / 118 degrees F
FPC 13 LU 3 TSen              OK          51 degrees C / 123 degrees F
FPC 13 LU 3 Chip              OK          48 degrees C / 118 degrees F
FPC 13 MQ 0 TSen              OK          46 degrees C / 114 degrees F
FPC 13 MQ 0 Chip              OK          46 degrees C / 114 degrees F
FPC 13 MQ 1 TSen              OK          46 degrees C / 114 degrees F
FPC 13 MQ 1 Chip              OK          50 degrees C / 122 degrees F
FPC 13 MQ 2 TSen              OK          46 degrees C / 114 degrees F
FPC 13 MQ 2 Chip              OK          44 degrees C / 111 degrees F
FPC 13 MQ 3 TSen              OK          46 degrees C / 114 degrees F
FPC 13 MQ 3 Chip              OK          46 degrees C / 114 degrees F
FPC 14 Intake                 OK          40 degrees C / 104 degrees F
FPC 14 Exhaust A              OK          50 degrees C / 122 degrees F
FPC 14 Exhaust B              OK          51 degrees C / 123 degrees F
FPC 14 LU 0 TSen              OK          50 degrees C / 122 degrees F
FPC 14 LU 0 Chip              OK          50 degrees C / 122 degrees F
FPC 14 LU 1 TSen              OK          50 degrees C / 122 degrees F
FPC 14 LU 1 Chip              OK          54 degrees C / 129 degrees F
FPC 14 LU 2 TSen              OK          50 degrees C / 122 degrees F
FPC 14 LU 2 Chip              OK          47 degrees C / 116 degrees F
FPC 14 LU 3 TSen              OK          50 degrees C / 122 degrees F
FPC 14 LU 3 Chip              OK          49 degrees C / 120 degrees F
FPC 14 MQ 0 TSen              OK          47 degrees C / 116 degrees F
FPC 14 MQ 0 Chip              OK          46 degrees C / 114 degrees F
FPC 14 MQ 1 TSen              OK          47 degrees C / 116 degrees F
FPC 14 MQ 1 Chip              OK          51 degrees C / 123 degrees F
FPC 14 MQ 2 TSen              OK          47 degrees C / 116 degrees F
FPC 14 MQ 2 Chip              OK          45 degrees C / 113 degrees F
FPC 14 MQ 3 TSen              OK          47 degrees C / 116 degrees F
FPC 14 MQ 3 Chip              OK          48 degrees C / 118 degrees F
FPC 15 Intake                 OK          44 degrees C / 111 degrees F
FPC 15 Exhaust A              OK          49 degrees C / 120 degrees F
FPC 15 Exhaust B              OK          60 degrees C / 140 degrees F
FPC 15 LU 0 TSen              OK          50 degrees C / 122 degrees F
FPC 15 LU 0 Chip              OK          56 degrees C / 132 degrees F
FPC 15 LU 1 TSen              OK          50 degrees C / 122 degrees F
FPC 15 LU 1 Chip              OK          50 degrees C / 122 degrees F
FPC 15 LU 2 TSen              OK          50 degrees C / 122 degrees F
FPC 15 LU 2 Chip              OK          58 degrees C / 136 degrees F
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FPC 15 LU 3 TSen              OK          50 degrees C / 122 degrees F
FPC 15 LU 3 Chip              OK          63 degrees C / 145 degrees F
FPC 15 XM 0 TSen              OK          50 degrees C / 122 degrees F
FPC 15 XM 0 Chip              OK          56 degrees C / 132 degrees F
FPC 15 XF 0 TSen              OK          50 degrees C / 122 degrees F
FPC 15 XF 0 Chip              OK          68 degrees C / 154 degrees F
FPC 15 PLX Switch TSen        OK          50 degrees C / 122 degrees F
FPC 15 PLX Switch Chip        OK          56 degrees C / 132 degrees F
FPC 16 Intake                 OK          42 degrees C / 107 degrees F
FPC 16 Exhaust A              OK          51 degrees C / 123 degrees F
FPC 16 Exhaust B              OK          53 degrees C / 127 degrees F
FPC 16 LU 0 TSen              OK          51 degrees C / 123 degrees F
FPC 16 LU 0 Chip              OK          52 degrees C / 125 degrees F
FPC 16 LU 1 TSen              OK          51 degrees C / 123 degrees F
FPC 16 LU 1 Chip              OK          55 degrees C / 131 degrees F
FPC 16 LU 2 TSen              OK          51 degrees C / 123 degrees F
FPC 16 LU 2 Chip              OK          48 degrees C / 118 degrees F
FPC 16 LU 3 TSen              OK          51 degrees C / 123 degrees F
FPC 16 LU 3 Chip              OK          49 degrees C / 120 degrees F
FPC 16 MQ 0 TSen              OK          49 degrees C / 120 degrees F
FPC 16 MQ 0 Chip              OK          48 degrees C / 118 degrees F
FPC 16 MQ 1 TSen              OK          49 degrees C / 120 degrees F
FPC 16 MQ 1 Chip              OK          53 degrees C / 127 degrees F
FPC 16 MQ 2 TSen              OK          49 degrees C / 120 degrees F
FPC 16 MQ 2 Chip              OK          46 degrees C / 114 degrees F
FPC 16 MQ 3 TSen              OK          49 degrees C / 120 degrees F
FPC 16 MQ 3 Chip              OK          49 degrees C / 120 degrees F
FPC 17 Intake                 OK          43 degrees C / 109 degrees F
FPC 17 Exhaust A              OK          51 degrees C / 123 degrees F
FPC 17 Exhaust B              OK          55 degrees C / 131 degrees F
FPC 17 LU 0 TSen              OK          54 degrees C / 129 degrees F
FPC 17 LU 0 Chip              OK          57 degrees C / 134 degrees F
FPC 17 LU 1 TSen              OK          54 degrees C / 129 degrees F
FPC 17 LU 1 Chip              OK          60 degrees C / 140 degrees F
FPC 17 LU 2 TSen              OK          54 degrees C / 129 degrees F
FPC 17 LU 2 Chip              OK          53 degrees C / 127 degrees F
FPC 17 LU 3 TSen              OK          54 degrees C / 129 degrees F
FPC 17 LU 3 Chip              OK          53 degrees C / 127 degrees F
FPC 17 MQ 0 TSen              OK          49 degrees C / 120 degrees F
FPC 17 MQ 0 Chip              OK          50 degrees C / 122 degrees F
FPC 17 MQ 1 TSen              OK          49 degrees C / 120 degrees F
FPC 17 MQ 1 Chip              OK          54 degrees C / 129 degrees F
FPC 17 MQ 2 TSen              OK          49 degrees C / 120 degrees F
FPC 17 MQ 2 Chip              OK          47 degrees C / 116 degrees F
FPC 17 MQ 3 TSen              OK          49 degrees C / 120 degrees F
FPC 17 MQ 3 Chip              OK          51 degrees C / 123 degrees F
FPC 18 Intake                 OK          44 degrees C / 111 degrees F
FPC 18 Exhaust A              OK          53 degrees C / 127 degrees F
FPC 18 Exhaust B              OK          57 degrees C / 134 degrees F
FPC 18 LU 0 TSen              OK          56 degrees C / 132 degrees F
FPC 18 LU 0 Chip              OK          57 degrees C / 134 degrees F
FPC 18 LU 1 TSen              OK          56 degrees C / 132 degrees F
FPC 18 LU 1 Chip              OK          62 degrees C / 143 degrees F
FPC 18 LU 2 TSen              OK          56 degrees C / 132 degrees F
FPC 18 LU 2 Chip              OK          53 degrees C / 127 degrees F
FPC 18 LU 3 TSen              OK          56 degrees C / 132 degrees F
FPC 18 LU 3 Chip              OK          55 degrees C / 131 degrees F
FPC 18 MQ 0 TSen              OK          51 degrees C / 123 degrees F
FPC 18 MQ 0 Chip              OK          54 degrees C / 129 degrees F
FPC 18 MQ 1 TSen              OK          51 degrees C / 123 degrees F
FPC 18 MQ 1 Chip              OK          58 degrees C / 136 degrees F
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FPC 18 MQ 2 TSen              OK         51 degrees C / 123 degrees F
FPC 18 MQ 2 Chip              OK         50 degrees C / 122 degrees F
FPC 18 MQ 3 TSen              OK         51 degrees C / 123 degrees F
FPC 18 MQ 3 Chip              OK         53 degrees C / 127 degrees F
FPC 19 Intake                 OK         48 degrees C / 118 degrees F
FPC 19 Exhaust A              OK         56 degrees C / 132 degrees F
FPC 19 Exhaust B              OK         64 degrees C / 147 degrees F
FPC 19 LU 0 TSen              OK         63 degrees C / 145 degrees F
FPC 19 LU 0 Chip              OK         64 degrees C / 147 degrees F
FPC 19 LU 1 TSen              OK         63 degrees C / 145 degrees F
FPC 19 LU 1 Chip              OK         70 degrees C / 158 degrees F
FPC 19 LU 2 TSen              OK         63 degrees C / 145 degrees F
FPC 19 LU 2 Chip              OK         61 degrees C / 141 degrees F
FPC 19 LU 3 TSen              OK         63 degrees C / 145 degrees F
FPC 19 LU 3 Chip              OK         62 degrees C / 143 degrees F
FPC 19 MQ 0 TSen              OK         56 degrees C / 132 degrees F
FPC 19 MQ 0 Chip              OK         60 degrees C / 140 degrees F
FPC 19 MQ 1 TSen              OK         56 degrees C / 132 degrees F
FPC 19 MQ 1 Chip              OK         62 degrees C / 143 degrees F
FPC 19 MQ 2 TSen              OK         56 degrees C / 132 degrees F
FPC 19 MQ 2 Chip              OK         56 degrees C / 132 degrees F
FPC 19 MQ 3 TSen              OK         56 degrees C / 132 degrees F
FPC 19 MQ 3 Chip              OK         57 degrees C / 134 degrees F
ADC 0 Intake                  OK         40 degrees C / 104 degrees F
ADC 0 Exhaust                 OK         52 degrees C / 125 degrees F
ADC 0 ADC-XF1                 OK         59 degrees C / 138 degrees F
ADC 0 ADC-XF0                 OK         66 degrees C / 150 degrees F
ADC 1 Intake                  OK         38 degrees C / 100 degrees F
ADC 1 Exhaust                 OK         50 degrees C / 122 degrees F
ADC 1 ADC-XF1                 OK         59 degrees C / 138 degrees F
ADC 1 ADC-XF0                 OK         63 degrees C / 145 degrees F
ADC 2 Intake                  OK         37 degrees C / 98 degrees F
ADC 2 Exhaust                 OK         52 degrees C / 125 degrees F
ADC 2 ADC-XF1                 OK         53 degrees C / 127 degrees F
ADC 2 ADC-XF0                 OK         61 degrees C / 141 degrees F
ADC 3 Intake                  OK         40 degrees C / 104 degrees F
ADC 3 Exhaust                 OK         51 degrees C / 123 degrees F
ADC 3 ADC-XF1                 OK         61 degrees C / 141 degrees F
ADC 3 ADC-XF0                 OK         64 degrees C / 147 degrees F
ADC 4 Intake                  OK         39 degrees C / 102 degrees F
ADC 4 Exhaust                 OK         51 degrees C / 123 degrees F
ADC 4 ADC-XF1                 OK         60 degrees C / 140 degrees F
ADC 4 ADC-XF0                 OK         63 degrees C / 145 degrees F
ADC 5 Intake                  OK         38 degrees C / 100 degrees F
ADC 5 Exhaust                 OK         54 degrees C / 129 degrees F
ADC 5 ADC-XF1                 OK         56 degrees C / 132 degrees F
ADC 5 ADC-XF0                 OK         67 degrees C / 152 degrees F
ADC 6 Intake                  OK         39 degrees C / 102 degrees F
ADC 6 Exhaust                 OK         52 degrees C / 125 degrees F
ADC 6 ADC-XF1                 OK         59 degrees C / 138 degrees F
ADC 6 ADC-XF0                 OK         66 degrees C / 150 degrees F
ADC 7 Intake                  OK         39 degrees C / 102 degrees F
ADC 7 Exhaust                 OK         54 degrees C / 129 degrees F
ADC 7 ADC-XF1                 OK         62 degrees C / 143 degrees F
ADC 7 ADC-XF0                 OK         70 degrees C / 158 degrees F
ADC 8 Intake                  OK         39 degrees C / 102 degrees F
ADC 8 Exhaust                 OK         52 degrees C / 125 degrees F
ADC 8 ADC-XF1                 OK         61 degrees C / 141 degrees F
ADC 8 ADC-XF0                 OK         65 degrees C / 149 degrees F
ADC 9 Intake                  OK         41 degrees C / 105 degrees F
ADC 9 Exhaust                 OK         51 degrees C / 123 degrees F
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```
          ADC 9 ADC-XF1                OK          63 degrees C / 145 degrees F
          ADC 9 ADC-XF0                OK          63 degrees C / 145 degrees F
          ADC 10 Intake                OK          48 degrees C / 118 degrees F
          ADC 10 Exhaust               OK          53 degrees C / 127 degrees F
          ADC 10 ADC-XF1               OK          67 degrees C / 152 degrees F
          ADC 10 ADC-XF0               OK          66 degrees C / 150 degrees F
          ADC 12 Intake                OK          49 degrees C / 120 degrees F
          ADC 12 Exhaust               OK          54 degrees C / 129 degrees F
          ADC 12 ADC-XF1               OK          67 degrees C / 152 degrees F
          ADC 12 ADC-XF0               OK          67 degrees C / 152 degrees F
          ADC 13 Intake                OK          49 degrees C / 120 degrees F
          ADC 13 Exhaust               OK          57 degrees C / 134 degrees F
          ADC 13 ADC-XF1               OK          66 degrees C / 150 degrees F
          ADC 13 ADC-XF0               OK          69 degrees C / 156 degrees F
          ADC 14 Intake                OK          51 degrees C / 123 degrees F
          ADC 14 Exhaust               OK          59 degrees C / 138 degrees F
          ADC 14 ADC-XF1               OK          69 degrees C / 156 degrees F
          ADC 14 ADC-XF0               OK          74 degrees C / 165 degrees F
          ADC 15 Intake                OK          50 degrees C / 122 degrees F
          ADC 15 Exhaust               OK          59 degrees C / 138 degrees F
          ADC 15 ADC-XF1               OK          68 degrees C / 154 degrees F
          ADC 15 ADC-XF0               OK          69 degrees C / 156 degrees F
          ADC 16 Intake                OK          52 degrees C / 125 degrees F
          ADC 16 Exhaust               OK          58 degrees C / 136 degrees F
          ADC 16 ADC-XF1               OK          68 degrees C / 154 degrees F
          ADC 16 ADC-XF0               OK          70 degrees C / 158 degrees F
          ADC 17 Intake                OK          52 degrees C / 125 degrees F
          ADC 17 Exhaust               OK          59 degrees C / 138 degrees F
          ADC 17 ADC-XF1               OK          69 degrees C / 156 degrees F
          ADC 17 ADC-XF0               OK          71 degrees C / 159 degrees F
          ADC 18 Intake                OK          53 degrees C / 127 degrees F
          ADC 18 Exhaust               OK          59 degrees C / 138 degrees F
          ADC 18 ADC-XF1               OK          68 degrees C / 154 degrees F
          ADC 18 ADC-XF0               OK          73 degrees C / 163 degrees F
          ADC 19 Intake                OK          50 degrees C / 122 degrees F
          ADC 19 Exhaust               OK          59 degrees C / 138 degrees F
          ADC 19 ADC-XF1               OK          68 degrees C / 154 degrees F
          ADC 19 ADC-XF0               OK          72 degrees C / 161 degrees F
Fans      Fan Tray 0 Fan 1             OK          7440 RPM
          Fan Tray 0 Fan 2             OK          7200 RPM
          Fan Tray 0 Fan 3             OK          6960 RPM
          Fan Tray 0 Fan 4             OK          7200 RPM
          Fan Tray 0 Fan 5             OK          7080 RPM
          Fan Tray 0 Fan 6             OK          6840 RPM
          Fan Tray 1 Fan 1             OK          6840 RPM
          Fan Tray 1 Fan 2             OK          6960 RPM
          Fan Tray 1 Fan 3             OK          6960 RPM
          Fan Tray 1 Fan 4             OK          7080 RPM
          Fan Tray 1 Fan 5             OK          6960 RPM
          Fan Tray 1 Fan 6             OK          6960 RPM
          Fan Tray 2 Fan 1             OK          8640 RPM
          Fan Tray 2 Fan 2             OK          8640 RPM
          Fan Tray 2 Fan 3             OK          8760 RPM
          Fan Tray 2 Fan 4             OK          8760 RPM
          Fan Tray 2 Fan 5             OK          8640 RPM
          Fan Tray 2 Fan 6             OK          8640 RPM
          Fan Tray 3 Fan 1             OK          8520 RPM
          Fan Tray 3 Fan 2             OK          8520 RPM
          Fan Tray 3 Fan 3             OK          8640 RPM
          Fan Tray 3 Fan 4             OK          8640 RPM
```



```
          Fan Tray 3 Fan 5                OK          8520 RPM
          Fan Tray 3 Fan 6                OK          8520 RPM
```

show chassis environment (MX2010 Router)

```
user@host> show chassis environment
Class Item                           Status      Measurement
Temp  PSM 0                          OK          7 degrees C / 44 degrees F
      PSM 1                          OK          7 degrees C / 44 degrees F
      PSM 2                          OK          7 degrees C / 44 degrees F
      PSM 3                          OK          6 degrees C / 42 degrees F
      PSM 4                          OK          6 degrees C / 42 degrees F
      PSM 5                          OK          6 degrees C / 42 degrees F
      PSM 6                          OK          6 degrees C / 42 degrees F
      PSM 7                          OK          7 degrees C / 44 degrees F
      PSM 8                          OK          7 degrees C / 44 degrees F
      PDM 0                          OK
      PDM 1                          Absent
      CB 0 IntakeA-Zone0             OK          14 degrees C / 57 degrees F
      CB 0 IntakeB-Zone1             OK          7 degrees C / 44 degrees F
      CB 0 IntakeC-Zone0             OK          22 degrees C / 71 degrees F
      CB 0 ExhaustA-Zone0            OK          14 degrees C / 57 degrees F
      CB 0 ExhaustB-Zone1            OK          9 degrees C / 48 degrees F
      CB 0 TCBC-Zone0                OK          11 degrees C / 51 degrees F
      CB 1 IntakeA-Zone0             OK          9 degrees C / 48 degrees F
      CB 1 IntakeB-Zone1             OK          5 degrees C / 41 degrees F
      CB 1 IntakeC-Zone0             OK          20 degrees C / 68 degrees F
      CB 1 ExhaustA-Zone0            OK          12 degrees C / 53 degrees F
      CB 1 ExhaustB-Zone1            OK          7 degrees C / 44 degrees F
      CB 1 TCBC-Zone0                OK          10 degrees C / 50 degrees F
      SPMB 0 Intake                  OK          5 degrees C / 41 degrees F
      SPMB 1 Intake                  OK          4 degrees C / 39 degrees F
      Routing Engine 0               OK          9 degrees C / 48 degrees F
      Routing Engine 0 CPU           OK          9 degrees C / 48 degrees F
      Routing Engine 1               OK          6 degrees C / 42 degrees F
      Routing Engine 1 CPU           OK          6 degrees C / 42 degrees F
      SFB 0 Intake-Zone0             OK          26 degrees C / 78 degrees F
      SFB 0 Exhaust-Zone1            OK          17 degrees C / 62 degrees F
      SFB 0 IntakeA-Zone0            OK          16 degrees C / 60 degrees F
      SFB 0 IntakeB-Zone1            OK          11 degrees C / 51 degrees F
      SFB 0 Exhaust-Zone0            OK          18 degrees C / 64 degrees F
      SFB 0 SFB-XF2-Zone1            OK          25 degrees C / 77 degrees F
      SFB 0 SFB-XF1-Zone0            OK          23 degrees C / 73 degrees F
      SFB 0 SFB-XF0-Zone0            OK          33 degrees C / 91 degrees F
      SFB 1 Intake-Zone0             OK          27 degrees C / 80 degrees F
      SFB 1 Exhaust-Zone1            OK          15 degrees C / 59 degrees F
      SFB 1 IntakeA-Zone0            OK          20 degrees C / 68 degrees F
      SFB 1 IntakeB-Zone1            OK          10 degrees C / 50 degrees F
      SFB 1 Exhaust-Zone0            OK          19 degrees C / 66 degrees F
      SFB 1 SFB-XF2-Zone1            OK          26 degrees C / 78 degrees F
      SFB 1 SFB-XF1-Zone0            OK          27 degrees C / 80 degrees F
      SFB 1 SFB-XF0-Zone0            OK          32 degrees C / 89 degrees F
      SFB 2 Intake-Zone0             OK          21 degrees C / 69 degrees F
      SFB 2 Exhaust-Zone1            OK          13 degrees C / 55 degrees F
      SFB 2 IntakeA-Zone0            OK          18 degrees C / 64 degrees F
      SFB 2 IntakeB-Zone1            OK          9 degrees C / 48 degrees F
      SFB 2 Exhaust-Zone0            OK          16 degrees C / 60 degrees F
      SFB 2 SFB-XF2-Zone1            OK          24 degrees C / 75 degrees F
      SFB 2 SFB-XF1-Zone0            OK          21 degrees C / 69 degrees F
      SFB 2 SFB-XF0-Zone0            OK          26 degrees C / 78 degrees F
      SFB 4 Intake-Zone0             OK          28 degrees C / 82 degrees F
```



```
      SFB 4 Exhaust-Zone1           OK         16 degrees C / 60 degrees F
SFB 4 IntakeA-Zone0           OK         18 degrees C / 64 degrees F
      SFB 4 IntakeB-Zone1           OK         11 degrees C / 51 degrees F
      SFB 4 Exhaust-Zone0           OK         19 degrees C / 66 degrees F
      SFB 4 SFB-XF2-Zone1           OK         27 degrees C / 80 degrees F
      SFB 4 SFB-XF1-Zone0           OK         27 degrees C / 80 degrees F
      SFB 4 SFB-XF0-Zone0           OK         32 degrees C / 89 degrees F
      SFB 5 Intake-Zone0            OK         22 degrees C / 71 degrees F
      SFB 5 Exhaust-Zone1           OK         14 degrees C / 57 degrees F
      SFB 5 IntakeA-Zone0           OK         18 degrees C / 64 degrees F
      SFB 5 IntakeB-Zone1           OK         10 degrees C / 50 degrees F
      SFB 5 Exhaust-Zone0           OK         17 degrees C / 62 degrees F
      SFB 5 SFB-XF2-Zone1           OK         22 degrees C / 71 degrees F
      SFB 5 SFB-XF1-Zone0           OK         29 degrees C / 84 degrees F
      SFB 5 SFB-XF0-Zone0           OK         27 degrees C / 80 degrees F
      SFB 6 Intake-Zone0            OK         27 degrees C / 80 degrees F
      SFB 6 Exhaust-Zone1           OK         13 degrees C / 55 degrees F
      SFB 6 IntakeA-Zone0           OK         19 degrees C / 66 degrees F
      SFB 6 IntakeB-Zone1           OK         10 degrees C / 50 degrees F
      SFB 6 Exhaust-Zone0           OK         20 degrees C / 68 degrees F
      SFB 6 SFB-XF2-Zone1           OK         24 degrees C / 75 degrees F
      SFB 6 SFB-XF1-Zone0           OK         32 degrees C / 89 degrees F
      SFB 6 SFB-XF0-Zone0           OK         33 degrees C / 91 degrees F
      SFB 7 Intake-Zone0            OK         25 degrees C / 77 degrees F
      SFB 7 Exhaust-Zone1           OK         13 degrees C / 55 degrees F
      SFB 7 IntakeA-Zone0           OK         14 degrees C / 57 degrees F
      SFB 7 IntakeB-Zone1           OK         8 degrees C / 46 degrees F
      SFB 7 Exhaust-Zone0           OK         17 degrees C / 62 degrees F
      SFB 7 SFB-XF2-Zone1           OK         21 degrees C / 69 degrees F
      SFB 7 SFB-XF1-Zone0           OK         21 degrees C / 69 degrees F
      SFB 7 SFB-XF0-Zone0           OK         33 degrees C / 91 degrees F
      FPC 0 Intake                  OK         13 degrees C / 55 degrees F
      FPC 0 Exhaust A               OK         13 degrees C / 55 degrees F
      FPC 0 Exhaust B               OK         14 degrees C / 57 degrees F
      FPC 0 LU 0 TSen               OK         28 degrees C / 82 degrees F
      FPC 0 LU 0 Chip               OK         25 degrees C / 77 degrees F
      FPC 0 LU 1 TSen               OK         28 degrees C / 82 degrees F
      FPC 0 LU 1 Chip               OK         27 degrees C / 80 degrees F
      FPC 0 LU 2 TSen               OK         28 degrees C / 82 degrees F
      FPC 0 LU 2 Chip               OK         19 degrees C / 66 degrees F
      FPC 0 LU 3 TSen               OK         28 degrees C / 82 degrees F
      FPC 0 LU 3 Chip               OK         23 degrees C / 73 degrees F
      FPC 0 XM 0 TSen               OK         28 degrees C / 82 degrees F
      FPC 0 XM 0 Chip               OK         33 degrees C / 91 degrees F
      FPC 0 XM 1 TSen               OK         28 degrees C / 82 degrees F
      FPC 0 XM 1 Chip               OK         26 degrees C / 78 degrees F
      FPC 0 PLX Switch TSen         OK         28 degrees C / 82 degrees F
      FPC 0 PLX Switch Chip         OK         26 degrees C / 78 degrees F
      FPC 1 Intake                  OK         10 degrees C / 50 degrees F
      FPC 1 Exhaust A               OK         24 degrees C / 75 degrees F
      FPC 1 Exhaust B               OK         28 degrees C / 82 degrees F
      FPC 1 LU 0 TSen               OK         22 degrees C / 71 degrees F
      FPC 1 LU 0 Chip               OK         31 degrees C / 87 degrees F
      FPC 1 LU 1 TSen               OK         22 degrees C / 71 degrees F
      FPC 1 LU 1 Chip               OK         21 degrees C / 69 degrees F
      FPC 1 LU 2 TSen               OK         22 degrees C / 71 degrees F
      FPC 1 LU 2 Chip               OK         25 degrees C / 77 degrees F
      FPC 1 LU 3 TSen               OK         22 degrees C / 71 degrees F
      FPC 1 LU 3 Chip               OK         33 degrees C / 91 degrees F
      FPC 1 XM 0 TSen               OK         22 degrees C / 71 degrees F
      FPC 1 XM 0 Chip               OK         30 degrees C / 86 degrees F
```



```
        FPC 1 XF 0 TSen                OK         22 degrees C / 71 degrees F
        FPC 1 XF 0 Chip                OK         37 degrees C / 98 degrees F
        FPC 1 PLX Switch TSen          OK         22 degrees C / 71 degrees F
  FPC 1 PLX Switch Chip          OK         22 degrees C / 71 degrees F
        FPC 2 Intake                   OK         9 degrees C / 48 degrees F
        FPC 2 Exhaust A                OK         10 degrees C / 50 degrees F
        FPC 2 Exhaust B                OK         10 degrees C / 50 degrees F
        FPC 2 LU 0 TSen                OK         26 degrees C / 78 degrees F
        FPC 2 LU 0 Chip                OK         25 degrees C / 77 degrees F
        FPC 2 LU 1 TSen                OK         26 degrees C / 78 degrees F
        FPC 2 LU 1 Chip                OK         26 degrees C / 78 degrees F
        FPC 2 LU 2 TSen                OK         26 degrees C / 78 degrees F
        FPC 2 LU 2 Chip                OK         17 degrees C / 62 degrees F
        FPC 2 LU 3 TSen                OK         26 degrees C / 78 degrees F
        FPC 2 LU 3 Chip                OK         22 degrees C / 71 degrees F
        FPC 2 XM 0 TSen                OK         26 degrees C / 78 degrees F
        FPC 2 XM 0 Chip                OK         34 degrees C / 93 degrees F
        FPC 2 XM 1 TSen                OK         26 degrees C / 78 degrees F
        FPC 2 XM 1 Chip                OK         26 degrees C / 78 degrees F
        FPC 2 PLX Switch TSen          OK         26 degrees C / 78 degrees F
        FPC 2 PLX Switch Chip          OK         20 degrees C / 68 degrees F
        FPC 3 Intake                   OK         12 degrees C / 53 degrees F
        FPC 3 Exhaust A                OK         16 degrees C / 60 degrees F
        FPC 3 Exhaust B                OK         26 degrees C / 78 degrees F
        FPC 3 LU 0 TSen                OK         23 degrees C / 73 degrees F
        FPC 3 LU 0 Chip                OK         26 degrees C / 78 degrees F
        FPC 3 LU 1 TSen                OK         23 degrees C / 73 degrees F
        FPC 3 LU 1 Chip                OK         27 degrees C / 80 degrees F
        FPC 3 LU 2 TSen                OK         23 degrees C / 73 degrees F
        FPC 3 LU 2 Chip                OK         22 degrees C / 71 degrees F
        FPC 3 LU 3 TSen                OK         23 degrees C / 73 degrees F
        FPC 3 LU 3 Chip                OK         21 degrees C / 69 degrees F
        FPC 3 MQ 0 TSen                OK         15 degrees C / 59 degrees F
        FPC 3 MQ 0 Chip                OK         18 degrees C / 64 degrees F
        FPC 3 MQ 1 TSen                OK         15 degrees C / 59 degrees F
        FPC 3 MQ 1 Chip                OK         20 degrees C / 68 degrees F
        FPC 3 MQ 2 TSen                OK         15 degrees C / 59 degrees F
        FPC 3 MQ 2 Chip                OK         17 degrees C / 62 degrees F
        FPC 3 MQ 3 TSen                OK         15 degrees C / 59 degrees F
        FPC 3 MQ 3 Chip                OK         16 degrees C / 60 degrees F
        FPC 4 Intake                   OK         11 degrees C / 51 degrees F
        FPC 4 Exhaust A                OK         22 degrees C / 71 degrees F
        FPC 4 Exhaust B                OK         28 degrees C / 82 degrees F
        FPC 4 LU 0 TSen                OK         22 degrees C / 71 degrees F
        FPC 4 LU 0 Chip                OK         33 degrees C / 91 degrees F
        FPC 4 LU 1 TSen                OK         22 degrees C / 71 degrees F
        FPC 4 LU 1 Chip                OK         21 degrees C / 69 degrees F
        FPC 4 LU 2 TSen                OK         22 degrees C / 71 degrees F
        FPC 4 LU 2 Chip                OK         26 degrees C / 78 degrees F
        FPC 4 LU 3 TSen                OK         22 degrees C / 71 degrees F
        FPC 4 LU 3 Chip                OK         33 degrees C / 91 degrees F
        FPC 4 XM 0 TSen                OK         22 degrees C / 71 degrees F
        FPC 4 XM 0 Chip                OK         30 degrees C / 86 degrees F
        FPC 4 XF 0 TSen                OK         22 degrees C / 71 degrees F
        FPC 4 XF 0 Chip                OK         37 degrees C / 98 degrees F
        FPC 4 PLX Switch TSen          OK         22 degrees C / 71 degrees F
        FPC 4 PLX Switch Chip          OK         23 degrees C / 73 degrees F
        FPC 5 Intake                   OK         12 degrees C / 53 degrees F
        FPC 5 Exhaust A                OK         12 degrees C / 53 degrees F
   FPC 5 Exhaust B               OK         12 degrees C / 53 degrees F
        FPC 5 LU 0 TSen                OK         27 degrees C / 80 degrees F
```

```
        FPC 5 LU 0 Chip                OK          28 degrees C / 82 degrees F
        FPC 5 LU 1 TSen                OK          27 degrees C / 80 degrees F
        FPC 5 LU 1 Chip                OK          27 degrees C / 80 degrees F
        FPC 5 LU 2 TSen                OK          27 degrees C / 80 degrees F
        FPC 5 LU 2 Chip                OK          19 degrees C / 66 degrees F
        FPC 5 LU 3 TSen                OK          27 degrees C / 80 degrees F
        FPC 5 LU 3 Chip                OK          22 degrees C / 71 degrees F
        FPC 5 XM 0 TSen                OK          27 degrees C / 80 degrees F
        FPC 5 XM 0 Chip                OK          36 degrees C / 96 degrees F
        FPC 5 XM 1 TSen                OK          27 degrees C / 80 degrees F
        FPC 5 XM 1 Chip                OK          26 degrees C / 78 degrees F
        FPC 5 PLX Switch TSen          OK          27 degrees C / 80 degrees F
        FPC 5 PLX Switch Chip          OK          24 degrees C / 75 degrees F
        FPC 6 Intake                   OK          12 degrees C / 53 degrees F
        FPC 6 Exhaust A                OK          17 degrees C / 62 degrees F
        FPC 6 Exhaust B                OK          28 degrees C / 82 degrees F
        FPC 6 LU 0 TSen                OK          24 degrees C / 75 degrees F
        FPC 6 LU 0 Chip                OK          29 degrees C / 84 degrees F
        FPC 6 LU 1 TSen                OK          24 degrees C / 75 degrees F
        FPC 6 LU 1 Chip                OK          30 degrees C / 86 degrees F
        FPC 6 LU 2 TSen                OK          24 degrees C / 75 degrees F
        FPC 6 LU 2 Chip                OK          24 degrees C / 75 degrees F
        FPC 6 LU 3 TSen                OK          24 degrees C / 75 degrees F
        FPC 6 LU 3 Chip                OK          22 degrees C / 71 degrees F
        FPC 6 MQ 0 TSen                OK          16 degrees C / 60 degrees F
        FPC 6 MQ 0 Chip                OK          19 degrees C / 66 degrees F
        FPC 6 MQ 1 TSen                OK          16 degrees C / 60 degrees F
        FPC 6 MQ 1 Chip                OK          20 degrees C / 68 degrees F
        FPC 6 MQ 2 TSen                OK          16 degrees C / 60 degrees F
        FPC 6 MQ 2 Chip                OK          17 degrees C / 62 degrees F
        FPC 6 MQ 3 TSen                OK          16 degrees C / 60 degrees F
        FPC 6 MQ 3 Chip                OK          16 degrees C / 60 degrees F
        FPC 7 Intake                   OK          10 degrees C / 50 degrees F
        FPC 7 Exhaust A                OK          10 degrees C / 50 degrees F
        FPC 7 Exhaust B                OK          11 degrees C / 51 degrees F
        FPC 7 LU 0 TSen                OK          26 degrees C / 78 degrees F
        FPC 7 LU 0 Chip                OK          26 degrees C / 78 degrees F
        FPC 7 LU 1 TSen                OK          26 degrees C / 78 degrees F
        FPC 7 LU 1 Chip                OK          29 degrees C / 84 degrees F
        FPC 7 LU 2 TSen                OK          26 degrees C / 78 degrees F
        FPC 7 LU 2 Chip                OK          19 degrees C / 66 degrees F
        FPC 7 LU 3 TSen                OK          26 degrees C / 78 degrees F
        FPC 7 LU 3 Chip                OK          24 degrees C / 75 degrees F
        FPC 7 XM 0 TSen                OK          26 degrees C / 78 degrees F
        FPC 7 XM 0 Chip                OK          34 degrees C / 93 degrees F
        FPC 7 XM 1 TSen                OK          26 degrees C / 78 degrees F
        FPC 7 XM 1 Chip                OK          32 degrees C / 89 degrees F
        FPC 7 PLX Switch TSen          OK          26 degrees C / 78 degrees F
        FPC 7 PLX Switch Chip          OK          22 degrees C / 71 degrees F
        FPC 8 Intake                   OK          10 degrees C / 50 degrees F
        FPC 8 Exhaust A                OK          22 degrees C / 71 degrees F
        FPC 8 Exhaust B                OK          28 degrees C / 82 degrees F
        FPC 8 LU 0 TSen                OK          20 degrees C / 68 degrees F
        FPC 8 LU 0 Chip                OK          33 degrees C / 91 degrees F
FPC 8 LU 1 TSen                OK          20 degrees C / 68 degrees F
        FPC 8 LU 1 Chip                OK          23 degrees C / 73 degrees F
        FPC 8 LU 2 TSen                OK          20 degrees C / 68 degrees F
        FPC 8 LU 2 Chip                OK          26 degrees C / 78 degrees F
        FPC 8 LU 3 TSen                OK          20 degrees C / 68 degrees F
        FPC 8 LU 3 Chip                OK          33 degrees C / 91 degrees F
        FPC 8 XM 0 TSen                OK          20 degrees C / 68 degrees F
```

```
      FPC 8 XM 0 Chip             OK         29 degrees C / 84 degrees F
      FPC 8 XF 0 TSen             OK         20 degrees C / 68 degrees F
      FPC 8 XF 0 Chip             OK         38 degrees C / 100 degrees F
      FPC 8 PLX Switch TSen       OK         20 degrees C / 68 degrees F
      FPC 8 PLX Switch Chip       OK         24 degrees C / 75 degrees F
      FPC 9 Intake                OK         11 degrees C / 51 degrees F
      FPC 9 Exhaust A             OK         11 degrees C / 51 degrees F
      FPC 9 Exhaust B             OK         11 degrees C / 51 degrees F
      FPC 9 LU 0 TSen             OK         25 degrees C / 77 degrees F
      FPC 9 LU 0 Chip             OK         24 degrees C / 75 degrees F
      FPC 9 LU 1 TSen             OK         25 degrees C / 77 degrees F
      FPC 9 LU 1 Chip             OK         26 degrees C / 78 degrees F
      FPC 9 LU 2 TSen             OK         25 degrees C / 77 degrees F
      FPC 9 LU 2 Chip             OK         16 degrees C / 60 degrees F
      FPC 9 LU 3 TSen             OK         25 degrees C / 77 degrees F
      FPC 9 LU 3 Chip             OK         21 degrees C / 69 degrees F
      FPC 9 XM 0 TSen             OK         25 degrees C / 77 degrees F
      FPC 9 XM 0 Chip             OK         32 degrees C / 89 degrees F
      FPC 9 XM 1 TSen             OK         25 degrees C / 77 degrees F
      FPC 9 XM 1 Chip             OK         25 degrees C / 77 degrees F
      FPC 9 PLX Switch TSen       OK         25 degrees C / 77 degrees F
      FPC 9 PLX Switch Chip       OK         21 degrees C / 69 degrees F
      ADC 0 Intake                OK         12 degrees C / 53 degrees F
      ADC 0 Exhaust               OK         20 degrees C / 68 degrees F
      ADC 0 ADC-XF1               OK         26 degrees C / 78 degrees F
      ADC 0 ADC-XF0               OK         32 degrees C / 89 degrees F
      ADC 1 Intake                OK         11 degrees C / 51 degrees F
      ADC 1 Exhaust               OK         21 degrees C / 69 degrees F
      ADC 1 ADC-XF1               OK         24 degrees C / 75 degrees F
      ADC 1 ADC-XF0               OK         31 degrees C / 87 degrees F
      ADC 2 Intake                OK         14 degrees C / 57 degrees F
      ADC 2 Exhaust               OK         21 degrees C / 69 degrees F
      ADC 2 ADC-XF1               OK         28 degrees C / 82 degrees F
      ADC 2 ADC-XF0               OK         34 degrees C / 93 degrees F
      ADC 3 Intake                OK         13 degrees C / 55 degrees F
      ADC 3 Exhaust               OK         19 degrees C / 66 degrees F
      ADC 3 ADC-XF1               OK         24 degrees C / 75 degrees F
      ADC 3 ADC-XF0               OK         31 degrees C / 87 degrees F
      ADC 4 Intake                OK         9 degrees C / 48 degrees F
      ADC 4 Exhaust               OK         22 degrees C / 71 degrees F
      ADC 4 ADC-XF1               OK         28 degrees C / 82 degrees F
      ADC 4 ADC-XF0               OK         35 degrees C / 95 degrees F
      ADC 5 Intake                OK         12 degrees C / 53 degrees F
      ADC 5 Exhaust               OK         22 degrees C / 71 degrees F
      ADC 5 ADC-XF1               OK         28 degrees C / 82 degrees F
      ADC 5 ADC-XF0               OK         34 degrees C / 93 degrees F
      ADC 6 Intake                OK         11 degrees C / 51 degrees F
      ADC 6 Exhaust               OK         21 degrees C / 69 degrees F
      ADC 6 ADC-XF1               OK         26 degrees C / 78 degrees F
ADC 6 ADC-XF0               OK         35 degrees C / 95 degrees F
      ADC 7 Intake                OK         14 degrees C / 57 degrees F
      ADC 7 Exhaust               OK         22 degrees C / 71 degrees F
      ADC 7 ADC-XF1               OK         26 degrees C / 78 degrees F
      ADC 7 ADC-XF0               OK         34 degrees C / 93 degrees F
      ADC 8 Intake                OK         14 degrees C / 57 degrees F
      ADC 8 Exhaust               OK         21 degrees C / 69 degrees F
      ADC 8 ADC-XF1               OK         24 degrees C / 75 degrees F
      ADC 8 ADC-XF0               OK         31 degrees C / 87 degrees F
      ADC 9 Intake                OK         10 degrees C / 50 degrees F
      ADC 9 Exhaust               OK         22 degrees C / 71 degrees F
      ADC 9 ADC-XF1               OK         28 degrees C / 82 degrees F
```



```
      ADC 9 ADC-XF0                 OK          36 degrees C / 96 degrees F
Fans  Fan Tray 0 Fan 1              OK          3480 RPM
      Fan Tray 0 Fan 2              OK          3480 RPM
      Fan Tray 0 Fan 3              OK          3480 RPM
      Fan Tray 0 Fan 4              OK          3360 RPM
      Fan Tray 0 Fan 5              OK          3360 RPM
      Fan Tray 0 Fan 6              OK          3480 RPM
      Fan Tray 1 Fan 1              OK          3360 RPM
      Fan Tray 1 Fan 2              OK          3360 RPM
      Fan Tray 1 Fan 3              OK          3360 RPM
      Fan Tray 1 Fan 4              OK          3480 RPM
      Fan Tray 1 Fan 5              OK          3480 RPM
      Fan Tray 1 Fan 6              OK          3480 RPM
      Fan Tray 2 Fan 1              OK          3360 RPM
      Fan Tray 2 Fan 2              OK          3360 RPM
      Fan Tray 2 Fan 3              OK          3480 RPM
      Fan Tray 2 Fan 4              OK          3480 RPM
      Fan Tray 2 Fan 5              OK          3360 RPM
      Fan Tray 2 Fan 6              OK          3480 RPM
      Fan Tray 3 Fan 1              OK          3360 RPM
      Fan Tray 3 Fan 2              OK          3360 RPM
      Fan Tray 3 Fan 3              OK          3480 RPM
      Fan Tray 3 Fan 4              OK          3480 RPM
      Fan Tray 3 Fan 5              OK          3480 RPM
      Fan Tray 3 Fan 6              OK          3360 RPM
```

show chassis environment (T320 Router)

```
user@host> show chassis environment
Class Item                    Status     Measurement
Power PEM 0                   OK
      PEM 1                   Absent
Temp  SCG 0                   OK         28 degrees C / 82 degrees F
      SCG 1                   OK         28 degrees C / 82 degrees F
      Routing Engine 0        OK         31 degrees C / 87 degrees F
      Routing Engine 1        OK         30 degrees C / 86 degrees F
      CB 0                    OK         32 degrees C / 89 degrees F
      CB 1                    OK         32 degrees C / 89 degrees F
      SIB 0                   OK         33 degrees C / 91 degrees F
      SIB 1                   OK         33 degrees C / 91 degrees F
      SIB 2                   OK         34 degrees C / 93 degrees F
      FPC 0 Top               OK         38 degrees C / 100 degrees F
      FPC 0 Bottom            OK         32 degrees C / 89 degrees F
      FPC 1 Top               OK         38 degrees C / 100 degrees F
      FPC 1 Bottom            OK         33 degrees C / 91 degrees F
      FPC 2 Top               OK         36 degrees C / 96 degrees F
      FPC 2 Bottom            OK         31 degrees C / 87 degrees F
      FPM GBUS                OK         26 degrees C / 78 degrees F
      FPM Display             OK         29 degrees C / 84 degrees F
Fans  Top Left Front fan      OK         Spinning at normal speed
      Top Left Middle fan     OK         Spinning at normal speed
      Top Left Rear fan       OK         Spinning at normal speed
      Top Right Front fan     OK         Spinning at normal speed
      Top Right Middle fan    OK         Spinning at normal speed
      Top Right Rear fan      OK         Spinning at normal speed
      Bottom Left Front fan   OK         Spinning at normal speed
      Bottom Left Middle fan OK          Spinning at normal speed
      Bottom Left Rear fan    OK         Spinning at normal speed
      Bottom Right Front fan OK          Spinning at normal speed
      Bottom Right Middle fan OK         Spinning at normal speed
      Bottom Right Rear fan   OK         Spinning at normal speed
```

```
       Rear Tray Top fan      OK         Spinning at normal speed
       Rear Tray Second fan   OK         Spinning at normal speed
       Rear Tray Middle fan   OK         Spinning at normal speed
       Rear Tray Fourth fan   OK         Spinning at normal speed
       Rear Tray Bottom fan   OK         Spinning at normal speed
Misc   CIP                    OK
       SPMB 0                 OK
       SPMB 1                 OK
```

show chassis environment (T640 Router)

```
user@host> show chassis environment
Class Item                    Status     Measurement
Temp   PEM 0                  Absent
       PEM 1                  OK         22 degrees C / 71 degrees F
       SCG 0                  OK         30 degrees C / 86 degrees F
       SCG 1                  OK         30 degrees C / 86 degrees F
       Routing Engine 0       Present
       Routing Engine 1       OK         27 degrees C / 80 degrees F
       CB 0                   Present
       CB 1                   OK         33 degrees C / 91 degrees F
       SIB 0                  Absent
       SIB 1                  Absent
       SIB 2                  Absent
       SIB 3                  Absent
       SIB 4                  Absent
       FPC 4 Top              Testing
       FPC 4 Bottom           Testing
       FPC 5 Top              Testing
       FPC 5 Bottom           Testing
       FPC 6 Top              Testing
       FPC 6 Bottom           Testing
       FPM GBUS               OK         23 degrees C / 73 degrees F
       FPM Display            Absent
Fans   Top Left Front fan     OK         Spinning at normal speed
       Top Left Middle fan    OK         Spinning at normal speed
       Top Left Rear fan      OK         Spinning at normal speed
       Top Right Front fan    OK         Spinning at normal speed
       Top Right Middle fan   OK         Spinning at normal speed
       Top Right Rear fan     OK         Spinning at normal speed
       Bottom Left Front fan  OK         Spinning at normal speed
       Bottom Left Middle fan OK         Spinning at normal speed
       Bottom Left Rear fan   OK         Spinning at normal speed
       Bottom Right Front fan OK         Spinning at normal speed
       Bottom Right Middle fan OK        Spinning at normal speed
       Bottom Right Rear fan  OK         Spinning at normal speed
       Fourth Blower from top OK         Spinning at normal speed
       Bottom Blower          OK         Spinning at normal speed
       Middle Blower          OK         Spinning at normal speed
       Top Blower             OK         Spinning at normal speed
       Second Blower from top OK         Spinning at normal speed
Misc   CIP                    OK
       SPMB 0                 OK
       SPMB 1                 OK
```

show chassis environment (T4000 Router)

```
user@host> show chassis environment
```



```
Class Item                          Status     Measurement
Temp  PEM 0                         OK         33 degrees C / 91 degrees F
      PEM 1                         Absent
      SCG 0                         OK         33 degrees C / 91 degrees F
      SCG 1                         OK         33 degrees C / 91 degrees F
      Routing Engine 0              OK         33 degrees C / 91 degrees F
      Routing Engine 0 CPU          OK         50 degrees C / 122 degrees F
      Routing Engine 1              OK         32 degrees C / 89 degrees F
      Routing Engine 1 CPU          OK         46 degrees C / 114 degrees F
      CB 0                          OK         32 degrees C / 89 degrees F
      CB 1                          OK         33 degrees C / 91 degrees F
      SIB 0                         OK         42 degrees C / 107 degrees F
      SIB 1                         OK         42 degrees C / 107 degrees F
      SIB 2                         OK         42 degrees C / 107 degrees F
      SIB 3                         OK         43 degrees C / 109 degrees F
      SIB 4                         OK         45 degrees C / 113 degrees F
      FPC 0 Fan Intake              OK         34 degrees C / 93 degrees F
      FPC 0 Fan Exhaust             OK         48 degrees C / 118 degrees F
      FPC 0 PMB                     OK         47 degrees C / 116 degrees F
      FPC 0 LMB0                    OK         50 degrees C / 122 degrees F
      FPC 0 LMB1                    OK         41 degrees C / 105 degrees F
      FPC 0 LMB2                    OK         35 degrees C / 95 degrees F
      FPC 0 PFE1 LU2                OK         46 degrees C / 114 degrees F
      FPC 0 PFE1 LU0                OK         41 degrees C / 105 degrees F
      FPC 0 PFE0 LU0                OK         57 degrees C / 134 degrees F
      FPC 0 XF1                     OK         46 degrees C / 114 degrees F
      FPC 0 XF0                     OK         52 degrees C / 125 degrees F
      FPC 0 XM1                     OK         41 degrees C / 105 degrees F
      FPC 0 XM0                     OK         50 degrees C / 122 degrees F
      FPC 0 PFE0 LU1                OK         56 degrees C / 132 degrees F
      FPC 0 PFE0 LU2                OK         45 degrees C / 113 degrees F
      FPC 0 PFE1 LU1                OK         37 degrees C / 98 degrees F
      FPC 3 Fan Intake              OK         36 degrees C / 96 degrees F
      FPC 3 Fan Exhaust             OK         51 degrees C / 123 degrees F
      FPC 3 PMB                     OK         43 degrees C / 109 degrees F
      FPC 3 LMB0                    OK         57 degrees C / 134 degrees F
      FPC 3 LMB1                    OK         54 degrees C / 129 degrees F
      FPC 3 LMB2                    OK         38 degrees C / 100 degrees F
      FPC 3 PFE1 LU2                OK         63 degrees C / 145 degrees F
      FPC 3 PFE1 LU0                OK         45 degrees C / 113 degrees F
      FPC 3 PFE0 LU0                OK         69 degrees C / 156 degrees F
      FPC 3 XF1                     OK         62 degrees C / 143 degrees F
      FPC 3 XF0                     OK         63 degrees C / 145 degrees F
      FPC 3 XM1                     OK         43 degrees C / 109 degrees F
      FPC 3 XM0                     OK         67 degrees C / 152 degrees F
      FPC 3 PFE0 LU1                OK         63 degrees C / 145 degrees F
      FPC 3 PFE0 LU2                OK         66 degrees C / 150 degrees F
      FPC 3 PFE1 LU1                OK         41 degrees C / 105 degrees F
      FPC 5 Top                     OK         39 degrees C / 102 degrees F
      FPC 5 Bottom                  OK         38 degrees C / 100 degrees F
      FPC 6 Fan Intake              OK         33 degrees C / 91 degrees F
      FPC 6 Fan Exhaust             OK         49 degrees C / 120 degrees F
      FPC 6 PMB                     OK         40 degrees C / 104 degrees F
      FPC 6 LMB0                    OK         60 degrees C / 140 degrees F
      FPC 6 LMB1                    OK         58 degrees C / 136 degrees F
      FPC 6 LMB2                    OK         40 degrees C / 104 degrees F
      FPC 6 PFE1 LU2                OK         69 degrees C / 156 degrees F
      FPC 6 PFE1 LU0                OK         45 degrees C / 113 degrees F
      FPC 6 PFE0 LU0                OK         71 degrees C / 159 degrees F
      FPC 6 XF1                     OK         58 degrees C / 136 degrees F
      FPC 6 XF0                     OK         65 degrees C / 149 degrees F
```



```
          FPC 6 XM1                    OK         39 degrees C / 102 degrees F
          FPC 6 XM0                    OK         66 degrees C / 150 degrees F
          FPC 6 PFE0 LU1               OK         69 degrees C / 156 degrees F
          FPC 6 PFE0 LU2               OK         69 degrees C / 156 degrees F
          FPC 6 PFE1 LU1               OK         42 degrees C / 107 degrees F
          FPM GBUS                     OK         24 degrees C / 75 degrees F
          FPM Display                  OK         27 degrees C / 80 degrees F
Fans      Top Left Front fan           OK         Spinning at high speed
          Top Left Middle fan          OK         Spinning at high speed
          Top Left Rear fan            OK         Spinning at high speed
          Top Right Front fan          OK         Spinning at high speed
          Top Right Middle fan         OK         Spinning at high speed
          Top Right Rear fan           OK         Spinning at high speed
          Bottom Left Front fan        OK         Spinning at high speed
          Bottom Left Middle fan       OK         Spinning at high speed
          Bottom Left Rear fan         OK         Spinning at high speed
          Bottom Right Front fan       OK         Spinning at high speed
          Bottom Right Middle fan      OK         Spinning at high speed
          Bottom Right Rear fan        OK         Spinning at high speed
          Rear Tray Top fan            OK         Spinning at high speed
          Rear Tray Second fan         OK         Spinning at high speed
          Rear Tray Third fan          OK         Spinning at high speed
          Rear Tray Fourth fan         OK         Spinning at high speed
          Rear Tray Fifth fan          OK         Spinning at high speed
          Rear Tray Sixth fan          OK         Spinning at high speed
          Rear Tray Seventh fan        OK         Spinning at high speed
          Rear Tray Bottom fan         OK         Spinning at high speed
Misc      CIP                          OK
          SPMB 0                       OK
          SPMB 1                       OK
```

show chassis environment (TX Matrix Router)

```
user@host> show chassis environment
scc-re0:
--------------------------------------------------------------------------
Class Item                      Status     Measurement
Temp  PEM 0                     Absent
      PEM 1                     OK         29 degrees C / 84 degrees F
      Routing Engine 0          OK         34 degrees C / 93 degrees F
      Routing Engine 1          OK         34 degrees C / 93 degrees F
      CB 0                      OK         32 degrees C / 89 degrees F
      CB 1                      OK         32 degrees C / 89 degrees F
      SIB 0                     OK         44 degrees C / 111 degrees F
      SIB 0 (B)                 OK         44 degrees C / 111 degrees F
      FPM GBUS                  OK         27 degrees C / 80 degrees F
      FPM Display               OK         32 degrees C / 89 degrees F
Fans  Top Left Front fan        OK         Spinning at normal speed
      Top Left Middle fan       OK         Spinning at normal speed
      Top Left Rear fan         OK         Spinning at normal speed
      Top Right Front fan       OK         Spinning at normal speed
      Top Right Middle fan      OK         Spinning at normal speed
      Top Right Rear fan        OK         Spinning at normal speed
      Bottom Left Front fan     OK         Spinning at normal speed
      Bottom Left Middle fan OK            Spinning at normal speed
      Bottom Left Rear fan      OK         Spinning at normal speed
      Bottom Right Front fan OK            Spinning at normal speed
      Bottom Right Middle fan OK           Spinning at normal speed
      Bottom Right Rear fan     OK         Spinning at normal speed
      Rear Tray Top fan         OK         Spinning at normal speed
      Rear Tray Second fan      OK         Spinning at normal speed
```

```
      Rear Tray Third fan    OK         Spinning at normal speed
      Rear Tray Fourth fan   OK         Spinning at normal speed
      Rear Tray Fifth fan    OK         Spinning at normal speed
      Rear Tray Sixth fan    OK         Spinning at normal speed
      Rear Tray Seventh fan  OK         Spinning at normal speed
      Rear Tray Bottom fan   OK         Spinning at normal speed
Misc  CIP 0                  OK
      CIP 1                  OK
      SPMB 0                 OK
      SPMB 1                 OK

lcc0-re0:
--------------------------------------------------------------------------
Class Item                   Status     Measurement
Temp  PEM 0                  OK         29 degrees C / 84 degrees F
      PEM 1                  Absent
      SCG 0                  OK         35 degrees C / 95 degrees F
      SCG 1                  Absent
      Routing Engine 0       OK         39 degrees C / 102 degrees F
      Routing Engine 1       OK         36 degrees C / 96 degrees F
      CB 0                   OK         32 degrees C / 89 degrees F
      CB 1                   OK         32 degrees C / 89 degrees F
      SIB 0                  OK         40 degrees C / 104 degrees F
      SIB 0 (B)              OK         51 degrees C / 123 degrees F
      FPC 0 Top              OK         45 degrees C / 113 degrees F
      FPC 0 Bottom           OK         31 degrees C / 87 degrees F
      FPC 1 Top              OK         34 degrees C / 93 degrees F
      FPC 1 Bottom           OK         31 degrees C / 87 degrees F
      FPM GBUS               OK         30 degrees C / 86 degrees F
      FPM Display            OK         34 degrees C / 93 degrees F
Fans  Top Left Front fan     OK         Spinning at normal speed
      Top Left Middle fan    OK         Spinning at normal speed
      Top Left Rear fan      OK         Spinning at normal speed
      Top Right Front fan    OK         Spinning at normal speed
      Top Right Middle fan   OK         Spinning at normal speed
      Top Right Rear fan     OK         Spinning at normal speed
      Bottom Left Front fan  OK         Spinning at normal speed
      Bottom Left Middle fan OK         Spinning at normal speed
      Bottom Left Rear fan   OK         Spinning at normal speed
      Bottom Right Front fan OK         Spinning at normal speed
      Bottom Right Middle fan OK        Spinning at normal speed
      Bottom Right Rear fan  OK         Spinning at normal speed
      Rear Tray Top fan      OK         Spinning at normal speed
      Rear Tray Second fan   OK         Spinning at normal speed
      Rear Tray Third fan    OK         Spinning at normal speed
      Rear Tray Fourth fan   OK         Spinning at normal speed
      Rear Tray Fifth fan    OK         Spinning at normal speed
      Rear Tray Sixth fan    OK         Spinning at normal speed
      Rear Tray Seventh fan  OK         Spinning at normal speed
      Rear Tray Bottom fan   OK         Spinning at normal speed
Misc  CIP                    OK
      SPMB 0                 OK
      SPMB 1                 OK

lcc2-re0:
--------------------------------------------------------------------------
Class Item                   Status     Measurement
Temp  PEM 0                  OK         29 degrees C / 84 degrees F
      PEM 1                  Absent
      SCG 0                  OK         32 degrees C / 89 degrees F
      SCG 1                  Absent
```

```
      Routing Engine 0      OK         31 degrees C / 87 degrees F
      Routing Engine 1      OK         32 degrees C / 89 degrees F
      CB 0                  OK         30 degrees C / 86 degrees F
      SIB 0                 OK         38 degrees C / 100 degrees F
      SIB 0 (B)             OK         49 degrees C / 120 degrees F
      FPC 0 Top             OK         45 degrees C / 113 degrees F
      FPC 0 Bottom          OK         33 degrees C / 91 degrees F
      FPC 1 Top             OK         37 degrees C / 98 degrees F
      FPC 1 Bottom          OK         33 degrees C / 91 degrees F
      FPM GBUS              OK         30 degrees C / 86 degrees F
      FPM Display           OK         34 degrees C / 93 degrees F
Fans  Top Left Front fan    OK         Spinning at normal speed
      Top Left Middle fan   OK         Spinning at normal speed
...
```

show chassis environment (T1600 Router)

```
user@host> show chassis environment
Class Item                          Status     Measurement
Temp  PEM 0                         OK         27 degrees C / 80 degrees F
      PEM 1                         Absent
      SCG 0                         OK         31 degrees C / 87 degrees F
      SCG 1                         OK         35 degrees C / 95 degrees F
      Routing Engine 0              OK         30 degrees C / 86 degrees F
      Routing Engine 1              OK         30 degrees C / 86 degrees F
      CB 0                          OK         31 degrees C / 87 degrees F
      CB 1                          OK         31 degrees C / 87 degrees F
      SIB 0                         OK         41 degrees C / 105 degrees F
      SIB 0 (B)                     OK         34 degrees C / 93 degrees F
      SIB 1                         OK         0 degrees C / 32 degrees F
      SIB 1 (B)                     OK         0 degrees C / 32 degrees F
      SIB 2                         OK         0 degrees C / 32 degrees F
      SIB 2 (B)                     OK         0 degrees C / 32 degrees F
      SIB 3                         OK         0 degrees C / 32 degrees F
      SIB 3 (B)                     OK         0 degrees C / 32 degrees F
      SIB 4                         OK         0 degrees C / 32 degrees F
      SIB 4 (B)                     OK         0 degrees C / 32 degrees F
      FPC 0 Top                     OK         49 degrees C / 120 degrees F
      FPC 0 Bottom                  OK         50 degrees C / 122 degrees F
      FPC 1 Top                     OK         48 degrees C / 118 degrees F
      FPC 1 Bottom                  OK         49 degrees C / 120 degrees F
      FPM GBUS                      OK         27 degrees C / 80 degrees F
      FPM Display                   OK         30 degrees C / 86 degrees F
Fans  Top Left Front fan            OK         Spinning at normal speed
      Top Left Middle fan           OK         Spinning at normal speed
      Top Left Rear fan             OK         Spinning at normal speed
      Top Right Front fan           OK         Spinning at normal speed
      Top Right Middle fan          OK         Spinning at normal speed
      Top Right Rear fan            OK         Spinning at normal speed
      Bottom Left Front fan         OK         Spinning at normal speed
      Bottom Left Middle fan        OK         Spinning at normal speed
      Bottom Left Rear fan          OK         Spinning at normal speed
      Bottom Right Front fan        OK         Spinning at normal speed
      Bottom Right Middle fan       OK         Spinning at normal speed
      Bottom Right Rear fan         OK         Spinning at normal speed
      Rear Tray Top fan             OK         Spinning at normal speed
      Rear Tray Second fan          OK         Spinning at normal speed
      Rear Tray Third fan           OK         Spinning at normal speed
      Rear Tray Fourth fan          OK         Spinning at normal speed
      Rear Tray Fifth fan           OK         Spinning at normal speed
      Rear Tray Sixth fan           OK         Spinning at normal speed
```



```
       Rear Tray Seventh fan          OK         Spinning at normal speed
       Rear Tray Bottom fan           OK         Spinning at normal speed
Misc   CIP                            OK
       SPMB 0                         OK
       SPMB 1                         OK
```

show chassis environment (TX Matrix Plus Router)

```
user@host> show chassis environment
sfc0-re0:
--------------------------------------------------------------------------
Class Item                           Status     Measurement
Temp  PEM 0                          OK         28 degrees C / 82 degrees F
      PEM 1                          Absent
      Routing Engine 0               OK         27 degrees C / 80 degrees F
      Routing Engine 1               OK         29 degrees C / 84 degrees F
      CB 0 Intake                    OK         26 degrees C / 78 degrees F
      CB 0 Exhaust A                 OK         25 degrees C / 77 degrees F
      CB 0 Exhaust B                 OK         25 degrees C / 77 degrees F
      CB 1 Intake                    OK         26 degrees C / 78 degrees F
      CB 1 Exhaust A                 OK         26 degrees C / 78 degrees F
      CB 1 Exhaust B                 OK         26 degrees C / 78 degrees F
      SIB F13 0                      OK         47 degrees C / 116 degrees F
      SIB F13 0 (B)                  OK         48 degrees C / 118 degrees F
      SIB F13 1                      OK         38 degrees C / 100 degrees F
      SIB F13 1 (B)                  OK         37 degrees C / 98 degrees F
      SIB F2S 0/0                    OK         27 degrees C / 80 degrees F
      SIB F2S 0/2                    OK         28 degrees C / 82 degrees F
      SIB F2S 0/4                    OK         27 degrees C / 80 degrees F
      SIB F2S 0/6                    OK         28 degrees C / 82 degrees F
      SIB F2S 1/0                    OK         26 degrees C / 78 degrees F
      SIB F2S 1/2                    OK         26 degrees C / 78 degrees F
      SIB F2S 1/4                    OK         26 degrees C / 78 degrees F
      SIB F2S 1/6                    OK         26 degrees C / 78 degrees F
      SIB F2S 2/0                    OK         25 degrees C / 77 degrees F
      SIB F2S 2/2                    OK         25 degrees C / 77 degrees F
      SIB F2S 2/4                    OK         23 degrees C / 73 degrees F
      CIP 0 Intake                   OK         23 degrees C / 73 degrees F
      CIP 0 Exhaust A                OK         24 degrees C / 75 degrees F
      CIP 0 Exhaust B                OK         24 degrees C / 75 degrees F
      CIP 1 Intake                   OK         24 degrees C / 75 degrees F
      CIP 1 Exhaust A                OK         25 degrees C / 77 degrees F
      CIP 1 Exhaust B                OK         25 degrees C / 77 degrees F
Fans  Fan Tray 0 Fan 1               OK         Spinning at normal speed
      Fan Tray 0 Fan 2               OK         Spinning at normal speed
      Fan Tray 0 Fan 3               OK         Spinning at normal speed
      Fan Tray 0 Fan 4               OK         Spinning at normal speed
      Fan Tray 0 Fan 5               OK         Spinning at normal speed
      Fan Tray 0 Fan 6               OK         Spinning at normal speed
      Fan Tray 1 Fan 1               OK         Spinning at normal speed
      Fan Tray 1 Fan 2               OK         Spinning at normal speed
      Fan Tray 1 Fan 3               OK         Spinning at normal speed
      Fan Tray 1 Fan 4               OK         Spinning at normal speed
      Fan Tray 1 Fan 5               OK         Spinning at normal speed
      Fan Tray 1 Fan 6               OK         Spinning at normal speed
      Fan Tray 2 Fan 1               OK         Spinning at normal speed
      Fan Tray 2 Fan 2               OK         Spinning at normal speed
      Fan Tray 2 Fan 3               OK         Spinning at normal speed
      Fan Tray 2 Fan 4               OK         Spinning at normal speed
      Fan Tray 2 Fan 5               OK         Spinning at normal speed
      Fan Tray 2 Fan 6               OK         Spinning at normal speed
```



```
      Fan Tray 2 Fan 7               OK         Spinning at normal speed
      Fan Tray 2 Fan 8               OK         Spinning at normal speed
      Fan Tray 2 Fan 9               OK         Spinning at normal speed
      Fan Tray 3 Fan 1               OK         Spinning at normal speed
      Fan Tray 3 Fan 2               OK         Spinning at normal speed
      Fan Tray 3 Fan 3               OK         Spinning at normal speed
      Fan Tray 3 Fan 4               OK         Spinning at normal speed
      Fan Tray 3 Fan 5               OK         Spinning at normal speed
      Fan Tray 3 Fan 6               OK         Spinning at normal speed
      Fan Tray 3 Fan 7               OK         Spinning at normal speed
      Fan Tray 3 Fan 8               OK         Spinning at normal speed
      Fan Tray 3 Fan 9               OK         Spinning at normal speed
      Fan Tray 4 Fan 1               OK         Spinning at normal speed
      Fan Tray 4 Fan 2               OK         Spinning at normal speed
      Fan Tray 4 Fan 3               OK         Spinning at normal speed
      Fan Tray 4 Fan 4               OK         Spinning at normal speed
      Fan Tray 4 Fan 5               OK         Spinning at normal speed
      Fan Tray 4 Fan 6               OK         Spinning at normal speed
      Fan Tray 4 Fan 7               OK         Spinning at normal speed
      Fan Tray 4 Fan 8               OK         Spinning at normal speed
      Fan Tray 4 Fan 9               OK         Spinning at normal speed
      Fan Tray 5 Fan 1               OK         Spinning at normal speed
      Fan Tray 5 Fan 2               OK         Spinning at normal speed
      Fan Tray 5 Fan 3               OK         Spinning at normal speed
      Fan Tray 5 Fan 4               OK         Spinning at normal speed
      Fan Tray 5 Fan 5               OK         Spinning at normal speed
      Fan Tray 5 Fan 6               OK         Spinning at normal speed
      Fan Tray 5 Fan 7               OK         Spinning at normal speed
      Fan Tray 5 Fan 8               OK         Spinning at normal speed
      Fan Tray 5 Fan 9               OK         Spinning at normal speed
Misc  SPMB 0                         OK
      SPMB 1                         OK

lcc0-re0:
--------------------------------------------------------------------------
Class Item                           Status     Measurement
Temp  PEM 0                          OK         27 degrees C / 80 degrees F
      PEM 1                          Absent
      SCG 0                          OK         31 degrees C / 87 degrees F
      SCG 1                          OK         35 degrees C / 95 degrees F
      Routing Engine 0               OK         30 degrees C / 86 degrees F
      Routing Engine 1               OK         30 degrees C / 86 degrees F
      CB 0                           OK         31 degrees C / 87 degrees F
      CB 1                           OK         31 degrees C / 87 degrees F
      SIB 0                          OK         41 degrees C / 105 degrees F
      SIB 0 (B)                      OK         34 degrees C / 93 degrees F
      SIB 1                          OK         0 degrees C / 32 degrees F
      SIB 1 (B)                      OK         0 degrees C / 32 degrees F
      SIB 2                          OK         0 degrees C / 32 degrees F
      SIB 2 (B)                      OK         0 degrees C / 32 degrees F
      SIB 3                          OK         0 degrees C / 32 degrees F
      SIB 3 (B)                      OK         0 degrees C / 32 degrees F
      SIB 4                          OK         0 degrees C / 32 degrees F
      SIB 4 (B)                      OK         0 degrees C / 32 degrees F
      FPC 0 Top                      OK         49 degrees C / 120 degrees F
      FPC 0 Bottom                   OK         50 degrees C / 122 degrees F
      FPC 1 Top                      OK         48 degrees C / 118 degrees F
      FPC 1 Bottom                   OK         49 degrees C / 120 degrees F
      FPM GBUS                       OK         27 degrees C / 80 degrees F
      FPM Display                    OK         30 degrees C / 86 degrees F
Fans  Top Left Front fan             OK         Spinning at normal speed
```

```
        Top Left Middle fan           OK         Spinning at normal speed
        Top Left Rear fan             OK         Spinning at normal speed
        Top Right Front fan           OK         Spinning at normal speed
        Top Right Middle fan          OK         Spinning at normal speed
        Top Right Rear fan            OK         Spinning at normal speed
        Bottom Left Front fan         OK         Spinning at normal speed
        Bottom Left Middle fan        OK         Spinning at normal speed
        Bottom Left Rear fan          OK         Spinning at normal speed
        Bottom Right Front fan        OK         Spinning at normal speed
        Bottom Right Middle fan       OK         Spinning at normal speed
        Bottom Right Rear fan         OK         Spinning at normal speed
        Rear Tray Top fan             OK         Spinning at normal speed
        Rear Tray Second fan          OK         Spinning at normal speed
        Rear Tray Third fan           OK         Spinning at normal speed
        Rear Tray Fourth fan          OK         Spinning at normal speed
        Rear Tray Fifth fan           OK         Spinning at normal speed
        Rear Tray Sixth fan           OK         Spinning at normal speed
        Rear Tray Seventh fan         OK         Spinning at normal speed
        Rear Tray Bottom fan          OK         Spinning at normal speed
Misc    CIP                           OK
        SPMB 0                        OK
        SPMB 1                        OK
```

show chassis environment (TX Matrix Plus router with 3D SIBs)

```
user@host> show chassis environment
sfc0-re0:
--------------------------------------------------------------------------
Class Item                            Status     Measurement
Temp    PEM 0                         Check      30 degrees C / 86 degrees F
        PEM 1                         OK         33 degrees C / 91 degrees F
        Routing Engine 0              OK         28 degrees C / 82 degrees F
        Routing Engine 0 CPU          OK         42 degrees C / 107 degrees F
        Routing Engine 1              OK         29 degrees C / 84 degrees F
        Routing Engine 1 CPU          OK         44 degrees C / 111 degrees F
        CB 0 Intake                   OK         30 degrees C / 86 degrees F
        CB 0 Exhaust A                OK         28 degrees C / 82 degrees F
        CB 0 Exhaust B                OK         30 degrees C / 86 degrees F
        CB 1 Intake                   OK         31 degrees C / 87 degrees F
        CB 1 Exhaust A                OK         27 degrees C / 80 degrees F
        CB 1 Exhaust B                OK         31 degrees C / 87 degrees F
        SIB F13 0 Board               OK         44 degrees C / 111 degrees F
        SIB F13 0 XF Junction         OK         62 degrees C / 143 degrees F
        SIB F13 3 Board               OK         45 degrees C / 113 degrees F
        SIB F13 3 XF Junction         OK         60 degrees C / 140 degrees F
        SIB F13 6 Board               OK         47 degrees C / 116 degrees F
        SIB F13 6 XF Junction         OK         62 degrees C / 143 degrees F
        SIB F2S 0/0 Board             OK         32 degrees C / 89 degrees F
        SIB F2S 0/0 XF Junction       OK         42 degrees C / 107 degrees F
        SIB F2S 0/2 Board             OK         31 degrees C / 87 degrees F
        SIB F2S 0/2 XF Junction       OK         41 degrees C / 105 degrees F
        SIB F2S 0/4 Board             OK         31 degrees C / 87 degrees F
        SIB F2S 0/4 XF Junction       OK         42 degrees C / 107 degrees F
        SIB F2S 0/6 Board             OK         31 degrees C / 87 degrees F
        SIB F2S 0/6 XF Junction       OK         41 degrees C / 105 degrees F
        SIB F2S 1/0 Board             OK         31 degrees C / 87 degrees F
        SIB F2S 1/0 XF Junction       OK         41 degrees C / 105 degrees F
        SIB F2S 1/2 Board             OK         29 degrees C / 84 degrees F
        SIB F2S 1/2 XF Junction       OK         39 degrees C / 102 degrees F
        SIB F2S 1/4 Board             OK         29 degrees C / 84 degrees F
        SIB F2S 1/4 XF Junction       OK         35 degrees C / 95 degrees F
```



```
         SIB F2S 1/6 Board            OK          30 degrees C / 86 degrees F
         SIB F2S 1/6 XF Junction      OK          41 degrees C / 105 degrees F
         SIB F2S 2/0 Board            OK          30 degrees C / 86 degrees F
         SIB F2S 2/0 XF Junction      OK          42 degrees C / 107 degrees F
         SIB F2S 2/2 Board            OK          28 degrees C / 82 degrees F
         SIB F2S 2/2 XF Junction      OK          39 degrees C / 102 degrees F
         SIB F2S 2/4 Board            OK          29 degrees C / 84 degrees F
         SIB F2S 2/4 XF Junction      OK          42 degrees C / 107 degrees F
         SIB F2S 2/6 Board            OK          29 degrees C / 84 degrees F
         SIB F2S 2/6 XF Junction      OK          41 degrees C / 105 degrees F
         CIP 0 Intake                 OK          25 degrees C / 77 degrees F
         CIP 0 Exhaust A              OK          26 degrees C / 78 degrees F
         CIP 0 Exhaust B              OK          26 degrees C / 78 degrees F
         CIP 1 Intake                 OK          26 degrees C / 78 degrees F
         CIP 1 Exhaust A              OK          27 degrees C / 80 degrees F
         CIP 1 Exhaust B              OK          27 degrees C / 80 degrees F
   Fans  Fan Tray 0 Fan 1             OK          Spinning at normal speed
         Fan Tray 0 Fan 2             OK          Spinning at normal speed
         Fan Tray 0 Fan 3             OK          Spinning at normal speed
         Fan Tray 0 Fan 4             OK          Spinning at normal speed
         Fan Tray 0 Fan 5             OK          Spinning at normal speed
         Fan Tray 0 Fan 6             OK          Spinning at normal speed
         Fan Tray 1 Fan 1             OK          Spinning at normal speed
         Fan Tray 1 Fan 2             OK          Spinning at normal speed
         Fan Tray 1 Fan 3             OK          Spinning at normal speed
         Fan Tray 1 Fan 4             OK          Spinning at normal speed
         Fan Tray 1 Fan 5             OK          Spinning at normal speed
         Fan Tray 1 Fan 6             OK          Spinning at normal speed
         Fan Tray 2 Fan 1             OK          Spinning at normal speed
         Fan Tray 2 Fan 2             OK          Spinning at normal speed
         Fan Tray 2 Fan 3             OK          Spinning at normal speed
         Fan Tray 2 Fan 4             OK          Spinning at normal speed
         Fan Tray 2 Fan 5             OK          Spinning at normal speed
         Fan Tray 2 Fan 6             OK          Spinning at normal speed
         Fan Tray 2 Fan 7             OK          Spinning at normal speed
         Fan Tray 2 Fan 8             OK          Spinning at normal speed
         Fan Tray 2 Fan 9             OK          Spinning at normal speed
         Fan Tray 3 Fan 1             OK          Spinning at normal speed
         Fan Tray 3 Fan 2             OK          Spinning at normal speed
         Fan Tray 3 Fan 3             OK          Spinning at normal speed
         Fan Tray 3 Fan 4             OK          Spinning at normal speed
         Fan Tray 3 Fan 5             OK          Spinning at normal speed
         Fan Tray 3 Fan 6             OK          Spinning at normal speed
         Fan Tray 3 Fan 7             OK          Spinning at normal speed
         Fan Tray 3 Fan 8             OK          Spinning at normal speed
         Fan Tray 3 Fan 9             OK          Spinning at normal speed
         Fan Tray 4 Fan 1             OK          Spinning at normal speed
         Fan Tray 4 Fan 2             OK          Spinning at normal speed
         Fan Tray 4 Fan 3             OK          Spinning at normal speed
         Fan Tray 4 Fan 4             OK          Spinning at normal speed
         Fan Tray 4 Fan 5             OK          Spinning at normal speed
         Fan Tray 4 Fan 6             OK          Spinning at normal speed
         Fan Tray 4 Fan 7             OK          Spinning at normal speed
         Fan Tray 4 Fan 8             OK          Spinning at normal speed
         Fan Tray 4 Fan 9             OK          Spinning at normal speed
         Fan Tray 5 Fan 1             OK          Spinning at normal speed
         Fan Tray 5 Fan 2             OK          Spinning at normal speed
         Fan Tray 5 Fan 3             OK          Spinning at normal speed
         Fan Tray 5 Fan 4             OK          Spinning at normal speed
         Fan Tray 5 Fan 5             OK          Spinning at normal speed
         Fan Tray 5 Fan 6             OK          Spinning at normal speed
```

```
      Fan Tray 5 Fan 7              OK         Spinning at normal speed
      Fan Tray 5 Fan 8              OK         Spinning at normal speed
      Fan Tray 5 Fan 9              Check
Misc  SPMB 0                        OK
      SPMB 1                        OK

lcc0-re0:
--------------------------------------------------------------------------
Class Item                          Status     Measurement
Temp  PEM 0                         OK         29 degrees C / 84 degrees F
      PEM 1                         Check      29 degrees C / 84 degrees F
      SCG 0                         OK         32 degrees C / 89 degrees F
      SCG 1                         OK         33 degrees C / 91 degrees F
      Routing Engine 0              OK         32 degrees C / 89 degrees F
      Routing Engine 0 CPU          OK         51 degrees C / 123 degrees F
      Routing Engine 1              OK         32 degrees C / 89 degrees F
      Routing Engine 1 CPU          OK         49 degrees C / 120 degrees F
      CB 0                          OK         34 degrees C / 93 degrees F
      CB 1                          OK         34 degrees C / 93 degrees F
      SIB 0                         OK         39 degrees C / 102 degrees F
      SIB 0 (B)                     Absent
      SIB 1                         OK         39 degrees C / 102 degrees F
      SIB 1 (B)                     Absent
      SIB 2                         OK         39 degrees C / 102 degrees F
      SIB 2 (B)                     Absent
      FPC 4 Top                     OK         43 degrees C / 109 degrees F
      FPC 4 Bottom                  OK         43 degrees C / 109 degrees F
      FPC 7 Fan Intake              OK         35 degrees C / 95 degrees F
      FPC 7 Fan Exhaust             OK         50 degrees C / 122 degrees F
      FPC 7 PMB                     OK         50 degrees C / 122 degrees F
      FPC 7 LMB0                    OK         55 degrees C / 131 degrees F
      FPC 7 LMB1                    OK         49 degrees C / 120 degrees F
      FPC 7 LMB2                    OK         39 degrees C / 102 degrees F
      FPC 7 PFE1 LU2                OK         55 degrees C / 131 degrees F
      FPC 7 PFE1 LU0                OK         45 degrees C / 113 degrees F
      FPC 7 PFE0 LU0                OK         62 degrees C / 143 degrees F
      FPC 7 XF1                     OK         52 degrees C / 125 degrees F
      FPC 7 XF0                     OK         61 degrees C / 141 degrees F
      FPC 7 XM1                     OK         39 degrees C / 102 degrees F
      FPC 7 XM0                     OK         56 degrees C / 132 degrees F
      FPC 7 PFE0 LU1                OK         60 degrees C / 140 degrees F
      FPC 7 PFE0 LU2                OK         55 degrees C / 131 degrees F
      FPC 7 PFE1 LU1                OK         41 degrees C / 105 degrees F
      FPM GBUS                      OK         24 degrees C / 75 degrees F
      FPM Display                   OK         28 degrees C / 82 degrees F
Fans  Top Left Front fan            OK         Spinning at normal speed
      Top Left Middle fan           OK         Spinning at normal speed
      Top Left Rear fan             OK         Spinning at normal speed
      Top Right Front fan           OK         Spinning at normal speed
      Top Right Middle fan          OK         Spinning at normal speed
      Top Right Rear fan            OK         Spinning at normal speed
      Bottom Left Front fan         OK         Spinning at normal speed
      Bottom Left Middle fan        OK         Spinning at normal speed
      Bottom Left Rear fan          OK         Spinning at normal speed
      Bottom Right Front fan        OK         Spinning at normal speed
      Bottom Right Middle fan       OK         Spinning at normal speed
      Bottom Right Rear fan         OK         Spinning at normal speed
      Rear Tray fan 1 (Top)         OK         Spinning at normal speed
      Rear Tray fan 2               OK         Spinning at normal speed
      Rear Tray fan 3               OK         Spinning at normal speed
      Rear Tray fan 4               OK         Spinning at normal speed
```

```
              Rear Tray fan 5              OK          Spinning at normal speed
              Rear Tray fan 6              OK          Spinning at normal speed
              Rear Tray fan 7              OK          Spinning at normal speed
              Rear Tray fan 8              OK          Spinning at normal speed
              Rear Tray fan 9              OK          Spinning at normal speed
              Rear Tray fan 10             OK          Spinning at normal speed
              Rear Tray fan 11             OK          Spinning at normal speed
              Rear Tray fan 12             OK          Spinning at normal speed
              Rear Tray fan 13             OK          Spinning at normal speed
              Rear Tray fan 14             OK          Spinning at normal speed
              Rear Tray fan 15             OK          Spinning at normal speed
              Rear Tray fan 16 (Bottom)    OK          Spinning at normal speed
        Misc  CIP                          OK
              SPMB 0                       OK
              SPMB 1                       OK
```

show chassis environment (EX4200 Standalone Switch)

```
user@switch> show chassis environment
Class Item                           Status     Measurement
Power FPC 0 Power Supply 0           OK
      FPC 0 Power Supply 1           Absent
Temp  FPC 0 CPU                      OK         41 degrees C / 105 degrees F
      FPC 0 EX-PFE1                  OK         42 degrees C / 107 degrees F
      FPC 0 EX-PFE2                  OK         46 degrees C / 114 degrees F
      FPC 0 GEPHY Front Left         OK         25 degrees C / 77 degrees F
      FPC 0 GEPHY Front Right        OK         27 degrees C / 80 degrees F
      FPC 0 Uplink Conn              OK         29 degrees C / 84 degrees F
Fans  FPC 0 Fan 1                    OK         Spinning at normal speed
      FPC 0 Fan 2                    OK         Spinning at normal speed
      FPC 0 Fan 3                    OK         Spinning at normal speed
```

show chassis environment (EX8216 Switch)

```
user@switch> show chassis environment
Class Item                           Status     Measurement
Power PSU 0                          OK
      PSU 1                          OK
      PSU 2                          OK
      PSU 3                          Check
      PSU 4                          Absent
      PSU 5                          Absent
Temp  CB 0 Intake                    OK         23 degrees C / 73 degrees F
      CB 0 Exhaust                   OK         26 degrees C / 78 degrees F
      CB 1 Intake                    OK         22 degrees C / 71 degrees F
      CB 1 Exhaust                   OK         25 degrees C / 77 degrees F
      FPC 4 Intake                   OK         49 degrees C / 120 degrees F
      FPC 4 Exhaust                  OK         59 degrees C / 138 degrees F
      SIB 5 Intake                   OK         25 degrees C / 77 degrees F
      SIB 5 Exhaust                  OK         35 degrees C / 95 degrees F
      SIB 6 Intake                   OK         25 degrees C / 77 degrees F
      SIB 6 Exhaust                  OK         38 degrees C / 100 degrees F
Fans  Top Fan 1                      OK         Spinning at normal speed
      Top Fan 2                      OK         Spinning at normal speed
      Top Fan 3                      OK         Spinning at normal speed
      Top Fan 4                      OK         Spinning at normal speed
      Top Fan 5                      OK         Spinning at normal speed
      Top Fan 6                      OK         Spinning at normal speed
      Top Fan 7                      OK         Spinning at normal speed
      Top Fan 8                      OK         Spinning at normal speed
      Top Fan 9                      OK         Spinning at normal speed
```



```
        Bottom Fan 1                  OK         Spinning at normal speed
        Bottom Fan 2                  OK         Spinning at normal speed
        Bottom Fan 3                  OK         Spinning at normal speed
        Bottom Fan 4                  OK         Spinning at normal speed
        Bottom Fan 5                  OK         Spinning at normal speed
        Bottom Fan 6                  OK         Spinning at normal speed
        Bottom Fan 7                  OK         Spinning at normal speed
        Bottom Fan 8                  OK         Spinning at normal speed
        Bottom Fan 9                  OK         Spinning at normal speed
```

show chassis environment (QFX Series)

```
user@switch> show chassis environment
Class Item                           Status     Measurement
Power FPC 0 Power Supply 0           OK
      FPC 0 Power Supply 1           OK
Temp  FPC 0 Sensor TopLeft I         OK         26 degrees C / 78 degrees F
      FPC 0 Sensor TopRight I        OK         24 degrees C / 75 degrees F
      FPC 0 Sensor TopLeft E         OK         30 degrees C / 86 degrees F
      FPC 0 Sensor TopRight E        OK         30 degrees C / 86 degrees F
      FPC 0 Sensor TopMiddle I       OK         30 degrees C / 86 degrees F
      FPC 0 Sensor TopMiddle E       OK         38 degrees C / 100 degrees F
      FPC 0 Sensor Bottom I          OK         34 degrees C / 93 degrees F
      FPC 0 Sensor Bottom E          OK         38 degrees C / 100 degrees F
      FPC 0 Sensor Die Temp          OK         38 degrees C / 100 degrees F
      FPC 0 Sensor Mgmnt Brd I       OK         24 degrees C / 75 degrees F
      FPC 0 Sensor Switch I          OK         28 degrees C / 82 degrees F
Fans  FPC 0 Fan 1 (left)             Failed
      FPC 0 Fan 2 (right)            OK         Spinning at normal speed
      FPC 0 Fan 3 (middle)           OK         Spinning at normal speed
```

show chassis environment interconnect-device (QFabric System)

```
user@switch> show chassis environment interconnect-device IC-A0004
Class Item                           Status     Measurement
      CB 0
      CB 0 L Intake                  OK         30 degrees C / 86 degrees F
      CB 0 R Intake                  OK         31 degrees C / 87 degrees F
      CB 0 L Exhaust                 OK         32 degrees C / 89 degrees F
      CB 0 R Exhaust                 OK         33 degrees C / 91 degrees F
      Routing Engine 0 CPU temp      OK         51 degrees C / 123 degrees F
      CB 1
      CB 1 L Intake                  OK         27 degrees C / 80 degrees F
      CB 1 R Intake                  OK         29 degrees C / 84 degrees F
      CB 1 L Exhaust                 OK         31 degrees C / 87 degrees F
      CB 1 R Exhaust                 OK         32 degrees C / 89 degrees F
      Routing Engine 1 CPU temp      OK         40 degrees C / 104 degrees F
      FC 0 FPC 0
      FPC 0 L Intake                 OK         25 degrees C / 77 degrees F
      FPC 0 R Intake                 OK         28 degrees C / 82 degrees F
      FPC 0 L Exhaust                OK         28 degrees C / 82 degrees F
      FPC 0 R Exhaust                OK         29 degrees C / 84 degrees F
      FC 7 FPC 7
      FPC 7 L Intake                 OK         25 degrees C / 77 degrees F
      FPC 7 R Intake                 OK         26 degrees C / 78 degrees F
      FPC 7 L Exhaust                OK         28 degrees C / 82 degrees F
      FPC 7 R Exhaust                OK         29 degrees C / 84 degrees F
      RC 0 FPC 8
      FPC 8 L Intake                 OK         25 degrees C / 77 degrees F
      FPC 8 R Intake                 OK         26 degrees C / 78 degrees F
      FPC 8 L Exhaust                OK         32 degrees C / 89 degrees F
```

```
          FPC 8 R Exhaust                OK         30 degrees C / 86 degrees F
          RC 7 FPC 15
          FPC 15 L Intake                OK         24 degrees C / 75 degrees F
          FPC 15 R Intake                OK         25 degrees C / 77 degrees F
          FPC 15 L Exhaust               OK         33 degrees C / 91 degrees F
          FPC 15 R Exhaust               OK         31 degrees C / 87 degrees F
    Fans  TFT 0 Fan 0                    OK         Spinning at normal speed
    Fans  TFT 0 Fan 1                    OK         Spinning at normal speed
    Fans  TFT 0 Fan 2                    OK         Spinning at normal speed
    Fans  TFT 0 Fan 3                    OK         Spinning at normal speed
    Fans  TFT 0 Fan 4                    OK         Spinning at normal speed
    Fans  TFT 0 Fan 5                    OK         Spinning at normal speed
    Fans  BFT 1 Fan 0                    OK         Spinning at normal speed
    Fans  BFT 1 Fan 1                    OK         Spinning at normal speed
    Fans  BFT 1 Fan 2                    OK         Spinning at normal speed
    Fans  BFT 1 Fan 3                    Check
    Fans  BFT 1 Fan 4                    OK         Spinning at normal speed
    Fans  BFT 1 Fan 5                    OK         Spinning at normal speed
    Fans  SFT 0 Fan 0 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 0 Fan 0 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 0 Fan 1 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 0 Fan 1 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 0 Fan 2 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 0 Fan 2 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 0 Fan 3 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 0 Fan 3 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 1 Fan 0 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 1 Fan 0 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 1 Fan 1 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 1 Fan 1 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 1 Fan 2 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 1 Fan 2 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 1 Fan 3 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 1 Fan 3 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 2 Fan 0 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 2 Fan 0 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 2 Fan 1 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 2 Fan 1 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 2 Fan 2 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 2 Fan 2 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 2 Fan 3 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 2 Fan 3 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 3 Fan 0 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 3 Fan 0 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 3 Fan 1 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 3 Fan 1 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 3 Fan 2 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 3 Fan 2 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 3 Fan 3 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 3 Fan 3 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 4 Fan 0 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 4 Fan 0 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 4 Fan 1 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 4 Fan 1 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 4 Fan 2 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 4 Fan 2 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 4 Fan 3 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 4 Fan 3 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 5 Fan 0 Rotor 0            OK         Spinning at normal speed
    Fans  SFT 5 Fan 0 Rotor 1            OK         Spinning at normal speed
    Fans  SFT 5 Fan 1 Rotor 0            OK         Spinning at normal speed
```



```
Fans  SFT 5 Fan 1 Rotor 1           OK         Spinning at normal speed
Fans  SFT 5 Fan 2 Rotor 0           OK         Spinning at normal speed
Fans  SFT 5 Fan 2 Rotor 1           OK         Spinning at normal speed
Fans  SFT 5 Fan 3 Rotor 0           OK         Spinning at normal speed
Fans  SFT 5 Fan 3 Rotor 1           OK         Spinning at normal speed
Fans  SFT 6 Fan 0 Rotor 0           OK         Spinning at normal speed
Fans  SFT 6 Fan 0 Rotor 1           OK         Spinning at normal speed
Fans  SFT 6 Fan 1 Rotor 0           OK         Spinning at normal speed
Fans  SFT 6 Fan 1 Rotor 1           OK         Spinning at normal speed
Fans  SFT 6 Fan 2 Rotor 0           OK         Spinning at normal speed
Fans  SFT 6 Fan 2 Rotor 1           OK         Spinning at normal speed
Fans  SFT 6 Fan 3 Rotor 0           OK         Spinning at normal speed
Fans  SFT 6 Fan 3 Rotor 1           OK         Spinning at normal speed
Fans  SFT 7 Fan 0 Rotor 0           OK         Spinning at normal speed
Fans  SFT 7 Fan 0 Rotor 1           OK         Spinning at normal speed
Fans  SFT 7 Fan 1 Rotor 0           OK         Spinning at normal speed
Fans  SFT 7 Fan 1 Rotor 1           OK         Spinning at normal speed
Fans  SFT 7 Fan 2 Rotor 0           OK         Spinning at normal speed
Fans  SFT 7 Fan 2 Rotor 1           OK         Spinning at normal speed
Fans  SFT 7 Fan 3 Rotor 0           OK         Spinning at normal speed
Fans  SFT 7 Fan 3 Rotor 1           OK         Spinning at normal speed
Power PEM 0                         OK         30 degrees C / 86 degrees F
Power PEM 1                         OK         30 degrees C / 86 degrees F
Power PEM 2                         OK         30 degrees C / 86 degrees F
Power PEM 3                         Absent
Power PEM 4                         Absent
Power PEM 5                         Absent
```

show chassis environment node-device (QFabric System)

```
user@switch> show chassis environment node-device node1
Class Item                          Status     Measurement
Power node1 Power Supply 0           Absent
      node1 Power Supply 1           Absent
Fans  node1 Fan Tray 0               Testing
      node1 Fan Tray 1               Testing
      node1 Fan Tray 2               Testing
```

show chassis environment pem node-device (QFabric System)

```
user@switch> show chassis environment pem node-device node1
FPC 0 PEM 0 status:
  State                        Check
  Airflow                      Front to Back
  Temperature                  OK
  AC Input:                    OK
  DC Output             Voltage(V) Current(A)  Power(W)  Load(%)
                            12         10           120       18
FPC 0 PEM 1 status:
  State                        Online
  Airflow                      Back to Front
  Temperature                  OK
  AC Input:                    OK
  DC Output             Voltage(V) Current(A)  Power(W)  Load(%)
                            11         10          110       17
```

show chassis environment (PTX5000 Packet Transport Router)

```
user@switch> show chassis environment
Class Item                          Status     Measurement
Temp  PDU 0                         OK
      PDU 0 PSM 0                   OK         36 degrees C / 96 degrees F
```



```
PDU 0 PSM 1                   OK         38 degrees C / 100 degrees F
PDU 0 PSM 2                   OK         38 degrees C / 100 degrees F
PDU 0 PSM 3                   OK         37 degrees C / 98 degrees F
PDU 1                         Absent
CCG 0                         OK         44 degrees C / 111 degrees F
CCG 1                         OK         44 degrees C / 111 degrees F
Routing Engine 0              OK         62 degrees C / 143 degrees F
Routing Engine 0 CPU          OK         75 degrees C / 167 degrees F
Routing Engine 1              OK         51 degrees C / 123 degrees F
Routing Engine 1 CPU          OK         64 degrees C / 147 degrees F
CB 0 Intake                   OK         38 degrees C / 100 degrees F
CB 0 Exhaust A                OK         46 degrees C / 114 degrees F
CB 0 Exhaust B                OK         42 degrees C / 107 degrees F
CB 1 Intake                   OK         35 degrees C / 95 degrees F
CB 1 Exhaust A                OK         39 degrees C / 102 degrees F
CB 1 Exhaust B                OK         36 degrees C / 96 degrees F
SIB 0 Exhaust                 OK         47 degrees C / 116 degrees F
SIB 0 Junction                OK         45 degrees C / 113 degrees F
SIB 1 Exhaust                 OK         44 degrees C / 111 degrees F
SIB 1 Junction                OK         43 degrees C / 109 degrees F
SIB 2 Exhaust                 OK         47 degrees C / 116 degrees F
SIB 2 Junction                OK         42 degrees C / 107 degrees F
SIB 3 Exhaust                 OK         43 degrees C / 109 degrees F
SIB 3 Junction                OK         43 degrees C / 109 degrees F
SIB 4 Exhaust                 OK         47 degrees C / 116 degrees F
SIB 4 Junction                OK         42 degrees C / 107 degrees F
SIB 5 Exhaust                 OK         42 degrees C / 107 degrees F
SIB 5 Junction                OK         40 degrees C / 104 degrees F
SIB 6 Exhaust                 OK         46 degrees C / 114 degrees F
SIB 6 Junction                OK         42 degrees C / 107 degrees F
SIB 7 Exhaust                 OK         43 degrees C / 109 degrees F
SIB 7 Junction                OK         39 degrees C / 102 degrees F
SIB 8 Exhaust                 OK         44 degrees C / 111 degrees F
SIB 8 Junction                OK         41 degrees C / 105 degrees F
FPC 0 PMB                     OK         35 degrees C / 95 degrees F
FPC 0 Intake                  OK         33 degrees C / 91 degrees F
FPC 0 Exhaust A               OK         51 degrees C / 123 degrees F
FPC 0 Exhaust B               OK         43 degrees C / 109 degrees F
FPC 0 TL0                     OK         48 degrees C / 118 degrees F
FPC 0 TQ0                     OK         53 degrees C / 127 degrees F
FPC 0 TL1                     OK         56 degrees C / 132 degrees F
FPC 0 TQ1                     OK         58 degrees C / 136 degrees F
FPC 0 TL2                     OK         55 degrees C / 131 degrees F
FPC 0 TQ2                     OK         56 degrees C / 132 degrees F
FPC 0 TL3                     OK         59 degrees C / 138 degrees F
FPC 0 TQ3                     OK         59 degrees C / 138 degrees F
FPC 2 PMB                     OK         35 degrees C / 95 degrees F
FPC 2 Intake                  OK         34 degrees C / 93 degrees F
FPC 2 Exhaust A               OK         51 degrees C / 123 degrees F
FPC 2 Exhaust B               OK         52 degrees C / 125 degrees F
FPC 2 TL0                     OK         53 degrees C / 127 degrees F
FPC 2 TQ0                     OK         53 degrees C / 127 degrees F
FPC 2 TL1                     OK         57 degrees C / 134 degrees F
FPC 2 TQ1                     OK         58 degrees C / 136 degrees F
FPC 2 TL2                     OK         54 degrees C / 129 degrees F
FPC 2 TQ2                     OK         59 degrees C / 138 degrees F
FPC 2 TL3                     OK         60 degrees C / 140 degrees F
FPC 2 TQ3                     OK         64 degrees C / 147 degrees F
PIC 2/0 Ambient               OK         49 degrees C / 120 degrees F
FPC 3 PMB                     OK         34 degrees C / 93 degrees F
FPC 3 Intake                  OK         35 degrees C / 95 degrees F
```



```
            FPC 3 Exhaust A              OK         54 degrees C / 129 degrees F
            FPC 3 Exhaust B              OK         49 degrees C / 120 degrees F
            FPC 3 TL0                    OK         49 degrees C / 120 degrees F
            FPC 3 TQ0                    OK         55 degrees C / 131 degrees F
            FPC 3 TL1                    OK         56 degrees C / 132 degrees F
            FPC 3 TQ1                    OK         58 degrees C / 136 degrees F
            FPC 3 TL2                    OK         56 degrees C / 132 degrees F
            FPC 3 TQ2                    OK         59 degrees C / 138 degrees F
            FPC 3 TL3                    OK         62 degrees C / 143 degrees F
            FPC 3 TQ3                    OK         63 degrees C / 145 degrees F
            PIC 3/1                      Absent
            FPC 5 PMB                    OK         35 degrees C / 95 degrees F
            FPC 5 Intake                 OK         34 degrees C / 93 degrees F
            FPC 5 Exhaust A              OK         51 degrees C / 123 degrees F
            FPC 5 Exhaust B              OK         53 degrees C / 127 degrees F
            FPC 5 TL0                    OK         54 degrees C / 129 degrees F
            FPC 5 TQ0                    OK         52 degrees C / 125 degrees F
            FPC 5 TL1                    OK         61 degrees C / 141 degrees F
            FPC 5 TQ1                    OK         60 degrees C / 140 degrees F
            FPC 5 TL2                    OK         55 degrees C / 131 degrees F
            FPC 5 TQ2                    OK         55 degrees C / 131 degrees F
            FPC 5 TL3                    OK         59 degrees C / 138 degrees F
            FPC 5 TQ3                    OK         58 degrees C / 136 degrees F
            PIC 5/0 Ambient              OK         51 degrees C / 123 degrees F
            PIC 5/1 Ambient              OK         34 degrees C / 93 degrees F
            PIC 5/1 cfp-5/1/0            OK         34 degrees C / 93 degrees F
            PIC 5/1 cfp-5/1/1            OK         36 degrees C / 96 degrees F
            FPC 6 PMB                    OK         36 degrees C / 96 degrees F
            FPC 6 Intake                 OK         33 degrees C / 91 degrees F
            FPC 6 Exhaust A              OK         51 degrees C / 123 degrees F
            FPC 6 Exhaust B              OK         39 degrees C / 102 degrees F
            FPC 6 TL0                    OK         44 degrees C / 111 degrees F
            FPC 6 TQ0                    OK         54 degrees C / 129 degrees F
            FPC 6 TL1                    OK         59 degrees C / 138 degrees F
            FPC 6 TQ1                    OK         58 degrees C / 136 degrees F
            FPC 6 TL2                    OK         60 degrees C / 140 degrees F
            FPC 6 TQ2                    OK         57 degrees C / 134 degrees F
            FPC 6 TL3                    OK         65 degrees C / 149 degrees F
            FPC 6 TQ3                    OK         60 degrees C / 140 degrees F
            FPC 7 PMB                    OK         35 degrees C / 95 degrees F
            FPC 7 Intake                 OK         33 degrees C / 91 degrees F
            FPC 7 Exhaust A              OK         53 degrees C / 127 degrees F
            FPC 7 Exhaust B              OK         40 degrees C / 104 degrees F
            FPC 7 TL0                    OK         46 degrees C / 114 degrees F
            FPC 7 TQ0                    OK         58 degrees C / 136 degrees F
            FPC 7 TL1                    OK         53 degrees C / 127 degrees F
            FPC 7 TQ1                    OK         59 degrees C / 138 degrees F
            FPC 7 TL2                    OK         56 degrees C / 132 degrees F
            FPC 7 TQ2                    OK         61 degrees C / 141 degrees F
            FPC 7 TL3                    OK         63 degrees C / 145 degrees F
            FPC 7 TQ3                    OK         63 degrees C / 145 degrees F
            FPM I2CS                     OK         37 degrees C / 98 degrees F
      Fans  Fan Tray 0 Fan 1             OK         3042 RPM
            Fan Tray 0 Fan 2             OK         3042 RPM
            Fan Tray 0 Fan 3             OK         3000 RPM
            Fan Tray 0 Fan 4             OK         3042 RPM
            Fan Tray 0 Fan 5             OK         3000 RPM
            Fan Tray 0 Fan 6             OK         3042 RPM
            Fan Tray 0 Fan 7             OK         3085 RPM
            Fan Tray 0 Fan 8             OK         3042 RPM
            Fan Tray 0 Fan 9             OK         3042 RPM
```

```
        Fan Tray 0 Fan 10              OK          3085 RPM
        Fan Tray 0 Fan 11              OK          3085 RPM
        Fan Tray 0 Fan 12              OK          3128 RPM
        Fan Tray 0 Fan 13              OK          3128 RPM
        Fan Tray 0 Fan 14              OK          3042 RPM
        Fan Tray 1 Fan 1               OK          2299 RPM
        Fan Tray 1 Fan 2               OK          2399 RPM
        Fan Tray 1 Fan 3               OK          2299 RPM
        Fan Tray 1 Fan 4               OK          2266 RPM
        Fan Tray 1 Fan 5               OK          2266 RPM
        Fan Tray 1 Fan 6               OK          2366 RPM
        Fan Tray 2 Fan 1               OK          2199 RPM
        Fan Tray 2 Fan 2               OK          2133 RPM
        Fan Tray 2 Fan 3               OK          2366 RPM
        Fan Tray 2 Fan 4               OK          2233 RPM
        Fan Tray 2 Fan 5               OK          2399 RPM
        Fan Tray 2 Fan 6               OK          2233 RPM
Misc    SPMB 0 Intake                  OK          50 degrees C / 122 degrees F
        SPMB 1 Intake                  OK          40 degrees C / 104 degrees F
```

show chassis environment (ACX2000 Universal Access Router)

```
user@host> show chassis environment
Class Item                             Status      Measurement
      PCB Left                         OK          44 degrees C / 111 degrees F
      SFP+ Xcvr                        OK          50 degrees C / 122 degrees F
      FEB                              OK          70 degrees C / 158 degrees F
      PCB Up                           OK          63 degrees C / 145 degrees F
      PCB Mid                          OK          66 degrees C / 150 degrees F
      Telecom Mod                      OK          65 degrees C / 149 degrees F
      Routing Engine                   OK          54 degrees C / 129 degrees F
      Heater off
```

show chassis environment (ACX4000 Universal Access Router)

On the ACX4000 router, the MIC output of the **show chassis environment** command varies depending on the number of temperature channels present in the installed MIC.

```
user@host> show chassis environment

Class Item                             Status      Measurement
Temp  PEM 0                            OK          33 degrees C / 91 degrees F
      PEM 1                            Absent
      PCB Bottom                       OK          30 degrees C / 86 degrees F
      PCB Middle                       OK          34 degrees C / 93 degrees F
      BCM56445                         OK          33 degrees C / 91 degrees F
      SFP+ Xcvr                        OK          32 degrees C / 89 degrees F
      Fan tray inlet                   OK          39 degrees C / 102 degrees F
      Exhaust                          OK          30 degrees C / 86 degrees F
      Routing Engine                   OK          32 degrees C / 89 degrees F
      Heater off
Pic   PIC 0/0 Channel 0                OK          28 degrees C / 82 degrees F
      PIC 0/0 Channel 1                OK          29 degrees C / 84 degrees F
      PIC 0/0 Channel 2                OK          0 degrees C / 32 degrees F
      PIC 0/0 Channel 3                OK          0 degrees C / 32 degrees F
      PIC 0/0 Channel 4                OK          0 degrees C / 32 degrees F
      PIC 0/0 Channel 5                OK          0 degrees C / 32 degrees F
      PIC 0/0 Channel 6                OK          0 degrees C / 32 degrees F
      PIC 0/0 Channel 7                OK          0 degrees C / 32 degrees F
      PIC 0/0 Channel 8                OK          0 degrees C / 32 degrees F
      PIC 0/0 Channel 9                OK          0 degrees C / 32 degrees F
```



```
          PIC 1/0 Channel 0              OK         33 degrees C / 91 degrees F
          PIC 1/0 Channel 1              OK         31 degrees C / 87 degrees F
          PIC 1/0 Channel 2              OK         30 degrees C / 86 degrees F
          PIC 1/0 Channel 3              OK         0 degrees C / 32 degrees F
          PIC 1/0 Channel 4              OK         0 degrees C / 32 degrees F
          PIC 1/0 Channel 5              OK         0 degrees C / 32 degrees F
          PIC 1/0 Channel 6              OK         0 degrees C / 32 degrees F
          PIC 1/0 Channel 7              OK         0 degrees C / 32 degrees F
          PIC 1/0 Channel 8              OK         0 degrees C / 32 degrees F
          PIC 1/1 Channel 0              OK         31 degrees C / 87 degrees F
          PIC 1/1 Channel 1              OK         29 degrees C / 84 degrees F
          PIC 1/1 Channel 2              OK         28 degrees C / 82 degrees F
          PIC 1/1 Channel 3              OK         0 degrees C / 32 degrees F
          PIC 1/1 Channel 4              OK         0 degrees C / 32 degrees F
          PIC 1/1 Channel 5              OK         0 degrees C / 32 degrees F
          PIC 1/1 Channel 6              OK         0 degrees C / 32 degrees F
          PIC 1/1 Channel 7              OK         0 degrees C / 32 degrees F
          PIC 1/1 Channel 8              OK         0 degrees C / 32 degrees F
    Fans  Fan 1                          OK         Spinning at normal speed
          Fan 2                          OK         Spinning at normal speed
```

show chassis environment fpc

Syntax

show chassis environment fpc
<*slot*>

Syntax (TX Matrix and TX Matrix Plus Routers)

show chassis environment fpc
<lcc *number*>
<*slot*>

Syntax (MX Series Routers)

show chassis environment fpc
<*slot*>
<all-members>
<local>
<member *member-id*>

Syntax (MX2010 3D Universal Edge Routers)

show chassis environment fpc
<*slot*>

Syntax (MX2020 3D Universal Edge Routers)

show chassis environment fpc
<*slot*>

Syntax (QFX Series)

show chassis environment fpc
<fpc-slot>
interconnect-device *name*

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for QFX Series.
Command introduced in Junos OS Release 12.1x48 for PTX Series Packet Transport Routers.
Command introduced in Junos OS Release 12.1 for T4000 Core Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.

Description

(M40e, M120, M160, M320, MX Series, T Series routers, EX Series, QFX Series, and PTX Series routers only) Display environmental information about Flexible PIC Concentrators (FPCs).

Options

none—Display environmental information about all FPCs. On a TX Matrix router, display environmental information about all FPCs on the TX Matrix router and its attached T640 routers. On a TX Matrix Plus router, display environmental information about all FPCs on the TX Matrix Plus router and its attached routers.

all-members—(MX Series routers only) (Optional) Display environmental information for the FPCs in all the members of the Virtual Chassis configuration.

interconnect-device ***name***—(QFabric systems only) (Optional) Display chassis environmental information for the Interconnect device.

lcc ***number***—(TX Matrix router and TX Matrix Plus router only) (Optional) Line-card chassis number.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Display environmental information for the FPCs in the local Virtual Chassis member.

member ***member-id***—(MX Series routers only) (Optional) Display environmental information for the FPCs in the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value of 0 or 1.

slot **or** ***fpc-slot***—(Optional) Display environmental information about an individual FPC:

- (TX Matrix and TX Matrix Plus routers only) On a TX Matrix router, if you specify the number of the T640 router by using only the **lcc** ***number*** option (the recommended method), replace ***slot*** with a value from **0** through **7**. Similarly, on a TX Matrix Plus router, if you specify the number of the router by using only the **lcc** ***number*** option (the recommended method), replace ***slot*** with a value from **0** through **7**. Otherwise, replace ***slot*** with a value from **0** through **31**. For example, the following commands have the same result:

  user@host> **show chassis environment fpc 1 lcc 1**
  user@host> **show chassis environment fpc 9**

- M120 router—Replace ***slot*** with a value from **0** through **5.**
- MX240 router—Replace ***slot*** with a value from **0** through **2**.
- MX480 router—Replace ***slot*** with a value from **0** through **5**.
- MX960 router—Replace ***slot*** with a value from **0** through **11**.
- MX2010 router—Replace ***slot*** with a value from **0** through **9**.
- MX2020 router—Replace ***slot*** with a value from **0** through **19**.
- Other routers—Replace ***slot*** with a value from **0** through **7**.
- EX Series switches:
  - EX3200 switches and EX4200 standalone switches—Replace ***slot*** with 0.
  - EX4200 switches in a Virtual Chassis configuration—Replace ***slot*** with a value from 0 through 9 (switch's member ID).

- EX6210 switches—Replace ***slot*** with a value from 0 through 3 (line card only), 4 or 5 (line card or Switch Fabric and Rotuing Engine (SRE) module), or 6 through 9 (line card only).
- EX8208 switches—Replace ***slot*** with a value from 0 through 7 (line card).
- EX8216 switches—Replace ***slot*** with a value from 0 through 15 (line card).

- QFX3500 switches —Replace ***fpc-slot*** with 0 through 15.
- PTX5000 Packet Transport Router—Replace ***fpc-slot*** with 0 through 7.

Required Privilege Level

view

Related Documentation

- request chassis fpc on page 357
- show chassis fpc on page 597
- *show chassis fpc-feb-connectivity*
- *Configuring the Junos OS to Resynchronize FPC Sequence Numbers with Active FPCs when an FPC Comes Online*
- *MX960 Flexible PIC Concentrator Description*

List of Sample Output

Output Fields

Table 56 on page 537 lists the output fields for the **show chassis environment fpc** command. Output fields are listed in the approximate order in which they appear.

Table 56: show chassis environment fpc Output Fields

Field Name	Field Description
State	Status of the FPC: • **Unknown**—FPC is not detected by the router. • **Empty**—No FPC is present. • **Present**—FPC is detected by the chassis daemon but is either not supported by the current version of the Junos OS, or the FPC is coming up but not yet online. • **Ready**—FPC is in intermediate or transition state. • **Announce online**—Intermediate state during which the FPC is coming up but not yet online, and the chassis manager acknowledges the chassisd FPC online initiative. • **Online**—FPC is online and running. • **Offline**—FPC is powered down. • **Diagnostics**—FPC is set to operate in diagnostics mode.
Temperature	(M40e and M160 routers and QFX Series only) Temperature of the air flowing past the FPC.
PMB Temperature	(PTX Series only) Temperature of the air flowing past the PMB (bottom of the FPC).
Temperature Intake	(M320 routers, MX2010 routers, MX2020 routers, and PTX Series only) Temperature of the air flowing into the chassis.
Temperature Top	(T Series routers only) Temperature of the air flowing past the top of the FPC.
Temperature Exhaust	(M120 and M320 routers, MX2010 routers, MX2020 routers, and PTX Series only) Temperature of the air flowing out of the chassis. The PTX Series Packet Transport Routers, and the MX2010 and MX2020 routers include exhaust temperatures for multiple zones (**Exhaust A** and **Exhaust B**).
Temperature Bottom	(T Series routers only) Temperature of the air flowing past the bottom of the FPC.
TL *n* Temperature	(PTX Series only) Temperature of the air flowing past the specified TL area of the packet forwarding engine (PFE) on the FPC.
TQ *n* Temperature	(PTX Series only) Temperature of the air flowing past the specified TQ area of the packet forwarding engine (PFE) on the FPC.
Temperature MMBO	(T640 router only) Temperature of the air flowing past the type 3 FPC.
Temperature MMB1	(M320 and T Series routers only) Temperature of the air flowing past the type 1, type 2, and type 3 FPC.
Power	Information about the voltage supplied to the FPC. The left column displays the required power, in volts. The right column displays the measured power, in millivolts.
CMB Revision or **BUS revision**	Revision level of the chassis management bus device (M Series router) or bus (T Series routers).

Sample Output

show chassis environment fpc (M120 Router)

```
user@host> show chassis environment fpc
FPC 2 status:
  State                       Online
  Temperature Exhaust A       32 degrees C / 89 degrees F
  Temperature Exhaust B       31 degrees C / 87 degrees F
  Power A-Board
    1.2 V                      1202 mV
    1.5 V                      1508 mV
    1.8 V                      1798 mV
    2.5 V                      2507 mV
    3.3 V                      3351 mV
    5.0 V                      4995 mV
    3.3 V bias                 3296 mV
    1.2 V Rocket IO            1205 mV
    1.5 V Rocket IO            1501 mV
  I2C Slave Revision          12
FPC 3 status:
  State                       Online
  Temperature Exhaust A       31 degrees C / 87 degrees F
  Temperature Exhaust B       33 degrees C / 91 degrees F
  Power A-Board
    1.2 V                      1211 mV
    1.5 V                      1501 mV
    1.8 V                      1798 mV
    2.5 V                      2471 mV
    3.3 V                      3293 mV
    5.0 V                      4930 mV
    3.3 V bias                 3296 mV
    1.2 V Rocket IO            1205 mV
    1.5 V Rocket IO            1501 mV
  Power B-Board
    1.2 V                      1214 mV
    1.5 V                      1501 mV
    2.5 V                      2471 mV
    3.3 V                      3300 mV
    5.0 V                      4943 mV
    3.3 V bias                 3296 mV
    1.2 V Rocket IO            1205 mV
    1.5 V Rocket IO            1501 mV
  I2C Slave Revision          12
FPC 4 status:
  State                       Online
  Temperature Exhaust A       32 degrees C / 89 degrees F
  Temperature Exhaust B       30 degrees C / 86 degrees F
  Power A-Board
    1.2 V                      1195 mV
    1.5 V                      1504 mV
    1.8 V                      1801 mV
    2.5 V                      2504 mV
    3.3 V                      3293 mV
    5.0 V                      4917 mV
    3.3 V bias                 3296 mV
    1.2 V Rocket IO            1202 mV
    1.5 V Rocket IO            1492 mV
  I2C Slave Revision          12
```


show chassis environment fpc (M160 Router)

```
user@host> show chassis environment fpc
FPC 0 status:
  State                       Online
  Temperature              42 degrees C / 107 degrees F
  Power:
    1.5 V                1500 mV
    2.5 V                2509 mV
    3.3 V                3308 mV
    5.0 V                4991 mV
    5.0 V bias           4952 mV
    8.0 V bias           8307 mV
  CMB Revision             12
FPC 1 status:
  State                       Online
  Temperature              45 degrees C / 113 degrees F
  Power:
    1.5 V                1498 mV
    2.5 V                2501 mV
    3.3 V                3319 mV
    5.0 V                5020 mV
    5.0 V bias           5025 mV
    8.0 V bias           8307 mV
  CMB Revision             12
```

show chassis environment fpc (M320 Router)

```
user@host> show chassis environment fpc
FPC 0 status:
  State                           Online
  Temperature Intake           27 degrees C / 80 degrees F
  Temperature Exhaust          38 degrees C / 100 degrees F
  Temperature MMB1             31 degrees C / 87 degrees F
  Power:
    1.5 V                    1487 mV
    1.5 V *                  1494 mV
    1.8 V                    1821 mV
    2.5 V                    2533 mV
    3.3 V                    3323 mV
    5.0 V                    5028 mV
    3.3 V bias               3296 mV
    5.0 V bias               4984 mV
  CMB Revision                 16
FPC 1 status:
  State                           Online
  Temperature Intake           27 degrees C / 80 degrees F
  Temperature Exhaust          37 degrees C / 98 degrees F
  Temperature MMB1             32 degrees C / 89 degrees F
  Power:
    1.5 V                    1504 mV
    1.5 V *                  1499 mV
    1.8 V                    1820 mV
    2.5 V                    2529 mV
    3.3 V                    3328 mV
    5.0 V                    5013 mV
    3.3 V bias               3294 mV
    5.0 V bias               4984 mV
  CMB Revision                 16
FPC 2 status:
  State                           Online
```

```
  Temperature Intake           28 degrees C / 82 degrees F
  Temperature Exhaust          38 degrees C / 100 degrees F
  Temperature MMB1             32 degrees C / 89 degrees F
  Power:
    1.5 V                    1498 mV
    1.5 V *                  1487 mV
    1.8 V                    1816 mV
    2.5 V                    2531 mV
    3.3 V                    3324 mV
    5.0 V                    5025 mV
    3.3 V bias               3277 mV
    5.0 V bias               5013 mV
  CMB Revision                 17
FPC 3 status:
...
```

show chassis environment fpc (MX2020 Router)

```
user@host> show chassis environment fpc
FPC 0 status:
  State                      Online
  Temperature Intake         41 degrees C / 105 degrees F
  Temperature Exhaust A      48 degrees C / 118 degrees F
  Temperature Exhaust B      60 degrees C / 140 degrees F
  Temperature LU 0 TSen      56 degrees C / 132 degrees F
  Temperature LU 0 Chip      59 degrees C / 138 degrees F
  Temperature LU 1 TSen      56 degrees C / 132 degrees F
  Temperature LU 1 Chip      61 degrees C / 141 degrees F
  Temperature LU 2 TSen      56 degrees C / 132 degrees F
  Temperature LU 2 Chip      52 degrees C / 125 degrees F
  Temperature LU 3 TSen      56 degrees C / 132 degrees F
  Temperature LU 3 Chip      52 degrees C / 125 degrees F
  Temperature MQ 0 TSen      49 degrees C / 120 degrees F
  Temperature MQ 0 Chip      49 degrees C / 120 degrees F
  Temperature MQ 1 TSen      49 degrees C / 120 degrees F
  Temperature MQ 1 Chip      52 degrees C / 125 degrees F
  Temperature MQ 2 TSen      49 degrees C / 120 degrees F
  Temperature MQ 2 Chip      45 degrees C / 113 degrees F
  Temperature MQ 3 TSen      49 degrees C / 120 degrees F
  Temperature MQ 3 Chip      46 degrees C / 114 degrees F
  Power
    AS-BIAS3V3-zl2105         3299 mV
    AS-VDD1V8-zl2006          1807 mV
    AS-VDD2V5-zl2006          2512 mV
    AS-AVDD1V0-zl2004          997 mV
    AS-PCIE_1V0-zl2004         996 mV
    AS-VDD3V3-zl2004          3294 mV
    AS-VDD_1V5A-zl2004        1501 mV
    AS-VDD_1V5B-zl2004        1498 mV
    AS-LU0_1V0-zl2004          998 mV
    AS-LU1_1V0-zl2004         1002 mV
    AS-MQ0_1V0-zl2004          999 mV
    AS-MQ1_1V0-zl2004          994 mV
    AS-LU2_1V0-zl2004         1000 mV
    AS-LU3_1V0-zl2004          998 mV
    AS-MQ2_1V0-zl2004         1002 mV
    AS-MQ3_1V0-zl2004          999 mV
    AS-PMB_1V1-zl2006         1096 mV
  I2C Slave Revision         68
FPC 1 status:
  State                      Online
```



```
    Temperature Intake          39 degrees C / 102 degrees F
    Temperature Exhaust A       48 degrees C / 118 degrees F
    Temperature Exhaust B       55 degrees C / 131 degrees F
    Temperature LU 0 TSen       52 degrees C / 125 degrees F
    Temperature LU 0 Chip       54 degrees C / 129 degrees F
    Temperature LU 1 TSen       52 degrees C / 125 degrees F
    Temperature LU 1 Chip       56 degrees C / 132 degrees F
    Temperature LU 2 TSen       52 degrees C / 125 degrees F
    Temperature LU 2 Chip       49 degrees C / 120 degrees F
    Temperature LU 3 TSen       52 degrees C / 125 degrees F
    Temperature LU 3 Chip       50 degrees C / 122 degrees F
    Temperature MQ 0 TSen       48 degrees C / 118 degrees F
    Temperature MQ 0 Chip       48 degrees C / 118 degrees F
    Temperature MQ 1 TSen       48 degrees C / 118 degrees F
    Temperature MQ 1 Chip       51 degrees C / 123 degrees F
    Temperature MQ 2 TSen       48 degrees C / 118 degrees F
    Temperature MQ 2 Chip       45 degrees C / 113 degrees F
    Temperature MQ 3 TSen       48 degrees C / 118 degrees F
    Temperature MQ 3 Chip       45 degrees C / 113 degrees F
    Power
      AS-BIAS3V3-zl2105          3291 mV
      AS-VDD1V8-zl2006           1786 mV
      AS-VDD2V5-zl2006           2496 mV
      AS-AVDD1V0-zl2004          1000 mV
      AS-PCIE_1V0-zl2004         1000 mV
      AS-VDD3V3-zl2004           3294 mV
      AS-VDD_1V5A-zl2004         1500 mV
      AS-VDD_1V5B-zl2004         1498 mV
      AS-LU0_1V0-zl2004          1003 mV
      AS-LU1_1V0-zl2004          1000 mV
      AS-MQ0_1V0-zl2004          1000 mV
      AS-MQ1_1V0-zl2004           995 mV
      AS-LU2_1V0-zl2004          1002 mV
      AS-LU3_1V0-zl2004           997 mV
      AS-MQ2_1V0-zl2004          1000 mV
      AS-MQ3_1V0-zl2004           998 mV
      AS-PMB_1V1-zl2006          1096 mV
    I2C Slave Revision          68
  FPC 2 status:
    State                       Online
    Temperature Intake          39 degrees C / 102 degrees F
    Temperature Exhaust A       48 degrees C / 118 degrees F
    Temperature Exhaust B       58 degrees C / 136 degrees F
    Temperature LU 0 TSen       55 degrees C / 131 degrees F
    Temperature LU 0 Chip       57 degrees C / 134 degrees F
    Temperature LU 1 TSen       55 degrees C / 131 degrees F
    Temperature LU 1 Chip       63 degrees C / 145 degrees F
    Temperature LU 2 TSen       55 degrees C / 131 degrees F
    Temperature LU 2 Chip       51 degrees C / 123 degrees F
    Temperature LU 3 TSen       55 degrees C / 131 degrees F
    Temperature LU 3 Chip       52 degrees C / 125 degrees F
    Temperature MQ 0 TSen       48 degrees C / 118 degrees F
    Temperature MQ 0 Chip       50 degrees C / 122 degrees F
    Temperature MQ 1 TSen       48 degrees C / 118 degrees F
    Temperature MQ 1 Chip       52 degrees C / 125 degrees F
    Temperature MQ 2 TSen       48 degrees C / 118 degrees F
    Temperature MQ 2 Chip       47 degrees C / 116 degrees F
    Temperature MQ 3 TSen       48 degrees C / 118 degrees F
    Temperature MQ 3 Chip       47 degrees C / 116 degrees F
    Power
      AS-BIAS3V3-zl2105          3299 mV
```



```
    AS-VDD1V8-zl2006          1805 mV
    AS-VDD2V5-zl2006          2510 mV
    AS-AVDD1V0-zl2004          999 mV
    AS-PCIE_1V0-zl2004         998 mV
    AS-VDD3V3-zl2004          3296 mV
    AS-VDD_1V5A-zl2004        1492 mV
    AS-VDD_1V5B-zl2004        1497 mV
    AS-LU0_1V0-zl2004          997 mV
    AS-LU1_1V0-zl2004         1000 mV
    AS-MQ0_1V0-zl2004          998 mV
    AS-MQ1_1V0-zl2004         1001 mV
    AS-LU2_1V0-zl2004          996 mV
    AS-LU3_1V0-zl2004          995 mV
    AS-MQ2_1V0-zl2004          998 mV
    AS-MQ3_1V0-zl2004          997 mV
    AS-PMB_1V1-zl2006         1100 mV
  I2C Slave Revision         68
FPC 3 status:
  State                      Online
  Temperature Intake         41 degrees C / 105 degrees F
  Temperature Exhaust A      48 degrees C / 118 degrees F
  Temperature Exhaust B      58 degrees C / 136 degrees F
  Temperature LU 0 TSen      56 degrees C / 132 degrees F
  Temperature LU 0 Chip      59 degrees C / 138 degrees F
  Temperature LU 1 TSen      56 degrees C / 132 degrees F
  Temperature LU 1 Chip      61 degrees C / 141 degrees F
  Temperature LU 2 TSen      56 degrees C / 132 degrees F
  Temperature LU 2 Chip      51 degrees C / 123 degrees F
  Temperature LU 3 TSen      56 degrees C / 132 degrees F
  Temperature LU 3 Chip      53 degrees C / 127 degrees F
  Temperature MQ 0 TSen      50 degrees C / 122 degrees F
  Temperature MQ 0 Chip      51 degrees C / 123 degrees F
  Temperature MQ 1 TSen      50 degrees C / 122 degrees F
  Temperature MQ 1 Chip      55 degrees C / 131 degrees F
  Temperature MQ 2 TSen      50 degrees C / 122 degrees F
  Temperature MQ 2 Chip      47 degrees C / 116 degrees F
  Temperature MQ 3 TSen      50 degrees C / 122 degrees F
  Temperature MQ 3 Chip      50 degrees C / 122 degrees F
  Power
    AS-BIAS3V3-zl2105         3305 mV
    AS-VDD1V8-zl2006          1810 mV
    AS-VDD2V5-zl2006          2508 mV
    AS-AVDD1V0-zl2004          999 mV
    AS-PCIE_1V0-zl2004        1001 mV
    AS-VDD3V3-zl2004          3294 mV
    AS-VDD_1V5A-zl2004        1500 mV
    AS-VDD_1V5B-zl2004        1498 mV
    AS-LU0_1V0-zl2004          998 mV
    AS-LU1_1V0-zl2004          998 mV
    AS-MQ0_1V0-zl2004          999 mV
    AS-MQ1_1V0-zl2004          998 mV
    AS-LU2_1V0-zl2004         1000 mV
    AS-LU3_1V0-zl2004         1001 mV
    AS-MQ2_1V0-zl2004          996 mV
    AS-MQ3_1V0-zl2004          998 mV
    AS-PMB_1V1-zl2006         1098 mV
  I2C Slave Revision         68
FPC 4 status:
...
```

show chassis environment fpc (MX2010 Router)

```
user@host> show chassis environment fpc
FPC 0 status:
  State                      Online
  Temperature Intake         36 degrees C / 96 degrees F
  Temperature Exhaust A      42 degrees C / 107 degrees F
  Temperature Exhaust B      51 degrees C / 123 degrees F
  Temperature LU 0 TSen      49 degrees C / 120 degrees F
  Temperature LU 0 Chip      50 degrees C / 122 degrees F
  Temperature LU 1 TSen      49 degrees C / 120 degrees F
  Temperature LU 1 Chip      54 degrees C / 129 degrees F
  Temperature LU 2 TSen      49 degrees C / 120 degrees F
  Temperature LU 2 Chip      45 degrees C / 113 degrees F
  Temperature LU 3 TSen      49 degrees C / 120 degrees F
  Temperature LU 3 Chip      46 degrees C / 114 degrees F
  Temperature MQ 0 TSen      40 degrees C / 104 degrees F
  Temperature MQ 0 Chip      41 degrees C / 105 degrees F
  Temperature MQ 1 TSen      40 degrees C / 104 degrees F
  Temperature MQ 1 Chip      44 degrees C / 111 degrees F
  Temperature MQ 2 TSen      40 degrees C / 104 degrees F
  Temperature MQ 2 Chip      38 degrees C / 100 degrees F
  Temperature MQ 3 TSen      40 degrees C / 104 degrees F
  Temperature MQ 3 Chip      41 degrees C / 105 degrees F
  Power
    AS-BIAS3V3-zl2105         3300 mV
    AS-VDD1V8-zl2006          1805 mV
    AS-VDD2V5-zl2006          2505 mV
    AS-AVDD1V0-zl2004          998 mV
    AS-PCIE_1V0-zl2004         999 mV
    AS-VDD3V3-zl2004          3303 mV
    AS-VDD_1V5A-zl2004        1497 mV
    AS-VDD_1V5B-zl2004        1497 mV
    AS-LU0_1V0-zl2004          998 mV
    AS-LU1_1V0-zl2004         1003 mV
    AS-MQ0_1V0-zl2004          998 mV
    AS-MQ1_1V0-zl2004          998 mV
    AS-LU2_1V0-zl2004          997 mV
    AS-LU3_1V0-zl2004         1001 mV
    AS-MQ2_1V0-zl2004          996 mV
    AS-MQ3_1V0-zl2004          994 mV
    AS-PMB_1V1-zl2006         1097 mV
  I2C Slave Revision         68
FPC 1 status:
  State                      Online
  Temperature Intake         34 degrees C / 93 degrees F
  Temperature Exhaust A      46 degrees C / 114 degrees F
  Temperature Exhaust B      54 degrees C / 129 degrees F
  Temperature LU 0 TSen      45 degrees C / 113 degrees F
  Temperature LU 0 Chip      55 degrees C / 131 degrees F
  Temperature LU 1 TSen      45 degrees C / 113 degrees F
  Temperature LU 1 Chip      44 degrees C / 111 degrees F
  Temperature LU 2 TSen      45 degrees C / 113 degrees F
  Temperature LU 2 Chip      50 degrees C / 122 degrees F
  Temperature LU 3 TSen      45 degrees C / 113 degrees F
  Temperature LU 3 Chip      58 degrees C / 136 degrees F
  Temperature XM 0 TSen      45 degrees C / 113 degrees F
  Temperature XM 0 Chip      51 degrees C / 123 degrees F
  Temperature XF 0 TSen      45 degrees C / 113 degrees F
  Temperature XF 0 Chip      63 degrees C / 145 degrees F
  Temperature PLX Switch TSen45 degrees C / 113 degrees F
```



```
  Temperature PLX Switch Chip47 degrees C / 116 degrees F
  Power
    MPC-BIAS3V3-zl2105        3300 mV
    MPC-VDD3V3-zl6100         3294 mV
    MPC-VDD2V5-zl6100         2505 mV
    MPC-VDD1V8-zl2004         1796 mV
    MPC-AVDD1V0-zl2004         991 mV
    MPC-VDD1V2-zl6100         1196 mV
    MPC-VDD1V5A-zl2004        1491 mV
    MPC-VDD1V5B-zl2004        1492 mV
    MPC-XF_0V9-zl2004          996 mV
    MPC-PCIE_1V0-zl6100       1003 mV
    MPC-LU0_1V0-zl2004         996 mV
    MPC-LU1_1V0-zl2004         996 mV
    MPC-LU2_1V0-zl2004         998 mV
    MPC-LU3_1V0-zl2004         994 mV
    MPC-12VA-BMR453          12031 mV
    MPC-12VB-BMR453          12003 mV
    MPC-PMB_1V1-zl2006        1104 mV
    MPC-PMB_1V2-zl2106        1194 mV
    MPC-XM_0V9-vt273m          911 mV
  I2C Slave Revision         110
FPC 8 status:
  State                      Online
  Temperature Intake         32 degrees C / 89 degrees F
  Temperature Exhaust A      44 degrees C / 111 degrees F
  Temperature Exhaust B      37 degrees C / 98 degrees F
  Temperature LU 0 TCAM TSen 41 degrees C / 105 degrees F
  Temperature LU 0 TCAM Chip 49 degrees C / 120 degrees F
  Temperature LU 0 TSen      41 degrees C / 105 degrees F
  Temperature LU 0 Chip      52 degrees C / 125 degrees F
  Temperature MQ 0 TSen      41 degrees C / 105 degrees F
  Temperature MQ 0 Chip      47 degrees C / 116 degrees F
  Temperature LU 1 TCAM TSen 39 degrees C / 102 degrees F
  Temperature LU 1 TCAM Chip 42 degrees C / 107 degrees F
  Temperature LU 1 TSen      39 degrees C / 102 degrees F
  Temperature LU 1 Chip      46 degrees C / 114 degrees F
  Temperature MQ 1 TSen      39 degrees C / 102 degrees F
  Temperature MQ 1 Chip      45 degrees C / 113 degrees F
  Power
    MPC-BIAS3V3-zl2105        3296 mV
    MPC-VDD3V3-zl2006         3298 mV
    MPC-VDD2V5-zl2006         2505 mV
    MPC-TCAM_1V0-zl2004        997 mV
    MPC-AVDD1V0-zl2006        1007 mV
    MPC-VDD1V8-zl2006         1803 mV
    MPC-PCIE_1V0-zl2006       1004 mV
    MPC-LU0_1V0-zl2004        1000 mV
    MPC-MQ0_1V0-zl2004         999 mV
    MPC-VDD_1V5-zl2004        1498 mV
    MPC-PMB_1V1-zl2006        1102 mV
    MPC-9VA-BMR453            9009 mV
    MPC-9VB-BMR453            8960 mV
    MPC-PMB_1V2-zl2105        1202 mV
    MPC-LU1_1V0-zl2004        1005 mV
    MPC-MQ1_1V0-zl2004        1000 mV
  I2C Slave Revision         70
FPC 9 status:
  State                      Online
  Temperature Intake         34 degrees C / 93 degrees F
  Temperature Exhaust A      41 degrees C / 105 degrees F
```



```
Temperature Exhaust B       54 degrees C / 129 degrees F
Temperature LU 0 TSen       51 degrees C / 123 degrees F
Temperature LU 0 Chip       52 degrees C / 125 degrees F
Temperature LU 1 TSen       51 degrees C / 123 degrees F
Temperature LU 1 Chip       55 degrees C / 131 degrees F
Temperature LU 2 TSen       51 degrees C / 123 degrees F
Temperature LU 2 Chip       47 degrees C / 116 degrees F
Temperature LU 3 TSen       51 degrees C / 123 degrees F
Temperature LU 3 Chip       47 degrees C / 116 degrees F
Temperature MQ 0 TSen       40 degrees C / 104 degrees F
Temperature MQ 0 Chip       42 degrees C / 107 degrees F
Temperature MQ 1 TSen       40 degrees C / 104 degrees F
Temperature MQ 1 Chip       44 degrees C / 111 degrees F
Temperature MQ 2 TSen       40 degrees C / 104 degrees F
Temperature MQ 2 Chip       38 degrees C / 100 degrees F
Temperature MQ 3 TSen       40 degrees C / 104 degrees F
Temperature MQ 3 Chip       40 degrees C / 104 degrees F
Power
  AS-BIAS3V3-zl2105          3302 mV
  AS-VDD1V8-zl2006           1808 mV
  AS-VDD2V5-zl2006           2513 mV
  AS-AVDD1V0-zl2004           997 mV
  AS-PCIE_1V0-zl2004          999 mV
  AS-VDD3V3-zl2004           3294 mV
  AS-VDD_1V5A-zl2004         1503 mV
  AS-VDD_1V5B-zl2004         1502 mV
  AS-LU0_1V0-zl2004           996 mV
  AS-LU1_1V0-zl2004           999 mV
  AS-MQ0_1V0-zl2004           997 mV
  AS-MQ1_1V0-zl2004           999 mV
  AS-LU2_1V0-zl2004           997 mV
  AS-LU3_1V0-zl2004           998 mV
  AS-MQ2_1V0-zl2004          1000 mV
  AS-MQ3_1V0-zl2004          1000 mV
  AS-PMB_1V1-zl2006          1102 mV
I2C Slave Revision          68
```

show chassis environment fpc (MX240 Router)

```
user@host> show chassis environment fpc
FPC 1 status:
  State                       Online
  Temperature Intake          34 degrees C / 93 degrees F
  Temperature Exhaust A       39 degrees C / 102 degrees F
  Temperature Exhaust B       53 degrees C / 127 degrees F
  Temperature I3 0 TSensor    51 degrees C / 123 degrees F
  Temperature I3 0 Chip       54 degrees C / 129 degrees F
  Temperature I3 1 TSensor    50 degrees C / 122 degrees F
  Temperature I3 1 Chip       53 degrees C / 127 degrees F
  Temperature I3 2 TSensor    48 degrees C / 118 degrees F
  Temperature I3 2 Chip       51 degrees C / 123 degrees F
  Temperature I3 3 TSensor    45 degrees C / 113 degrees F
  Temperature I3 3 Chip       48 degrees C / 118 degrees F
  Temperature IA 0 TSensor    45 degrees C / 113 degrees F
  Temperature IA 0 Chip       45 degrees C / 113 degrees F
  Temperature IA 1 TSensor    45 degrees C / 113 degrees F
  Temperature IA 1 Chip       49 degrees C / 120 degrees F
  Power
    1.5 V                      1492 mV
    2.5 V                      2507 mV
    3.3 V                      3306 mV
```



```
    1.8 V PFE 0                1801 mV
    1.8 V PFE 1                1804 mV
    1.8 V PFE 2                1798 mV
    1.8 V PFE 3                1798 mV
    1.2 V PFE 0                1169 mV
    1.2 V PFE 1                1189 mV
    1.2 V PFE 2                1182 mV
    1.2 V PFE 3                1176 mV
  I2C Slave Revision          42
FPC 2 status:
  State                       Online
  Temperature Intake          33 degrees C / 91 degrees F
  Temperature Exhaust A       41 degrees C / 105 degrees F
  Temperature Exhaust B       53 degrees C / 127 degrees F
  Temperature I3 0 TSensor    53 degrees C / 127 degrees F
  Temperature I3 0 Chip       58 degrees C / 136 degrees F
  Temperature I3 1 TSensor    52 degrees C / 125 degrees F
  Temperature I3 1 Chip       56 degrees C / 132 degrees F
  Temperature I3 2 TSensor    50 degrees C / 122 degrees F
  Temperature I3 2 Chip       52 degrees C / 125 degrees F
  Temperature I3 3 TSensor    46 degrees C / 114 degrees F
  Temperature I3 3 Chip       49 degrees C / 120 degrees F
  Temperature IA 0 TSensor    51 degrees C / 123 degrees F
  Temperature IA 0 Chip       49 degrees C / 120 degrees F
  Temperature IA 1 TSensor    48 degrees C / 118 degrees F
  Temperature IA 1 Chip       53 degrees C / 127 degrees F
  Power
    1.5 V                      1492 mV
    2.5 V                      2445 mV
    3.3 V                      3293 mV
    1.8 V PFE 0                1827 mV
    1.8 V PFE 1                1775 mV
    1.8 V PFE 2                1788 mV
    1.8 V PFE 3                1798 mV
    1.2 V PFE 0                1250 mV
    1.2 V PFE 1                1234 mV
    1.2 V PFE 2                1231 mV
    1.2 V PFE 3                1192 mV
  I2C Slave Revision          42
```

show chassis environment fpc (MX480 Router)

```
user@host> show chassis environment fpc
FPC 1 status:
  State                       Online
  Temperature Intake          36 degrees C / 96 degrees F
  Temperature Exhaust A       41 degrees C / 105 degrees F
  Temperature Exhaust B       55 degrees C / 131 degrees F
  Temperature I3 0 TSensor    55 degrees C / 131 degrees F
  Temperature I3 0 Chip       57 degrees C / 134 degrees F
  Temperature I3 1 TSensor    53 degrees C / 127 degrees F
  Temperature I3 1 Chip       53 degrees C / 127 degrees F
  Temperature I3 2 TSensor    52 degrees C / 125 degrees F
  Temperature I3 2 Chip       49 degrees C / 120 degrees F
  Temperature I3 3 TSensor    47 degrees C / 116 degrees F
  Temperature I3 3 Chip       47 degrees C / 116 degrees F
  Temperature IA 0 TSensor    54 degrees C / 129 degrees F
  Temperature IA 0 Chip       58 degrees C / 136 degrees F
  Temperature IA 1 TSensor    48 degrees C / 118 degrees F
  Temperature IA 1 Chip       53 degrees C / 127 degrees F
  Power
```



```
    1.5 V                     1479 mV
    2.5 V                     2542 mV
    3.3 V                     3319 mV
    1.8 V PFE 0               1811 mV
    1.8 V PFE 1               1804 mV
    1.8 V PFE 2               1804 mV
    1.8 V PFE 3               1814 mV
    1.2 V PFE 0               1192 mV
    1.2 V PFE 1               1202 mV
    1.2 V PFE 2               1205 mV
    1.2 V PFE 3               1189 mV
  I2C Slave Revision         40
```

show chassis environment fpc (MX960 Router)

```
user@host> show chassis environment fpc
FPC 5 status:
  State                      Online
  Temperature Intake         27 degrees C / 80 degrees F
  Temperature Exhaust A      34 degrees C / 93 degrees F
  Temperature Exhaust B      40 degrees C / 104 degrees F
  Temperature I3 0 TSensor   39 degrees C / 102 degrees F
  Temperature I3 0 Chip      41 degrees C / 105 degrees F
  Temperature I3 1 TSensor   38 degrees C / 100 degrees F
  Temperature I3 1 Chip      37 degrees C / 98 degrees F
  Temperature I3 2 TSensor   37 degrees C / 98 degrees F
  Temperature I3 2 Chip      34 degrees C / 93 degrees F
  Temperature I3 3 TSensor   32 degrees C / 89 degrees F
  Temperature I3 3 Chip      33 degrees C / 91 degrees F
  Temperature IA 0 TSensor   39 degrees C / 102 degrees F
  Temperature IA 0 Chip      44 degrees C / 111 degrees F
  Temperature IA 1 TSensor   36 degrees C / 96 degrees F
  Temperature IA 1 Chip      44 degrees C / 111 degrees F
  Power
    1.5 V                     1479 mV
    2.5 V                     2523 mV
    3.3 V                     3254 mV
    1.8 V PFE 0               1798 mV
    1.8 V PFE 1               1798 mV
    1.8 V PFE 2               1807 mV
    1.8 V PFE 3               1791 mV
    1.2 V PFE 0               1173 mV
    1.2 V PFE 1               1179 mV
    1.2 V PFE 2               1179 mV
    1.2 V PFE 3               1185 mV
  I2C Slave Revision         6
FPC 6 status:
  State                      Online
  Temperature Intake         25 degrees C / 77 degrees F
  Temperature Exhaust A      38 degrees C / 100 degrees F
  Temperature Exhaust B      38 degrees C / 100 degrees F
  Temperature I3 0 TSensor   40 degrees C / 104 degrees F
  Temperature I3 0 Chip      40 degrees C / 104 degrees F
  Temperature I3 1 TSensor   40 degrees C / 104 degrees F
  Temperature I3 1 Chip      38 degrees C / 100 degrees F
  Temperature I3 2 TSensor   37 degrees C / 98 degrees F
  Temperature I3 2 Chip      32 degrees C / 89 degrees F
  Temperature I3 3 TSensor   34 degrees C / 93 degrees F
  Temperature I3 3 Chip      33 degrees C / 91 degrees F
  Temperature IA 0 TSensor   45 degrees C / 113 degrees F
  Temperature IA 0 Chip      47 degrees C / 116 degrees F
```



```
  Temperature IA 1 TSensor   37 degrees C / 98 degrees F
  Temperature IA 1 Chip      42 degrees C / 107 degrees F
  Power
    1.5 V                     1485 mV
    2.5 V                     2510 mV
    3.3 V                     3332 mV
    1.8 V PFE 0               1801 mV
    1.8 V PFE 1               1814 mV
    1.8 V PFE 2               1804 mV
    1.8 V PFE 3               1820 mV
    1.2 V PFE 0               1192 mV
    1.2 V PFE 1               1189 mV
    1.2 V PFE 2               1202 mV
    1.2 V PFE 3               1156 mV
  I2C Slave Revision         40
```

show chassis environment fpc (MX480 Router with 100-Gigabit Ethernet CFP)

```
user@host> show chassis environment fpc
FPC 0 status:
  State                      Online
  Temperature Intake         32 degrees C / 89 degrees F
  Temperature Exhaust A      39 degrees C / 102 degrees F
  Temperature Exhaust B      37 degrees C / 98 degrees F
  Temperature QX 0 TSen      44 degrees C / 111 degrees F
  Temperature QX 0 Chip      48 degrees C / 118 degrees F
  Temperature LU 0 TCAM TSen 44 degrees C / 111 degrees F
  Temperature LU 0 TCAM Chip 47 degrees C / 116 degrees F
  Temperature LU 0 TSen      44 degrees C / 111 degrees F
  Temperature LU 0 Chip      48 degrees C / 118 degrees F
  Temperature MQ 0 TSen      44 degrees C / 111 degrees F
  Temperature MQ 0 Chip      47 degrees C / 116 degrees F
  Power
    MPC-BIAS3V3-zl2105        3297 mV
    MPC-VDD3V3-zl2105         3306 mV
    MPC-VDD2V5-zl2105         2498 mV
    MPC-TCAM_1V0-zl2004        999 mV
    MPC-AVDD1V0-zl2006         999 mV
    MPC-VDD1V8-zl2006         1796 mV
    MPC-PCIE_1V0-zl2006       1002 mV
    MPC-LU0_1V0-zl2004         997 mV
    MPC-MQ0_1V0-zl2004         995 mV
    MPC-VDD_1V5-zl2004        1496 mV
    MPC-PMB_1V1-zl2006        1094 mV
    MPC-9VA-BMR453            9054 mV
    MPC-9VB-BMR453            9037 mV
    MPC-PMB_1V2-zl2106        1191 mV
    MPC-QXM0_1V0-zl2006       1000 mV
  I2C Slave Revision         66
FPC 1 status:
  State                      Online
  Temperature Intake         35 degrees C / 95 degrees F
  Temperature Exhaust A      50 degrees C / 122 degrees F
  Temperature Exhaust B      56 degrees C / 132 degrees F
  Temperature LU 0 TSen      46 degrees C / 114 degrees F
  Temperature LU 0 Chip      59 degrees C / 138 degrees F
  Temperature LU 1 TSen      46 degrees C / 114 degrees F
  Temperature LU 1 Chip      45 degrees C / 113 degrees F
  Temperature LU 2 TSen      46 degrees C / 114 degrees F
  Temperature LU 2 Chip      60 degrees C / 140 degrees F
  Temperature LU 3 TSen      46 degrees C / 114 degrees F
```



```
  Temperature LU 3 Chip       71 degrees C / 159 degrees F
  Temperature XM 0 TSen       46 degrees C / 114 degrees F
  Temperature XM 0 Chip       -18 degrees C / 0 degrees F
  Temperature XF 0 TSen       46 degrees C / 114 degrees F
  Temperature XF 0 Chip       76 degrees C / 168 degrees F
  Power
    MPC-BIAS3V3-zl2105         3292 mV
    MPC-VDD3V3-zl6100          3303 mV
    MPC-VDD2V5-zl6100          2501 mV
    MPC-VDD1V8-zl2004          1801 mV
    MPC-AVDD1V0-zl2006          996 mV
    MPC-VDD1V2-zl6100          1199 mV
    MPC-VDD1V5A-zl2004         1493 mV
    MPC-VDD1V5B-zl2004         1498 mV
    MPC-XF_0V9-zl2006           996 mV
    MPC-PCIE_1V0-zl6100        1000 mV
    MPC-LU0_1V0-zl2004          994 mV
    MPC-LU1_1V0-zl2004          994 mV
    MPC-LU2_1V0-zl2004          992 mV
    MPC-LU3_1V0-zl2004          993 mV
    MPC-12VA-BMR453           12003 mV
    MPC-12VB-BMR453           12043 mV
    MPC-PMB_1V1-zl2006         1091 mV
    MPC-PMB_1V2-zl2106         1196 mV
    MPC-XM_0V9-vt273m           899 mV
  I2C Slave Revision          106
```

show chassis environment fpc (MX240, MX480, MX960 with Application Services Modular Line Card

```
user@host>show chassis environment fpc 1
FPC 1 status:
  State                       Online
  Temperature Intake          36 degrees C / 96 degrees F
  Temperature Exhaust A       39 degrees C / 102 degrees F
  Temperature LU TSen         52 degrees C / 125 degrees F
  Temperature LU Chip         54 degrees C / 129 degrees F
  Temperature XM TSen         52 degrees C / 125 degrees F
  Temperature XM Chip         60 degrees C / 140 degrees F
  Temperature PCIe TSen       52 degrees C / 125 degrees F
  Temperature PCIe Chip       69 degrees C / 156 degrees F
  Power
    MPC-BIAS3V3-zl2106         3302 mV
    MPC-VDD3V3-zl6100          3325 mV
    MPC-AVDD1V0-zl6100         1007 mV
    MPC-PCIE_1V0-zl6100         904 mV
    MPC-LU0_1V0-zl2004          996 mV
    MPC-VDD_1V5-zl2004         1498 mV
    MPC-12VA-BMR453           11733 mV
    MPC-12VB-BMR453           11728 mV
    MPC-XM_0V9-vt273m           900 mV
  I2C Slave Revision          81
```

show chassis environment fpc (T320, T640, and T1600 Routers)

```
user@host> show chassis environment fpc
FPC 0 status:
  State                            Online
  Temperature Top                42 degrees C / 107 degrees F
  Temperature Bottom             36 degrees C / 96 degrees F
  Temperature MMB1               39 degrees C / 102 degrees F
  Power:
```



```
    1.8 V                    1959 mV
    2.5 V                    2495 mV
    3.3 V                    3344 mV
    5.0 V                    5047 mV
    1.8 V bias               1787 mV
    3.3 V bias               3291 mV
    5.0 V bias               4998 mV
    8.0 V bias               7343 mV
  BUS Revision                 40
FPC 1 status:
  State                           Online
  Temperature Top              42 degrees C / 107 degrees F
  Temperature Bottom           39 degrees C / 102 degrees F
  Temperature MMB1             40 degrees C / 104 degrees F
  Power:
    1.8 V                    1956 mV
    2.5 V                    2498 mV
    3.3 V                    3340 mV
    5.0 V                    5023 mV
    1.8 V bias               1782 mV
    3.3 V bias               3277 mV
    5.0 V bias               4989 mV
    8.0 V bias               7289 mV
  BUS Revision                 40
FPC 2 status:
  State                           Online
  Temperature Top              43 degrees C / 109 degrees F
  Temperature Bottom           39 degrees C / 102 degrees F
  Temperature MMB1             41 degrees C / 105 degrees F
  Power:
    1.8 V                    1963 mV
    2.5 V                    2503 mV
    3.3 V                    3340 mV
    5.0 V                    5042 mV
    1.8 V bias               1797 mV
    3.3 V bias               3311 mV
    5.0 V bias               5013 mV
    8.0 V bias               7221 mV
  BUS Revision                 40
```

show chassis environment fpc (T4000 Router)

```
user@host> show chassis environment fpc
FPC 0 status:
  State                      Online
  Fan Intake                 34 degrees C / 93 degrees F
  Fan Exhaust                48 degrees C / 118 degrees F
  PMB                        47 degrees C / 116 degrees F
  LMB0                       50 degrees C / 122 degrees F
  LMB1                       41 degrees C / 105 degrees F
  LMB2                       35 degrees C / 95 degrees F
  PFE1 LU2                   46 degrees C / 114 degrees F
  PFE1 LU0                   41 degrees C / 105 degrees F
  PFE0 LU0                   57 degrees C / 134 degrees F
  XF1                        47 degrees C / 116 degrees F
  XF0                        52 degrees C / 125 degrees F
  XM1                        41 degrees C / 105 degrees F
  XM0                        50 degrees C / 122 degrees F
  PFE0 LU1                   56 degrees C / 132 degrees F
  PFE0 LU2                   45 degrees C / 113 degrees F
  PFE1 LU1                   37 degrees C / 98 degrees F
```



```
  Power 1
    1.0 V                    991 mV
    1.2 V bias              1195 mV
    1.8 V                   1788 mV
    2.5 V                   2483 mV
    3.3 V                   3289 mV
    3.3 V bias              3299 mV
    12.0 V A               10608 mV
    12.0 V B               10637 mV
  Power 2
    0.9 V                    881 mV
    0.9 V PFE0               916 mV
    0.9 V PFE1               903 mV
    1.0 V PFE0              1012 mV
    1.0 V PFE1              1002 mV
    1.1 V                   1095 mV
    1.5 V_0                 1494 mV
    1.5 V_1                 1479 mV
  Power 3
    1.0 V PFE0              1000 mV
    1.0 V PFE1              1002 mV
    1.0 V PFE0 *             995 mV
    1.0 V PFE1 *             995 mV
    1.8 V PFE 0             1788 mV
    1.8 V PFE 1             1789 mV
    2.5 V                   2482 mV
    12.0 V                 11614 mV
  Power 4
    1.0 V PFE0 LU0          1003 mV
    1.0 V PFE1 LU0          1003 mV
    1.0 V PFE1 LU2          1004 mV
    1.0 V PFE0 LU0 *         995 mV
    1.0 V PFE1 LU0 *         998 mV
    1.0 V PFE1 LU2 *         996 mV
    12.0 V                 11643 mV
    12.0 V C               11711 mV
  Power (Base/PMB/MMB)
    LMB0 VDD2V5             2488 mV
    LMB0 VDD1V8             1788 mV
    LMB0 VDD1V5             1496 mV
    LMB0 PFE0 LU0 AVDD1V0   1002 mV
    LMB0 PFE0 LU0 VDD1V0    1000 mV
    LMB0 VDD12V0           10752 mV
    LMB1 VDD2V5             2472 mV
    LMB1 VDD1V8             1792 mV
    LMB1 VDD1V5             1480 mV
    LMB1 PFE0 LU2 AVDD1V0    994 mV
    LMB1 PFE0 LU2 VDD1V0    1002 mV
    LMB1 VDD12V0           10800 mV
    LMB2 VDD2V5             2472 mV
    LMB2 VDD1V8             1792 mV
    LMB2 VDD1V5             1486 mV
    LMB2 PFE1 LU1 AVDD1V0    996 mV
    LMB2 PFE1 LU1 VDD1V0     998 mV
    LMB2 VDD12V0           10704 mV
    PMB 1.05v               1049 mV
    PMB 1.5v                1500 mV
    PMB 2.5v                2500 mV
    PMB 3.3v                3299 mV
  Bus Revision             113
FPC 3 status:
```

```
State                      Online
Fan Intake                 37 degrees C / 98 degrees F
Fan Exhaust                51 degrees C / 123 degrees F
PMB                        43 degrees C / 109 degrees F
LMB0                       57 degrees C / 134 degrees F
LMB1                       54 degrees C / 129 degrees F
LMB2                       38 degrees C / 100 degrees F
PFE1 LU2                   63 degrees C / 145 degrees F
PFE1 LU0                   45 degrees C / 113 degrees F
PFE0 LU0                   69 degrees C / 156 degrees F
XF1                        62 degrees C / 143 degrees F
XF0                        63 degrees C / 145 degrees F
XM1                        43 degrees C / 109 degrees F
XM0                        67 degrees C / 152 degrees F
PFE0 LU1                   63 degrees C / 145 degrees F
PFE0 LU2                   66 degrees C / 150 degrees F
PFE1 LU1                   41 degrees C / 105 degrees F
Power 1
  1.0 V                     1002 mV
  1.2 V bias                1201 mV
  1.8 V                     1785 mV
  2.5 V                     2485 mV
  3.3 V                     3288 mV
  3.3 V bias                3285 mV
  12.0 V A                 10412 mV
  12.0 V B                 10515 mV
Power 2
  0.9 V                      882 mV
  0.9 V PFE0                 920 mV
  0.9 V PFE1                 905 mV
  1.0 V PFE0                1015 mV
  1.0 V PFE1                1001 mV
  1.1 V                     1094 mV
  1.5 V_0                   1495 mV
  1.5 V_1                   1478 mV
Power 3
  0.92 V PFE1                998 mV
  1.0 V PFE0                 997 mV
  1.0 V PFE0 *               992 mV
  1.0 V PFE1 *               991 mV
  1.8 V PFE 0               1780 mV
  1.8 V PFE 1               1797 mV
  2.5 V                     2492 mV
  12.0 V                   11604 mV
Power 4
  1.0 V PFE0 LU0            1003 mV
  1.0 V PFE1 LU0            1004 mV
  1.0 V PFE1 LU2            1003 mV
  1.0 V PFE0 LU0 *          1000 mV
  1.0 V PFE1 LU0 *          1001 mV
  1.0 V PFE1 LU2 *          1003 mV
  12.0 V                   11653 mV
  12.0 V C                 11672 mV
Power (Base/PMB/MMB)
  LMB0 VDD2V5               2512 mV
  LMB0 VDD1V8               1790 mV
  LMB0 VDD1V5               1500 mV
  LMB0 PFE0 LU0 AVDD1V0     1004 mV
  LMB0 PFE0 LU0 VDD1V0      1002 mV
  LMB0 VDD12V0             10608 mV
  LMB1 VDD2V5               2472 mV
```



```
    LMB1 VDD1V8              1788 mV
    LMB1 VDD1V5              1480 mV
    LMB1 PFE0 LU2 AVDD1V0    1000 mV
    LMB1 PFE0 LU2 VDD1V0     1004 mV
    LMB1 VDD12V0            10672 mV
    LMB2 VDD2V5              2488 mV
    LMB2 VDD1V8              1798 mV
    LMB2 VDD1V5              1494 mV
    LMB2 PFE1 LU1 AVDD1V0    1000 mV
    LMB2 PFE1 LU1 VDD1V0     1004 mV
    LMB2 VDD12V0            10528 mV
    PMB 1.05v                1050 mV
    PMB 1.5v                 1500 mV
    PMB 2.5v                 2499 mV
    PMB 3.3v                 3299 mV
  Bus Revision              113
FPC 5 status:
  State                     Online
  Temperature Top           39 degrees C / 102 degrees F
  Temperature Bottom        38 degrees C / 100 degrees F
  Power
    1.8 V                    1804 mV
    1.8 V bias               1802 mV
    3.3 V                    3294 mV
    3.3 V bias               3277 mV
    5.0 V bias               5008 mV
    5.0 V TOP                5067 mV
    8.0 V bias               6642 mV
  Power (Base/PMB/MMB)
    1.2 V                    1202 mV
    1.5 V                    1504 mV
    5.0 V BOT                5079 mV
    12.0 V TOP Base         11848 mV
    12.0 V BOT Base         11780 mV
    1.1 V PMB                1111 mV
    1.2 V PMB                1189 mV
    1.5 V PMB                1494 mV
    1.8 V PMB                1819 mV
    2.5 V PMB                2503 mV
    3.3 V PMB                3294 mV
    5.0 V PMB                5035 mV
    12.0  V PMB             11788 mV
    0.75 MMB TOP              766 mV
    1.5 V MMB TOP            1484 mV
    1.8 V MMB TOP            1772 mV
    2.5 V MMB TOP            2485 mV
    1.2 V MMB TOP            1137 mV
    5.0 V MMB TOP            4946 mV
    12.0 V MMB TOP          11772 mV
    3.3 V MMB TOP            3289 mV
    0.75 MMB BOT              759 mV
    1.5 V MMB BOT            1482 mV
    1.8 V MMB BOT            1792 mV
    2.5 V MMB BOT            2490 mV
    1.2 V MMB BOT            1145 mV
    5.0 V MMB BOT            4922 mV
    12.0 V MMB BOT          11625 mV
    3.3 V MMB BOT            3282 mV
    APS 00                   2495 mV
    APS 01                   3308 mV
    APS 02                   3301 mV
```

```
    5.0 V PIC 0                4967 mV
    APS 10                     2512 mV
    APS 11                     3316 mV
    APS 12                     3304 mV
    5.0 V PIC 1                5081 mV
  Bus Revision                49
FPC 6 status:
  State                       Online
  Fan Intake                  34 degrees C / 93 degrees F
  Fan Exhaust                 49 degrees C / 120 degrees F
  PMB                         40 degrees C / 104 degrees F
  LMB0                        60 degrees C / 140 degrees F
  LMB1                        58 degrees C / 136 degrees F
  LMB2                        40 degrees C / 104 degrees F
  PFE1 LU2                    69 degrees C / 156 degrees F
  PFE1 LU0                    45 degrees C / 113 degrees F
  PFE0 LU0                    71 degrees C / 159 degrees F
  XF1                         58 degrees C / 136 degrees F
  XF0                         65 degrees C / 149 degrees F
  XM1                         40 degrees C / 104 degrees F
  XM0                         66 degrees C / 150 degrees F
  PFE0 LU1                    69 degrees C / 156 degrees F
  PFE0 LU2                    68 degrees C / 154 degrees F
  PFE1 LU1                    42 degrees C / 107 degrees F
  Power 1
    1.0 V                       998 mV
    1.2 V bias                 1191 mV
    1.8 V                      1781 mV
    2.5 V                      2487 mV
    3.3 V                      3302 mV
    3.3 V bias                 3300 mV
    12.0 V A                  10388 mV
    12.0 V B                  10388 mV
  Power 2
    0.9 V                       902 mV
    0.9 V PFE0                  921 mV
    0.9 V PFE1                  907 mV
    1.0 V PFE0                  996 mV
    1.0 V PFE1                  974 mV
    1.1 V                      1095 mV
    1.5 V_0                    1495 mV
    1.5 V_1                    1478 mV
  Power 3
    1.0 V PFE0                  997 mV
    1.0 V PFE1                  998 mV
    1.0 V PFE0 *                993 mV
    1.0 V PFE1 *                991 mV
    1.8 V PFE 0                1796 mV
    1.8 V PFE 1                1789 mV
    2.5 V                      2465 mV
    12.0 V                    11609 mV
  Power 4
    1.0 V PFE0 LU0             1003 mV
    1.0 V PFE1 LU0             1006 mV
    1.0 V PFE1 LU2             1002 mV
    1.0 V PFE0 LU0 *           1000 mV
    1.0 V PFE1 LU0 *            998 mV
    1.0 V PFE1 LU2 *            998 mV
    12.0 V                    11638 mV
    12.0 V C                  11702 mV
  Power (Base/PMB/MMB)
```



```
    LMB0 VDD2V5               2484 mV
    LMB0 VDD1V8               1780 mV
    LMB0 VDD1V5               1496 mV
    LMB0 PFE0 LU0 AVDD1V0      998 mV
    LMB0 PFE0 LU0 VDD1V0      1004 mV
    LMB0 VDD12V0             10528 mV
    LMB1 VDD2V5               2472 mV
    LMB1 VDD1V8               1776 mV
    LMB1 VDD1V5               1474 mV
    LMB1 PFE0 LU2 AVDD1V0      994 mV
    LMB1 PFE0 LU2 VDD1V0      1004 mV
    LMB1 VDD12V0             10544 mV
    LMB2 VDD2V5               2476 mV
    LMB2 VDD1V8               1790 mV
    LMB2 VDD1V5               1492 mV
    LMB2 PFE1 LU1 AVDD1V0      996 mV
    LMB2 PFE1 LU1 VDD1V0      1010 mV
    LMB2 VDD12V0             10528 mV
    PMB 1.05v                 1050 mV
    PMB 1.5v                  1499 mV
    PMB 2.5v                  2500 mV
    PMB 3.3v                  3300 mV
  Bus Revision               80
```

show chassis environment fpc lcc (TX Matrix Router)

```
user@host> show chassis environment fpc lcc 0
lcc0-re0:
--------------------------------------------------------------------------
FPC 1 status:
  State                           Online
  Temperature Top               30 degrees C / 86 degrees F
  Temperature Bottom            25 degrees C / 77 degrees F
  Temperature MMB0                Absent
  Temperature MMB1              27 degrees C / 80 degrees F
  Power:
    1.8 V                     1813 mV
    2.5 V                     2504 mV
    3.3 V                     3338 mV
    5.0 V                     5037 mV
    1.8 V bias                1797 mV
    3.3 V bias                3301 mV
    5.0 V bias                5013 mV
    8.0 V bias                7345 mV
  BUS Revision                  40
FPC 2 status:
  State                           Online
  Temperature Top               37 degrees C / 98 degrees F
  Temperature Bottom            26 degrees C / 78 degrees F
  Temperature MMB0              32 degrees C / 89 degrees F
  Temperature MMB1              27 degrees C / 80 degrees F
  Power:
    1.8 V                     1791 mV
    2.5 V                     2517 mV
    3.3 V                     3308 mV
    5.0 V                     5052 mV
    1.8 V bias                1797 mV
    3.3 V bias                3289 mV
    5.0 V bias                4991 mV
    8.0 V bias                7477 mV
  BUS Revision                  40
```


show chassis environment fpc lcc (TX Matrix Plus Router)

```
user@host> show chassis environment fpc lcc 0
lcc0-re0:
--------------------------------------------------------------------------
FPC 1 status:
  State                      Online
  Temperature Top            46 degrees C / 114 degrees F
  Temperature Bottom         47 degrees C / 116 degrees F
  Power
    1.8 V                     1788 mV
    1.8 V bias                1787 mV
    3.3 V                     3321 mV
    3.3 V bias                3306 mV
    5.0 V bias                5018 mV
    5.0 V TOP                 5037 mV
    8.0 V bias                7223 mV
  Power (Base/PMB/MMB)
    1.2 V                     1205 mV
    1.5 V                     1503 mV
    5.0 V BOT                 5084 mV
    12.0 V TOP Base          11775 mV
    12.0 V BOT Base          11794 mV
    1.1 V PMB                 1108 mV
    1.2 V PMB                 1196 mV
    1.5 V PMB                 1499 mV
    1.8 V PMB                 1811 mV
    2.5 V PMB                 2515 mV
    3.3 V PMB                 3318 mV
    5.0 V PMB                 5030 mV
    12.0  V PMB              11832 mV
    0.75 MMB TOP               752 mV
    1.5 V MMB TOP             1489 mV
    1.8 V MMB TOP             1782 mV
    2.5 V MMB TOP             2498 mV
    1.2 V MMB TOP             1155 mV
    5.0 V MMB TOP             4902 mV
    12.0 V MMB TOP           11721 mV
    3.3 V MMB TOP             3316 mV
    0.75 MMB BOT               754 mV
    1.5 V MMB BOT             1482 mV
    1.8 V MMB BOT             1758 mV
    2.5 V MMB BOT             2488 mV
    1.2 V MMB BOT             1157 mV
    5.0 V MMB BOT             4962 mV
    12.0 V MMB BOT           11691 mV
    3.3 V MMB BOT             3308 mV
    APS 00                    1484 mV
    APS 01                    2503 mV
    APS 02                    3313 mV
    5.0 V PIC 0               5025 mV
    APS 10                    1501 mV
    APS 11                    2466 mV
    APS 12                    3311 mV
    5.0 V PIC 1               5081 mV
  Bus Revision               49
```

show chassis environment fpc (QFX Series)

```
user@switch> show chassis environment fpc 0
```

```
FPC 0 status:
  State                        Online
  Temperature                  42 degrees C / 107 degrees F
```

show chassis environment fpc interconnect-device (QFabric Systems)

```
user@switch> show chassis environment fpc interconnect-device interconnect1 0
FC 0 FPC 0 status:
  State                        Online
  Left Intake Temperature      24 degrees C / 75 degrees F
  Right Intake Temperature     24 degrees C / 75 degrees F
  Left Exhaust Temperature     27 degrees C / 80 degrees F
  Right Exhaust Temperature    27 degrees C / 80 degrees F
  Power
    BIAS 3V3                    3330 mV
    VDD 3V3                     3300 mV
    VDD 2V5                     2502 mV
    VDD 1V5                     1496 mV
    VDD 1V2                     1194 mV
    VDD 1V0                     1000 mV
    SW0 VDD  1V0                1020 mV
    SW0 CVDD 1V025              1032 mV
    SW1 VDD  1V0                1022 mV
    SW1 CVDD 1V025              1030 mV
    VDD 12V0 DIV3_33            3414 mV
```

show chassis environment fpc 0 (PTX5000 Packet Transport Router)

```
user@switch> show chassis environment fpc 0
FPC 0 status:
  State                        Online
  PMB Temperature              35 degrees C / 95 degrees F
  Intake Temperature           33 degrees C / 91 degrees F
  Exhaust A Temperature        51 degrees C / 123 degrees F
  Exhaust B Temperature        43 degrees C / 109 degrees F
  TL0 Temperature              48 degrees C / 118 degrees F
  TQ0 Temperature              53 degrees C / 127 degrees F
  TL1 Temperature              56 degrees C / 132 degrees F
  TQ1 Temperature              58 degrees C / 136 degrees F
  TL2 Temperature              55 degrees C / 131 degrees F
  TQ2 Temperature              57 degrees C / 134 degrees F
  TL3 Temperature              59 degrees C / 138 degrees F
  TQ3 Temperature              59 degrees C / 138 degrees F
  Power
    PMB   1.05v                 1049 mV
    PMB   1.5v                  1500 mV
    PMB   2.5v                  2500 mV
    PMB   3.3v                  3299 mV
    PFE0  1.5v                  1500 mV
    PFE0  1.0v                   999 mV
    TQ0   0.9v                   900 mV
    TL0   0.9v                   900 mV
    PFE1  1.5v                  1499 mV
    PFE1  1.0v                   999 mV
    TQ1   0.9v                   899 mV
    TL1   0.9v                   900 mV
    PFE2  1.5v                  1500 mV
    PFE2  1.0v                  1000 mV
    TQ2   0.9v                   900 mV
    TL2   0.9v                   900 mV
    PFE3  1.5v                  1499 mV
```



```
    PFE3  1.0v                1000 mV
    TQ3   0.9v                 900 mV
    TL3   0.9v                 900 mV
    Bias  3.3v                3327 mV
    FPC   3.3v                3300 mV
    FPC   2.5v                2500 mV
    SAM   0.9v                 900 mV
    A    12.0v                2014 mV
    B    12.0v                2030 mV
```

show chassis environment FPC 1 (MX Routers with Media Services Blade [MSB])

```
user@switch> show chassis environment fpc 1
FPC 1 status:
  State                        Online
  Temperature Intake           36 degrees C / 96 degrees F
  Temperature Exhaust A        39 degrees C / 102 degrees F
  Temperature LU TSen          52 degrees C / 125 degrees F
  Temperature LU Chip          54 degrees C / 129 degrees F
  Temperature XM TSen          52 degrees C / 125 degrees F
  Temperature XM Chip          60 degrees C / 140 degrees F
  Temperature PCIe TSen        52 degrees C / 125 degrees F
  Temperature PCIe Chip        69 degrees C / 156 degrees F
  Power
    MPC-BIAS3V3-zl2106          3302 mV
    MPC-VDD3V3-zl6100           3325 mV
    MPC-AVDD1V0-zl6100          1007 mV
    MPC-PCIE_1V0-zl6100          904 mV
    MPC-LU0_1V0-zl2004           996 mV
    MPC-VDD_1V5-zl2004          1498 mV
    MPC-12VA-BMR453            11733 mV
    MPC-12VB-BMR453            11728 mV
    MPC-XM_0V9-vt273m            900 mV
  I2C Slave Revision           81
```

show chassis environment pem

Syntax

show chassis environment pem
<*slot*>

Syntax (ACX4000 Router)

show chassis environment pem

Syntax (TX Matrix Routers)

show chassis environment pem
<lcc *number* | scc>
<*slot*>

Syntax (TX Matrix Plus Routers)

show chassis environment pem
<lcc *number* | sfc *number*>
<*slot*>

Syntax (MX Series Router)

show chassis environment pem
<*slot*>
<all-members>
<local>
<member *member-id*>

Syntax (MX104 3D Universal Edge Routers)

show chassis environment pem
<*slot*>

Syntax (QFX Series)

show chassis environment pem
<*slot* (interconnect-device *name slot*) | (node-device *name*)>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS 11.3 for the QFX Series.
Command introduced in Junos OS 12.3R2 for EX Series.
Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.

Description

Display Power Entry Module (PEM) environmental status information.

NOTE: The new high-capacity (4100W) enhanced DC PEM on MX960 routers includes a new design that can condition the input voltage. This results in the output voltage differing from the input voltage. The earlier generation of DC PEMs coupled the input power directly to the output, thereby making it safe to assume that the output voltage was equal to the input voltage.

Options

none—Display environmental information about both PEMs. For the TX Matrix router, display environmental information about the PEMs, the TX Matrix router, and its attached T640 routers. For the TX Matrix Plus router, display environmental information about the PEMs, the TX Matrix Plus router, and its attached routers.

all-members—(MX Series routers only) (Optional) Display environmental information about the PEMs in all the member routers of the Virtual Chassis configuration.

interconnect-device *name*—(QFabric systems only) (Optional) Display chassis environmental information about the PEMs in the Interconnect device.

lcc *number*—(TX Matrix router and TX Matrix Plus router only) (Optional) Line-card chassis number.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Display environmental information about the PEM in the local Virtual Chassis member.

member *member-id*—(MX Series routers only) (Optional) Display environmental information about the PEM in the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value of 0 or 1.

node-device *name*—(QFabric systems only) (Optional) Display chassis environmental information about the PEMs in the Node device.

scc—(TX Matrix routers only) (Optional) Display environmental information about the PEM in the TX Matrix router (switch-card chassis).

sfc—(TX Matrix Plus routers only) (Optional) Display environmental information about the PEM in the TX Matrix Plus router (or switch-fabric chassis).

slot —(Optional) Display environmental information about an individual PEM. Replace ***slot*** with **0** or **1**.

Required Privilege Level view

Related Documentation

- show chassis hardware on page 628

List of Sample Output

show chassis environment pem (M40e Router) on page 562
show chassis environment pem (M120 Router) on page 562
show chassis environment pem (M160 Router) on page 562
show chassis environment pem (M320 Router) on page 562
show chassis environment pem (MX104 Router) on page 563
show chassis environment pem (MX240 Router) on page 563
show chassis environment pem (MX480 Router) on page 563
show chassis environment pem (MX960 Router) on page 563

show chassis environment pem (T320 Router) on page 564
show chassis environment pem (T640 Router) on page 564
show chassis environment pem (T4000 Router) on page 564
show chassis environment pem (T640/T1600/T4000 Routers With Six-Input DC Power Supply) on page 564
show chassis environment pem lcc (TX Matrix Routing Matrix) on page 565
show chassis environment pem scc (TX Matrix Routing Matrix) on page 565
show chassis environment pem sfc (TX Matrix Plus Routing Matrix) on page 565
show chassis environment pem lcc (TX Matrix Plus Routing Matrix) on page 566
show chassis environment pem node-device (QFabric System on page 566
show chassis environment pem (QFX Series) on page 567
show chassis environment pem interconnect-device (QFabric System) on page 567

Output Fields Table 57 on page 561 lists the output fields for the **show chassis environment pem** command. Output fields are listed in the approximate order in which they appear.

Table 57: show chassis environment pem Output Fields

Field Name	Field Description
PEM *slot* status	Number of the PEM slot.
State	Status of the PEM.
Temperature	Temperature of the air flowing past the PEM.
AC Input	Status of the AC input for the specified component
AC Output	Status of the AC output for the specified component.
DC input	Status of the DC input for the specified component.
DC output	Status of the DC output for the specified component.
Load	(Not available on M40e or M160 routers) Information about the load on supply, in percentage of rated current being used.
Voltage	(M120, M160, M320, T640, T1600, TX Matrix, and TX Matrix Plus routers only) Information about voltage supplied to the PEM. (MX104 routers only) Information about voltage supplied by the PEM to the system.
Current	(T640, T1600, TX Matrix, and TX Matrix Plus routers only) Information about the PEM current.
Power	(T640, T1600, TX Matrix, and TX Matrix Plus routers only) Information about the PEM power.
SCG/CB/SIB	(T640, T1600, TX Matrix, and TX Matrix Plus routers only) SONET Clock Generator/Control Board/Switch Interface Board.
FAN	(T640, T1600, and T4000 routers with six-input DC power supply only) Information about the DC output to the fan.

Sample Output

show chassis environment pem (M40e Router)

```
user@host> show chassis environment pem
PEM 0 status:
  State                          Online
  Temperature                    OK
  AC input                       OK
  DC output                      OK
```

show chassis environment pem (M120 Router)

```
user@host> show chassis environment pem
PEM 0 status:
  State                     Online
  Temperature               OK
  DC Input:                 OK
  DC Output:                OK
  Load                      Less than 20 percent
  Voltage:
    48.0 V input            52864 mV
    48.0 V fan supply       41655 mV
    3.3 V                    3399 mV
PEM 1 status:
  State                     Online
  Temperature               OK
  DC Input:                 OK
  DC Output:                OK
  Load                      Less than 20 percent
  Voltage:
    48.0 V input            54537 mV
    48.0 V fan supply       42910 mV
    3.3 V                    3506 mV
```

show chassis environment pem (M160 Router)

```
user@host> show chassis environment pem
PEM 0 status:
  State                          Online
  Temperature                    OK
  DC input                       OK
  DC output                      OK
  Load                           Less than 20 percent
  Voltage:
    48.0 V input            54833 mV
    48.0 V fan supply       50549 mV
    8.0 V bias              8239 mV
    5.0 V bias              5006 mV
```

show chassis environment pem (M320 Router)

```
user@host> show chassis environment pem
PEM 2 status:
  State                          Online
  Temperature                    OK
  DC input                       OK
  Load                           Less than 40 percent
    48.0 V input           51853 mV
    48.0 V fan supply      48877 mV
    8.0 V bias              8449 mV
```



```
    5.0 V bias               4998 mV
PEM 3 status:
  State                           Online
  Temperature                     OK
  DC input                        OK
  Load                            Less than 40 percent
    48.0 V input            51717 mV
    48.0 V fan supply       49076 mV
    8.0 V bias               8442 mV
    5.0 V bias               4998 mV
```

show chassis environment pem (MX104 Router)

```
user@host> show chassis environment pem
PEM 0 status:
  State                      Online
  Temperature                OK
  DC Output:                 OK
  Voltage:
    12.0 V output            12281 mV
    3.3 V output              3353 mV
PEM 1 status:
  State                      Empty
```

show chassis environment pem (MX240 Router)

```
user@host> show chassis environment pem
PEM 0 status:
  State                      Online
  Temperature                 OK
  DC Output:                  OK
PEM 1 status:
  State                      Online
  Temperature                 OK
  DC Output:                  OK
```

show chassis environment pem (MX480 Router)

```
user@host> show chassis environment pem
PEM 0 status:
  State                      Online
  Temperature                 OK
  DC Input:                   OK
  DC Output:                  OK
  Voltage:
PEM 1 status:
  State                      Online
  Temperature                 OK
  DC Input:                   OK
  DC Output:                  OK
  Voltage:
```

show chassis environment pem (MX960 Router)

```
user@host> show chassis environment pem
PEM 2 status:
  State                      Present
PEM 3 status:
  State                      Online
  Temperature                 OK
  DC Output:                  OK
```


show chassis environment pem (T320 Router)

```
user@host> show chassis environment pem
PEM 0 status:
  State                         Online
  Temperature                   OK
  DC input:                     OK
```

show chassis environment pem (T640 Router)

```
user@host> show chassis environment pem
PEM 0 status:
  State                         Online
  Temperature                22 degrees C / 71 degrees F
  AC input: OK
  DC output:          Voltage   Current        Power    Load
       FPC 0            56875       606           34       4
       FPC 1            57016       525           29       3
       FPC 2                0         0            0       0
       FPC 3                0         0            0       0
       FPC 4                0         0            0       0
       FPC 5                0         0            0       0
       FPC 6            57158      1581           90      12
       FPC 7                0         0            0       0
  SCG/CB/SIB            56750      1125           63       5
```

show chassis environment pem (T4000 Router)

```
user@host> show chassis environment pem
PEM 0 status:
  State                    Online
  Temperature              33 degrees C / 91 degrees F
  DC Input:                OK
                    Voltage(V)  Current(A)  Power(W)  Load(%)
      INPUT 0         54.625       9.812      535       22
      INPUT 1         54.625      10.250      559       23
      INPUT 2         55.125       0.125        6        0
      INPUT 3         54.500      10.062      548       22
      INPUT 4         54.750       9.375      513       21
      INPUT 5         54.750      10.187      557       23
  DC Output         Voltage(V)  Current(A)  Power(W)  Load(%)
      FPC 0           55.750      10.125      564       37
      FPC 1           51.625       0.000        0        0
      FPC 2           52.000       0.000        0        0
      FPC 3           55.062      10.437      574       38
      FPC 4           52.125       0.000        0        0
      FPC 5           55.000       9.375      515       34
      FPC 6           55.187       9.687      534       35
      FPC 7           51.437       0.000        0        0
      SCG/CB/SIB      55.375      15.750      872       35
      FAN             54.562      14.750      804       42
```

show chassis environment pem (T640/T1600/T4000 Routers With Six-Input DC Power Supply)

```
user@host> show chassis environment pem
PEM 1 status:
  State                    Online
  Temperature              36 degrees C / 96 degrees F
  DC Input:                OK
                    Voltage(V)  Current(A)  Power(W)  Load(%)
      INPUT 0          0.000       0.000        0        0
```

```
    INPUT 1          54.875      3.812      209       27
    INPUT 2          55.375      3.937      218       29
    INPUT 3          54.625      3.750      204       27
    INPUT 4          55.125      3.375      186       24
    INPUT 5          55.125      3.375      186       24
DC Output           Voltage(V)  Current(A)  Power(W)  Load(%)
    FPC 0            52.312      0.000        0        0
    FPC 1            52.687      0.000        0        0
    FPC 2            52.812      0.000        0        0
    FPC 3            55.812      7.062      394       52
    FPC 4            52.625      0.000        0        0
    FPC 5            52.625      0.000        0        0
    FPC 6            52.750      0.000        0        0
    FPC 7            52.750      0.000        0        0
    SCG/CB/SIB       55.937     11.937      667       55
    FAN              55.812      4.937      275       36
```

show chassis environment pem lcc (TX Matrix Routing Matrix)

```
user@host> show chassis environment pem 0 lcc 0
lcc0-re0:
--------------------------------------------------------------------------
PEM 0 status:
  State                         Present
  Temperature                27 degrees C / 80 degrees F
  DC input:                     Check
  DC output:            Voltage  Current        Power     Load
       FPC 0                  0          0            0        0
       FPC 1                  0          0            0        0
       FPC 2                  0          0            0        0
       FPC 3                  0          0            0        0
       FPC 4                  0          0            0        0
       FPC 5                  0          0            0        0
       FPC 6                  0          0            0        0
       FPC 7                  0          0            0        0
  SCG/CB/SIB                  0          0            0        0
```

show chassis environment pem scc (TX Matrix Routing Matrix)

```
user@host> show chassis environment pem scc
scc-re0:
--------------------------------------------------------------------------
PEM 1 status:
  State                         Online
  Temperature                24 degrees C / 75 degrees F
  DC input:                     OK
  DC output:            Voltage  Current        Power     Load
       SIB 0                  0          0            0        0
       SIB 1                  0          0            0        0
       SIB 2                  0          0            0        0
       SIB 3              56550          0            0        0
       SIB 4              55958       6912          386       51
```

show chassis environment pem sfc (TX Matrix Plus Routing Matrix)

```
user@host> show chassis environment pem sfc 0
sfc0-re0:
--------------------------------------------------------------------------
PEM 0 status:
  State                    Online
  Temperature              35 degrees C / 95 degrees F
  DC Input:                 OK
```

```
  DC Output              Voltage   Current      Power    Load
      Channel 0            53820     14140        761      59
      Channel 1            53550     12720        681      53
      Channel 2            53840     12930        696      54
      Channel 3            53690     14990        804      63
      Channel 4            53620     15070        808      63
      Channel 5            53900     14820        798      62
      Channel 6            54120     5020         271      21
```

show chassis environment pem lcc (TX Matrix Plus Routing Matrix)

```
user@host> show chassis environment lcc 0

lcc0-re1:
--------------------------------------------------------------------------
PEM 0 status:
  State                       Online
  Temperature                 38 degrees C / 100 degrees F
  DC Input:                   OK
  DC Output              Voltage   Current      Power    Load
      FPC 0                0         0            0        0
      FPC 1                0         0            0        0
      FPC 2                0         0            0        0
      FPC 3                0         0            0        0
      FPC 4                56408     7575         427      56
      FPC 5                0         0            0        0
      FPC 6                56266     7956         447      59
      FPC 7                56283     6100         343      45
      SCG/CB/SIB           55916     8950         500      41
PEM 1 status:
  State                       Present
  Temperature                 35 degrees C / 95 degrees F
  DC Input:                   Check
  DC Output              Voltage   Current      Power    Load
      FPC 0                0         0            0        0
      FPC 1                0         0            0        0
      FPC 2                0         0            0        0
      FPC 3                0         0            0        0
      FPC 4                0         0            0        0
      FPC 5                0         0            0        0
      FPC 6                0         0            0        0
      FPC 7                0         0            0        0
      SCG/CB/SIB           0         0            0        0
```

show chassis environment pem node-device (QFabric System

```
user@switch> show chassis environment pem node-device node1
FPC 0 PEM 0 status:
  State                       Check
  Airflow                     Front to Back
  Temperature                 OK
  AC Input:                   OK
  DC Output            Voltage(V) Current(A)  Power(W)  Load(%)
                           12         10          120       18
FPC 0 PEM 1 status:
  State                       Online
  Airflow                     Back to Front
  Temperature                 OK
  AC Input:                   OK
  DC Output            Voltage(V) Current(A)  Power(W)  Load(%)
                           11         10         110       17
```


show chassis environment pem (QFX Series)

```
user@switch> show chassis environment pem
FPC 0 PEM 1 status:
  State                       Online
  Airflow                     Front to Back
  Temperature                 OK
  AC Input:                   OK
  DC Output           Voltage(V) Current(A)  Power(W)  Load(%)
                          12         17           204      31
```

show chassis environment pem interconnect-device (QFabric System)

```
user@switch> show chassis environment pem interconnect-device IC11
IC1 PEM 1 status:
  State                       Online
  Airflow                     Front to Back
  Temperature                 OK
  AC Input:                   OK
  DC Output           Voltage(V) Current(A)  Power(W)  Load(%)
                          12         18           216      33
```

show chassis environment routing-engine

Syntax

show chassis environment routing-engine
<*slot*>

Syntax (TX Matrix Routers)

show chassis environment routing-engine
<lcc *number* | scc>
<*slot*>

Syntax (TX Matrix Plus Routers)

show chassis environment routing-engine
<lcc *number* | sfc *number*>
<*slot*>

Syntax (MX104, MX2010, and MX2020 3D Universal Edge Routers)

show chassis environment routing-engine
<*slot*>

Syntax (MX Series Routers)

show chassis environment routing-engine
<*slot*>
<all-members>
<local>
<member *member-id*>

Syntax (QFX Series)

show chassis environment routing-engine
interconnect-device *name*

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 12.1 for the PTX Series Packet Transport Routers.
Command introduced in Junos OS Release 12.1 for the T4000 Core Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.

Description

Display Routing Engine environmental status information.

Options

none—Display environmental information about all Routing Engines. For a TX Matrix router, display environmental information about all Routing Engines on the TX Matrix router and its attached T640 routers. For a TX Matrix Plus router, display environmental information about all Routing Engines on the TX Matrix Plus router and its attached routers.

all-members—(MX Series routers only) (Optional) Display environmental information about the Routing Engines in all member routers in the Virtual Chassis configuration.

interconnect-device ***name***—(QFabric systems only) (Optional) Display environmental information about the Routing Engines for the Interconnect device.

lcc ***number***——(TX Matrix router and TX Matrix Plus router only) (Optional) Line-card chassis number.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Display environmental information about the Routing Engines in the local Virtual Chassis member.

member ***member-id***—(MX Series routers only) (Optional) Display environmental information about the Routing Engines in the specified member in the Virtual Chassis configuration. Replace ***member-id*** with the value of 0 or 1.

scc—(TX Matrix router only) (Optional) Display environmental information about the Routing Engine in the TX Matrix router (switch-card chassis).

sfc—(TX Matrix Plus router only) (Optional) Display environmental information about the Routing Engine in the TX Matrix Plus router (or switch-fabric chassis).

slot—(Optional) Display environmental information about an individual Routing Engine. On M10i, M20, M40e, M120, M160, M320, MX Series, MX104 routers, MX2010 routers, MX2020 routers, and T Series routers, replace ***slot*** with **0** or **1**. On M5, M7i, M10, and M40 routers and on the J Series router, replace ***slot*** with **0**. On EX3200 and EX4200 standalone switches, replace ***slot*** with **0**. On EX4200 switches in a Virtual Chassis configuration and on EX8208 and EX8216 switches, replace ***slot*** with **0** or **1**. On the QFX3500 switch, there is only one Routing Engine, so you do not need to specify the slot number. On PTX Series Packet Transport Routers, replace ***slot*** with **0** or **1**

Required Privilege Level

view

Related Documentation

- request chassis routing-engine master on page 365
- show chassis routing-engine on page 804

List of Sample Output

show chassis environment routing-engine (QFX Series) on page 571
show chassis environment routing-engine interconnect-device (QFabric System) on page 572
show chassis environment routing-engine (PTX5000 Packet Transport Router) on page 572

Output Fields Table 58 on page 570 lists the output fields for the **show chassis environment routing-engine** command. Output fields are listed in the approximate order in which they appear.

Table 58: show chassis environment routing-engine Output Fields

Field Name	Field Description
Routing engine *slot* status	Number of the Routing Engine slot: **0** or **1**.
State	Status of the Routing Engine: • **Online Master**—Routing Engine is online, operating as Master. • **Online Standby**—Routing Engine is online, operating as Standby. • **Offline**—Routing Engine is offline.
Temperature	Temperature of the air flowing past the Routing Engine.
CPU Temperature	(PTX Series and T4000 Core Routers only) Temperature of the air flowing past the Routing Engine CPU.

Sample Output

show chassis environment routing-engine (Nonredundant)

```
user@host> show chassis environment routing-engine
Routing Engine 0 status:
  State                           Online Master
  Temperature                  27 degrees C / 80 degrees
```

show chassis environment routing-engine (Redundant)

```
user@host> show chassis environment routing-engine
Route Engine 0 status:
  State:                      Online Master
  Temperature:              26 degrees C / 78 degrees F
Route Engine 1 status:
  State:                      Online Standby
  Temperature:              26 degrees C / 78 degrees F
```

show chassis environment routing-engine (MX104 Router)

```
user@ host >show chassis environment routing-engine
Routing Engine 0 status:
  State                      Online Master
  Temperature                34 degrees C / 93 degrees F
  CPU Temperature            43 degrees C / 109 degrees F
Routing Engine 1 status:
  State                      Online Standby
  Temperature                33 degrees C / 91 degrees F
  CPU Temperature            39 degrees C / 102 degrees F
```


show chassis environment routing-engine (MX2010 Router)

```
user@host> show chassis environment routing-engine
Routing Engine 0 status:
  State                      Online Master
  Temperature                37 degrees C / 98 degrees F
  CPU Temperature            37 degrees C / 98 degrees F
Routing Engine 1 status:
  State                      Online Standby
  Temperature                35 degrees C / 95 degrees F
  CPU Temperature            34 degrees C / 93 degrees F
```

show chassis environment routing-engine (MX2020 Router)

```
user@host> show chassis environment routing-engine
Routing Engine 0 status:
  State                      Online Master
  Temperature                35 degrees C / 95 degrees F
  CPU Temperature            34 degrees C / 93 degrees F
Routing Engine 1 status:
  State                      Online Standby
  Temperature                44 degrees C / 111 degrees F
  CPU Temperature            43 degrees C / 109 degrees F
```

show chassis environment routing-engine (TX Matrix Plus Router)

```
user@host> show chassis environment routing-engine
sfc0-re0:
--------------------------------------------------------------------------
Routing Engine 0 status:
  State                      Online Master
  Temperature                26 degrees C / 78 degrees F
Routing Engine 1 status:
  State                      Online Standby
  Temperature                28 degrees C / 82 degrees F

lcc0-re0:
--------------------------------------------------------------------------
Routing Engine 0 status:
  State                      Online Master
  Temperature                30 degrees C / 86 degrees F
Routing Engine 1 status:
  State                      Online Standby
  Temperature                29 degrees C / 84 degrees F
```

show chassis environment routing-engine (T4000 Core Router)

```
user@host> show chassis environment routing-engine
Routing Engine 0 status:
  State                      Online Master
  Temperature                33 degrees C / 91 degrees F
  CPU Temperature            50 degrees C / 122 degrees F
Routing Engine 1 status:
  State                      Online Standby
  Temperature                33 degrees C / 91 degrees F
  CPU Temperature            46 degrees C / 114 degrees F
```

show chassis environment routing-engine (QFX Series)

```
user@switch> show chassis environment routing-engine
```

```
Routing Engine 0 status:
  State                       Online Master
  Temperature                 42 degrees C / 107 degrees F
```

show chassis environment routing-engine interconnect-device (QFabric System)

```
user@switch> show chassis environment routing-engine interconnect-device interconnect1
routing-engine interconnect-device interconnect1
Routing Engine 0 status:
  State                       Online Standby
  Temperature                 52 degrees C / 125 degrees F
Routing Engine 1 status:
  State                       Online Master
  Temperature                 57 degrees C / 134 degrees F
```

show chassis environment routing-engine (PTX5000 Packet Transport Router)

```
user@switch> show chassis environment routing-engine
Routing Engine 0 status:
  State                       Online Master
  Temperature                 55 degrees C / 131 degrees F
  CPU Temperature             66 degrees C / 150 degrees F
Routing Engine 1 status:
  State                       Online Standby
  Temperature                 52 degrees C / 125 degrees F
  CPU Temperature             64 degrees C / 147 degrees F
```


show chassis fan

Syntax

show chassis fan

Syntax (ACX4000 Series Router)

show chassis fan

Syntax (MX Series Router)

show chassis fan
<all-members>
<local>
<member *member-id*>

Syntax (T Series Routers)

show chassis fan

Syntax (MX104, MX2010, and MX2020 3D Universal Edge Router)

show chassis fan

Syntax (QFabric Systems)

show chassis fan
<interconnect-device *name*>

Syntax (TX Matrix Router)

show chassis fan
<lcc *number* | scc>

Syntax (TX Matrix Plus Router)

show chassis fan
<lcc *number* | sfc *number*>

Release Information

Command introduced in Junos OS Release 10.0 on MX Series 3D Universal Edge Routers, M120 routers, and M320 routers, T320 routers, T640 routers, T1600 routers, TX Matrix Routers, and TX Matrix Plus routers.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 11.4 for EX Series switches.
Command introduced in Junos OS Release 12.3 for PTX5000 Packet Transport Routers.
Command introduced in Junos OS Release 12.1 for T4000 routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for ACX Series Routers.
Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.

Description

(T Series routers, TX Matrix routers, TX Matrix Plus routers, M120 routers, M320 routers, MX104 routers, MX2010 routers, MX2020 routers, MX Series 3D Universal Edge Routers, QFX3008-I Interconnect devices, EX Series switches, and PTX Series Packet Transport Routers only) Show information about the fan tray and fans.

Options

all-members—(MX Series routers only) (Optional) Display information about the fan tray and fans for all members of the Virtual Chassis configuration.

local—(MX Series routers only) (Optional) Display information about the fan tray and fans for the local Virtual Chassis member.

member ***member-id***—(MX Series routers only) (Optional) Display information about the fan tray and fans for the specified member of the Virtual Chassis configuration. For an MX Series Virtual Chassis, replace *member-id* variable with a value 0 or 1.

interconnect-device ***name***—(QFX3000-G QFabric systems only) (Optional) Display information about the fan tray and fans for the specified QFX3008-I Interconnect device.

lcc ***number***—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display information about the fan tray and fans for the specified T640 router (line-card chassis) that is connected to a TX Matrix router. On a TX Matrix Plus router, display information about the fan tray and fans for the specified router (line-card chassis) that is connected to a TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

scc —(TX Matrix routers only) (Optional) Display information about the fan tray and fans for the TX Matrix router (switch-card chassis).

sfc ***number***—(TX Matrix Plus routers only) (Optional) Display information about the fan tray and fans for the TX Matrix Plus router (switch-fabric chassis). Replace *number* variable with **0**.

Required Privilege Level

view

List of Sample Output

show chassis fan (ACX4000 Router) on page 585
show chassis fan (QFX5100 Switch) on page 585

Output Fields Table 59 on page 575 lists the output fields for the **show chassis fan** command. Output fields are listed in the approximate order in which they appear.

Table 59: show chassis fan Output Fields

Field Name	Field Description
Item	Fan item identifier.
Status	Status of the fan: • **OK**—Fan is running properly and within the normal range. • **Check**—Fan is in **Check** state because of some fault or alarm condition.
RPM	(T Series routers, TX Matrix routers, TX Matrix Plus routers, MX Series 3D Universal Edge Routers, QFX3108 Interconnect devices, and EX Series switches only) Fan speed in revolutions per minute (RPM).
% RPM	(MX2010 routers, MX2020 routers, and PTX Series Packet Transport Routers only) Percentage of the fan speed being used.
Measurement	(T Series routers, TX Matrix routers, TX Matrix Plus routers, MX Series 3D Universal Edge Routers, QFX3108 Interconnect devices, and EX Series switches only) Fan speed status based on different chassis cooling requirements: • Spinning at high speed • Spinning at intermediate speed • Spinning at normal speed • Spinning at low speed (except EX Series switches) (MX2010 routers, MX2020 routers, and PTX Series Packet Transport Routers only) Fan speed in revolutions per minute (RPM) for each fan in the fan tray.

Sample Output

show chassis fan

```
user@host> show chassis fan

        Item                      Status    RPM     Measurement
        Top Tray Fan 1            OK        3790    Spinning at normal speed
        Top Tray Fan 2            OK        3769    Spinning at normal speed
        Top Tray Fan 3            OK        3769    Spinning at normal speed
        Top Tray Fan 4            OK        3790    Spinning at normal speed
        Top Tray Fan 5            OK        3790    Spinning at normal speed
        Top Tray Fan 6            OK        3769    Spinning at normal speed
        Top Tray Fan 7            OK        3790    Spinning at normal speed
        Top Tray Fan 8            OK        3769    Spinning at normal speed
        Top Tray Fan 9            OK        3769    Spinning at normal speed
        Top Tray Fan 10           OK        3790    Spinning at normal speed
```

```
Top Tray Fan 11          OK       3790    Spinning at normal speed
Top Tray Fan 12          OK       3769    Spinning at normal speed
Bottom Tray Fan 1        OK       2880    Spinning at normal speed
Bottom Tray Fan 2        OK       2912    Spinning at normal speed
Bottom Tray Fan 3        OK       2928    Spinning at normal speed
Bottom Tray Fan 4        OK       2896    Spinning at normal speed
Bottom Tray Fan 5        OK       2896    Spinning at normal speed
Bottom Tray Fan 6        OK       2928    Spinning at normal speed
```

show chassis fan (QFabric Systems)

`user@host>` **show chassis fan interconnect-device** *interconnect1*

```
Item                     Status   RPM     Measurement
TFT 0 Fan 0              OK       2849    Spinning at normal speed
TFT 0 Fan 1              OK       2821    Spinning at normal speed
TFT 0 Fan 2              OK       2735    Spinning at normal speed
TFT 0 Fan 3              OK       2815    Spinning at normal speed
TFT 0 Fan 4              OK       2828    Spinning at normal speed
TFT 0 Fan 5              OK       2863    Spinning at normal speed
BFT 1 Fan 0              OK       2941    Spinning at normal speed
BFT 1 Fan 1              OK       3008    Spinning at normal speed
BFT 1 Fan 2              OK       3073    Spinning at normal speed
BFT 1 Fan 3              OK       2925    Spinning at normal speed
BFT 1 Fan 4              OK       2863    Spinning at normal speed
BFT 1 Fan 5              OK       2933    Spinning at normal speed
SFT 0 Fan 0 Rotor 0      OK       15472   Spinning at normal speed
SFT 0 Fan 0 Rotor 1      OK       14477   Spinning at normal speed
SFT 0 Fan 1 Rotor 0      OK       15561   Spinning at normal speed
SFT 0 Fan 1 Rotor 1      OK       14210   Spinning at normal speed
SFT 0 Fan 2 Rotor 0      OK       16167   Spinning at normal speed
SFT 0 Fan 2 Rotor 1      OK       14248   Spinning at normal speed
SFT 0 Fan 3 Rotor 0      OK       16463   Spinning at normal speed
SFT 0 Fan 3 Rotor 1      OK       14099   Spinning at normal speed
SFT 1 Fan 0 Rotor 0      OK       15083   Spinning at normal speed
SFT 1 Fan 0 Rotor 1      OK       13533   Spinning at normal speed
SFT 1 Fan 1 Rotor 0      OK       16071   Spinning at normal speed
SFT 1 Fan 1 Rotor 1      OK       14400   Spinning at normal speed
SFT 1 Fan 2 Rotor 0      OK       15517   Spinning at normal speed
SFT 1 Fan 2 Rotor 1      OK       14210   Spinning at normal speed
SFT 1 Fan 3 Rotor 0      OK       16413   Spinning at normal speed
SFT 1 Fan 3 Rotor 1      OK       14400   Spinning at normal speed
SFT 2 Fan 0 Rotor 0      OK       15297   Spinning at normal speed
SFT 2 Fan 0 Rotor 1      OK       14634   Spinning at normal speed
SFT 2 Fan 1 Rotor 0      OK       15561   Spinning at normal speed
SFT 2 Fan 1 Rotor 1      OK       14285   Spinning at normal speed
SFT 2 Fan 2 Rotor 0      OK       15835   Spinning at normal speed
SFT 2 Fan 2 Rotor 1      OK       14400   Spinning at normal speed
SFT 2 Fan 3 Rotor 0      OK       15789   Spinning at normal speed
SFT 2 Fan 3 Rotor 1      OK       14323   Spinning at normal speed
SFT 3 Fan 0 Rotor 0      OK       16314   Spinning at normal speed
SFT 3 Fan 0 Rotor 1      OK       14876   Spinning at normal speed
SFT 3 Fan 1 Rotor 0      OK       15835   Spinning at normal speed
SFT 3 Fan 1 Rotor 1      OK       14323   Spinning at normal speed
SFT 3 Fan 2 Rotor 0      OK       16265   Spinning at normal speed
SFT 3 Fan 2 Rotor 1      OK       14594   Spinning at normal speed
SFT 3 Fan 3 Rotor 0      OK       16071   Spinning at normal speed
SFT 3 Fan 3 Rotor 1      OK       14323   Spinning at normal speed
SFT 4 Fan 0 Rotor 0      OK       15652   Spinning at normal speed
SFT 4 Fan 0 Rotor 1      OK       14438   Spinning at normal speed
SFT 4 Fan 1 Rotor 0      OK       16167   Spinning at normal speed
```

```
SFT 4 Fan 1 Rotor 1        OK       14555    Spinning at normal speed
SFT 4 Fan 2 Rotor 0        OK       16023    Spinning at normal speed
SFT 4 Fan 2 Rotor 1        OK       14361    Spinning at normal speed
SFT 4 Fan 3 Rotor 0        OK       16216    Spinning at normal speed
SFT 4 Fan 3 Rotor 1        OK       14438    Spinning at normal speed
SFT 5 Fan 0 Rotor 0        OK       15297    Spinning at normal speed
SFT 5 Fan 0 Rotor 1        OK       14173    Spinning at normal speed
SFT 5 Fan 1 Rotor 0        OK       15472    Spinning at normal speed
SFT 5 Fan 1 Rotor 1        OK       13846    Spinning at normal speed
SFT 5 Fan 2 Rotor 0        OK       15340    Spinning at normal speed
SFT 5 Fan 2 Rotor 1        OK       13917    Spinning at normal speed
SFT 5 Fan 3 Rotor 0        OK       15835    Spinning at normal speed
SFT 5 Fan 3 Rotor 1        OK       13917    Spinning at normal speed
SFT 6 Fan 0 Rotor 0        OK       15743    Spinning at normal speed
SFT 6 Fan 0 Rotor 1        OK       14594    Spinning at normal speed
SFT 6 Fan 1 Rotor 0        OK       16167    Spinning at normal speed
SFT 6 Fan 1 Rotor 1        OK       14634    Spinning at normal speed
SFT 6 Fan 2 Rotor 0        OK       16167    Spinning at normal speed
SFT 6 Fan 2 Rotor 1        OK       14516    Spinning at normal speed
SFT 6 Fan 3 Rotor 0        OK       16666    Spinning at normal speed
SFT 6 Fan 3 Rotor 1        OK       14438    Spinning at normal speed
SFT 7 Fan 0 Rotor 0        OK       15517    Spinning at normal speed
SFT 7 Fan 0 Rotor 1        OK       14438    Spinning at normal speed
SFT 7 Fan 1 Rotor 0        OK       15517    Spinning at normal speed
SFT 7 Fan 1 Rotor 1        OK       14361    Spinning at normal speed
SFT 7 Fan 2 Rotor 0        OK       16167    Spinning at normal speed
SFT 7 Fan 2 Rotor 1        OK       14555    Spinning at normal speed
SFT 7 Fan 3 Rotor 0        OK       15697    Spinning at normal speed
SFT 7 Fan 3 Rotor 1        OK       14361    Spinning at normal speed
```

show chassis fan (EX Series Switches)

`user@host>` **show chassis fan**

```
Item                       Status   RPM      Measurement
Fan 1                      OK       3477     Spinning at normal speed
Fan 2                      OK       3477     Spinning at normal speed
Fan 3                      OK       3479     Spinning at normal speed
Fan 4                      OK       3508     Spinning at normal speed
Fan 5                      OK       3517     Spinning at normal speed
Fan 6                      OK       3531     Spinning at normal speed
Fan 7                      OK       3439     Spinning at normal speed
Fan 8                      OK       3424     Spinning at normal speed
Fan 9                      OK       3413     Spinning at normal speed
Fan 10                     OK       3439     Spinning at normal speed
Fan 11                     OK       3446     Spinning at normal speed
Fan 12                     OK       3432     Spinning at normal speed
```

show chassis fan (T320 Router)

`user@host>` **show chassis fan**

```
     Item                 Status    RPM      Measurement
Top Left Front fan         OK       2850     Spinning at normal speed
Top Left Middle fan        OK       2820     Spinning at normal speed
Top Left Rear fan          OK       2970     Spinning at normal speed
Top Right Front fan        OK       2790     Spinning at normal speed
Top Right Middle fan       OK       2640     Spinning at normal speed
Top Right Rear fan         OK       2790     Spinning at normal speed
Bottom Left Front fan      OK       2520     Spinning at normal speed
Bottom Left Middle fan     OK       2610     Spinning at normal speed
```

```
Bottom Left Rear fan      OK      2550    Spinning at normal speed
Bottom Right Front fan    OK      2610    Spinning at normal speed
Bottom Right Middle fan   OK      2880    Spinning at normal speed
Bottom Right Rear fan     OK      2790    Spinning at normal speed
Rear Tray Top fan         OK      2130    Spinning at normal speed
Rear Tray Second fan      OK      2190    Spinning at normal speed
Rear Tray Middle fan      OK      2250    Spinning at normal speed
Rear Tray Fourth fan      OK      2220    Spinning at normal speed
Rear Tray Bottom fan      OK      2280    Spinning at normal speed
```

show chassis fan (T640 Router)

user@host> **show chassis fan**

```
   Item                  Status   RPM     Measurement
Top Left Front fan        OK      3420    Spinning at normal speed
Top Left Middle fan       OK      3420    Spinning at normal speed
Top Left Rear fan         OK      3420    Spinning at normal speed
Top Right Front fan       OK      3420    Spinning at normal speed
Top Right Middle fan      OK      3420    Spinning at normal speed
Top Right Rear fan        OK      3450    Spinning at normal speed
Bottom Left Front fan     OK      3390    Spinning at normal speed
Bottom Left Middle fan    OK      3420    Spinning at normal speed
Bottom Left Rear fan      OK      3390    Spinning at normal speed
Bottom Right Front fan    OK      3390    Spinning at normal speed
Bottom Right Middle fan   OK      3390    Spinning at normal speed
Bottom Right Rear fan     OK      3390    Spinning at normal speed
Rear Tray Top fan         OK      5220    Spinning at normal speed
Rear Tray Second fan      OK      5220    Spinning at normal speed
Rear Tray Third fan       OK      5220    Spinning at normal speed
Rear Tray Fourth fan      OK      5220    Spinning at normal speed
Rear Tray Fifth fan       OK      5220    Spinning at normal speed
Rear Tray Sixth fan       OK      5220    Spinning at normal speed
Rear Tray Seventh fan     OK      5220    Spinning at normal speed
Rear Tray Bottom fan      OK      5220    Spinning at normal speed
```

show chassis fan (T1600 Router)

user@host> **show chassis fan**

```
  Item                   Status   RPM     Measurement
Top Left Front fan        OK      3420    Spinning at normal speed
Top Left Middle fan       OK      3420    Spinning at normal speed
Top Left Rear fan         OK      3450    Spinning at normal speed
Top Right Front fan       OK      3420    Spinning at normal speed
Top Right Middle fan      OK      3420    Spinning at normal speed
Top Right Rear fan        OK      3390    Spinning at normal speed
Bottom Left Front fan     OK      3420    Spinning at normal speed
Bottom Left Middle fan    OK      3420    Spinning at normal speed
Bottom Left Rear fan      OK      3390    Spinning at normal speed
Bottom Right Front fan    OK      3390    Spinning at normal speed
Bottom Right Middle fan   OK      3420    Spinning at normal speed
Bottom Right Rear fan     OK      3390    Spinning at normal speed
Rear Tray Top fan         OK      5190    Spinning at normal speed
Rear Tray Second fan      OK      5190    Spinning at normal speed
Rear Tray Third fan       OK      5190    Spinning at normal speed
Rear Tray Fourth fan      OK      5190    Spinning at normal speed
Rear Tray Fifth fan       OK      5190    Spinning at normal speed
Rear Tray Sixth fan       OK      5190    Spinning at normal speed
Rear Tray Seventh fan     OK      5190    Spinning at normal speed
Rear Tray Bottom fan      OK      5190    Spinning at normal speed
```


show chassis fan (T4000 Core Router)

```
user@host> show chassis fan

      Item                      Status   RPM     Measurement
      Top Left Front fan        OK       5190    Spinning at high speed
      Top Left Middle fan       OK       5220    Spinning at high speed
      Top Left Rear fan         OK       5190    Spinning at high speed
      Top Right Front fan       OK       5160    Spinning at high speed
      Top Right Middle fan      OK       5190    Spinning at high speed
      Top Right Rear fan        OK       5160    Spinning at high speed
      Bottom Left Front fan     OK       6030    Spinning at high speed
      Bottom Left Middle fan    OK       6090    Spinning at high speed
      Bottom Left Rear fan      OK       6090    Spinning at high speed
      Bottom Right Front fan    OK       6030    Spinning at high speed
      Bottom Right Middle fan   OK       6060    Spinning at high speed
      Bottom Right Rear fan     OK       6060    Spinning at high speed
      Rear Tray Top fan         OK       10000   Spinning at high speed
      Rear Tray Second fan      OK       10000   Spinning at high speed
      Rear Tray Third fan       OK       10000   Spinning at high speed
      Rear Tray Fourth fan      OK       10000   Spinning at high speed
      Rear Tray Fifth fan       OK       10000   Spinning at high speed
      Rear Tray Sixth fan       OK       10000   Spinning at high speed
      Rear Tray Seventh fan     OK       10000   Spinning at high speed
      Rear Tray Bottom fan      OK       10000   Spinning at high speed
```

show chassis fan (TX Matrix Router)

```
user@host> show chassis fan
scc-re0:
--------------------------------------------------------------------------
      Item                      Status   RPM     Measurement
      Top Left Front fan        OK       3420    Spinning at normal speed
      Top Left Middle fan       OK       3390    Spinning at normal speed
      Top Left Rear fan         OK       3420    Spinning at normal speed
      Top Right Front fan       OK       3390    Spinning at normal speed
      Top Right Middle fan      OK       3420    Spinning at normal speed
      Top Right Rear fan        OK       3390    Spinning at normal speed
      Bottom Left Front fan     OK       3420    Spinning at normal speed
      Bottom Left Middle fan    OK       3450    Spinning at normal speed
      Bottom Left Rear fan      OK       3420    Spinning at normal speed
      Bottom Right Front fan    OK       3420    Spinning at normal speed
      Bottom Right Middle fan   OK       3420    Spinning at normal speed
      Bottom Right Rear fan     OK       3420    Spinning at normal speed
      Rear Tray Top fan         OK       3420    Spinning at normal speed
      Rear Tray Second fan      OK       5190    Spinning at normal speed
      Rear Tray Third fan       OK       5190    Spinning at normal speed
      Rear Tray Fourth fan      OK       5190    Spinning at normal speed
      Rear Tray Fifth fan       OK       3420    Spinning at normal speed
      Rear Tray Sixth fan       OK       3420    Spinning at normal speed
      Rear Tray Seventh fan     OK       3420    Spinning at normal speed
      Rear Tray Bottom fan      OK       3420    Spinning at normal speed

lcc2-re0:
--------------------------------------------------------------------------
      Item                      Status   RPM     Measurement
      Top Left Front fan        OK       3420    Spinning at normal speed
      Top Left Middle fan       OK       3420    Spinning at normal speed
      Top Left Rear fan         OK       3450    Spinning at normal speed
      Top Right Front fan       OK       3420    Spinning at normal speed
      Top Right Middle fan      OK       3450    Spinning at normal speed
```



```
      Top Right Rear fan          OK        3360     Spinning at normal speed
      Bottom Left Front fan       OK        3420     Spinning at normal speed
      Bottom Left Middle fan      OK        3480     Spinning at normal speed
      Bottom Left Rear fan        OK        3420     Spinning at normal speed
      Bottom Right Front fan      OK        3420     Spinning at normal speed
      Bottom Right Middle fan     OK        3390     Spinning at normal speed
      Bottom Right Rear fan       OK        3420     Spinning at normal speed
      Rear Tray Top fan           OK        3420     Spinning at normal speed
      Rear Tray Second fan        OK        3420     Spinning at normal speed
      Rear Tray Third fan         OK        3420     Spinning at normal speed
      Rear Tray Fourth fan        OK        3420     Spinning at normal speed
      Rear Tray Fifth fan         OK        3420     Spinning at normal speed
      Rear Tray Sixth fan         OK        3420     Spinning at normal speed
      Rear Tray Seventh fan       OK        3420     Spinning at normal speed
      Rear Tray Bottom fan        OK        3420     Spinning at normal speed
```

show chassis fan (TX Matrix Plus Router)

```
user@host> show chassis fan
  sfc0-re0:
--------------------------------------------------------------------------
      Item                        Status    RPM      Measurement
      Fan Tray 0 Fan 1            OK        4350     Spinning at normal speed
      Fan Tray 0 Fan 2            OK        4380     Spinning at normal speed
      Fan Tray 0 Fan 3            OK        4410     Spinning at normal speed
      Fan Tray 0 Fan 4            OK        4380     Spinning at normal speed
      Fan Tray 0 Fan 5            OK        4350     Spinning at normal speed
      Fan Tray 0 Fan 6            OK        4380     Spinning at normal speed
      Fan Tray 1 Fan 1            OK        4410     Spinning at normal speed
      Fan Tray 1 Fan 2            OK        4380     Spinning at normal speed
      Fan Tray 1 Fan 3            OK        4410     Spinning at normal speed
      Fan Tray 1 Fan 4            OK        4380     Spinning at normal speed
      Fan Tray 1 Fan 5            OK        4410     Spinning at normal speed
      Fan Tray 1 Fan 6            OK        4410     Spinning at normal speed
      Fan Tray 2 Fan 1            OK        4380     Spinning at normal speed
      Fan Tray 2 Fan 2            OK        4380     Spinning at normal speed
      Fan Tray 2 Fan 3            OK        4380     Spinning at normal speed
      Fan Tray 2 Fan 4            OK        4410     Spinning at normal speed
      Fan Tray 2 Fan 5            OK        4380     Spinning at normal speed
      Fan Tray 2 Fan 6            OK        4410     Spinning at normal speed
      Fan Tray 2 Fan 7            OK        4410     Spinning at normal speed
      Fan Tray 2 Fan 8            OK        4380     Spinning at normal speed
      Fan Tray 2 Fan 9            OK        4380     Spinning at normal speed
      Fan Tray 3 Fan 1            OK        4350     Spinning at normal speed
      Fan Tray 3 Fan 2            OK        4380     Spinning at normal speed
      Fan Tray 3 Fan 3            OK        4410     Spinning at normal speed
      Fan Tray 3 Fan 4            OK        4440     Spinning at normal speed
      Fan Tray 3 Fan 5            OK        4380     Spinning at normal speed
      Fan Tray 3 Fan 6            OK        4410     Spinning at normal speed
      Fan Tray 3 Fan 7            OK        4410     Spinning at normal speed
      Fan Tray 3 Fan 8            OK        4380     Spinning at normal speed
      Fan Tray 3 Fan 9            OK        4410     Spinning at normal speed
      Fan Tray 4 Fan 1            OK        4410     Spinning at normal speed
      Fan Tray 4 Fan 2            OK        4410     Spinning at normal speed
      Fan Tray 4 Fan 3            OK        4380     Spinning at normal speed
      Fan Tray 4 Fan 4            OK        4380     Spinning at normal speed
      Fan Tray 4 Fan 5            OK        4410     Spinning at normal speed
      Fan Tray 4 Fan 6            OK        4410     Spinning at normal speed
      Fan Tray 4 Fan 7            OK        4410     Spinning at normal speed
      Fan Tray 4 Fan 8            OK        4410     Spinning at normal speed
      Fan Tray 4 Fan 9            OK        4410     Spinning at normal speed
```



```
        Fan Tray 5 Fan 1          OK        4350     Spinning at normal speed
        Fan Tray 5 Fan 2          OK        4380     Spinning at normal speed
        Fan Tray 5 Fan 3          OK        4380     Spinning at normal speed
        Fan Tray 5 Fan 4          OK        4350     Spinning at normal speed
        Fan Tray 5 Fan 5          OK        4380     Spinning at normal speed
        Fan Tray 5 Fan 6          OK        4410     Spinning at normal speed
        Fan Tray 5 Fan 7          OK        4410     Spinning at normal speed
        Fan Tray 5 Fan 8          OK        4380     Spinning at normal speed
        Fan Tray 5 Fan 9          OK        4410     Spinning at normal speed

lcc0-re0:
--------------------------------------------------------------------------
        Item                      Status    RPM      Measurement
        Top Left Front fan        OK        3420     Spinning at normal speed
        Top Left Middle fan       OK        3420     Spinning at normal speed
        Top Left Rear fan         OK        3420     Spinning at normal speed
        Top Right Front fan       OK        3450     Spinning at normal speed
        Top Right Middle fan      OK        3420     Spinning at normal speed
        Top Right Rear fan        OK        3420     Spinning at normal speed
        Bottom Left Front fan     OK        3420     Spinning at normal speed
        Bottom Left Middle fan    OK        3420     Spinning at normal speed
        Bottom Left Rear fan      OK        3390     Spinning at normal speed
        Bottom Right Front fan    OK        3420     Spinning at normal speed
        Bottom Right Middle fan   OK        3390     Spinning at normal speed
        Bottom Right Rear fan     OK        3390     Spinning at normal speed
        Rear Tray Top fan         OK        7050     Spinning at normal speed
        Rear Tray Second fan      OK        7050     Spinning at normal speed
        Rear Tray Third fan       OK        7050     Spinning at normal speed
        Rear Tray Fourth fan      OK        7050     Spinning at normal speed
        Rear Tray Fifth fan       OK        7050     Spinning at normal speed
        Rear Tray Sixth fan       OK        7050     Spinning at normal speed
        Rear Tray Seventh fan     OK        7050     Spinning at normal speed
        Rear Tray Bottom fan      OK        7050     Spinning at normal speed
```

show chassis fan (TX Matrix Plus Router with 3D SIBs)

```
user@host> show chassis fan
sfc0-re0:
--------------------------------------------------------------------------
        Item                      Status    RPM      Measurement
        Fan Tray 0 Fan 1          OK        4830     Spinning at normal speed
        Fan Tray 0 Fan 2          OK        4860     Spinning at normal speed
        Fan Tray 0 Fan 3          OK        4830     Spinning at normal speed
        Fan Tray 0 Fan 4          OK        4800     Spinning at normal speed
        Fan Tray 0 Fan 5          OK        4830     Spinning at normal speed
        Fan Tray 0 Fan 6          OK        4770     Spinning at normal speed
        Fan Tray 1 Fan 1          OK        4800     Spinning at normal speed
        Fan Tray 1 Fan 2          OK        4770     Spinning at normal speed
        Fan Tray 1 Fan 3          OK        4800     Spinning at normal speed
        Fan Tray 1 Fan 4          OK        4770     Spinning at normal speed
        Fan Tray 1 Fan 5          OK        4770     Spinning at normal speed
        Fan Tray 1 Fan 6          OK        4800     Spinning at normal speed
        Fan Tray 2 Fan 1          OK        4800     Spinning at normal speed
        Fan Tray 2 Fan 2          OK        4800     Spinning at normal speed
        Fan Tray 2 Fan 3          OK        4830     Spinning at normal speed
        Fan Tray 2 Fan 4          OK        4830     Spinning at normal speed
        Fan Tray 2 Fan 5          OK        4830     Spinning at normal speed
        Fan Tray 2 Fan 6          OK        4830     Spinning at normal speed
        Fan Tray 2 Fan 7          OK        4800     Spinning at normal speed
        Fan Tray 2 Fan 8          OK        4830     Spinning at normal speed
        Fan Tray 2 Fan 9          OK        4800     Spinning at normal speed
```

```
      Fan Tray 3 Fan 1          OK       4860    Spinning at normal speed
      Fan Tray 3 Fan 2          OK       4860    Spinning at normal speed
      Fan Tray 3 Fan 3          OK       4800    Spinning at normal speed
      Fan Tray 3 Fan 4          OK       4830    Spinning at normal speed
      Fan Tray 3 Fan 5          OK       4830    Spinning at normal speed
      Fan Tray 3 Fan 6          OK       4830    Spinning at normal speed
      Fan Tray 3 Fan 7          OK       4830    Spinning at normal speed
      Fan Tray 3 Fan 8          OK       4800    Spinning at normal speed
      Fan Tray 3 Fan 9          OK       4800    Spinning at normal speed
      Fan Tray 4 Fan 1          OK       4830    Spinning at normal speed
      Fan Tray 4 Fan 2          OK       4830    Spinning at normal speed
      Fan Tray 4 Fan 3          OK       4830    Spinning at normal speed
      Fan Tray 4 Fan 4          OK       4830    Spinning at normal speed
      Fan Tray 4 Fan 5          OK       4830    Spinning at normal speed
      Fan Tray 4 Fan 6          OK       4860    Spinning at normal speed
      Fan Tray 4 Fan 7          OK       4800    Spinning at normal speed
      Fan Tray 4 Fan 8          OK       4860    Spinning at normal speed
      Fan Tray 4 Fan 9          OK       4770    Spinning at normal speed
      Fan Tray 5 Fan 1          OK       4830    Spinning at normal speed
      Fan Tray 5 Fan 2          OK       4830    Spinning at normal speed
      Fan Tray 5 Fan 3          OK       4830    Spinning at normal speed
      Fan Tray 5 Fan 4          OK       4800    Spinning at normal speed
      Fan Tray 5 Fan 5          OK       4800    Spinning at normal speed
      Fan Tray 5 Fan 6          OK       4800    Spinning at normal speed
      Fan Tray 5 Fan 7          OK       4830    Spinning at normal speed
      Fan Tray 5 Fan 8          OK       4830    Spinning at normal speed
      Fan Tray 5 Fan 9          Check    2010

lcc0-re0:
--------------------------------------------------------------------------
      Item                      Status   RPM     Measurement
      Top Left Front fan        OK       3420    Spinning at normal speed
      Top Left Middle fan       OK       3390    Spinning at normal speed
      Top Left Rear fan         OK       3390    Spinning at normal speed
      Top Right Front fan       OK       3420    Spinning at normal speed
      Top Right Middle fan      OK       3420    Spinning at normal speed
      Top Right Rear fan        OK       3450    Spinning at normal speed
      Bottom Left Front fan     OK       3420    Spinning at normal speed
      Bottom Left Middle fan    OK       3390    Spinning at normal speed
      Bottom Left Rear fan      OK       3420    Spinning at normal speed
      Bottom Right Front fan    OK       3420    Spinning at normal speed
      Bottom Right Middle fan   OK       3390    Spinning at normal speed
      Bottom Right Rear fan     OK       3420    Spinning at normal speed
      Rear Tray fan 1 (Top)     OK       7740    Spinning at normal speed
      Rear Tray fan 2           OK       7740    Spinning at normal speed
      Rear Tray fan 3           OK       7740    Spinning at normal speed
      Rear Tray fan 4           OK       7740    Spinning at normal speed
      Rear Tray fan 5           OK       7740    Spinning at normal speed
      Rear Tray fan 6           OK       7740    Spinning at normal speed
      Rear Tray fan 7           OK       7740    Spinning at normal speed
      Rear Tray fan 8           OK       7740    Spinning at normal speed
      Rear Tray fan 9           OK       7740    Spinning at normal speed
      Rear Tray fan 10          OK       7740    Spinning at normal speed
      Rear Tray fan 11          OK       7740    Spinning at normal speed
      Rear Tray fan 12          OK       7740    Spinning at normal speed
      Rear Tray fan 13          OK       7740    Spinning at normal speed
      Rear Tray fan 14          OK       7740    Spinning at normal speed
      Rear Tray fan 15          OK       7740    Spinning at normal speed
      Rear Tray fan 16 (Bottom) OK       7740    Spinning at normal speed

lcc2-re0:
```



```
--------------------------------------------------------------------------
      Item                      Status   RPM    Measurement
      Top Left Front fan        OK       3420   Spinning at normal speed
      Top Left Middle fan       OK       3390   Spinning at normal speed
      Top Left Rear fan         OK       3420   Spinning at normal speed
      Top Right Front fan       OK       3420   Spinning at normal speed
      Top Right Middle fan      OK       3420   Spinning at normal speed
      Top Right Rear fan        OK       3450   Spinning at normal speed
      Bottom Left Front fan     OK       3420   Spinning at normal speed
      Bottom Left Middle fan    OK       3390   Spinning at normal speed
      Bottom Left Rear fan      OK       3420   Spinning at normal speed
      Bottom Right Front fan    OK       3420   Spinning at normal speed
      Bottom Right Middle fan   OK       3390   Spinning at normal speed
      Bottom Right Rear fan     OK       3420   Spinning at normal speed
      Rear Tray fan 1 (Top)     OK       7740   Spinning at normal speed
      Rear Tray fan 2           OK       7740   Spinning at normal speed
      Rear Tray fan 3           OK       7740   Spinning at normal speed
      Rear Tray fan 4           OK       7740   Spinning at normal speed
      Rear Tray fan 5           OK       7740   Spinning at normal speed
      Rear Tray fan 6           OK       7740   Spinning at normal speed
      Rear Tray fan 7           OK       7740   Spinning at normal speed
      Rear Tray fan 8           OK       7740   Spinning at normal speed
      Rear Tray fan 9           OK       7740   Spinning at normal speed
      Rear Tray fan 10          OK       7740   Spinning at normal speed
      Rear Tray fan 11          OK       7740   Spinning at normal speed
      Rear Tray fan 12          OK       7740   Spinning at normal speed
      Rear Tray fan 13          OK       7740   Spinning at normal speed
      Rear Tray fan 14          OK       7740   Spinning at normal speed
      Rear Tray fan 15          OK       7740   Spinning at normal speed
      Rear Tray fan 16 (Bottom) OK       7740   Spinning at normal speed
```

show chassis fan (PTX5000 Packet Transport Router)

```
user@host> show chassis fan
user@host> show chassis fan
      Item                      Status   % RPM    Measurement
      Fan Tray 0 Fan 1          OK       29%      2700 RPM
      Fan Tray 0 Fan 2          OK       29%      2700 RPM
      Fan Tray 0 Fan 3          OK       29%      2742 RPM
      Fan Tray 0 Fan 4          OK       29%      2700 RPM
      Fan Tray 0 Fan 5          OK       30%      2828 RPM
      Fan Tray 0 Fan 6          OK       30%      2828 RPM
      Fan Tray 0 Fan 7          OK       29%      2700 RPM
      Fan Tray 0 Fan 8          OK       30%      2785 RPM
      Fan Tray 0 Fan 9          OK       30%      2828 RPM
      Fan Tray 0 Fan 10         OK       30%      2828 RPM
      Fan Tray 0 Fan 11         OK       30%      2785 RPM
      Fan Tray 0 Fan 12         OK       30%      2828 RPM
      Fan Tray 0 Fan 13         OK       31%      2871 RPM
      Fan Tray 0 Fan 14         OK       30%      2828 RPM
      Fan Tray 1 Fan 1          OK       42%      3033 RPM
      Fan Tray 1 Fan 2          OK       42%      3066 RPM
      Fan Tray 1 Fan 3          OK       43%      3099 RPM
      Fan Tray 1 Fan 4          OK       43%      3166 RPM
      Fan Tray 1 Fan 5          OK       45%      3266 RPM
      Fan Tray 1 Fan 6          OK       43%      3133 RPM
      Fan Tray 2 Fan 1          OK       29%      2099 RPM
      Fan Tray 2 Fan 2          OK       30%      2199 RPM
      Fan Tray 2 Fan 3          OK       30%      2166 RPM
      Fan Tray 2 Fan 4          OK       33%      2399 RPM
```

```
          Fan Tray 2 Fan 5          OK        29%        2133 RPM
          Fan Tray 2 Fan 6          OK        32%        2366 RPM
```

show chassis fan (MX104 Router)

```
user@host > show chassis fan
Item                         Status    RPM     Measurement
      Fan 1                        OK        5640     Spinning at normal speed
      Fan 2                        OK        5640     Spinning at normal speed
      Fan 3                        OK        5760     Spinning at normal speed
      Fan 4                        OK        5640     Spinning at normal speed
      Fan 5                        OK        5640     Spinning at normal speed
```

show chassis fan (MX2010 Router)

```
user@host > show chassis fan
Item                         Status    % RPM     Measurement
      Fan Tray 0 Fan 1             OK        37%        3360 RPM
      Fan Tray 0 Fan 2             OK        38%        3480 RPM
      Fan Tray 0 Fan 3             OK        37%        3360 RPM
      Fan Tray 0 Fan 4             OK        37%        3360 RPM
      Fan Tray 0 Fan 5             OK        38%        3480 RPM
      Fan Tray 0 Fan 6             OK        37%        3360 RPM
      Fan Tray 1 Fan 1             OK        38%        3480 RPM
      Fan Tray 1 Fan 2             OK        40%        3600 RPM
      Fan Tray 1 Fan 3             OK        38%        3480 RPM
      Fan Tray 1 Fan 4             OK        38%        3480 RPM
      Fan Tray 1 Fan 5             OK        38%        3480 RPM
      Fan Tray 1 Fan 6             OK        38%        3480 RPM
      Fan Tray 2 Fan 1             OK        38%        3480 RPM
      Fan Tray 2 Fan 2             OK        41%        3720 RPM
      Fan Tray 2 Fan 3             OK        38%        3480 RPM
      Fan Tray 2 Fan 4             OK        38%        3480 RPM
      Fan Tray 2 Fan 5             OK        38%        3480 RPM
      Fan Tray 2 Fan 6             OK        38%        3480 RPM
      Fan Tray 3 Fan 1             OK        38%        3480 RPM
      Fan Tray 3 Fan 2             OK        40%        3600 RPM
      Fan Tray 3 Fan 3             OK        40%        3600 RPM
      Fan Tray 3 Fan 4             OK        40%        3600 RPM
      Fan Tray 3 Fan 5             OK        40%        3600 RPM
      Fan Tray 3 Fan 6             OK        38%        3480 RPM
```

show chassis fan (MX2020 Router)

```
user@host > show chassis fan
      Item                         Status    % RPM     Measurement
      Fan Tray 0 Fan 1             OK        37%        3360 RPM
      Fan Tray 0 Fan 2             OK        37%        3360 RPM
      Fan Tray 0 Fan 3             OK        36%        3240 RPM
      Fan Tray 0 Fan 4             OK        37%        3360 RPM
      Fan Tray 0 Fan 5             OK        37%        3360 RPM
      Fan Tray 0 Fan 6             OK        37%        3360 RPM
      Fan Tray 1 Fan 1             OK        37%        3360 RPM
      Fan Tray 1 Fan 2             OK        37%        3360 RPM
      Fan Tray 1 Fan 3             OK        37%        3360 RPM
      Fan Tray 1 Fan 4             OK        37%        3360 RPM
      Fan Tray 1 Fan 5             OK        37%        3360 RPM
      Fan Tray 1 Fan 6             OK        36%        3240 RPM
      Fan Tray 2 Fan 1             OK        37%        3360 RPM
      Fan Tray 2 Fan 2             OK        37%        3360 RPM
      Fan Tray 2 Fan 3             OK        37%        3360 RPM
      Fan Tray 2 Fan 4             OK        37%        3360 RPM
```

```
Fan Tray 2 Fan 5          OK        37%        3360 RPM
Fan Tray 2 Fan 6          OK        38%        3480 RPM
Fan Tray 3 Fan 1          OK        38%        3480 RPM
Fan Tray 3 Fan 2          OK        38%        3480 RPM
Fan Tray 3 Fan 3          OK        38%        3480 RPM
Fan Tray 3 Fan 4          OK        37%        3360 RPM
Fan Tray 3 Fan 5          OK        37%        3360 RPM
Fan Tray 3 Fan 6          OK        37%        3360 RPM
```

show chassis fan (ACX4000 Router)

```
user@host > show chassis fan
      Item                      Status    RPM     Measurement
      Fan 1                     OK        4140    Spinning at normal speed
      Fan 2                     OK        4200    Spinning at normal speed
```

show chassis fan (QFX5100 Switch)

```
user@switch > show chassis fan
Item                      Status    RPM     Measurement
FPC 0 Tray 0 Fan 0        OK        6428    Spinning at normal speed
FPC 0 Tray 0 Fan 1        OK        5515    Spinning at normal speed
FPC 0 Tray 1 Fan 0        OK        6360    Spinning at normal speed
FPC 0 Tray 1 Fan 1        OK        5532    Spinning at normal speed
```


show chassis firmware

Syntax

show chassis firmware

Syntax (TX Matrix Routers)

show chassis firmware
<lcc *number* | scc>

Syntax (TX Matrix Plus Routers)

show chassis firmware
<lcc *number* | sfc *number*>

Syntax (MX Series Routers)

show chassis firmware
<all-members>
<local>
<member *member-id*>

Syntax (MX104, MX2010, and MX2020 3D Universal Edge Routers)

show chassis firmware

Syntax (QFX Series)

show chassis firmware
interconnect-device *name*
node-device *name*

Syntax (ACX Series Universal Access Routers)

show chassis firmware

Syntax (EX Series Switches)

show chassis firmware
<detail>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.4 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced for EX8200 switches in Junos OS Release 10.2 for EX Series switches.
Command introduced in Junos OS Release 11.1 for QFX Series.
Command introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for ACX4000 Universal Access Routers.
Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.

Description

On routers and switches, display the version levels of the firmware running on the System Control Board (SCB), Switching and Forwarding Module (SFM), System and Switch Board (SSB), Forwarding Engine Board (FEB), Flexible PIC Concentrators (FPCs), and Routing Engines. On a TX Matrix Plus router, display the version levels of the firmware running on the FPCs and the Switch Processor Mezzanine Board (SPMBs).

On EX2200, EX3200, and EX4200 switches, and the QFX Series, display the version levels of the firmware running on the switch. On an EX8208 switch, display the version levels of the firmware running on the Switch Fabric and Routing Engine (SRE) modules and on the line cards (shown as FPCs). On an EX8216 switch, display the version levels of the firmware running on the Routing Engine (RE) modules and on the line cards (shown as FPCs).

Options

none—Display the version levels of the firmware running. For an EX4200 switch that is a member of a Virtual Chassis, display version levels for all members. For a TX Matrix router, display version levels for the firmware on the TX Matrix router and on all the T640 routers connected to the TX Matrix router. For a TX Matrix Plus router, display version levels for the firmware on the TX Matrix Plus router and on all the routers connected to the TX Matrix Plus router.

all-members—(MX Series routers only) (Optional) Display the version levels of the firmware running for all members of the Virtual Chassis configuration.

interconnect-device *name*—(QFabric systems) (Optional) Display the version levels of the firmware running on the Interconnect device.

lcc *number*—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display version levels for the firmware on a specified T640 router (line-card chassis) that is connected to the TX Matrix router. On a TX Matrix Plus router, display the version levels for the firmware on a specified router (line-card chassis) that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Display the version levels of the firmware running for the local Virtual Chassis member.

member *member-id*—(MX Series routers only) (Optional) Display the version levels of the firmware running for the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value of 0 or 1.

node-device—(QFabric systems only) (Optional) Display the version levels of the firmware running on the Node device.

scc—(TX Matrix router only) (Optional) Display version levels for the firmware on the TX Matrix router (switch-card chassis).

sfc *number*—(TX Matrix Plus router only) (Optional) Display version levels for the firmware on the TX Matrix Plus router (or switch-fabric chassis). Replace ***number*** with **0**.

detail—(EX3200, EX3300, EX4200, and EX4500 standalone and Virtual Chassis member switches only) (Optional) Display version levels of the firmware running on the switch for its programmable hardware components.

Required Privilege Level

view

Related Documentation

- *Upgrading the HSM Firmware*

List of Sample Output

Output Fields

Table 60 on page 588 lists the output fields for the **show chassis firmware** command. Output fields are listed in the approximate order in which they appear.

Table 60: show chassis firmware Output Fields

Field Name	Field Description
Part	(MX Series, MX2010, and MX2020 routers) Chassis part name.
Type	(MX Series, MX2010, and MX2020 routers) Type of firmware: On routers: **ROM** or **O/S.** On switches: **uboot** or **loader**.
Version	(MX Series, MX2010, and MX2020 routers) Version of firmware running on the chassis part.

Table 60: show chassis firmware Output Fields *(continued)*

Field Name	Field Description
FPC	(*detail* option only) Number of FPC. For a standalone switch, the value is 0. For a Virtual Chassis configuration, value in the range of 0-9; refers to the member ID assigned to the switch.
AFEB	(MX104 routers) Version of the compact Forwarding Engine Board.
Boot	(*detail* option only) Version of the SYSPLD.
PoE	(*detail* option only) Version of the PoE firmware.
PFE-<*number*>	(*detail* option only) Version of the PFE used in the switch.
PHY-	(*detail* option only) Version of the physical layer device (PHY) used in the switch.
microcode	(*detail* option only) Microcode of the physical layer devices (PHY) used in the switch.
uboot	(*detail* option only) Version of the u-boot used in the switch.
loader	(*detail* option only) Version of the loader used in the switch.

Sample Output

show chassis firmware (M10 Router)

```
user@host> show chassis firmware
Part                     Type       Version
Forwarding engine board  ROM        Juniper ROM Monitor Version 4.1b2
                         O/S        Version 4.1I1 by tlim on 2000-04-24 11:27
```

show chassis firmware (M20 Router)

```
user@host> show chassis firmware
Part                     Type       Version
System switch board      ROM        Juniper ROM Monitor Version 3.4b26
                         O/S        Version 3.4I16 by smackie on 2000-02-29 2
FPC 1                    ROM        Juniper ROM Monitor Version 3.0b1
                         O/S        Version 3.4I4 by smackie on 2000-02-25 21
FPC 2                    ROM        Juniper ROM Monitor Version 3.0b1
                         O/S        Version 3.4I4 by smackie on 2000-02-25 21
```

show chassis firmware (M40 Router)

```
user@host> show chassis firmware
Part                     Type       Version
System control board     ROM        Juniper ROM Monitor Version 2.0i126Copyri
                         O/S        Version 2.0i1 by root on Thu Jul 23 00:51
FPC 5                    ROM        Juniper ROM Monitor Version 2.0i49Copyrig
                         O/S        Version 2.0i1 by root on Thu Jul 23 00:59
```


show chassis firmware (M120 Router)

```
user@host> show chassis firmware
FPC 2                    ROM        Juniper ROM Monitor Version 8.0b29
                         O/S        Version 8.2B1 by builder on 2006-10-18 16:2
FPC 3                    ROM        Juniper ROM Monitor Version 8.0b29
                         O/S        Version 8.2B1 by builder on 2006-10-18 16:2
FPC 4                    ROM        Juniper ROM Monitor Version 8.0b29
                         O/S        Version 8.2B1 by builder on 2006-10-18 16:2
FEB 3                    ROM        Juniper ROM Monitor Version 8.0b29
                         O/S        Version 8.2B1 by builder on 2006-10-18 16:1
FEB 4                    ROM        Juniper ROM Monitor Version 8.0b29
                         O/S        Version 8.2B1 by builder on 2006-10-18 16:1
```

show chassis firmware (M160 Router)

```
user@host> show chassis firmware
Part                     Type       Version
SFM 0                    ROM        Juniper ROM Monitor Version 4.0b2
                         O/S        Version 4.0I1 by tlim on 2000-02-29 11:50
SFM 1                    ROM        Juniper ROM Monitor Version 4.0b2
                         O/S        Version 4.0I1 by tlim on 2000-02-29 11:50
FPC 0                    ROM        Juniper ROM Monitor Version 4.0b2
                         O/S        Version 4.0I1 by tlim on 2000-02-29 11:56
FPC 1                    ROM        Juniper ROM Monitor Version 4.0b2
                         O/S        Version 4.0I1 by tlim on 2000-02-29 11:56
FPC 2                    ROM        Juniper ROM Monitor Version 4.0b3
                         O/S        Version 4.0I1 by tlim on 2000-02-29 11:56
```

show chassis firmware (MX104 Router)

```
user@host > show chassis firmware
Part                     Type       Version
FPC 0                    ROM        Juniper ROM Monitor Version 13.1b24
                         O/S        Version 13.2-20130514.1 by builder on 2013-
FPC 1                    ROM        Juniper ROM Monitor Version 13.1b24
                         O/S        Version 13.2-20130514.1 by builder on 2013-
FPC 2                    ROM        Juniper ROM Monitor Version 13.1b24
                         O/S        Version 13.2-20130514.1 by builder on 2013-
AFEB                     ROM        Juniper ROM Monitor Version 13.1b24
                         O/S        Version 13.2-20130514.1 by builder on 2013-
```

show chassis firmware (MX240 Router)

```
user@host> show chassis firmware
Part                     Type       Version
FPC 1                    ROM        Juniper ROM Monitor Version 8.3b1
                         O/S        Version 9.0-20080103.0 by builder on 2008-0
FPC 2                    ROM        Juniper ROM Monitor Version 8.3b1
                         O/S        Version 9.0-20080103.0 by builder on 2008-0
```

show chassis firmware (MX480 Router)

```
user@host> show chassis firmware
Part                     Type       Version
FPC 1                    ROM        Juniper ROM Monitor Version 8.3b1
                         O/S        Version 9.0-20070916.3 by builder on 2007-0
```

show chassis firmware (MX960 Router)

```
user@host> show chassis firmware
```



```
Part                     Type       Version
FPC 4                    ROM        Juniper ROM Monitor Version 8.0b8
                         O/S        Version 8.2I59 by artem on 2006-10-31 19:22
FPC 7                    ROM        Juniper ROM Monitor Version 8.2b1
                         O/S        Version 8.2-20061026.1 by builder on 2006-1
```

show chassis firmware (MX2010 Router)

```
user@host> show chassis firmware
Part                     Type       Version
FPC 0                    ROM        Juniper ROM Monitor Version 12.3b1
                         O/S        Version 12.3-20121220.0 by builder on 2012-
FPC 1                    ROM        Juniper ROM Monitor Version 10.1b3
                         O/S        Version 12.3-20121220.0 by builder on 2012-
FPC 2                    ROM        Juniper ROM Monitor Version 10.1b3
                         O/S        Version 12.3-20121220.0 by builder on 2012-
FPC 3                    ROM        Juniper ROM Monitor Version 10.1b3
                         O/S        Version 12.3-20121220.0 by builder on 2012-
FPC 4                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20121220.0 by builder on 2012-
FPC 5                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20121220.0 by builder on 2012-
FPC 6                    ROM        Juniper ROM Monitor Version 10.4b1
                         O/S        Version 12.3-20121220.0 by builder on 2012-
FPC 7                    ROM        Juniper ROM Monitor Version 10.1b3
                         O/S        Version 12.3-20121220.0 by builder on 2012-
FPC 8                    ROM        Juniper ROM Monitor Version 10.4b1
                         O/S        Version 12.3-20121220.0 by builder on 2012-
FPC 9                    ROM        Juniper ROM Monitor Version 10.4b1
                         O/S        Version 12.3-20121220.0 by builder on 2012-
SPMB 0                   ROM        Juniper ROM Monitor Version 12.1b1
                         O/S        Version 12.3-20121220.0 by builder on 2012-
SPMB 1                   ROM        Juniper ROM Monitor Version 12.1b1
                         O/S        Version 12.3-20121220.0 by builder on 2012-
```

show chassis firmware (MX2020 Router)

```
user@host> show chassis firmware
Part                     Type       Version
FPC 0                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 1                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 2                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 3                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 4                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 5                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 6                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 7                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 8                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 9                    ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 10                   ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
```

```
FPC 11                   ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 12                   ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 13                   ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 14                   ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 15                   ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 16                   ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 17                   ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 18                   ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
FPC 19                   ROM        Juniper ROM Monitor Version 10.0b39
                         O/S        Version 12.3-20130415.0 by builder on 2013-
SPMB 0                   ROM        Juniper ROM Monitor Version 12.1b1
                         O/S        Version 12.3-20130415.0 by builder on 2013-
SPMB 1                   ROM        Juniper ROM Monitor Version 12.1b1
                         O/S        Version 12.3-20130415.0 by builder on 2013-
```

show chassis firmware (MX240, MX480, MX960 Router with Application Services Modular Line Card)

user@host> **show chassis firmware**

```
Part                     Type       Version
FPC 1                    ROM        Juniper ROM Monitor Version 12.1b1
                         O/S        Version 12.2I21 by manish on 2012-06-19 17:
```

show chassis firmware (EX4200 Switch)

user@switch> **show chassis firmware**

```
Part                   Type       Version
FPC 0                  uboot      U-Boot 1.1.6 (Feb  6 2008 - 11:27:42)
                       loader     FreeBSD/PowerPC U-Boot bootstrap loader 2.1
FPC 1                  uboot      U-Boot 1.1.6 (Feb  6 2008 - 11:27:42)
                       loader     FreeBSD/PowerPC U-Boot bootstrap loader 2.1
FPC 2                  uboot      U-Boot 1.1.6 (Feb  6 2008 - 11:27:42)
                       loader     FreeBSD/PowerPC U-Boot bootstrap loader 2.1
```

show chassis firmware (EX8200 Switch)

user@switch> **show chassis firmware**

```
Part                     Type       Version
FPC 0                    U-Boot     U-Boot 1.1.6 (Mar 25 2009 - 06:13:12) 2.4.0
                         loader     FreeBSD/PowerPC U-Boot bootstrap loader 2.2
FPC 3                    U-Boot     U-Boot 1.1.6 (Dec  4 2009 - 13:17:34) 3.1.0
                         loader     FreeBSD/PowerPC U-Boot bootstrap loader 2.2
FPC 5                    U-Boot     U-Boot 1.1.6 (Mar 25 2009 - 06:13:12) 2.4.0
                         loader     FreeBSD/PowerPC U-Boot bootstrap loader 2.2
FPC 7                    U-Boot     U-Boot 1.1.6 (Feb  6 2009 - 05:31:46) 2.4.0
                         loader     FreeBSD/PowerPC U-Boot bootstrap loader 2.2
Routing Engine 0         U-Boot     U-Boot 1.1.6 (Mar 25 2009 - 06:13:12) 2.4.0
                                    FreeBSD/PowerPC U-Boot bootstrap loader 2.2
                         loader
Routing Engine 1         U-Boot     U-Boot 1.1.6 (Mar 25 2009 - 06:13:12) 2.4.0
                         loader     FreeBSD/PowerPC U-Boot bootstrap loader 2.2
```

show chassis firmware lcc (TX Matrix Router)

```
user@host> show chassis firmware lcc 0
lcc0-re0:
--------------------------------------------------------------------------
Part                     Type       Version
FPC 1                    ROM        Juniper ROM Monitor Version 6.4b18
                         O/S        Version 7.0-20040804.0 by builder on 2004-0
FPC 2                    ROM        Juniper ROM Monitor Version 6.4b20
                         O/S        Version 7.0-20040804.0 by builder on 2004-0
SPMB 0                   ROM        Juniper ROM Monitor Version 6.4b18
                         O/S        Version 7.0-20040804.0 by builder on 2004-0
```

show chassis firmware scc (TX Matrix Router)

```
user@host> show chassis firmware scc
scc-re0:
--------------------------------------------------------------------------
Part                     Type       Version
SPMB 0                   ROM        Juniper ROM Monitor Version 6.4b18
                         O/S        Version 7.0-20040804.0 by builder on 2004-0
```

show chassis firmware (TX Matrix Plus Router)

```
user@host> show chassis firmware
sfc0-re0:
--------------------------------------------------------------------------
Part                     Type       Version
Global FPC 4
Global FPC 6
Global FPC 7
Global FPC 12
Global FPC 14
Global FPC 15
Global FPC 20
Global FPC 21
Global FPC 22
Global FPC 23
Global FPC 24
Global FPC 25
Global FPC 26
Global FPC 28
Global FPC 29
Global FPC 31
SPMB 0                   ROM        Juniper ROM Monitor Version 9.5b1
                         O/S        Version 9.6-20090507.0 by builder on 2009-0
SPMB 1                   ROM        Juniper ROM Monitor Version 9.5b1
                         O/S        Version 9.6-20090507.0 by builder on 2009-0

lcc0-re1:
--------------------------------------------------------------------------
Part                     Type       Version
FPC 4                    ROM        Juniper ROM Monitor Version 9.0b2
                         O/S        Version 9.6-20090507.0 by builder on 2009-0
FPC 6                    ROM        Juniper ROM Monitor Version 9.0b2
                         O/S        Version 9.6-20090507.0 by builder on 2009-0
FPC 7                    ROM        Juniper ROM Monitor Version 9.0b2
                         O/S        Version 9.6-20090507.0 by builder on 2009-0
SPMB 0                   ROM        Juniper ROM Monitor Version 9.5b1
                         O/S        Version 9.6-20090507.0 by builder on 2009-0
SPMB 1                   ROM        Juniper ROM Monitor Version 9.5b1
```



```
                         O/S         Version 9.6-20090507.0 by builder on 2009-0

lcc1-re1:
--------------------------------------------------------------------------
Part                     Type        Version
FPC 4                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
FPC 6                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
FPC 7                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
SPMB 0                   ROM         Juniper ROM Monitor Version 9.5b1
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
SPMB 1                   ROM         Juniper ROM Monitor Version 9.5b1
                         O/S         Version 9.6-20090507.0 by builder on 2009-0

lcc2-re1:
--------------------------------------------------------------------------
Part                     Type        Version
FPC 4                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
FPC 5                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
FPC 6                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
FPC 7                    ROM         Juniper ROM Monitor Version 7.5b4
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
SPMB 0                   ROM         Juniper ROM Monitor Version 9.5b1
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
SPMB 1                   ROM         Juniper ROM Monitor Version 9.5b1
                         O/S         Version 9.6-20090507.0 by builder on 2009-0

lcc3-re1:
--------------------------------------------------------------------------
Part                     Type        Version
FPC 0                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
FPC 1                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
FPC 2                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
FPC 4                    ROM         Juniper ROM Monitor Version 7.5b4
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
FPC 5                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
FPC 7                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
SPMB 0                   ROM         Juniper ROM Monitor Version 9.5b1
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
SPMB 1                   ROM         Juniper ROM Monitor Version 9.5b1
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
```

show chassis firmware lcc (TX Matrix Plus Router)

```
user@host> show chassis firmware lcc 0
lcc0-re1:
--------------------------------------------------------------------------
Part                     Type        Version
FPC 4                    ROM         Juniper ROM Monitor Version 9.0b2
                         O/S         Version 9.6-20090507.0 by builder on 2009-0
FPC 6                    ROM         Juniper ROM Monitor Version 9.0b2
```



```
                          O/S        Version 9.6-20090507.0 by builder on 2009-0
FPC 7                     ROM        Juniper ROM Monitor Version 9.0b2
                          O/S        Version 9.6-20090507.0 by builder on 2009-0
SPMB 0                    ROM        Juniper ROM Monitor Version 9.5b1
                          O/S        Version 9.6-20090507.0 by builder on 2009-0
SPMB 1                    ROM        Juniper ROM Monitor Version 9.5b1
                          O/S        Version 9.6-20090507.0 by builder on 2009-0
```

show chassis firmware sfc (TX Matrix Plus Router)

```
user@host> show chassis firmware sfc 0
sfc0-re0:
--------------------------------------------------------------------------
Part                      Type       Version
Global FPC 4
Global FPC 6
Global FPC 7
Global FPC 12
Global FPC 14
Global FPC 15
Global FPC 20
Global FPC 21
Global FPC 22
Global FPC 23
Global FPC 24
Global FPC 25
Global FPC 26
Global FPC 28
Global FPC 29
Global FPC 31
SPMB 0                    ROM        Juniper ROM Monitor Version 9.5b1
                          O/S        Version 9.6-20090507.0 by builder on 2009-0
SPMB 1                    ROM        Juniper ROM Monitor Version 9.5b1
                          O/S        Version 9.6-20090507.0 by builder on 2009-0
```

show chassis firmware (QFX Series)

```
user@switch> show chassis firmware
Part                      Type       Version
FPC 0
Routing Engine 0          U-Boot     U-Boot 1.1.6 (Sep 15 2010 - 02:11:11) 1.0.5
                          loader     FreeBSD/MIPS U-Boot bootstrap loader 0.1
```

show chassis firmware interconnect-device (QFabric System)

```
user@switch> show chassis firmware interconnect-device interconnect1
Part                      Type       Version
Routing Engine 0          U-Boot     U-Boot 1.1.6 (May 10 2011 - 04:52:59) 1.1.1
                          loader     FreeBSD/MIPS U-Boot bootstrap loader 0.1
Routing Engine 1          U-Boot     U-Boot 1.1.6 (May 10 2011 - 04:52:59) 1.1.1
                          loader     FreeBSD/MIPS U-Boot bootstrap loader 0.1
```

show chassis firmware (ACX2000 Universal Access Router)

```
user@switch> show chassis firmware
Part                      Type       Version
FPC                       O/S        Version 12.2I13 by jisjoy on 2012-05-29 06:
FEB                       O/S        Version 12.2I13 by jisjoy on 2012-05-29 06:
```

show chassis firmware detail (EX3300 Switch)

```
user@switch> show chassis firmware detail
```



```
FPC 0
   Boot SYSPLD               3
   PoE firmware              4.1.6
   PFE-0                     3
   PFE-1                     3
   PHY
      microcode              0x514
   Boot Firmware
      uboot                  U-Boot 1.1.6 (Aug 21 2011 - 01:45:26)   1.0.0
      loader                 FreeBSD/arm U-Boot loader 1.0
```

show chassis firmware (MX Routers with Media Services Blade [MSB])

```
user@switch> show chassis firmware
Part                     Type       Version
FPC 1                    ROM        Juniper ROM Monitor Version 12.1b1
                         O/S        Version 12.2I21 by manish on 2012-06-19 17:
```


show chassis fpc

Syntax

show chassis fpc
<detail <*slot*>> | <pic-status <*slot*>>

Syntax (EX Series Switches)

show chassis fpc
<detail <*fpc-slot*>> | <pic-status <*fpc-slot*>>
<*fpc-slot*>

Syntax (T4000 Routers)

show chassis fpc
<detail <*fpc-slot*>>
<pic-status <*fpc-slot*>>

Syntax (TX Matrix and TX Matrix Plus Routers)

show chassis fpc
<detail <*fpc-slot*>> | <pic-status <*fpc-slot*>>
<*slot*>

Syntax (MX Series Routers and EX Series switches)

show chassis fpc
<detail <*slot*>> | <pic-status <*slot*>>
<all-members>
<local>
<member *member-id*>

Syntax (MX104, MX2010, and MX2020 3D Universal Edge Routers)

show chassis fpc
<*slot*> detail | <detail <*slot*>> | <pic-status <*slot*>>
<*fpc-slot*>

Syntax (QFX Series)

show chassis fpc
<detail>
<interconnect-device *name* <fpc-slot *fpc-slot*>>
<node-device *name*>

Syntax (PTX Series Packet Transport Routers)

show chassis fpc
<detail <*fpc-slot*>> | <pic-status <*fpc-slot*>>
<*fpc-slot*>

Syntax (ACX Series Universal Access Routers)

show chassis fpc
<detail <*fpc-slot*>> | <pic-status <*fpc-slot*>>
<*fpc-slot*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for QFX Series.
Command introduced in Junos OS Release 12.1x48 for PTX Series Packet Transport Routers.
Command introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.

Description Display status information about the installed Flexible PIC Concentrators (FPCs)and PICs.

Options **none**—Display status information for all FPCs. On a TX Matrix router, display status information for all FPCs on the attached T640 routers in the routing matrix. On a TX Matrix Plus router, display status information for all FPCs on the attached routers in the routing matrix.

NOTE: In EX8200 switches, line cards initialize Packet Forwarding Engine during startup. If an error occurs during hardware initialization, the FPCs with bad hardware parts power down after transferring the debug information to the Routing Engine. The Routing Engine marks the FPC offline, logs the error in system log messages (/var/log/messages), and generates an alarm to inform the user.

See the following sample output:

```
user@host> show chassis fpc
                     Temp  CPU Utilization (%)   Memory
Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap
  Buffer
  0  Empty
  1  Empty
  2  Empty
  3  Empty
  4  Empty
  5  Offline         ---Hard FPC error---
  6  Empty
  7  Online            26      4          0       1024        0
     32
```

The following sample output shows the alarm raised for the failed FPCs.

```
user@host > show chassis alarms
4 alarms currently active
Alarm time               Class  Description
2011-03-24 00:52:51 UTC  Major  FPC 5 Hard errors
2011-03-24 00:52:31 UTC  Major  Fan Tray Failure
2011-03-24 00:52:31 UTC  Major  Fan Tray Failure
2011-03-24 00:51:26 UTC  Minor  Loss of communication with Backup
RE
```


NOTE: On T4000 routers, when you include the **enhanced-mode** statement at the **[edit chassis network-services]** hierarchy level and reboot the system, only the T4000 Type 5 FPCs present on the router become online while the remaining FPCs are offline, and FPC misconfiguration alarms are generated. The **show chassis alarm** command output displays FPC misconfiguration (**FPC *fpc-slot* misconfig**) as the reason for the generation the alarms.

The following sample output shows the FPC status after the **enhanced-mode** statement is configured on the T4000 router. The T4000 Type 5 FPC present in slot 5 becomes online while the remaining FPCs are offline.

```
user@host> show chassis fpc
                     Temp  CPU Utilization (%)   Memory    
Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap
  Buffer
  0  offline         ---FPC misconfiguration---
  1  offline         ---FPC misconfiguration---
  2  offline         ---FPC misconfiguration---
  3  Empty
  4  Empty
  5  Online           66      50          0       2816       29
    27
```

The following sample output shows FPC misconfiguration alarms.

```
user@host > show chassis alarms
3 alarms currently active
Alarm time               Class  Description
2011-03-24 00:52:51 PST  Major  FPC 1 misconfig
2011-03-24 00:52:31 PST  Major  FPC 2 misconfig
2011-03-24 00:52:31 PST  Major  FPC 3 misconfig
```

detail—(Optional) Display detailed status information for all FPCs or for the FPC in the specified slot (see ***fpc-slot*** or ***slot***).

all-members—(MX Series routers and EX Series switches only) (Optional) Display status information for all FPCs on all members of the Virtual Chassis configuration.

interconnect-device ***name***—(QFabric systems only) (Optional) Display status information for all FPCs on the Interconnect device.

fpc-slot—(Optional) FPC slot number:

- (TX Matrix and TX Matrix Plus router only—On a TX Matrix router, if you specify the number of the T640 router (line-card chassis) by using the **lcc** ***number*** option (the recommended method), replace ***fpc-slot*** with a value from **0** through **7**. Otherwise, replace ***fpc-slot*** with a value from **0** through **31**. Likewise, on a TX Matrix Plus router, if you specify the number of the specified router (line-card chassis) by using the **lcc** ***number*** option (the recommended method), replace ***fpc-slot*** with a value from **0** through **7**. Otherwise, replace ***fpc-slot*** with a value from **0** through **31**. For example, the following commands have the same result:

user@host> **show chassis fpc detail 1 lcc 1**
user@host> **show chassis fpc detail 9**

- M120 router—Replace ***fpc-slot*** with a value from **0** through **5**.
- MX80 router—Replace ***fpc-slot*** with a value from **0** through **1**.
- MX104 router—Replace ***fpc-slot*** with a value from **0** through **2**.
- MX240 router—Replace ***fpc-slot*** with a value from **0** through **2**.
- MX480 router—Replace ***fpc-slot*** with a value from **0** through **5**.
- MX-960 router—Replace ***fpc-slot*** with a value from **0** through **11**.
- MX2010 router—Replace ***fpc-slot-number*** with a value from **0** through **9**.
- MX2020 router—Replace ***fpc-slot-number*** with a value from **0** through **19**.
- Other routers—Replace ***fpc-slot*** with a value from **0** through **7**.
- EX Series switches:
  - EX3200 switches and EX4200 standalone switches—Replace ***fpc-slot*** with **0**.
  - EX4200 switches in a Virtual Chassis configuration—Replace ***fpc-slot*** with a value from **0** through **9**.
  - EX6210 switches—Replace ***fpc-slot*** with a value from **0** through **9**.
  - EX8208 switches—Replace ***fpc-slot*** with a value from **0** through **7**.
  - EX8216 switches—Replace ***fpc-slot*** with a value from **0** through **15**.
- QFX Series:
  - QFX3500 switches—Replace ***fpc-slot*** with 0.
  - QFabric systems—Replace ***fpc-slot*** with 0 through 31 on the Interconnect device.
- PTX Series Packet Transport Routers:
  - PTX5000 Packet Transport Router—Replace ***fpc-slot*** with a value from **0** through **7**.
- ACX Series Universal Access Routers:
  - ACX1000 and ACX2000 Universal Access Routers—Replace ***fpc-slot*** with **0**.

local—(MX Series routers and EX Series switches only) (Optional) Display status information for all FPCs on the local Virtual Chassis member.

member ***member-id***—(MX Series routers and EX Series switches only) (Optional) Display status information for all FPCs on the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value of 0 or 1.

node-device ***name***—(QFabric systems only) (Optional) Display status information for each Node device. Each Node device is equivalent to an FPC.

pic-status—(Optional) Display status information for all PICs or for the PIC in the specified slot (see ***fpc-slot***).

NOTE: On T1600 routers, Type 4 FPCs with ASICs based on the SL2.0 chipset do not support the 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (10x10GE [LAN/WAN] SFPP). If you issue the **show chassis fpc** command with the **pic-status** option, the CLI displays the string “Not Supported” for 10x10GE(LAN/WAN) SFPP PICs installed on such FPCs. The following is a sample output:

```
user@host> show chassis fpc pic-status
Slot 0   Online       E2-FPC Type 1
  PIC 0  Online       1x G/E SFP, 1000 BASE
  PIC 1  Online       Adaptive Services-II
  PIC 2  Online       1x G/E IQ, 1000 BASE
  PIC 3  Online       1x G/E IQ, 1000 BASE
Slot 1   Online       FPC Type 3-ES
  PIC 0  Present      UNUSED- Not Supported
Slot 2   Online       FPC Type 4-ES
  PIC 0  Offline      4x OC-192 SONET XFP
  PIC 1  Present      10x10GE(LAN/WAN) SFPP- Not Supported
<<<<<<
Slot 4   Offline      FPC Type 1-ES
Slot 5   Offline      FPC Type 2-ES
Slot 6   Online       E2-FPC Type 3
  PIC 0  Online       1x OC-192 SONET XFP
  PIC 1  Online       4x OC-48 SONET
  PIC 2  Online       4x OC-48 SONET
  PIC 3  Online       MultiServices 500
Slot 7   Online       FPC Type 4-ES
  PIC 0  Online       4x 10GE (LAN/WAN) XFP
  PIC 1  Online       4x 10GE (LAN/WAN) XFP
```

In addition, an entry is logged in the system log messages (/var/log/messages) that the PIC is not supported. The following is a sample message logged in the system log:

```
Apr  5 08:47:36  router1 chassisd[2770]: CHASSISD_UNSUPPORTED_PIC:
 PIC 1 in FPC 2 (type 763, version 257) is not supported
```

If you see this issue, contact Juniper Networks Technical Assistance Center (JTAC) for a possible fix. For more information about this issue and a possible solution, see PSN-2010-03-696.

NOTE: When there is a double-bit ECC error in a network processor's memory, the Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP or Channelized E1/T1 Circuit Emulation MIC is switched to the offline state.

```
user@host> show chassis fpc pic-status
Slot 1   Online       MPC Type 2 3D Q
PIC 0   Offline      1xCOC12/4xCOC3 CH-CE- ECC error detected
```

lcc ***number***—(TX Matrix router and TX Matrix Plus router only) (Optional) Line-card chassis number.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

Required Privilege Level

view

Related Documentation

- request chassis fpc on page 357
- *show chassis fpc-feb-connectivity*
- *show chassis fabric fpcs*
- *Configuring the Junos OS to Resynchronize FPC Sequence Numbers with Active FPCs when an FPC Comes Online*
- *MX960 Flexible PIC Concentrator Description*
- *ACX2000 and ACX2100 Routers Hardware and CLI Terminology Mapping*
- *enhanced-mode*

List of Sample Output

Output Fields Table 61 on page 604 lists the output fields for the **show chassis fpc** command. Output fields are listed in the approximate order in which they appear.

Table 61: show chassis fpc Output Fields

Field Name	Field Description	Level of Output

Slot or **Slot State**	Slot number and state. The state can be one of the following conditions:
	• **Dead**—Held in reset because of errors.
	• **Diag**—Slot is being ignored while the FPC is running diagnostics.
	• **Dormant**—Held in reset.
	• **Empty**—No FPC is present.
	• **Offline**—(PTX Series Packet Transport Routers only) One of the following two states is displayed:
	  ◦ **FPC offlined due to unreachable destinations**
	  ◦ **FPC Offlined due to degraded FPC action**
	• **Online**—FPC is online and running.
	• **Present**—FPC is detected by the chassis daemon but either is not supported by the current version of Junos OS or is inserted in the wrong slot. The output also states either **Hardware Not Supported** or **Hardware Not In Right Slot**. The FPC is coming up but not yet online.
	• **Probed**—Probe is complete; awaiting restart of the Packet Forwarding Engine.
	• **Probe-wait**—Waiting to be probed.
		all levels

Logical slot	Slot number.	all levels
Temp (C) or **Temperature**	Temperature of the air passing by the FPC, in degrees Celsius or in both Celsius and Fahrenheit.	all levels all levels

Table 61: show chassis fpc Output Fields *(continued)*

Field Name	Field Description	Level of Output
Temperature (PTX Series)	On PTX Series Packet Transport Routers, temperature details are provided in degrees Celsius and Fahrenheit. Output includes: • Temperature (PMB)—Temperature of the air passing by the Processor Mezzanine Board (PMB) at the bottom of the FPC. • Temperature (Intake)—Temperature of the air flowing into the chassis. • Temperature (Exhaust)—Exhaust temperatures for multiple zones (Exhaust A and Exhaust B). • Temperature (TL*n*)-–Temperature of the specified Lookup ASIC (TL) of the packet forwarding engine on the FPC. • Temperature (TQ*n*)-–Temperature of the specified Queuing and Memory Interface ASIC (TQ) of the packet forwarding engine on the FPC.	**detail**
Total CPU Utilization (%)	Total percentage of CPU being used by the FPC's processor.	all levels
Interrupt CPU Utilization (%)	Of the total CPU being used by the FPC's processor, the percentage being used for interrupts.	none specified
Memory DRAM (MB)	Total DRAM, in megabytes, available to the FPC's processor.	none specified
Heap Utilization (%)	Percentage of heap space (dynamic memory) being used by the FPC's processor. If this number exceeds 80 percent, there may be a software problem (memory leak). NOTE: On MX Series routers and EX Series switches in a broadband edge environment, heap utilization levels higher than 70 percent can affect unified ISSU, router stability, or scaling capability.	none specified
Buffer Utilization (%)	Percentage of buffer space being used by the FPC's processor for buffering internal messages.	none specified
Total CPU DRAM	Amount of DRAM available to the FPC's CPU.	**detail**
Total RLDRAM	Amount of reduced latency dynamic random access memory (RLDRAM) available to the FPC CPU.	**detail**
Total DDR DRAM	Amount of double data rate dynamic random access memory (DDR DRAM) available to the FPC CPU.	**detail**
Total SRAM	Amount of static RAM (SRAM) used by the FPC's CPU.	**detail**
Total SDRAM	Total amount of memory used for storing packets and notifications.	**detail**
I/O Manager ASICs information	I/O Manager version number, manufacturer, and part number.	**detail**
Start time	Time when the Routing Engine detected that the FPC was running.	**detail**

Table 61: show chassis fpc Output Fields *(continued)*

Field Name	Field Description	Level of Output
Uptime	How long the Routing Engine has been connected to the FPC and, therefore, how long the FPC has been up and running.	**detail**
PIC type	(**pic-status** output only) Type of PIC.	none specified

Sample Output

show chassis fpc (EX6210 Switch)

```
user@switch> show chassis fpc
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Empty
  1  Online             7      5          0        1024       0         32
  2  Empty
  3  Empty
  4  Online            25     17          2        2048       0         30
  5  Online            25      3          0        2048       0         24
  6  Online             6      5          0        1024       0         32
  7  Empty
  8  Empty
  9  Online             8      7          0        1024       0         32
```

show chassis fpc (M10 Router)

```
user@host> show chassis fpc
FPC status:
               Temp
Slot State      (C)
  0  Online      27
  1  Online      28
```

show chassis fpc (M20 Router)

```
user@host> show chassis fpc
FPC status:
               Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State      (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Empty        0      0          0         0         0          0
  1  Online      38      0          0         8         0          4
  2  Online      35      0          0         8         0          3
  3  Empty        0      0          0         0         0          0
```

show chassis fpc detail (M Series Routers)

```
user@host> show chassis fpc detail 1
Slot 1 information:
  State                                  Online
  Temperature                         48 degrees C
  Total CPU DRAM                      32 MB
  Total SRAM                           4 MB
  Total SDRAM                        256 MB
  I/O Manager ASICs information          Version 2.0, Foundry IBM, Part number 0
  I/O Manager ASICs information          Version 2.0, Foundry IBM, Part number 0
```



```
  Start time                        2000-02-08 02:18:49 UTC
  Uptime                            14 hours, 41 minutes, 41 seconds
```

show chassis fpc detail (MX80 Router)

```
user@host> show chassis fpc detail
Slot 0 information:
  State                             Online
  Temperature                    47 degrees C / 116 degrees F
  Total CPU DRAM               1024 MB
  Total SRAM                    331 MB
  Total SDRAM                  1280 MB
  Start time                        2010-02-08 12:25:33 PST
  Uptime                            2 hours, 13 minutes, 19 seconds
Slot 1 information:
  State                             Online
  Temperature                    47 degrees C / 116 degrees F
  Total CPU DRAM               1024 MB
  Total SRAM                    331 MB
  Total SDRAM                  1280 MB
  Start time                        2010-02-08 12:25:33 PST
  Uptime                            2 hours, 13 minutes, 19 seconds
```

show chassis fpc (MX104 Router)

```
user@host> show chassis fpc
Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Online            32     15          5        2048       22         13
  1  Online            32     15          5        2048       22         13
  2  Online            32     15          5        2048       22         13
```

show chassis fpc detail (MX104 Router)

```
user@host> show chassis fpc detail
Slot 0 information:
  State                             Online
  Temperature                    32 (C)
  Total CPU DRAM               2048 MB
  Total SRAM                    403 MB
  Total SDRAM                  1316 MB
  Start time                        2013-05-23 14:39:18 IST
  Uptime                            1 hour, 20 minutes, 22 seconds
Slot 1 information:
  State                             Online
  Temperature                    32 (C)
  Total CPU DRAM               2048 MB
  Total SRAM                    403 MB
  Total SDRAM                  1316 MB
  Start time                        2013-05-23 14:39:18 IST
  Uptime                            1 hour, 20 minutes, 22 seconds
Slot 2 information:
  State                             Online
  Temperature                    32 (C)
  Total CPU DRAM               2048 MB
  Total SRAM                    403 MB
  Total SDRAM                  1316 MB
  Start time                        2013-05-23 14:39:18 IST
  Uptime                            1 hour, 20 minutes, 22 seconds
```

show chassis fpc pic-status (MX104 Router)

```
user@host> show chassis fpc pic-status
Slot 0   Online
Slot 1   Online
  PIC 0  Online        10x 1GE(LAN) -E  SFP
  PIC 1  Online        10x 1GE(LAN) -E  SFP
Slot 2   Online
  PIC 0  Online        4x 10GE(LAN) SFP+
```

show chassis fpc (MX240 Router)

```
user@host> show chassis fpc
               Temp    CPU Utilization (%)    Memory      Utilization (%)
Slot State              (C)  Total  Interrupt     DRAM (MB) Heap      Buffer
  0  Empty
  1  Online             34     6           0       1024       18          30
  2  Online             33     9           0       1024       24          30
```

show chassis fpc (EX Series Switch)

```
user@host> show chassis fpc
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap      Buffer
  0  Empty
  1  Online            41     13          0       2048       19          14
  2  Online            42     12          0       2048       19          14
```

show chassis fpc (MX480 Router)

```
user@host> show chassis fpc
              Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap      Buffer
  0  Empty
  1  Online            36      9          0       1024       17          57
  2  Empty
  3  Empty
  4  Empty
  5  Empty
```

show chassis fpc (MX480 Router with 100-Gigabit Ethernet CFP)

```
user@host> show chassis fpc
        Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State     (C)  Total  Interrupt      DRAM (MB) Heap      Buffer
 0  Online      33   4      0              2048      10        13
 1  Online      36   7      0              2048      16        13
 2  Online      29   6      0              1024      27        29
 3  Online      33   0      0                 0       0         0
 4  Online      36   7      0              2048      19        13
 5  Online      34  31      11             2048      14        13
```

show chassis fpc pic-status (MX480 Router with 100-Gigabit Ethernet CFP)

```
user@host> show chassis fpc pic-status
Slot 1   Online        MPC Type 3
  PIC 2  Online        1X100GE CFP
 Slot 2  Online        DPCE 40x 1GE R EQ
  PIC 0  Online        10x 1GE(LAN) EQ
  PIC 1  Online        10x 1GE(LAN) EQ
  PIC 2  Online        10x 1GE(LAN) EQ
```

```
  PIC 3  Online       10x 1GE(LAN) EQ
 Slot 3  Online       MPC Type 3
  PIC 0  Online       1X100GE CFP
  PIC 2  Online       1X100GE CFP
 Slot 4  Online       MPC Type 3
  PIC 0  Online       1X100GE CFP
  PIC 2  Online       1X100GE CFP
 Slot 5  Online       MPC Type 2 3D EQ
  PIC 0  Online       2x 10GE  XFP
  PIC 1  Online       2x 10GE  XFP
  PIC 2  Online       10x 1GE(LAN) SFP
  PIC 3  Online       10x 1GE(LAN) SFP
```

show chassis fpc pic-status (EX Series Switch)

```
user@host> show chassis fpc pic-status
Slot 1   Online       EX9200 32x10G SFP
  PIC 0  Online       8X10GE SFPP
  PIC 1  Online       8X10GE SFPP
  PIC 2  Online       8X10GE SFPP
  PIC 3  Online       8X10GE SFPP
Slot 2   Online       EX9200 32x10G SFP
  PIC 0  Online       8X10GE SFPP
  PIC 1  Online       8X10GE SFPP
  PIC 2  Online       8X10GE SFPP
  PIC 3  Online       8X10GE SFPP
```

show chassis fpc (MX480 Router with MPC4E)

```
user@host> show chassis fpc
       Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)   Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Empty
  1  Empty
  2  Online            38       7          0       2048       19          14
  3  Online            39       8          0       2048       18          14
  4  Online            39       7          0       2048       17          14
  5  Empty
```

show chassis fpc detail (MX480 Router with MPC4E)

```
user@host> show chassis fpc detail
Slot 2 information:
  State                               Online
  Temperature                      38
  Total CPU DRAM                 2048 MB
  Total RLDRAM                   1036 MB
  Total DDR DRAM                 11264 MB
  Start time:                         2013-02-18 05:06:57 PST
  Uptime:                             17 hours, 41 minutes, 9 seconds
  Max Power Consumption           610 Watts
Slot 3 information:
  State                               Online
  Temperature                      38
  Total CPU DRAM                 2048 MB
  Total RLDRAM                   1036 MB
  Total DDR DRAM                 11264 MB
  Start time:                         2013-02-18 05:07:00 PST
  Uptime:                             17 hours, 41 minutes, 6 seconds
  Max Power Consumption           610 Watts
Slot 4 information:
  State                               Diagnostics
```

```
  Temperature                        37
  Total CPU DRAM                      0 MB
  Total RLDRAM                        0 MB
  Total DDR DRAM                      0 MB
  Max Power Consumption             520 Watts
```

show chassis fpc (MX480 Router with MPC4E)

```
user@host> show chassis fpc
                Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State       (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Empty
  1  Empty
  2  Online       38      7          0       2048       19         14
  3  Online       39      8          0       2048       18         14
  4  Online       39      7          0       2048       17         14
  5  Empty
```

show chassis fpc detail (MX480 Router with MPC4E)

```
user@host> show chassis fpc detail
Slot 2 information:
  State                                 Online
  Temperature                        38
  Total CPU DRAM                   2048 MB
  Total RLDRAM                     1036 MB
  Total DDR DRAM                  11264 MB
  Start time:                           2013-02-18 05:06:57 PST
  Uptime:                               17 hours, 41 minutes, 9 seconds
  Max Power Consumption             610 Watts
Slot 3 information:
  State                                 Online
  Temperature                        38
  Total CPU DRAM                   2048 MB
  Total RLDRAM                     1036 MB
  Total DDR DRAM                  11264 MB
  Start time:                           2013-02-18 05:07:00 PST
  Uptime:                               17 hours, 41 minutes, 6 seconds
  Max Power Consumption             610 Watts
Slot 4 information:
  State                                 Diagnostics
  Temperature                        37
  Total CPU DRAM                      0 MB
  Total RLDRAM                        0 MB
  Total DDR DRAM                      0 MB
  Max Power Consumption             520 Watts
```

show chassis fpc (MX960 Router)

```
user@host> show chassis fpc
                      Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State             (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
 0  Empty
 1  Empty
 2  Empty
 3  Online         25      19          0       1024        15          57
 4  Empty
 5  Online         26      27          0       1024        15          57
 6  Empty
 7  Empty
 8  Empty
 9  Empty
```



```
 10  Empty
 11  Empty
```

show chassis fpc (MX240, MX480, MX960 Routers with Application Services Modular Line Card

```
user@host> show chassis fpc 1
    Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  1  Online            34      5          0       3072         5         13
```

show chassis fpc (MX240, MX480, MX960 with Application Services Modular Line Card

```
user@host> show chassis fpc 1 detail
Slot 1 information:
  State                               Online
  Temperature                      34
  Total CPU DRAM                 3072 MB
  Total RLDRAM                    259 MB
  Total DDR DRAM                 4864 MB
  Start time:                         2012-06-19 10:51:43 PDT
  Uptime:                             16 minutes, 48 seconds
  Max Power Consumption           550 Watts
```

show chassis fpc (MX2010 Routers)

```
user@host> show chassis fpc
     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Online            34      9          0       2048        18         13
  1  Online            32      9          0       2048        15         13
  2  Empty
  3  Empty
  4  Empty
  5  Empty
  6  Empty
  7  Empty
  8  Online            31     13          0       2048        11         13
  9  Online            33     10          0       2048        18         13
```

show chassis fpc (MX2020 Routers)

```
user@host> show chassis fpc
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Online            10     12          0       2048        18         13
  1  Online             8      9          0       2048        18         13
  2  Online             7      9          0       2048        18         13
  3  Online             8     10          0       2048        18         13
  4  Online             9     10          0       2048        18         13
  5  Online             8      9          0       2048        18         13
  6  Online             8     10          0       2048        18         13
  7  Online             9      9          0       2048        18         13
  8  Online             9     10          0       2048        18         13
  9  Online            10      9          0       2048        18         13
 10  Online            16      8          0       2048        18         13
 11  Online            11     10          0       2048        18         13
 12  Online            10     10          0       2048        18         13
 13  Online            11      9          0       2048        18         13
 14  Online            12     10          0       2048        18         13
 15  Online            13      9          0       2048        18         13
 16  Online            13      9          0       2048        18         13
 17  Online            12      9          0       2048        18         13
```

```
  18  Online            12     8           0       2048       18          13
  19  Online            14    10           0       2048       18          13
```

show chassis fpc (MX2020 Router with MPC4E)

```
user@host> show chassis fpc
     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Online           33     12           2       2048       11          13
  1  Empty
  2  Empty
  3  Empty
  4  Empty
  5  Empty
  6  Empty
  7  Empty
  8  Empty
  9  Online           31     10           0       2048       11          13
 10  Online           32      7           0       2048       14          13
 11  Empty
 12  Empty
 13  Empty
 14  Online           28     12           0       2048       15          14
 15  Empty
 16  Empty
 17  Empty
 18  Empty
 19  Online           38      8           0       2048       18          13
```

show chassis fpc detail (MX2020 Router with MPC4E)

```
user@host> show chassis fpc detail
Slot 0 information:
  State                               Online
  Temperature                      34
  Total CPU DRAM                 2048 MB
  Total RLDRAM                    806 MB
  Total DDR DRAM                 2632 MB
  Start time:                         2013-02-17 08:17:35 PST
  Uptime:                             1 day, 14 hours, 50 minutes, 39 seconds
  Max Power Consumption           368 Watts
Slot 9 information:
  State                               Online
  Temperature                      32
  Total CPU DRAM                 2048 MB
  Total RLDRAM                    806 MB
  Total DDR DRAM                 2632 MB
  Start time:                         2013-02-17 08:17:43 PST
  Uptime:                             1 day, 14 hours, 50 minutes, 31 seconds
  Max Power Consumption           368 Watts
Slot 10 information:
  State                               Online
  Temperature                      37
  Total CPU DRAM                 2048 MB
  Total RLDRAM                   1036 MB
  Total DDR DRAM                 6656 MB
  Start time:                         2013-02-17 08:17:54 PST
  Uptime:                             1 day, 14 hours, 50 minutes, 20 seconds
  Max Power Consumption           520 Watts
Slot 14 information:
  State                               Online
```



```
  Temperature                        32
  Total CPU DRAM                   2048 MB
  Total RLDRAM                     1036 MB
  Total DDR DRAM                   11264 MB
  Start time:                           2013-02-17 08:18:01 PST
  Uptime:                               1 day, 14 hours, 50 minutes, 13 seconds
  Max Power Consumption             610 Watts
Slot 19 information:
  State                                 Online
  Temperature                        38
  Total CPU DRAM                   2048 MB
  Total RLDRAM                     1324 MB
  Total DDR DRAM                   5120 MB
  Start time:                           2013-02-17 08:18:08 PST
  Uptime:                               1 day, 14 hours, 50 minutes, 6 seconds
  Max Power Consumption             440 Watts
```

show chassis fpc detail (MX Series Routers)

```
user@host> show chassis fpc detail 2
Slot 0 information:
  State                                 Online
  Temperature                        36 degrees C / 96 degrees F
  Total CPU DRAM                   1024 MB
  Total RLDRAM                      256 MB
  Total DDR DRAM                   4096 MB
  Start time:                           2009-08-11 21:20:30 PDT
  Uptime:                               2 hours, 8 minutes, 50 seconds
  Max Power Consumption             335 Watts
```

show chassis fpc detail (EX Series Switches)

```
user@host> show chassis fpc detail 2
Slot 1 information:
  State                                 Online
  Temperature                        41
  Total CPU DRAM                   2048 MB
  Total RLDRAM                     1036 MB
  Total DDR DRAM                   11264 MB
  Start time:                           2013-04-02 00:04:52 PDT
  Uptime:                               7 days, 9 hours, 47 minutes, 46 seconds
  Max Power Consumption             610 Watts
Slot 2 information:
  State                                 Online
  Temperature                        41
  Total CPU DRAM                   2048 MB
  Total RLDRAM                     1036 MB
  Total DDR DRAM                   11264 MB
  Start time:                           2013-04-02 00:04:56 PDT
  Uptime:                               7 days, 9 hours, 47 minutes, 42 seconds
  Max Power Consumption             610 Watts
```

show chassis fpc (Hardware Not Supported)

```
user@host> show chassis fpc
show chassis fpc
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
 Slot State           (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Online          -------------------- CPU less FPC --------------------
  1  Present         ------ Hardware Not In Right Slot ------
  2  Online                 0          0          0          0          0
  3  Present         ------ Hardware Not Supported ------
```



```
  4  Empty
  5  Empty
  6  Online                   0          0          0          0          0
```

show chassis fpc detail (Hardware Not Supported)

```
user@host> show chassis fpc detail
Slot 0 information:
  State                                Online
  Total CPU DRAM                       ---- CPU less FPC ----
  Start time                           2006-07-07 03:21:00 UTC
  Uptime                               27 minutes, 51 seconds
 Slot 1 information:
  State                                Present
  Reason                               --- Hardware Not In Right Slot ---
 Slot 2 information:
  State                                Online
  Total CPU DRAM                    32 MB
  Start time                           2006-07-07 03:20:59 UTC
  Uptime                               27 minutes, 52 seconds
 Slot 3 information:
  State                                Present
  Reason                               --- Hardware Not Supported ---
  Total CPU DRAM                     0 MB
 Slot 6 information:
  State                                Online
  Total CPU DRAM                    32 MB
  Start time                           2006-07-07 03:21:01 UTC
  Uptime                               27 minutes, 50 seconds
```

show chassis fpc pic-status

```
user@host> show chassis fpc pic-status
Slot 0 Online
  PIC 1     1x OC-12 ATM, MM
  PIC 2     1x OC-12 ATM, MM
  PIC 3     1x OC-12 ATM, MM
Slot 1 Online
  PIC 0     1x OC-48 SONET, SMIR
Slot 2 Online
  PIC 0     1x OC-192 SONET, SMSR
```

show chassis fpc pic-status (M Series Routers)

```
user@host> show chassis fpc pic-status
Slot 1    Online       FPC Type 1
  PIC 0   Present      2x OC-3 ATM, MM- Hardware Error
  PIC 1   Online       4x OC-3 SONET, SMIR
Slot 2    Online       E-FPC Type 2
  PIC 0   Online       4x G/E, 1000 BASE-SX
  PIC 1   Online       2x G/E SFP, 1000 BASE
  PIC 3   Online       1x Tunnel
Slot 3    Online       E-FPC Type 1
  PIC 0   Online       1x G/E IQ, 1000 BASE
  PIC 2   Online       1x G/E SFP, 1000 BASE
Slot 4    Online       E-FPC Type 2
  PIC 0   Online       4x G/E SFP, 1000 BASE
  PIC 1   Online       4x G/E SFP, 1000 BASE
  PIC 2   Online       4x G/E SFP, 1000 BASE
  PIC 3   Online       4x G/E SFP, 1000 BASE
```



```
Slot 5   Online       FPC Type 2
...
```

show chassis fpc pic-status (M120 Router)

```
user@host> show chassis fpc pic-status
Slot 1   Online       M120 CFPC 10GE
  PIC 0  Online       1x 10GE(LAN/WAN) XFP
Slot 3   Online       M120 FPC Type 2 (proto)
  PIC 0  Online       2x G/E IQ, 1000 BASE
  PIC 1  Online       4x OC-3 SONET, SMIR
  PIC 2  Online       2x G/E IQ, 1000 BASE
  PIC 3  Online       8x 1GE(LAN), IQ2
Slot 4   Online       M120 FPC Type 3 (proto)
  PIC 0  Online       10x 1GE(LAN), 1000 BASE
Slot 5   Online       M120 FPC Type 1 (proto)
  PIC 0  Present      1x G/E, 1000 BASE-LX- Not Supported
  PIC 1  Online       1x CHOC3 IQ SONET, SMLR
  PIC 2  Online       4x CHDS3 IQ
  PIC 3  Online       1x G/E SFP, 1000 BASE
```

show chassis fpc pic-status (MX240, MX480, and MX960 Routers with Application Services Modular Line Card)

In the following output **Slot 1 and Slot 5** are the Application Services Modular Carrier Cards (AS MCC), **PIC 0** is the Application Services Modular Storage Card (AS MSC), and **PIC 2** is the Application Services Modular Processing Card (AS MXC).

```
user@host>show chassis fpc pic-status
Slot 2   Online       MPC Type 1 3D Q
  Slot 1   Online       AS-MCC
  PIC 0  Online       AS-MSC
  PIC 2  Online       AS-MXC
Slot 4   Offline      MPC 3D 16x 10GE
Slot 5   Offline      AS-MCC
```

show chassis fpc lcc (TX Matrix Router)

```
user@host> show chassis fpc lcc 0
lcc0-re0:
--------------------------------------------------------------------------
                     Temp  CPU       Utilization (%)  Memory    Utilization (%)
Slot State        (C)  Total  Interrupt      DRAM (MB)       Heap   Buffer
  0  Empty
  1  Online        27      2          0        256          8         44
  2  Online        27      3          0         256         15         44
  3  Empty
  4  Empty
  5  Empty
  6  Empty
  7  Empty
```

show chassis fpc pic-status (TX Matrix Router)

```
user@host> show chassis fpc pic-status
lcc0-re0:
--------------------------------------------------------------------------
Slot 0   Online       FPC Type 3
  PIC 0  Online       1x OC-192 SM SR1
  PIC 1  Online       1x OC-192 SM SR2
  PIC 2  Online       1x OC-192 SM SR1
  PIC 3  Online       1x Tunnel
```

```
Slot 1   Online       FPC Type 2
  PIC 0  Online       1x OC-48 SONET, SMSR
  PIC 1  Online       1x OC-48 SONET, SMSR

lcc1-re0:
--------------------------------------------------------------------------

lcc2-re0:
--------------------------------------------------------------------------
Slot 1   Online       FPC Type 3
  PIC 0  Online       1x OC-192 SM SR1
Slot 5   Online       FPC Type 2
  PIC 0  Online       1x OC-48 SONET, SMSR
  PIC 1  Online       2x G/E, 1000 BASE-LX
  PIC 2  Online       2x G/E, 1000 BASE-LX
  PIC 3  Online       1x OC-48 SONET, SMSR

lcc3-re0:
--------------------------------------------------------------------------
```

show chassis fpc pic-status lcc (TX Matrix Router)

```
user@host> show chassis fpc pic-status lcc 0
lcc0-re0:
--------------------------------------------------------------------------
Slot 0   Online       FPC Type 3
  PIC 0  Online       1x OC-192 SM SR2
Slot 1   Online       FPC Type 2
  PIC 0  Online       2x OC-12 ATM2 IQ, MM
  PIC 1  Online       1x OC-48 SONET, SMSR
  PIC 2  Online       1x OC-48 SONET, SMSR
  PIC 3  Online       4x G/E, 1000 BASE-SX
```

show chassis fpc (TX Matrix Plus Router)

```
user@host> show chassis fpc
lcc0-re0:
--------------------------------------------------------------------------
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Empty
  1  Online            38      4          0       2048        3         24
  2  Online            43      8          0       2048        6         24
  3  Empty
  4  Online            43      6          0       2048        6         24
  5  Empty
  6  Online            42     13          0       2048        6         24
  7  Online            45      7          0       2048        3         24

lcc2-re0:
--------------------------------------------------------------------------
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Online            42     10          0      2048         6         24
  1  Empty
  2  Online            42     11          0       2048        6         24
  3  Online            40      5          0       2048        3         24
  4  Online            33     26          0       1024        8         49
  5  Empty
  6  Online            43      8          0       2048        6         24
  7  Online            46      6          0       2048        3         24
```

```
lcc3-re0:
--------------------------------------------------------------------------
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Empty
  1  Empty
  2  Online            39     30          0       2048        7         24
  3  Empty
  4  Online            41      8          0       2048        6         24
  5  Online            41     12          0       2048        6         24
  6  Online            40      8          0       2048        6         24
  7  Online            42      4          0       2048        3         24
```

show chassis fpc lcc (TX Matrix Plus Router)

```
user@host> show chassis fpc lcc 0
lcc0-re0:
--------------------------------------------------------------------------
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Empty
  1  Online            38      4          0       2048        3         24
  2  Online            43      8          0       2048        6         24
  3  Empty
  4  Online            43      6          0       2048        6         24
  5  Empty
  6  Online            42     14          0       2048        6         24
  7  Online            45      6          0       2048        3         24
```

show chassis fpc detail (TX Matrix Plus Router)

```
user@host> show chassis fpc details

lcc0-re0:
--------------------------------------------------------------------------
Slot 1 information:
  State                               Online
  Temperature                      38 degrees C / 100 degrees F
  Total CPU DRAM                 2048 MB
  Total SRAM                       64 MB
  Total SDRAM                    1280 MB
  Start time                          2010-10-04 20:06:22 PDT
  Uptime                              1 hour, 32 minutes, 51 seconds
Slot 2 information:
  State                               Online
  Temperature                      43 degrees C / 109 degrees F
  Total CPU DRAM                 2048 MB
  Total SRAM                      128 MB
  Total SDRAM                    2560 MB
  Start time                          2010-10-04 20:06:37 PDT
  Uptime                              1 hour, 32 minutes, 36 seconds
Slot 4 information:
  State                               Online
  Temperature                      43 degrees C / 109 degrees F
  Total CPU DRAM                 2048 MB
  Total SRAM                      128 MB
  Total SDRAM                    2560 MB
  Start time                          2010-10-04 20:06:40 PDT
  Uptime                              1 hour, 32 minutes, 33 seconds
Slot 6 information:
```

```
  State                            Online
  Temperature                   42 degrees C / 107 degrees F
  Total CPU DRAM              2048 MB
  Total SRAM                   128 MB
  Total SDRAM                 2560 MB
  Start time                       2010-10-04 20:06:42 PDT
  Uptime                           1 hour, 32 minutes, 31 seconds
Slot 7 information:
  State                            Online
  Temperature                   45 degrees C / 113 degrees F
  Total CPU DRAM              2048 MB
  Total SRAM                    64 MB
  Total SDRAM                 1280 MB
  Start time                       2010-10-04 20:06:43 PDT
  Uptime                           1 hour, 32 minutes, 30 seconds

lcc2-re0:
--------------------------------------------------------------------------
Slot 0 information:
  State                            Online
  Temperature                   42 degrees C / 107 degrees F
  Total CPU DRAM              2048 MB
  Total SRAM                   128 MB
  Total SDRAM                 2560 MB
  Start time                       2010-10-04 20:06:35 PDT
  Uptime                           1 hour, 32 minutes, 38 seconds
Slot 2 information:
  State                            Online
  Temperature                   42 degrees C / 107 degrees F
  Total CPU DRAM              2048 MB
  Total SRAM                   128 MB
  Total SDRAM                 2560 MB
  Start time                       2010-10-04 20:06:37 PDT
  Uptime                           1 hour, 32 minutes, 36 seconds
Slot 3 information:
  State                            Online
  Temperature                   40 degrees C / 104 degrees F
  Total CPU DRAM              2048 MB
  Total SRAM                    64 MB
  Total SDRAM                 1280 MB
  Start time                       2010-10-04 20:06:28 PDT
  Uptime                           1 hour, 32 minutes, 45 seconds
Slot 4 information:
  State                            Online
  Temperature                   33 degrees C / 91 degrees F
  Total CPU DRAM              1024 MB
  Total SRAM                    64 MB
  Total SDRAM                 1280 MB
  Start time                       2010-10-04 20:08:03 PDT
  Uptime                           1 hour, 31 minutes, 10 seconds
Slot 6 information:
  State                            Online
  Temperature                   43 degrees C / 109 degrees F
  Total CPU DRAM              2048 MB
  Total SRAM                   128 MB
  Total SDRAM                 2560 MB
  Start time                       2010-10-04 20:06:44 PDT
  Uptime                           1 hour, 32 minutes, 29 seconds
Slot 7 information:
  State                            Online
  Temperature                   46 degrees C / 114 degrees F
```



```
  Total CPU DRAM                 2048 MB
  Total SRAM                       64 MB
  Total SDRAM                    1280 MB
  Start time                          2010-10-04 20:06:46 PDT
  Uptime                              1 hour, 32 minutes, 27 seconds

lcc3-re0:
--------------------------------------------------------------------------
Slot 2 information:
  State                               Online
  Temperature                      38 degrees C / 100 degrees F
  Total CPU DRAM                 2048 MB
  Total SRAM                      128 MB
  Total SDRAM                    2560 MB
  Start time                          2010-10-04 20:17:31 PDT
  Uptime                              1 hour, 21 minutes, 42 seconds
Slot 4 information:
  State                               Online
  Temperature                      41 degrees C / 105 degrees F
  Total CPU DRAM                 2048 MB
  Total SRAM                      128 MB
  Total SDRAM                    2560 MB
  Start time                          2010-10-04 20:17:34 PDT
  Uptime                              1 hour, 21 minutes, 39 seconds
Slot 5 information:
  State                               Online
  Temperature                      41 degrees C / 105 degrees F
  Total CPU DRAM                 2048 MB
  Total SRAM                      128 MB
  Total SDRAM                    2560 MB
  Start time                          2010-10-04 20:17:36 PDT
  Uptime                              1 hour, 21 minutes, 37 seconds
Slot 6 information:
  State                               Online
  Temperature                      40 degrees C / 104 degrees F
  Total CPU DRAM                 2048 MB
  Total SRAM                      128 MB
  Total SDRAM                    2560 MB
  Start time                          2010-10-04 20:17:39 PDT
  Uptime                              1 hour, 21 minutes, 34 seconds
Slot 7 information:
  State                               Online
  Temperature                      42 degrees C / 107 degrees F
  Total CPU DRAM                 2048 MB
  Total SRAM                       64 MB
  Total SDRAM                    1280 MB
  Start time                          2010-10-04 20:17:41 PDT
  Uptime                              1 hour, 21 minutes, 32 seconds
```

show chassis fpc pic-status (TX Matrix Plus Router)

```
user@host> show chassis fpc pic-status

lcc0-re0:
--------------------------------------------------------------------------
Slot 1   Online       FPC Type 2-ES
  PIC 0  Online       8x 1GE(LAN), IQ2
Slot 2   Online       FPC Type 4-ES
  PIC 0  Online       4x 10GE (LAN/WAN) XFP
Slot 4   Online       FPC Type 4-ES
  PIC 0  Online       4x 10GE (LAN/WAN) XFP
```

```
Slot 6   Online       FPC Type 4-ES
  PIC 0  Online       4x 10GE (LAN/WAN) XFP
  PIC 1  Online       4x 10GE (LAN/WAN) XFP
Slot 7   Online       FPC Type 3-ES
  PIC 0  Online       10x 1GE(LAN), 1000 BASE
  PIC 2  Online       1x OC-192 SM SR2
  PIC 3  Online       10x 1GE(LAN), 1000 BASE

lcc2-re0:
--------------------------------------------------------------------------
Slot 0   Online       FPC Type 4-ES
  PIC 0  Online       4x 10GE (LAN/WAN) XFP
Slot 2   Online       FPC Type 4-ES
  PIC 0  Online       4x 10GE (LAN/WAN) XFP
  PIC 1  Online       4x 10GE (LAN/WAN) XFP
Slot 3   Online       FPC Type 2-ES
  PIC 0  Online       8x 1GE(LAN), IQ2
Slot 4   Online       FPC Type 4
  PIC 0  Online       10x10GE(LAN/WAN) SFPP
Slot 6   Online       FPC Type 4-ES
  PIC 0  Online       4x OC-192 SONET XFP
Slot 7   Online       FPC Type 3-ES
  PIC 0  Online       10x 1GE(LAN), 1000 BASE
  PIC 1  Offline      1x 10GE(LAN/WAN) IQ2E
  PIC 2  Online       1x OC-192 SM SR2
  PIC 3  Online       1x Tunnel

lcc3-re0:
--------------------------------------------------------------------------
Slot 2   Online       FPC Type 4-ES
  PIC 0  Online       10x10GE(LAN/WAN) SFPP
Slot 4   Online       FPC Type 4-ES
  PIC 0  Online       4x OC-192 SONET XFP
Slot 5   Online       FPC Type 4-ES
  PIC 0  Online       4x OC-192 SONET XFP
  PIC 1  Online       4x 10GE (LAN/WAN) XFP
Slot 6   Online       FPC Type 4-ES
  PIC 1  Online       4x 10GE (LAN/WAN) XFP
Slot 7   Online       FPC Type 3-ES
  PIC 0  Online       10x 1GE(LAN), 1000 BASE
  PIC 1  Online       8x 1GE(TYPE3), IQ2E
  PIC 2  Online       4x OC-48 SONET
```

show chassis fpc (T1600 Router)

```
user@host> show chassis fpc
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Empty
  1  Empty
  2  Online            49      3          0       2048        3         24
  3  Online            46      6          0       2048        6         24
  4  Empty
  5  Online            46      5          0       2048        3         24
  6  Empty
  7  Online            44      8          0       1024        7         49
```

show chassis fpc detail (T1600 Router)

```
user@host> show chassis fpc detail
```

```
show chassis fpc detail
Slot 2 information:
  State                                Online
  Temperature                       49 degrees C / 120 degrees F
  Total CPU DRAM                  2048 MB
  Total SRAM                        64 MB
  Total SDRAM                     1280 MB
  Start time                           2010-10-04 21:12:52 PDT
  Uptime                               32 minutes, 9 seconds
Slot 3 information:
  State                                Online
  Temperature                       47 degrees C / 116 degrees F
  Total CPU DRAM                  2048 MB
  Total SRAM                       128 MB
  Total SDRAM                     2560 MB
  Start time                           2010-10-04 21:13:06 PDT
  Uptime                               31 minutes, 55 seconds
Slot 5 information:
  State                                Online
  Temperature                       46 degrees C / 114 degrees F
  Total CPU DRAM                  2048 MB
  Total SRAM                        64 MB
  Total SDRAM                     1280 MB
  Start time                           2010-10-04 21:12:56 PDT
  Uptime                               32 minutes, 5 seconds
Slot 7 information:
  State                                Online
  Temperature                       44 degrees C / 111 degrees F
  Total CPU DRAM                  1024 MB
  Total SRAM                        64 MB
  Total SDRAM                     1280 MB
  Start time                           2010-10-04 21:14:34 PDT
  Uptime                               30 minutes, 27 seconds
```

show chassis fpc <fpc-slot> (EX Series Switch)

user@host> **show chassis fpc 2**

```
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap      Buffer
  2  Online            40     12          0       2048        19         14
```

show chassis fpc slot (T1600 Router)

user@host> **show chassis fpc slot 2**

```
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap      Buffer
  2  Online            49      3          0       2048         3         24
```

show chassis fpc pic-status (T1600 Router)

user@host> **show chassis fpc pic-status**

```
Slot 2    Online        FPC Type 1-ES
  PIC 0   Online        Load Type 1
  PIC 1   Online        4x 1GE(LAN), IQ2E
  PIC 3   Online        1x OC-12-3 SFP
Slot 3    Online        FPC Type 4-ES
  PIC 0   Online        4x 10GE (LAN/WAN) XFP
  PIC 1   Online        4x OC-192 SONET XFP
```



```
Slot 5   Online        FPC Type 2-ES
  PIC 0  Online        Load Type 2
  PIC 1  Online        8x 1GE(LAN), IQ2E
  PIC 2  Online        8x 1GE(LAN), IQ2E
  PIC 3  Online        1x OC-48-12-3 SFP
Slot 7   Online        FPC Type 4
  PIC 0  Online        4x 10GE (LAN/WAN) XFP
```

show chassis fpc (T4000 Router)

```
user@host> show chassis fpc

regress@stymphalian# run show chassis fpc
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Online            48     15          0       2816        21        27
  1  Empty
  2  Empty
  3  Online            51     15          0       2816        21        27
  4  Empty
  5  Online            39      8          0       2048         6        23
  6  Online            49     15          0       2816        21        27
  7  Empty
```

show chassis fpc detail (T4000 Router)

```
user@host> show chassis fpc detail
Slot 0 information:
  State                            Online
  Temperature                   48 degrees C / 118 degrees F
  Total CPU DRAM              2816 MB
  Total SRAM                  1554 MB
  Total SDRAM                 10752 MB
  Start time                       2012-02-09 22:56:25 PST
  Uptime                           2 hours, 40 minutes, 52 seconds
Slot 3 information:
  State                            Online
  Temperature                   51 degrees C / 123 degrees F
  Total CPU DRAM              2816 MB
  Total SRAM                  1554 MB
  Total SDRAM                 10752 MB
  Start time                       2012-02-09 22:56:22 PST
  Uptime                           2 hours, 40 minutes, 55 seconds
Slot 5 information:
  State                            Online
  Temperature                   39 degrees C / 102 degrees F
  Total CPU DRAM              2048 MB
  Total SRAM                   128 MB
  Total SDRAM                 2560 MB
  Start time                       2012-02-09 22:51:27 PST
  Uptime                           2 hours, 45 minutes, 50 seconds
Slot 6 information:
  State                            Online
  Temperature                   49 degrees C / 120 degrees F
  Total CPU DRAM              2816 MB
  Total SRAM                  1554 MB
  Total SDRAM                 10752 MB
  Start time                       2012-02-09 22:56:29 PST
  Uptime                           2 hours, 40 minutes, 48 seconds
```


show chassis fpc pic-status (T4000 Router)

```
user@host> show chassis fpc pic-status
Slot 0   Online       FPC Type 5-3D
  PIC 0  Online       12x10GE (LAN/WAN) SFPP
  PIC 1  Online       12x10GE (LAN/WAN) SFPP
Slot 3   Online       FPC Type 5-3D
  PIC 0  Online       1x100GE
  PIC 1  Online       12x10GE (LAN/WAN) SFPP
Slot 5   Online       FPC Type 4-ES
  PIC 0  Online       100GE
  PIC 1  Online       100GE CFP
Slot 6   Online       FPC Type 5-3D
  PIC 0  Online       12x10GE (LAN/WAN) SFPP
  PIC 1  Online       12x10GE (LAN/WAN) SFPP
```

show chassis fpc (QFX Series)

```
user@switch> show chassis fpc
Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
0  Online            26      2          0      2820         0         49
```

show chassis fpc detail (QFX3500 Switches)

```
user@switch> show chassis fpc detail
Slot 0 information:
  State                               Online
  Temperature                      28 degrees C / 82 degrees F
  Total CPU DRAM                 2820 MB
  Total SRAM                        0 MB
  Total SDRAM                       0 MB
  Start time                          2010-09-20 01:34:13 PDT
  Uptime                              3 days, 3 hours, 31 minutes, 48 seconds
```

show chassis fpc pic-status (QFX3500 Switches)

```
user@switch> show chassis fpc pic-status
Slot 0   Online       QFX 48x10G 4x40G Switch
  PIC 0  Online       48x 10G-SFP+
  PIC 1  Online       15x 10G-SFP+
```

show chassis fpc interconnect-device (QFabric System)

```
user@switch> show chassis fpc interconnect-device interconnect1
FPC status:
                     Temp
Slot State            (C)
  0  Online             0
  1  Online             0
  2  Online             0
  3  Online             0
  4  Online             0
  5  Online             0
  6  Online             0
  7  Online             0
  8  Online             0
  9  Online             0
 10  Online             0
 11  Online             0
 12  Online             0
```



```
 13  Online           0
 14  Online           0
 15  Online           0
```

show chassis fpc interconnect-device (QFabric System)

```
user@switch> show chassis fpc interconnect-device interconnect1 3
FPC status:
                     Temp
Slot State            (C)
  3  Online           0
```

show chassis fpc interconnect-device detail (QFabric System)

```
user@switch> show chassis fpc interconnect-device interconnect1 3 detail
Slot 3 information:
  State                              Online
  Temperature                      0 degrees C / 32 degrees F
  Start time                         2011-08-18 10:45:04 PDT
  Uptime                             1 minute, 49 seconds
```

show chassis fpc pic-status interconnect-device (QFabric System)

```
user@switch> show chassis fpc pic-status interconnect-device interconnect1
Slot 0   Online       QFX 16-port QSFP+ Front Card
  PIC 0  Online       16x 40G-QSFP+
  PIC 1  Online       16x 40G-GE
Slot 1   Online       QFX 16-port QSFP+ Front Card
  PIC 0  Online       16x 40G-QSFP+
 PIC 1  Online       16x 40G-GE
Slot 2   Online       QFX 16-port QSFP+ Front Card
  PIC 0  Online       16x 40G-QSFP+
  PIC 1  Online       16x 40G-GE
Slot 3   Online       QFX 16-port QSFP+ Front Card
  PIC 0  Online       16x 40G-QSFP+
  PIC 1  Online       16x 40G-GE
Slot 4   Online       QFX 16-port QSFP+ Front Card
  PIC 0  Online       16x 40G-QSFP+
  PIC 1  Online       16x 40G-GE
Slot 5   Online       QFX 16-port QSFP+ Front Card
  PIC 0  Online       16x 40G-QSFP+
  PIC 1  Online       16x 40G-GE
Slot 6   Online       QFX 16-port QSFP+ Front Card
  PIC 0  Online       16x 40G-QSFP+
  PIC 1  Online       16x 40G-GE
Slot 7   Online       QFX 16-port QSFP+ Front Card
  PIC 0  Online       16x 40G-QSFP+
  PIC 1  Online       16x 40G-GE
Slot 8   Online       QFX Fabric Rear Card
  PIC 0  Online       16x 40G-GE
Slot 9   Online       QFX Fabric Rear Card
  PIC 0  Online       16x 40G-GE
Slot 10  Online       QFX Fabric Rear Card
  PIC 0  Online       16x 40G-GE
Slot 11  Online       QFX Fabric Rear Card
  PIC 0  Online       16x 40G-GE
Slot 12  Online       QFX Fabric Rear Card
  PIC 0  Online       16x 40G-GE
Slot 13  Online       QFX Fabric Rear Card
  PIC 0  Online       16x 40G-GE
Slot 14  Online       QFX Fabric Rear Card
  PIC 0  Online       16x 40G-GE
```



```
Slot 15   Online       QFX Fabric Rear Card
  PIC 0   Online       16x 40G-GE
```

show chassis fpc pic-status node-device (QFabric System)

```
user@switch> show chassis fpc pic-status node-device node1
Slot node1 Online       QFX 48x10G 4x40G Switch
  PIC 0   Online       48x 10G-SFP+
  PIC 1   Online       4x 40G-QSFP+
```

show chassis fpc (PTX5000 Packet Transport Router)

```
user@host> show chassis fpc
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Empty
  1  Empty
  2  Online            50      6          0       2816         5         27
  3  Empty
  4  Empty
  5  Online            48      9          0       2816         5         27
  6  Empty
  7  Online            49      8          0       2816         5         27
```

show chassis fpc detail (PTX5000 Packet Transport Router)

```
user@host> show chassis fpc detail
Slot 2 information:
  State                               Online
  Temperature                      35 degrees C / 95 degrees F (PMB)
  Temperature                      35 degrees C / 95 degrees F (Intake)
  Temperature                      50 degrees C / 122 degrees F (Exhaust A)
  Temperature                      54 degrees C / 129 degrees F (Exhaust B)
  Temperature                      54 degrees C / 129 degrees F (TL0)
  Temperature                      52 degrees C / 125 degrees F (TQ0)
  Temperature                      61 degrees C / 141 degrees F (TL1)
  Temperature                      58 degrees C / 136 degrees F (TQ1)
  Temperature                      57 degrees C / 134 degrees F (TL2)
  Temperature                      58 degrees C / 136 degrees F (TQ2)
  Temperature                      62 degrees C / 143 degrees F (TL3)
  Temperature                      61 degrees C / 141 degrees F (TQ3)
  Total CPU DRAM                 2816 MB
  Total SRAM                        0 MB
  Total SDRAM                       0 MB
  Start time                          2012-01-12 12:05:42 PST
  Uptime                              3 hours, 14 minutes, 7 seconds
Slot 5 information:
  State                               Online
  Temperature                      35 degrees C / 95 degrees F (PMB)
  Temperature                      34 degrees C / 93 degrees F (Intake)
  Temperature                      48 degrees C / 118 degrees F (Exhaust A)
  Temperature                      53 degrees C / 127 degrees F (Exhaust B)
  Temperature                      54 degrees C / 129 degrees F (TL0)
  Temperature                      52 degrees C / 125 degrees F (TQ0)
  Temperature                      69 degrees C / 156 degrees F (TL1)
  Temperature                      56 degrees C / 132 degrees F (TQ1)
  Temperature                      54 degrees C / 129 degrees F (TL2)
  Temperature                      56 degrees C / 132 degrees F (TQ2)
  Temperature                      59 degrees C / 138 degrees F (TL3)
  Temperature                      60 degrees C / 140 degrees F (TQ3)
  Total CPU DRAM                 2816 MB
```



```
  Total SRAM                         0 MB
  Total SDRAM                        0 MB
  Start time                           2012-01-12 12:05:43 PST
  Uptime                               3 hours, 14 minutes, 6 seconds
Slot 7 information:
  State                                Online
  Temperature                       35 degrees C / 95 degrees F (PMB)
  Temperature                       33 degrees C / 91 degrees F (Intake)
  Temperature                       50 degrees C / 122 degrees F (Exhaust A)
  Temperature                       55 degrees C / 131 degrees F (Exhaust B)
  Temperature                       56 degrees C / 132 degrees F (TL0)
  Temperature                       56 degrees C / 132 degrees F (TQ0)
  Temperature                       61 degrees C / 141 degrees F (TL1)
  Temperature                       57 degrees C / 134 degrees F (TQ1)
  Temperature                       55 degrees C / 131 degrees F (TL2)
  Temperature                       59 degrees C / 138 degrees F (TQ2)
  Temperature                       62 degrees C / 143 degrees F (TL3)
  Temperature                       62 degrees C / 143 degrees F (TQ3)
  Total CPU DRAM                  2816 MB
  Total SRAM                         0 MB
  Total SDRAM                        0 MB
  Start time                           2012-01-12 12:05:44 PST
  Uptime                               3 hours, 14 minutes, 5 seconds
```

show chassis fpc pic-status (PTX5000 Packet Transport Router)

```
user@host> show chassis fpc pic-status
Slot 2   Online        FPC
  PIC 0  Online        24x 10GE(LAN) SFP+
  PIC 1  Online        24x 10GE(LAN) SFP+
Slot 5   Online        FPC
  PIC 0  Online        24x 10GE(LAN) SFP+
  PIC 1  Online        2x 40GE CFP
Slot 7   Online        FPC
  PIC 0  Online        24x 10GE(LAN) SFP+
  PIC 1  Online        2x 40GE CFP
```

show chassis fpc (ACX2000 Universal Access Router)

```
user@host> show chassis fpc
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Online           61     17           6       512        21         37
```

show chassis fpc 0 (ACX2000 Universal Access Router)

```
user@host> show chassis fpc 0
                     Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State            (C)  Total  Interrupt      DRAM (MB) Heap     Buffer
  0  Online           61     17           6       512        21         37
```

show chassis fpc detail (ACX2000 Universal Access Router)

```
user@host> show chassis fpc detail
Slot 0 information:
  State                                Online
  Temperature                       61 degrees C / 141 degrees F
  Total CPU DRAM                   512 MB
  Start time                           2012-05-29 02:52:06 PDT
  Uptime                               27 minutes, 17 seconds
```


show chassis fpc pic-status (ACX2000 Universal Access Router)

```
user@host> show chassis fpc pic-status
Slot 0   Online
  PIC 0  Online       16x CHE1T1, RJ48
  PIC 1  Online       8x 1GE(LAN) RJ45
  PIC 2  Online       2x 1GE(LAN) SFP
  PIC 3  Online       2x 10GE(LAN) SFP+
```

show chassis FPC 1 (MX Routers with Media Services Blade [MSB])

```
user@switch> show chassis fpc 1
                  Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State         (C)  Total  Interrupt      DRAM (MB) Heap      Buffer
  1  Online         34      5          0       3072         5         13
```

show chassis FPC 1 detail (MX Routers with Media Services Blade [MSB])

```
user@switch> show chassis fpc 1 detail
Slot 1 information:
  State                                  Online
  Temperature                         34
  Total CPU DRAM                    3072 MB
  Total RLDRAM                       259 MB
  Total DDR DRAM                    4864 MB
  Start time:                            2012-06-19 10:51:43 PDT
  Uptime:                                16 minutes, 48 seconds
  Max Power Consumption              550 Watts
```

show chassis hardware

Syntax

show chassis hardware
<detail | extensive>
<clei-models>
<models>

Syntax (EX Series)

show chassis hardware
<clei-models>
<detail | extensive>
<models>

Syntax (T4000 Router)

show chassis hardware
<clei-models>
<detail | extensive>
<models>

Syntax (TX Matrix Router)

show chassis hardware
<clei-models>
<detail | extensive>
<models>
<lcc *number* | scc>

Syntax (TX Matrix Plus Router)

show chassis hardware
<clei-models>
<detail | extensive>
<models>
<lcc *number* | sfc *number*>

Syntax (MX Series Routers)

show chassis hardware
<detail | extensive>
<clei-models>
<models>
<all-members>
<local>
<member *member-id*>

Syntax (MX104, MX2010, and MX2020 3D Universal Edge Routers)

show chassis hardware
<clei-models>
<detail | extensive>
<models>

Syntax (QFX Series)

show chassis hardware
<detail | extensive>
<clei-models>
<interconnect-device *name*>
<node-device *name*>
<models>

Syntax (PTX Series Packet Transport Routers)

show chassis hardware
<detail | extensive>
<clei-models>
<models>

Syntax (ACX Series Universal Access Routers)

show chassis hardware
<detail | extensive>
<clei-models>
<models>

Release Information

Command introduced before Junos OS Release 7.4.
models option introduced in Junos OS Release 8.2.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for QFX Series.
Command introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.
Command introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.

Description

Display a list of all Flexible PIC Concentrators (FPCs) and PICs installed in the router or switch chassis, including the hardware version level and serial number.

In the EX Series switch command output, FPC refers to the following:

- On EX2200 switches, EX3200 switches, EX4200 standalone switches, and EX4500 switches—Refers to the switch; FPC *number* is always 0.
- On EX4200 switches in a Virtual Chassis configuration—Refers to the member of a Virtual Chassis; FPC *number* equals the member ID, from 0 through 9.
- On EX8208 and EX8216 switches—Refers to a line card; FPC *number* equals the slot number for the line card.

On QFX3500 and QFX5100 standalone switches, both the FPC and FPC *number* are always **0**.

On Type 5 FPC on T4000 routers, there are no **top temperature sensor** or **bottom temperature sensor** parameters. Instead, **fan intake temperature sensor** and **fan exhaust temperature sensors** parameters are displayed.

Options

none—Display information about hardware. For a TX Matrix router, display information about the TX Matrix router and its attached T640 routers. For a TX Matrix Plus router, display information about the TX Matrix Plus router and its attached routers.

clei-models—(Optional) Display Common Language Equipment Identifier (CLEI) barcode and model number for orderable field-replaceable units (FRUs).

detail—(Optional) Include RAM and disk information in output.

extensive—(Optional) Display ID EEPROM information.

all-members—(MX Series routers only) (Optional) Display hardware-specific information for all the members of the Virtual Chassis configuration.

interconnect-device *name*—(QFabric systems only) (Optional) Display hardware-specific information for the Interconnect device.

lcc *number*—(TX Matrix routers and TX Matrix Plus router only) (Optional) On a TX Matrix router, display hardware information for a specified T640 router (line-card chassis) that is connected to the TX Matrix router. On a TX Matrix Plus router, display hardware information for a specified router (line-card chassis) that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Display hardware-specific information for the local Virtual Chassis members.

member *member-id*—(MX Series routers and EX Series switches) (Optional) Display hardware-specific information for the specified member of the Virtual Chassis configuration. Replace *member-id* variable with a value 0 or 1.

models—(Optional) Display model numbers and part numbers for orderable FRUs and, for components that use ID EEPROM format v2, the CLEI code.

node-device *name*—(QFabric systems only) (Optional) Display hardware-specific information for the Node device.

scc—(TX Matrix router only) (Optional) Display hardware information for the TX Matrix router (switch-card chassis).

sfc *number*—(TX Matrix Plus router only) (Optional) Display hardware information for the TX Matrix Plus router (switch-fabric chassis). Replace *number* variable with **0**.

Additional Information The **show chassis hardware detail** command now displays DIMM information for the following Routing Engines:

Table 62: Routing Engines Displaying DIMM Information

Routing Engines	Routers
RE-S-1800x2 and RE-S-1800x4	MX240, MX480, and MX960 routers
RE-A-1800x2	M120 and M320 routers

Required Privilege Level

view

Related Documentation

- *show chassis power*

List of Sample Output

show chassis hardware node-device (QFabric Systems) on page 746
show chassis hardware (PTX5000 Packet Transport Router) on page 746
show chassis hardware clei-models (PTX5000 Packet Transport Router) on page 747
show chassis hardware detail (PTX5000 Packet Transport Router) on page 748
show chassis hardware models (PTX5000 Packet Transport Router) on page 749
show chassis hardware extensive (PTX5000 Packet Transport Router) on page 750
show chassis hardware (MX Routers with Media Services Blade [MSB]) on page 751
show chassis hardware extensive (MX Routers with Media Services Blade [MSB]) on page 751
show chassis hardware (QFX3500 Switch running Enhanced Layer 2 Software) on page 752
show chassis hardware (QFX5100 Switch running Enhanced Layer 2 Software) on page 753

Output Fields Table 63 on page 634 lists the output fields for the **show chassis hardware** command. Output fields are listed in the approximate order in which they appear.

Table 63: show chassis hardware Output Fields

Field Name	Field Description	Level of Output
Item	Chassis component: • (EX Series switches)—Information about the chassis, Routing Engine (SRE and Routing Engine modules in EX8200 switches), power supplies, fan trays, and LCD panel. Also displays information about Flexible PIC Concentrators (FPCs) and associated Physical Interface Cards (PICs). Information about the backplane, midplane, and SIBs (SF modules) is displayed for EX8200 switches. See *EX Series Switches Hardware and CLI Terminology Mapping*. • (MX Series routers and EX Series switches)—Information about the backplane, Routing Engine, Power Entry Modules (PEMs), and fan trays. Also displays information about Flexible PIC Concentrators (FPCs) and associated Physical Interface Cards (PICs), Modular Port Concentrators (MPCs) and associated Modular Interface Cards (MICs), or Dense Port Concentrators (DPCs). MX80 routers have a single Routing Engine and a built-in Packet Forwarding Engine that attaches directly to MICs. The Packet Forwarding Engine has two “pseudo” FPCs (FPC 0 and FPC1). MX80 routers also have a Forwarding Engine Board (FEB). MX104 routers have a built-in Packet forwarding Engine and a Forwarding Engine Board (FEB). The Packet Forwarding Engine of the MX104 router has three “pseudo” FPCs (FPC0, FPC1, and FPC2). • (M Series routers, except for the M320 router)—Information about the backplane; power supplies; fan trays; Routing Engine; maxicab (the connection between the Routing Engine and the backplane, for the M40 router only); SCB, SSB, SFM, or FEB; MCS and PCG (for the M160 router only); each FPC and PIC; and each fan, blower, and impeller. • (M120, M320, and T Series routers)—Information about the backplane, power supplies, fan trays, midplane, FPM (craft interface), CIP, PEM, SCG, CB, FPC, PIC, SFP, SPMB, and SIB. • (QFX Series)—Information about the chassis, Pseudo CB, Routing Engine, power supplies, fan trays, Interconnect devices, and Node devices. Also displays information about Flexible PIC Concentrators (FPCs) and associated Physical Interface Cards (PICs). • (PTX Series)—Information about the chassis, midplane, craft interface (FPM), power distribution units (PDUs) and Power Supply Modules (PSMs), Centralized Clock Generators (CCGs), Routing Engines, Control Boards (CBs) and Switch Processor Mezzanine Boards (SPMBs), Flexible PIC Concentrators (FPCs), PICs, Switch Interface Boards (SIBs), and fan trays (vertical and horizontal). • (MX2010 and MX2020 routers)—Information about the chassis, midplane, craft interface (FPM), power midplane (PMP), Power Supply Modules (PSMs), Power Distribution Modules (PDMs), Routing Engines, Control Boards (CBs) and Switch Processor Mezzanine Boards (SPMBs), Switch Fabric Boards (SFBs), Flexible PIC Concentrators (FPCs), PICs, adapter cards (ADCs) and fan trays.	All levels
Version	Revision level of the chassis component.	All levels
Part number	Part number of the chassis component.	All levels
Serial number	Serial number of the chassis component. The serial number of the backplane is also the serial number of the router chassis. Use this serial number when you need to contact Juniper Networks Customer Support about the router or switch chassis.	All levels

Table 63: show chassis hardware Output Fields *(continued)*

Field Name	Field Description	Level of Output
Assb ID or **Assembly ID**	(**extensive** keyword only) Identification number that describes the FRU hardware.	**extensive**
Assembly Version	(**extensive** keyword only) Version number of the FRU hardware.	**extensive**
Assembly Flags	(**extensive** keyword only) Flags.	**extensive**
FRU model number	(**clei-models**, **extensive**, and **models** keyword only) Model number of the FRU hardware component.	none specified
CLEI code	(**clei-models** and **extensive** keyword only) Common Language Equipment Identifier code. This value is displayed only for hardware components that use ID EEPROM format v2. This value is not displayed for components that use ID EEPROM format v1.	none specified
EEPROM Version	ID EEPROM version used by the hardware component: **0x00** (version 0), **0x01** (version 1), or **0x02** (version 2).	**extensive**
Description	Brief description of the hardware item: • Type of power supply. • Type of PIC. If the PIC type is not supported on the current software release, the output states **Hardware Not Supported**. • Type of FPC: **FPC Type 1**, **FPC Type 2**, **FPC Type 3**, **FPC Type 4** , or **FPC TypeOC192**. On EX Series switches, a brief description of the FPC. On the J Series routers, the FPC type corresponds to the Physical Interface Module (PIM). The following list shows the PIM abbreviation in the output and the corresponding PIM name. ◦ **2x FE**—Either two built-in Fast Ethernet interfaces (fixed PIM) or dual-port Fast Ethernet PIM ◦ **4x FE**—4-port Fast Ethernet ePIM ◦ **1x GE Copper**—Copper Gigabit Ethernet ePIM (one 10-Mbps, 100-Mbps, or 1000-Mbps port) ◦ **1x GE SFP**—SFP Gigabit Ethernet ePIM (one fiber port) ◦ **4x GE Base PIC**—Four built-in Gigabit Ethernet ports on a J4350 or J6350 chassis (fixed PIM) ◦ **2x Serial**—Dual-port serial PIM ◦ **2x T1**—Dual-port T1 PIM ◦ **2x E1**—Dual-port E1 PIM ◦ **2x CT1E1**—Dual-port channelized T1/E1 PIM ◦ **1x T3**—T3 PIM (one port) ◦ **1x E3**—E3 PIM (one port) ◦ **4x BRI S/T**—4-port ISDN BRI S/T PIM ◦ **4x BRI U**—4-port ISDN BRI U PIM ◦ **1x ADSL Annex A**—ADSL 2/2+ Annex A PIM (one port, for POTS) ◦ **1x ADSL Annex B**—ADSL 2/2+ Annex B PIM (one port, for ISDN)	All levels

Table 63: show chassis hardware Output Fields *(continued)*

Field Name	Field Description	Level of Output
	• **2x SHDSL (ATM)**—G SHDSL PIM (2-port two-wire module or 1-port four-wire module) • **1x TGM550**—TGM550 Telephony Gateway Module (Avaya VoIP gateway module with one console port, two analog **LINE** ports, and two analog **TRUNK** ports) • **1x DS1 TIM510**—TIM510 E1/T1 Telephony Interface Module (Avaya VoIP media module with one E1 or T1 trunk termination port and ISDN PRI backup) • **4x FXS, 4xFX0, TIM514**—TIM514 Analog Telephony Interface Module (Avaya VoIP media module with four analog **LINE** ports and four analog **TRUNK** ports) • **4x BRI TIM521**—TIM521 BRI Telephony Interface Module (Avaya VoIP media module with four ISDN BRI ports) • **Crypto Accelerator Module**—For enhanced performance of cryptographic algorithms used in IP Security (IPsec) services • **MPC M 16x 10GE**—16-port 10-Gigabit Module Port Concentrator that supports SFP+ optical transceivers. (Not on EX Series switches.) • For hosts, the Routing Engine type. • For small form-factor pluggable transceiver (SFP) modules, the type of fiber: **LX**, **SX**, **LH**, or **T**. • LCD description for EX Series switches (except EX2200 switches). • **MPC2**—1-port MPC2 that supports two separate slots for MICs. • **MPC3E**—1-port MPC3E that supports two separate slots for MICs (MIC-3D-1X100GE-CFP and MIC-3D-20GE-SFP) on MX960, MX480, and MX240 routers. The MPC3E maps one MIC to one PIC (1 MIC, 1 PIC), which differs from the mapping of legacy MPCs. • 100GBASE-LR4, pluggable CFP optics • Supports the Enhanced MX Switch Control Board with fabric redundancy and existing SCBs without fabric redundancy. • Interoperates with existing MX Series line cards, including Flexible Port Concentrators (FPC), Dense Port Concentrators (DPCs), and Modular Port Concentrators (MPCs). • **MPC4E**—Fixed configuration MPC4E that is available in two flavors: MPC4E-3D-32XGE-SFPP and MPC4E-3D-2CGE-8XGE on MX2020, MX960, MX480, and MX240 routers. • LCD description for MX Series routers	

Sample Output

show chassis hardware (EX8216 Switch)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis          REV 06                CY0109220035      EX8216
Midplane         REV 06   710-016845   BA0909120112      EX8216-MP
CB 0             REV 22   710-020771   AX0109197723      EX8216-RE320
CB 1             REV 22   710-020771   AX0109197726      EX8216-RE320
  Routing Engine 1        BUILTIN      BUILTIN           RE-EX8216
FPC 3            REV 19   710-020683   BC0109083125      EX8200-48F
```

```
  CPU             REV 13    710-020598    BF0109144549      EX8200-CPU
FPC 4             REV 17    710-020683    BC0108500127      EX8200-48F
  CPU             REV 10    710-020598    BF0108460510      EX8200-CPU
  PIC 0                     BUILTIN       BUILTIN           48x 100 Base-QFX/1000
Base-X
    Xcvr 1        REV 01    740-011613    PE70V89           SFP-SX
    Xcvr 11       REV 01    740-011613    PE70YCE           SFP-SX
    Xcvr 12       REV 01    740-011613    PE70VSH           SFP-SX
    Xcvr 13       REV 01    740-011613    E08C02063         SFP-SX
    Xcvr 14       REV 01    740-011613    PE70VKU           SFP-SX
    Xcvr 15       REV 01    740-011613    E08E03372         SFP-SX
    Xcvr 21       REV 01    740-011613    PE70VAD           SFP-SX
    Xcvr 22       REV 01    740-011613    E08E01228         SFP-SX
    Xcvr 23       REV 01    740-011613    PE70VSL           SFP-SX
    Xcvr 24       REV 01    740-011613    E08E03409         SFP-SX
    Xcvr 25       REV 01    740-011613    PE70VL4           SFP-SX
    Xcvr 26       REV 01    740-011613    PDQ4L2Z           SFP-SX
    Xcvr 27       REV 01    740-011613    PE70WFK           SFP-SX
    Xcvr 28       REV 01    740-011782    PBD2B5U           SFP-SX
    Xcvr 29       REV 01    740-011613    PE70UQX           SFP-SX
    Xcvr 30       REV 01    740-011613    PE70VL5           SFP-SX
    Xcvr 31       REV 01    740-011613    PE70V0F           SFP-SX
    Xcvr 32       REV 01    740-011613    E08C02052         SFP-SX
    Xcvr 33       REV 01    740-011613    E08C02197         SFP-SX
    Xcvr 34       REV 01    740-011613    PE70V0L           SFP-SX
    Xcvr 35       REV 01    740-011613    E08E03390         SFP-SX
    Xcvr 36       REV 01    740-011613    PDQ4VL9           SFP-SX
    Xcvr 37       REV 01    740-011613    E08E03370         SFP-SX
    Xcvr 38       REV 01    740-011613    E08E03362         SFP-SX
    Xcvr 39       REV 01    740-011613    E08C02065         SFP-SX
    Xcvr 40       REV 01    740-011613    E08E03405         SFP-SX
    Xcvr 41       REV 01    740-011613    E08E03411         SFP-SX
    Xcvr 43       REV 01    740-011613    E08C02171         SFP-SX
    Xcvr 45       REV 01    740-011613    E08E03410         SFP-SX
FPC 13            REV 16    710-016837    BB0109051344      EX8200-8XS
  CPU
SIB 0             REV 10    710-021613    AY0109166244      EX8216-SF320
SIB 1             REV 10    710-021613    AY0109166357      EX8216-SF320
SIB 2             REV 10    710-021613    AY0109166362      EX8216-SF320
SIB 3             REV 10    710-021613    AY0109166338      EX8216-SF320
SIB 4             REV 10    710-021613    AY0109166350      EX8216-SF320
SIB 5             REV 10    710-021613    AY0109166365      EX8216-SF320
SIB 6             REV 10    710-021613    AY0109166361      EX8216-SF320
SIB 7             REV 10    710-021613    AY0109166399      EX8216-SF320
PSU 0             REV 17    740-021466    BG0709170003      EX8200-AC2K
PSU 1             REV 17    740-021466    BG0709170004      EX8200-AC2K
PSU 2             REV 17    740-021466    BG0709170020      EX8200-AC2K
PSU 3             REV 17    740-021466    BG0709170017      EX8200-AC2K
PSU 4             REV 17    740-021466    BG0709170008      EX8200-AC2K
PSU 5             REV 17    740-021466    BG0709170018      EX8200-AC2K
Top Fan Tray
  FTC 0           REV 4     760-022620    CX1209140212      EX8216-FT
  FTC 1           REV 4     760-022620    CX1209140212      EX8216-FT
Bottom Fan Tray
  FTC 0           REV 4     760-022620    CX1209140211      EX8216-FT
  FTC 1           REV 4     760-022620    CX1209140211      EX8216-FT
LCD 0             REV 04    710-025742    CE0109186919      EX8200 LCD
```

show chassis hardware clei-models (EX8216 Switch)

`user@host>` **show chassis hardware clei-models**

```
Hardware inventory:
Item             Version  Part number  CLEI code         FRU model number
Midplane         REV 08   710-016845
PSU 0            REV 05   740-023002   COUPAEAEAA        EX8200-PWR-AC3KR
PSU 1            REV 05   740-023002   COUPAEAEAA        EX8200-PWR-AC3KR
PSU 2            REV 05   740-023002   COUPAEAEAA        EX8200-PWR-AC3KR
PSU 3            REV 05   740-023002   COUPAEAEAA        EX8200-PWR-AC3KR
PSU 4            REV 05   740-023002   COUPAEAEAA        EX8200-PWR-AC3KR
PSU 5            REV 05   740-023002   COUPAEAEAA        EX8200-PWR-AC3KR
Top Fan Tray
Bottom Fan Tray
```

show chassis hardware clei-models (T1600 Router)

```
user@host> show chassis hardware clei-models
Hardware inventory:
Item             Version  Part number  CLEI code         FRU model number
Midplane         REV 03   710-005608                     CHAS-BP-T640-S
FPM Display      REV 05   710-002897                     CRAFT-T640-S
CIP              REV 06   710-002895                     CIP-L-T640-S
PEM 0            Rev 07   740-017906   IPUPAC7KTA        PWR-T1600-3-80-DC-S
PEM 1            Rev 18   740-002595                     PWR-T-DC-S
SCG 0            REV 15   710-003423                     SCG-T-S
Routing Engine 0 REV 08   740-014082                     RE-A-2000-4096-S
Routing Engine 1 REV 07   740-014082                     RE-A-2000-4096-S
CB 0             REV 05   710-007655                     CB-T-S
CB 1             REV 03   710-017707                     CB-T-S
FPC 0            REV 07   710-013558                     T640-FPC2-E2
  PIC 0          REV 01   750-010618                     PB-4GE-SFP
  PIC 1          REV 06   750-001900                     PB-1OC48-SON-SMSR
  PIC 2          REV 14   750-001901                     PB-4OC12-SON-SMIR
  PIC 3          REV 07   750-001900                     PB-1OC48-SON-SMSR
FPC 1            REV 06   710-013553                     T640-FPC1-E2
  PIC 0          REV 08   750-001072                     P-1GE-SX
  PIC 1          REV 10   750-012266                     PB-4GE-TYPE1-SFP-IQ2
  PIC 2          REV 22   750-005634                     PB-1CHOC12SMIR-QPP
FPC 2
  PIC 0          REV 16   750-007141                     PC-10GE-SFP
  PIC 1          REV 06   750-015217                     PC-8GE-TYPE3-SFP-IQ2
  PIC 2          REV 05   750-004695                     PC-TUNNEL
  PIC 3          REV 17   750-009553                     PC-4OC48-SON-SFP
FPC 3            REV 01   710-010154                     T640-FPC3-E
  PIC 0          REV 07   750-012793                     PC-1XGE-TYPE3-XFP-IQ2
  PIC 1          REV 25   750-007141                     PC-10GE-SFP
  PIC 2          REV 17   750-009553                     PC-4OC48-SON-SFP
  PIC 3          REV 32   750-003700                     PC-1OC192-SON-VSR
FPC 4            REV 16   710-013037                     T1600-FPC4-ES
 PIC 1           REV 06   750-034781                     PD-1CE-CFP
FPC 5            REV 02   710-013037                     T1600-FPC4-ES
  PIC 0          REV 16   750-012518                     PD-4OC192-SON-XFP
  PIC 1          REV 01   750-010850                     PD-1OC768-SON-SR
FPC 6            REV 14   710-013037                     T1600-FPC4-ES
  PIC 0          REV 11   750-017405                     PD-4XGE-XFP
  PIC 1          REV 13   750-017405                     PD-4XGE-XFP
FPC 7            REV 09   710-007529                     T640-FPC3
  PIC 0          REV 10   750-012793                     PC-1XGE-TYPE3-XFP-IQ2
  PIC 1          REV 01   750-015217                     PC-8GE-TYPE3-SFP-IQ2
  PIC 2          REV 01   750-015217                     PC-8GE-TYPE3-SFP-IQ2
  PIC 3          REV 15   750-009450                     PC-1OC192-SON-SR2
SIB 0            REV 07   710-013074                     SIB-I-T1600-S
SIB 1            REV 07   710-013074                     SIB-I-T1600-S
```



```
SIB 2            REV 07   710-013074                      SIB-I-T1600-S
SIB 3            REV 07   710-013074                      SIB-I-T1600-S
SIB 4            REV 07   710-013074                      SIB-I-T1600-S
Fan Tray 0                                                FANTRAY-T-S
Fan Tray 1                                                FANTRAY-T-S
Fan Tray 2                                                FAN-REAR-TX-T640-S
```

show chassis hardware detail (EX4200 Switch)

```
user@host> show chassis hardware detail
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                BM0208327733      EX4200-24T
Routing Engine 0 REV 11   750-021256   BM0208327733      EX4200-24T, 8 POE
Routing Engine 0                       BM0208327733      EX4200-24T, 8 POE
FPC 0            REV 11   750-021256   BM0208327733      EX4200-24T, 8 POE
  CPU                     BUILTIN      BUILTIN           FPC CPU
  PIC 0                   BUILTIN      BUILTIN           24x 10/100/1000 Base-T
  PIC 1          REV 03B  711-021270   AR0208162285      4x GE SFP
  BRD            REV 08   711-021264   AK0208328289      EX4200-24T, 8 POE
Power Supply 0   REV 03   740-020957   AT0508346354      PS 320W AC
Fan Tray                                                 Fan Tray
```

show chassis hardware models (EX4500 Switch)

```
user@host> show chassis hardware models
Hardware inventory:
Item             Version  Part number  Serial number     FRU model number
Routing Engine 0 REV 01   750-035700   GG0210271867      EX4500-40F-FB-C
FPC 0            REV 01   750-035700   GG0210271867      EX4500-40F-FB-C
  PIC 0                   BUILTIN      BUILTIN           EX4500-40F-FB-C
Power Supply 1   REV 01   740-029654   H884FS00JC09      EX4500-PWR1-AC-FB
```

show chassis hardware (J6350 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN1090E07ADB      JSR6350
Midplane         REV 03   710-014593   NP1265
System IO        REV 01   710-016210   NN9950            JX350 System IO
Crypto Module                                            Crypto Acceleration
Routing Engine   REV 08   710-015273   NM6509            RE-J6350-3400
   ad0      248 MB  256MB CKS            00102006C24A00000039 Compact
Flash
FPC 0                                                    FPC
   PIC 0                                                  4x GE Base PIC
FPC 1            REV 06   750-010355   AI07030023        FPC
   PIC 0                                                  2x T1
FPC 3            REV 06   750-011148   AJ06520151        FPC
   PIC 0                                                  2x E1
FPC 6            REV 06   750-013492   NC4170            FPC
   PIC 0                                                  4x FE
Power Supply 0
```

show chassis hardware (J6300 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN000164AB        J6300
Midplane         REV 02.04 710-010001  CORE99570
```

```
System IO         REV 02.00 710-010003  CORE100848        System IO board
Routing Engine    RevX2.6   750-010006  IWGS40735390      RE-J.3
FPC 0                                                     FPC
  PIC 0                                                   2x FE
FPC 1             RevX2.0   750-011380  N3960005          FPC
  PIC 0                                                   1xADSL pic Annex A
FPC 2             RevX2.0   750-011380  N3960002          FPC
  PIC 0                                                   1xADSL pic Annex B
FPC 3             REV 03    750-010354  N0780028          FPC
  PIC 0                                                   1x T3
```

show chassis hardware (M7i Router)

```
user@host> show chassis hardware
Hardware inventory:
Item              Version   Part number Serial number     Description
Chassis                                 31959             M7i
Midplane          REV 02    710-008761  CA0209            M7i Midplane
Power Supply 0    Rev 04    740-008537  PD10272           AC Power Supply
Routing Engine    REV 01    740-008846  1000396803        RE-5.0
CFEB              REV 02    750-009492  CA0166            Internet Processor IIv1
FPC 0                                                     E-FPC
  PIC 0           REV 04    750-003163  HJ6416            1x G/E, 1000 BASE-SX
  PIC 1           REV 04    750-003163  HJ6423            1x G/E, 1000 BASE-SX
  PIC 2           REV 04    750-003163  HJ6421            1x G/E, 1000 BASE-SX
  PIC 3           REV 02    750-003163  HJ0425            1x G/E, 1000 BASE-SX
FPC 1                                                     E-FPC
  PIC 2           REV 01    750-009487  HM2275            ASP - Integrated
  PIC 3           REV 01    750-009098  CA0142            2x F/E, 100 BASE-TX

Hardware inventory:
Item              Version   Part number Serial number     Description
Chassis                                 B1157             M7i
Midplane          REV 05    710-008761  DM0840            M7i Midplane
Power Supply 0    Rev 08    740-008537  TE53755           AC Power Supply
Routing Engine    REV 07    740-011202  1000736567        RE-850
CFEB              REV 09    750-010463  DK6952            Internet Processor II
FPC 0                                                     E-FPC
  PIC 0           REV 12    750-012838  DL7993            4x 1GE(LAN), IQ2
    Xcvr 0        REV 01    740-011614  PD94TDJ           SFP-LX10
    Xcvr 1        REV 01    740-011615  PAD5EER           UNSUPPORTED
    Xcvr 2        REV 01    740-011614  PD94THU           SFP-LX10
    Xcvr 3                  NON-JNPR    PDC2E7A           SFP-LX10
  PIC 1           REV 03    750-023116  JT0203            4x CHSTM1 SDH CE SFP
    Xcvr 0        REV 01    740-012434  AGT063832PS       SFP-SR
    Xcvr 1        REV 01    740-012434  AGT063832LY       SFP-SR
    Xcvr 3        REV 01    740-016064  C06J19018         SFP-LR
  PIC 2           REV 15    750-014895  DM5757            MultiServices 100
  PIC 3           REV 01    750-025390  JW9448            12x T1/E1 CE
FPC 1                                                     E-FPC
  PIC 2                     BUILTIN     BUILTIN           1x Tunnel
  PIC 3           REV 09    750-009099  DM0899            1x G/E, 1000 BASE
    Xcvr 0        REV 01    740-012434  AGT07150HGJ       UNSUPPORTED
Fan Tray                                                  Rear Fan Tray
```

show chassis hardware (M10 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item              Version   Part number Serial number     Description
Chassis                                 1122              M10
Midplane          REV 1.1   710-001950  S/N AC6626
```



```
Power supply A   Rev 01   740-002497   S/N LC36095      AC
Power supply B   Rev 01   740-002497   S/N LC36100      AC
Display          REV 1.2  710-001995   S/N AC6656
Host                                   18000005dfb3fb01 teknor
FEB              REV 01   710-001948   S/N AC6632       Internet Processor II
FPC 0
  PIC 0          REV 08   750-001072   S/N AB2485       1x G/E, 1000 BASE-SX
  PIC 1          REV 01   750-000613   S/N AA1048       1x OC-12 SONET, SMIR
FPC 1
Fan Tray 0                                              FANTRAY-M10I-S
Fan Tray 1                                              FANTRAY-M10I-S
```

show chassis hardware models (M10 Router)

```
user@host> show chassis hardware models
Hardware inventory:
Item             Version  Part number  CLEI code        FRU model number
Midplane         REV 04   710-008920                    CHAS-MP-M10i-S
Power Supply 0   Rev 06   740-008537                    PWR-M10i-M7i-AC-S
Power Supply 1   Rev 06   740-008537                    PWR-M10i-M7i-AC-S
HCM 0            REV 03   710-010580                    HCM-M10i-S
HCM 1            REV 03   710-010580                    HCM-M10i-S
Routing Engine 0 REV 09   740-009459                    RE-400-256-S
CFEB 0           REV 05   750-010465                    FEB-M10i-M7i-S
FPC 0
  PIC 0          REV 10   750-002971                    PE-4OC3-SON-MM
  PIC 1          REV 11   750-002992                    PE-4FE-TX
  PIC 2          REV 03   750-002977                    PE-2OC3-ATM-MM
  PIC 3          REV 08   750-005724                    PE-2OC3-ATM2-MM
FPC 1
  PIC 2          REV 12   750-008425                    PE-AS
  PIC 3          REV 13   750-005636                    PE-4CHDS3-QPP
Fan Tray 0                                              FANTRAY-M10I-S
Fan Tray 1                                              FANTRAY-M10I-S
```

show chassis hardware (M20 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number    Description
Chassis                                20033            M20
Backplane        REV 07   710-001517   S/N AA7940
Power supply B   Rev 01   740-001465   S/N 000001       AC
Display          REV 02   710-001519   S/N AA9704
Host 0                                 98000004f8f27501 teknor
SSB slot 0       REV 01   710-001951   S/N AD5905       Internet Processor II
  SSRAM bank 0   REV 01   710-001385   S00480           2 MB
  SSRAM bank 1   REV 01   710-001385   S00490           2 MB
  SSRAM bank 2   REV 01   710-001385   S001:?           2 MB
  SSRAM bank 3   REV 01   710-001385   S00483           2 MB
SSB slot 1       N/A      N/A          N/A              Backup
FPC 1            REV 01   710-001292   S/N AB7528
  SSRAM          REV 01   710-000077   S/N 304209       1 MB
  SDRAM bank 0   REV 01   710-000099   S/N 000603       64 MB
  SDRAM bank 1   REV 01   710-000099   S/N 000414       64 MB
  PIC 0          REV 03   750-000612   S/N AB8433       2x OC-3 ATM, MM
  PIC 1          REV 01   750-000616   S/N AA1168       1x OC-12 ATM, MM
  PIC 2          REV 01   750-000613   S/N AA1008       1x OC-12 SONET, SMIR
  PIC 3          REV 01   750-002501   S/N AD5810       4x E3
FPC 2            REV 01   710-001292   S/N AC0119
  SSRAM          REV 01   710-000077   S/N 503241       1 MB
```

```
  SDRAM bank 0   REV 01    710-000099   S/N 306835        64 MB
  SDRAM bank 1   REV 01    710-000099   S/N 306832        64 MB
Fan Tray 0                                                Front Upper Fan Tray
Fan Tray 1                                                Front Middle Fan Tray
Fan Tray 2                                                Front Bottom Fan Tray
Fan Tray 3                                                Rear Fan Tray
```

show chassis hardware models (M20 Router)

```
user@host> show chassis hardware models
Hardware inventory:
Item             Version   Part number  CLEI code         FRU model number
Backplane        REV 03    710-002334                     CHAS-MP-M20-S
Power Supply A   REV 06    740-001465                     PWR-M20-AC-S
Display          REV 04    710-001519                     CRAFT-M20-S
Routing Engine 0 REV 06    740-003239                     RE-333-768-S
Routing Engine 1 REV 06    740-003239                     RE-333-768-S
SSB 0            REV 02    710-001951                     SSB-E-M20
SSB 1            N/A       N/A
FPC 0            REV 03    710-003308                     FPC-E
  PIC 0          REV 08    750-002303                     P-4FE-TX
  PIC 1          REV 07    750-004745                     P-2MCDS3
  PIC 2          REV 03    750-002965                     PE-4CHDS3
FPC 1            REV 03    710-003308                     FPC-E
  PIC 0          REV 03    750-002914                     P-2OC3-ATM-MM
Fan Tray 0                                                FANTRAY-F-M20-S
Fan Tray 1                                                FANTRAY-F-M20-S
Fan Tray 2                                                FANTRAY-F-M20-S
Fan Tray 3                                                FANTRAY-R-M20-S
```

show chassis hardware (M40 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version   Part number  Serial number     Description
Backplane        REV 02    710-000073   S/N AA0053
Power supply A   Rev 2     740-000235   S/N 000042        DC
Maxicab          REV X1    710-000229   S/N AA0139
Minicab          REV X1    710-000482   S/N AA0201
Display          REV 06    710-000150   S/N AA0905
Host                                                      cpv5000
SCB              REV X1    710-000075   S/N AA0158        Internet Processor I
  SSRAM bank 0   REV 02    710-000077   S/N AA2267        1 MB
  SSRAM bank 1   REV 02    710-000077   S/N AA2270        1 MB
  SSRAM bank 2   REV 02    710-000077   S/N AA2269        1 MB
  SSRAM bank 3   REV 02    710-000077   S/N AA2268        1 MB
FPC 0            REV 01    710-000175   S/N AA0048
  SSRAM          REV 01    710-000077   S/N AA2333        1 MB
  SDRAM bank 0   REV 01    710-000099   S/N AA2332        64 MB
  SDRAM bank 1   REV X1    710-000099   S/N AA2337        64 MB
  PIC 0          REV 04    750-000613   S/N aa0343        1x OC-12 SONET, SMIR
  PIC 1          REV 04    750-000613   S/N AA0379        1x OC-12 SONET, SMIR
  PIC 2          REV 04    750-000613   S/N AA0377        1x OC-12 SONET, SMIR
  PIC 3          REV 04    750-000613   S/N AA0378        1x Tunnel
FPC 2            REV 01    710-000175   S/N AA0042
  SSRAM          REV 02    710-000077   S/N AA2288        1 MB
  SDRAM bank 0   REV 01    710-000099   S/N AA2331        64 MB
  SDRAM bank 1   REV 01    710-000099   S/N AA2330        64 MB
  PIC 0          REV X1    750-000603   S/N AA0143        4x OC-3 SONET, SMIR
  PIC 1          REV X1    750-000615   S/N AA0149        4x OC-3 SONET, MM
  PIC 2          REV X1    750-000611   S/N AA0148        4x OC-3 SONET, MM
```



```
  PIC 3          REV 04   750-000613   S/N AA0330        1x OC-12 SONET, SMIR
FPC 4            REV 01   710-000175   S/N AA0050
  SSRAM          REV 01   710-000077   S/N AA2327        1 MB
  SDRAM bank 0   REV 01   710-000099   S/N AA2329        64 MB
  SDRAM bank 1   REV 01   710-000099   S/N AA2328        64 MB
  PIC 0          REV 04   750-000613   S/N AA0320        1x OC-12 SONET, SMIR
  PIC 2          REV 05   750-000616   S/N AA1341        1x OC-12 ATM, MM
  PIC 3          REV 08   750-001072   S/N AB2462        1x G/E, 1000 BASE-SX
FPC 5            REV 10   710-000175   S/N AA7663
  SSRAM          REV 01   710-000077   S/N 501590        1 MB
  SDRAM bank 0   REV 01   710-000099   S/N 300949        64 MB
  SDRAM bank 1   REV 01   710-000099   S/N 300868        64 MB
  PIC 1          REV 01   750-001323   S/N AB1670        1x Tunnel
```

show chassis hardware (M40e Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                                  m40e
Midplane         REV 01   710-005071   AX3671
FPM CMB          REV 03   710-001642   AR9074
FPM Display      REV 03   710-001647   AR7331
CIP              REV 04   710-002649   BB4449
PEM 0            Rev 01   740-003787   MC12364           Power Entry Module
PEM 1            Rev 01   740-003787   MC12383           Power Entry Module
PCG 0            REV 07   710-001568   AG1332
PCG 1            REV 07   710-001568   AR3789
Host 0                                 3e000007c8176601  Present
MCS 0            REV 11   710-001226   AN5813
SFM 0 SPP        REV 07   710-001228   AG4676
SFM 0 SPR        REV 05   710-002189   AE4735            Internet Processor II
SFM 1 SPP        REV 07   710-001228   AP1347
SFM 1 SPR        REV 05   710-002189   BE0063            Internet Processor II
FPC 0            REV 01   710-011725   BE0669            M40e-EP-FPC Type 1
  CPU            REV 01   710-004600   BD9504
  PIC 0          REV 03   750-003737   AY3991            4x G/E, 1000 BASE-SX
FPC 1            REV 01   710-005197   BD9842            M40e-FPC Type 2
  CPU            REV 01   710-004600   BB4869
  PIC 0          REV 07   750-001900   AR8278            1x OC-48 SONET, SMSR
FPC 2            REV 02   710-005197   BD9824            M40e-FPC Type 2
  CPU            REV 01   710-004600   BD9531
  PIC 0          REV 03   750-003737   AY3986            4x G/E, 1000 BASE-SX
FPC 4            REV 02   710-005078   BE0664            M40e-FPC Type 1
  CPU            REV 01   710-004600   BD9559
  PIC 0          REV 03   750-001894   AG7963            1x G/E, 1000 BASE-SX
  PIC 2          REV 01   750-002575   AF2472            4x OC-3 SONET, SMIR
FPC 6            REV 02   710-005078   BE0652            M40e-FPC Type 1
  CPU            REV 01   710-004600   BD9607
  PIC 0          REV 02   750-002911   AN2286            4x F/E, 100 BASE-TX
  PIC 2          REV 01   750-002577   AP6345            4x OC-3 SONET, MM
```

show chassis hardware (M120 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN000054AC        M120
Midplane         REV 01   710-013667   RB4170            M120 Midplane
FPM Board        REV 02   710-011407   CJ9186            M120 FPM Board
FPM Display      REV 02   710-011405   CJ9173            M120 FPM Display
```

```
FPM CIP          REV 02   710-011410   CJ9221           M120 FPM CIP
PEM 0            Rev 05   740-011936   RM28320          AC Power Entry Module
PEM 1            Rev 05   740-011936   RM28321          AC Power Entry Module
Routing Engine 0 REV 03   740-014080   1000642883       RE-A-1000
CB 0             REV 03   710-011403   CM8346           M120 Control Board
CB 1             REV 06   710-011403   CP6728           M120 Control Board
FPC 1            REV 02   710-015908   CP6925           M120 CFPC 10GE
  PIC 0                   BUILTIN      BUILTIN          1x 10GE(LAN/WAN) XFP
    Xcvr 0       REV 01   740-014279   62E204N00007     XFP-10G-LR
FPC 3            REV 03   710-011393   CJ9234           M120 FPC Type 2
  PIC 0          REV 16   750-008155   NB5229           2x G/E IQ, 1000 BASE
    Xcvr 0       REV 01   740-011613   P9F15JB          SFP-SX
    Xcvr 1       REV 01   740-007326   P4Q0R9G          SFP-SX
  PIC 1          REV 09   750-007745   CG4360           4x OC-3 SONET, SMIR
  PIC 2          REV 16   750-008155   ND7787           2x G/E IQ, 1000 BASE
    Xcvr 0       REV 01   740-011613   P9F12AS          SFP-SX
    Xcvr 1       REV 01   740-011613   P9F1ALU          SFP-SX
  PIC 3          REV 07   750-011800   JW1284           8x 1GE(LAN), IQ2
    Xcvr 0       REV 01   740-011613   P9F1AM6          SFP-SX
    Xcvr 6       REV 01   740-011613   P9F16NN          SFP-SX
    Xcvr 7       REV 01   740-011782   P8C29Y7          SFP-SX
  Board B        REV 02   710-011395   CN3754           M120 FPC Mezz
FPC 4            REV 02   710-011398   CP6741           M120 FPC Type 3
  PIC 0          REV 16   750-007141   NB2855           10x 1GE(LAN), 1000 BASE

    Xcvr 0       REV 01   740-011782   P922A1F          SFP-SX
    Xcvr 1       REV 01   740-011782   P922A16          SFP-SX
    Xcvr 2       REV 01   740-011782   P922A0U          SFP-SX
    Xcvr 3       REV 01   740-011782   P9229UZ          SFP-SX
    Xcvr 4       REV 01   740-009029   P11JXWP          SFP-LX
    Xcvr 6       REV 01   740-011613   P9F1ALW          SFP-SX
FPC 5            REV 01   710-011388   CJ9088           M120 FPC Type 1
  PIC 0          *** Hardware Not Supported ***
  PIC 1          REV 05   750-012052   NB0410           1x CHOC3 IQ SONET, SMLR

  PIC 2          REV 01   750-013167   CM3824           4x CHDS3 IQ
  PIC 3          REV 01   750-010240   CB5366           1x G/E SFP, 1000 BASE
  Board B        REV 01   710-011390   CJ9103           M120 FPC Mezz Board
FEB 3            REV 04   710-011663   CP6673           M120 FEB
FEB 4            REV 04   710-011663   CJ9368           M120 FEB
FEB 5            REV 04   710-011663   CJ9386           M120 FEB
Fan Tray 0                                              Front Top Fan Tray
Fan Tray 1                                              Front Bottom Fan Tray
Fan Tray 2                                              Rear Top Fan Tray
Fan Tray 3                                              Rear Bottom Fan Tray
```

show chassis hardware detail (M120 Router)

```
user@host> show chassis hardware detail
Hardware inventory:
Item             Version  Part number  Serial number    Description
Chassis                                JN000054AC       M120
Midplane         REV 01   710-013667   RB4170           M120 Midplane
FPM Board        REV 02   710-011407   CJ9186           M120 FPM Board
FPM Display      REV 02   710-011405   CJ9173           M120 FPM Display
FPM CIP          REV 02   710-011410   CJ9221           M120 FPM CIP
PEM 0            Rev 05   740-011936   RM28320          AC Power Entry Module
PEM 1            Rev 05   740-011936   RM28321          AC Power Entry Module
Routing Engine 0 REV 03   740-014080   1000642883       RE-A-1000
  ad0      248 MB   SILICONSYSTEMS INC 256M 126CT505S0763SC00110 Compact Flash
  ad2    38154 MB   HTE541040G9SA00      MPBBT0X2HS2E3M     Hard Disk
```



```
CB 0             REV 03   710-011403   CM8346          M120 Control Board
CB 1             REV 06   710-011403   CP6728          M120 Control Board
FPC 1            REV 02   710-015908   CP6925          M120 CFPC 10GE
  PIC 0                   BUILTIN      BUILTIN         1x 10GE(LAN/WAN) XFP
    Xcvr 0       REV 01   740-014279   62E204N00007    XFP-10G-LR
FPC 3            REV 03   710-011393   CJ9234          M120 FPC Type 2
  PIC 0          REV 16   750-008155   NB5229          2x G/E IQ, 1000 BASE
    Xcvr 0       REV 01   740-011613   P9F15JB         SFP-SX
    Xcvr 1       REV 01   740-007326   P4Q0R9G         SFP-SX
  PIC 1          REV 09   750-007745   CG4360          4x OC-3 SONET, SMIR
  PIC 2          REV 16   750-008155   ND7787          2x G/E IQ, 1000 BASE
    Xcvr 0       REV 01   740-011613   P9F12AS         SFP-SX
    Xcvr 1       REV 01   740-011613   P9F1ALU         SFP-SX
  PIC 3          REV 07   750-011800   JW1284          8x 1GE(LAN), IQ2
    Xcvr 0       REV 01   740-011613   P9F1AM6         SFP-SX
    Xcvr 6       REV 01   740-011613   P9F16NN         SFP-SX
    Xcvr 7       REV 01   740-011782   P8C29Y7         SFP-SX
  Board B        REV 02   710-011395   CN3754          M120 FPC Mezz
FPC 4            REV 02   710-011398   CP6741          M120 FPC Type 3
  PIC 0          REV 16   750-007141   NB2855          10x 1GE(LAN), 1000 BASE

    Xcvr 0       REV 01   740-011782   P922A1F         SFP-SX
    Xcvr 1       REV 01   740-011782   P922A16         SFP-SX
    Xcvr 2       REV 01   740-011782   P922A0U         SFP-SX
    Xcvr 3       REV 01   740-011782   P9229UZ         SFP-SX
    Xcvr 4       REV 01   740-009029   P11JXWP         SFP-LX
    Xcvr 6       REV 01   740-011613   P9F1ALW         SFP-SX
FPC 5            REV 01   710-011388   CJ9088          M120 FPC Type 1
  PIC 0          *** Hardware Not Supported ***
  PIC 1          REV 05   750-012052   NB0410          1x CHOC3 IQ SONET, SMLR

  PIC 2          REV 01   750-013167   CM3824          4x CHDS3 IQ
  PIC 3          REV 01   750-010240   CB5366          1x G/E SFP, 1000 BASE
  Board B        REV 01   710-011390   CJ9103          M120 FPC Mezz Board
FEB 3            REV 04   710-011663   CP6673          M120 FEB
FEB 4            REV 04   710-011663   CJ9368          M120 FEB
FEB 5            REV 04   710-011663   CJ9386          M120 FEB
Fan Tray 0                                             Front Top Fan Tray
Fan Tray 1                                             Front Bottom Fan Tray
Fan Tray 2                                             Rear Top Fan Tray
Fan Tray 3                                             Rear Bottom Fan Tray
```

show chassis hardware models (M120 Router)

```
user@host> show chassis hardware models
Hardware inventory:
Item             Version  Part number  CLEI code       FRU model number
Midplane         REV 01   710-013667
FPM CIP          REV 02   710-011410                   CRAFT-M120-S
PEM 0            Rev 05   740-011936                   PWR-M120-AC-S
PEM 1            Rev 05   740-011936                   PWR-M120-AC-S
Routing Engine 0 REV 03   740-014080                   RE-A-1000-2048-S
CB 0             REV 03   710-011403                   CB-M120-S
CB 1             REV 06   710-011403                   CB-M120-S
FPC 1            REV 02   710-015908                   M120-cFPC-1XGE-XFP
FPC 3
  PIC 0          REV 16   750-008155                   PB-2GE-SFP-QPP
  PIC 1          REV 09   750-007745                   PC-4OC3-SON-SMIR
  PIC 2          REV 16   750-008155                   PB-2GE-SFP-QPP
  PIC 3          REV 07   750-011800                   PB-8GE-TYPE2-SFP-IQ2
FPC 4
```



```
  PIC 0          REV 16   750-007141                      PC-10GE-SFP
FPC 5
  PIC 1          REV 05   750-012052                      PB-1CHOC3-SMIR-QPP
  PIC 2          REV 01   750-013167                      PE-4CHDS3-QPP
  PIC 3          REV 01   750-010240                      PB-1GE-SFP
Fan Tray 0                                                FFANTRAY-M120-S
Fan Tray 1                                                FFANTRAY-M120-S
Fan Tray 2                                                RFANTRAY-M120-S
Fan Tray 3                                                RFANTRAY-M120-S
```

show chassis hardware (M160 Router)

```
user@host> show chassis hardware
Item             Version  Part number  Serial number     Description
Chassis                                101               M160
Midplane         REV 02   710-001245   S/N AB4107
FPM CMB          REV 01   710-001642   S/N AA2911
FPM Display      REV 01   710-001647   S/N AA2999
CIP              REV 02   710-001593   S/N AA9563
PEM 0            Rev 01   740-001243   S/N KJ35769       DC
PEM 1            Rev 01   740-001243   S/N KJ35765       DC
PCG 0            REV 01   710-001568   S/N AA9794
PCG 1            REV 01   710-001568   S/N AA9804
Host 1                                 da000004f8d57001  teknor
MCS 1            REV 03   710-001226   S/N AA9777
SFM 0 SPP        REV 04   710-001228   S/N AA2975
SFM 0 SPR        REV 02   710-001224   S/N AA9838        Internet Processor I
SFM 1 SPP        REV 04   710-001228   S/N AA2860
SFM 1 SPR        REV 01   710-001224   S/N AB0139        Internet Processor I
FPC 0            REV 03   710-001255   S/N AA9806        FPC Type 1
  CPU            REV 02   710-001217   S/N AA9590
  PIC 1          REV 05   750-000616   S/N AA1527        1x OC-12 ATM, MM
  PIC 2          REV 05   750-000616   S/N AA1535        1x OC-12 ATM, MM
  PIC 3          REV 01   750-000616   S/N AA1519        1x OC-12 ATM, MM
FPC 1            REV 02   710-001611   S/N AA9523        FPC Type 2
  CPU            REV 02   710-001217   S/N AA9571
  PIC 0          REV 03   750-001900   S/N AA9626        1x STM-16 SDH, SMIR
  PIC 1          REV 01   710-002381   S/N AD3633        2x G/E, 1000 BASE-SX
FPC 2                                                    FPC Type OC192
  CPU            REV 03   710-001217   S/N AB3329
  PIC 0          REV 01                                  1x OC-192 SM SR-2
Fan Tray 0                                               Rear Bottom Blower
Fan Tray 1                                               Rear Top Blower
Fan Tray 2                                               Front Top Blower
Fan Tray 3                                               Front Fan Tray
```

show chassis hardware models (M160 Router)

```
user@host> show chassis hardware models
 Hardware inventory:
Item             Version  Part number  CLEI code         FRU model number
Midplane         REV 03   710-009120                     CHAS-BP-M320-S
FPM Display      REV 02   710-009351                     CRAFT-M320-S
CIP              REV 03   710-005926                     CIP-M320-S
PEM 2            Rev X4   740-009148                     PWR-M-DC-S
PEM 3            Rev X4   740-009148                     PWR-M-DC-S
Routing Engine 0 REV 02   740-008883                     RE-1600-2048-S
Routing Engine 1 REV 02   740-008883                     RE-1600-2048-S
FPC 0            REV 02   710-010419                     M320-FPC1
  PIC 0          REV 01   750-001323                     P-TUNNEL
  PIC 1          REV 02   750-002987                     PE-1OC12-SON-SMIR
```



```
  PIC 2          REV 04   750-001894                     PB-1GE-SX
  PIC 3          REV 04   750-001896                     PB-1OC12-SON-SMIR
FPC 1            REV 02   710-010419                     M320-FPC1
  PIC 0          REV 04   750-001894                     PB-1GE-SX
  PIC 1          REV 04   750-001894                     PB-1GE-SX
  PIC 3          REV 03   750-001894                     PB-1GE-SX
FPC 2            REV 02   710-010419                     M320-FPC1
  PIC 0          REV 10   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 1          REV 10   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 2          REV 07   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 3          REV 07   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 1          REV 10   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 2          REV 07   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 3          REV 07   750-005634                     PB-1CHOC12SMIR-QPP
FPC 3
  PIC 0          REV 03   750-001895                     PB-1OC12-SON-MM
  PIC 1          REV 04   750-001894                     PB-1GE-SX
  PIC 3          REV 04   750-003141                     PB-1GE-SX-B
FPC 4            REV 02   710-010419                     M320-FPC1
FPC 5            REV 02   710-010419                     M320-FPC1
FPC 6            REV 02   710-010419                     M320-FPC1
FPC 7
  PIC 0          REV 15   750-001901                     PB-4OC12-SON-SMIR
  PIC 1          REV 06   750-001900                     PB-1OC48-SON-SMSR
  PIC 2          REV 07   750-001900                     PB-1OC48-SON-SMSR
  PIC 3          REV 05   750-003737                     PB-4GE-SX
SIB 0            REV 03   710-009184                     SIB-M-S
SIB 1            REV 03   710-009184                     SIB-M-S
SIB 2            REV 03   710-009184                     SIB-M-S
SIB 3            REV 03   710-009184                     SIB-M-S
Fan Tray 0                                               FFANTRAY-M320-S
Fan Tray 1                                               FFANTRAY-M320-S
Fan Tray 2                                               RFANTRAY-M320-S
```

show chassis hardware detail (M160 Router)

```
user@host> show chassis hardware detail
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                101               M160
Midplane         REV 02   710-001245   S/N AB4107
FPM CMB          REV 01   710-001642   S/N AA2911
FPM Display      REV 01   710-001647   S/N AA2999
CIP              REV 02   710-001593   S/N AA9563
PEM 0            Rev 01   740-001243   S/N KJ35769       DC
PEM 1            Rev 01   740-001243   S/N KJ35765       DC
PCG 0            REV 01   710-001568   S/N AA9794
PCG 1            REV 01   710-001568   S/N AA9804
Host 1                                 da000004f8d57001  teknor
MCS 1            REV 03   710-001226   S/N AA9777
SFM 0 SPP        REV 04   710-001228   S/N AA2975
SFM 0 SPR        REV 02   710-001224   S/N AA9838        Internet Processor I
  SSRAM bank 0   REV 01   710-000077   S/N 306456        1 MB
  SSRAM bank 1   REV 01   710-000077   S/N 306474        1 MB
  SSRAM bank 2   REV 01   710-000077   S/N 306388        1 MB
  SSRAM bank 3   REV 01   710-000077   S/N 306392        1 MB
SFM 1 SPP        REV 04   710-001228   S/N AA2860
SFM 1 SPR        REV 01   710-001224   S/N AB0139        Internet Processor I
  SSRAM bank 0   REV 01   710-000077   S/N 302917        1 MB
  SSRAM bank 1   REV 01   710-000077   S/N 302662        1 MB
  SSRAM bank 2   REV 01   710-000077   S/N 302593        1 MB
```



```
  SSRAM bank 3     REV 01    710-000077    S/N 100160         1 MB
FPC 0              REV 03    710-001255    S/N AA9806         FPC Type 1
  CPU              REV 02    710-001217    S/N AA9590
  SSRAM            REV 01    710-000077    S/N 302836         1 MB
  SDRAM 0          REV 01    710-001196    S00141             32 MB
  SDRAM 1          REV 01    710-001196    S0010;             32 MB
  SSRAM            REV 01    710-000077    S/N 302633         1 MB
  SDRAM 0          REV 01    710-001196    S00143             32 MB
  SDRAM 1          REV 01    710-001196    S00115             32 MB
  SSRAM            REV 01    710-000077    S/N 302952         1 MB
  SDRAM 0          REV 01    710-001196    S00135             32 MB
  SDRAM 1          REV 01    710-001196    S001=3             32 MB
  SSRAM            REV 01    710-000077    S/N 302892         1 MB
  SDRAM 0          REV 01    710-001196    S000?6             32 MB
  SDRAM 1          REV 01    710-001196    S001=5             32 MB
  PIC 1            REV 05    750-000616    S/N AA1527         1x OC-12 ATM, MM
  PIC 2            REV 05    750-000616    S/N AA1535         1x OC-12 ATM, MM
  PIC 3            REV 01    750-000616    S/N AA1519         1x OC-12 ATM, MM
FPC 1              REV 02    710-001611    S/N AA9523         FPC Type 2
  CPU              REV 02    710-001217    S/N AA9571
  SSRAM            REV 01    710-000077    S/N 306340         1 MB
  SDRAM 0          REV 01    710-001196    S00012             32 MB
  SDRAM 1          REV 01    710-001196    S0001?             32 MB
  SSRAM            REV 01    710-000077    S/N 306454         1 MB
  SDRAM 0          REV 01    710-001196    S00028             32 MB
  SDRAM 1          REV 01    710-001196    S0002?             32 MB
  SSRAM            REV 01    710-000077    S/N 306492         1 MB
  SDRAM 0          REV 01    710-001196    S00015             32 MB
  SDRAM 1          REV 01    710-001196    S00031             32 MB
  SSRAM            REV 01    710-000077    S/N 306363         1 MB
  SDRAM 0          REV 01    710-001196    S00013             32 MB
  SDRAM 1          REV 01    710-001196    S00032             32 MB
  PIC 0            REV 03    750-001900    S/N AA9626         1x STM-16 SDH, SMIR
  PIC 1            REV 01    710-002381    S/N AD3633         2x G/E, 1000 BASE-SX
FPC 2                                                         FPC Type OC192
... SSRAM            REV 01    710-000077    S/N 306466         1 MB
```

show chassis hardware (M320 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item               Version   Part number   Serial number      Description
Chassis                                    67245              M320
Midplane           REV 05    710-009120    RB1202             M320 Midplane
FPM GBUS           REV 04    710-005928    HZ5697             M320 Board
FPM Display        REV 05    710-009351    HR1464             M320 FPM Display
CIP                REV 04    710-005926    HT8672             M320 CIP
PEM 0              Rev 05    740-009148    QK34208            DC Power Entry Module
PEM 1              Rev 05    740-009148    QK34262            DC Power Entry Module
PEM 2              Rev 05    740-009148    QF10449            DC Power Entry Module
PEM 3              Rev 05    740-009148    QJ18257            DC Power Entry Module
Routing Engine 0   REV 06    740-008883    P11123901185       RE-4.0
CB 0               REV 07    710-009115    JB2382             M320 Control Board
FPC 0              REV 02    710-005017    CD9926             M320 FPC Type 2
  CPU              REV 01    710-011659    CJ6940             M320 PCA SCPU
  PIC 0            REV 07    750-001900    AT1594             1x OC-48 SONET, SMSR
  PIC 1            REV 03    750-001850    HS2746             1x Tunnel
  PIC 2            REV 05    750-010618    JE7117             4x G/E SFP, 1000 BASE
  PIC 3            REV 06    750-001900    HE6083             1x OC-48 SONET, SMSR
FPC 2              REV 02    710-005017    CH0319             M320 FPC Type 1
  CPU              REV 01    710-011659    CJ6942             M320 PCA SCPU
```

```
  PIC 0          REV 05   750-003034   BD8705            4x OC-3 SONET, SMIR
FPC 5            REV 02   710-005017   CD9938            M320 FPC Type 2
  CPU
FPC 7            REV 02   710-005017   CD9934            M320 FPC Type 2
  CPU
SIB 0            REV 09   710-009184   JA6540            M320 SIB
SIB 1            REV 09   710-009184   HV9511            M320 SIB
SIB 2            REV 09   710-009184   HW2057            M320 SIB
SIB 3            REV 09   710-009184   JA6687            M320 SIB
Fan Tray 0                                               Front Top Fan Tray
Fan Tray 1                                               Front Bottom Fan Tray
Fan Tray 2                                               Rear Fan Tray
```

show chassis hardware models (M320 Router)

```
user@host> show chassis hardware models
Hardware inventory:
Item             Version  Part number  CLEI code         FRU model number
Midplane         REV 03   710-009120                     CHAS-BP-M320-S
FPM Display      REV 02   710-009351                     CRAFT-M320-S
CIP              REV 03   710-005926                     CIP-M320-S
PEM 2            Rev X4   740-009148                     PWR-M-DC-S
PEM 3            Rev X4   740-009148                     PWR-M-DC-S
Routing Engine 0 REV 02   740-008883                     RE-1600-2048-S
Routing Engine 1 REV 02   740-008883                     RE-1600-2048-S
FPC 0            REV 02   710-010419                     M320-FPC1
  PIC 0          REV 01   750-001323                     P-TUNNEL
  PIC 1          REV 02   750-002987                     PE-1OC12-SON-SMIR
  PIC 2          REV 04   750-001894                     PB-1GE-SX
  PIC 3          REV 04   750-001896                     PB-1OC12-SON-SMIR
FPC 1            REV 02   710-010419                     M320-FPC1
  PIC 0          REV 04   750-001894                     PB-1GE-SX
  PIC 1          REV 04   750-001894                     PB-1GE-SX
  PIC 3          REV 03   750-001894                     PB-1GE-SX
FPC 2            REV 02   710-010419                     M320-FPC1
  PIC 0          REV 10   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 1          REV 10   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 2          REV 07   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 3          REV 07   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 1          REV 10   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 2          REV 07   750-005634                     PB-1CHOC12SMIR-QPP
  PIC 3          REV 07   750-005634                     PB-1CHOC12SMIR-QPP
FPC 3
  PIC 0          REV 03   750-001895                     PB-1OC12-SON-MM
  PIC 1          REV 04   750-001894                     PB-1GE-SX
  PIC 3          REV 04   750-003141                     PB-1GE-SX-B
FPC 4            REV 02   710-010419                     M320-FPC1
FPC 5            REV 02   710-010419                     M320-FPC1
FPC 6            REV 02   710-010419                     M320-FPC1
FPC 7
  PIC 0          REV 15   750-001901                     PB-4OC12-SON-SMIR
  PIC 1          REV 06   750-001900                     PB-1OC48-SON-SMSR
  PIC 2          REV 07   750-001900                     PB-1OC48-SON-SMSR
  PIC 3          REV 05   750-003737                     PB-4GE-SX
SIB 0            REV 03   710-009184                     SIB-M-S
SIB 1            REV 03   710-009184                     SIB-M-S
SIB 2            REV 03   710-009184                     SIB-M-S
SIB 3            REV 03   710-009184                     SIB-M-S
Fan Tray 0                                               FFANTRAY-M320-S
Fan Tray 1                                               FFANTRAY-M320-S
Fan Tray 2                                               RFANTRAY-M320-S
```

show chassis hardware (MX5 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                E1368             MX5-T
Midplane         REV 01   711-038215   YF5288            MX5-T
PEM 0            Rev 04   740-028288   VA01215           AC Power Entry Module
PEM 1            Rev 04   740-028288   VA01218           AC Power Entry Module
Routing Engine            BUILTIN      BUILTIN           Routing Engine
TFEB 0                    BUILTIN      BUILTIN           Forwarding Engine
Processor
  QXM 0          REV 05   711-028408   ZA9136            MPC QXM
FPC 0                     BUILTIN      BUILTIN           MPC BUILTIN
  MIC 0                   BUILTIN      BUILTIN           4x 10GE XFP
    PIC 0                 BUILTIN      BUILTIN           4x 10GE XFP
FPC 1                     BUILTIN      BUILTIN           MPC BUILTIN
  MIC 0          REV 24   750-028392   YX9820            3D 20x 1GE(LAN) SFP
    PIC 0                 BUILTIN      BUILTIN           10x 1GE(LAN) SFP
      Xcvr 0     REV 01   740-031851   AM1045SUAQ3       SFP-SX
      Xcvr 1     REV 01   740-031851   AM1045SUAPA       SFP-SX
      Xcvr 2     REV 01   740-031851   AM1045SUAN7       SFP-SX
      Xcvr 3     REV 01   740-031851   AM1045SU91Q       SFP-SX
      Xcvr 4     REV 01   740-031851   AM1045SUDDR       SFP-SX
      Xcvr 9     REV 01   740-011613   AM0848SB6A1       SFP-SX
    PIC 1                 BUILTIN      BUILTIN           10x 1GE(LAN) SFP
      Xcvr 0     REV 01   740-031851   AM1045SUAN0       SFP-SX
      Xcvr 1     REV 01   740-011613   AS0812S0719       SFP-SX
      Xcvr 2     REV 01   740-011613   AM0821SA121       SFP-SX
      Xcvr 3     REV 01   740-011613   PF21K21           SFP-SX
      Xcvr 4     REV 01   740-011613   AM0848SB69Z       SFP-SX
      Xcvr 5     REV 01   740-011782   P9P0XV3           SFP-SX
      Xcvr 6     REV 01   740-011613   AM0812S8WJN       SFP-SX
      Xcvr 7     REV 01   740-011613   PAM3G9Q           SFP-SX
      Xcvr 8     REV 01   740-011613   AM0848SB4A6       SFP-SX
      Xcvr 9     REV 01   740-011782   P9M0U37           SFP-SX
  MIC 1          REV 20   750-028380   ZG2657            3D 2x 10GE XFP
    PIC 2                 BUILTIN      BUILTIN           1x 10GE XFP
    PIC 3                 BUILTIN      BUILTIN           1x 10GE XFP
Fan Tray                                                 Fan Tray
```

show chassis hardware (MX10 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                E1372             MX10-T
Midplane         REV 01   711-038211   YF5285            MX10-T
PEM 0            Rev 04   740-028288   VB01678           AC Power Entry Module
Routing Engine            BUILTIN      BUILTIN           Routing Engine
TFEB 0                    BUILTIN      BUILTIN           Forwarding Engine
Processor
  QXM 0          REV 05   711-028408   ZA9053            MPC QXM
FPC 0                     BUILTIN      BUILTIN           MPC BUILTIN
  MIC 0                   BUILTIN      BUILTIN           4x 10GE XFP
    PIC 0                 BUILTIN      BUILTIN           4x 10GE XFP
FPC 1                     BUILTIN      BUILTIN           MPC BUILTIN
  MIC 0          REV 24   750-028392   YX9436            3D 20x 1GE(LAN) SFP
    PIC 0                 BUILTIN      BUILTIN           10x 1GE(LAN) SFP
      Xcvr 0     REV 01   740-031851   AM1107SUFQW       SFP-SX
```



```
    PIC 1                BUILTIN      BUILTIN            10x 1GE(LAN) SFP
Fan Tray                                                 Fan Tray
```

show chassis hardware (MX40 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                E1367             MX40-T
Midplane         REV 01   711-038211   YF5284            MX40-T
PEM 0            Rev 04   740-028288   VB01680           AC Power Entry Module
PEM 1            Rev 04   740-028288   VB01700           AC Power Entry Module
Routing Engine            BUILTIN      BUILTIN           Routing Engine
TFEB 0                    BUILTIN      BUILTIN           Forwarding Engine
Processor
  QXM 0          REV 05   711-028408   ZA9048            MPC QXM
FPC 0                     BUILTIN      BUILTIN           MPC BUILTIN
  MIC 0                   BUILTIN      BUILTIN           4x 10GE XFP
    PIC 0                 BUILTIN      BUILTIN           4x 10GE XFP
      Xcvr 0     REV 01   740-014279   M7067UPP          XFP-10G-LR
      Xcvr 1              NON-JNPR     K9J02UN           XFP-10G-LR
FPC 1                     BUILTIN      BUILTIN           MPC BUILTIN
  MIC 0          REV 24   750-028392   YX3504            3D 20x 1GE(LAN) SFP
    PIC 0                 BUILTIN      BUILTIN           10x 1GE(LAN) SFP
      Xcvr 0     REV 01   740-011613   AM0812S8WTE       SFP-SX
      Xcvr 1     REV 01   740-011613   PFA6KV2           SFP-SX
      Xcvr 2     REV 01   740-031851   AM1045SUDDM       SFP-SX
      Xcvr 3     REV 01   740-011613   PD63C7M           SFP-SX
      Xcvr 4     REV 01   740-011613   PD63DJY           SFP-SX
      Xcvr 5     REV 02   740-011613   AA0950STLL9       SFP-SX
      Xcvr 6     REV 01   740-011782   PAR1YHC           SFP-SX
      Xcvr 7     REV 01   740-011782   P9P0XXL           SFP-SX
      Xcvr 8     REV 01   740-011613   PD63D95           SFP-SX
      Xcvr 9     REV 01   740-031851   AM1045SU9B8       SFP-SX
    PIC 1                 BUILTIN      BUILTIN           10x 1GE(LAN) SFP
      Xcvr 0     REV 01   740-011613   PF21L3Z           SFP-SX
      Xcvr 1     REV 01   740-031851   AM1045SU7M9       SFP-SX
      Xcvr 2     REV 01   740-031851   AM1045SUAPT       SFP-SX
      Xcvr 3     REV 01   740-011613   PFF2BZH           SFP-SX
      Xcvr 4     REV 01   740-031851   AM1045SUDDN       SFP-SX
      Xcvr 5     REV 01   740-031851   AM1039S00ZR       SFP-SX
      Xcvr 6     REV 01   740-031851   AM1045SUD6Y       SFP-SX
      Xcvr 8     REV 01   740-011613   PFM1QBS           SFP-SX
      Xcvr 9     REV 01   740-011613   PFF2E25           SFP-SX
  MIC 1          REV 01   750-021130   KG4391            3D 2x 10GE XFP
    PIC 2                 BUILTIN      BUILTIN           1x 10GE XFP
      Xcvr 0     REV 01   740-011571   C645XJ04G         XFP-10G-SR
    PIC 3                 BUILTIN      BUILTIN           1x 10GE XFP
      Xcvr 0              NON-JNPR     CA49BK0AE         XFP-10G-SR
Fan Tray                                                 Fan Tray
```

show chassis hardware (Fixed MX80 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                                  MX80-48T
Midplane         REV 01   711-031603   KF9250            MX80-48T
Routing Engine            BUILTIN      BUILTIN           Routing Engine
FEB 0                     BUILTIN      BUILTIN           Forwarding Engine Board
FPC 0                     BUILTIN      BUILTIN           MPC BUILTIN
```

```
  MIC 0                    BUILTIN      BUILTIN            4x 10GE XFP
    PIC 0                  BUILTIN      BUILTIN            4x 10GE XFP
      Xcvr 0               NON-JNPR     M6439D41           XFP-10G-LR
      Xcvr 1      REV 01   740-014279   6XE931N00202       XFP-10G-LR
      Xcvr 2      REV 01   740-014289   C715XU05F          XFP-10G-SR
      Xcvr 3      REV 01   740-014289   C650XU0EP          XFP-10G-SR
FPC 1                      BUILTIN      BUILTIN            MPC BUILTIN
  MIC 0           REV 01   711-029399   JR6981             12x 1GE(LAN) RJ45
    PIC 0                  BUILTIN      BUILTIN            12x 1GE(LAN) RJ45
    PIC 1                  BUILTIN      BUILTIN            12x 1GE(LAN) RJ45
  MIC 1           REV 01   BUILTIN      BUILTIN            12x 1GE(LAN) RJ45
    PIC 2                  BUILTIN      BUILTIN            12x 1GE(LAN) RJ45
    PIC 3                  BUILTIN      BUILTIN            12x 1GE(LAN) RJ45
Fan Tray                                                   Fan Tray
```

show chassis hardware (Modular MX80 Router)

```
user@host> show chassis hardware

Hardware inventory:
Item              Version  Part number  Serial number      Description
Chassis                                                    MX80
Midplane          REV 02   711-031594   JR7084             MX80
PEM 0             Rev 01   740-028288   000018             AC Power Entry Module
Routing Engine             BUILTIN      BUILTIN            Routing Engine
FEB 0                      BUILTIN      BUILTIN            Forwarding Engine Board

  QXM 0           REV 05   711-028408   JR7041             MPC QXM
FPC 0                      BUILTIN      BUILTIN            MPC BUILTIN
  MIC 0                    BUILTIN      BUILTIN            4x 10GE XFP
    PIC 0                  BUILTIN      BUILTIN            4x 10GE XFP
FPC 1                      BUILTIN      BUILTIN            MPC BUILTIN
  MIC 0           REV 02   750-028380   JR6598             3D 2x 10GE XFP
    PIC 0                  BUILTIN      BUILTIN            1x 10GE XFP
      Xcvr 0      REV 01   740-014289   T07M86365          XFP-10G-SR
    PIC 1                  BUILTIN      BUILTIN            1x 10GE XFP
      Xcvr 0      REV 01   740-014289   T07M71094          XFP-10G-SR
  MIC 1           REV 02   750-028380   JG8548             3D 2x 10GE XFP
    PIC 2                  BUILTIN      BUILTIN            1x 10GE XFP
      Xcvr 0      REV 02   740-014289   T08L86302          XFP-10G-SR
    PIC 3                  BUILTIN      BUILTIN            1x 10GE XFP
      Xcvr 0      REV 02   740-014289   C810XU0BA          XFP-10G-SR
Fan Tray                                                   Fan Tray
```

show chassis hardware (MX104 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item              Version  Part number  Serial number      Description
Chassis                                 G3503              MX104
Midplane          REV 28   750-044219   CAAX5741           MX104
PEM 0             REV 03   740-045933   1H072500016        AC Power Entry Module
PEM 1             REV 03   740-045932   1H073050017        DC Power Entry Module
Routing Engine 0  REV 20   750-044228   CAAY7935           RE-MX-104
Routing Engine 1  REV 13   750-044228   CAAM6380           RE-MX-104
AFEB 0                     BUILTIN      BUILTIN            Forwarding Engine
Processor
FPC 0                      BUILTIN      BUILTIN            MPC BUILTIN
FPC 1                      BUILTIN      BUILTIN            MPC BUILTIN
  MIC 0           REV 15   750-036132   CAAF7948           2xOC12/8xOC3 CC-CE
    PIC 0                  BUILTIN      BUILTIN            2xOC12/8xOC3 CC-CE
```

```
        Xcvr 0      REV 01    740-011615    PCQ0U2J          SFP-IR
        Xcvr 1      REV 01    740-016068    PJL7A6G          SFP-SR
        Xcvr 2      REV 01    740-016068    PJL7A5J          SFP-SR
        Xcvr 3      REV 01    740-016065    PJN5HPZ          SFP-SR
        Xcvr 4      REV 01    740-029122    PKB38TL          SFP-LR
        Xcvr 5      REV 01    740-011787    P6A107G          SFP-LR
        Xcvr 6      REV 01    740-029122    PKB38TR          SFP-LR
        Xcvr 7      REV 01    740-011787    PBK0NK3          SFP-LR
  MIC 1
FPC 2                         BUILTIN       BUILTIN          MPC BUILTIN
  MIC 0                       BUILTIN       BUILTIN          4x 10GE(LAN) SFP+
    PIC 0                     BUILTIN       BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0      REV 01    740-031980    B10F00465        SFP+-10G-SR
      Xcvr 1      REV 01    740-031980    B10F00461        SFP+-10G-SR
      Xcvr 2      REV 01    740-031980    B10G01545        SFP+-10G-SR
      Xcvr 3      REV 01    740-031980    B10G01385        SFP+-10G-SR
Fan Tray 0        REV 02    711-049570    CAAX6538         Fan Tray
```

show chassis hardware detail (MX104 Router)

```
user@host> show chassis hardware detail
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                G3503             MX104
Midplane         REV 28   750-044219   CAAX5741          MX104
PEM 0            REV 03   740-045933   1H072500016       AC Power Entry Module
PEM 1            REV 03   740-045932   1H073050017       DC Power Entry Module
Routing Engine 0 REV 20   750-044228   CAAY7935          RE-MX-104
  da0     7836 MB  ATP IG eUSB SSD                       Nand Flash 0
  usb0 (addr 1)  EHCI root hub 0       Freescale         uhub0
  usb0 (addr 2)  USB2513Bi  9491       SMSC              uhub1
  usb0 (addr 3)  ATP IG eUSB SSD 44801 ATP Electronics   umass0
Routing Engine 1 REV 13   750-044228   CAAM6380          RE-MX-104
  da0     7836 MB  ATP IG eUSB SSD                       Nand Flash 0
AFEB 0                    BUILTIN      BUILTIN           Forwarding Engine
Processor
FPC 0                     BUILTIN      BUILTIN           MPC BUILTIN
FPC 1                     BUILTIN      BUILTIN           MPC BUILTIN
  MIC 0          REV 15   750-036132   CAAF7948          2xOC12/8xOC3 CC-CE
    PIC 0                 BUILTIN      BUILTIN           2xOC12/8xOC3 CC-CE
      Xcvr 0     REV 01   740-011615   PCQ0U2J           SFP-IR
      Xcvr 1     REV 01   740-016068   PJL7A6G           SFP-SR
      Xcvr 2     REV 01   740-016068   PJL7A5J           SFP-SR
      Xcvr 3     REV 01   740-016065   PJN5HPZ           SFP-SR
      Xcvr 4     REV 01   740-029122   PKB38TL           SFP-LR
      Xcvr 5     REV 01   740-011787   P6A107G           SFP-LR
      Xcvr 6     REV 01   740-029122   PKB38TR           SFP-LR
      Xcvr 7     REV 01   740-011787   PBK0NK3           SFP-LR
  MIC 1
FPC 2                     BUILTIN      BUILTIN           MPC BUILTIN
  MIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    PIC 0                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
      Xcvr 0     REV 01   740-031980   B10F00465         SFP+-10G-SR
      Xcvr 1     REV 01   740-031980   B10F00461         SFP+-10G-SR
      Xcvr 2     REV 01   740-031980   B10G01545         SFP+-10G-SR
      Xcvr 3     REV 01   740-031980   B10G01385         SFP+-10G-SR
Fan Tray 0       REV 02   711-049570   CAAX6538          Fan Tray
```

show chassis hardware extensive (MX104 Router)

```
user@host> show chassis hardware extensive
```

```
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                G3503             MX104
 Jedec Code:   0x7fb0           EEPROM Version:    0x02
                                S/N:               G3503
 Assembly ID:  0x0560           Assembly Version:  00.00
 Date:         00-00-0000       Assembly Flags:    0x00
 ID: MX104
 Board Information Record:
  Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 05 60 00 00 00 00 00 00 00 00 00 00
  Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x20: 47 33 35 30 33 00 00 00 00 00 00 00 00 00 00 00
  Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Midplane         REV 28   750-044219   CAAX5741          MX104
 Jedec Code:   0x7fb0           EEPROM Version:    0x02
 P/N:          750-044219       S/N:               S/N CAAX5741
 Assembly ID:  0x0560           Assembly Version:  01.28
 Date:         03-27-2013       Assembly Flags:    0x00
 Version:      REV 28           CLEI Code:         PROTOXCLEI
 ID: MX104                      FRU Model Number:  PROTO-ASSEMBLY
 Board Information Record:
  Address 0x00: ad 01 08 00 b0 a8 6e a7 f8 00 ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 05 60 01 1c 52 45 56 20 32 38 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 34 34 32 31 39 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 58 35 37 34 31 00 1b 03 07
  Address 0x30: dd ff ff ff ad 01 08 00 b0 a8 6e a7 f8 00 ff ff
  Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
  Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff c2 47 33 35 30 33 00 00 00 00 00 00 00
PEM 0            REV 03   740-045933   1H072500016       AC Power Entry Module
 Jedec Code:   0x7fb0           EEPROM Version:    0x02
 P/N:          740-045933       S/N:               1H072500016
 Assembly ID:  0x0475           Assembly Version:  00.03
 Date:         12-14-2012       Assembly Flags:    0x00
 Version:      REV 03           CLEI Code:         IPUPAJ9KAA
 ID: AC Power Entry Module      FRU Model Number:  PWR-AMX1100-AC-S
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff 02 02 00 ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 75 00 03 52 45 56 20 30 33 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 35 39 33 33 00 00
  Address 0x20: 31 48 30 37 32 35 30 30 30 31 36 00 00 0e 0c 07
  Address 0x30: dc 30 43 ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: 02 02 00 ff 01 49 50 55 50 41 4a 39 4b 41 41 50
  Address 0x50: 57 52 2d 41 4d 58 31 31 30 30 2d 41 43 2d 53 00
  Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 70 ff ff ff ff ff ff ff ff ff ff ff ff
PEM 1            REV 03   740-045932   1H073050017       DC Power Entry Module
Jedec Code:   0x7fb0           EEPROM Version:    0x02
 P/N:          740-045932       S/N:               1H073050017
 Assembly ID:  0x0476           Assembly Version:  00.03
 Date:         01-30-2013       Assembly Flags:    0x00
 Version:      REV 03           CLEI Code:         IPUPAJ8KAA
```



```
  ID: DC Power Entry Module       FRU Model Number:  PWR-AMX1100-DC-S
  Board Information Record:
   Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff 02 02 00 ff
  I2C Hex Data:
   Address 0x00: 7f b0 02 ff 04 76 00 03 52 45 56 20 30 33 00 00
   Address 0x10: 00 00 00 00 37 34 30 2d 30 34 35 39 33 32 00 00
   Address 0x20: 31 48 30 37 33 30 35 30 30 31 37 00 00 1e 01 07
   Address 0x30: dd 30 44 ff ff ff ff ff ff ff ff ff ff ff ff ff
   Address 0x40: 02 02 00 ff 01 49 50 55 50 41 4a 38 4b 41 41 50
   Address 0x50: 57 52 2d 41 4d 58 31 31 30 30 2d 44 43 2d 53 00
   Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
   Address 0x70: ff ff ff 72 ff ff ff ff ff ff ff ff ff ff ff ff
Routing Engine 0 REV 20   750-044228   CAAY7935         RE-MX-104
  Jedec Code:   0x7fb0            EEPROM Version:    0x02
  P/N:          750-044228        S/N:               S/N CAAY7935
  Assembly ID:  0x0b81            Assembly Version:  01.20
  Date:         03-18-2013        Assembly Flags:    0x00
  Version:      REV 20            CLEI Code:         PROTOXCLEI
  ID: RE-MX-104                   FRU Model Number:  PROTO-ASSEMBLY
  Board Information Record:
   Address 0x00: ad 01 00 08 b0 a8 6e a6 fc 10 ff ff ff ff ff ff
  I2C Hex Data:
   Address 0x00: 7f b0 02 fe 0b 81 01 14 52 45 56 20 32 30 00 00
   Address 0x10: 00 00 00 00 37 35 30 2d 30 34 34 32 32 38 00 00
   Address 0x20: 53 2f 4e 20 43 41 41 59 37 39 33 35 00 12 03 07
   Address 0x30: dd ff ff ff ad 01 00 08 b0 a8 6e a6 fc 10 ff ff
   Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
   Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
   Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
   Address 0x70: ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff ff
   da0    7836 MB  ATP IG eUSB SSD                        Nand Flash 0
   usb0 (addr 1)  EHCI root hub 0       Freescale         uhub0
   usb0 (addr 2)  USB2513Bi  9491       SMSC              uhub1
   usb0 (addr 3)  ATP IG eUSB SSD 44801 ATP Electronics   umass0
Routing Engine 1 REV 13   750-044228   CAAM6380         RE-MX-104
  Jedec Code:   0x7fb0            EEPROM Version:    0x02
  P/N:          750-044228        S/N:               S/N CAAM6380
  Assembly ID:  0x0b81            Assembly Version:  01.13
  Date:         09-17-2012        Assembly Flags:    0x00
  Version:      REV 13            CLEI Code:         PROTOXCLEI
  ID: RE-MX-104                   FRU Model Number:  PROTO-ASSEMBLY
  Board Information Record:
   Address 0x00: ad 01 00 08 64 87 88 27 08 18 ff ff ff ff ff ff
  I2C Hex Data:
   Address 0x00: 7f b0 02 fe 0b 81 01 0d 52 45 56 20 31 33 00 00
   Address 0x10: 00 00 00 00 37 35 30 2d 30 34 34 32 32 38 00 00
   Address 0x20: 53 2f 4e 20 43 41 41 4d 36 33 38 30 00 11 09 07
   Address 0x30: dc ff ff ff ad 01 00 08 64 87 88 27 08 18 ff ff
   Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
   Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
   Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
Address 0x70: ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff ff
   da0    7836 MB  ATP IG eUSB SSD                        Nand Flash 0
AFEB 0                    BUILTIN      BUILTIN            Forwarding Engine
Processor
FPC 0                     BUILTIN      BUILTIN            MPC BUILTIN
FPC 1                     BUILTIN      BUILTIN            MPC BUILTIN
   MIC 0          REV 15   750-036132   CAAF7948          2xOC12/8xOC3 CC-CE
  Jedec Code:   0x7fb0            EEPROM Version:    0x02
  P/N:          750-036132        S/N:               S/N CAAF7948
  Assembly ID:  0x0a1a            Assembly Version:  01.15
```



```
 Date:          07-03-2012        Assembly Flags:    0x00
 Version:       REV 15            CLEI Code:         IP9IAM2DAA
 ID: 2xOC12/8xOC3 CC-CE           FRU Model Number:  MIC-3D-8OC3-2OC12-ATM
 Board Information Record:
  Address 0x00: 12 01 05 03 05 ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0a 1a 01 0f 52 45 56 20 31 35 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 33 36 31 33 32 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 46 37 39 34 38 00 03 07 07
  Address 0x30: dc ff ff ff 12 01 05 03 05 ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 49 50 39 49 41 4d 32 44 41 41 4d
  Address 0x50: 49 43 2d 33 44 2d 38 4f 43 33 2d 32 4f 43 31 32
  Address 0x60: 2d 41 54 4d 00 00 41 00 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff e3 c0 02 a3 9c 00 00 00 00 0a 60 00 00
    PIC 0                 BUILTIN      BUILTIN           2xOC12/8xOC3 CC-CE
      Xcvr 0     REV 01   740-011615   PCQ0U2J           SFP-IR
      Xcvr 1     REV 01   740-016068   PJL7A6G           SFP-SR
      Xcvr 2     REV 01   740-016068   PJL7A5J           SFP-SR
      Xcvr 3     REV 01   740-016065   PJN5HPZ           SFP-SR
      Xcvr 4     REV 01   740-029122   PKB38TL           SFP-LR
      Xcvr 5     REV 01   740-011787   P6A107G           SFP-LR
      Xcvr 6     REV 01   740-029122   PKB38TR           SFP-LR
      Xcvr 7     REV 01   740-011787   PBK0NK3           SFP-LR
  MIC 1
FPC 2                     BUILTIN      BUILTIN           MPC BUILTIN
  MIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
 Jedec Code:    0x0000            EEPROM Version:    0x00
 P/N:           BUILTIN           S/N:               BUILTIN
 Assembly ID:   0x0a60            Assembly Version:  00.00
 Date:          00-00-0000        Assembly Flags:    0x00
 ID: 4x 10GE(LAN) SFP+
 Board Information Record:
  Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
 I2C Hex Data:
  Address 0x00: 00 00 00 00 0a 60 00 00 00 00 00 00 00 00 00 00
  Address 0x10: 00 00 00 00 42 55 49 4c 54 49 4e 00 4d 58 43 00
  Address 0x20: 42 55 49 4c 54 49 4e 00 4d 58 43 00 00 00 00 00
  Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x70: 00 00 00 00 c0 02 a5 04 7f b0 02 ff 0a 1a 01 0f
    PIC 0                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
      Xcvr 0     REV 01   740-031980   B10F00465         SFP+-10G-SR
      Xcvr 1     REV 01   740-031980   B10F00461         SFP+-10G-SR
      Xcvr 2     REV 01   740-031980   B10G01545         SFP+-10G-SR
      Xcvr 3     REV 01   740-031980   B10G01385         SFP+-10G-SR
Fan Tray 0       REV 02   711-049570   CAAX6538          Fan Tray
 Jedec Code:    0x7fb0            EEPROM Version:    0x02
 P/N:           711-049570        S/N:               S/N CAAX6538
 Assembly ID:   0x0b82            Assembly Version:  01.02
 Date:          03-01-2013        Assembly Flags:    0x00
 Version:       REV 02            CLEI Code:         PROTOXCLEI
 ID: Fan Tray                     FRU Model Number:  PROTO-ASSEMBLY
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 82 01 02 52 45 56 20 30 32 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 34 39 35 37 30 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 58 36 35 33 38 00 01 03 07
  Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
```



```
Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
Address 0x70: ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff ff
```

show chassis hardware models (MX104 Router)

```
user@host> show chassis hardware models
Hardware inventory:
Item             Version  Part number  Serial number     FRU model number
Midplane         REV 20   750-044219   CAAS5849          PROTO-ASSEMBLY
PEM 0            REV 01   740-045932   1H072400065
Routing Engine 0 REV 16   750-044228   CAAR5915          PROTO-ASSEMBLY
AFEB 0                    BUILTIN      BUILTIN
FPC 0                     BUILTIN      BUILTIN
FPC 1                     BUILTIN      BUILTIN
  MIC 0          REV 01   750-046905   CAAK7103          MIC-3D-20GE-SFP-EH
FPC 2                     BUILTIN      BUILTIN
Fan Tray         REV 02   711-049570   CAAX6538          PROTO-ASSEMBLY
```

show chassis hardware clei-models (MX104 Router)

```
user@host> show chassis hardware clei-models
Hardware inventory:
Item             Version  Part number  CLEI code         FRU model number
Midplane         REV 20   750-044219   PROTOXCLEI        PROTO-ASSEMBLY
PEM 0            REV 01   740-045932
Routing Engine 0 REV 16   750-044228   PROTOXCLEI        PROTO-ASSEMBLY
AFEB 0                    BUILTIN
FPC 0                     BUILTIN
FPC 1                     BUILTIN
  MIC 0          REV 01   750-046905   PROTOXCLEI        MIC-3D-20GE-SFP-EH
FPC 2                     BUILTIN
Fan Tray        REV 02   711-049570   CAAX6538          PROTO-ASSEMBLY
```

show chassis hardware (MX240 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN10C7F7EAFC      MX240
Midplane         REV 01   710-021041   TR1502            MX240 Backplane
FPM Board        REV 01   710-017254   KD4017            Front Panel Display
PEM 0            Rev 02   740-017330   000332            PS 1.2-1.7kW; 100-240V
AC in
PEM 1            Rev 02   740-017330   000226            PS 1.2-1.7kW; 100-240V
AC in
Routing Engine 0 REV 06   740-013063   1000703522        RE-S-2000
Routing Engine 1 REV 06   740-015113   1000687625        RE-S-1300
CB 0             REV 07   710-013385   KC9057            MX SCB
CB 1             REV 05   710-013385   JY4760            MX SCB
FPC 1            REV 01   750-021679   KC7340            DPCE 40x 1GE R
  CPU            REV 06   710-013713   KD4078            DPC PMB
  PIC 0                   BUILTIN      BUILTIN           10x 1GE(LAN)
    Xcvr 0       REV 01   740-011613   P9F18ME           SFP-SX
  PIC 1                   BUILTIN      BUILTIN           10x 1GE(LAN)
  PIC 2                   BUILTIN      BUILTIN           10x 1GE(LAN)
  PIC 3                   BUILTIN      BUILTIN           10x 1GE(LAN)
FPC 2            REV 04   710-016669   JS4529            DPCE 40x 1GE R EQ
  CPU            REV 06   710-013713   KB3969            DPC PMB
  PIC 0                   BUILTIN      BUILTIN           10x 1GE(LAN) EQ
    Xcvr 0       REV 01   740-011613   PBG3Y79           SFP-SX
```



```
    Xcvr 1        REV 01   740-011613   PBG3XU8          SFP-SX
    Xcvr 2        REV 01   740-011613   PBG3YG6          SFP-SX
    Xcvr 3        REV 01   740-011613   PBG3XUG          SFP-SX
    Xcvr 4        REV 01   740-011613   PBG3XTJ          SFP-SX
  PIC 1                    BUILTIN      BUILTIN          10x 1GE(LAN) EQ
    Xcvr 0        REV 01   740-011613   PBG3ZUM          SFP-SX
    Xcvr 1        REV 01   740-011613   PBG3Y5H          SFP-SX
    Xcvr 2        REV 01   740-011613   PBG3UZT          SFP-SX
    Xcvr 3        REV 01   740-011613   PBG3US1          SFP-SX
  PIC 2                    BUILTIN      BUILTIN          10x 1GE(LAN) EQ
    Xcvr 0        REV 01   740-011613   PBG3YG7          SFP-SX
    Xcvr 1        REV 01   740-011613   PBG3XZ9          SFP-SX
    Xcvr 2        REV 01   740-011613   PBG3XTY          SFP-SX
    Xcvr 3        REV 01   740-011613   PBG3UZG          SFP-SX
  PIC 3                    BUILTIN      BUILTIN          10x 1GE(LAN) EQ
    Xcvr 0        REV 01   740-011613   PBG3Y8W          SFP-SX
    Xcvr 1        REV 01   740-011613   PBG3YVX          SFP-SX
    Xcvr 2        REV 01   740-011613   PBG3YB3          SFP-SX
    Xcvr 3        REV 01   740-011613   PBG43VQ          SFP-SX
Fan Tray 0        REV 01   710-021113   JS4642           MX240 Fan Tray
```

show chassis hardware detail (MX 240 Router with Routing Engine Displaying DIMM information)

```
user@host> show chassis hardware detail

Item              Version  Part number  Serial number    Description
Chassis                                 JN11279B4AFC     MX240 Backplane
Midplane          REV 07   760-021404   TS2474           MX240 Backplane
FPM Board         REV 03   760-021392   XC2643           Front Panel Display
PEM 0             Rev 03   740-017343   QCS0908A068      DC Power Entry Module
Routing Engine 0  REV 01   740-031117   AARCH00          RE-S-1800x4
  ad0    3764 MB  STEC M2+ CF 9.0.2   STIM2Q3209239145303 Removable Compact Flash

  ad1   28626 MB   WDC SSD-F0030S-5000  C933Z036237215548S00 Compact Flash
  usb0 (addr 1)   EHCI root hub 0       Intel            uhub0
  usb0 (addr 2)   product 0x0020 32     vendor 0x8087    uhub1
  DIMM 0          VL31B5263E-F8S DIE REV-0 PCB REV-0     MFR ID-ce80
  DIMM 1          VL31B5263E-F8S DIE REV-0 PCB REV-0     MFR ID-ce80
  DIMM 2          VL31B5263E-F8S DIE REV-0 PCB REV-0     MFR ID-ce80
  DIMM 3          SL31B5263E-F8S DIE REV-0 PCB REV-0     MFR ID-ce80
CB 0              REV 03   710-021523   XD7225           MX SCB
Fan Tray 0        REV 01   710-021113   WZ4986           MX240 Fan Tray
```

show chassis hardware (MX240 Router with Enhanced MX SCB)

```
user@host> show chassis hardware
Hardware inventory:
Item              Version  Part number  Serial number    Description
Chassis                                 JN10C7F7EAFC     MX240
Midplane          REV 01   710-021041   TR1502           MX240 Backplane
FPM Board         REV 01   710-017254   KD4017           Front Panel Display
PEM 0             Rev 02   740-017330   000332           PS 1.2-1.7kW; 100-240V
AC in
PEM 1             Rev 02   740-017330   000226           PS 1.2-1.7kW; 100-240V
AC in
Routing Engine 0  REV 06   740-013063   1000703522       RE-S-2000
Routing Engine 1  REV 06   740-015113   1000687625       RE-S-1300
CB 0              REV 02   710-031391   YE8494           Enhanced MX SCB
CB 1              REV 05   710-031391   YOP5764          Enhanced MX SCB
FPC 1             REV 01   750-021679   KC7340           DPCE 40x 1GE R
  CPU             REV 06   710-013713   KD4078           DPC PMB
```

```
  PIC 0                    BUILTIN      BUILTIN           10x 1GE(LAN)
    Xcvr 0        REV 01   740-011613   P9F18ME           SFP-SX
  PIC 1                    BUILTIN      BUILTIN           10x 1GE(LAN)
  PIC 2                    BUILTIN      BUILTIN           10x 1GE(LAN)
  PIC 3                    BUILTIN      BUILTIN           10x 1GE(LAN)
FPC 2             REV 04   710-016669   JS4529            DPCE 40x 1GE R EQ
  CPU             REV 06   710-013713   KB3969            DPC PMB
  PIC 0                    BUILTIN      BUILTIN           10x 1GE(LAN) EQ
    Xcvr 0        REV 01   740-011613   PBG3Y79           SFP-SX
    Xcvr 1        REV 01   740-011613   PBG3XU8           SFP-SX
    Xcvr 2        REV 01   740-011613   PBG3YG6           SFP-SX
    Xcvr 3        REV 01   740-011613   PBG3XUG           SFP-SX
    Xcvr 4        REV 01   740-011613   PBG3XTJ           SFP-SX
  PIC 1                    BUILTIN      BUILTIN           10x 1GE(LAN) EQ
    Xcvr 0        REV 01   740-011613   PBG3ZUM           SFP-SX
    Xcvr 1        REV 01   740-011613   PBG3Y5H           SFP-SX
    Xcvr 2        REV 01   740-011613   PBG3UZT           SFP-SX
    Xcvr 3        REV 01   740-011613   PBG3US1           SFP-SX
  PIC 2                    BUILTIN      BUILTIN           10x 1GE(LAN) EQ
    Xcvr 0        REV 01   740-011613   PBG3YG7           SFP-SX
    Xcvr 1        REV 01   740-011613   PBG3XZ9           SFP-SX
    Xcvr 2        REV 01   740-011613   PBG3XTY           SFP-SX
    Xcvr 3        REV 01   740-011613   PBG3UZG           SFP-SX
  PIC 3                    BUILTIN      BUILTIN           10x 1GE(LAN) EQ
    Xcvr 0        REV 01   740-011613   PBG3Y8W           SFP-SX
    Xcvr 1        REV 01   740-011613   PBG3YVX           SFP-SX
    Xcvr 2        REV 01   740-011613   PBG3YB3           SFP-SX
    Xcvr 3        REV 01   740-011613   PBG43VQ           SFP-SX
Fan Tray 0        REV 01   710-021113   JS4642            MX240 Fan Tray
```

show chassis hardware (MX480 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item              Version  Part number  Serial number     Description
Chassis                                 JN10C7F7FAFB      MX480
Midplane          REV 04   710-017414   TR2071            MX480 Midplane
FPM Board         REV 02   710-017254   KB8459            Front Panel Display
PEM 0             Rev 02   740-017330   QCS07519029       PS 1.2-1.7kW; 100-240V
AC in
PEM 1             Rev 02   740-017330   QCS07519041       PS 1.2-1.7kW; 100-240V
AC in
PEM 2             Rev 02   740-017330   QCS07519097       PS 1.2-1.7kW; 100-240V
AC in
Routing Engine 0 REV 07    740-013063   1000733381        RE-S-2000
Routing Engine 1 REV 07    740-013063   1000733540        RE-S-2000
CB 0              REV 07   710-013385   KA8022            MX SCB
CB 1              REV 07   710-013385   KA8303            MX SCB
FPC 0             REV 09   750-020452   KA8660            DPCE 40x 1GE X EQ
  CPU             REV 06   710-013713   KA8185            DPC PMB
  PIC 0                    BUILTIN      BUILTIN           10x 1GE(LAN) EQ
  PIC 1                    BUILTIN      BUILTIN           10x 1GE(LAN) EQ
  PIC 2                    BUILTIN      BUILTIN           10x 1GE(LAN) EQ
  PIC 3                    BUILTIN      BUILTIN           10x 1GE(LAN) EQ
Fan Tray                                                  Left Fan Tray
```

show chassis hardware (MX480 Router with Enhanced MX SCB)

```
user@host> show chassis hardware
Hardware inventory:
Item              Version  Part number  Serial number     Description
```



```
Chassis                                      JN10C7F7FAFB       MX480
Midplane          REV 04    710-017414    TR2071             MX480 Midplane
FPM Board         REV 02    710-017254    KB8459             Front Panel Display
PEM 0             Rev 02    740-017330    QCS07519029        PS 1.2-1.7kW; 100-240V
AC in
PEM 1             Rev 02    740-017330    QCS07519041        PS 1.2-1.7kW; 100-240V
AC in
PEM 2             Rev 02    740-017330    QCS07519097        PS 1.2-1.7kW; 100-240V
AC in
Routing Engine 0 REV 07    740-013063    1000733381         RE-S-2000
Routing Engine 1 REV 07    740-013063    1000733540         RE-S-2000
CB 0              REV 07    710-013385    KA8022             Enhanced MX SCB
CB 1              REV 07    710-013385    KA8303             Enhanced MX SCB
FPC 0             REV 09    750-020452    KA8660             DPCE 40x 1GE X EQ
  CPU             REV 06    710-013713    KA8185             DPC PMB
  PIC 0                     BUILTIN       BUILTIN            10x 1GE(LAN) EQ
  PIC 1                     BUILTIN       BUILTIN            10x 1GE(LAN) EQ
  PIC 2                     BUILTIN       BUILTIN            10x 1GE(LAN) EQ
  PIC 3                     BUILTIN       BUILTIN            10x 1GE(LAN) EQ
Fan Tray                                                     Left Fan Tray
```

show chassis hardware (MX960 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item              Version   Part number   Serial number      Description
Chassis                                                      MX960
Midplane          REV 01    710-013698    AA6082             MX960 Midplane
PIM               Rev 01    740-013110    000008             Power Inlet Module
PEM 2
PEM 3             Rev 01    740-013682    000038             PS 1.7kW; 200-240VAC in
Routing Engine 0 REV 00    740-015113    1000617944         RE-S-1300
CB 0              REV 05    710-013725    JK6947             MX960 Test SCB
FPC 4             REV 01    710-013305    JM7617             MX960 Test DPC
  CPU
  PIC 0                     BUILTIN       BUILTIN            1x 10GE(LAN/WAN)
  PIC 1                     BUILTIN       BUILTIN            10x 1GE
FPC 7             REV 01    710-013305    JL9634             MX960 Test DPC
  CPU
  PIC 0                     BUILTIN       BUILTIN            1x 10GE(LAN/WAN)
    Xcvr 0                  NON-JNPR      MYBG65I82C         XFP-10G-SR
  PIC 1                     BUILTIN       BUILTIN            10x 1GE
    Xcvr 1        REV 01    740-011782    P7N0368            SFP-SX
    Xcvr 4        REV 01    740-011782    P8J1W27            SFP-SX
    Xcvr 6        REV 01    740-011782    P8J1VSD            SFP-SX
    Xcvr 9        REV 01    740-011782    P8J1W25            SFP-SX
Fan Tray 0
Fan Tray 1
```

show chassis hardware (MX960 Router with Bidirectional Optics)

```
user@host> show chassis hardware
Hardware inventory:
Item              Version   Part number   Serial number      Description
Chassis                                   JN10BA5B9AFA       MX960
Midplane          REV 03    710-013698    TR0234             MX960 Backplane
FPM Board         REV 03    710-014974    JA0878             Front Panel Display
PDM              Rev 03    740-013110    QCS11135028        Power Distribution Module
PEM 0             Rev 03    740-013682    QCS11154036        PS 1.7kW; 200-240VAC in
PEM 1             Rev 03    740-013682    QCS11154010        PS 1.7kW; 200-240VAC in
PEM 2             Rev 03    740-013682    QCS11154022        PS 1.7kW; 200-240VAC in
```



```
Routing Engine 0 REV 06   740-013063   1000691458        RE-S-2000
CB 0             REV 07   710-013385   KA2190            MX SCB
CB 1             REV 07   710-013385   KA0837            MX SCB
FPC 3            REV 02   750-018122   KB3890            DPCE 40x 1GE R
  CPU
FPC 4            REV 01   750-018122   KB3889            DPCE 40x 1GE R
  CPU            REV 06   710-013713   KB3976            DPC PMB
  PIC 0                   BUILTIN      BUILTIN           10x 1GE(LAN)
    Xcvr 1       REV 01   740-020426   4910549           SFP-1000BASE-BX40-D
    Xcvr 2       REV 01   740-020426   4910551           SFP-1000BASE-BX40-D
    Xcvr 5       REV 01   740-021340   77E245N00006      SFP-1000BASE-BX10-U
    Xcvr 6       REV 01   740-020425   4882821           SFP-1000BASE-BX40-U
    Xcvr 8       REV 01   740-020425   4882820           SFP-1000BASE-BX40-U
  PIC 1                   BUILTIN      BUILTIN           10x 1GE(LAN)
    Xcvr 0       REV 01   740-020465   77E555N00894      SFP-1000BASE-BX10-D
    Xcvr 1       REV 01   740-020465   75E467X00818      SFP-1000BASE-BX10-D
    Xcvr 2       REV 01   740-020465   75E467X00573      SFP-1000BASE-BX10-D
    Xcvr 3       REV 01   740-020465   4888227           SFP-1000BASE-BX10-D
    Xcvr 4       REV 01   740-020465   4888241           SFP-1000BASE-BX10-D
    Xcvr 5       REV 01   740-021340   77E245N00005      SFP-1000BASE-BX10-U
    Xcvr 6       REV 01   740-021340   76E245X00487      SFP-1000BASE-BX10-U
    Xcvr 7       REV 01   740-021341   5255889           SFP-1000BASE-BX10-U
    Xcvr 8       REV 01   740-021341   5255887           SFP-1000BASE-BX10-U
    Xcvr 9       REV 01   740-021340   77E245N00004      SFP-1000BASE-BX10-U
  PIC 2                   BUILTIN      BUILTIN           10x 1GE(LAN)
    Xcvr 0       REV 01   740-020424   5007582           SFP-1000BASE-BX10-D
    Xcvr 1       REV 01   740-020424   4888187           SFP-1000BASE-BX10-D
    Xcvr 2       REV 01   740-020424   4656500           SFP-1000BASE-BX10-D
    Xcvr 5       REV 01   740-021341   5255886           SFP-1000BASE-BX10-U
    Xcvr 7       REV 01   740-021340   77E245N00003      SFP-1000BASE-BX10-U
    Xcvr 8       REV 01   740-021341   5255888           SFP-1000BASE-BX10-U
  PIC 3                   BUILTIN      BUILTIN           10x 1GE(LAN)
    Xcvr 0       REV 01   740-017726   74S184H30341      SFP-EX
    Xcvr 1       REV 01   740-017726   4814061           SFP-EX
    Xcvr 5       REV 01   740-017726   6ZS184H31108      SFP-EX
    Xcvr 9       REV 01   740-021340   76E245X00486      SFP-1000BASE-BX10-U
Fan Tray 0
Fan Tray 1       REV 03   740-014971   TP0850            Fan Tray
```

show chassis hardware (MX960 Router with Enhanced MX SCB)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN1096805AFA      MX960
Midplane         REV 03   710-013698   TR0183            MX960 Backplane
Fan Extender     REV 02   710-018051   JY5227            Extended Cable Manager
FPM Board        REV 03   710-014974   JZ6876            Front Panel Display
PDM             Rev 03   740-013110   QCS11035023       Power Distribution Module
PEM 1            Rev 03   740-013682   QCS1109400L       PS 1.7kW; 200-240VAC in
PEM 2            Rev 03   740-013682   QCS11094015       PS 1.7kW; 200-240VAC in
PEM 3            Rev 03   740-013682   QCS11094012       PS 1.7kW; 200-240VAC in
Routing Engine 0 REV 06   740-013063   1000687969        RE-S-2000
Routing Engine 1 REV 06   740-013063   1000687955        RE-S-2000
CB 0             REV 11   750-031391   YZ6072            Enhanced MX SCB
CB 1             REV 11   750-031391   YZ6068            Enhanced MX SCB
CB 2             REV 11   750-031391   YZ6081            Enhanced MX SCB
FPC 0            REV 01   750-018122   KA5576            DPCE 40x 1GE R
  CPU            REV 06   710-013713   KB3961            DPC PMB
  PIC 0                   BUILTIN      BUILTIN           10x 1GE(LAN)
    Xcvr 0       REV 01   740-011613   P9F18GF           SFP-SX
```



```
    Xcvr 2       REV 01   740-011782   P9M0TL9            SFP-SX
    Xcvr 7       REV 01   740-011782   P9P0XXH            SFP-SX
    Xcvr 9       REV 01   740-011782   P9M0TN1            SFP-SX
  PIC 1                   BUILTIN      BUILTIN            10x 1GE(LAN)
    Xcvr 0       REV 01   740-011613   PAJ4UHC            SFP-SX
  PIC 2                   BUILTIN      BUILTIN            10x 1GE(LAN)
    Xcvr 0       REV 01   740-011613   PFF2CD0            SFP-SX
    Xcvr 1       REV 01   740-011613   PBG3ZUT            SFP-SX
    Xcvr 2       REV 01   740-011613   PFF2DDV            SFP-SX
    Xcvr 5       REV 01   740-011613   P8E2SST            SFP-SX
    Xcvr 9       REV 01   740-011782   PB8329N            SFP-SX
  PIC 3                   BUILTIN      BUILTIN            10x 1GE(LAN)
    Xcvr 0       REV 01   740-026192   1U0201084503342    SFP-100BASE-BX10-U
    Xcvr 1       REV 01   740-026193   1U1201084503313    SFP-100BASE-BX10-D
    Xcvr 2       REV 01   740-011613   PAJ4Y5B            SFP-SX
    Xcvr 6       REV 01   740-011782   P9M0U3M            SFP-SX
    Xcvr 7       REV 01   740-011782   P9M0TLA            SFP-SX
FPC 1            REV 16   750-031089   YL0719             MPC Type 2 3D
  CPU            REV 06   711-030884   YL1463             MPC PMB 2G
  MIC 0          REV 07   750-028387   JR6500             3D 4x 10GE  XFP
    PIC 0                 BUILTIN      BUILTIN            2x 10GE  XFP
      Xcvr 0     REV 01   740-014279   733019A00154       XFP-10G-LR
      Xcvr 1     REV 02   740-014289   T09F55034          XFP-10G-SR
    PIC 1                 BUILTIN      BUILTIN            2x 10GE  XFP
      Xcvr 0     REV 01   740-014279   913019B00791       XFP-10G-LR
      Xcvr 1     REV 01   740-014289   98S803A90384       XFP-10G-SR
  MIC 1          REV 24   750-028387   YJ3950             3D 4x 10GE  XFP
    PIC 2                 BUILTIN      BUILTIN            2x 10GE  XFP
      Xcvr 0     REV 02   740-014279   T10B36134          XFP-10G-LR
      Xcvr 1     REV 01   740-014289   T07M86354          XFP-10G-SR
    PIC 3                 BUILTIN      BUILTIN            2x 10GE  XFP
FPC 2            REV 08   710-014219   JY9654             DPCE 4x 10GE R
  CPU            REV 06   710-013713   JZ6549             DPC PMB
  PIC 0                   BUILTIN      BUILTIN            1x 10GE(LAN/WAN)
  PIC 1                   BUILTIN      BUILTIN            1x 10GE(LAN/WAN)
  PIC 2                   BUILTIN      BUILTIN            1x 10GE(LAN/WAN)
    Xcvr 0       REV 03   740-011571   C931BK028          XFP-10G-SR
  PIC 3                   BUILTIN      BUILTIN            1x 10GE(LAN/WAN)
FPC 3            REV 10   750-024199   XJ6692             MX FPC Type 3
  CPU            REV 03   710-022351   XF5182             DPC PMB
  PIC 0          REV 17   750-009553   RJ2945             4x OC-48 SONET
    Xcvr 1       REV 01   740-011785   PCP3YLL            SFP-SR
    Xcvr 3       REV 01   740-011785   PDS0MRY            SFP-SR
  PIC 1          REV 32   750-003700   DP2113             1x OC-192 12xMM VSR
FPC 5            REV 25   750-028467   YM8256             MPC 3D 16x 10GE
  CPU            REV 10   711-029089   YL3029             AMPC PMB
  PIC 0                   BUILTIN      BUILTIN            4x 10GE(LAN) SFP+
    Xcvr 1       REV 01   740-031980   AHN0X1Z            SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN            4x 10GE(LAN) SFP+
  PIC 2                   BUILTIN      BUILTIN            4x 10GE(LAN) SFP+
  PIC 3                   BUILTIN      BUILTIN            4x 10GE(LAN) SFP+
FPC 7            REV 02   750-031092   JR6658             MPC Type 1 3D Q
  CPU            REV 01   711-030884   JZ9038             MPC PMB 2G
  MIC 0          REV 08   750-028392   JZ8737             3D 20x 1GE(LAN) SFP
    PIC 0                 BUILTIN      BUILTIN            10x 1GE(LAN) SFP
      Xcvr 0     REV 01   740-011782   PBE2C6Y            SFP-SX
      Xcvr 2              NON-JNPR     U8105N8            SFP-SX
      Xcvr 4     REV 01   740-011613   PFM18EF            SFP-SX
      Xcvr 7     REV 01   740-011613   PFF2AM8            SFP-SX
      Xcvr 8     REV 01   740-011613   PFF2CT6            SFP-SX
    PIC 1                 BUILTIN      BUILTIN            10x 1GE(LAN) SFP
```



```
      Xcvr 0      REV 01   740-011782   PB82VHH          SFP-SX
      Xcvr 1      REV 01   740-011613   PFF2CSW          SFP-SX
      Xcvr 9      REV 01   740-011613   PFF2BY0          SFP-SX
  QXM 0           REV 04   711-028408   JR6372           MPC QXM
FPC 8             REV 05   750-024387   JW9754           MX FPC Type 2
  CPU             REV 03   710-022351   KF1651           DPC PMB
  PIC 0           REV 08   750-014730   DM3664           4x OC-3 1x OC-12 SFP
    Xcvr 0        REV 01   740-016065   81S290N00077     SFP-SR
    Xcvr 1                 NON-JNPR     2191844          SFP-SR
    Xcvr 2        REV 01   740-011618   PD81EE5          SFP-IR
  PIC 1           REV 08   750-014637   DM3671           4x OC-12-3 SFP
    Xcvr 0        REV 01   740-011785   PCK3UNK          SFP-SR
    Xcvr 3        REV 01   740-011785   PDSOMPZ          SFP-SR
FPC 10            REV 04   710-013699   JY4654           DPCE 40x 1GE R
  CPU             REV 05   710-013713   JS9717           DPC PMB
  PIC 0                    BUILTIN      BUILTIN          10x 1GE(LAN)
    Xcvr 5        REV 01   740-011782   PAR1L72          SFP-SX
    Xcvr 6        REV 01   740-011782   P8N1YQ4          SFP-SX
  PIC 1                    BUILTIN      BUILTIN          10x 1GE(LAN)
  PIC 2                    BUILTIN      BUILTIN          10x 1GE(LAN)
    Xcvr 0        REV 01   740-011782   P8Q2AVL          SFP-SX
    Xcvr 5        REV 01   740-011782   PAR1L7B          SFP-SX
    Xcvr 6        REV 01   740-011782   PAR1L2J          SFP-SX
    Xcvr 8        REV 01   740-011782   P8N1YMY          SFP-SX
  PIC 3                    BUILTIN      BUILTIN          10x 1GE(LAN)
Fan Tray 0        REV 03   740-014971   TP0567           Fan Tray
Fan Tray 1        REV 03   740-014971   TP0702           Fan Tray
```

show chassis hardware models (MX960 Router with Enhanced MX SCB)

```
user@host> show chassis hardware models
Hardware inventory:
Item              Version  Part number  Serial number    FRU model number
Midplane          REV 03   710-013698   TR0183           CHAS-BP-MX960-S
Fan Extender      REV 02   710-018051   JY5227           ECM-MX960
FPM Board         REV 03   710-014974   JZ6876           CRAFT-MX960-S
Routing Engine 0  REV 06   740-013063   1000687969       RE-S-2000-4096-S
Routing Engine 1  REV 06   740-013063   1000687955       RE-S-2000-4096-S
CB 0              REV 11   750-031391   YZ6072           SCBE-MX-S
CB 1              REV 11   750-031391   YZ6068           SCBE-MX-S
CB 2              REV 11   750-031391   YZ6081           SCBE-MX-S
FPC 0             REV 01   750-018122   KA5576           DPCE-R-40GE-SFP
FPC 1             REV 16   750-031089   YL0719           MX-MPC2-3D
  MIC 0           REV 07   750-028387   JR6500           MIC-3D-4XGE-XFP
  MIC 1           REV 24   750-028387   YJ3950           MIC-3D-4XGE-XFP
FPC 2             REV 08   710-014219   JY9654           DPC-R-4XGE-XFP
FPC 3             REV 10   750-024199   XJ6692           MX-FPC3
  PIC 0           REV 17   750-009553   RJ2945           PC-4OC48-SON-SFP
  PIC 1           REV 32   750-003700   DP2113           PC-1OC192-SON-VSR
FPC 5             REV 25   750-028467   YM8256           MPC-3D-16XGE-SFPP
FPC 7             REV 02   750-031092   JR6658           MX-MPC1-3D-Q
  MIC 0           REV 08   750-028392   JZ8737           MIC-3D-20GE-SFP
FPC 8             REV 05   750-024387   JW9754           MX-FPC2
  PIC 0           REV 08   750-014730   DM3664           PB-4OC3-1OC12-SON2-SFP
  PIC 1           REV 08   750-014637   DM3671           PB-4OC3-4OC12-SON-SFP
FPC 10            REV 04   710-013699   JY4654           DPC-R-40GE-SFP
Fan Tray 0        REV 03   740-014971   TP0567           FFANTRAY-MX960-S
Fan Tray 1        REV 03   740-014971   TP0702           FFANTRAY-MX960-S
```


show chassis hardware detail (MX960 Router)

```
user@host> show chassis hardware detail
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                                  MX960
Midplane         REV 01   710-013698   AA6082            MX960 Midplane
PIM              Rev 01   740-013110   000008            Power Inlet Module
PEM 2
PEM 3            Rev 01   740-013682   000038            PS 1.7kW; 200-240VAC in
Routing Engine 0 REV 00   740-015113   1000617944        RE-S-1300
  ad0      245 MB  SanDisk SDCFB-256   111419E1805T1141  Compact Flash
  ad2    38154 MB  FUJITSU MHT2040BH   NR0WT5925N77      Hard Disk
CB 0             REV 05   710-013725   JK6947            MX960 Test SCB
FPC 4            REV 01   710-013305   JM7617            MX960 Test DPC
  CPU
  PIC 0                   BUILTIN      BUILTIN           1x 10GE(LAN/WAN)
  PIC 1                   BUILTIN      BUILTIN           10x 1GE
FPC 7            REV 01   710-013305   JL9634            MX960 Test DPC
  CPU
  PIC 0                   BUILTIN      BUILTIN           1x 10GE(LAN/WAN)
    Xcvr 0                NON-JNPR     MYBG65I82C        XFP-10G-SR
  PIC 1                   BUILTIN      BUILTIN           10x 1GE
    Xcvr 1       REV 01   740-011782   P7N0368           SFP-SX
    Xcvr 4       REV 01   740-011782   P8J1W27           SFP-SX
    Xcvr 6       REV 01   740-011782   P8J1VSD           SFP-SX
    Xcvr 9       REV 01   740-011782   P8J1W25           SFP-SX
Fan Tray 0
Fan Tray 1
```

show chassis hardware (MX2010 Router)

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user@host > show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11E3217AFK      MX2010
Midplane         REV 01   750-044636   ABAB8506          Lower Backplane
Midplane 1       REV 01   711-044557   ZY8296            Upper Backplane
PMP              REV 03   711-032426   ACAJ1388          Power Midplane
FPM Board        REV 06   711-032349   ZX8744            Front Panel Display
PSM 4            REV 0C   740-033727   VK00254           DC 52V Power Supply
Module
PSM 5            REV 0B   740-033727   VG00015           DC 52V Power Supply
Module
PSM 6            REV 0B   740-033727   VH00097           DC 52V Power Supply
Module
PSM 7            REV 0C   740-033727   VJ00151           DC 52V Power Supply
Module
PSM 8            REV 0C   740-033727   VJ00149           DC 52V Power Supply
Module
PDM 0            REV 0B   740-038109   WA00008           DC Power Dist Module
PDM 1            REV 0B   740-038109   WA00014           DC Power Dist Module
Routing Engine 0 REV 02   740-041821   9009094134        RE-S-1800x4
Routing Engine 1 REV 02   740-041821   9009094141        RE-S-1800x4
CB 0             REV 08   750-040257   CAAB3491          Control Board
CB 1             REV 08   750-040257   CAAB3489          Control Board
SPMB 0           REV 02   711-041855   CAAA6135          PMB Board
SPMB 1           REV 02   711-041855   CAAA6137          PMB Board
SFB 0            REV 06   711-032385   ZV1828            Switch Fabric Board
SFB 1            REV 07   711-032385   ZZ2568            Switch Fabric Board
SFB 2            REV 07   711-032385   ZZ2563            Switch Fabric Board
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SFB 3            REV 07   711-032385   ZZ2564          Switch Fabric Board
SFB 4            REV 07   711-032385   ZZ2580          Switch Fabric Board
SFB 5            REV 07   711-032385   ZZ2579          Switch Fabric Board
SFB 6            REV 07   711-032385   CAAB4882        Switch Fabric Board
SFB 7            REV 07   711-032385   CAAB4898        Switch Fabric Board
FPC 0            REV 33   750-028467   CAAB1919        MPC 3D 16x 10GE
  CPU            REV 11   711-029089   CAAB7174        AMPC PMB
  PIC 0                   BUILTIN      BUILTIN         4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   AMH02RE         SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   AMH038C         SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   AMH0390         SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   AMG0SUA         SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN         4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   AMH0579         SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   AMG0SGP         SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   AMH04SV         SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   AMH04X3         SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN         4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   AMH0135         SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   AMH02NC         SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   AMH02XB         SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   AMH02PN         SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN         4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   AMH057Y         SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   AMG0JHE         SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   AMH02HT         SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   AMH04V4         SFP+-10G-SR
FPC 1            REV 21   750-033205   ZG5027          MPC Type 3
  CPU            REV 04   711-035209   YT4780          HMPC PMB 2G
  MIC 0          REV 03   750-033307   ZV6299          10X10GE SFPP
    PIC 0                 BUILTIN      BUILTIN         10X10GE SFPP
      Xcvr 0     REV 01   740-031980   083363A00410    SFP+-10G-SR
      Xcvr 1     REV 01   740-031980   083363A00334    SFP+-10G-SR
      Xcvr 2     REV 01   740-031980   113363A00125    SFP+-10G-SR
      Xcvr 3     REV 01   740-031980   083363A00953    SFP+-10G-SR
      Xcvr 4     REV 01   740-031980   AHR013D         SFP+-10G-SR
      Xcvr 5     REV 01   740-031980   AJ40JUR         SFP+-10G-SR
      Xcvr 6     REV 01   740-031980   AJ40JKL         SFP+-10G-SR
      Xcvr 7     REV 01   740-031980   AJ30ECK         SFP+-10G-SR
      Xcvr 8     REV 01   740-021308   19T511100864    SFP+-10G-SR
      Xcvr 9     REV 01   740-021308   19T511100868    SFP+-10G-SR
  MIC 1          REV 03   750-033307   ZV6268          10X10GE SFPP
    PIC 2                 BUILTIN      BUILTIN         10X10GE SFPP
      Xcvr 0     REV 01   740-031980   AJC0JML         SFP+-10G-SR
      Xcvr 1     REV 01   740-031980   AJ403PC         SFP+-10G-SR
      Xcvr 2     REV 01   740-031980   AJ10N25         SFP+-10G-SR
      Xcvr 3     REV 01   740-031980   AJ40JF4         SFP+-10G-SR
      Xcvr 4     REV 01   740-031980   AJ40JSJ         SFP+-10G-SR
      Xcvr 5     REV 01   740-031980   AJ403V7         SFP+-10G-SR
      Xcvr 6     REV 01   740-031980   AJ40JN3         SFP+-10G-SR
      Xcvr 7     REV 01   740-031980   AJ40JSU         SFP+-10G-SR
      Xcvr 8     REV 01   740-021308   19T511100468    SFP+-10G-SR
      Xcvr 9     REV 01   740-021308   19T511101363    SFP+-10G-SR
FPC 8            REV 22   750-031089   ZT9746          MPC Type 2 3D
  CPU            REV 06   711-030884   ZS1271          MPC PMB 2G
  MIC 0          REV 26   750-028392   ABBS1150        3D 20x 1GE(LAN) SFP
    PIC 0                 BUILTIN      BUILTIN         10x 1GE(LAN) SFP
      Xcvr 0     REV 01   740-031851   PLG023C         SFP-SX
      Xcvr 1     REV 01   740-031851   PLG09C6         SFP-SX
      Xcvr 2     REV 02   740-011613   AM0950SF9L7     SFP-SX
      Xcvr 3     REV 02   740-011613   AM1001SFN1H     SFP-SX
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          Xcvr 4     REV 02   740-011613   AM1001SFM9D      SFP-SX
          Xcvr 5     REV 02   740-011613   AM1001SFLTJ      SFP-SX
          Xcvr 6     REV 01   740-031851   AC1108S03L9      SFP-SX
          Xcvr 7     REV 01   740-031851   AC1102S00NC      SFP-SX
          Xcvr 8     REV 01   740-031851   AC1102S00MX      SFP-SX
          Xcvr 9     REV 01   740-031851   AC1102S0085      SFP-SX
        PIC 1                 BUILTIN      BUILTIN          10x 1GE(LAN) SFP
          Xcvr 0     REV 01   740-031851   AC1102S00KU      SFP-SX
          Xcvr 1     REV 01   740-031851   AC1102S00NG      SFP-SX
          Xcvr 2     REV 01   740-031851   AC1102S00K3      SFP-SX
          Xcvr 3     REV 01   740-031851   AC1102S008R      SFP-SX
          Xcvr 4     REV 01   740-031851   AM1107SUFVJ      SFP-SX
          Xcvr 5     REV 01   740-031851   AC1108S03LG      SFP-SX
      MIC 1          REV 26   750-028387   ABBR9582         3D 4x 10GE  XFP
        PIC 2                 BUILTIN      BUILTIN          2x 10GE  XFP
          Xcvr 0              NON-JNPR     T10A91703        XFP-10G-SR
          Xcvr 1              NON-JNPR     T09L42604        XFP-10G-SR
        PIC 3                 BUILTIN      BUILTIN          2x 10GE  XFP
    FPC 9            REV 11   750-036284   ZL3591           MPC 3D 16x 10GE EM
      CPU            REV 10   711-029089   ZL0513           AMPC PMB
      PIC 0                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
        Xcvr 0       REV 01   740-031980   1YT517101825     SFP+-10G-SR
        Xcvr 1       REV 01   740-031980   1YT517101821     SFP+-10G-SR
        Xcvr 2       REV 01   740-031980   1YT517101682     SFP+-10G-SR
        Xcvr 3       REV 01   740-031980   ALQ13R6          SFP+-10G-SR
      PIC 1                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
        Xcvr 0       REV 01   740-031980   1YT517101828     SFP+-10G-SR
        Xcvr 1       REV 01   740-031980   1YT517101716     SFP+-10G-SR
        Xcvr 2       REV 01   740-031980   1YT517101732     SFP+-10G-SR
        Xcvr 3       REV 01   740-031980   ALP0TR1          SFP+-10G-SR
      PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
        Xcvr 0       REV 01   740-031980   1YT517101741     SFP+-10G-SR
        Xcvr 1       REV 01   740-031980   1YT517101829     SFP+-10G-SR
        Xcvr 2       REV 01   740-031980   1YT517101669     SFP+-10G-SR
        Xcvr 3       REV 01   740-031980   ALQ14E3          SFP+-10G-SR
      PIC 3                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
        Xcvr 0       REV 01   740-031980   1YT517101826     SFP+-10G-SR
        Xcvr 1       REV 01   740-031980   1YT517101817     SFP+-10G-SR
        Xcvr 2       REV 01   740-031980   1YT517101735     SFP+-10G-SR
        Xcvr 3       REV 01   740-031980   ALQ159A          SFP+-10G-SR
    ADC 0            REV 05   750-043596   CAAC2073         Adapter Card
    ADC 1            REV 01   750-043596   ZV4117           Adapter Card
    ADC 8            REV 01   750-043596   ZV4107           Adapter Card
    ADC 9            REV 02   750-043596   ZW1555           Adapter Card
    Fan Tray 0       REV 2A   760-046960   ACAY0015         172mm FanTray - 6 Fans
    Fan Tray 1       REV 2A   760-046960   ACAY0019         172mm FanTray - 6 Fans
    Fan Tray 2       REV 2A   760-046960   ACAY0020         172mm FanTray - 6 Fans
    Fan Tray 3       REV 2A   760-046960   ACAY0021         172mm FanTray - 6 Fans
```

show chassis hardware detail (MX2010 Router)

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user@host > show chassis hardware detail
Hardware inventory:
Item             Version  Part number  Serial number    Description
Chassis                                JN11E233DAFK     MX2010
Midplane         REV 26   750-044636   ABAB9357         Lower Backplane
Midplane 1       REV 01   711-044557   ABAB8643         Upper Backplane
PMP              REV 04   711-032426   ACAJ1677         Power Midplane
FPM Board        REV 08   760-044634   ABBV9726         Front Panel Display
PSM 0            REV 01   740-045050   1E02224000P      DC 52V Power Supply
Module
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PSM 1            REV 01   740-045050   1E02224000M       DC 52V Power Supply
Module
PSM 2            REV 01   740-045050   1E022240010       DC 52V Power Supply
Module
PSM 3            REV 01   740-045050   1E02224000G       DC 52V Power Supply
Module
PSM 4            REV 01   740-045050   1E022240013       DC 52V Power Supply
Module
PSM 5            REV 01   740-045050   1E022240007       DC 52V Power Supply
Module
PSM 6            REV 01   740-045050   1E02224001C       DC 52V Power Supply
Module
PSM 7            REV 01   740-045050   1E02224001D       DC 52V Power Supply
Module
PSM 8            REV 01   740-045050   1E02224001B       DC 52V Power Supply
Module
PDM 0            REV 01   740-045234   1E262250067       DC Power Dist Module
Routing Engine 0 REV 02   740-041821   9009099704        RE-S-1800x4
  ad0    3831 MB  UGB30SFA4000T1       SFA4000T1 00000651 Compact Flash
  ad1   30533 MB  UGB94BPH32H0S1-KCI   11000019592       Disk 1
  usb0 (addr 1)  EHCI root hub 0       Intel             uhub0
  usb0 (addr 2)  product 0x0020 32     vendor 0x8087     uhub1
  DIMM 0         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
  DIMM 1         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
  DIMM 2         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
  DIMM 3         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
Routing Engine 1 REV 02   740-041821   9009099706        RE-S-1800x4
  ad0    3998 MB  Virtium - TuffDrive VCF P1T0200262860208 114 Compact Flash
  ad1   30533 MB  UGB94ARF32H0S3-KC    UNIGEN-499551-000404 Disk 1
CB 0             REV 13   750-040257   CAAF8436          Control Board
CB 1             REV 13   750-040257   CAAF8434          Control Board
SPMB 0           REV 02   711-041855   ABBV3825          PMB Board
SPMB 1           REV 02   711-041855   ABBV3833          PMB Board
SFB 0            REV 05   711-044466   ABBX5682          Switch Fabric Board
SFB 1            REV 05   711-044466   ABBX5676          Switch Fabric Board
SFB 2            REV 05   711-044466   ABBX5665          Switch Fabric Board
SFB 3            REV 05   711-044466   ABBX5699          Switch Fabric Board
SFB 4            REV 05   711-044466   ABBX5603          Switch Fabric Board
SFB 5            REV 05   711-044466   ABBX5587          Switch Fabric Board
SFB 6            REV 05   711-044466   ABBX5607          Switch Fabric Board
SFB 7            REV 05   711-044466   ABBX5669          Switch Fabric Board
FPC 0            REV 09   750-037355   CAAF0924          MPC Type 4-2
  CPU            REV 08   711-035209   CAAB9842          HMPC PMB 2G
  PIC 0                   BUILTIN      BUILTIN           4x10GE SFPP
    Xcvr 0       REV 01   740-021308   19T511101656      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AMA04RU           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   193363A00558      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B10M00202         SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           1X100GE CFP
    Xcvr 0                NON-JNPR     X12J00328         CFP-100G-SR10
  PIC 2                   BUILTIN      BUILTIN           4x10GE SFPP
    Xcvr 0       REV 01   740-031980   AMA088W           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B10L04211         SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   19T511101602      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B10L04151         SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           1X100GE CFP
Xcvr 0                NON-JNPR     X12J00332         CFP-100G-SR10
FPC 1            REV 18   750-033205   ZE0128            MPC Type 3
  CPU            REV 06   711-035209   ZG5431            HMPC PMB 2G
  MIC 0          REV 15   750-033199   ZP6435            1X100GE CFP
    PIC 0                 BUILTIN      BUILTIN           1X100GE CFP
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      Xcvr 0     REV 01   740-032210   J11E46118        CFP-100G-LR4
  MIC 1          REV 15   750-033199   ZP6442           1X100GE CFP
    PIC 2                 BUILTIN      BUILTIN          1X100GE CFP
      Xcvr 0     REV 01   740-032210   UMN03T4          CFP-100G-LR4
FPC 2            REV 16   750-037358   CAAL1001         MPC Type 4-1
  CPU            REV 08   711-035209   CAAK7927         HMPC PMB 2G
  PIC 0                   BUILTIN      BUILTIN          8X10GE SFPP
    Xcvr 0       REV 01   740-031980   193363A00589     SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   973152A00028     SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   193363A00376     SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   973152A00016     SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   193363A00499     SFP+-10G-SR
    Xcvr 5       REV 01   740-021308   973152A00039     SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   B11E01239        SFP+-10G-SR
    Xcvr 7       REV 01   740-021308   973152A00058     SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN          8X10GE SFPP
    Xcvr 0       REV 01   740-031980   B10M00075        SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   973152A00014     SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AMA0638          SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   973152A00063     SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   AMA0629          SFP+-10G-SR
    Xcvr 5       REV 01   740-021308   973152A00053     SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   193363A00344     SFP+-10G-SR
    Xcvr 7       REV 01   740-021308   973152A00046     SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN          8X10GE SFPP
    Xcvr 0       REV 01   740-031980   AMA062M          SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   973152A00080     SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   193363A00580     SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   973152A00064     SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   093363A01494     SFP+-10G-SR
    Xcvr 5       REV 01   740-021308   973152A00020     SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   123363A00047     SFP+-10G-SR
    Xcvr 7       REV 01   740-021308   973152A00072     SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN          8X10GE SFPP
    Xcvr 0       REV 01   740-021308   03DZ06A01033     SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   973152A00022     SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   03DZ06A01026     SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   973152A00013     SFP+-10G-SR
    Xcvr 4       REV 01   740-021308   03DZ06A01028     SFP+-10G-SR
    Xcvr 5       REV 01   740-021308   973152A00079     SFP+-10G-SR
    Xcvr 6       REV 01   740-021308   03DZ06A01018     SFP+-10G-SR
    Xcvr 7       REV 01   740-021308   973152A00025     SFP+-10G-SR
FPC 3            REV 33   750-028467   CAAF5400         MPC 3D 16x 10GE
  CPU            REV 11   711-029089   CAAH7626         AMPC PMB
  PIC 0                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   973152A00066     SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   973152A00021     SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   973152A00062     SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   973152A00027     SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   973152A00065     SFP+-10G-SR
 Xcvr 1       REV 01   740-021308   973152A00069     SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   973152A00026     SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   973152A00003     SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   973152A00035     SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   973152A00004     SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   973152A00049     SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   973152A00055     SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   973152A00010     SFP+-10G-SR
```



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    Xcvr 1       REV 01   740-021308   973152A00001      SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   973152A00073      SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   973152A00012      SFP+-10G-SR
FPC 4            REV 21   750-033205   ZG5028            MPC Type 3
  CPU            REV 05   711-035209   YX3911            HMPC PMB 2G
  MIC 0          REV 03   750-036233   ZL2036            2X40GE QSFP
    PIC 0                 BUILTIN      BUILTIN           2X40GE QSFP
      Xcvr 0     REV 01   740-032986   QB220708          QSFP+-40G-SR4
      Xcvr 1     REV 01   740-032986   QB220735          QSFP+-40G-SR4
  MIC 1          REV 03   750-036233   ZL2028            2X40GE QSFP
    PIC 2                 BUILTIN      BUILTIN           2X40GE QSFP
      Xcvr 0     REV 01   740-032986   QB220727          QSFP+-40G-SR4
      Xcvr 1     REV 01   740-032986   QB220715          QSFP+-40G-SR4
FPC 5            REV 11   750-037358   CAAE2196          MPC Type 4-1
  CPU            REV 08   711-035209   CAAD9074          HMPC PMB 2G
  PIC 0                   BUILTIN      BUILTIN           8X10GE SFPP
    Xcvr 0       REV 01   740-031980   AMA062S           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AMA062P           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AMA052R           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AMA0632           SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   193363A00564      SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   193363A00229      SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   193363A00363      SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   193363A00278      SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           8X10GE SFPP
    Xcvr 0       REV 01   740-031980   AMA04CC           SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   AD0927A001W       SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AMA04N2           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AMA062U           SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   193363A00491      SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   183363A01511      SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   193363A00565      SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   193363A00405      SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN           8X10GE SFPP
    Xcvr 0       REV 01   740-031980   AMA07QX           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AMA06MS           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   193363A00318      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   193363A00402      SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   193363A00174      SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   193363A00388      SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   193363A00377      SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   193363A00234      SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           8X10GE SFPP
    Xcvr 0       REV 01   740-031980   AMA062T           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   193363A00550      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   193363A00364      SFP+-10G-SR
Xcvr 3       REV 01   740-031980   AMA0630           SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   193363A00509      SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   193363A00459      SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   113363A00191      SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   193363A00352      SFP+-10G-SR
FPC 6            REV 33   750-028467   CAAF5552          MPC 3D 16x 10GE
  CPU            REV 11   711-029089   CAAH7601          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   AD0927A0036       SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   AD0927A003M       SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   AD0927A003G       SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   AD0927A0031       SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   193363A00331      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   193363A00325      SFP+-10G-SR
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    Xcvr 2       REV 01   740-031980   193363A00417     SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   183363A02509     SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   T09K75140        SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11A04356        SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K01952        SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11K01914        SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   T09K75157        SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   T09K75194        SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K01926        SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11K01936        SFP+-10G-SR
FPC 7            REV 16   750-037358   CAAL1012         MPC Type 4-1
  CPU            REV 08   711-035209   CAAJ3851         HMPC PMB 2G
  PIC 0                   BUILTIN      BUILTIN          8X10GE SFPP
    Xcvr 0       REV 01   740-031980   AMA04NK          SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11F00260        SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11E02192        SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AMA04CP          SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   AJ40JKK          SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   B11F00238        SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   B10M00275        SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   193363A00211     SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN          8X10GE SFPP
    Xcvr 0       REV 01   740-031980   B11D05577        SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11G00586        SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AMA08B7          SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AMA04Q0          SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   B11D05840        SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   B11E00467        SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   B11E00029        SFP+-10G-SR
    Xcvr 7       REV 01   740-021308   19T511101712     SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN          8X10GE SFPP
    Xcvr 0       REV 01   740-031980   193363A00568     SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B10M00166        SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B10M00212        SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11D05823        SFP+-10G-SR
    Xcvr 4       REV 01   740-021308   03DZ06A01005     SFP+-10G-SR
    Xcvr 5       REV 01   740-021308   03DZ06A01003     SFP+-10G-SR
    Xcvr 6       REV 01   740-021308   03DZ06A01009     SFP+-10G-SR
    Xcvr 7       REV 01   740-021308   03DZ06A01004     SFP+-10G-SR
PIC 3                   BUILTIN      BUILTIN          8X10GE SFPP
    Xcvr 0       REV 01   740-021308   03DZ06A01017     SFP+-10G-SR
    Xcvr 1       REV 01   740-021308   03DZ06A01016     SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   03DZ06A01024     SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   03DZ06A01008     SFP+-10G-SR
    Xcvr 4       REV 01   740-030658   AD0946A02UH      SFP+-10G-USR
    Xcvr 5       REV 01   740-021308   T09J67913        SFP+-10G-SR
    Xcvr 6       REV 01   740-021308   AD0837ES09G      SFP+-10G-SR
    Xcvr 7       REV 01   740-021308   03DZ06A01015     SFP+-10G-SR
FPC 8            REV 03   750-045372   CAAD3111         MPC Type 3
  CPU            REV 08   711-035209   CAAD8033         HMPC PMB 2G
  MIC 0          REV 03   750-036233   ZL2032           2X40GE QSFP
    PIC 0                 BUILTIN      BUILTIN          2X40GE QSFP
      Xcvr 0     REV 01   740-032986   QB230273         QSFP+-40G-SR4
      Xcvr 1     REV 01   740-032986   QB230254         QSFP+-40G-SR4
  MIC 1          REV 03   750-036233   ZL2021           2X40GE QSFP
    PIC 2                 BUILTIN      BUILTIN          2X40GE QSFP
      Xcvr 0     REV 01   740-032986   QB390962         QSFP+-40G-SR4
      Xcvr 1     REV 01   740-032986   QB390960         QSFP+-40G-SR4
FPC 9            REV 09   750-037355   CAAF1531         MPC Type 4-2
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  CPU            REV 08   711-035209   CAAB9927         HMPC PMB 2G
  PIC 0                   BUILTIN      BUILTIN          4x10GE SFPP
    Xcvr 0       REV 01   740-031980   193363A00525     SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   193363A00504     SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   193363A00368     SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AJ40JSS          SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN          1X100GE CFP
  PIC 2                   BUILTIN      BUILTIN          4x10GE SFPP
    Xcvr 0       REV 01   740-031980   123363A00042     SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B10M00023        SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AJ802EM          SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11E02348        SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN          1X100GE CFP
ADC 0            REV 13   750-043596   ABBX5532         Adapter Card
ADC 1            REV 13   750-043596   ABBX5550         Adapter Card
ADC 2            REV 13   750-043596   ABBX5571         Adapter Card
ADC 3            REV 13   750-043596   ABBX5568         Adapter Card
ADC 4            REV 13   750-043596   ABBX5556         Adapter Card
ADC 5            REV 13   750-043596   ABBX5553         Adapter Card
ADC 6            REV 13   750-043596   ABBX5541         Adapter Card
ADC 7            REV 13   750-043596   ABBX5578         Adapter Card
ADC 8            REV 13   750-043596   ABBX5560         Adapter Card
ADC 9            REV 07   750-043596   ABBV7188         Adapter Card
Fan Tray 0       REV 03   760-046960   ACAY0127         172mm FanTray - 6 Fans
Fan Tray 1       REV 2A   760-046960   ACAY0068         172mm FanTray - 6 Fans
Fan Tray 2       REV 2A   760-046960   ACAY0072         172mm FanTray - 6 Fans
Fan Tray 3       REV 2A   760-046960   ACAY0070         172mm FanTray - 6 Fans
```

show chassis hardware extensive (MX2010 Router)

```
user@host > show chassis hardware extensive
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11E233DAFK      MX2010
 Jedec Code:    0x7fb0            EEPROM Version:    0x02
                                  S/N:               JN11E233DAFK
 Assembly ID:   0x0557            Assembly Version:  00.00
 Date:          00-00-0000        Assembly Flags:    0x00
 ID: MX2010
 Board Information Record:
  Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 05 57 00 00 00 00 00 00 00 00 00 00
  Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x20: 4a 4e 31 31 45 32 33 33 44 41 46 4b 00 00 00 00
  Address 0x30: 00 00 00 ff 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Midplane         REV 26   750-044636   ABAB9357          Lower Backplane
 Jedec Code:    0x7fb0            EEPROM Version:    0x02
 P/N:           750-044636        S/N:               S/N ABAB9357
 Assembly ID:   0x0b66            Assembly Version:  01.26
 Date:          08-28-2012        Assembly Flags:    0x00
 Version:       REV 26            CLEI Code:         PROTOXCLEI
 ID: Lower Backplane              FRU Model Number:  PROTO-ASSEMBLY
 Board Information Record:
  Address 0x00: ad 01 08 00 2c 21 72 70 a0 00 ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 66 01 1a 52 45 56 20 32 36 00 00
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  Address 0x10: 00 00 00 00 37 35 30 2d 30 34 34 36 33 36 00 00
  Address 0x20: 53 2f 4e 20 41 42 41 42 39 33 35 37 00 1c 08 07
  Address 0x30: dc ff ff ff ad 01 08 00 2c 21 72 70 a0 00 ff ff
  Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
  Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff ff
Midplane 1       REV 01   711-044557   ABAB8643          Upper Backplane
 Jedec Code:   0x7fb0           EEPROM Version:    0x01
 P/N:          711-044557       S/N:               S/N ABAB8643
 Assembly ID:  0x0b65           Assembly Version:  01.01
 Date:         07-27-2012       Assembly Flags:    0x00
 Version:      REV 01
 ID: Upper Backplane
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 01 ff 0b 65 01 01 52 45 56 20 30 31 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 34 34 35 35 37 00 00
  Address 0x20: 53 2f 4e 20 41 42 41 42 38 36 34 33 00 1b 07 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff ff
  Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
PMP              REV 04   711-032426   ACAJ1677          Power Midplane
Jedec Code:   0x7fb0           EEPROM Version:    0x01
 P/N:          711-032426       S/N:               S/N ACAJ1677
 Assembly ID:  0x045d           Assembly Version:  01.04
 Date:         07-20-2012       Assembly Flags:    0x00
 Version:      REV 04
 ID: Power Midplane
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 01 ff 04 5d 01 04 52 45 56 20 30 34 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 33 32 34 32 36 00 00
  Address 0x20: 53 2f 4e 20 41 43 41 4a 31 36 37 37 00 14 07 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff ff
  Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
FPM Board        REV 08   760-044634   ABBV9726          Front Panel Display
 Jedec Code:   0x7fb0           EEPROM Version:    0x02
 P/N:          760-044634       S/N:               S/N ABBV9726
 Assembly ID:  0x0b64           Assembly Version:  01.08
 Date:         09-10-2012       Assembly Flags:    0x00
 Version:      REV 08           CLEI Code:         IPMYA4EJRA
 ID: Front Panel Display        FRU Model Number:  MX2010-CRAFT-S
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 64 01 08 52 45 56 20 30 38 00 00
  Address 0x10: 00 00 00 00 37 36 30 2d 30 34 34 36 33 34 00 00
  Address 0x20: 53 2f 4e 20 41 42 42 56 39 37 32 36 00 0a 09 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 49 50 4d 59 41 34 45 4a 52 41 4d
  Address 0x50: 58 32 30 31 30 2d 43 52 41 46 54 2d 53 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 00 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 93 ff ff ff ff ff ff ff ff ff ff ff ff
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```
PSM 0           REV 01   740-045050   1E02224000P       DC 52V Power Supply
Module
 Jedec Code:   0x7fb0            EEPROM Version:    0x02
 P/N:          740-045050        S/N:               1E02224000P
 Assembly ID:  0x0478            Assembly Version:  01.01
 Date:         12-06-2012        Assembly Flags:    0x00
 Version:      REV 01            CLEI Code:         XXXXXXXXXX
 ID: DC 52V Power Supply Module  FRU Model Number:  MX2000-PSM-HC-DC-S-A
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 35 30 35 30 00 00
  Address 0x20: 31 45 30 32 32 32 34 30 30 30 50 00 00 06 0c 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 58 58 58 58 58 58 58 58 58 58 4d
  Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 48 43 2d 44 43 2d
  Address 0x60: 53 2d 41 00 00 00 31 30 31 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 4a 00 00 00 00 00 00 00 00 00 00 00 00
PSM 1           REV 01   740-045050   1E02224000M       DC 52V Power Supply
Module
 Jedec Code:   0x7fb0            EEPROM Version:    0x02
 P/N:          740-045050        S/N:               1E02224000M
Assembly ID:  0x0478            Assembly Version:  01.01
 Date:         12-06-2012        Assembly Flags:    0x00
 Version:      REV 01            CLEI Code:         XXXXXXXXXX
 ID: DC 52V Power Supply Module  FRU Model Number:  MX2000-PSM-HC-DC-S-A
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 78 01 01 52 45 56 20 30 31 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 35 30 35 30 00 00
  Address 0x20: 31 45 30 32 32 32 34 30 30 30 4d 00 00 06 0c 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 58 58 58 58 58 58 58 58 58 58 4d
  Address 0x50: 58 32 30 30 30 2d 50 53 4d 2d 48 43 2d 44 43 2d
  Address 0x60: 53 2d 41 00 00 00 31 30 31 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 4a 00 00 00 00 00 00 00 00 00 00 00 00
...
PDM 0           REV 01   740-045234   1E262250067       DC Power Dist Module
 Jedec Code:   0x7fb0            EEPROM Version:    0x02
 P/N:          740-045234        S/N:               1E262250067
 Assembly ID:  0x047b            Assembly Version:  01.01
 Date:         06-28-2012        Assembly Flags:    0x00
 Version:      REV 01            CLEI Code:         IPUPAJSKAA
 ID: DC Power Dist Module        FRU Model Number:  MX2000-PDM-DC-S-A
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 7b 01 01 52 45 56 20 30 31 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 35 32 33 34 00 00
  Address 0x20: 31 45 32 36 32 32 35 30 30 36 37 00 00 1c 06 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 49 50 55 50 41 4a 53 4b 41 41 4d
  Address 0x50: 58 32 30 30 30 2d 50 44 4d 2d 44 43 2d 53 2d 41
  Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 89 00 00 00 00 00 00 00 00 00 00 00 00
Routing Engine 0 REV 02   740-041821   9009099704        RE-S-1800x4
 Jedec Code:   0x7fb0            EEPROM Version:    0x02
 P/N:          740-041821        S/N:               9009099704
 Assembly ID:  0x09c0            Assembly Version:  01.02
```

```
 Date:         03-15-2012        Assembly Flags:    0x00
 Version:      REV 02
 ID: RE-S-1800x4                 FRU Model Number:  RE-S-1800X4-16G-S
 Board Information Record:
  Address 0x00: 54 32 30 32 37 44 41 2d 34 34 47 42 23 41 23 00
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 09 c0 01 02 52 45 56 20 30 32 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 31 38 32 31 00 00
  Address 0x20: 39 30 30 39 30 39 39 37 30 34 00 00 00 0f 03 07
  Address 0x30: dc ff ff ff 54 32 30 32 37 44 41 2d 34 34 47 42
  Address 0x40: 23 41 23 00 01 00 00 00 00 00 00 00 00 00 00 52
  Address 0x50: 45 2d 53 2d 31 38 30 30 58 34 2d 31 36 47 2d 53
  Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 8c ff ff ff ff ff ff ff ff ff ff ff ff
  ad0    3831 MB  UGB30SFA4000T1       SFA4000T1 00000651 Compact Flash
  ad1   30533 MB  UGB94BPH32H0S1-KCI   11000019592       Disk 1
  usb0 (addr 1)  EHCI root hub 0       Intel             uhub0
  usb0 (addr 2)  product 0x0020 32     vendor 0x8087     uhub1
  DIMM 0         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
  DIMM 1         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
  DIMM 2         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
  DIMM 3         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
Routing Engine 1 REV 02   740-041821   9009099706        RE-S-1800x4
 Jedec Code:   0x7fb0            EEPROM Version:    0x02
 P/N:          740-041821        S/N:               9009099706
 Assembly ID:  0x09c0            Assembly Version:  01.02
 Date:         02-23-2012        Assembly Flags:    0x00
 Version:      REV 02
 ID: RE-S-1800x4                 FRU Model Number:  RE-S-1800X4-16G-S
 Board Information Record:
  Address 0x00: 54 32 30 32 37 44 41 2d 34 34 47 42 23 41 23 00
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 09 c0 01 02 52 45 56 20 30 32 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 31 38 32 31 00 00
 Address 0x20: 39 30 30 39 30 39 39 37 30 36 00 00 00 17 02 07
  Address 0x30: dc ff ff ff 54 32 30 32 37 44 41 2d 34 34 47 42
  Address 0x40: 23 41 23 00 01 00 00 00 00 00 00 00 00 00 00 52
  Address 0x50: 45 2d 53 2d 31 38 30 30 58 34 2d 31 36 47 2d 53
  Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 8c ff ff ff ff ff ff ff ff ff ff ff ff
  ad0    3998 MB  Virtium - TuffDrive VCF P1T0200262860208 114 Compact Flash
  ad1   30533 MB  UGB94ARF32H0S3-KC    UNIGEN-499551-000404 Disk 1
CB 0             REV 13   750-040257   CAAF8436          Control Board
 Jedec Code:   0x7fb0            EEPROM Version:    0x02
 P/N:          750-040257        S/N:               S/N CAAF8436
 Assembly ID:  0x0b26            Assembly Version:  01.13
 Date:         08-29-2012        Assembly Flags:    0x00
 Version:      REV 13            CLEI Code:         PROTOXCLEI
 ID: Control Board               FRU Model Number:  PROTO-ASSEMBLY
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 26 01 0d 52 45 56 20 31 33 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 34 30 32 35 37 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 46 38 34 33 36 00 1d 08 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
  Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff ff
...
```



```
SPMB 0           REV 02   711-041855   ABBV3825         PMB Board
 Jedec Code:   0x7fb0           EEPROM Version:    0x01
 P/N:          711-041855       S/N:               S/N ABBV3825
 Assembly ID:  0x0b29           Assembly Version:  01.02
 Date:         08-14-2012       Assembly Flags:    0x00
 Version:      REV 02
 ID: PMB Board
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 01 ff 0b 29 01 02 52 45 56 20 30 32 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 34 31 38 35 35 00 00
  Address 0x20: 53 2f 4e 20 41 42 42 56 33 38 32 35 00 0e 08 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff ff
  Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00
...
SFB 0            REV 05   711-044466   ABBX5682         Switch Fabric Board
 Jedec Code:   0x7fb0           EEPROM Version:    0x02
 P/N:          711-044466       S/N:               S/N ABBX5682
 Assembly ID:  0x0b25           Assembly Version:  01.05
 Date:         09-07-2012       Assembly Flags:    0x00
 Version:      REV 05           CLEI Code:         PROTOXCLEI
 ID: Switch Fabric Board        FRU Model Number:  PROTO-ASSEMBLY
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 25 01 05 52 45 56 20 30 35 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 34 34 34 36 36 00 00
  Address 0x20: 53 2f 4e 20 41 42 42 58 35 36 38 32 00 07 09 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
  Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff c2 00 00 00 01 00 00 00 00 00 00 48 00
...
FPC 0            REV 09   750-037355   CAAF0924         MPC Type 4-2
 Jedec Code:   0x7fb0           EEPROM Version:    0x02
 P/N:          750-037355       S/N:               S/N CAAF0924
 Assembly ID:  0x0b4e           Assembly Version:  01.09
 Date:         05-21-2012       Assembly Flags:    0x00
 Version:      REV 09           CLEI Code:         PROTOXCLEI
 ID: MPC Type 4-2               FRU Model Number:  MPC4E-2CGE-8XGE
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 4e 01 09 52 45 56 20 30 39 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 33 35 35 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 46 30 39 32 34 00 15 05 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 4d
  Address 0x50: 50 43 34 45 2d 32 43 47 45 2d 38 58 47 45 00 00
  Address 0x60: 00 00 00 00 00 00 30 39 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff c6 ff ff ff ff ff ff ff ff ff ff ff ff
  CPU            REV 08   711-035209   CAAB9842         HMPC PMB 2G
 Jedec Code:   0x7fb0           EEPROM Version:    0x01
 P/N:          711-035209       S/N:               S/N CAAB9842
 Assembly ID:  0x0b04           Assembly Version:  01.08
 Date:         05-17-2012       Assembly Flags:    0x00
```



```
 Version:      REV 08
 ID: HMPC PMB 2G
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 01 ff 0b 04 01 08 52 45 56 20 30 38 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 33 35 32 30 39 00 00
  Address 0x20: 53 2f 4e 20 43 41 41 42 39 38 34 32 00 11 05 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff ff
  Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00
  PIC 0                  BUILTIN      BUILTIN          4x10GE SFPP
 Jedec Code:   0x0000            EEPROM Version:    0x00
 P/N:          BUILTIN           S/N:               BUILTIN
 Assembly ID:  0x0a53            Assembly Version:  00.00
 Date:         00-00-0000        Assembly Flags:    0x00
 ID: 4x10GE SFPP
 Board Information Record:
  Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
 I2C Hex Data:
  Address 0x00: 00 00 00 00 0a 53 00 00 00 00 00 00 00 00 00 00
  Address 0x10: 00 00 00 00 42 55 49 4c 54 49 4e 00 4d 58 43 00
  Address 0x20: 42 55 49 4c 54 49 4e 00 4d 58 43 00 00 00 00 00
  Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: 00 00 00 00 c0 02 ae 64 00 00 00 00 0a 52 00 00
    Xcvr 0       REV 01   740-021308   19T511101656      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AMA04RU           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   193363A00558      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B10M00202         SFP+-10G-SR
...
ADC 0            REV 13   750-043596   ABBX5532          Adapter Card
 Jedec Code:   0x7fb0            EEPROM Version:    0x02
 P/N:          750-043596        S/N:               S/N ABBX5532
 Assembly ID:  0x0b3d            Assembly Version:  01.13
 Date:         09-12-2012        Assembly Flags:    0x00
 Version:      REV 13            CLEI Code:         IPUCBA8CAA
 ID: Adapter Card                FRU Model Number:  MX2000-LC-ADAPTER
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 3d 01 0d 52 45 56 20 31 33 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 34 33 35 39 36 00 00
  Address 0x20: 53 2f 4e 20 41 42 42 58 35 35 33 32 00 0c 09 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 49 50 55 43 42 41 38 43 41 41 4d
  Address 0x50: 58 32 30 30 30 2d 4c 43 2d 41 44 41 50 54 45 52
  Address 0x60: 00 00 00 00 00 00 41 00 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 3a 00 00 00 00 00 00 00 00 00 00 00 00
...
```

show chassis hardware models (MX2010 Router)

```
user@host > show chassis hardware models
Hardware inventory:
Item             Version  Part number  Serial number     FRU model number
FPM Board        REV 06   711-032349   ZX8744            711-032349
```



```
PSM 4            REV 0C   740-033727   VK00254       0000000000000000000000
PSM 5            REV 0B   740-033727   VG00015       0000000000000000000000
PSM 6            REV 0B   740-033727   VH00097       0000000000000000000000
PSM 7            REV 0C   740-033727   VJ00151       0000000000000000000000
PSM 8            REV 0C   740-033727   VJ00149       0000000000000000000000
PDM 0            REV 0B   740-038109   WA00008
PDM 1            REV 0B   740-038109   WA00014
Routing Engine 0 REV 02   740-041821   9009094134    RE-S-1800X4-16G-S
Routing Engine 1 REV 02   740-041821   9009094141    RE-S-1800X4-16G-S
CB 0             REV 08   750-040257   CAAB3491      750-040257
CB 1             REV 08   750-040257   CAAB3489      750-040257
SFB 0            REV 06   711-032385   ZV1828        711-032385
SFB 1            REV 07   711-032385   ZZ2568        711-032385
SFB 2            REV 07   711-032385   ZZ2563        711-032385
SFB 3            REV 07   711-032385   ZZ2564        711-032385
SFB 4            REV 07   711-032385   ZZ2580        711-032385
SFB 5            REV 07   711-032385   ZZ2579        711-0323856
SFB 6            REV 07   711-032385   CAAB4882      711-044170
SFB 7            REV 07   711-032385   CAAB4898      711-044170
FPC 0            REV 33   750-028467   CAAB1919      MPC-3D-16XGE-SFPP
FPC 1            REV 21   750-033205   ZG5027        MX-MPC3-3D
  MIC 0          REV 03   750-033307   ZV6299        MIC3-3D-10XGE-SFPP
  MIC 1          REV 03   750-033307   ZV6268        MIC3-3D-10XGE-SFPP
FPC 8            REV 22   750-031089   ZT9746        MX-MPC2-3D
  MIC 0          REV 26   750-028392   ABBS1150      MIC-3D-20GE-SFP
  MIC 1          REV 26   750-028387   ABBR9582      MIC-3D-4XGE-XFP
FPC 9            REV 11   750-036284   ZL3591        MPCE-3D-16XGE-SFPP
ADC 0            REV 05   750-043596   CAAC2073      750-043596
ADC 1            REV 01   750-043596   ZV4117        750-043596
ADC 8            REV 01   750-043596   ZV4107        750-043596
ADC 9            REV 02   750-043596   ZW1555        750-043596
Fan Tray 0       REV 2A   760-046960   ACAY0015
Fan Tray 1       REV 2A   760-046960   ACAY0019
Fan Tray 2       REV 2A   760-046960   ACAY0020
Fan Tray 3       REV 2A   760-046960   ACAY0021
```

show chassis hardware clei-models (MX2010 Routers)

```
user@host > show chassis hardware clei-models
Hardware inventory:
Item             Version  Part number  CLEI code     FRU model number
FPM Board        REV 06   711-032349   PROTOXCLEI    711-032349
PSM 4            REV 0C   740-033727   0000000000    0000000000000000000000
PSM 5            REV 0B   740-033727   0000000000    0000000000000000000000
PSM 6            REV 0B   740-033727   0000000000    0000000000000000000000
PSM 7            REV 0C   740-033727   0000000000    0000000000000000000000
PSM 8            REV 0C   740-033727   0000000000    0000000000000000000000
PDM 0            REV 0B   740-038109
PDM 1            REV 0B   740-038109
Routing Engine 0 REV 02   740-041821                 RE-S-1800X4-16G-S
Routing Engine 1 REV 02   740-041821                 RE-S-1800X4-16G-S
CB 0             REV 08   750-040257   PROTOXCLEI    750-040257
CB 1             REV 08   750-040257   PROTOXCLEI    750-040257
SFB 0            REV 06   711-032385   PROTOXCLEI    711-032385
SFB 1            REV 07   711-032385   PROTOXCLEI    711-032385
SFB 2            REV 07   711-032385   PROTOXCLEI    711-032385
SFB 3            REV 07   711-032385   PROTOXCLEI    711-032385
SFB 4            REV 07   711-032385   PROTOXCLEI    711-032385
SFB 5            REV 07   711-032385   PROTOXCLEI    711-0323856
SFB 6            REV 07   711-032385   PROTOXCLEI    711-044170
SFB 7            REV 07   711-032385   PROTOXCLEI    711-044170
```

```
FPC 0            REV 33   750-028467                  MPC-3D-16XGE-SFPP
FPC 1            REV 21   750-033205                  MX-MPC3-3D
  MIC 0          REV 03   750-033307   PROTOXCLEI     MIC3-3D-10XGE-SFPP
  MIC 1          REV 03   750-033307   PROTOXCLEI     MIC3-3D-10XGE-SFPP
FPC 8            REV 22   750-031089   COUIBAYBAA     MX-MPC2-3D
  MIC 0          REV 26   750-028392   COUIA15BAA     MIC-3D-20GE-SFP
  MIC 1          REV 26   750-028387   COUIA16BAA     MIC-3D-4XGE-XFP
FPC 9            REV 11   750-036284   CMUIACGBAA     MPCE-3D-16XGE-SFPP
ADC 0            REV 05   750-043596   PROTOXCLEI     750-043596
ADC 1            REV 01   750-043596   PROTOXCLEI     750-043596
ADC 8            REV 01   750-043596   PROTOXCLEI     750-043596
ADC 9            REV 02   750-043596   PROTOXCLEI     750-043596
Fan Tray 0       REV 2A   760-046960
Fan Tray 1       REV 2A   760-046960
Fan Tray 2       REV 2A   760-046960
Fan Tray 3       REV 2A   760-046960
```

show chassis hardware (MX2020 Router)

```
user@host > show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number  Description
Chassis                                JN11E2227AFJ   MX2020
Midplane         REV 27   750-040240   ABAB9384       Lower Power Midplane
Midplane 1       REV 04   711-032386   ABAB9386       Upper Backplane
PMP 1            REV 05   711-032428   ACAJ1579       Upper Power Midplane
PMP 0            REV 04   711-032426   ACAJ1524       Lower Power Midplane
FPM Board        REV 06   760-040242   ABBT8837       Front Panel Display
PSM 0            REV 01   740-045050   1E022240056    DC 52V Power Supply
Module
PSM 1            REV 01   740-045050   1E022240054    DC 52V Power Supply
Module
PSM 2            REV 01   740-045050   1E02224005H    DC 52V Power Supply
Module
PSM 3            REV 01   740-045050   1E022240053    DC 52V Power Supply
Module
PSM 4            REV 01   740-045050   1E02224004K    DC 52V Power Supply
Module
PSM 7            REV 01   740-045050   1E02224006W    DC 52V Power Supply
Module
PSM 8            REV 01   740-045050   1E022240062    DC 52V Power Supply
Module
PSM 9            REV 01   740-045050   1E02224005B    DC 52V Power Supply
Module
PSM 10           REV 01   740-045050   1E02224005A    DC 52V Power Supply
Module
PSM 11           REV 01   740-045050   1E022240052    DC 52V Power Supply
Module
PSM 12           REV 01   740-045050   1E022240051    DC 52V Power Supply
Module
PSM 13           REV 01   740-045050   1E022240058    DC 52V Power Supply
Module
PSM 14           REV 01   740-045050   1E02224004L    DC 52V Power Supply
Module
PSM 15           REV 01   740-045050   1E02224005M    DC 52V Power Supply
Module
PSM 16           REV 01   740-045050   1E02224006S    DC 52V Power Supply
Module
PSM 17           REV 01   740-045050   1E02224005Z    DC 52V Power Supply
Module
PDM 0            REV 01   740-045234   1E012150033    DC Power Dist Module
```



```
PDM 1            REV 01   740-045234   1E012150027       DC Power Dist Module
PDM 2            REV 01   740-045234   1E012150028       DC Power Dist Module
PDM 3            REV 01   740-045234   1E012150045       DC Power Dist Module
Routing Engine 0 REV 02   740-041821   9009089704        RE-S-1800x4
Routing Engine 1 REV 02   740-041821   9009094138        RE-S-1800x4
CB 0             REV 14   750-040257   CAAF8430          Control Board
CB 1             REV 08   750-040257   CAAB3482          Control Board
SPMB 0           REV 01   711-041855   ZS2290            PMB Board
SPMB 1           REV 02   711-041855   CAAA6141          PMB Board
SFB 0            REV 03   711-044466   ABBV6789          Switch Fabric Board
SFB 1            REV 05   711-044466   ABBX5666          Switch Fabric Board
SFB 2            REV 05   711-044466   ABBX5678          Switch Fabric Board
SFB 3            REV 05   711-044466   ABBX5687          Switch Fabric Board
SFB 4            REV 05   711-044466   ABBX5609          Switch Fabric Board
SFB 5            REV 05   711-044466   ABBX5675          Switch Fabric Board
SFB 6            REV 03   711-044466   ABBV6805          Switch Fabric Board
SFB 7            REV 05   711-044466   ABBX5701          Switch Fabric Board
FPC 0            REV 30   750-028467   ABBN0284          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBN0507          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E00990         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E04357         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01327         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E04375         SFP+-10G-USR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E02760         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E02904         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E03963         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E00756         SFP+-10G-USR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E04418         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E01077         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E01128         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11F01253         SFP+-10G-USR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E01140         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11F01626         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E01075         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E01177         SFP+-10G-USR
FPC 1            REV 30   750-028467   ABBN0208          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBJ1084          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E04745         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11F01570         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E04388         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11F01439         SFP+-10G-USR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E04739         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11F01869         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01675         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11F01901         SFP+-10G-USR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11F01346         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11F01288         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01824         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E04312         SFP+-10G-USR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E02811         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E03847         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01495         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11F01265         SFP+-10G-USR
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FPC 2            REV 30   750-028467   ZM5111            MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ZP6607            AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LJA           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80MFZ           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80NKL           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80KF4           SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80FBJ           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80MM2           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80LJV           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80NXV           SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80N1H           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80NLS           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80FL5           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80NL9           SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80NG2           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80KDU           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80MG1           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80MM0           SFP+-10G-SR
FPC 3            REV 30   750-028467   ABBN0302          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBN0495          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11F01581         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E01176         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01251         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E02752         SFP+-10G-USR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E00786         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E01020         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E01023         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E02819         SFP+-10G-USR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E02812         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11D04437         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01279         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11F01333         SFP+-10G-USR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E00978         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E01018         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01784         SFP+-10G-USR
    Xcvr 3       REV 01   740-031980   AK80NKP           SFP+-10G-SR
FPC 4            REV 30   750-028467   ABBN0308          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBJ1095          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E04305         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E01147         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E01195         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11F01743         SFP+-10G-USR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11F01892         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E02880         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E00725         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E01057         SFP+-10G-USR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E02816         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11C04501         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E02764         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E00789         SFP+-10G-USR
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  PIC 3                  BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-030658   B11F01250         SFP+-10G-USR
    Xcvr 1      REV 01   740-030658   B11E02847         SFP+-10G-USR
    Xcvr 2      REV 01   740-030658   B11E00787         SFP+-10G-USR
    Xcvr 3      REV 01   740-030658   B11E03803         SFP+-10G-USR
FPC 5           REV 30   750-028467   ABBN0316          MPC 3D 16x 10GE
  CPU           REV 10   711-029089   ABBJ1082          AMPC PMB
  PIC 0                  BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   B11K00523         SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   B11K01848         SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   B11K01865         SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   B11K00540         SFP+-10G-SR
  PIC 1                  BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   B11K00422         SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   B11K00428         SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   B11K00423         SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   B11K01855         SFP+-10G-SR
  PIC 2                  BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   B11K01847         SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   B11K00526         SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   B11K00529         SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   B11K00525         SFP+-10G-SR
  PIC 3                  BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   B11K00425         SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   B11K00530         SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   B11K01851         SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   B11K00528         SFP+-10G-SR
FPC 6           REV 32   750-028467   ABBN6832          MPC 3D 16x 10GE
  CPU           REV 10   711-029089   ABBK6534          AMPC PMB
  PIC 0                  BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   AK80MB4           SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   AK80FQ6           SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   AK80N1F           SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   AK80NLQ           SFP+-10G-SR
  PIC 1                  BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   AK80KDR           SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   AK80FGJ           SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   AK80N5G           SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   AK80KD8           SFP+-10G-SR
  PIC 2                  BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   AK80LET           SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   AK80N1X           SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   AK80NRF           SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   AK80NL2           SFP+-10G-SR
  PIC 3                  BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   AK80N3D           SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   AK80MRB           SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   AK80LEQ           SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   AK80LER           SFP+-10G-SR
FPC 7           REV 32   750-028467   ABBN6811          MPC 3D 16x 10GE
  CPU           REV 10   711-029089   ABBN7288          AMPC PMB
  PIC 0                  BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   AK80NK8           SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   AK80LJG           SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   AK80LBU           SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   AK80N21           SFP+-10G-SR
  PIC 1                  BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   AK80LEU           SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   AK80NLM           SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   AK80NL6           SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   AK80LES           SFP+-10G-SR
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  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LEN           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80ME0           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80LMG           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80MM1           SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80MG7           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80KF9           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80NRQ           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80NLE           SFP+-10G-SR
FPC 8            REV 23   750-028467   YN2977            MPC 3D 16x 10GE
  CPU            REV 10   711-029089   YP1856            AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   183363A00875      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   183363A00851      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   183363A00772      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   183363A00882      SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   183363A00735      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   183363A00169      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   183363A00726      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   183363A00077      SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   183363A00168      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   183363A00676      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   183363A00732      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   183363A00091      SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   183363A00725      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   183363A00642      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   183363A00871      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   183363A00853      SFP+-10G-SR
FPC 9            REV 32   750-028467   ABBN6798          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBK6556          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   9ZDZ06A00055      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   183363A00239      SFP+-10G-SR
    Xcvr 2       REV 01   740-021308   AD0915E003K       SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   AD0915E003A       SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80MRC           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80NL5           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80NKN           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80N3U           SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80N1T           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AJ808DJ           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80NG4           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80FND           SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80FKQ           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80NLT           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80NKR           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80LKM           SFP+-10G-SR
FPC 10           REV 32   750-028467   ABBN6813          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBK6542          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80NA3           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80NLF           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80MRH           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80KE4           SFP+-10G-SR
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  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021308   973152A00030      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80L9H           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80ME8           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80NLR           SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80NG1           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80MCA           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80LFC           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80LEM           SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80N9X           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80LAC           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80LF2           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80N8T           SFP+-10G-SR
FPC 11           REV 30   750-028467   ABBN0281          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBN0526          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11F01326         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E03973         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E00950         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E00674         SFP+-10G-USR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E00775         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E04461         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E01074         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E02821         SFP+-10G-USR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E04501         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E00757         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01623         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E01022         SFP+-10G-USR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E04359         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E02751         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E02736         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E01178         SFP+-10G-USR
FPC 12           REV 32   750-028467   ABBN6796          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBN7259          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   B11K01856         SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11K01853         SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K01863         SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A02863      SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   163363A02668      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   163363A02881      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   163363A01671      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A02627      SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   163363A02725      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   163363A02692      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   163363A02730      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A03081      SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   163363A02736      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   163363A02568      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   163363A02747      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A02579      SFP+-10G-SR
FPC 13           REV 30   750-028467   ABBN0270          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBJ0966          AMPC PMB
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  PIC 0                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80NL1           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80NXW           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80KD2           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80FMD           SFP+-10G-SR
  PIC 1                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80NKQ           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80MGH           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80N38           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80NL7           SFP+-10G-SR
  PIC 2                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LEL           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80NKD           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80KCY           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80LHK           SFP+-10G-SR
  PIC 3                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80M5J           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80MBE           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80NLG           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80LFH           SFP+-10G-SR
FPC 14           REV 32   750-028467   ABBN6790          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBK6515          AMPC PMB
  PIC 0                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LZM           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80MCC           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80KCM           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80KE0           SFP+-10G-SR
  PIC 1                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021310   C10F99155         SFP+-10G-LRM
    Xcvr 1       REV 01   740-021310   C10F99049         SFP+-10G-LRM
    Xcvr 2       REV 01   740-021310   C10F99128         SFP+-10G-LRM
    Xcvr 3       REV 01   740-021310   C10F99169         SFP+-10G-LRM
  PIC 2                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LF3           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   163363A02597      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   163363A03060      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A03057      SFP+-10G-SR
  PIC 3                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LEX           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80FEU           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80FNM           SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   AJQ0Q5G           SFP+-10G-SR
FPC 15           REV 32   750-028467   ABBN6791          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBN7289          AMPC PMB
  PIC 0                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   B11K00424         SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11K01849         SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K01862         SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11K01852         SFP+-10G-SR
  PIC 1                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   B11K00427         SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11K00430         SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K01854         SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11K00426         SFP+-10G-SR
  PIC 2                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   B11K00429         SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11K01864         SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K01850         SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11K00522         SFP+-10G-SR
  PIC 3                 BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E01144         SFP+-10G-USR
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    Xcvr 1      REV 01   740-030658   B11E00985        SFP+-10G-USR
    Xcvr 2      REV 01   740-030658   B11E00796        SFP+-10G-USR
    Xcvr 3      REV 01   740-031980   B11K01866        SFP+-10G-SR
FPC 16          REV 30   750-028467   ABBM4592         MPC 3D 16x 10GE
  CPU           REV 10   711-029089   ABBN0465         AMPC PMB
  PIC 0                  BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-030658   B11F01435        SFP+-10G-USR
    Xcvr 1      REV 01   740-030658   B11E01052        SFP+-10G-USR
    Xcvr 2      REV 01   740-030658   B11F01328        SFP+-10G-USR
    Xcvr 3      REV 01   740-030658   B11F01254        SFP+-10G-USR
  PIC 1                  BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-030658   B11E02738        SFP+-10G-USR
    Xcvr 1      REV 01   740-030658   B11E02881        SFP+-10G-USR
    Xcvr 2      REV 01   740-030658   B11F01624        SFP+-10G-USR
    Xcvr 3      REV 01   740-030658   B11E00889        SFP+-10G-USR
  PIC 2                  BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-030658   B11E02883        SFP+-10G-USR
    Xcvr 1      REV 01   740-030658   B11E00681        SFP+-10G-USR
    Xcvr 2      REV 01   740-030658   B11E04306        SFP+-10G-USR
    Xcvr 3      REV 01   740-030658   B11E02813        SFP+-10G-USR
  PIC 3                  BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-030658   B11F01801        SFP+-10G-USR
    Xcvr 1      REV 01   740-030658   B11E02753        SFP+-10G-USR
    Xcvr 2      REV 01   740-030658   B11E01156        SFP+-10G-USR
    Xcvr 3      REV 01   740-030658   B11E04324        SFP+-10G-USR
FPC 17          REV 32   750-028467   ABBN6810         MPC 3D 16x 10GE
  CPU           REV 10   711-029089   ABBN7237         AMPC PMB
  PIC 0                  BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   163363A02638     SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   163363A02082     SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   163363A01674     SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   163363A03058     SFP+-10G-SR
  PIC 1                  BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   163363A03048     SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   163363A02729     SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   163363A02566     SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   163363A02567     SFP+-10G-SR
  PIC 2                  BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   163363A02878     SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   163363A02739     SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   163363A01959     SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   163363A02660     SFP+-10G-SR
  PIC 3                  BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   163363A02731     SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   163363A02588     SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   163363A02673     SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   163363A02654     SFP+-10G-SR
FPC 18          REV 30   750-028467   ABBM4739         MPC 3D 16x 10GE
  CPU           REV 10   711-029089   ABBN0487         AMPC PMB
  PIC 0                  BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   163363A02569     SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   163363A02886     SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   163363A03082     SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   133363A00297     SFP+-10G-SR
  PIC 1                  BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   163363A02726     SFP+-10G-SR
    Xcvr 1      REV 01   740-031980   163363A03050     SFP+-10G-SR
    Xcvr 2      REV 01   740-031980   163363A02884     SFP+-10G-SR
    Xcvr 3      REV 01   740-031980   163363A03076     SFP+-10G-SR
  PIC 2                  BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0      REV 01   740-031980   163363A02581     SFP+-10G-SR
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      Xcvr 1       REV 01   740-031980   163363A02873      SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   163363A02582      SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   163363A03083      SFP+-10G-SR
    PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031981   UL70BU6           SFP+-10G-LR
      Xcvr 1       REV 01   740-031981   UL50QC6           SFP+-10G-LR
      Xcvr 2       REV 01   740-031981   UL708N6           SFP+-10G-LR
      Xcvr 3       REV 01   740-031981   UL603KK           SFP+-10G-LR
  FPC 19           REV 32   750-028467   ABBN6827          MPC 3D 16x 10GE
    CPU            REV 10   711-029089   ABBK6508          AMPC PMB
    PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   163363A01688      SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   163363A01724      SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   163363A01773      SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   163363A02593      SFP+-10G-SR
    PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   163363A03061      SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   163363A03056      SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   163363A02669      SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   163363A03070      SFP+-10G-SR
    PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   163363A02572      SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   163363A02697      SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   163363A02585      SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   163363A03052      SFP+-10G-SR
    PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   163363A02591      SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   163363A02649      SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   163363A02577      SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   163363A02698      SFP+-10G-SR
  ADC 0            REV 13   750-043596   ABBX5561          Adapter Card
  ADC 1            REV 13   750-043596   ABBX5546          Adapter Card
  ADC 2            REV 13   750-043596   ABBX5535          Adapter Card
  ADC 3            REV 13   750-043596   ABBX5552          Adapter Card
  ADC 4            REV 13   750-043596   ABBX5581          Adapter Card
  ADC 5            REV 13   750-043596   ABBX5545          Adapter Card
  ADC 6            REV 13   750-043596   ABBX5554          Adapter Card
  ADC 7            REV 07   750-043596   ABBV7194          Adapter Card
  ADC 8            REV 07   750-043596   ABBV7251          Adapter Card
  ADC 9            REV 07   750-043596   ABBV7202          Adapter Card
  ADC 10           REV 13   750-043596   ABBX5538          Adapter Card
  ADC 11           REV 13   750-043596   ABBX5566          Adapter Card
  ADC 12           REV 13   750-043596   ABBX5542          Adapter Card
  ADC 13           REV 13   750-043596   ABBX5539          Adapter Card
  ADC 14           REV 13   750-043596   ABBX5555          Adapter Card
  ADC 15           REV 13   750-043596   ABBX5557          Adapter Card
  ADC 16           REV 13   750-043596   ABBX5536          Adapter Card
  ADC 17           REV 13   750-043596   ABBX5559          Adapter Card
  ADC 18           REV 13   750-043596   ABBX5537          Adapter Card
  ADC 19           REV 11   750-043596   ABBW5685          Adapter Card
  Fan Tray 0       REV 2A   760-046960   ACAY0030          172mm FanTray - 6 Fans
  Fan Tray 1       REV 2A   760-046960   ACAY0039          172mm FanTray - 6 Fans
  Fan Tray 2       REV 2A   760-046960   ACAY0033          172mm FanTray - 6 Fans
  Fan Tray 3       REV 2A   760-046960   ACAY0062          172mm FanTray - 6 Fans
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show chassis hardware detail (MX2020 Router)

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user@host> show chassis hardware detail
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11E2227AFJ      MX2020
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Midplane         REV 27   750-040240   ABAB9384         Lower Power Midplane
Midplane 1       REV 04   711-032386   ABAB9386         Upper Backplane
PMP 1            REV 05   711-032428   ACAJ1821         Upper Power Midplane
PMP 0            REV 04   711-032426   ACAJ1524         Lower Power Midplane
FPM Board        REV 06   760-040242   ABBT8837         Front Panel Display
PSM 0            REV 01   740-045050   1E02224006G      DC 52V Power Supply
Module
PSM 1            REV 01   740-045050   1E022240053      DC 52V Power Supply
Module
PSM 2            REV 01   740-045050   1E02224004K      DC 52V Power Supply
Module
PSM 3            REV 01   740-045050   1E022240056      DC 52V Power Supply
Module
PSM 4            REV 01   740-045050   1E022240054      DC 52V Power Supply
Module
PSM 5            REV 01   740-045050   1E02224005H      DC 52V Power Supply
Module
PSM 6            REV 01   740-045050   1E02224006S      DC 52V Power Supply
Module
PSM 7            REV 01   740-045050   1E02224005M      DC 52V Power Supply
Module
PSM 8            REV 01   740-045050   1E022240062      DC 52V Power Supply
Module
PSM 9            REV 03   740-045050   1EDB2350095      DC 52V Power Supply
Module
PSM 10           REV 03   740-045050   1EDB235009L      DC 52V Power Supply
Module
PSM 11           REV 03   740-045050   1EDB2350092      DC 52V Power Supply
Module
PSM 12           REV 03   740-045050   1EDB23500AT      DC 52V Power Supply
Module
PSM 13           REV 03   740-045050   1EDB2350094      DC 52V Power Supply
Module
PSM 15           REV 03   740-045050   1EDB235008X      DC 52V Power Supply
Module
PDM 0            REV 01   740-045234   1E012150033      DC Power Dist Module
PDM 1            REV 01   740-045234   1E012150027      DC Power Dist Module
PDM 2            REV 01   740-045234   1E262250072      DC Power Dist Module
Routing Engine 0 REV 02   740-041821   9009094138       RE-S-1800x4
  ad0    3998 MB  Virtium - TuffDisk VCF3 20110825A021D0000064 Compact Flash
  ad1   30533 MB  UGB94ARF32H0S3-KC    UNIGEN-499551-000347 Disk 1
  usb0 (addr 1)  EHCI root hub 0       Intel            uhub0
  usb0 (addr 2)  product 0x0020 32     vendor 0x8087    uhub1
  DIMM 0         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
  DIMM 1         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
  DIMM 2         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
  DIMM 3         SGU04G72H1BD2SA-BB DIE REV-52 PCB REV-54 MFR ID-ce80
Routing Engine 1 REV 02   740-041821   9009089709       RE-S-1800x4
  ad0    3831 MB  UGB30SFA4000T1       SFA4000T1 00000113 Compact Flash
  ad1   30533 MB  UGB94ARF32H0S3-KC    UNIGEN-478612-001044 Disk 1
CB 0             REV 08   750-040257   CAAB3482         Control Board
CB 1             REV 04   750-040257   ZT2864           Control Board
SPMB 0           REV 02   711-041855   CAAA6141         PMB Board
SPMB 1           REV 01   711-041855   ZS2275           PMB Board
SFB 0            REV 05   711-044466   ABBT2161         Switch Fabric Board
SFB 1            REV 05   711-044466   ABBT2159         Switch Fabric Board
SFB 2            REV 05   711-044466   ABBX3718         Switch Fabric Board
SFB 3            REV 05   711-044466   ABBT2152         Switch Fabric Board
SFB 4            REV 05   711-044466   ABBT2160         Switch Fabric Board
SFB 5            REV 05   711-044466   ABBT2145         Switch Fabric Board
SFB 6            REV 05   711-044466   ABBT2150         Switch Fabric Board
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SFB 7            REV 05   711-044466   ABBT2163          Switch Fabric Board
FPC 0            REV 30   750-028467   ABBN0284          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBN0507          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E00990         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E04357         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01327         SFP+-10G-USR
Xcvr 3       REV 01   740-030658   B11E04375         SFP+-10G-USR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E02760         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E02904         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E03963         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E00756         SFP+-10G-USR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E04418         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E01077         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E01128         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11F01253         SFP+-10G-USR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E01140         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11F01626         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E01075         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E01177         SFP+-10G-USR
FPC 1            REV 30   750-028467   ABBN0308          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBJ1095          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E04305         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E01147         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E01195         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11F01743         SFP+-10G-USR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11F01892         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E02880         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E00725         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E01057         SFP+-10G-USR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E02816         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11C04501         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E02764         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E00789         SFP+-10G-USR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11F01250         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E02847         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E00787         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E03803         SFP+-10G-USR
FPC 2            REV 30   750-028467   ABBN0316          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBJ1082          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   B11K00523         SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11K01848         SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K01865         SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11K00540         SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   B11K00422         SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11K00428         SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K00423         SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11K01855         SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   B11K01847         SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11K00526         SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K00529         SFP+-10G-SR
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    Xcvr 3       REV 01   740-031980   B11K00525         SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
Xcvr 0       REV 01   740-031980   B11K00425         SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11K00530         SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K01851         SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11K00528         SFP+-10G-SR
FPC 3            REV 32   750-028467   ABBN6832          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBK6534          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80MB4           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80FQ6           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80N1F           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80NLQ           SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80KDR           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80FGJ           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80N5G           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80KD8           SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LET           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80N1X           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80NRF           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80NL2           SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80N3D           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80MRB           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80LEQ           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80LER           SFP+-10G-SR
FPC 4            REV 32   750-028467   ABBN6811          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBN7288          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80NK8           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80LJG           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80LBU           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80N21           SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LEU           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80NLM           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80NL6           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80LES           SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LEN           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80ME0           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80LMG           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80MM1           SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80MG7           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80KF9           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80NRQ           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80NLE           SFP+-10G-SR
FPC 5            REV 32   750-028467   ABBN6791          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBN7289          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   B11K00424         SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11K01849         SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K01862         SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11K01852         SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP
Xcvr 0       REV 01   740-031980   B11K00427         SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11K00430         SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11K01854         SFP+-10G-SR
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      Xcvr 3       REV 01   740-031980   B11K00426        SFP+-10G-SR
    PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   B11K00429        SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   B11K01864        SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   B11K01850        SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   B11K00522        SFP+-10G-SR
    PIC 3                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-030658   B11E01144        SFP+-10G-USR
      Xcvr 1       REV 01   740-030658   B11E00985        SFP+-10G-USR
      Xcvr 2       REV 01   740-030658   B11E00796        SFP+-10G-USR
      Xcvr 3       REV 01   740-031980   B11K01866        SFP+-10G-SR
  FPC 6            REV 30   750-028467   ABBM4592         MPC 3D 16x 10GE
    CPU            REV 10   711-029089   ABBN0465         AMPC PMB
    PIC 0                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-030658   B11F01435        SFP+-10G-USR
      Xcvr 1       REV 01   740-030658   B11E01052        SFP+-10G-USR
      Xcvr 2       REV 01   740-030658   B11F01328        SFP+-10G-USR
      Xcvr 3       REV 01   740-030658   B11F01254        SFP+-10G-USR
    PIC 1                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-030658   B11E02738        SFP+-10G-USR
      Xcvr 1       REV 01   740-030658   B11E02881        SFP+-10G-USR
      Xcvr 2       REV 01   740-030658   B11F01624        SFP+-10G-USR
      Xcvr 3       REV 01   740-030658   B11E00889        SFP+-10G-USR
    PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-030658   B11E02883        SFP+-10G-USR
      Xcvr 1       REV 01   740-030658   B11E00681        SFP+-10G-USR
      Xcvr 2       REV 01   740-030658   B11E04306        SFP+-10G-USR
      Xcvr 3       REV 01   740-030658   B11E02813        SFP+-10G-USR
    PIC 3                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-030658   B11F01801        SFP+-10G-USR
      Xcvr 1       REV 01   740-030658   B11E02753        SFP+-10G-USR
      Xcvr 2       REV 01   740-030658   B11E01156        SFP+-10G-USR
      Xcvr 3       REV 01   740-030658   B11E04324        SFP+-10G-USR
  FPC 7            REV 32   750-028467   ABBN6810         MPC 3D 16x 10GE
    CPU            REV 10   711-029089   ABBN7237         AMPC PMB
    PIC 0                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   163363A03058     SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   163363A02082     SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   163363A01674     SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   163363A02638     SFP+-10G-SR
    PIC 1                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   163363A03048     SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   163363A02729     SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   163363A02566     SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   163363A02567     SFP+-10G-SR
    PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   163363A02878     SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   163363A02739     SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   163363A01959     SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   163363A02660     SFP+-10G-SR
    PIC 3                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   163363A02731     SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   163363A02588     SFP+-10G-SR
   Xcvr 2       REV 01   740-031980   163363A02673     SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   163363A02654     SFP+-10G-SR
  FPC 8            REV 30   750-028467   ABBM4739         MPC 3D 16x 10GE
    CPU            REV 10   711-029089   ABBN0487         AMPC PMB
    PIC 0                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   163363A02569     SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   163363A02886     SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   163363A03082     SFP+-10G-SR
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    Xcvr 3       REV 01   740-031980   133363A00297      SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   163363A02726      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   163363A03050      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   163363A02884      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A03076      SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   163363A02581      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   163363A02873      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   163363A02582      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A03083      SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031981   UL70BU6           SFP+-10G-LR
    Xcvr 1       REV 01   740-031981   UL50QC6           SFP+-10G-LR
    Xcvr 2       REV 01   740-031981   UL708N6           SFP+-10G-LR
    Xcvr 3       REV 01   740-031981   UL603KK           SFP+-10G-LR
FPC 9            REV 32   750-028467   ABBN6827          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBK6508          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   163363A01688      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   163363A01724      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   163363A01773      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A02593      SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   163363A03061      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   163363A03056      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   163363A02669      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A03070      SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   163363A02572      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   163363A02697      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   163363A02585      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A03052      SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   163363A02591      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   163363A02649      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   163363A02577      SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A02698      SFP+-10G-SR
FPC 10           REV 30   750-028467   ABBN0302          MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBN0495          AMPC PMB
  PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11F01581         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E01176         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01251         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E02752         SFP+-10G-USR
  PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E00786         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E01020         SFP+-10G-USR
 Xcvr 2       REV 01   740-030658   B11E01023         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E02819         SFP+-10G-USR
  PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E02812         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11D04437         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01279         SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11F01333         SFP+-10G-USR
  PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E00978         SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11E01018         SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01784         SFP+-10G-USR
    Xcvr 3       REV 01   740-031980   AK80NKP           SFP+-10G-SR
FPC 11           REV 32   750-028467   ABBN6790          MPC 3D 16x 10GE
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  CPU            REV 10   711-029089   ABBK6515         AMPC PMB
  PIC 0                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LZM          SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80MCC          SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80KCM          SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80KE0          SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-021310   C10F99155        SFP+-10G-LRM
    Xcvr 1       REV 01   740-021310   C10F99049        SFP+-10G-LRM
    Xcvr 2       REV 01   740-021310   C10F99128        SFP+-10G-LRM
    Xcvr 3       REV 01   740-021310   C10F99169        SFP+-10G-LRM
  PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LF3          SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   163363A02597     SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   163363A03060     SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   163363A03057     SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LEX          SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80FEU          SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80FNM          SFP+-10G-SR
    Xcvr 3       REV 01   740-021308   AJQ0Q5G          SFP+-10G-SR
FPC 12           REV 30   750-028467   ZM5111           MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ZP6607           AMPC PMB
  PIC 0                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80LJA          SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80MFZ          SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80NKL          SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80KF4          SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80FBJ          SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80MM2          SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80LJV          SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80NXV          SFP+-10G-SR
  PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80N1H          SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80NLS          SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80FL5          SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80NL9          SFP+-10G-SR
  PIC 3                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   AK80NG2          SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AK80KDU          SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AK80MG1          SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AK80MM0          SFP+-10G-SR
FPC 13           REV 30   750-028467   ABBN0208         MPC 3D 16x 10GE
  CPU            REV 10   711-029089   ABBJ1084         AMPC PMB
  PIC 0                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E04745        SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11F01570        SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11E04388        SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11F01439        SFP+-10G-USR
  PIC 1                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11E04739        SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11F01869        SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01675        SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11F01901        SFP+-10G-USR
  PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-030658   B11F01346        SFP+-10G-USR
    Xcvr 1       REV 01   740-030658   B11F01288        SFP+-10G-USR
    Xcvr 2       REV 01   740-030658   B11F01824        SFP+-10G-USR
    Xcvr 3       REV 01   740-030658   B11E04312        SFP+-10G-USR
  PIC 3                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
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      Xcvr 0       REV 01   740-030658   B11E02811        SFP+-10G-USR
      Xcvr 1       REV 01   740-030658   B11E03847        SFP+-10G-USR
      Xcvr 2       REV 01   740-030658   B11F01495        SFP+-10G-USR
      Xcvr 3       REV 01   740-030658   B11F01265        SFP+-10G-USR
  FPC 14           REV 23   750-028467   YN2977           MPC 3D 16x 10GE
    CPU            REV 10   711-029089   YP1856           AMPC PMB
    PIC 0                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   183363A00875     SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   183363A00851     SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   183363A00772     SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   183363A00882     SFP+-10G-SR
    PIC 1                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   183363A00735     SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   183363A00169     SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   183363A00726     SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   183363A00077     SFP+-10G-SR
    PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   183363A00168     SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   183363A00676     SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   183363A00732     SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   183363A00091     SFP+-10G-SR
    PIC 3                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   183363A00725     SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   183363A00642     SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   183363A00871     SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   183363A00853     SFP+-10G-SR
  FPC 15           REV 32   750-028467   ABBN6798         MPC 3D 16x 10GE
    CPU            REV 10   711-029089   ABBK6556         AMPC PMB
    PIC 0                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-021308   9ZDZ06A00055     SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   183363A00239     SFP+-10G-SR
      Xcvr 2       REV 01   740-021308   AD0915E003K      SFP+-10G-SR
      Xcvr 3       REV 01   740-021308   AD0915E003A      SFP+-10G-SR
    PIC 1                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   AK80MRC          SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   AK80NL5          SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   AK80NKN          SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   AK80N3U          SFP+-10G-SR
   PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   AK80N1T          SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   AJ808DJ          SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   AK80NG4          SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   AK80FND          SFP+-10G-SR
    PIC 3                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   AK80FKQ          SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   AK80NLT          SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   AK80NKR          SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   AK80LKM          SFP+-10G-SR
  FPC 16           REV 30   750-028467   ABBN0270         MPC 3D 16x 10GE
    CPU            REV 10   711-029089   ABBJ0966         AMPC PMB
    PIC 0                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   AK80NL1          SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   AK80NXW          SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   AK80KD2          SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   AK80FMD          SFP+-10G-SR
    PIC 1                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
      Xcvr 0       REV 01   740-031980   AK80NKQ          SFP+-10G-SR
      Xcvr 1       REV 01   740-031980   AK80MGH          SFP+-10G-SR
      Xcvr 2       REV 01   740-031980   AK80N38          SFP+-10G-SR
      Xcvr 3       REV 01   740-031980   AK80NL7          SFP+-10G-SR
    PIC 2                   BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
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    Xcvr 0        REV 01   740-031980   AK80M5J          SFP+-10G-SR
    Xcvr 1        REV 01   740-031980   AK80NKD          SFP+-10G-SR
    Xcvr 2        REV 01   740-031980   AK80KCY          SFP+-10G-SR
    Xcvr 3        REV 01   740-031980   AK80LHK          SFP+-10G-SR
  PIC 3                    BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01   740-031980   AK80LEL          SFP+-10G-SR
    Xcvr 1        REV 01   740-031980   AK80MBE          SFP+-10G-SR
    Xcvr 2        REV 01   740-031980   AK80NLG          SFP+-10G-SR
    Xcvr 3        REV 01   740-031980   AK80LFH          SFP+-10G-SR
FPC 17            REV 32   750-028467   ABBN6796         MPC 3D 16x 10GE
  CPU             REV 10   711-029089   ABBN7259         AMPC PMB
  PIC 0                    BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01   740-031980   B11K01856        SFP+-10G-SR
    Xcvr 1        REV 01   740-031980   B11K01853        SFP+-10G-SR
    Xcvr 2        REV 01   740-031980   B11K01863        SFP+-10G-SR
    Xcvr 3        REV 01   740-031980   163363A02863     SFP+-10G-SR
  PIC 1                    BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01   740-031980   163363A02668     SFP+-10G-SR
    Xcvr 1        REV 01   740-031980   163363A02881     SFP+-10G-SR
    Xcvr 2        REV 01   740-031980   163363A01671     SFP+-10G-SR
    Xcvr 3        REV 01   740-031980   163363A02627     SFP+-10G-SR
  PIC 2                    BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01   740-031980   163363A02725     SFP+-10G-SR
    Xcvr 1        REV 01   740-031980   163363A02692     SFP+-10G-SR
    Xcvr 2        REV 01   740-031980   163363A02730     SFP+-10G-SR
    Xcvr 3        REV 01   740-031980   163363A03081     SFP+-10G-SR
  PIC 3                    BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01   740-031980   163363A02736     SFP+-10G-SR
    Xcvr 1        REV 01   740-031980   163363A02568     SFP+-10G-SR
    Xcvr 2        REV 01   740-031980   163363A02747     SFP+-10G-SR
    Xcvr 3        REV 01   740-031980   163363A02579     SFP+-10G-SR
FPC 18            REV 30   750-028467   ABBN0281         MPC 3D 16x 10GE
  CPU             REV 10   711-029089   ABBN0526         AMPC PMB
PIC 0                    BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01   740-030658   B11F01326        SFP+-10G-USR
    Xcvr 1        REV 01   740-030658   B11E03973        SFP+-10G-USR
    Xcvr 2        REV 01   740-030658   B11E00950        SFP+-10G-USR
    Xcvr 3        REV 01   740-030658   B11E00674        SFP+-10G-USR
  PIC 1                    BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01   740-030658   B11E00775        SFP+-10G-USR
    Xcvr 1        REV 01   740-030658   B11E04461        SFP+-10G-USR
    Xcvr 2        REV 01   740-030658   B11E01074        SFP+-10G-USR
    Xcvr 3        REV 01   740-030658   B11E02821        SFP+-10G-USR
  PIC 2                    BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01   740-030658   B11E04501        SFP+-10G-USR
    Xcvr 1        REV 01   740-030658   B11E00757        SFP+-10G-USR
    Xcvr 2        REV 01   740-030658   B11F01623        SFP+-10G-USR
    Xcvr 3        REV 01   740-030658   B11E01022        SFP+-10G-USR
  PIC 3                    BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01   740-030658   B11E04359        SFP+-10G-USR
    Xcvr 1        REV 01   740-030658   B11E02751        SFP+-10G-USR
    Xcvr 2        REV 01   740-030658   B11E02736        SFP+-10G-USR
    Xcvr 3        REV 01   740-030658   B11E01178        SFP+-10G-USR
FPC 19            REV 32   750-028467   ABBN6813         MPC 3D 16x 10GE
  CPU             REV 10   711-029089   ABBK6542         AMPC PMB
  PIC 0                    BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01   740-031980   AK80NA3          SFP+-10G-SR
    Xcvr 1        REV 01   740-031980   AK80NLF          SFP+-10G-SR
    Xcvr 2        REV 01   740-031980   AK80MRH          SFP+-10G-SR
    Xcvr 3        REV 01   740-031980   AK80KE4          SFP+-10G-SR
  PIC 1                    BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
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    Xcvr 0        REV 01    740-021308    973152A00030     SFP+-10G-SR
    Xcvr 1        REV 01    740-031980    AK80L9H          SFP+-10G-SR
    Xcvr 2        REV 01    740-031980    AK80ME8          SFP+-10G-SR
    Xcvr 3        REV 01    740-031980    AK80NLR          SFP+-10G-SR
  PIC 2                     BUILTIN       BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01    740-031980    AK80NG1          SFP+-10G-SR
    Xcvr 1        REV 01    740-031980    AK80MCA          SFP+-10G-SR
    Xcvr 2        REV 01    740-031980    AK80LFC          SFP+-10G-SR
    Xcvr 3        REV 01    740-031980    AK80LEM          SFP+-10G-SR
  PIC 3                     BUILTIN       BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0        REV 01    740-031980    AK80N9X          SFP+-10G-SR
    Xcvr 1        REV 01    740-031980    AK80LAC          SFP+-10G-SR
    Xcvr 2        REV 01    740-031980    AK80LF2          SFP+-10G-SR
    Xcvr 3        REV 01    740-031980    AK80N8T          SFP+-10G-SR
ADC 0             REV 13    750-043596    ABBX5561         Adapter Card
ADC 1             REV 13    750-043596    ABBX5546         Adapter Card
ADC 2             REV 13    750-043596    ABBX5535         Adapter Card
ADC 3             REV 13    750-043596    ABBX5552         Adapter Card
ADC 4             REV 13    750-043596    ABBX5581         Adapter Card
ADC 5             REV 13    750-043596    ABBX5545         Adapter Card
ADC 6             REV 13    750-043596    ABBX5554         Adapter Card
ADC 7             REV 07    750-043596    ABBV7194         Adapter Card
ADC 8             REV 07    750-043596    ABBV7251         Adapter Card
ADC 9             REV 07    750-043596    ABBV7202         Adapter Card
ADC 10            REV 13    750-043596    ABBX5579         Adapter Card
ADC 11            REV 13    750-043596    ABBX5548         Adapter Card
ADC 12            REV 13    750-043596    ABBX5575         Adapter Card
ADC 13            REV 13    750-043596    ABBX5539         Adapter Card
ADC 14            REV 13    750-043596    ABBX5555         Adapter Card
ADC 15            REV 13    750-043596    ABBX5557         Adapter Card
ADC 16            REV 13    750-043596    ABBX5536         Adapter Card
ADC 17            REV 13    750-043596    ABBX5559         Adapter Card
ADC 18            REV 13    750-043596    ABBX5537         Adapter Card
ADC 19            REV 11    750-043596    ABBW5685         Adapter Card
Fan Tray 0        REV 04    760-046960    ACAY0090         172mm FanTray - 6 Fans
Fan Tray 1        REV 04    760-046960    ACAY0088         172mm FanTray - 6 Fans
Fan Tray 2        REV 04    760-046960    ACAY0089         172mm FanTray - 6 Fans
Fan Tray 3        REV 04    760-046960    ACAY0108         172mm FanTray - 6 Fans
```

show chassis hardware models (MX2020 Router)

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user@host > show chassis hardware models
Hardware inventory:
Item              Version   Part number   Serial number    FRU model number
Midplane          REV 27    750-040240    ABAB9384         750-040240
FPM Board         REV 06    760-040242    ABBT8837         760-040242
PSM 0             REV 01    740-045050    1E02224006G      MX2000-PSM-HC-DC-S-A
PSM 1             REV 01    740-045050    1E022240053      MX2000-PSM-HC-DC-S-A
PSM 2             REV 01    740-045050    1E02224004K      MX2000-PSM-HC-DC-S-A
PSM 3             REV 01    740-045050    1E022240056      MX2000-PSM-HC-DC-S-A
PSM 4             REV 01    740-045050    1E022240054      MX2000-PSM-HC-DC-S-A
PSM 5             REV 01    740-045050    1E02224005H      MX2000-PSM-HC-DC-S-A
PSM 6             REV 01    740-045050    1E02224006S      MX2000-PSM-HC-DC-S-A
PSM 7             REV 01    740-045050    1E02224005M      MX2000-PSM-HC-DC-S-A
PSM 8             REV 01    740-045050    1E022240062      MX2000-PSM-HC-DC-S-A
PSM 9             REV 03    740-045050    1EDB2350095      MX2000-PSM-DC-S-A
PSM 10            REV 03    740-045050    1EDB235009L      MX2000-PSM-DC-S-A
PSM 11            REV 03    740-045050    1EDB2350092      MX2000-PSM-DC-S-A
PSM 12            REV 03    740-045050    1EDB23500AT      MX2000-PSM-DC-S-A
PSM 13            REV 03    740-045050    1EDB2350094      MX2000-PSM-DC-S-A
PSM 15            REV 03    740-045050    1EDB235008X      MX2000-PSM-DC-S-A
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PDM 0            REV 01   740-045234   1E012150033
PDM 1            REV 01   740-045234   1E012150027
PDM 2            REV 01   740-045234   1E262250072        MX2000-PDM-DC-S-A
Routing Engine 0 REV 02   740-041821   9009094138         RE-S-1800X4-16G-S
Routing Engine 1 REV 02   740-041821   9009089709         RE-S-1800X4-16G-S
CB 0             REV 08   750-040257   CAAB3482           750-040257
CB 1             REV 04   750-040257   ZT2864             750-040257
SFB 0            REV 05   711-044466   ABBT2161           MX2000-SFB-S
SFB 1            REV 05   711-044466   ABBT2159           MX2000-SFB-S
SFB 2            REV 05   711-044466   ABBX3718           MX2000-SFB-S
SFB 4            REV 05   711-044466   ABBT2160           MX2000-SFB-S
SFB 5            REV 05   711-044466   ABBT2145           MX2000-SFB-S
SFB 7            REV 05   711-044466   ABBT2163           MX2000-SFB-S
FPC 0            REV 30   750-028467   ABBN0284           MPC-3D-16XGE-SFPP
FPC 1            REV 30   750-028467   ABBN0308           MPC-3D-16XGE-SFPP
FPC 2            REV 30   750-028467   ABBN0316           MPC-3D-16XGE-SFPP
FPC 3            REV 32   750-028467   ABBN6832           MPC-3D-16XGE-SFPP
FPC 4            REV 32   750-028467   ABBN6811           MPC-3D-16XGE-SFPP
FPC 5            REV 32   750-028467   ABBN6791           MPC-3D-16XGE-SFPP
FPC 6            REV 30   750-028467   ABBM4592           MPC-3D-16XGE-SFPP
FPC 7            REV 32   750-028467   ABBN6810           MPC-3D-16XGE-SFPP
FPC 8            REV 30   750-028467   ABBM4739           MPC-3D-16XGE-SFPP
FPC 9            REV 32   750-028467   ABBN6827           MPC-3D-16XGE-SFPP
FPC 10           REV 30   750-028467   ABBN0302           MPC-3D-16XGE-SFPP
FPC 11           REV 32   750-028467   ABBN6790           MPC-3D-16XGE-SFPP
FPC 12           REV 30   750-028467   ZM5111             MPC-3D-16XGE-SFPP
FPC 13           REV 30   750-028467   ABBN0208           MPC-3D-16XGE-SFPP
FPC 14           REV 23   750-028467   YN2977             MPC-3D-16XGE-SFPP
FPC 15           REV 32   750-028467   ABBN6798           MPC-3D-16XGE-SFPP
FPC 16           REV 30   750-028467   ABBN0270           MPC-3D-16XGE-SFPP
FPC 17           REV 32   750-028467   ABBN6796           MPC-3D-16XGE-SFPP
FPC 18           REV 30   750-028467   ABBN0281           MPC-3D-16XGE-SFPP
FPC 19           REV 32   750-028467   ABBN6813           MPC-3D-16XGE-SFPP
ADC 0            REV 13   750-043596   ABBX5561           PROTO-ASSEMBLY
ADC 1            REV 13   750-043596   ABBX5546           PROTO-ASSEMBLY
ADC 2            REV 13   750-043596   ABBX5535           MX2000-LC-ADAPTER
ADC 3            REV 13   750-043596   ABBX5552           MX2000-LC-ADAPTER
ADC 4            REV 13   750-043596   ABBX5581           MX2000-LC-ADAPTER
ADC 5            REV 13   750-043596   ABBX5545           PROTO-ASSEMBLY
ADC 6            REV 13   750-043596   ABBX5554           PROTO-ASSEMBLY
ADC 7            REV 07   750-043596   ABBV7194           MX2000-LC-ADAPTER
ADC 8            REV 07   750-043596   ABBV7251           MX2000-LC-ADAPTER
ADC 9            REV 07   750-043596   ABBV7202           MX2000-LC-ADAPTER
ADC 10           REV 13   750-043596   ABBX5579           MX2000-LC-ADAPTER
ADC 12           REV 13   750-043596   ABBX5575           MX2000-LC-ADAPTER
ADC 13           REV 13   750-043596   ABBX5539           PROTO-ASSEMBLY
ADC 14           REV 13   750-043596   ABBX5555           PROTO-ASSEMBLY
ADC 15           REV 13   750-043596   ABBX5557           MX2000-LC-ADAPTER
ADC 16           REV 13   750-043596   ABBX5536           PROTO-ASSEMBLY
ADC 17           REV 13   750-043596   ABBX5559           PROTO-ASSEMBLY
ADC 18           REV 13   750-043596   ABBX5537           PROTO-ASSEMBLY
ADC 19           REV 11   750-043596   ABBW5685           PROTO-ASSEMBLY
Fan Tray 0       REV 04   760-046960   ACAY0090
Fan Tray 1       REV 04   760-046960   ACAY0088
Fan Tray 2       REV 04   760-046960   ACAY0089
Fan Tray 3       REV 04   760-046960   ACAY0108
```

show chassis hardware clei-models (MX2020 Router)

`user@ host >` **show chassis hardware clei-models**


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Hardware inventory:
Item             Version  Part number  CLEI code         FRU model number
Midplane         REV 27   750-040240   PROTOXCLEI        750-040240
FPM Board        REV 06   760-040242   PROTOXCLEI        760-040242
PSM 0            REV 01   740-045050   IPUPAJMKAA        MX2000-PSM-HC-DC-S-A
PSM 1            REV 01   740-045050   IPUPAJMKAA        MX2000-PSM-HC-DC-S-A
PSM 2            REV 01   740-045050   IPUPAJMKAA        MX2000-PSM-HC-DC-S-A
PSM 3            REV 01   740-045050   IPUPAJMKAA        MX2000-PSM-HC-DC-S-A
PSM 4            REV 01   740-045050   IPUPAJMKAA        MX2000-PSM-HC-DC-S-A
PSM 5            REV 01   740-045050   IPUPAJMKAA        MX2000-PSM-HC-DC-S-A
PSM 6            REV 01   740-045050   IPUPAJMKAA        MX2000-PSM-HC-DC-S-A
PSM 7            REV 01   740-045050   IPUPAJMKAA        MX2000-PSM-HC-DC-S-A
PSM 8            REV 01   740-045050   IPUPAJMKAA        MX2000-PSM-HC-DC-S-A
PSM 9            REV 03   740-045050   IPUPAJMKAA        MX2000-PSM-DC-S-A
PSM 10           REV 03   740-045050   IPUPAJMKAA        MX2000-PSM-DC-S-A
PSM 11           REV 03   740-045050   IPUPAJMKAA        MX2000-PSM-DC-S-A
PSM 12           REV 03   740-045050   IPUPAJMKAA        MX2000-PSM-DC-S-A
PSM 13           REV 03   740-045050   IPUPAJMKAA        MX2000-PSM-DC-S-A
PSM 15           REV 03   740-045050   IPUPAJMKAA        MX2000-PSM-DC-S-A
PDM 0            REV 01   740-045234
PDM 1            REV 01   740-045234
PDM 2            REV 01   740-045234   IPUPAJSKAA        MX2000-PDM-DC-S-A
Routing Engine 0 REV 02   740-041821                     RE-S-1800X4-16G-S
Routing Engine 1 REV 02   740-041821                     RE-S-1800X4-16G-S
CB 0             REV 08   750-040257   PROTOXCLEI        750-040257
CB 1             REV 04   750-040257   PROTOXCLEI        750-040257
SFB 0            REV 05   711-044466   IPUCBA6CAA        MX2000-SFB-S
SFB 1            REV 05   711-044466   IPUCBA6CAA        MX2000-SFB-S
SFB 2            REV 05   711-044466   IPUCBA6CAA        MX2000-SFB-S
SFB 4            REV 05   711-044466   IPUCBA6CAA        MX2000-SFB-S
SFB 5            REV 05   711-044466   IPUCBA6CAA        MX2000-SFB-S
SFB 7            REV 05   711-044466   IPUCBA6CAA        MX2000-SFB-S
FPC 0            REV 30   750-028467                     MPC-3D-16XGE-SFPP
FPC 1            REV 30   750-028467                     MPC-3D-16XGE-SFPP
FPC 2            REV 30   750-028467                     MPC-3D-16XGE-SFPP
FPC 3            REV 32   750-028467                     MPC-3D-16XGE-SFPP
FPC 4            REV 32   750-028467                     MPC-3D-16XGE-SFPP
FPC 5            REV 32   750-028467                     MPC-3D-16XGE-SFPP
FPC 6            REV 30   750-028467                     MPC-3D-16XGE-SFPP
FPC 7            REV 32   750-028467                     MPC-3D-16XGE-SFPP
FPC 8            REV 30   750-028467                     MPC-3D-16XGE-SFPP
FPC 9            REV 32   750-028467                     MPC-3D-16XGE-SFPP
FPC 10           REV 30   750-028467                     MPC-3D-16XGE-SFPP
FPC 11           REV 32   750-028467                     MPC-3D-16XGE-SFPP
FPC 12           REV 30   750-028467                     MPC-3D-16XGE-SFPP
FPC 13           REV 30   750-028467                     MPC-3D-16XGE-SFPP
FPC 14           REV 23   750-028467                     MPC-3D-16XGE-SFPP
FPC 15           REV 32   750-028467                     MPC-3D-16XGE-SFPP
FPC 16           REV 30   750-028467                     MPC-3D-16XGE-SFPP
FPC 17           REV 32   750-028467                     MPC-3D-16XGE-SFPP
FPC 18           REV 30   750-028467                     MPC-3D-16XGE-SFPP
FPC 19           REV 32   750-028467                     MPC-3D-16XGE-SFPP
ADC 0            REV 13   750-043596   PROTOXCLEI        PROTO-ASSEMBLY
ADC 1            REV 13   750-043596   PROTOXCLEI        PROTO-ASSEMBLY
ADC 2            REV 13   750-043596   IPUCBA8CAA        MX2000-LC-ADAPTER
ADC 3            REV 13   750-043596   IPUCBA8CAA        MX2000-LC-ADAPTER
ADC 4            REV 13   750-043596   IPUCBA8CAA        MX2000-LC-ADAPTER
ADC 5            REV 13   750-043596   PROTOXCLEI        PROTO-ASSEMBLY
ADC 6            REV 13   750-043596   PROTOXCLEI        PROTO-ASSEMBLY
ADC 7            REV 07   750-043596   PROTOXCLEI        MX2000-LC-ADAPTER
ADC 8            REV 07   750-043596   PROTOXCLEI        MX2000-LC-ADAPTER
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ADC 9            REV 07   750-043596   PROTOXCLEI        MX2000-LC-ADAPTER
ADC 10           REV 13   750-043596   IPUCBA8CAA        MX2000-LC-ADAPTER
ADC 12           REV 13   750-043596   IPUCBA8CAA        MX2000-LC-ADAPTER
ADC 13           REV 13   750-043596   PROTOXCLEI        PROTO-ASSEMBLY
ADC 14           REV 13   750-043596   PROTOXCLEI        PROTO-ASSEMBLY
ADC 15           REV 13   750-043596   IPUCBA8CAA        MX2000-LC-ADAPTER
ADC 16           REV 13   750-043596   PROTOXCLEI        PROTO-ASSEMBLY
ADC 17           REV 13   750-043596   PROTOXCLEI        PROTO-ASSEMBLY
ADC 18           REV 13   750-043596   PROTOXCLEI        PROTO-ASSEMBLY
ADC 19           REV 11   750-043596   PROTOXCLEI        PROTO-ASSEMBLY
Fan Tray 0       REV 04   760-046960
Fan Tray 1       REV 04   760-046960
Fan Tray 2       REV 04   760-046960
Fan Tray 3       REV 04   760-046960
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show chassis hardware (MX Series routers with ATM MIC)

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user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN115736EAFC      MX240
Midplane         REV 07   760-021404   ABAA5038          MX240 Backplane
FPM Board        REV 03   760-021392   ABBA2758          Front Panel Display
PEM 0            Rev 01   740-022697   QCS0937C07K       PS 1.2-1.7kW; 100-240V
AC in
PEM 1            Rev 01   740-022697   QCS0939C04X       PS 1.2-1.7kW; 100-240V
AC in
PEM 2            Rev 01   740-022697   QCS0937C06B       PS 1.2-1.7kW; 100-240V
AC in
PEM 3            Rev 01   740-022697   QCS0937C07U       PS 1.2-1.7kW; 100-240V
AC in
Routing Engine 0 REV 12   740-013063   9009042291        RE-S-2000
Routing Engine 1 REV 12   740-013063   9009042266        RE-S-2000
CB 0             REV 06   710-021523   ABBC1435          MX SCB
CB 1             REV 06   710-021523   ABBC1497          MX SCB
FPC 2      REV 14    750-031088    YH8446            MPC Type 2 3D Q
  CPU            REV 06   711-030884   YH9612            MPC PMB 2G
  MIC 0
  MIC 1          REV 10   750-036132   ZP7062            2xOC12/8xOC3 CC-CE
    PIC 2                 BUILTIN      BUILTIN           2xOC12/8xOC3 CC-CE

  Xcvr 0              NON-JNPR     23393-00492       UNKNOWN
      Xcvr 1              NON-JNPR     23393-00500       UNKNOWN
      Xcvr 2              NON-JNPR     23393-00912       UNKNOWN
      Xcvr 3     REV 01   740-015638   22216-00575       Load SFP
      Xcvr 4     REV 01   740-015638   24145-00110       Load SFP
      Xcvr 5     REV 01   740-015638   24145-00016       Load SFP
      Xcvr 6     REV 01   740-015638   24145-00175       Load SFP
      Xcvr 7              NON-JNPR     23393-00627       UNKNOWN
  QXM 0          REV 05   711-028408   YF4681            MPC QXM
  QXM 1          REV 05   711-028408   YF4817            MPC QXM
Fan Tray 0       REV 01   710-021113   XL3645            MX240 Fan Tray
```

show chassis hardware (MX240, MX480, MX960 routers with Application Services Modular Line Card)

```
user@host>show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11D969BAFA      MX960
Midplane         REV 03   710-013698   ACAA2362          MX960 Backplane
FPM Board        REV 03   710-014974   ZR0639            Front Panel Display
```

```
PDM              Rev 03   740-013110   QCS152250SX       Power Distribution Module
PEM 0             Rev 10   740-013683   QCS1512718W       DC Power Entry Module
PEM 1             Rev 10   740-013683   QCS1512702Y       DC Power Entry Module
Routing Engine 0 REV 15   740-013063   9012024667        RE-S-2000
Routing Engine 1 REV 15   740-013063   9012024649        RE-S-2000
CB 0             REV 14   750-031391   ZJ7749            Enhanced MX SCB
CB 1             REV 14   750-031391   ZJ7750            Enhanced MX SCB
CB 2             REV 14   750-031391   ZY9233            Enhanced MX SCB
FPC 0            REV 17   750-031089   YR7434            MPC Type 2 3D
  CPU
FPC 1            REV 11   750-037207   ZW9727            AS-MCC
  CPU            REV 04   711-038173   ZW4817            AS-MCC-PMB
  MIC 0          REV 01   750-037214   ZH3764            AS-MSC
    PIC 0                 BUILTIN      BUILTIN           AS-MSC
  MIC 1          REV 01   711-028408   JZ9200            AS-MXC
    PIC 2                 BUILTIN      BUILTIN           AS-MXC
FPC 4            REV 30   750-028467   ABBN0232          MPC 3D 16x 10GE
  CPU
FPC 5            REV 04   750-037207   ZK9074            AS-MCC
  CPU
Fan Tray 0       REV 05   740-014971   VT5683            Fan Tray
Fan Tray 1       REV 05   740-014971   VT5684            Fan Tray
```

show chassis hardware extensive (MX240, MX480, MX960 routers with Application Services Modular Line Card)

user@host> **show chassis hardware extensive**

```
ID: AS-MCC                      FRU Model Number:  750-037207
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff  I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 37 01 0b 52 45 56 20 31 31 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 32 30 37 00 00
  Address 0x20: 53 2f 4e 20 5a 57 39 37 32 37 00 00 00 11 02 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 37
  Address 0x50: 35 30 2d 30 33 37 32 30 37 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 31 31 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 5e ff ff ff ff ff ff ff ff ff ff ff ff
  CPU            REV 04   711-038173   ZW4817            AS-MCC-PMB
 Jedec Code:   0x7fb0            EEPROM Version:    0x02
 P/N:          711-038173        S/N:               S/N ZW4817
 Assembly ID:  0x0b38            Assembly Version:  01.04
 Date:         12-30-2011        Assembly Flags:    0x00
 Version:      REV 04
 ID: AS-MCC-PMB
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff  I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 38 01 04 52 45 56 20 30 34 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 33 38 31 37 33 00 00
  Address 0x20: 53 2f 4e 20 5a 57 34 38 31 37 00 00 00 1e 0c 07
  Address 0x30: db ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 00 50 52 4f 54 4f 58 43 4c 45 49 37
  Address 0x50: 31 31 2d 30 33 38 31 37 33 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 30 34 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 60 00 00 00 00 00 00 00 00 00 00 00 00
  MIC 0          REV 01   750-037214   ZH3764            AS-MSC
 Jedec Code:   0x7fb0            EEPROM Version:    0x02
 P/N:          750-037214        S/N:               S/N ZH3764
 Assembly ID:  0x0a44            Assembly Version:  01.01
```

```
 Date:          07-04-2011        Assembly Flags:    0x00
 Version:       REV 01
 ID: AS-MSC
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff  I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0a 44 01 01 52 45 56 20 30 31 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 32 31 34 00 00
  Address 0x20: 53 2f 4e 20 5a 48 33 37 36 34 00 00 00 04 07 07
  Address 0x30: db ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 00 00 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff f6 c0 03 e1 bc 00 00 00 00 00 00 00 00
    PIC 0                 BUILTIN      BUILTIN           AS-MSC
FPC 4            REV 30   750-028467   ABBN0232          MPC 3D 16x 10GE
 Jedec Code:    0x7fb0            EEPROM Version:    0x01
```

show chassis hardware (MX480 Router with MPC4E)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN10FF57BAFB      MX480
Midplane         REV 05   750-047849   Good              MX480 Midplane
FPM Board        REV 02   710-017254   KG2066            Front Panel Display
PEM 0            Rev 03   740-017330   QCS081590BJ       PS 1.2-1.7kW; 100-240V
AC in
PEM 1            Rev 03   740-017330   QCS0815908Z       PS 1.2-1.7kW; 100-240V
AC in
PEM 2            Rev 03   740-029970   QCS1001U001       PS 1.4-2.52kW; 90-264V
AC in
Routing Engine 0 REV 05   740-031116   9009089502        RE-S-1800x4
Routing Engine 1 REV 05   740-031116   9009089624        RE-S-1800x4
CB 0             REV 02   750-031391   YE8506            Enhanced MX SCB
CB 1             REV 14   750-031391   ZK8265            Enhanced MX SCB
FPC 2            REV 05   750-037358   ZT0638            MPC4E 3D 32XGE
  CPU            REV 07   711-035209   ZK3187            HMPC PMB 2G
  PIC 0                   BUILTIN      BUILTIN           8X10GE SFPP
  PIC 1                   BUILTIN      BUILTIN           8X10GE SFPP
  PIC 2                   BUILTIN      BUILTIN           8X10GE SFPP
  PIC 3                   BUILTIN      BUILTIN           8X10GE SFPP
FPC 3            REV 06   750-037355   CAAB1144          MPC4E 3D 2CGE+8XGE
  CPU            REV 08   711-035209   CAAB1278          HMPC PMB 2G
  PIC 0                   BUILTIN      BUILTIN           4x10GE SFPP
    Xcvr 0       REV 01   740-031980   B11E01439         SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11D05809         SFP+-10G-SR
  PIC 1                   BUILTIN      BUILTIN           1X100GE CFP
    Xcvr 0                NON-JNPR     D5418             UNKNOWN
  PIC 2                   BUILTIN      BUILTIN           4x10GE SFPP
  PIC 3                   BUILTIN      BUILTIN           1X100GE CFP
    Xcvr 0                NON-JNPR     X12J00362         CFP-100G-SR10
FPC 4            REV 12.3.10 750-033205 YR9445           MPCE Type 3 3D
  CPU
Fan Tray                                                 Enhanced Left Fan Tray
```

show chassis hardware (MX2020 Router with MPC4E)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11E188CAFJ      MX2020
```



```
Midplane          REV 04   711-032387   ABAC7474         Lower Backplane
Midplane 1        REV 04   711-032386   ABAC7408         Upper Backplane
PMP 1             REV 03   711-032428   ACAJ1137         Upper Power Midplane
PMP 0             REV 03   711-032426   ACAJ1016         Lower Power Midplane
FPM Board         REV 06   760-040242   ABBT8832         Front Panel Display
PSM 3             REV 0C   740-033727   VK00255          DC 52V Power Supply
Module
PSM 4             REV 0C   740-033727   VJ00148          DC 52V Power Supply
Module
PSM 5             REV 0C   740-033727   VK00207          DC 52V Power Supply
Module
PSM 6             REV 0C   740-033727   VK00319          DC 52V Power Supply
Module
PSM 7             REV 0C   740-033727   VK00264          DC 52V Power Supply
Module
PSM 8             REV 0B   740-033727   VG00025          DC 52V Power Supply
Module
PSM 13            REV 0C   740-033727   VK00274          DC 52V Power Supply
Module
PSM 14            REV 0C   740-033727   VJ00167          DC 52V Power Supply
Module
PSM 15            REV 0C   740-033727   VK00299          DC 52V Power Supply
Module
PSM 16            REV 0C   740-033727   VK00213          DC 52V Power Supply
Module
PSM 17            REV 0C   740-033727   VK00253          DC 52V Power Supply
Module
PDM 0             REV 0B   740-038109   VJ00040          DC Power Dist Module
PDM 2             REV 0B   740-038109   VJ00025          DC Power Dist Module
Routing Engine 0 REV 02    740-041821   9009089735       RE-S-1800x4
Routing Engine 1 REV 02    740-041821   9009089731       RE-S-1800x4
CB 0              REV 04   750-040257   ZT2846           Control Board
CB 1              REV 04   750-040257   ZT2877           Control Board
SPMB 0            REV 01   711-041855   ZS2282           PMB Board
SPMB 1            REV 01   711-041855   ZS2261           PMB Board
SFB 0             REV 07   711-032385   ZZ2582           Switch Fabric Board
SFB 1             REV 04   711-032385   ZV4229           Switch Fabric Board
SFB 2             REV 07   711-032385   CAAB4902         Switch Fabric Board
SFB 3             REV 07   711-032385   CAAB4891         Switch Fabric Board
SFB 4             REV 07   711-032385   CAAB4883         Switch Fabric Board
SFB 5             REV 07   711-032385   CAAB4889         Switch Fabric Board
SFB 6             REV 06   711-032385   ZV1818           Switch Fabric Board
SFB 7             REV 07   711-032385   CAAB4897         Switch Fabric Board
FPC 0             REV 34   750-031090   ZT9799           MPC Type 2 3D EQ
  CPU             REV 06   711-030884   ZS1122           MPC PMB 2G
  MIC 0           REV 11   750-033535   CAAD7674         MIC-3D-1OC192-XFP
    PIC 0                  BUILTIN      BUILTIN          MIC-3D-1OC192-XFP
      Xcvr 0      REV 01   740-014279   753019A00404     XFP-OC192-SR
  MIC 1           REV 14   750-031967   ZM6103           MIC-3D-8OC3OC12-4OC48
    PIC 2                  BUILTIN      BUILTIN          MIC-3D-8OC3OC12-4OC48
      Xcvr 0      REV 01   740-011615   PEF1AZP          SFP-IR
      Xcvr 1      REV 01   740-011615   PEF1AZN          SFP-IR
      Xcvr 2      REV 01   740-021308   ANA0N8S          SFP+-10G-SR
  QXM 0           REV 06   711-028408   ZT9339           MPC QXM
  QXM 1           REV 06   711-028408   ZT9237           MPC QXM
FPC 9             REV 34   750-031090   ZT9770           MPC Type 2 3D EQ
  CPU             REV 06   711-030884   ZS1302           MPC PMB 2G
  MIC 0           REV 24   750-028387   YJ3950           3D 4x 10GE  XFP
    PIC 0                  BUILTIN      BUILTIN          2x 10GE  XFP
      Xcvr 0               NON-JNPR     T09M52516        XFP-10G-SR
      Xcvr 1               NON-JNPR     CA49BK095        XFP-10G-SR
```

```
    PIC 1                    BUILTIN      BUILTIN          2x 10GE  XFP
      Xcvr 0       REV 02    740-014289   C834XU01T        XFP-10G-SR
      Xcvr 1                 NON-JNPR     T09M52515        XFP-10G-SR
  MIC 1            REV 11    750-033535   CAAD7681         MIC-3D-1OC192-XFP
    PIC 2                    BUILTIN      BUILTIN          MIC-3D-1OC192-XFP
      Xcvr 0       REV 01    740-014279   KBQ02BE          XFP-OC192-SR
  QXM 0            REV 06    711-028408   ZT9151           MPC QXM
  QXM 1            REV 06    711-028408   ZT9116           MPC QXM
FPC 10             REV 27    750-033205   ZL6215           MPCE Type 3 3D
  CPU              REV 07    711-035209   ZK9038           HMPC PMB 2G
  MIC 0            REV 18    750-028380   YG6885           3D 2x 10GE XFP
    PIC 0                    BUILTIN      BUILTIN          1x 10GE XFP
      Xcvr 0       REV 01    740-014289   C706XU0AG        XFP-10G-SR
    PIC 1                    BUILTIN      BUILTIN          1x 10GE XFP
      Xcvr 0       REV 02    740-014289   T08L84366        XFP-10G-SR
FPC 14             REV 09    750-037355   CAAF1534         MPC4E 3D 2CGE+8XGE
  CPU              REV 08    711-035209   CAAB9879         HMPC PMB 2G
  PIC 0                      BUILTIN      BUILTIN          4x10GE SFPP
    Xcvr 0         REV 01    740-021308   21T511100436     SFP+-10G-SR
    Xcvr 1         REV 01    740-031980   AHP0GPM          SFP+-10G-SR
    Xcvr 2         REV 01    740-031980   123363A00032     SFP+-10G-SR
    Xcvr 3         REV 01    740-021308   19T511100477     SFP+-10G-SR
  PIC 1                      BUILTIN      BUILTIN          1X100GE CFP
    Xcvr 0                   NON-JNPR     X12J00260        CFP-100G-SR10
  PIC 2                      BUILTIN      BUILTIN          4x10GE SFPP
    Xcvr 0         REV 01    740-021308   21T511104086     SFP+-10G-SR
    Xcvr 1         REV 01    740-021308   21T511104627     SFP+-10G-SR
    Xcvr 3         REV 01    740-021308   21T511104644     SFP+-10G-SR
  PIC 3                      BUILTIN      BUILTIN          1X100GE CFP
FPC 19             REV 32    750-028467   ZR2008           MPC 3D 16x 10GE
  CPU              REV 10    711-029089   ZT6933           AMPC PMB
  PIC 0                      BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0         REV 01    740-021308   19T511100291     SFP+-10G-SR
    Xcvr 1         REV 01    740-021308   AMH02VE          SFP+-10G-SR
  PIC 1                      BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0         REV 01    740-021308   23T511102128     SFP+-10G-SR
  PIC 2                      BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0         REV 01    740-021308   AMS15PP          SFP+-10G-SR
  PIC 3                      BUILTIN      BUILTIN          4x 10GE(LAN) SFP+
    Xcvr 0         REV 01    740-031980   123363A00716     SFP+-10G-SR
ADC 0              REV 05    750-043596   CAAC2072         Adapter Card
ADC 9              REV 01    750-043596   ZV4111           Adapter Card
ADC 10             REV 05    750-043596   CAAC2058         Adapter Card
ADC 14             REV 02    750-043596   ZW1561           Adapter Card
ADC 19             REV 01    750-043596   ZV4127           Adapter Card
Fan Tray 0         REV 03    760-046960   ACAY0124         172mm FanTray - 6 Fans
Fan Tray 1         REV 2A    760-046960   ACAY0022         172mm FanTray - 6 Fans
Fan Tray 2         REV 2A    760-046960   ACAY0023         172mm FanTray - 6 Fans
Fan Tray 3         REV 2A    760-046960   ACAY0025         172mm FanTray - 6 Fans
```

show chassis hardware (T320 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item               Version   Part number  Serial number    Description
Chassis                                   19093            T320
Midplane           REV 04    710-004339   BC1436           T320 Backplane
FPM GBUS           REV 03    710-004461   BC1407           T320 FPM Board
FPM Display        REV 04    710-002897   BE0763           FPM Display
CIP                REV 05    710-002895   BB2311           T Series CIP
PEM 0              Rev 01    740-004359   NB12546          Power Entry Module
```



```
SCG 0            REV 06   710-004455   AY4522           T320 Sonet
Clock Gen.
Routing Engine 0                                        unknown
CB 0             REV 13   710-002728   BC1577           T Series
Control Board
CB 1             REV 13   710-002728   BC1595           T Series
Control Board
FPC 1            REV 09   710-007531   HS1572           FPC Type 2
   CPU            REV 15   710-001726   HR8763           FPC CPU
   PIC 0          REV 01   750-010618   CB5579           4x G/E SFP,
1000 BASE
     SFP 0        REV 01   740-007326   P5809Z1          SFP-SX
     SFP 1        REV 01   740-007326   P4Q10XU          SFP-SX
     SFP 2                 NON-JNPR     RA45020031       SFP-SX
     SFP 3                 NON-JNPR     RA45020032       SFP-SX
   PIC 1          REV 01   750-010618   CD9587           4x G/E SFP,
1000 BASE
     SFP 0                 NON-JNPR     P5A08QZ          SFP-T
     SFP 1        REV 01   740-007326   P4Q133K          SFP-SX
     SFP 2        REV 01   740-007326   P5809YY          SFP-SX
     SFP 3        REV 01   740-007327   4C81704          SFP-LX
   MMB 1          REV 03   710-005555   HR9401           MMB-288mbit
   PPB 0          REV 04   710-003758   HR2886           PPB Type 2
FPC 2            REV 07   710-005860   HP2392           FPC Type 1
   CPU            REV 14   710-001726   HP7797           FPC CPU
   PIC 0          REV 02   750-007643   HM0853           1x G/E QPP,
1000 BASE
     SFP 0        REV 01   740-007326   P11E9JJ          SFP-SX
   MMB 1          REV 02   710-005555   HN2379           MMB-288mbit
   PPB 0          REV 04   710-003758   HP8092           PPB Type 2
FPC 3            REV 07   710-005860   HP2393           FPC Type 1
   CPU            REV 14   710-001726   HP0968           FPC CPU
   PIC 0          REV 01   750-010240   CB5363           1x G/E SFP,
1000 BASE
     SFP 0        REV 01   740-007326   P4R0PNH          SFP-SX
   PIC 1          REV 03   750-003034   HD2832           4x OC-3 SONET,
SMIR
   MMB 1          REV 02   710-005555   HN6307           MMB-288mbit
   PPB 0          REV 04   710-003758   HP5051           PPB Type 2
FPC 4            REV 01   710-010845   JD3872           FPC Type 4
   CPU            REV 02   710-011481   JB6042           FPC CPU
 5            REV 01   710-005802   BC1566           FPC Type 2
   CPU            REV 09   710-001726   AY4922           FPC CPU
   PIC 0          REV 02   750-008155   BE2114           2x G/E QPP,
1000 BASE
     SFP 0        REV 01   740-007326   P4R0PMQ          SFP-SX
     SFP 1        REV 01   740-007326   P4R0PN9          SFP-SX
   PIC 1          REV 01   750-008155   BE2116           2x G/E QPP,
1000 BASE
     SFP 0        REV 01   740-007326   P4R0PNZ          SFP-SX
     SFP 1                 NON-JNPR     2908             SFP-T
   MMB 1          REV 01   710-005555   AZ2246           MMB-288mbit
   PPB 0          REV 03   710-003758   AY4839           PPB Type 2
FPC 7            REV 01   710-005803   AZ2123           FPC Type 3
...
```

show chassis hardware (T640 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
```

```
Chassis                                            19182            T640
Midplane          REV 04   710-002726   AX5608           T640 Backplane
FPM GBUS          REV 02   710-002901   HE3064           T640 FPM Board
FPM Display       REV 02   710-002897   HE7864           FPM Display
CIP               REV 05   710-002895   HA5024           T Series CIP
PEM 0             Rev 02   740-029522   VH26235          AC PEM 10kW US
PEM 1             Rev 02   740-029522   VH26230          AC PEM 10kW US
SCG 0             REV 03   710-003423   HA4508           T640 Sonet Clock Gen.
Routing Engine 0  REV 02   740-005022   210865700483     RE-3.0 (RE-600)
CB 0              REV 01   710-002728   HD3044           T Series Control Board
FPC 2             REV 04   710-001721   HD5572           FPC Type 3
  CPU             REV 06   710-001726   HA4712           FPC CPU
  PIC 1           REV 03   750-009567   HV2331           1x 10GE(LAN),XENPAK
    SFP 0         REV 01   740-009898   USC202R103       XENPAK-SR
  PIC 2           REV 03   750-009567   HV2332           1x 10GE(LAN),XENPAK
    SFP 0         REV 01   740-011268   USC202R112       XENPAK-ZR
  PIC 3           REV 03   750-009567   HX4416           1x 10GE(LAN),XENPAK
    SFP 0         REV 01   740-012056   434TC004         XENPAK-CX4
  PIC 4           REV 03   750-009567   HX4420           1x 10GE(LAN),XENPAK
    SFP 0         REV 01   740-012058   434TC124         XENPAK-LX4
FPC 5             REV 01   710-013553   JE4839           E2-FPC Type 1
  CPU             REV 01   710-013569   JW9163           FPC CPU
  PIC 0           REV 01   750-009567   HX4419           1x 10GE(LAN),XENPAK
    SFP 0         REV 01   740-009898   USC202RT05       XENPAK-LR
  PIC 1           REV 03   750-009567   HN7426           1x 10GE(LAN),XENPAK
    SFP 0         REV 01   740-009550   03L90051         XENPAK-ER
  PIC 2           REV 03   750-009467   HT7423           1x 10GE(LAN),XENPAK
    SFP 0                  NON-JNPR                      UNKNOWON
  PIC 3           REV 04   750-005100   AY4850           1x 10GE(LAN),DWDM
FPC 4             REV 01   710-010845   JD3872           FPC Type 4
  CPU             REV 02   710-011481   JB6042           FPC CPU
Fan Tray 0                                               Front Top Fan Tray
Fan Tray 1                                               Front Bottom Fan Tray
Fan Tray 2                                               Rear Fan Tray
```

show chassis hardware models (T640 Router)

```
user@host> show chassis hardware models
Hardware inventory:
Item              Version  Part number  CLEI code        FRU model number
Midplane          REV 04   710-002726                    CHAS-BP-T640-S
FPM Display       REV 02   710-002897                    CRAFT-T640-S
CIP               REV 05   710-002895                    CIP-L-T640-S
PEM 0             Rev 01   740-002595                    PWR-T-DC-S
SCG 0             REV 04   710-003423                    SCG-T-S
SCG 1             REV 04   710-003423                    SCG-T-S
Routing Engine 0  REV 01   740-005022                    RE-600-2048-S
Routing Engine 1  REV 07   740-005022                    RE-600-2048-S
CB 0              REV 06   710-002726                    CHAS-BP-T640-S
CB 1              REV 06   710-002728                    CB-L-T-S
FPC 5             REV 05   710-007527                    T640-FPC2
  PIC 0           REV 05   750-002510                    PB-2GE-SX
  PIC 1           REV 05   750-001901                    PB-4OC12-SON-SMIR
FPC 6             REV 03   710-001721                    T640-FPC3
  PIC 1           REV 01   750-009553                    PC-4OC48-SON-SFP
SIB 4             REV 02   750-005486                    SIB-I-T640-S
Fan Tray 0                                               FANTRAY-T-S
Fan Tray 1                                               FANTRAY-T-S
Fan Tray 2                                               FAN-REAR-TX-T640-S
```

show chassis hardware extensive (T640 Router)

```
user@host> show chassis hardware extensive
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                                  T640
 Jedec Code:   0x7fb0           EEPROM Version:    0x01
 P/N:        ...........       S/N:              ...........
 Assembly ID:  0x0507           Assembly Version:  00.00
 Date:         00-00-0000       Assembly Flags:    0x00
 Version:    ...........
 ID: Gibson LCC Chassis
 Board Information Record:
  Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
 I2C Hex Data:
  Address 0x00: 7f b0 01 ff 05 07 00 00 00 00 00 00 00 00 00 00
  Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x20: ff ff ff ff ff ff ff ff ff ff ff ff 00 00 00 00
  Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Midplane         REV 04   710-002726   AX5633
 Jedec Code:   0x7fb0           EEPROM Version:    0x01
 P/N:          710-002726.      S/N:               S/N AX5633.
 Assembly ID:  0x0127           Assembly Version:  01.04
 Date:         06-27-2001       Assembly Flags:    0x00
 Version:      REV 04.....
 ID: Gibson Backplane
 Board Information Record:
  Address 0x00: ad 01 08 00 00 90 69 0e f8 00 ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 01 ff 01 27 01 04 52 45 56 20 30 34 00 00
  Address 0x10: 00 00 00 00 37 31 30 2d 30 30 32 37 32 36 00 00
  Address 0x20: 53 2f 4e 20 41 58 35 36 33 33 00 00 00 1b 06 07
  Address 0x30: d1 ff ff ff ad 01 08 00 00 90 69 0e f8 00 ff ff
  Address 0x40: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
FPM GBUS         REV 02   710-002901   HE3245
 ...
FPM Display      REV 02   710-002897   HA4873
 ...
CIP              REV 05   710-002895   HA4729
...
PEM 1            RevX02   740-002595   MD21815           Power Entry Module
 ...
SCG 0            REV 04   710-003423   HF6023
 ...
SCG 1            REV 04   710-003423   HF6061
 ...
Routing Engine 0 REV 01   740-005022   210865700292      RE-3.0
...
CB 0             REV 06   710-002728   HE3614
...
FPC 1            REV 01   710-002385   HE3009            FPC Type 1
...              REV 06   710-001726   HC0010
```

show chassis hardware (T4000 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN1172F25AHA      T4000
Midplane         REV 01   710-027486   RC8355            T-series Backplane
```

```
FPM GBUS         REV 13   710-002901   BBAE0927         T640 FPM Board
FPM Display      REV 01   710-021387   EF6764           T1600 FPM Display
CIP              REV 06   710-002895   BBAD9210         T-series CIP
PEM 0            REV 01   740-036442   VA00016          Power Entry Module 6x60
SCG 0            REV 18   710-003423   BBAD7248         T640 Sonet Clock Gen.
SCG 1            REV 18   710-003423   BBAE3874         T640 Sonet Clock Gen.
Routing Engine 0 REV 05   740-026941   P737F-002248     RE-DUO-1800
Routing Engine 1 REV 06   740-026941   P737F-002653     RE-DUO-1800
CB 0             REV 09   710-022597   ED0295           LCC Control Board
CB 1             REV 09   710-022597   EA6050           LCC Control Board
FPC 0            REV 26   750-032819   EK1173           FPC Type 5-3D
  CPU            REV 12   711-030686   EJ8584           SNG PMB
  PIC 0          REV 07   750-034624   EF6837           12x10GE (LAN/WAN) SFPP
    Xcvr 0       REV 01   740-031980   123363A01145     SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   123363A01147     SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AJJ01P3          SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B10M03256        SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   AJJ01M2          SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   123363A01137     SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   AJJ01PN          SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   AJJ01NW          SFP+-10G-SR
    Xcvr 8       REV 01   740-031980   123363A01139     SFP+-10G-SR
    Xcvr 9       REV 01   740-031980   AJJ01KE          SFP+-10G-SR
    Xcvr 10      REV 01   740-031980   123363A01336     SFP+-10G-SR
    Xcvr 11      REV 01   740-031980   B10M01325        SFP+-10G-SR
  PIC 1          REV 07   750-034624   EF6800           12x10GE (LAN/WAN) SFPP
    Xcvr 0       REV 01   740-031980   AJJ01SA          SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AJJ01QZ          SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AJH0217          SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AJJ01TE          SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   AJJ01KV          SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   AJJ01MU          SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   AJJ01R0          SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   AJJ01TC          SFP+-10G-SR
    Xcvr 8       REV 01   740-031980   AJJ0364          SFP+-10G-SR
    Xcvr 9       REV 01   740-031980   AJD0GV3          SFP+-10G-SR
    Xcvr 10      REV 01   740-031980   B10M03343        SFP+-10G-SR
    Xcvr 11      REV 01   740-031980   AJJ01QJ          SFP+-10G-SR
  LMB 0          REV 05   711-034381   EJ8490           Type-0 LMB
  LMB 1          REV 04   711-035774   EJ8517           Type-1 LMB
  LMB 2          REV 05   711-034381   EJ8489           Type-0 LMB
FPC 3            REV 07   750-032819   EG3637           FPC Type 5-3D
  CPU            REV 09   711-030686   EG0150           SNG PMB
  PIC 0          REV 08   750-035293   EF3657           1x100GE
    Xcvr 0       REV 01   740-032210   C22CQNJ          CFP-100G-LR4
  PIC 1          REV 10   750-034624   BBAN4098         12x10GE (LAN/WAN) SFPP
    Xcvr 0       REV 01   740-031980   B11J04902        SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11J04891        SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AJJ01MX          SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11J04183        SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   B11J04894        SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   B11J04184        SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   B11J04897        SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   B11J04899        SFP+-10G-SR
    Xcvr 8       REV 01   740-031980   AJJ01TV          SFP+-10G-SR
    Xcvr 9       REV 01   740-031980   B11J04057        SFP+-10G-SR
    Xcvr 10      REV 01   740-031980   AJJ01M4          SFP+-10G-SR
    Xcvr 11      REV 01   740-031980   B11J04905        SFP+-10G-SR
  LMB 0          REV 04   711-034381   EG1524           Type-0 LMB
  LMB 1          REV 03   711-035774   EG0345           Type-1 LMB
  LMB 2          REV 04   711-034381   EG1522           Type-0 LMB
```

```
FPC 5            REV 03   710-033871   BBAJ0768         FPC Type 4-ES
  CPU            REV 11   710-016744   BBAH9342         ST-PMB2
  PIC 0          REV 09   750-029262   EE6789           100GE
  PIC 1          REV 03   750-034781   EE6655           100GE CFP
    Xcvr 0       REV 01   740-032210   J11A22334        CFP-100G-LR4
  BRIDGE 0       REV 03   711-029995   EE6572           100GE Bridge Board
  MMB 0          REV 07   710-025563   BBAJ4657         ST-MMB2
  MMB 1          REV 07   710-025563   BBAJ3073         ST-MMB2
FPC 6            REV 05   750-010153   EF4936           FPC Type 5-3D
  CPU            REV 06   711-030686   EF4189           SNG PMB
  PIC 0          REV 10   750-034624   BBAN4109         12x10GE (LAN/WAN) SFPP
    Xcvr 0       REV 01   740-031980   B11J04895        SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   B11J04898        SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   B11J04021        SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B11J04903        SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   B11J04311        SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   B11J04059        SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   B11J04016        SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   B11J04017        SFP+-10G-SR
    Xcvr 8       REV 01   740-031980   B11J04887        SFP+-10G-SR
    Xcvr 9       REV 01   740-031980   B11J04297        SFP+-10G-SR
    Xcvr 10      REV 01   740-031980   B11J04893        SFP+-10G-SR
    Xcvr 11      REV 01   740-031980   B11J04022        SFP+-10G-SR
  PIC 1          REV 02   750-034624   EE3711           12x10GE (LAN/WAN) SFPP
    Xcvr 0       REV 01   740-031980   AJH033X          SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AJJ01N0          SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AJJ01SV          SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AJJ032L          SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   B10M01593        SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   AJD0FF1          SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   AJJ01NU          SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   123363A01305     SFP+-10G-SR
    Xcvr 8       REV 01   740-031980   B10M00361        SFP+-10G-SR
    Xcvr 9       REV 01   740-031980   AJJ01M7          SFP+-10G-SR
    Xcvr 10      REV 01   740-031980   AJJ032X          SFP+-10G-SR
    Xcvr 11      REV 01   740-031980   AJJ01PG          SFP+-10G-SR
  LMB 0          REV 04   711-034381   EF3838           Type-0 LMB
  LMB 1          REV 03   711-035774   EF3821           Type-1 LMB
  LMB 2          REV 04   711-034381   EF3834           Type-0 LMB
SPMB 0           REV 05   710-023321   ED1990           LCC Switch CPU
SPMB 1           REV 05   710-023321   EA2768           LCC Switch CPU
SIB 0            REV 02   711-036340   EF8802           SIB-HC-3D
SIB 1            REV 07   711-036340   EG2286           SIB-HC-3D
SIB 2            REV 07   711-036340   EG2252           SIB-HC-3D
SIB 3            REV 02   711-036340   EF1358           SIB-HC-3D
SIB 4            REV 02   711-036340   EF8806           SIB-HC-3D
Fan Tray 0                                              Front Top Fan Tray
Fan Tray 1                                              Front Bottom Fan Tray
-- Rev 2
Fan Tray 2                                              Rear Fan Tray -- Rev 3
```

show chassis hardware (T4000 Router with 16 GB line card chassis (LCC) Routing Engine)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number    Description
Chassis                                JN11BDF2CAHA     T1600
Midplane         REV 01   710-027486   ACAJ0774         T640 Backplane
FPM GBUS         REV 13   710-002901   BBAL6812         T640 FPM Board
FPM Display      REV 04   710-021387   BBAP2679         T1600 FPM Display
CIP              REV 06   710-002895   BBAP4758         T-series CIP
```



```
PEM 0             Rev 03   740-026384   XF86421          Power Entry Module 3x80
PEM 1             Rev 03   740-026384   XF86429          Power Entry Module 3x80
SCG 0             REV 18   710-003423   BBAP1896         T640 Sonet Clock Gen.
SCG 1             REV 18   710-003423   BBAN8659         T640 Sonet Clock Gen.
Routing Engine 0 REV 01   740-042243   737F-002238      RE-DUO-1800-16G
Routing Engine 1 REV 01   740-042243   737F-002403      RE-DUO-1800-16G
CB 1              REV 11   710-022597   EK4526           LCC Control Board
CB 1              REV 11   710-022597   EK4527           LCC Control Board
FPC 0             REV 05   710-033871   EK5644           FPC Type 4-ES
  CPU             REV 11   710-016744   EK3428           ST-PMB2
  PIC 0           REV 20   750-017405   EJ3041           4x 10GE (LAN/WAN) XFP
  PIC 1           REV 17   750-026962   EH7536           10x10GE(LAN/WAN) SFPP
  MMB 0           REV 07   710-025563   EK6039           ST-MMB2
  MMB 1           REV 07   710-025563   EK6086           ST-MMB2
FPC 1             REV 05   710-033871   EK6583           FPC Type 4-ES
  CPU             REV 11   710-016744   EK3401           ST-PMB2
  PIC 0           REV 17   750-026962   EJ8948           10x10GE(LAN/WAN) SFPP
  MMB 0           REV 07   710-025563   EK6202           ST-MMB2
  MMB 1           REV 07   710-025563   EK6112           ST-MMB2
SPMB 1            REV 05   710-023321   EK4900           LCC Switch CPU
SIB 0             REV 11   710-013074   EK5958           SIB-I8-SF
SIB 1             REV 11   710-013074   EK4606           SIB-I8-SF
SIB 2             REV 11   710-013074   EK5971           SIB-I8-SF
SIB 3             REV 11   710-013074   EK4609           SIB-I8-SF
SIB 4             REV 11   710-013074   EK4602           SIB-I8-SF
Fan Tray 0                                               Front Top Fan Tray
Fan Tray 1                                               Front Bottom Fan Tray
Fan Tray 2                                               Rear Fan Tray -- Rev 2
```

show chassis hardware (T4000 Router with LSR FPC)

```
user@switch> show chassis hardware
Hardware inventory:
Item              Version  Part number  Serial number    Description
Chassis                                 JN1173A24AHA     T4000
FPC 3             REV      750-048373   AN7797           FPC Type 5-LSR
  CPU             REV 10   711-030686   AN6649           SNG PMB
  PIC 0           REV 07   750-034624   EF6830           12x10GE (LAN/WAN) SFPP
```

show chassis hardware clei-models (T4000 Router)

```
user@host> show chassis hardware clei-models
Hardware inventory:
Item              Version  Part number  CLEI code        FRU model number
Midplane          REV 01   710-027486   IPMJ700DRD       CHAS-BP-T1600-S
FPM Display       REV 01   710-021387                    CRAFT-T1600-S
CIP               REV 06   710-002895                    CIP-L-T640-S
PEM 0             REV 01   740-036442   IPUPAG6KAA       PWR-T-6-60-DC
SCG 0             REV 18   710-003423                    SCG-T-S
SCG 1             REV 18   710-003423                    SCG-T-S
Routing Engine 0 REV 05   740-026941                    RE-DUO-C1800-8G-S
Routing Engine 1 REV 06   740-026941                    RE-DUO-C1800-8G-S
CB 0              REV 09   710-022597                    CB-LCC-S
CB 1              REV 09   710-022597                    CB-LCC-S
FPC 3
  PIC 0           REV 08   750-035293   XXXXXXXXBB       PF-1CGE-CFP
  PIC 1           REV 10   750-034624   XXXXXXXXCC       PF-12XGE-SFPP
FPC 5             REV 03   710-033871   IPUCAMBCTD       T1600-FPC4-ES
  PIC 1           REV 03   750-034781   IPUIBKLMAA       PD-1CE-CFP-FPC4
FPC 6
  PIC 0           REV 10   750-034624   XXXXXXXXCC       PF-12XGE-SFPP
```



```
Fan Tray 0                                               FANTRAY-T-S
Fan Tray 1                                               FANTRAY-T4000-S
Fan Tray 2                                               FANTRAY-TXP-R-S
```

show chassis hardware detail (T4000 Router)

```
user@host> show chassis hardware detail
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN1172F25AHA      T4000
Midplane         REV 01   710-027486   RC8355            T-series Backplane
FPM GBUS         REV 13   710-002901   BBAE0927          T640 FPM Board
FPM Display      REV 01   710-021387   EF6764            T1600 FPM Display
CIP              REV 06   710-002895   BBAD9210          T-series CIP
PEM 0            REV 01   740-036442   VA00016           Power Entry Module 6x60
SCG 0            REV 18   710-003423   BBAD7248          T640 Sonet Clock Gen.
SCG 1            REV 18   710-003423   BBAE3874          T640 Sonet Clock Gen.
Routing Engine 0 REV 05   740-026941   P737F-002248      RE-DUO-1800
  ad0    3823 MB  SMART CF             2009121602A661576157 Compact Flash
  ad1   59690 MB  STEC MACH-8 SSD      STM000103FDB      Disk 1
Routing Engine 1 REV 06   740-026941   P737F-002653      RE-DUO-1800
  ad0    3823 MB  SMART CF             201011150153F52CF52C Compact Flash
  ad1   62720 MB  SMART Lite SATA Drive 2010110900150A880A88 Disk 1
CB 0             REV 09   710-022597   ED0295            LCC Control Board
CB 1             REV 09   710-022597   EA6050            LCC Control Board
FPC 0            REV 26   750-032819   EK1173            FPC Type 5-3D
  CPU            REV 12   711-030686   EJ8584            SNG PMB
  PIC 0          REV 07   750-034624   EF6837            12x10GE (LAN/WAN) SFPP
    Xcvr 0       REV 01   740-031980   123363A01145      SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   123363A01147      SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AJJ01P3           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   B10M03256         SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   AJJ01M2           SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   123363A01137      SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   AJJ01PN           SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   AJJ01NW           SFP+-10G-SR
    Xcvr 8       REV 01   740-031980   123363A01139      SFP+-10G-SR
    Xcvr 9       REV 01   740-031980   AJJ01KE           SFP+-10G-SR
    Xcvr 10      REV 01   740-031980   123363A01336      SFP+-10G-SR
    Xcvr 11      REV 01   740-031980   B10M01325         SFP+-10G-SR
  PIC 1          REV 07   750-034624   EF6800            12x10GE (LAN/WAN) SFPP
    Xcvr 0       REV 01   740-031980   AJJ01SA           SFP+-10G-SR
    Xcvr 1       REV 01   740-031980   AJJ01QZ           SFP+-10G-SR
    Xcvr 2       REV 01   740-031980   AJH0217           SFP+-10G-SR
    Xcvr 3       REV 01   740-031980   AJJ01TE           SFP+-10G-SR
    Xcvr 4       REV 01   740-031980   AJJ01KV           SFP+-10G-SR
    Xcvr 5       REV 01   740-031980   AJJ01MU           SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   AJJ01R0           SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   AJJ01TC           SFP+-10G-SR
    Xcvr 8       REV 01   740-031980   AJJ0364           SFP+-10G-SR
    Xcvr 9       REV 01   740-031980   AJD0GV3           SFP+-10G-SR
    Xcvr 10      REV 01   740-031980   B10M03343         SFP+-10G-SR
    Xcvr 11      REV 01   740-031980   AJJ01QJ           SFP+-10G-SR
  LMB 0          REV 05   711-034381   EJ8490            Type-0 LMB
  LMB 1          REV 04   711-035774   EJ8517            Type-1 LMB
  LMB 2          REV 05   711-034381   EJ8489            Type-0 LMB
FPC 3            REV 07   750-032819   EG3637            FPC Type 5-3D
  CPU            REV 09   711-030686   EG0150            SNG PMB
  PIC 0          REV 08   750-035293   EF3657            1x100GE
    Xcvr 0       REV 01   740-032210   C22CQNJ           CFP-100G-LR4
  PIC 1          REV 10   750-034624   BBAN4098          12x10GE (LAN/WAN) SFPP
```

```
      Xcvr 0        REV 01   740-031980   B11J04902        SFP+-10G-SR
      Xcvr 1        REV 01   740-031980   B11J04891        SFP+-10G-SR
      Xcvr 2        REV 01   740-031980   AJJ01MX          SFP+-10G-SR
      Xcvr 3        REV 01   740-031980   B11J04183        SFP+-10G-SR
      Xcvr 4        REV 01   740-031980   B11J04894        SFP+-10G-SR
      Xcvr 5        REV 01   740-031980   B11J04184        SFP+-10G-SR
      Xcvr 6        REV 01   740-031980   B11J04897        SFP+-10G-SR
      Xcvr 7        REV 01   740-031980   B11J04899        SFP+-10G-SR
      Xcvr 8        REV 01   740-031980   AJJ01TV          SFP+-10G-SR
      Xcvr 9        REV 01   740-031980   B11J04057        SFP+-10G-SR
      Xcvr 10       REV 01   740-031980   AJJ01M4          SFP+-10G-SR
      Xcvr 11       REV 01   740-031980   B11J04905        SFP+-10G-SR
    LMB 0           REV 04   711-034381   EG1524           Type-0 LMB
    LMB 1           REV 03   711-035774   EG0345           Type-1 LMB
    LMB 2           REV 04   711-034381   EG1522           Type-0 LMB
  FPC 5             REV 03   710-033871   BBAJ0768         FPC Type 4-ES
    CPU             REV 11   710-016744   BBAH9342         ST-PMB2
    PIC 0           REV 09   750-029262   EE6789           100GE
    PIC 1           REV 03   750-034781   EE6655           100GE CFP
      Xcvr 0        REV 01   740-032210   J11A22334        CFP-100G-LR4
    BRIDGE 0        REV 03   711-029995   EE6572           100GE Bridge Board
    MMB 0           REV 07   710-025563   BBAJ4657         ST-MMB2
    MMB 1           REV 07   710-025563   BBAJ3073         ST-MMB2
  FPC 6             REV 05   750-010153   EF4936           FPC Type 5-3D
    CPU             REV 06   711-030686   EF4189           SNG PMB
    PIC 0           REV 10   750-034624   BBAN4109         12x10GE (LAN/WAN) SFPP
      Xcvr 0        REV 01   740-031980   B11J04895        SFP+-10G-SR
      Xcvr 1        REV 01   740-031980   B11J04898        SFP+-10G-SR
      Xcvr 2        REV 01   740-031980   B11J04021        SFP+-10G-SR
      Xcvr 3        REV 01   740-031980   B11J04903        SFP+-10G-SR
      Xcvr 4        REV 01   740-031980   B11J04311        SFP+-10G-SR
      Xcvr 5        REV 01   740-031980   B11J04059        SFP+-10G-SR
      Xcvr 6        REV 01   740-031980   B11J04016        SFP+-10G-SR
      Xcvr 7        REV 01   740-031980   B11J04017        SFP+-10G-SR
      Xcvr 8        REV 01   740-031980   B11J04887        SFP+-10G-SR
      Xcvr 9        REV 01   740-031980   B11J04297        SFP+-10G-SR
      Xcvr 10       REV 01   740-031980   B11J04893        SFP+-10G-SR
      Xcvr 11       REV 01   740-031980   B11J04022        SFP+-10G-SR
    PIC 1           REV 02   750-034624   EE3711           12x10GE (LAN/WAN) SFPP
      Xcvr 0        REV 01   740-031980   AJH033X          SFP+-10G-SR
      Xcvr 1        REV 01   740-031980   AJJ01N0          SFP+-10G-SR
      Xcvr 2        REV 01   740-031980   AJJ01SV          SFP+-10G-SR
      Xcvr 3        REV 01   740-031980   AJJ032L          SFP+-10G-SR
      Xcvr 4        REV 01   740-031980   B10M01593        SFP+-10G-SR
      Xcvr 5        REV 01   740-031980   AJD0FF1          SFP+-10G-SR
      Xcvr 6        REV 01   740-031980   AJJ01NU          SFP+-10G-SR
      Xcvr 7        REV 01   740-031980   123363A01305     SFP+-10G-SR
      Xcvr 8        REV 01   740-031980   B10M00361        SFP+-10G-SR
      Xcvr 9        REV 01   740-031980   AJJ01M7          SFP+-10G-SR
      Xcvr 10       REV 01   740-031980   AJJ032X          SFP+-10G-SR
      Xcvr 11       REV 01   740-031980   AJJ01PG          SFP+-10G-SR
    LMB 0           REV 04   711-034381   EF3838           Type-0 LMB
    LMB 1           REV 03   711-035774   EF3821           Type-1 LMB
    LMB 2           REV 04   711-034381   EF3834           Type-0 LMB
  SPMB 0            REV 05   710-023321   ED1990           LCC Switch CPU
  SPMB 1            REV 05   710-023321   EA2768           LCC Switch CPU
  SIB 0             REV 02   711-036340   EF8802           SIB-HC-3D
  SIB 1             REV 07   711-036340   EG2286           SIB-HC-3D
  SIB 2             REV 07   711-036340   EG2252           SIB-HC-3D
  SIB 3             REV 02   711-036340   EF1358           SIB-HC-3D
  SIB 4             REV 02   711-036340   EF8806           SIB-HC-3D
```



```
Fan Tray 0                                                  Front Top Fan Tray
Fan Tray 1                                                  Front Bottom Fan Tray
-- Rev 2
Fan Tray 2                                                  Rear Fan Tray -- Rev 3
```

show chassis hardware models (T4000 Router)

```
user@host> show chassis hardware models

Hardware inventory:
Item             Version  Part number  Serial number     FRU model number
Midplane         REV 01   710-027486   RC8355            CHAS-BP-T1600-S
FPM Display      REV 01   710-021387   EF6764            CRAFT-T1600-S
CIP              REV 06   710-002895   BBAD9210          CIP-L-T640-S
PEM 0            REV 01   740-036442   VA00016           PWR-T-6-60-DC
SCG 0            REV 18   710-003423   BBAD7248          SCG-T-S
SCG 1            REV 18   710-003423   BBAE3874          SCG-T-S
Routing Engine 0 REV 05   740-026941   P737F-002248      RE-DUO-C1800-8G-S
Routing Engine 1 REV 06   740-026941   P737F-002653      RE-DUO-C1800-8G-S
CB 0             REV 09   710-022597   ED0295            CB-LCC-S
CB 1             REV 09   710-022597   EA6050            CB-LCC-S
FPC 3
  PIC 0          REV 08   750-035293   EF3657            PF-1CGE-CFP
  PIC 1          REV 10   750-034624   BBAN4098          PF-12XGE-SFPP
FPC 5            REV 03   710-033871   BBAJ0768          T1600-FPC4-ES
  PIC 1          REV 03   750-034781   EE6655            PD-1CE-CFP-FPC4
FPC 6
  PIC 0          REV 10   750-034624   BBAN4109          PF-12XGE-SFPP
Fan Tray 0                                               FANTRAY-T-S
Fan Tray 1                                               FANTRAY-T4000-S
Fan Tray 2                                               FAN-REAR-TXP-LCC
```

show chassis hardware lcc (TX Matrix Router)

```
user@host> show chassis hardware lcc 0
lcc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                65751             T640
Midplane         REV 03   710-005608   RA1408            T640 Backplane
FPM GBUS         REV 09   710-002901   RA2784            T640 FPM Board
FPM Display      REV 05   710-002897   RA2825            FPM Display
CIP              REV 06   710-002895   HT0684            T Series CIP
PEM 0            Rev 11   740-002595   PM18483           Power Entry Module
PEM 1            Rev 11   740-002595   qb13984           Power Entry Module
SCG 0            REV 11   710-003423   HT0022            T640 Sonet Clock Gen.
Routing Engine 0 REV 13   740-005022   210865700363      RE-3.0 (RE-600)
CB 0             REV 03   710-007655   HW1195            Control Board (CB-T)
FPC 1            REV 05   710-007527   HM3245            FPC Type 2
  CPU            REV 14   710-001726   HM1084            FPC CPU
  PIC 0          REV 02   750-007218   AZ1112            2x OC-12 ATM2 IQ, SMIR
  PIC 1          REV 02   750-007745   HG3462            4x OC-3 SONET, SMIR
  PIC 2          REV 14   750-001901   BA5390            4x OC-12 SONET, SMIR
  PIC 3          REV 09   750-008155   HS3012            2x G/E IQ, 1000 BASE
    SFP 0                 NON-JNPR     P1186TY           SFP-S
    SFP 1        REV 01   740-007326   P11WLTF           SFP-SX
  MMB 1          REV 02   710-005555   HL7514            MMB-288mbit
  PPB 0          REV 04   710-003758   HM4405            PPB Type 2
  PPB 1          REV 04   710-003758   AV1960            PPB Type 2
FPC 2            REV 08   710-010154   HZ3578            E-FPC Type 3
```



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  CPU              REV 05    710-010169    HZ3219           FPC CPU-Enhanced
  PIC 0            REV 02    750-009567    HX2882           1x 10GE(LAN),XENPAK
    SFP 0          REV 01    740-009898    USC202U709       XENPAK-LR
  PIC 1            REV 03    750-003336    HJ9954           4x OC-48 SONET, SMSR
  PIC 2            REV 01    750-004535    HC0235           1x OC-192 SM SR1
  PIC 3            REV 07    750-007141    HX1699           10x 1GE(LAN), 1000 BASE

    SFP 0          REV 01    740-007326    2441042          SFP-SX
    SFP 1          REV 01    740-007326    2441027          SFP-SX
  MMB 0            REV 03    710-010171    HV2365           MMB-5M3-288mbit
  MMB 1            REV 03    710-010171    HZ3888           MMB-5M3-288mbit
SPMB 0             REV 09    710-003229    HW5245           T Series Switch CPU
SIB 3              REV 07    710-005781    HR5927           SIB-L8-F16
  B Board          REV 06    710-005782    HR5971           SIB-L8-F16 (B)
SIB 4              REV 07    710-005781    HR5903           SIB-L8-F16
  B Board          REV 06    710-005782    HZ5275           SIB-L8-F16 (B)
```

show chassis hardware scc (TX Matrix Router)

```
user@host> show chassis hardware scc
scc-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                                  TX Matrix
Midplane         REV 04   710-004396   RB0014            SCC Midplane
FPM GBUS         REV 04   710-004617   HW9141            SCC FPM Board
FPM Display      REV 04   710-004619   HS5950            SCC FPM
CIP 0            REV 01   710-010218   HV9151            SCC CIP
CIP 1            REV 01   710-010218   HV9152            SCC CIP
PEM 1            Rev 11   740-002595   QB13977           Power Entry Module
Routing Engine 0 REV 05   740-008883   P11123900153      RE-4.0 (RE-1600)
CB 0             REV 01   710-011709   HR5964            Control Board (CB-TX)
SPMB 0           REV 09   710-003229   HW5293            T Series Switch CPU
SIB 3
SIB 4            REV 01   710-005839   HW1177            SIB-S8-F16
  B Board        REV 01   710-005840   HW1202            SIB-S8-F16 (B)
```

show chassis hardware (T1600 Router)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                B2703             T1600
Midplane         REV 03   710-005608   RC4137            T640 Backplane
FPM GBUS         REV 10   710-002901   DT7062            T640 FPM Board
FPM Display      REV 05   710-002897   DS3067            FPM Display
CIP              REV 06   710-002895   DT3386            T-series CIP
PEM 0            Rev 07   740-017906   UA26344           Power Entry Module 3x80
PEM 1            Rev 18   740-002595   UF38441           Power Entry Module
SCG 0            REV 15   710-003423   DV0941            T640 Sonet Clock Gen.
Routing Engine 0 REV 08   740-014082   9009014502        RE-A-2000
Routing Engine 1 REV 07   740-014082   9009009591        RE-A-2000
CB 0             REV 05   710-007655   JA9360            Control Board (CB-T)
CB 1             REV 03   710-017707   DT3251            Control Board (CB-T)
FPC 0            REV 07   710-013558   DR4253            E2-FPC Type 2
  CPU            REV 05   710-013563   DS3902            FPC CPU-Enhanced
  PIC 0          REV 01   750-010618   CB5446            4x G/E SFP, 1000 BASE
    Xcvr 0       REV 01   740-011613   P9F11CW           SFP-SX
    Xcvr 1       REV 01   740-011613   P9F15C2           SFP-SX
    Xcvr 2       REV 01   740-011782   PB94K0L           SFP-SX
```



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  PIC 1          REV 06   750-001900   HB6399           1x OC-48 SONET, SMSR
  PIC 2          REV 14   750-001901   AP1092           4x OC-12 SONET, SMIR
  PIC 3          REV 07   750-001900   AR8275           1x OC-48 SONET, SMSR
  MMB 1          REV 07   710-010171   DS1524           MMB-5M3-288mbit
FPC 1            REV 06   710-013553   DL9067           E2-FPC Type 1
  CPU            REV 04   710-013563   DM1685           FPC CPU-Enhanced
  PIC 0          REV 08   750-001072   AB1688           1x G/E, 1000 BASE-SX
  PIC 1          REV 10   750-012266   JX5519           4x 1GE(LAN), IQ2
    Xcvr 0       REV 01   740-011613   AM0812S8UK6      SFP-SX
    Xcvr 2       REV 01   740-011613   AM0812S8UK1      SFP-SX
    Xcvr 3       REV 01   740-011782   P8N1YHG          SFP-SX
  PIC 2         REV 22   750-005634   DP0083          1x CHOC12 IQ SONET, SMIR

  MMB 1          REV 07   710-008923   DN1862           MMB 3M 288-bit
FPC 2            REV 01   710-005548   HJ9899           FPC Type 3
  CPU            REV 06   710-001726   HC0586           FPC CPU
  PIC 0          REV 16   750-007141   NC9660           10x 1GE(LAN), 1000 BASE

    Xcvr 0       REV 01   740-011613   AM0812S8XAR      SFP-SX
    Xcvr 1       REV 01   740-011782   P920E7B          SFP-SX
    Xcvr 2       REV 01   740-011613   AM0812S8XAU      SFP-SX
    Xcvr 4       REV 01   740-011613   AM0812S8XAK      SFP-SX
    Xcvr 5       REV 01   740-011613   AM0812S8XAA      SFP-SX
    Xcvr 6       REV 01   740-011613   PAJ4NKY          SFP-SX
    Xcvr 7       REV 01   740-011613   AM0812S8UJW      SFP-SX
    Xcvr 8       REV 01   740-011782   PB81X89          SFP-SX
    Xcvr 9       REV 01   740-011613   AM0812S8UJX      SFP-SX
  PIC 1          REV 06   750-015217   DK3280           8x 1GE(TYPE3), IQ2
    Xcvr 0       REV 01   740-011782   P8P0A3T          SFP-SX
    Xcvr 1       REV 01   740-013111   5090002          SFP-T
    Xcvr 2       REV 01   740-011613   AM0814S93BQ      SFP-SX
    Xcvr 4                NON-JNPR     PDE0FAN          SFP-SX
    Xcvr 5       REV 01   740-011782   P8Q20XY          SFP-SX
    Xcvr 6       REV 01   740-011613   AM0812S8UJV      SFP-SX
    Xcvr 7       REV 01   740-011613   AM0812S8UP7      SFP-SX
  PIC 2          REV 05   750-004695   HT4383           1x Tunnel
  PIC 3          REV 17   750-009553   RL0204           4x OC-48 SONET
    Xcvr 0       REV 01   740-011785   PDS3T23          SFP-SR
    Xcvr 1       REV 01   740-011785   P6Q0F3E          SFP-SR
  MMB 0          REV 03   710-004047   HD5843           MMB-288mbit
  MMB 1          REV 03   710-004047   HE3208           MMB-288mbit
  PPB 0          REV 02   710-002845   HA4524           PPB Type 3
  PPB 1          REV 02   710-002845   HA4766           PPB Type 3
FPC 3            REV 01   710-010154   HR0863           E-FPC Type 3
  CPU            REV 01   710-010169   HN3422           FPC CPU-Enhanced
  PIC 0          REV 07   750-012793   WF5096           1x 10GE(LAN/WAN) IQ2
    Xcvr 0                NON-JNPR     M64294TP         XFP-10G-LR
  PIC 1          REV 25   750-007141   DV2127           10x 1GE(LAN), 1000 BASE

    Xcvr 0       REV 01   740-011613   PFA6LTJ          SFP-SX
    Xcvr 1       REV 01   740-011782   P9P0XV4          SFP-SX
    Xcvr 2       REV 01   740-011782   P9M0TNX          SFP-SX
    Xcvr 4       REV 01   740-011782   P9B0TTP          SFP-SX
    Xcvr 5                NON-JNPR     PBS4LED          SFP-SX
  PIC 2          REV 17   750-009553   RL0212           4x OC-48 SONET
    Xcvr 0       REV 01   740-011785   PDS3T8G          SFP-SR
  PIC 3          REV 32   750-003700   DL1279           1x OC-192 12xMM VSR
  MMB 0          REV 01   710-010171   HR0821           MMB-288mbit
  MMB 1          REV 01   710-010171   HR0818           MMB-288mbit
FPC 4            REV 16   710-013037   EB4919           FPC Type 4-ES
  CPU            REV 09   710-016744   BBAA4382         ST-PMB2
```

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  PIC 0         REV 03   711-029996   EB1569           100GE
  PIC 1         REV 05   711-029999   EB9983           100GE CFP
    Xcvr 0      REV 0    740-032210   J10G80746        CFP-100G-LR4
  BRIDGE 0      REV 02   711-029995   EB2235           100GE Bridge Board
  MMB 0         REV 04   710-025563   BBAA7112         ST-MMB2
  MMB 1         REV 04   710-025563   BBAA7149         ST-MMB2
FPC 5           REV 02   710-013037   DE3407           FPC Type 4-ES
  CPU           REV 04   710-016744   DA2124           ST-PMB2
  PIC 0         REV 16   750-012518   DF2554           4x OC-192 SONET XFP
    Xcvr 0      REV 01   740-014279   AA0745N1FX8      XFP-OC192-SR
    Xcvr 1      REV 01   740-014279   AA0748N1HN5      XFP-OC192-SR
    Xcvr 2      REV 01   740-014279   AA0748N1HT6      XFP-OC192-SR
    Xcvr 3      REV 01   740-014279   AA0744N1EC9      XFP-OC192-SR
  PIC 1         REV 01   750-010850   JA0329           1x OC-768 SONET SR
  MMB 0         REV 04   710-016036   DE9577           ST-MMB2
  MMB 1         REV 04   710-016036   DK4060           ST-MMB2
FPC 6           REV 14   710-013037   DV1431           FPC Type 4-ES
  CPU           REV 09   710-016744   DT9020           ST-PMB2
  PIC 0         REV 11   750-017405   DM6261           4x 10GE (LAN/WAN) XFP
    Xcvr 0      REV 01   740-014289   C701XU05Q        XFP-10G-SR
    Xcvr 1      REV 01   740-014279   AA0748N1HPT      XFP-10G-LR
    Xcvr 2      REV 01   740-014289   T08E19189        XFP-10G-SR
    Xcvr 3      REV 01   740-014289   C715XU058        XFP-10G-SR
  PIC 1         REV 13   750-017405   DP8772           4x 10GE (LAN/WAN) XFP
    Xcvr 0      REV 02   740-011571   C850XJ037        XFP-10G-SR
    Xcvr 1      REV 02   740-014289   C839XU0L9        XFP-10G-SR
    Xcvr 2      REV 02   740-014289   C834XU05A        XFP-10G-SR
    Xcvr 3      REV 02   740-014289   C810XU0CE        XFP-10G-SR
  MMB 0         REV 01   710-025563   DT8454           ST-MMB2
  MMB 1         REV 01   710-025563   DT8366           ST-MMB2
FPC 7           REV 09   710-007529   HZ7624           FPC Type 3
  CPU           REV 15   710-001726   HZ1413           FPC CPU
  PIC 0         REV 10   750-012793   DM5627           1x 10GE(LAN/WAN) IQ2
    Xcvr 0      REV 02   740-011571   C831XJ062        XFP-10G-SR
  PIC 1         REV 01   750-015217   JT6762           8x 1GE(TYPE3), IQ2
    Xcvr 0      REV 01   740-011782   P8Q25JU          SFP-SX
    Xcvr 1      REV 01   740-011782   P9B0U0K          SFP-SX
  PIC 2         REV 01   750-015217   JS4268           8x 1GE(TYPE3), IQ2
    Xcvr 0      REV 01   740-011613   AM0812S8XBZ      SFP-SX
    Xcvr 1      REV 01   740-011613   AM0812S8XAP      SFP-SX
    Xcvr 2      REV 01   740-011613   AM0812S8XBY      SFP-SX
    Xcvr 3      REV 01   740-011613   AM0812S8XBX      SFP-SX
    Xcvr 4      REV 01   740-011613   P9F1652          SFP-SX
    Xcvr 5      REV 01   740-011782   P8Q21YC          SFP-SX
    Xcvr 6      REV 01   740-011782   P8Q27HQ          SFP-SX
    Xcvr 7      REV 01   740-011613   P8E2SSU          SFP-SX
  PIC 3         REV 15   750-009450   NB6790           1x OC-192 SM SR2
  MMB 0         REV 03   710-005555   HZ3450           MMB-288mbit
  MMB 1         REV 03   710-005555   HZ3415           MMB-288mbit
  PPB 0         REV 04   710-002845   HP0887           PPB Type 3
  PPB 1         REV 04   710-002845   HW5255           PPB Type 3
SPMB 0          REV 10   710-003229   HX3699           T-series Switch CPU
SPMB 1          REV 12   710-003229   DT3091           T-series Switch CPU
SIB 0           REV 07   710-013074   DS4747           SIB-I8-SF
SIB 1           REV 07   710-013074   DS4942           SIB-I8-SF
SIB 2           REV 07   710-013074   DS4965           SIB-I8-SF
SIB 3           REV 07   710-013074   DS4990           SIB-I8-SF
SIB 4           REV 07   710-013074   DS4944           SIB-I8-SF
Fan Tray 0                                             Front Top Fan Tray
Fan Tray 1                                             Front Bottom Fan Tray
Fan Tray 2                                             Rear Fan Tray -- Rev 2
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show chassis hardware (TX Matrix Plus Router)

```
user@host> show chassis hardware
sfc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN113186EAHB      TXP
Midplane         REV 05   710-022574   TS3822            SFC Midplane
FPM Display      REV 03   710-024027   DW4701            TXP FPM Display
CIP 0            REV 05   710-023792   DW7998            TXP CIP
CIP 1            REV 05   710-023792   DW7999            TXP CIP
PEM 0            Rev 04   740-027463   UM26367           Power Entry Module
PEM 1            Rev 04   740-027463   UM26346           Power Entry Module
Routing Engine 0 REV 06   740-026942   737A-1081         RE-DUO-2600
Routing Engine 1 REV 06   740-026942   737A-1043         RE-DUO-2600
CB 0             REV 05   710-022606   DW4435            SFC Control Board
CB 1             REV 09   710-022606   DW6100            SFC Control Board
SPMB 0                    BUILTIN                        SFC Switch CPU
SPMB 1                    BUILTIN                        SFC Switch CPU
SIB F13 0        REV 04   750-024564   DW5764            F13 SIB
  B Board        REV 03   710-023431   DW9053            F13 SIB Mezz
SIB F13 3        REV 04   750-024564   DW5785            F13 SIB
  B Board        REV 03   710-023431   DW9030            F13 SIB Mezz
SIB F13 6
SIB F13 8        REV 04   750-024564   DW5752            F13 SIB
  B Board        REV 03   710-023431   DW9051            F13 SIB Mezz
SIB F13 11       REV 04   750-024564   DW5782            F13 SIB
  B Board        REV 03   710-023431   DW9058            F13 SIB Mezz
SIB F13 12       REV 03   750-024564   DT9466            F13 SIB
  B Board        REV 02   710-023431   DT6556            F13 SIB Mezz
SIB F2S 0/0      REV 05   710-022603   DW7898            F2S SIB
  B Board        REV 05   710-023787   DW7625            F2S SIB Mezz
SIB F2S 0/2      REV 05   710-022603   DW7811            F2S SIB
  B Board        REV 05   710-023787   DW7550            F2S SIB Mezz
SIB F2S 0/4      REV 04   710-022603   DW4873            F2S SIB
  B Board        REV 05   710-023787   DW8509            F2S SIB Mezz
SIB F2S 0/6      REV 04   710-022603   DW4867            F2S SIB
  B Board        REV 05   710-023787   DW8472            F2S SIB Mezz
SIB F2S 1/0      REV 04   710-022603   DW4871            F2S SIB
  B Board        REV 05   710-023787   DW8497            F2S SIB Mezz
SIB F2S 1/2      REV 05   710-022603   DW7868            F2S SIB
  B Board        REV 05   710-023787   DW7551            F2S SIB Mezz
SIB F2S 1/4      REV 04   710-022603   DW4854            F2S SIB
  B Board        REV 05   710-023787   DW8496            F2S SIB Mezz
SIB F2S 1/6      REV 05   710-022603   DW7889            F2S SIB
  B Board        REV 05   710-023787   DW7496            F2S SIB Mezz
SIB F2S 2/0      REV 04   710-022603   DW4852            F2S SIB
  B Board        REV 05   710-023787   DW8498            F2S SIB Mezz
SIB F2S 2/2      REV 04   710-022603   DW4845            F2S SIB
  B Board        REV 05   710-023787   DW8457            F2S SIB Mezz
SIB F2S 2/4      REV 05   710-022603   DW7802            F2S SIB
  B Board        REV 05   710-023787   DW7562            F2S SIB Mezz
SIB F2S 2/6      REV 04   710-022603   DW4822            F2S SIB
  B Board        REV 05   710-023787   DW8467            F2S SIB Mezz
SIB F2S 3/0      REV 05   710-022603   DW7815            F2S SIB
  B Board        REV 05   710-023787   DW7518            F2S SIB Mezz
SIB F2S 3/2      REV 03   710-022603   DV0068            F2S SIB
  B Board        REV 03   710-023787   DT9974            F2S SIB Mezz
SIB F2S 3/4      REV 05   710-022603   DW7874            F2S SIB
  B Board        REV 05   710-023787   DW7601            F2S SIB Mezz
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SIB F2S 3/6      REV 03   710-022603   DV0033            F2S SIB
  B Board        REV 03   710-023787   DT9969            F2S SIB Mezz
SIB F2S 4/0      REV 03   710-022603   DV0043            F2S SIB
  B Board        REV 03   710-023787   DT9948            F2S SIB Mezz
SIB F2S 4/2      REV 05   710-022603   DW5446            F2S SIB
  B Board        REV 05   710-023787   DW7611            F2S SIB Mezz
SIB F2S 4/4      REV 04   710-022603   DW4826            F2S SIB
  B Board        REV 05   710-023787   DW8458            F2S SIB Mezz
SIB F2S 4/6      REV 03   710-022603   DV0026            F2S SIB
  B Board        REV 03   710-023787   DT9963            F2S SIB Mezz
Fan Tray 0       REV 02   760-024497   DR8290            Front Fan Tray
Fan Tray 1       REV 02   760-024497   DR8293            Front Fan Tray
Fan Tray 2       REV 05   760-024502   DR8280            Rear Fan Tray
Fan Tray 3
Fan Tray 4       REV 05   760-024502   DR8276            Rear Fan Tray
Fan Tray 5       REV 02   760-024502   DP5643            Rear Fan Tray

lcc0-re0:
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Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11036F8AHA      T1600
Midplane         REV 03   710-017247   RC3799            T-series Backplane
FPM GBUS         REV 10   710-002901   DP7009            T640 FPM Board
FPM Display      REV 01   710-021387   DN7026            T1600 FPM Display
CIP              REV 06   710-002895   DP6024            T-series CIP
PEM 1           Rev 02   740-023211   WA50019          Power Entry Module 4x60A
SCG 0            REV 15   710-003423   DR6757            T640 Sonet Clock Gen.
SCG 1            REV 15   710-003423   DS2225            T640 Sonet Clock Gen.
Routing Engine 0 REV 01   740-026941   737F-1040         RE-DUO-1800
Routing Engine 1 REV 01   740-026941   737F-1016         RE-DUO-1800
CB 0             REV 06   710-022597   DX4011            LCC Control Board
CB 1             REV 06   710-022597   DX4017            LCC Control Board
FPC 1            REV 07   710-013035   DN5847            FPC Type 3-ES
  CPU            REV 08   710-016744   DP2570            ST-PMB2
  PIC 0          REV 05   750-015217   DB0418            8x 1GE(TYPE3), IQ2
    Xcvr 0       REV 01   740-011782   P8Q27ZG           SFP-SX
    Xcvr 1                NON-JNPR     PDA1U0D           SFP-SX
    Xcvr 2       REV 01   740-011613   P9F1ALW           SFP-SX
    Xcvr 3       REV 01   740-011782   PBA403V           SFP-SX
    Xcvr 4                NON-JNPR     PDE09DP           SFP-SX
    Xcvr 5       REV 01   740-011782   PCH2P4K           SFP-SX
    Xcvr 6       REV 01   740-011782   PB94K0F           SFP-SX
    Xcvr 7       REV 01   740-011782   PBA2R2A           SFP-SX
  PIC 1          REV 03   750-004424   HJ4020            1x 10GE(LAN),DWDM
  PIC 2          REV 01   750-003336   HG6073            4x OC-48 SONET, SMSR
  MMB 0          REV 04   710-016036   DP3401            ST-MMB2
FPC 3            REV 12   710-013037   DR1169            FPC Type 4-ES
  CPU            REV 08   710-016744   DP9429            ST-PMB2
  PIC 0          REV 02   750-010850   JA0332            1x OC-768 SONET SR
  MMB 0          REV 04   710-016036   DR0628            ST-MMB2
  MMB 1          REV 04   710-016036   DR0592            ST-MMB2
FPC 4            REV 05   710-021534   DR7350            FPC Type 1-ES
  CPU            REV 08   710-016744   DP8096            ST-PMB2
  PIC 0          REV 04   750-014627   DP9171            4x OC-3 1x OC-12 SFP
    Xcvr 0       REV 02   740-011615   PDE2RVR           SFP-SR
  PIC 1         REV 22   750-005634   DS5815           1x CHOC12 IQ SONET, SMIR

  PIC 2          REV 09   750-002911   CF4539            4x F/E, 100 BASE-TX
  PIC 3          REV 08   750-021652   DR2827            1x CHOC12 IQE SONET
    Xcvr 0                NON-JNPR     8                 UNKNOWN
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  MMB 0         REV 04   710-016036   DR0809          ST-MMB2
FPC 5           REV 07   710-007529   HS5608          FPC Type 3
  CPU           REV 15   710-001726   HX4351          FPC CPU
  PIC 0         REV 14   750-009567   WJ8961          1x 10GE(LAN),XENPAK
    Xcvr 0      REV 01   740-013170   J05K05961       XENPAK-LR
  PIC 1         REV 16   750-007141   JJ8146          10x 1GE(LAN), 1000 BASE

    Xcvr 1      REV 01   740-011613   P9F117T         SFP-SX
    Xcvr 2      REV 01   740-011782   PBA2VCL         SFP-SX
    Xcvr 3      REV 01   740-011782   PB83DRB         SFP-SX
    Xcvr 4      REV 01   740-011613   AM0812S8UP8     SFP-SX
  PIC 2         REV 12   750-009567   WF3566          1x 10GE(LAN),XENPAK
    Xcvr 0      REV 02   740-013170   T07C94489       XENPAK-LR
  MMB 0         REV 03   710-005555   HZ1907          MMB-288mbit
  MMB 1         REV 03   710-005555   HW5283          MMB-288mbit
  PPB 0         REV 04   710-002845   HZ7717          PPB Type 3
  PPB 1         REV 04   710-002845   HS0110          PPB Type 3
FPC 6           REV 07   710-013035   DP7486          FPC Type 3-ES
  CPU           REV 08   710-016744   DP2545          ST-PMB2
  PIC 0         REV 09   750-009567   NE6323          1x 10GE(LAN),XENPAK
    Xcvr 0      REV 02   740-013170   T09C71959       XENPAK-LR
  PIC 1         REV 06   750-015217   DN4775          8x 1GE(TYPE3), IQ2
    Xcvr 0      REV 01   740-011782   P7E0T6M         SFP-SX
    Xcvr 1      REV 01   740-011613   AM0812S8XAY     SFP-SX
    Xcvr 2      REV 01   740-011782   P7E0T6J         SFP-SX
    Xcvr 3      REV 01   740-011782   PCH2P7D         SFP-SX
    Xcvr 4      REV 01   740-011782   P9B0QYT         SFP-SX
    Xcvr 5      REV 01   740-011613   AM0812S8WQJ     SFP-SX
    Xcvr 6      REV 02   740-013111   9301220         SFP-T
    Xcvr 7      REV 01   740-011782   P9B0TZ5         SFP-SX
  PIC 2         REV 06   750-015217   DM6747          8x 1GE(TYPE3), IQ2
    Xcvr 0      REV 01   740-011613   PAP0ZB2         SFP-SX
    Xcvr 1      REV 01   740-013111   70191002        SFP-T
    Xcvr 6      REV 01   740-011782   PBA29H8         SFP-SX
    Xcvr 7      REV 01   740-011613   AM0812S8WQG     SFP-SX
  MMB 0         REV 04   710-016036   DP3238          ST-MMB2
FPC 7           REV 03   710-021540   DV3154          FPC Type 2-ES
  CPU           REV 09   710-016744   DT9053          ST-PMB2
  PIC 0         REV 13   750-001901   HB4225          4x OC-12 SONET, SMIR
  PIC 1         REV 05   750-001900   AD3644          1x OC-48 SONET, SMSR
  PIC 2         REV 10   750-008155   HV0335          2x G/E IQ, 1000 BASE
    Xcvr 0      REV 01   740-011782   PCH2UKF         SFP-SX
    Xcvr 1      REV 01   740-011782   PCH2V19         SFP-SX
  PIC 3         REV 03   750-014638   JS9493          1x OC-48-12-3 SFP
    Xcvr 0      REV 01   740-011785   P6Q0ENK         SFP-SR
  MMB 0         REV 05   710-016036   DP3323          ST-MMB2
SPMB 0          REV 04   710-023321   DX3004          LCC Switch CPU
SPMB 1          REV 04   710-023321   DX3009          LCC Switch CPU
SIB 0           REV 07   710-022594   DW4195          LCC SIB
  B Board       REV 07   710-023185   DW3930          LCC SIB Mezz
SIB 1           REV 07   710-022594   DW4179          LCC SIB
  B Board       REV 07   710-023185   DW3919          LCC SIB Mezz
SIB 2
SIB 3           REV 06   710-022594   DT8251          LCC SIB
  B Board       REV 06   710-023185   DT5792          LCC SIB Mezz
SIB 4           REV 08   710-022594   DW8014          LCC SIB
  B Board       REV 07   710-023185   DW3917          LCC SIB Mezz
Fan Tray 0                                            Front Top Fan Tray
Fan Tray 1                                            Front Bottom Fan Tray
Fan Tray 2                                            Rear Fan Tray -- Rev 3
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lcc1-re0:
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Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN1102270AHA      T1600
Midplane         REV 04   710-017247   RC5358            T-series Backplane
FPM GBUS         REV 10   710-002901   DS3443            T640 FPM Board
FPM Display      REV 01   710-021387   DS6411            T1600 FPM Display
CIP              REV 06   710-002895   DS4235            T-series CIP
PEM 0           Rev 02   740-023211   VM82438           Power Entry Module 4x60A
SCG 0            REV 15   710-003423   DS6649            T640 Sonet Clock Gen.
SCG 1            REV 15   710-003423   DR6775            T640 Sonet Clock Gen.
Routing Engine 0 REV 01   740-026941   737F-1083         RE-DUO-1800
Routing Engine 1 REV 01   740-026941   737F-1104         RE-DUO-1800
CB 0             REV 06   710-022597   DW8542            LCC Control Board
CB 1             REV 06   710-022597   DW8530            LCC Control Board
FPC 0            REV 02   710-010845   JE2392            FPC Type 4
  CPU            REV 02   710-011481   JF6820            FPC CPU-Enhanced
  PIC 0          REV 11   750-017405   DP7259            4x 10GE (LAN/WAN) XFP
    Xcvr 0       REV 01   740-014279   AA0741N1C8T       XFP-10G-LR
    Xcvr 1       REV 01   740-014279   AA0746N1GAM       XFP-10G-LR
    Xcvr 2       REV 01   740-014279   AA0747N1H0B       XFP-10G-LR
    Xcvr 3       REV 01   740-014279   AA0748N1HZ5       XFP-10G-LR
  MMB 0          REV 03   710-010842   HY7601            ST-MMB
FPC 1            REV 16   710-013037   BBAA7398          FPC Type 4-ES
  CPU            REV 09   710-016744   BBAA2329          ST-PMB2
  PIC 0          REV 03   711-029996   EB1575            100GE
  PIC 1          REV 06   750-034781   EB9980            100GE CFP
  MMB 0          REV 04   710-025563   BBAA5325          ST-MMB2
  MMB 1          REV 04   710-025563   BBAA5444          ST-MMB2
FPC 2            REV 16   710-013037   BBAA7185          FPC Type 4-ES
  CPU            REV 09   710-016744   BBAA3522          ST-PMB2
  PIC 0          REV 03   711-029996   EB1557            100GE
  PIC 1          REV 05   750-034781   EB4660            100GE CFP
    Xcvr 0       REV 0    740-032210   J10F73666         CFP-100G-LR4
  BRIDGE 0       REV 02   711-029995   EB2237            100GE Bridge Board
  MMB 0          REV 04   710-025563   BBAA5347          ST-MMB2
  MMB 1          REV 04   710-025563   BBAA5401          ST-MMB2
FPC 3            REV 10   710-021534   DZ0941            FPC Type 1-ES
  CPU            REV 09   710-016744   DY6364            ST-PMB2
  PIC 0          REV 13   750-012266   DK9192            4x 1GE(LAN), IQ2
    Xcvr 0       REV 01   740-011613   AM0812S8WVD       SFP-SX
    Xcvr 1                NON-JNPR     PDD63Q4           SFP-SX
    Xcvr 2                NON-JNPR     PDE4G54           SFP-SX
    Xcvr 3                NON-JNPR     PD40MAG           SFP-SX
  PIC 1          REV 01   750-007641   HJ2003            1x G/E IQ, 1000 BASE
    Xcvr 0       REV 01   740-011613   AM0812S8WVG       SFP-SX
  PIC 3          REV 17   750-007444   JB6873            1x CHSTM1 IQ SDH, SMIR
  MMB 0          REV 04   710-025563   DZ0281            ST-MMB2
FPC 4            REV 06   710-013035   DK0614            FPC Type 3-ES
  CPU            REV 07   710-016744   DK1616            ST-PMB2
  PIC 0          REV 22   750-007141   DM1870            10x 1GE(LAN), 1000 BASE

    Xcvr 0       REV 01   740-011782   PCL3UKW           SFP-SX
    Xcvr 1       REV 01   740-011782   P7E0T73           SFP-SX
    Xcvr 2       REV 01   740-007326   P4T0WLR           SFP-SX
    Xcvr 3       REV 01   740-011782   PAR1LRL           SFP-SX
    Xcvr 4       REV 01   740-011782   P9M0U3Z           SFP-SX
    Xcvr 5       REV 01   740-011782   P9M0U0C           SFP-SX
    Xcvr 6       REV 01   740-011782   P9M0TLG           SFP-SX
    Xcvr 7       REV 01   740-011782   P9M0U0F           SFP-SX
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    Xcvr 8        REV 01   740-011613   PFA6LAP          SFP-SX
    Xcvr 9        REV 01   740-011782   PCH2P0U          SFP-SX
  PIC 1           REV 16   750-009450   CV2565           1x OC-192 SM SR2
  PIC 2           REV 05   750-004424   HH3057           1x 10GE(LAN),10GBASE-LR

  PIC 3           REV 12   750-013423   DP0403           MultiServices 500
  MMB 0           REV 04   710-016036   DK1988           ST-MMB2
FPC 5             REV 07   710-013560   DR0004           E2-FPC Type 3
  CPU             REV 05   710-013563   DR0089           FPC CPU-Enhanced
  PIC 0           REV 11   750-012793   DR6107           1x 10GE(LAN/WAN) IQ2
    Xcvr 0        REV 01   740-014289   C743XU074        XFP-10G-SR
  PIC 1           REV 01   750-004695   HD5980           1x Tunnel
  PIC 2           REV 32   750-003700   DL3770           1x OC-192 12xMM VSR
  PIC 3           REV 12   750-009553   WB8901           4x OC-48 SONET
    Xcvr 0        REV 01   740-011785   P9D1GTQ          SFP-SR
    Xcvr 1        REV 01   740-011785   PDS0MMB          SFP-SR
    Xcvr 3        REV 01   740-011785   PDE1KXP          SFP-SR
  MMB 0           REV 07   710-010171   DP7374           MMB-5M3-288mbit
  MMB 1           REV 07   710-010171   DP7404           MMB-5M3-288mbit
FPC 6             REV 07   710-013035   DM0994           FPC Type 3-ES
  CPU             REV 07   710-016744   DM3651           ST-PMB2
  PIC 0           REV 07   750-015217   DN4743           8x 1GE(TYPE3), IQ2
    Xcvr 3        REV 01   740-011613   AM0812S8XB0      SFP-SX
    Xcvr 4        REV 01   740-011782   PB829RB          SFP-SX
    Xcvr 5        REV 01   740-011782   P8J1SYX          SFP-SX
  PIC 1           REV 03   750-003336   HJ9954           4x OC-48 SONET, SMSR
  PIC 3           REV 02   750-012793   JM7665           1x 10GE(LAN/WAN) IQ2
  MMB 0           REV 04   710-016036   DN6913           ST-MMB2
FPC 7             REV 08   710-010845   JM3958           FPC Type 4
  CPU             REV 04   710-011481   JK3669           FPC CPU-Enhanced
  PIC 0           REV 11   750-017405   DP8837           4x 10GE (LAN/WAN) XFP
    Xcvr 1        REV 01   740-014279   753019A00277     XFP-10G-LR
    Xcvr 2        REV 02   740-011571   C850XJ00P        XFP-10G-SR
    Xcvr 3        REV 01   740-014279   AA0813N1RTG      XFP-10G-LR
  MMB 0           REV 04   710-010842   JN1971           ST-MMB
SPMB 0            REV 04   710-023321   DW3629           LCC Switch CPU
SPMB 1            REV 04   710-023321   DW3621           LCC Switch CPU
SIB 0             REV 07   710-022594   DW4200           LCC SIB
  B Board         REV 07   710-023185   DW3932           LCC SIB Mezz
SIB 1             REV 07   710-022594   DW4193           LCC SIB
  B Board         REV 07   710-023185   DW3904           LCC SIB Mezz
SIB 2
SIB 3             REV 07   710-022594   DW4210           LCC SIB
  B Board         REV 06   710-023185   DT5780           LCC SIB Mezz
SIB 4             REV 08   710-022594   DW8019           LCC SIB
  B Board         REV 06   710-023185   DT5795           LCC SIB Mezz
Fan Tray 0                                               Front Top Fan Tray
Fan Tray 1                                               Front Bottom Fan Tray
Fan Tray 2                                               Rear Fan Tray -- Rev 3
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show chassis hardware sfc (TX Matrix Plus Router)

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user@host> show chassis hardware sfc 0
sfc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item              Version  Part number  Serial number    Description
Chassis                                 JN112F007AHB     TXP
Midplane          REV 05   710-022574   TS4027           SFC Midplane
FPM Display       REV 03   710-024027   DX0282           TXP FPM Display
CIP 0             REV 04   710-023792   DW4889           TXP CIP
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CIP 1            REV 04   710-023792   DW4887            TXP CIP
PEM 0            Rev 07   740-027463   UM26368           Power Entry Module
Routing Engine 0 REV 01   740-026942   737A-1064         SFC RE
Routing Engine 1 REV 01   740-026942   737A-1082         SFC RE
CB 0             REV 09   710-022606   DW6099            SFC Control Board
CB 1             REV 09   710-022606   DW6096            SFC Control Board
SPMB 0                    BUILTIN                        SFC Switch CPU
SPMB 1                    BUILTIN                        SFC Switch CPU
SIB F13 0        REV 04   710-022600   DX0841            F13 SIB
  B Board        REV 03   710-023431   DX0966            F13 SIB Mezz
SIB F13 1        REV 04   750-024564   DW5776            F13 SIB
  B Board        REV 03   710-023431   DW9028            F13 SIB
SIB F13 3        REV 04   750-024564   DW5762            F13 SIB
  B Board        REV 03   710-023431   DW9059            F13 SIB
SIB F13 4        REV 04   750-024564   DW5797            F13 SIB
  B Board        REV 03   710-023431   DW9041            F13 SIB
SIB F13 6        REV 04   750-024564   DW5770            F13 SIB
  B Board        REV 03   710-023431   DW9079            F13 SIB Mezz
SIB F13 7        REV 04   750-024564   DW5758            F13 SIB
  B Board        REV 03   710-023431   DW9047            F13 SIB
SIB F13 8        REV 04   750-024564   DW5761            F13 SIB
  B Board        REV 03   710-023431   DW9043            F13 SIB Mezz
SIB F13 9        REV 04   750-024564   DW5754            F13 SIB
  B Board        REV 03   710-023431   DW9078            F13 SIB Mezz
SIB F13 11       REV 04   710-022600   DX0826            F13 SIB
  B Board        REV 03   710-023431   DX0967            F13 SIB Mezz
SIB F13 12       REV 04   750-024564   DW5794            F13 SIB
  B Board        REV 03   710-023431   DW9044            F13 SIB Mezz
SIB F2S 0/0      REV 05   710-022603   DW7897            F2S SIB
  B Board        REV 05   710-023787   DW7657            NEO PMB
SIB F2S 0/2      REV 05   710-022603   DW7833            F2S SIB
  B Board        REV 05   710-023787   DW7526            NEO PMB
SIB F2S 0/4      REV 05   710-022603   DW7875            F2S SIB
  B Board        REV 05   710-023787   DW7588            NEO PMB
SIB F2S 0/6      REV 05   710-022603   DW7860            F2S SIB
  B Board        REV 05   710-023787   DW7589            NEO PMB
SIB F2S 1/0      REV 04   710-022603   DW4820            F2S SIB
  B Board        REV 05   710-023787   DW8510            NEO PMB
SIB F2S 1/2      REV 05   710-022603   DW7849            F2S SIB
  B Board        REV 05   710-023787   DW7525            NEO PMB
SIB F2S 1/4      REV 05   710-022603   DW7927            F2S SIB
  B Board        REV 05   710-023787   DW7556            F2S SIB Mezz
SIB F2S 1/6      REV 05   710-022603   DW7866            F2S SIB
  B Board        REV 05   710-023787   DW7651            NEO PMB
SIB F2S 2/0      REV 05   710-022603   DW7880            F2S SIB
  B Board        REV 05   710-023787   DW7523            NEO PMB
SIB F2S 2/2      REV 05   710-022603   DW7895            F2S SIB
  B Board        REV 05   710-023787   DW7591            NEO PMB
SIB F2S 2/4      REV 05   710-022603   DW7907            F2S SIB
  B Board        REV 05   710-023787   DW7590            NEO PMB
SIB F2S 2/6      REV 05   710-022603   DW7785            F2S SIB
  B Board        REV 05   710-023787   DW7524            NEO PMB
SIB F2S 3/0      REV 05   710-022603   DW7782            F2S SIB
  B Board        REV 05   710-023787   DW7634            NEO PMB
SIB F2S 3/2      REV 05   710-022603   DW7793            F2S SIB
  B Board        REV 05   710-023787   DW7548            NEO PMB
SIB F2S 3/4      REV 05   710-022603   DW7779            F2S SIB
  B Board        REV 05   710-023787   DW7587            NEO PMB
SIB F2S 3/6      REV 05   710-022603   DW7930            F2S SIB
  B Board        REV 05   710-023787   DW7505            NEO PMB
SIB F2S 4/0      REV 05   710-022603   DW7867            F2S SIB
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  B Board        REV 05   710-023787   DW7656           NEO PMB
SIB F2S 4/2      REV 05   710-022603   DW7917           F2S SIB
  B Board        REV 05   710-023787   DW7640           NEO PMB
SIB F2S 4/4      REV 05   710-022603   DW7929           F2S SIB
  B Board        REV 05   710-023787   DW7643           NEO PMB
SIB F2S 4/6      REV 05   710-022603   DW7870           F2S SIB
  B Board        REV 05   710-023787   DW7635           NEO PMB
Fan Tray 0       REV 06   760-024497   DV7831           Front Fan Tray
Fan Tray 1       REV 06   760-024497   DV9614           Front Fan Tray
Fan Tray 2       REV 06   760-024502   DV9618           Rear Fan Tray
Fan Tray 3       REV 06   760-024502   DV9616           Rear Fan Tray
Fan Tray 4       REV 06   760-024502   DV7807           Rear Fan Tray
Fan Tray 5       REV 06   760-024502   DV7828           Rear Fan Tray
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show chassis hardware extensive (TX Matrix Plus Router)

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user@host> show chassis hardware extensive
sfc0-re0:
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Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN112F007AHB      TXP
 Jedec Code:    0x7fb0            EEPROM Version:    0x02
                                  S/N:               JN112F007AHB
 Assembly ID:   0x052c            Assembly Version:  00.00
 Date:          00-00-0000        Assembly Flags:    0x00
 ID: TXP
 Board Information Record:
  Address 0x00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 05 2c 00 00 00 00 00 00 00 00 00 00
  Address 0x10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x20: 4a 4e 31 31 32 46 30 30 37 41 48 42 00 00 00 00
  Address 0x30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x40: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x70: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Midplane         REV 05   710-022574   TS4027            SFC Midplane
 Jedec Code:    0x7fb0            EEPROM Version:    0x01
 P/N:           710-022574        S/N:               S/N TS4027
 Assembly ID:   0x0962            Assembly Version:  01.05
 Date:          03-23-2009        Assembly Flags:    0x00
 Version:       REV 05
 ID: SFC Midplane
 Board Information Record:
  Address 0x00: ad 01 ff ff 00 1d b5 14 00 00 ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 01 ff 09 62 01 05 52 45 56 20 30 35 00 00
  Address 0x10: 00 00 00 00 37 31 30 2d 30 32 32 35 37 34 00 00
  Address 0x20: 53 2f 4e 20 54 53 34 30 32 37 00 00 00 17 03 07
  Address 0x30: d9 ff ff ff ad 01 ff ff 00 1d b5 14 00 00 ff ff
  Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff ff
  Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
FPM Display      REV 03   710-024027   DX0282            TXP FPM Display
 Jedec Code:    0x7fb0            EEPROM Version:    0x01
 P/N:           710-024027        S/N:               S/N DX0282
 Assembly ID:   0x096c            Assembly Version:  01.03
 Date:          02-10-2009        Assembly Flags:    0x00
```

```
 Version:       REV 03
 ID: TXP FPM Display             FRU Model Number:   CRAFT-TXP
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 01 ff 09 6c 01 03 52 45 56 20 30 33 00 00
  Address 0x10: 00 00 00 00 37 31 30 2d 30 32 34 30 32 37 00 00
  Address 0x20: 53 2f 4e 20 44 58 30 32 38 32 00 00 00 0a 02 07
  Address 0x30: d9 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 43
  Address 0x50: 52 41 46 54 2d 54 58 50 00 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 ff ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
CIP 0             REV 04   710-023792   DW4889          TXP CIP
 Jedec Code:    0x7fb0               EEPROM Version:     0x01
 P/N:           710-023792           S/N:                S/N DW4889
 Assembly ID:   0x0969               Assembly Version:   01.04
 Date:          01-26-2009           Assembly Flags:     0x00
 Version:       REV 04
 ID: TXP CIP                         FRU Model Number:   CIP-TXP
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
```

show chassis hardware clei-models (TX Matrix Plus Router)

```
user@host> show chassis hardware clei-models
sfc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item              Version   Part number  CLEI code         FRU model number
Midplane          REV 05    710-022574                     CHAS-BP-TXP-S
FPM Display       REV 03    710-024027                     CRAFT-TXP-S
CIP 0             REV 05    710-023792                     CIP-TXP-S
CIP 1             REV 05    710-023792                     CIP-TXP-S
PEM 0             Rev 04    740-027463   IPUPAFGKTA        PWR-TXP-7-60-DC
PEM 1             Rev 04    740-027463   IPUPAFGKTA        PWR-TXP-7-60-DC
Routing Engine 0  REV 06    740-026942                     RE-DUO-C2600-16G-S
Routing Engine 1  REV 06    740-026942                     RE-DUO-C2600-16G-S
CB 0              REV 05    710-022606                     CB-TXP-S
CB 1              REV 09    710-022606                     CB-TXP-S
SIB F13 0         REV 04    750-024564                     SIB-TXP-F13
SIB F13 3         REV 04    750-024564                     SIB-TXP-F13
SIB F13 8         REV 04    750-024564                     SIB-TXP-F13
SIB F13 11        REV 04    750-024564                     SIB-TXP-F13
SIB F13 12        REV 03    750-024564                     SIB-TXP-F13
SIB F2S 0/0       REV 05    710-022603                     SIB-TXP-F2S-S
SIB F2S 0/2       REV 05    710-022603                     SIB-TXP-F2S-S
SIB F2S 0/4       REV 04    710-022603                     SIB-TXP-F2S-S
SIB F2S 0/6       REV 04    710-022603                     SIB-TXP-F2S-S
SIB F2S 1/0       REV 04    710-022603                     SIB-TXP-F2S-S
SIB F2S 1/2       REV 05    710-022603                     SIB-TXP-F2S-S
SIB F2S 1/4       REV 04    710-022603                     SIB-TXP-F2S-S
SIB F2S 1/6       REV 05    710-022603                     SIB-TXP-F2S-S
SIB F2S 2/0       REV 04    710-022603                     SIB-TXP-F2S-S
SIB F2S 2/2       REV 04    710-022603                     SIB-TXP-F2S-S
SIB F2S 2/4       REV 05    710-022603                     SIB-TXP-F2S-S
SIB F2S 2/6       REV 04    710-022603                     SIB-TXP-F2S-S
SIB F2S 3/0       REV 05    710-022603                     SIB-TXP-F2S-S
SIB F2S 3/2       REV 03    710-022603                     SIB-TXP-F2S-S
SIB F2S 3/4       REV 05    710-022603                     SIB-TXP-F2S-S
SIB F2S 3/6       REV 03    710-022603                     SIB-TXP-F2S-S
```



```
SIB F2S 4/0      REV 03   710-022603                        SIB-TXP-F2S-S
SIB F2S 4/2      REV 05   710-022603                        SIB-TXP-F2S-S
SIB F2S 4/4      REV 04   710-022603                        SIB-TXP-F2S-S
SIB F2S 4/6      REV 03   710-022603                        SIB-TXP-F2S-S
Fan Tray 0       REV 02   760-024497                        FANTRAY-TXP-H-S
Fan Tray 1       REV 02   760-024497                        FANTRAY-TXP-H-S
Fan Tray 2       REV 05   760-024502                        FANTRAY-TXP-V-S
Fan Tray 3
Fan Tray 4       REV 05   760-024502                        FANTRAY-TXP-V-S
Fan Tray 5       REV 02   760-024502                        FANTRAY-TXP-V-S

lcc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  CLEI code         FRU model number
Midplane         REV 03   710-017247                        CHAS-BP-T1600-S
FPM Display      REV 01   710-021387                        CRAFT-T1600-S
CIP              REV 06   710-002895                        CIP-L-T640-S
PEM 1            Rev 02   740-023211   IPUPAC8KTA        PWR-T1600-4-60-DC-S
SCG 0            REV 15   710-003423                        SCG-T-S
SCG 1            REV 15   710-003423                        SCG-T-S
Routing Engine 0 REV 01   740-026941                        RE-DUO-C1800-8G-S
Routing Engine 1 REV 01   740-026941                        RE-DUO-C1800-8G-S
CB 0             REV 06   710-022597                        CB-LCC-S
CB 1             REV 06   710-022597                        CB-LCC-S
FPC 1            REV 07   710-013035                        T640-FPC3-ES
  PIC 0          REV 05   750-015217                        PC-8GE-TYPE3-SFP-IQ2
  PIC 1          REV 03   750-004424                        PC-1XGE-LR
  PIC 2          REV 01   750-003336                        PC-4OC48-SON-SMSR
FPC 3            REV 12   710-013037                        T1600-FPC4-ES
  PIC 0          REV 02   750-010850                        PD-1OC768-SON-SR
FPC 4            REV 05   710-021534                        T640-FPC1-ES
  PIC 0          REV 04   750-014627                        PB-4OC3-1OC12-SON-SFP
  PIC 1          REV 22   750-005634                        PB-1CHOC12SMIR-QPP
  PIC 2          REV 09   750-002911                        PB-4FE-TX
  PIC 3          REV 08   750-021652                        PB-1CHOC12-STM4-IQE-SFP
FPC 5            REV 07   710-007529                        T640-FPC3
  PIC 0          REV 14   750-009567                        PC-1XGE-XENPAK
  PIC 1          REV 16   750-007141                        PC-10GE-SFP
  PIC 2          REV 12   750-009567                        PC-1XGE-XENPAK
FPC 6            REV 07   710-013035                        T640-FPC3-ES
  PIC 0          REV 09   750-009567                        PC-1XGE-XENPAK
  PIC 1          REV 06   750-015217                        PC-8GE-TYPE3-SFP-IQ2
  PIC 2          REV 06   750-015217                        PC-8GE-TYPE3-SFP-IQ2
FPC 7            REV 03   710-021540                        T640-FPC2-ES
  PIC 0          REV 13   750-001901                        PB-4OC12-SON-SMIR
  PIC 1          REV 05   750-001900                        PB-1OC48-SON-SMSR
  PIC 2          REV 10   750-008155                        PB-2GE-SFP-QPP
  PIC 3          REV 03   750-014638                        PB-1OC48-SON-B-SFP
SIB 0            REV 07   710-022594                        SIB-TXP-T1600-S
SIB 1            REV 07   710-022594                        SIB-TXP-T1600-S
SIB 3            REV 06   710-022594                        SIB-TXP-T1600-S
SIB 4            REV 08   710-022594                        SIB-TXP-T1600-S
Fan Tray 0                                                  FANTRAY-T-S
Fan Tray 1                                                  FANTRAY-T-S
Fan Tray 2                                                  FANTRAY-TXP-R-S

lcc1-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  CLEI code         FRU model number
```

```
Midplane         REV 04   710-017247                   CHAS-BP-T1600-S
FPM Display      REV 01   710-021387                   CRAFT-T1600-S
CIP              REV 06   710-002895                   CIP-L-T640-S
PEM 0            Rev 02   740-023211   IPUPAC8KTA      PWR-T1600-4-60-DC-S
SCG 0            REV 15   710-003423                   SCG-T-S
SCG 1            REV 15   710-003423                   SCG-T-S
Routing Engine 0 REV 01   740-026941                   RE-DUO-C1800-8G-S
Routing Engine 1 REV 01   740-026941                   RE-DUO-C1800-8G-S
CB 0             REV 06   710-022597                   CB-LCC-S
CB 1             REV 06   710-022597                   CB-LCC-S
FPC 0            REV 02   710-010845                   T640-FPC4-ES
  PIC 0          REV 11   750-017405                   PD-4XGE-XFP
FPC 1            REV 16   710-013037                   T1600-FPC4-ES
  PIC 1          REV 06   750-034781                   PD-1CE-CFP
FPC 2            REV 16   710-013037                   T1600-FPC4-ES
  PIC 1          REV 05   750-034781                   PD-1CE-CFP
FPC 3            REV 10   710-021534                   T640-FPC1-ES
  PIC 0          REV 13   750-012266                   PB-4GE-TYPE1-SFP-IQ2
  PIC 1          REV 01   750-007641                   PE-1GE-SFP-QPP
  PIC 3          REV 17   750-007444                   PB-1CHSTM1-SMIR-QPP
FPC 4            REV 06   710-013035                   T640-FPC3-ES
  PIC 0          REV 22   750-007141                   PC-10GE-SFP
  PIC 1          REV 16   750-009450                   PC-1OC192-SON-SR2
  PIC 2          REV 05   750-004424                   PC-1XGE-LR
  PIC 3          REV 12   750-013423                   PC-MS-500-3
FPC 5            REV 07   710-013560                   T640-FPC3-E2
  PIC 0          REV 11   750-012793                   PC-1XGE-TYPE3-XFP-IQ2
  PIC 1          REV 01   750-004695                   PC-TUNNEL
  PIC 2          REV 32   750-003700                   PC-1OC192-SON-VSR
  PIC 3          REV 12   750-009553                   PC-4OC48-SON-SFP
FPC 6            REV 07   710-013035                   T640-FPC3-ES
  PIC 0          REV 07   750-015217                   PC-8GE-TYPE3-SFP-IQ2
  PIC 1          REV 03   750-003336                   PC-4OC48-SON-SMSR
  PIC 3          REV 02   750-012793                   PC-1XGE-TYPE3-XFP-IQ2
FPC 7            REV 08   710-010845                   T640-FPC4-ES
  PIC 0          REV 11   750-017405                   PD-4XGE-XFP
SIB 0            REV 07   710-022594                   SIB-TXP-T1600-S
SIB 1            REV 07   710-022594                   SIB-TXP-T1600-S
SIB 3            REV 07   710-022594                   SIB-TXP-T1600-S
SIB 4            REV 08   710-022594                   SIB-TXP-T1600-S
Fan Tray 0                                             FANTRAY-T-S
Fan Tray 1                                             FANTRAY-T-S
Fan Tray 2                                             FANTRAY-TXP-R-S
```

show chassis hardware detail (TX Matrix Plus Router)

```
user@host> show chassis hardware detail
sfc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN111B023AHB      TXP
Midplane         REV 01   710-022574   TR7990            SFC Midplane
FPM Display      REV 03   710-024027   DW4699            TXP FPM Display
CIP 0            REV 01   710-023792   DR1437            TXP CIP
CIP 1            REV 02   710-023792   DS4564            TXP CIP
PEM 0            Rev 07   740-027463   UM26360           Power Entry Module
Routing Engine 0 REV 01   740-026942   737A-1024         SFC RE
  ad0     3887 MB  SMART CF            200811050193CEB1CEB1 Compact Flash
  ad1    30533 MB  SAMSUNG MCBQE32G8MPP-0V SY814A0762    Disk 1
Routing Engine 1 REV 01   740-026942   737A-1024         SFC RE
```



```
  ad0    3887 MB  SMART CF             20081105004C19A019A0 Compact Flash
  ad1   30533 MB  SAMSUNG MCBQE32G8MPP-0V SY814A0794     Disk 1
CB 0             REV 03   710-022606   DR7134            SFC Control Board
CB 1             REV 01   710-022606   DP8890            SFC Control Board
SPMB 0                    BUILTIN                        SFC Switch CPU
SPMB 1                    BUILTIN                        SFC Switch CPU
SIB F13 0        REV 03   750-024564   DT9478            F13 SIB
  B Board        REV 02   710-023431   DT6554            F13 SIB
SIB F13 1        REV 03   750-024564   DT9454            F13 SIB
  B Board        REV 02   710-023431   DT6551            F13 SIB
SIB F2S 0/0      REV 02   710-022603   DT2838            F2S SIB
  B Board        REV 02   710-023787   DT1725            NEO PMB
SIB F2S 0/2      REV 02   710-022603   DT2824            F2S SIB
  B Board        REV 02   710-023787   DT1706            NEO PMB
SIB F2S 0/4      REV 02   710-022603   DT2822            F2S SIB
  B Board        REV 02   710-023787   DT1696            NEO PMB
SIB F2S 0/6      REV 02   710-022603   DT2823            F2S SIB
  B Board        REV 02   710-023787   DT1717            NEO PMB
SIB F2S 1/0      REV 03   710-022603   DV0059            F2S SIB
  B Board        REV 03   710-023787   DT9942            NEO PMB
SIB F2S 1/2      REV 02   710-022603   DT2826            F2S SIB
  B Board        REV 02   710-023787   DT1713            NEO PMB
SIB F2S 1/4      REV 03   710-022603   DV0092            F2S SIB
  B Board        REV 03   710-023787   DV0000            NEO PMB
SIB F2S 1/6      REV 03   710-022603   DV0079            F2S SIB
  B Board        REV 03   710-023787   DT9972            NEO PMB
SIB F2S 2/0      REV 03   710-022603   DV0100            F2S SIB
  B Board        REV 03   710-023787   DT9925            NEO PMB
SIB F2S 2/2      REV 03   710-022603   DV0050            F2S SIB
  B Board        REV 03   710-023787   DV0005            NEO PMB
SIB F2S 2/4      REV 03   710-022603   DV0097            F2S SIB
  B Board        REV 03   710-023787   DT9936            NEO PMB
Fan Tray 0       REV 02   760-024497   DR8286            Front Fan Tray
Fan Tray 1       REV 06   760-024497   DV9624            Front Fan Tray
Fan Tray 2       REV 02   760-024502   DR8259            Rear Fan Tray
Fan Tray 3       REV 02   760-024502   DR8270            Rear Fan Tray
Fan Tray 4       REV 02   760-024502   DR8284            Rear Fan Tray
Fan Tray 5       REV 06   760-024502   DV7813            Rear Fan Tray

lcc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN1101F27AHA      T1600
Midplane         REV 04   710-017247   RC5317            T Series Backplane
FPM GBUS         REV 10   710-002901   DS8197            T640 FPM Board
FPM Display      REV 01   710-021387   DS6433            T1600 FPM Display
CIP              REV 06   710-002895   DS1493            T Series CIP
PEM 0            Rev 08   740-017906   UD26601           Power Entry Module 3x80
SCG 0            REV 15   710-003423   DP5847            T640 Sonet Clock Gen.
SCG 1            REV 15   710-003423   DR0924            T640 Sonet Clock Gen.
Routing Engine 0 REV 01   740-026942   737F-1024         LCC RE
  ad0    3887 MB  SMART CF             2008110502B63E513E51 Compact Flash
  ad1   30533 MB  SAMSUNG MCBQE32G8MPP-0V SY814A1208     Disk 1
Routing Engine 1 REV 01   740-026942   737F-1024         LCC RE
  ad0    3887 MB  SMART CF             2008110500F9A8A8A8A8 Compact Flash
  ad1   30533 MB  SAMSUNG MCBQE32G8MPP-0V SY814A1076     Disk 1
CB 0             REV 05   710-022597   DV4264            LCC Control Board
CB 1             REV 03   710-022597   DP8558            LCC Control Board
FPC 0            REV 14   710-013037   DS9967            FPC Type 4-ES
  CPU            REV 08   710-016744   DS3989            ST-PMB2
```

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  PIC 0          REV 12   750-013198   DL7506           1x Tunnel
  PIC 1          REV 12   750-013198   DL7505           1x Tunnel
  MMB 0          REV 01   710-025563   DS8524           ST-MMB2
  MMB 1          REV 01   710-025563   DS8373           ST-MMB2
FPC 1            REV 14   710-013037   DT0027           FPC Type 4-ES
  CPU            REV 09   710-016744   DS7684           ST-PMB2
  PIC 0          REV 12   750-013198   DL7512           1x Tunnel
  PIC 1          REV 12   750-013198   DL7498           1x Tunnel
  MMB 0          REV 01   710-025563   DS8494           ST-MMB2
  MMB 1          REV 01   710-025563   DS8436           ST-MMB2
SPMB 0           REV 04   710-023321   DV3867           LCC Switch CPU
SPMB 1           REV 02   710-023321   DP0238           LCC Switch CPU
SIB 0            REV 06   710-022594   DT8268           LCC SIB
  B Board        REV 06   710-023185   DT5791           LCC SIB Mezz
SIB 1            REV 06   710-022594   DT8261           LCC SIB
  B Board        REV 06   710-023185   DT5769           LCC SIB Mezz
SIB 2            REV 04   710-022594   DS2315           LCC SIB
  B Board        REV 06   710-023185   DT5788           LCC SIB Mezz
SIB 3            REV 06   710-022594   DT8253           LCC SIB
  B Board        REV 06   710-023185   DT5811           LCC SIB Mezz
SIB 4            REV 06   710-022594   DT8248           LCC SIB
  B Board        REV 06   710-023185   DT5812           LCC SIB Mezz
Fan Tray 0                                              Front Top Fan Tray
Fan Tray 1                                              Front Bottom Fan Tray
Fan Tray 2                                              Rear Fan Tray
```

show chassis hardware models (TX Matrix Plus Router)

```
user@host> show chassis hardware models
sfc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  Serial number    FRU model number
FPM Display      REV 03   710-024027   DX0282           CRAFT-TXP
CIP 0            REV 04   710-023792   DW4889           CIP-TXP
CIP 1            REV 04   710-023792   DW4887           CIP-TXP
PEM 0            Rev 07   740-027463   UM26368          ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
Routing Engine 0 REV 01   740-026942   737A-1064        RE-TXP-SFC-DUO-2600-16G
Routing Engine 1 REV 01   740-026942   737A-1082        RE-TXP-SFC-DUO-2600-16G
CB 0             REV 09   710-022606   DW6099           CB-TXP
CB 1             REV 09   710-022606   DW6096           CB-TXP
SIB F13 1        REV 04   750-024564   DW5776           SIB-TXP-F13
SIB F13 3        REV 04   750-024564   DW5762           SIB-TXP-F13
SIB F13 4        REV 04   750-024564   DW5797           SIB-TXP-F13
SIB F13 6        REV 04   750-024564   DW5770           SIB-TXP-F13
SIB F13 7        REV 04   750-024564   DW5758           SIB-TXP-F13
SIB F13 8        REV 04   750-024564   DW5761           SIB-TXP-F13
SIB F13 9        REV 04   750-024564   DW5754           SIB-TXP-F13
SIB F13 12       REV 04   750-024564   DW5794           SIB-TXP-F13
SIB F2S 0/0      REV 05   710-022603   DW7897
SIB F2S 0/2      REV 05   710-022603   DW7833
SIB F2S 0/4      REV 05   710-022603   DW7875
SIB F2S 0/6      REV 05   710-022603   DW7860
SIB F2S 1/0      REV 04   710-022603   DW4820
SIB F2S 1/2      REV 05   710-022603   DW7849
SIB F2S 1/4      REV 05   710-022603   DW7927           SIB-TXP-F2S
SIB F2S 1/6      REV 05   710-022603   DW7866
SIB F2S 2/0      REV 05   710-022603   DW7880
SIB F2S 2/2      REV 05   710-022603   DW7895
SIB F2S 2/4      REV 05   710-022603   DW7907
SIB F2S 2/6      REV 05   710-022603   DW7785
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SIB F2S 3/0      REV 05   710-022603   DW7782
SIB F2S 3/2      REV 05   710-022603   DW7793
SIB F2S 3/4      REV 05   710-022603   DW7779
SIB F2S 3/6      REV 05   710-022603   DW7930
SIB F2S 4/0      REV 05   710-022603   DW7867
SIB F2S 4/2      REV 05   710-022603   DW7917
SIB F2S 4/4      REV 05   710-022603   DW7929
SIB F2S 4/6      REV 05   710-022603   DW7870
Fan Tray 0       REV 06   760-024497   DV7831            FANTRAY-TXP-F
Fan Tray 1       REV 06   760-024497   DV9614            FANTRAY-TXP-F
Fan Tray 2       REV 06   760-024502   DV9618            FANTRAY-TXP-R
Fan Tray 3       REV 06   760-024502   DV9616            FANTRAY-TXP-R
Fan Tray 4       REV 06   760-024502   DV7807            FANTRAY-TXP-R
Fan Tray 5       REV 06   760-024502   DV7828            FANTRAY-TXP-R

lcc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  Serial number     FRU model number
Midplane         REV 03   710-017247   RC3765            CHAS-BP-T1600-S
FPM Display      REV 01   710-021387   DN5441            CRAFT-T1600-S
CIP              REV 06   710-002895   DP6021            CIP-L-T640-S
PEM 0            Rev 07   740-017906   UA26384           PWR-T1600-3-80-DC-S
PEM 1            Rev 07   740-017906   UA26296           PWR-T1600-3-80-DC-S
SCG 0            REV 15   710-003423   DR0875            SCG-T-S
CB 0             REV 06   710-022597   DW8534            CB-LCC
CB 1             REV 06   710-022597   DW8527            CB-LCC
FPC 4            REV 12   710-013037   DJ8717            T1600-FPC4-ES
  PIC 0          REV 11   750-017405   DP8795            PD-4XGE-XFP
  PIC 1          REV 11   750-017405   DP8794            PD-4XGE-XFP
FPC 6            REV 14   710-013037   DS5335            T1600-FPC4-ES
  PIC 0          REV 13   750-017405   DS7634            PD-4XGE-XFP
  PIC 1          REV 13   750-017405   DS7637            PD-4XGE-XFP
FPC 7            REV 07   710-013035   DM0990            T1600-FPC3-ES
  PIC 0          REV 16   750-007141   JJ8067            PC-10GE-SFP
  PIC 1          REV 08   750-015749   WE9598            PC-1OC192-SON-XFP
  PIC 2          REV 10   750-009450   HX6466            PC-1OC192-SON-SR2
SIB 0            REV 08   710-022594   DW8033            SIB-TXP-T1600-S
SIB 1            REV 08   710-022594   DW8044            SIB-TXP-T1600-S
SIB 2            REV 08   710-022594   DW8020            SIB-TXP-T1600-S
SIB 3            REV 08   710-022594   DW8063            SIB-TXP-T1600-S
SIB 4            REV 08   710-022594   DW8064            SIB-TXP-T1600-S
Fan Tray 0                                               FANTRAY-T-S
Fan Tray 1                                               FANTRAY-T-S
Fan Tray 2                                               FANTRAY-TXP-R-S

lcc1-re0:
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Hardware inventory:
Item             Version  Part number  Serial number     FRU model number
Midplane         REV 04   710-017247   RC5361            CHAS-BP-T1600-S
FPM Display      REV 01   710-021387   DS6430            CRAFT-T1600-S
CIP              REV 06   710-002895   DS4239            CIP-L-T640-S
PEM 0            Rev 08   740-017906   UD26649           PWR-T1600-3-80-DC-S
SCG 0            REV 15   710-003423   DP5820            SCG-T-S
CB 0             REV 06   710-022597   DW8523            CB-LCC
CB 1             REV 06   710-022597   DW8528            CB-LCC
FPC 4            REV 12   710-013037   DP8509            T1600-FPC4-ES
  PIC 0          REV 11   750-017405   DP8808            PD-4XGE-XFP
  PIC 1          REV 11   750-017405   DP7263            PD-4XGE-XFP
FPC 6            REV 14   710-013037   DS9961            T1600-FPC4-ES
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  PIC 0         REV 13   750-017405   DS5532            PD-4XGE-XFP
  PIC 1         REV 13   750-017405   DS7639            PD-4XGE-XFP
FPC 7           REV 03   710-013035   DF5564            T1600-FPC3-ES
  PIC 0         REV 16   750-007141   JJ8063            PC-10GE-SFP
SIB 0           REV 08   710-022594   DW8035            SIB-TXP-T1600-S
SIB 1           REV 10   710-022594   DX7672            SIB-TXP-T1600-S
SIB 2           REV 08   710-022594   DW8060            SIB-TXP-T1600-S
SIB 3           REV 08   710-022594   DW8072            SIB-TXP-T1600-S
SIB 4           REV 08   710-022594   DW8043            SIB-TXP-T1600-S
Fan Tray 0                                              FANTRAY-T-S
Fan Tray 1                                              FANTRAY-T-S
Fan Tray 2                                              FANTRAY-TXP-R-S

lcc2-re0:
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Hardware inventory:
Item            Version  Part number  Serial number     FRU model number
Midplane        REV 03   710-017247   RC3956            CHAS-BP-T1600-S
FPM Display     REV 01   710-021387   DN7030            CRAFT-T1600-S
CIP             REV 06   710-002895   DM3962            CIP-L-T640-S
PEM 0           Rev 08   740-017906   UD26519           PWR-T1600-3-80-DC-S
PEM 1           Rev 07   740-017906   UC26601           PWR-T1600-3-80-DC-S
SCG 0           REV 15   710-003423   DP0277            SCG-T-S
CB 0            REV 06   710-022597   DW8524            CB-LCC
CB 1            REV 06   710-022597   DW8536            CB-LCC
FPC 4           REV 12   710-013037   DR1194            T1600-FPC4-ES
  PIC 0         REV 11   750-017405   DP8811            PD-4XGE-XFP
  PIC 1         REV 11   750-017405   DP8823            PD-4XGE-XFP
FPC 5           REV 12   710-013037   DR1184            T1600-FPC4-ES
  PIC 1         REV 11   750-017405   DP4744            PD-4XGE-XFP
FPC 6           REV 12   710-013037   DN8622            T1600-FPC4-ES
  PIC 0         REV 14   750-012518   JY9924            PD-4OC192-SON-XFP
  PIC 1         REV 11   750-017405   DP8776            PD-4XGE-XFP
FPC 7           REV 04   710-013560   JR3968            T640-FPC3-E2
  PIC 0         REV 16   750-007141   NC9330            PC-10GE-SFP
SIB 0           REV 07   710-022594   DW4217            SIB-TXP-T1600-S
SIB 1           REV 07   710-022594   DW4213            SIB-TXP-T1600-S
SIB 2           REV 07   710-022594   DW4189            SIB-TXP-T1600-S
SIB 3           REV 07   710-022594   DW4173            SIB-TXP-T1600-S
SIB 4           REV 07   710-022594   DW4201            SIB-TXP-T1600-S
Fan Tray 0                                              FANTRAY-T-S
Fan Tray 1                                              FANTRAY-T-S
Fan Tray 2                                              FANTRAY-TXP-R-S

lcc3-re0:
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Hardware inventory:
Item            Version  Part number  Serial number     FRU model number
Midplane        REV 04   710-017247   RC5319            CHAS-BP-T1600-S
FPM Display     REV 01   710-021387   DS6402            CRAFT-T1600-S
CIP             REV 06   710-002895   DR9973            CIP-L-T640-S
PEM 0           Rev 07   740-017906   UC26496           PWR-T1600-3-80-DC-S
PEM 1           Rev 07   740-017906   UC26599           PWR-T1600-3-80-DC-S
SCG 0           REV 15   710-003423   DP5831            SCG-T-S
CB 0            REV 06   710-022597   DW8533            CB-LCC
CB 1            REV 06   710-022597   DW8538            CB-LCC
FPC 0           REV 14   710-013037   DS5345            T1600-FPC4-ES
  PIC 0         REV 13   750-017405   DS7641            PD-4XGE-XFP
  PIC 1         REV 13   750-017405   DS5479            PD-4XGE-XFP
FPC 1           REV 14   710-013037   DS7338            T1600-FPC4-ES
  PIC 0         REV 13   750-017405   DS7631            PD-4XGE-XFP
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  PIC 1          REV 13   750-017405   DS7632          PD-4XGE-XFP
FPC 2            REV 14   710-013037   DS9962          T1600-FPC4-ES
  PIC 0          REV 13   750-017405   DS7581          PD-4XGE-XFP
  PIC 1          REV 13   750-017405   DS7627          PD-4XGE-XFP
FPC 4            REV 10   710-010845   JZ6573          T640-FPC4-ES
  PIC 0          REV 14   750-012518   JT5124          PD-4OC192-SON-XFP
FPC 5            REV 14   710-013037   DT0016          T1600-FPC4-ES
  PIC 0          REV 14   750-012518   JY9918          PD-4OC192-SON-XFP
FPC 7            REV 07   710-013035   DM0967          T1600-FPC3-ES
  PIC 0          REV 16   750-007141   JJ8059          PC-10GE-SFP
  PIC 1          REV 13   750-004695   DM5712          PC-TUNNEL
SIB 0            REV 07   710-022594   DW4174          SIB-TXP-T1600-S
SIB 1            REV 07   710-022594   DW4207          SIB-TXP-T1600-S
SIB 2            REV 06   710-022594   DT8231          SIB-TXP-T1600-S
SIB 3            REV 07   710-022594   DW4175          SIB-TXP-T1600-S
SIB 4            REV 07   710-022594   DW4209          SIB-TXP-T1600-S
Fan Tray 0                                             FANTRAY-T-S
Fan Tray 1                                             FANTRAY-T-S
Fan Tray 2                                             FANTRAY-TXP-R-S
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show chassis hardware (TX Matrix Plus router with 3D SIBs)

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user@host> show chassis hardware
sfc0-re0:
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Hardware inventory:
Item             Version  Part number  Serial number   Description
Chassis                                JN11CAAA4AHB    TXP
Midplane         REV 05   710-022574   ABAC4696        SFC Midplane
FPM Display      REV 09   710-024027   EH3138          TXP FPM Display
CIP 0            REV 12   710-023792   EF6349          TXP CIP
CIP 1            REV 12   710-023792   EG5294          TXP CIP
PEM 0            Rev 06   740-027463   XH04595         Power Entry Module
PEM 1            Rev 06   740-027463   XH04592         Power Entry Module
Routing Engine 0 REV 07   740-026942   P737A-002541    RE-DUO-2600
Routing Engine 1 REV 07   740-026942   P737A-002602    RE-DUO-2600
CB 0             REV 15   710-022606   EH4376          SFC Control Board
CB 1             REV 15   710-022606   EH4379          SFC Control Board
SPMB 0                    BUILTIN                      SFC Switch CPU
SPMB 1                    BUILTIN                      SFC Switch CPU
SIB F13 0        REV 10   750-035002   EM9305          F13 SIB 3D
  B Board        REV 06   711-035082   EM9667          F13 SIB 3D Mezz
  P Board        REV 05   711-043544   EM9708          F13 SIB 3D Power
  Xcvr 0         REV 01   740-047547   XB34FB00S       CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB01H       CXP Module
  Xcvr 4         REV 01   740-047547   XB34FB02W       CXP Module
  Xcvr 6         REV 01   740-047547   XB34FB01T       CXP Module
  Xcvr 8         REV 01   740-047547   XB48FB00W       CXP Module
  Xcvr 10        REV 01   740-047547   XB34FB01S       CXP Module
  Xcvr 12        REV 01   740-047547   XB34FB03H       CXP Module
  Xcvr 14        REV 01   740-047547   XB34FB023       CXP Module
SIB F13 3        REV 01   710-035001   EJ2612          F13 SIB 3D
  B Board        REV 01   711-035082   EJ3815          F13 SIB 3D Mezz
  P Board        REV 01   711-043544   EJ2678          F13 SIB 3D Power
  Xcvr 0         REV 01   740-047547   XB48FB04C       CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB00Z       CXP Module
  Xcvr 4         REV 01   740-047547   XB47FB036       CXP Module
  Xcvr 6         REV 01   740-047547   XB47FB029       CXP Module
  Xcvr 8         REV 01   740-047547   XB48FB02N       CXP Module
  Xcvr 10        REV 01   740-047547   XB42FB0CS       CXP Module
  Xcvr 12        REV 01   740-047547   XB47FB01X       CXP Module
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  Xcvr 14        REV 01   740-047547   XB48FB02F         CXP Module
SIB F13 6        REV 05   750-035002   EK2675            F13 SIB 3D
  B Board        REV 03   711-035082   EK2612            F13 SIB 3D Mezz
  P Board        REV 04   711-043544   EK1179            F13 SIB 3D Power
  Xcvr 0         REV 01   740-047547   XB48FB01T         CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB02M         CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB031         CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB04P         CXP Module
  Xcvr 8         REV 01   740-047547   XB48FB02T         CXP Module
  Xcvr 10        REV 01   740-047547   XB34FB01V         CXP Module
  Xcvr 12        REV 01   740-047547   XB48FB02C         CXP Module
  Xcvr 14                 NON-JNPR                       No Module
SIB F13 12       REV 01   710-035001   EJ2631            F13 SIB 3D
  B Board        REV 01   711-035082   EJ3808            F13 SIB 3D Mezz
  P Board        REV 01   711-043544   EJ2676            F13 SIB 3D Power
SIB F2S 0/0      REV 01   711-034977   EH9829            F2S SIB 3D
  B Board        REV 01   711-034979   EH9927            F2S SIB 3D Mezz
SIB F2S 0/2      REV 01   711-034977   EH9791            F2S SIB 3D
  B Board        REV 01   711-034979   EH9852            F2S SIB 3D Mezz
SIB F2S 0/4      REV 01   711-034977   EH9803            F2S SIB 3D
  B Board        REV 01   711-034979   EH9915            F2S SIB 3D Mezz
SIB F2S 0/6      REV 01   711-034977   EH9763            F2S SIB 3D
  B Board        REV 01   711-034979   EH9880            F2S SIB 3D Mezz
SIB F2S 1/0      REV 01   711-034977   EH9757            F2S SIB 3D
  B Board        REV 01   711-034979   EH9889            F2S SIB 3D Mezz
SIB F2S 1/2      REV 01   711-034977   EH9815            F2S SIB 3D
  B Board        REV 01   711-034979   EH9890            F2S SIB 3D Mezz
SIB F2S 1/4      REV 08   750-034978   EN1954            F2S SIB 3D
  B Board        REV 02   711-034979   EN1436            F2S SIB 3D Mezz
SIB F2S 1/6      REV 01   711-034977   EJ7054            F2S SIB 3D
  B Board        REV 01   711-034979   EJ8238            F2S SIB 3D Mezz
SIB F2S 2/0      REV 01   711-034977   EH9830            F2S SIB 3D
  B Board        REV 01   711-034979   EH9844            F2S SIB 3D Mezz
SIB F2S 2/2      REV 01   711-034977   EH9818            F2S SIB 3D
  B Board        REV 01   711-034979   EH9888            F2S SIB 3D Mezz
SIB F2S 2/4      REV 01   711-034977   EH9795            F2S SIB 3D
  B Board        REV 01   711-034979   EH9869            F2S SIB 3D Mezz
SIB F2S 2/6      REV 01   711-034977   EJ7026            F2S SIB 3D
  B Board        REV 01   711-034979   EJ8273            F2S SIB 3D Mezz
SIB F2S 3/0      REV 01   711-034977   EH9811            F2S SIB 3D
  B Board        REV 01   711-034979   EH9892            F2S SIB 3D Mezz
SIB F2S 3/2      REV 01   711-034977   EH9812            F2S SIB 3D
  B Board        REV 01   711-034979   EH9877            F2S SIB 3D Mezz
SIB F2S 3/4      REV 08   750-034978   EN1947            F2S SIB 3D
  B Board        REV 02   711-034979   EN1471            F2S SIB 3D Mezz
Fan Tray 0       REV 10   760-024497   EH3313            Front Fan Tray
Fan Tray 1       REV 10   760-024497   EH3290            Front Fan Tray
Fan Tray 2       REV 10   760-024502   EH3292            Rear Fan Tray
Fan Tray 3       REV 10   760-024502   EH3287            Rear Fan Tray
Fan Tray 4       REV 10   760-024502   EH3286            Rear Fan Tray
Fan Tray 5       REV 10   760-024502   EH3285            Rear Fan Tray

lcc0-re0:
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Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11B23FEAHA      T1600
Midplane         REV 01   710-027486   RC9787            T-series Backplane
FPM GBUS         REV 13   710-002901   BBAG5132          T640 FPM Board
FPM Display      REV 04   710-021387   BBAL9612          T1600 FPM Display
CIP              REV 06   710-002895   BBAN0605          T-series CIP
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PEM 0            REV 05   740-036442   1G022060143      Power Entry Module 6x60
PEM 1            REV 05   740-036442   1G022060011      Power Entry Module 6x60
SCG 0            REV 18   710-003423   BBAL7318         T640 Sonet Clock Gen.
SCG 1            REV 18   710-003423   BBAL7255         T640 Sonet Clock Gen.
Routing Engine 0 REV 07   740-026941   P737F-002933     RE-DUO-1800
Routing Engine 1 REV 06   740-026941   P737F-002749     RE-DUO-1800
CB 0             REV 11   710-022597   EH3611           LCC Control Board
CB 1             REV 11   710-022597   EH4798           LCC Control Board
FPC 5            REV 17   710-013037   BBAC5333         FPC Type 4-ES
  CPU            REV 10   710-016744   BBAB7619         ST-PMB2
  PIC 0          REV 18   750-017405   BBAE3420         4x 10GE (LAN/WAN) XFP
    Xcvr 0       REV 03   740-014289   T10C90659        XFP-10G-SR
  MMB 0          REV 05   710-025563   BBAB9538         ST-MMB2
  MMB 1          REV 05   710-025563   BBAB9502         ST-MMB2
FPC 7            REV 01   750-045173   BBAV0032         FPC Type 5-3D
  CPU
SPMB 0           REV 05   710-023321   EG9434           LCC Switch CPU
SPMB 1           REV 05   710-023321   EH3878           LCC Switch CPU
SIB 0            REV 01   750-041657   EH7997           LCC SIB 3D
  B Board        REV 01   711-042424   EH7674           LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB48FB014        CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB05A        CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB052        CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB01B        CXP Module
SIB 1            REV 01   750-041657   EH8023           LCC SIB 3D
  B Board        REV 01   711-042424   EH7659           LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB48FB05J        CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB01E        CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB01J        CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB02S        CXP Module
SIB 2            REV 03   750-041657   EJ6554           LCC SIB 3D
  B Board        REV 02   711-042424   EJ5756           LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB34FB01Z        CXP Module
  Xcvr 2         REV 01   740-047547   XB34FB013        CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB04Z        CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB05N        CXP Module
Fan Tray 0                                              Front Top Fan Tray
Fan Tray 1                                              Front Bottom Fan Tray
Fan Tray 2                                              Rear Fan Tray -- Rev 4

lcc2-re0:
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Hardware inventory:
Item             Version  Part number  Serial number    Description
Chassis                                JN11B3975AHA     T1600
Midplane         REV 01   710-027486   RC9826           T-series Backplane
FPM GBUS         REV 13   710-002901   BBAG5124         T640 FPM Board
FPM Display      REV 03   710-021387   BBAJ1112         T1600 FPM Display
CIP              REV 06   710-002895   BBAL3744         T-series CIP
PEM 0            REV 05   740-036442   1G022060081      Power Entry Module 6x60
PEM 1            REV 05   740-036442   1G022060188      Power Entry Module 6x60
SCG 0            REV 18   710-003423   BBAH8775         T640 Sonet Clock Gen.
SCG 1            REV 18   710-003423   BBAL7272         T640 Sonet Clock Gen.
Routing Engine 0 REV 07   740-026941   P737F-002992     RE-DUO-1800
Routing Engine 1 REV 07   740-026941   P737F-002938     RE-DUO-1800
CB 0             REV 11   710-022597   EH4805           LCC Control Board
CB 1             REV 11   710-022597   EH4786           LCC Control Board
FPC 1            REV 01   710-033873   BBAH0320         FPC Type 3-ES
  CPU            REV 11   710-016744   BBAF3281         ST-PMB2
  MMB 0          REV 06   710-025563   BBAF5061         ST-MMB2
FPC 5            REV 04   710-033871   BBAM5070         FPC Type 4-ES
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  CPU            REV 11   710-016744   BBAM6653         ST-PMB2
  PIC 1          REV 20   750-017405   BBAM1296         4x 10GE (LAN/WAN) XFP
    Xcvr 0       REV 03   740-014289   T10B42981        XFP-10G-SR
  MMB 0          REV 07   710-025563   BBAN2631         ST-MMB2
  MMB 1          REV 07   710-025563   BBAN2538         ST-MMB2
SPMB 0           REV 05   710-023321   EH3903           LCC Switch CPU
SPMB 1           REV 05   710-023321   EH3902           LCC Switch CPU
SIB 0            REV 01   750-041657   EH8019           LCC SIB 3D
  B Board        REV 01   711-042424   EH7680           LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB48FB04F        CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB04S        CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB04B        CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB043        CXP Module
SIB 1            REV 01   750-041657   EH8012           LCC SIB 3D
  B Board        REV 01   711-042424   EH7658           LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB48FB05E        CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB01Z        CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB018        CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB054        CXP Module
SIB 2            REV 01   750-041657   EH7993           LCC SIB 3D
  B Board        REV 01   711-042424   EH7678           LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB48FB05C        CXP Module
  Xcvr 2         REV 01   740-047547   XB47FB00N        CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB05U        CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB05L        CXP Module
Fan Tray 0                                              Front Top Fan Tray
Fan Tray 1                                              Front Bottom Fan Tray
Fan Tray 2                                              Rear Fan Tray -- Rev 4
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show chassis hardware clei-models (TX Matrix Plus router with 3D SIBs)

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user@host> show chassis hardware clei-models
sfc0-re0:
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Hardware inventory:
Item             Version  Part number  CLEI code        FRU model number
Midplane         REV 05   710-022574                    CHAS-BP-TXP-S
FPM Display      REV 09   710-024027                    CRAFT-TXP-S
CIP 0            REV 12   710-023792                    CIP-TXP-S
CIP 1            REV 12   710-023792                    CIP-TXP-S
PEM 0            Rev 06   740-027463   IPUPAFGKTA       PWR-TXP-7-60-DC-S
Routing Engine 0 REV 07   740-026942                    RE-DUO-C2600-16G-S
Routing Engine 1 REV 07   740-026942                    RE-DUO-C2600-16G-S
CB 0             REV 13   710-022606                    CB-TXP-S
CB 1             REV 14   710-022606                    CB-TXP-S
SIB F13 0        REV 10   750-035002   PROTOXCLEI       SIB-TXP-3D-F13-S
  Xcvr 0         REV 01   740-048813
  Xcvr 1         REV 01   740-048813
  Xcvr 2         REV 01   740-048813
  Xcvr 3         REV 01   740-048813
  Xcvr 4         REV 01   740-048813
  Xcvr 5         REV 01   740-048813
  Xcvr 6         REV 01   740-048813
  Xcvr 7         REV 01   740-048813
  Xcvr 8         REV 01   740-047547                    CXP-TXP-3D
  Xcvr 10        REV 01   740-047547                    CXP-TXP-3D
  Xcvr 12        REV 01   740-047547                    CXP-TXP-3D
  Xcvr 14        REV 01   740-047547                    CXP-TXP-3D
SIB F13 1        REV 10   750-035002   PROTOXCLEI       SIB-TXP-3D-F13-S
  Xcvr 0         REV 01   740-047547                    CXP-TXP-3D
  Xcvr 1         REV 01   740-047547                    CXP-TXP-3D
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  Xcvr 2          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 3          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 4          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 5          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 6          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 7          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 8          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 10         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 12         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 14         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 0          REV 01   740-048813
  Xcvr 1          REV 01   740-048813
  Xcvr 2          REV 01   740-048813
  Xcvr 3          REV 01   740-048813
  Xcvr 4          REV 01   740-048813
  Xcvr 5          REV 01   740-048813
  Xcvr 6          REV 01   740-048813
  Xcvr 7          REV 01   740-048813
  Xcvr 8          REV 01   740-048813
  Xcvr 10         REV 01   740-048813
  Xcvr 12         REV 01   740-048813
  Xcvr 14         REV 01   740-048813
  Xcvr 0          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 1          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 2          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 3          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 4          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 5          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 6          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 7          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 8          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 10         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 12         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 14         REV 01   740-047547                      CXP-TXP-3D
SIB F13 6         REV 16   750-035002   PROTOXCLEI         SIB-TXP-3D-F13
  Xcvr 0          REV 01   740-048813
  Xcvr 1          REV 01   740-048813
  Xcvr 2          REV 01   740-048813
  Xcvr 3          REV 01   740-048813
  Xcvr 4          REV 01   740-048813
  Xcvr 5          REV 01   740-048813
  Xcvr 6          REV 01   740-048813
  Xcvr 7          REV 01   740-048813
  Xcvr 8          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 10         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 12         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 14         REV 01   740-047547                      CXP-TXP-3D
SIB F13 7         REV 10   750-035002   PROTOXCLEI         SIB-TXP-3D-F13-S
  Xcvr 0          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 1          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 2          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 3          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 4          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 5          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 6          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 7          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 8          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 10         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 12         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 14         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 0          REV 01   740-048813
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  Xcvr 1          REV 01   740-048813
  Xcvr 2          REV 01   740-048813
  Xcvr 3          REV 01   740-048813
  Xcvr 4          REV 01   740-048813
  Xcvr 5          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 6          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 7          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 8          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 10         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 12         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 14         REV 01   740-047547                      CXP-TXP-3D
SIB F13 9         REV 16   750-035002   PROTOXCLEI         SIB-TXP-3D-F13
  Xcvr 0          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 1          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 2          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 3          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 4          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 5          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 6          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 7          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 8          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 10         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 12         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 14         REV 01   740-047547                      CXP-TXP-3D
SIB F13 11        REV 10   750-035002   PROTOXCLEI         750-035002
  Xcvr 0          REV 01   740-048813
  Xcvr 1          REV 01   740-048813
  Xcvr 2          REV 01   740-048813
  Xcvr 3          REV 01   740-048813
  Xcvr 4          REV 01   740-048813
  Xcvr 5          REV 01   740-048813
  Xcvr 6          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 7          REV 01   740-048813
  Xcvr 8          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 12         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 14         REV 01   740-047547                      CXP-TXP-3D
SIB F13 12        REV 16   750-035002   PROTOXCLEI         SIB-TXP-3D-F13
  Xcvr 0          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 1          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 2          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 3          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 4          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 5          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 6          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 7          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 8          REV 01   740-047547                      CXP-TXP-3D
  Xcvr 10         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 12         REV 01   740-047547                      CXP-TXP-3D
  Xcvr 14         REV 01   740-047547                      CXP-TXP-3D
SIB F2S 0/0       REV 06   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
SIB F2S 0/2       REV 07   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
SIB F2S 0/4       REV 06   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
SIB F2S 0/6       REV 06   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
SIB F2S 1/0       REV 07   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
SIB F2S 1/2       REV 07   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
SIB F2S 1/4       REV 07   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
SIB F2S 1/6       REV 08   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
SIB F2S 2/0       REV 06   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
SIB F2S 2/2       REV 06   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
SIB F2S 2/4       REV 07   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
SIB F2S 2/6       REV 06   750-034978   PROTOXCLEI         SIB-TXP-3D-F2S
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SIB F2S 3/0      REV 07   750-034978   PROTOXCLEI        SIB-TXP-3D-F2S
SIB F2S 3/2      REV 06   750-034978   PROTOXCLEI        SIB-TXP-3D-F2S
SIB F2S 3/4      REV 06   750-034978   PROTOXCLEI        SIB-TXP-3D-F2S
SIB F2S 3/6      REV 06   750-034978   PROTOXCLEI        SIB-TXP-3D-F2S
SIB F2S 4/0      REV 07   750-034978   PROTOXCLEI        SIB-TXP-3D-F2S
SIB F2S 4/2      REV 06   750-034978   PROTOXCLEI        SIB-TXP-3D-F2S
SIB F2S 4/4      REV 06   750-034978   PROTOXCLEI        SIB-TXP-3D-F2S
SIB F2S 4/6      REV 06   750-034978   PROTOXCLEI        SIB-TXP-3D-F2S
Fan Tray 0       REV 10   760-024497                     FANTRAY-TXP-H-S
Fan Tray 1       REV 10   760-024497                     FANTRAY-TXP-H-S
Fan Tray 2       REV 10   760-024502                     FANTRAY-TXP-V-S
Fan Tray 3       REV 10   760-024502                     FANTRAY-TXP-V-S
Fan Tray 4       REV 10   760-024502                     FANTRAY-TXP-V-S
Fan Tray 5       REV 10   760-024502                     FANTRAY-TXP-V-S

lcc0-re0:
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Hardware inventory:
Item             Version  Part number  CLEI code         FRU model number
Midplane         REV 01   710-027486   IPMJ700DRD        CHAS-BP-T1600-S
FPM Display      REV 04   710-021387                     CRAFT-T1600-S
CIP              REV 06   710-002895                     CIP-L-T640-S
PEM 0            REV 05   740-036442   IPUPAG6KAA        PWR-T-6-60-DC-S
PEM 1            REV 05   740-036442   IPUPAG6KAA        PWR-T-6-60-DC-S
SCG 0            REV 18   710-003423                     SCG-T-S
SCG 1            REV 18   710-003423                     SCG-T-S
Routing Engine 0 REV 10   740-026941                     RE-DUO-C1800-8G-S
Routing Engine 1 REV 07   740-026941                     RE-DUO-C1800-8G-S
CB 0             REV 11   710-022597                     CB-LCC-S
CB 1             REV 11   710-022597                     CB-LCC-S
FPC 0            REV 01   750-045173   IP9IAL4DAB        T4000-FPC5-3D
  PIC 0          REV 17   750-034624   IP9IAL2DAA        PF-12XGE-SFPP
  PIC 1          REV 17   750-034624   IP9IAL2DAA        PF-12XGE-SFPP
FPC 3            REV 01   750-045173   IP9IAL4DAB        T4000-FPC5-3D
  PIC 0          REV 13   750-033423   XXXXXXXXDD        PF-12-24XGE-SFPP
FPC 4            REV 02   750-045173   IP9IAL4DAC        T4000-FPC5-3D
  PIC 0          REV 17   750-034624   IP9IAL2DAA        PF-12XGE-SFPP
  PIC 1          REV 17   750-034624   IP9IAL2DAA        PF-12XGE-SFPP
FPC 5            REV 01   750-045173   IP9IAL4DAB        T4000-FPC5-3D
  PIC 0          REV 17   750-034624   IP9IAL2DAA        PF-12XGE-SFPP
  PIC 1          REV 17   750-034624   IP9IAL2DAA        PF-12XGE-SFPP
FPC 6            REV 01   750-045173   IP9IAL4DAB        T4000-FPC5-3D
  PIC 0          REV 17   750-034624   IP9IAL2DAA        PF-12XGE-SFPP
  PIC 1          REV 10   750-035293   IP9IAL3DAA        PF-1CGE-CFP
SIB 0            REV 06   750-041657   PROTOXCLEI        SIB-TXP-3D-LCC
  Xcvr 0         REV 01   740-048813
  Xcvr 1         REV 01   740-048813
  Xcvr 2         REV 01   740-048813
  Xcvr 3         REV 01   740-048813
  Xcvr 4         REV 01   740-048813
  Xcvr 5         REV 01   740-048813
  Xcvr 6         REV 01   740-048813
  Xcvr 7         REV 01   740-048813
SIB 1            REV 06   750-041657   PROTOXCLEI        SIB-TXP-3D-LCC
  Xcvr 0         REV 01   740-048813
  Xcvr 1         REV 01   740-048813
  Xcvr 2         REV 01   740-048813
  Xcvr 3         REV 01   740-048813
  Xcvr 4         REV 01   740-048813
  Xcvr 5         REV 01   740-048813
  Xcvr 6         REV 01   740-048813
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  Xcvr 7         REV 01   740-048813
SIB 2            REV 06   750-041657   PROTOXCLEI       SIB-TXP-3D-LCC
  Xcvr 0         REV 01   740-048813
  Xcvr 1         REV 01   740-048813
  Xcvr 2         REV 01   740-048813
  Xcvr 3         REV 01   740-048813
  Xcvr 4         REV 01   740-048813
  Xcvr 5         REV 01   740-048813
  Xcvr 6         REV 01   740-048813
  Xcvr 7         REV 01   740-048813
SIB 3            REV 07   750-041657   PROTOXCLEI       SIB-TXP-3D-LLC
  Xcvr 0         REV 01   740-048813
  Xcvr 1         REV 01   740-048813
  Xcvr 2         REV 01   740-048813
  Xcvr 3         REV 01   740-048813
  Xcvr 4         REV 01   740-048813
  Xcvr 5         REV 01   740-048813
  Xcvr 6         REV 01   740-048813
  Xcvr 7         REV 01   740-048813
SIB 4            REV 06   750-041657   PROTOXCLEI       SIB-TXP-3D-LCC
  Xcvr 0         REV 01   740-048813
  Xcvr 1         REV 01   740-048813
  Xcvr 2         REV 01   740-048813
  Xcvr 3         REV 01   740-048813
  Xcvr 4         REV 01   740-048813
  Xcvr 5         REV 01   740-048813
  Xcvr 6         REV 01   740-048813
  Xcvr 7         REV 01   740-048813
Fan Tray 0                                              FANTRAY-T-S
Fan Tray 1                                              FANTRAY-T-S
Fan Tray 2                                              FANTRAY-TXP3D-LCC-R-S
[Output Truncated]
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show chassis hardware detail (TX Matrix Plus router with 3D SIBs)

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user@host> show chassis hardware detail
sfc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  Serial number    Description
Chassis                                JN11CAAA4AHB     TXP
Midplane         REV 05   710-022574   ABAC4696         SFC Midplane
FPM Display      REV 09   710-024027   EH3138           TXP FPM Display
CIP 0            REV 12   710-023792   EF6349           TXP CIP
CIP 1            REV 12   710-023792   EG5294           TXP CIP
PEM 0            Rev 06   740-027463   XH04595          Power Entry Module
PEM 1            Rev 06   740-027463   XH04592          Power Entry Module
Routing Engine 0 REV 07   740-026942   P737A-002541     RE-DUO-2600
  ad0     3823 MB  SMART CF            2011030400062C132C13 Compact Flash
  ad1    62720 MB  SMART Lite SATA Drive 201105100009A452A452 Disk 1
Routing Engine 1 REV 07   740-026942   P737A-002602     RE-DUO-2600
  ad0     3823 MB  SMART CF            20110508085EE471E471 Compact Flash
  ad1    62720 MB  SMART Lite SATA Drive 201110210089DF39DF39 Disk 1
CB 0             REV 15   710-022606   EH4376           SFC Control Board
CB 1             REV 15   710-022606   EH4379           SFC Control Board
SPMB 0                    BUILTIN                       SFC Switch CPU
SPMB 1                    BUILTIN                       SFC Switch CPU
SIB F13 0        REV 10   750-035002   EM9305           F13 SIB 3D
  B Board        REV 06   711-035082   EM9667           F13 SIB 3D Mezz
  P Board        REV 05   711-043544   EM9708           F13 SIB 3D Power
  Xcvr 0         REV 01   740-047547   XB34FB00S        CXP Module
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  Xcvr 2         REV 01   740-047547   XB48FB01H         CXP Module
  Xcvr 4         REV 01   740-047547   XB34FB02W         CXP Module
  Xcvr 6         REV 01   740-047547   XB34FB01T         CXP Module
  Xcvr 8         REV 01   740-047547   XB48FB00W         CXP Module
  Xcvr 10        REV 01   740-047547   XB34FB01S         CXP Module
  Xcvr 12        REV 01   740-047547   XB34FB03H         CXP Module
  Xcvr 14        REV 01   740-047547   XB34FB023         CXP Module
SIB F13 3        REV 01   710-035001   EJ2612            F13 SIB 3D
  B Board        REV 01   711-035082   EJ3815            F13 SIB 3D Mezz
  P Board        REV 01   711-043544   EJ2678            F13 SIB 3D Power
  Xcvr 0         REV 01   740-047547   XB48FB04C         CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB00Z         CXP Module
  Xcvr 4         REV 01   740-047547   XB47FB036         CXP Module
  Xcvr 6         REV 01   740-047547   XB47FB029         CXP Module
  Xcvr 8         REV 01   740-047547   XB48FB02N         CXP Module
  Xcvr 10        REV 01   740-047547   XB42FB0CS         CXP Module
  Xcvr 12        REV 01   740-047547   XB47FB01X         CXP Module
  Xcvr 14        REV 01   740-047547   XB48FB02F         CXP Module
SIB F13 6        REV 05   750-035002   EK2675            F13 SIB 3D
  B Board        REV 03   711-035082   EK2612            F13 SIB 3D Mezz
  P Board        REV 04   711-043544   EK1179            F13 SIB 3D Power
  Xcvr 0         REV 01   740-047547   XB48FB01T         CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB02M         CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB031         CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB04P         CXP Module
  Xcvr 8         REV 01   740-047547   XB48FB02T         CXP Module
  Xcvr 10        REV 01   740-047547   XB34FB01V         CXP Module
  Xcvr 12        REV 01   740-047547   XB48FB02C         CXP Module
  Xcvr 14                 NON-JNPR                       No Module
SIB F13 12       REV 01   710-035001   EJ2631            F13 SIB 3D
  B Board        REV 01   711-035082   EJ3808            F13 SIB 3D Mezz
  P Board        REV 01   711-043544   EJ2676            F13 SIB 3D Power
SIB F2S 0/0      REV 01   711-034977   EH9829            F2S SIB 3D
  B Board        REV 01   711-034979   EH9927            F2S SIB 3D Mezz
SIB F2S 0/2      REV 01   711-034977   EH9791            F2S SIB 3D
  B Board        REV 01   711-034979   EH9852            F2S SIB 3D Mezz
SIB F2S 0/4      REV 01   711-034977   EH9803            F2S SIB 3D
  B Board        REV 01   711-034979   EH9915            F2S SIB 3D Mezz
SIB F2S 0/6      REV 01   711-034977   EH9763            F2S SIB 3D
  B Board        REV 01   711-034979   EH9880            F2S SIB 3D Mezz
SIB F2S 1/0      REV 01   711-034977   EH9757            F2S SIB 3D
  B Board        REV 01   711-034979   EH9889            F2S SIB 3D Mezz
SIB F2S 1/2      REV 01   711-034977   EH9815            F2S SIB 3D
  B Board        REV 01   711-034979   EH9890            F2S SIB 3D Mezz
SIB F2S 1/4      REV 08   750-034978   EN1954            F2S SIB 3D
  B Board        REV 02   711-034979   EN1436            F2S SIB 3D Mezz
SIB F2S 1/6      REV 01   711-034977   EJ7054            F2S SIB 3D
  B Board        REV 01   711-034979   EJ8238            F2S SIB 3D Mezz
SIB F2S 2/0      REV 01   711-034977   EH9830            F2S SIB 3D
  B Board        REV 01   711-034979   EH9844            F2S SIB 3D Mezz
SIB F2S 2/2      REV 01   711-034977   EH9818            F2S SIB 3D
  B Board        REV 01   711-034979   EH9888            F2S SIB 3D Mezz
SIB F2S 2/4      REV 01   711-034977   EH9795            F2S SIB 3D
  B Board        REV 01   711-034979   EH9869            F2S SIB 3D Mezz
SIB F2S 2/6      REV 01   711-034977   EJ7026            F2S SIB 3D
  B Board        REV 01   711-034979   EJ8273            F2S SIB 3D Mezz
SIB F2S 3/0      REV 01   711-034977   EH9811            F2S SIB 3D
  B Board        REV 01   711-034979   EH9892            F2S SIB 3D Mezz
SIB F2S 3/2      REV 01   711-034977   EH9812            F2S SIB 3D
  B Board        REV 01   711-034979   EH9877            F2S SIB 3D Mezz
SIB F2S 3/4      REV 08   750-034978   EN1947            F2S SIB 3D
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  B Board        REV 02   711-034979   EN1471            F2S SIB 3D Mezz
Fan Tray 0       REV 10   760-024497   EH3313            Front Fan Tray
Fan Tray 1       REV 10   760-024497   EH3290            Front Fan Tray
Fan Tray 2       REV 10   760-024502   EH3292            Rear Fan Tray
Fan Tray 3       REV 10   760-024502   EH3287            Rear Fan Tray
Fan Tray 4       REV 10   760-024502   EH3286            Rear Fan Tray
Fan Tray 5       REV 10   760-024502   EH3285            Rear Fan Tray

lcc0-re0:
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Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11B23FEAHA      T1600
Midplane         REV 01   710-027486   RC9787            T-series Backplane
FPM GBUS         REV 13   710-002901   BBAG5132          T640 FPM Board
FPM Display      REV 04   710-021387   BBAL9612          T1600 FPM Display
CIP              REV 06   710-002895   BBAN0605          T-series CIP
PEM 0            REV 05   740-036442   1G022060143       Power Entry Module 6x60
PEM 1            REV 05   740-036442   1G022060011       Power Entry Module 6x60
SCG 0            REV 18   710-003423   BBAL7318          T640 Sonet Clock Gen.
SCG 1            REV 18   710-003423   BBAL7255          T640 Sonet Clock Gen.
Routing Engine 0 REV 07   740-026941   P737F-002933      RE-DUO-1800
  ad0    3823 MB  SMART CF             201103030490604E604E Compact Flash
  ad1   62720 MB  SMART Lite SATA Drive 20110729028B11D411D4 Disk 1
Routing Engine 1 REV 06   740-026941   P737F-002749      RE-DUO-1800
  ad0    3823 MB  SMART CF             2011010504EB99649964 Compact Flash
  ad1   62720 MB  SMART Lite SATA Drive 201102140058934A934A Disk 1
CB 0             REV 11   710-022597   EH3611            LCC Control Board
CB 1             REV 11   710-022597   EH4798            LCC Control Board
FPC 5            REV 17   710-013037   BBAC5333          FPC Type 4-ES
  CPU            REV 10   710-016744   BBAB7619          ST-PMB2
  PIC 0          REV 18   750-017405   BBAE3420          4x 10GE (LAN/WAN) XFP
    Xcvr 0       REV 03   740-014289   T10C90659         XFP-10G-SR
  MMB 0          REV 05   710-025563   BBAB9538          ST-MMB2
  MMB 1          REV 05   710-025563   BBAB9502          ST-MMB2
FPC 7            REV 01   750-045173   BBAV0032          FPC Type 5-3D
  CPU
SPMB 0           REV 05   710-023321   EG9434            LCC Switch CPU
SPMB 1           REV 05   710-023321   EH3878            LCC Switch CPU
SIB 0            REV 01   750-041657   EH7997            LCC SIB 3D
  B Board        REV 01   711-042424   EH7674            LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB48FB014         CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB05A         CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB052         CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB01B         CXP Module
SIB 1            REV 01   750-041657   EH8023            LCC SIB 3D
  B Board        REV 01   711-042424   EH7659            LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB48FB05J         CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB01E         CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB01J         CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB02S         CXP Module
SIB 2            REV 03   750-041657   EJ6554            LCC SIB 3D
  B Board        REV 02   711-042424   EJ5756            LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB34FB01Z         CXP Module
  Xcvr 2         REV 01   740-047547   XB34FB013         CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB04Z         CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB05N         CXP Module
Fan Tray 0                                               Front Top Fan Tray
Fan Tray 1                                               Front Bottom Fan Tray
Fan Tray 2                                               Rear Fan Tray -- Rev 4
```



```
lcc2-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11B3975AHA      T1600
Midplane         REV 01   710-027486   RC9826            T-series Backplane
FPM GBUS         REV 13   710-002901   BBAG5124          T640 FPM Board
FPM Display      REV 03   710-021387   BBAJ1112          T1600 FPM Display
CIP              REV 06   710-002895   BBAL3744          T-series CIP
PEM 0            REV 05   740-036442   1G022060081       Power Entry Module 6x60
PEM 1            REV 05   740-036442   1G022060188       Power Entry Module 6x60
SCG 0            REV 18   710-003423   BBAH8775          T640 Sonet Clock Gen.
SCG 1            REV 18   710-003423   BBAL7272          T640 Sonet Clock Gen.
Routing Engine 0 REV 07   740-026941   P737F-002992      RE-DUO-1800
  ad0     3823 MB  SMART CF            201103030356329E329E Compact Flash
  ad1    62720 MB  SMART Lite SATA Drive 2011051000488D8B8D8B Disk 1
Routing Engine 1 REV 07   740-026941   P737F-002938      RE-DUO-1800
  ad0     3823 MB  SMART CF            20110304000F02680268 Compact Flash
  ad1    62720 MB  SMART Lite SATA Drive 201105300A70F325F325 Disk 1
CB 0             REV 11   710-022597   EH4805            LCC Control Board
CB 1             REV 11   710-022597   EH4786            LCC Control Board
FPC 1            REV 01   710-033873   BBAH0320          FPC Type 3-ES
  CPU            REV 11   710-016744   BBAF3281          ST-PMB2
  MMB 0          REV 06   710-025563   BBAF5061          ST-MMB2
FPC 5            REV 04   710-033871   BBAM5070          FPC Type 4-ES
  CPU            REV 11   710-016744   BBAM6653          ST-PMB2
  PIC 1          REV 20   750-017405   BBAM1296          4x 10GE (LAN/WAN) XFP
    Xcvr 0       REV 03   740-014289   T10B42981         XFP-10G-SR
  MMB 0          REV 07   710-025563   BBAN2631          ST-MMB2
  MMB 1          REV 07   710-025563   BBAN2538          ST-MMB2
SPMB 0           REV 05   710-023321   EH3903            LCC Switch CPU
SPMB 1           REV 05   710-023321   EH3902            LCC Switch CPU
SIB 0            REV 01   750-041657   EH8019            LCC SIB 3D
  B Board        REV 01   711-042424   EH7680            LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB48FB04F         CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB04S         CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB04B         CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB043         CXP Module
SIB 1            REV 01   750-041657   EH8012            LCC SIB 3D
  B Board        REV 01   711-042424   EH7658            LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB48FB05E         CXP Module
  Xcvr 2         REV 01   740-047547   XB48FB01Z         CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB018         CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB054         CXP Module
SIB 2            REV 01   750-041657   EH7993            LCC SIB 3D
  B Board        REV 01   711-042424   EH7678            LCC SIB 3D Mezz
  Xcvr 0         REV 01   740-047547   XB48FB05C         CXP Module
  Xcvr 2         REV 01   740-047547   XB47FB00N         CXP Module
  Xcvr 4         REV 01   740-047547   XB48FB05U         CXP Module
  Xcvr 6         REV 01   740-047547   XB48FB05L         CXP Module
Fan Tray 0                                               Front Top Fan Tray
Fan Tray 1                                               Front Bottom Fan Tray
Fan Tray 2                                               Rear Fan Tray -- Rev 4
```

show chassis hardware lcc (TX Matrix Plus router with 3D SIBs)

```
user@host> show chassis hardware lcc 0
lcc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item             Version  Part number  Serial number     Description
```

```
Chassis                                    JN11B23FEAHA      T1600
Midplane          REV 01   710-027486      RC9787            T-series Backplane
FPM GBUS          REV 13   710-002901      BBAG5132          T640 FPM Board
FPM Display       REV 04   710-021387      BBAL9612          T1600 FPM Display
CIP               REV 06   710-002895      BBAN0605          T-series CIP
PEM 0             REV 05   740-036442      1G022060143       Power Entry Module 6x60
PEM 1             REV 05   740-036442      1G022060011       Power Entry Module 6x60
SCG 0             REV 18   710-003423      BBAL7318          T640 Sonet Clock Gen.
SCG 1             REV 18   710-003423      BBAL7255          T640 Sonet Clock Gen.
Routing Engine 0  REV 07   740-026941      P737F-002933      RE-DUO-1800
Routing Engine 1  REV 06   740-026941      P737F-002749      RE-DUO-1800
CB 0              REV 11   710-022597      EH3611            LCC Control Board
CB 1              REV 11   710-022597      EH4798            LCC Control Board
FPC 5             REV 17   710-013037      BBAC5333          FPC Type 4-ES
  CPU             REV 10   710-016744      BBAB7619          ST-PMB2
  PIC 0           REV 18   750-017405      BBAE3420          4x 10GE (LAN/WAN) XFP
    Xcvr 0        REV 03   740-014289      T10C90659         XFP-10G-SR
  MMB 0           REV 05   710-025563      BBAB9538          ST-MMB2
  MMB 1           REV 05   710-025563      BBAB9502          ST-MMB2
FPC 7             REV 01   750-045173      BBAV0032          FPC Type 5-3D
  CPU
SPMB 0            REV 05   710-023321      EG9434            LCC Switch CPU
SPMB 1            REV 05   710-023321      EH3878            LCC Switch CPU
SIB 0             REV 01   750-041657      EH7997            LCC SIB 3D
  B Board         REV 01   711-042424      EH7674            LCC SIB 3D Mezz
  Xcvr 0          REV 01   740-047547      XB48FB014         CXP Module
  Xcvr 2          REV 01   740-047547      XB48FB05A         CXP Module
  Xcvr 4          REV 01   740-047547      XB48FB052         CXP Module
  Xcvr 6          REV 01   740-047547      XB48FB01B         CXP Module
SIB 1             REV 01   750-041657      EH8023            LCC SIB 3D
  B Board         REV 01   711-042424      EH7659            LCC SIB 3D Mezz
  Xcvr 0          REV 01   740-047547      XB48FB05J         CXP Module
  Xcvr 2          REV 01   740-047547      XB48FB01E         CXP Module
  Xcvr 4          REV 01   740-047547      XB48FB01J         CXP Module
  Xcvr 6          REV 01   740-047547      XB48FB02S         CXP Module
SIB 2             REV 03   750-041657      EJ6554            LCC SIB 3D
  B Board         REV 02   711-042424      EJ5756            LCC SIB 3D Mezz
  Xcvr 0          REV 01   740-047547      XB34FB01Z         CXP Module
  Xcvr 2          REV 01   740-047547      XB34FB013         CXP Module
  Xcvr 4          REV 01   740-047547      XB48FB04Z         CXP Module
  Xcvr 6          REV 01   740-047547      XB48FB05N         CXP Module
Fan Tray 0                                                   Front Top Fan Tray
Fan Tray 1                                                   Front Bottom Fan Tray
Fan Tray 2                                                   Rear Fan Tray -- Rev 4
```

show chassis hardware sfc (TX Matrix Plus router with 3D SIBs)

```
user@host> show chassis hardware sfc 0
sfc0-re0:
--------------------------------------------------------------------------
Hardware inventory:
Item              Version  Part number  Serial number     Description
Chassis                                 JN11CAAA4AHB      TXP
Midplane          REV 05   710-022574   ABAC4696          SFC Midplane
FPM Display       REV 09   710-024027   EH3138            TXP FPM Display
CIP 0             REV 12   710-023792   EF6349            TXP CIP
CIP 1             REV 12   710-023792   EG5294            TXP CIP
PEM 0             Rev 06   740-027463   XH04595           Power Entry Module
PEM 1             Rev 06   740-027463   XH04592           Power Entry Module
Routing Engine 0  REV 07   740-026942   P737A-002541      RE-DUO-2600
Routing Engine 1  REV 07   740-026942   P737A-002602      RE-DUO-2600
```

```
CB 0              REV 15   710-022606   EH4376            SFC Control Board
CB 1              REV 15   710-022606   EH4379            SFC Control Board
SPMB 0                     BUILTIN                        SFC Switch CPU
SPMB 1                     BUILTIN                        SFC Switch CPU
SIB F13 0         REV 10   750-035002   EM9305            F13 SIB 3D
  B Board         REV 06   711-035082   EM9667            F13 SIB 3D Mezz
  P Board         REV 05   711-043544   EM9708            F13 SIB 3D Power
  Xcvr 0          REV 01   740-047547   XB34FB00S         CXP Module
  Xcvr 2          REV 01   740-047547   XB48FB01H         CXP Module
  Xcvr 4          REV 01   740-047547   XB34FB02W         CXP Module
  Xcvr 6          REV 01   740-047547   XB34FB01T         CXP Module
  Xcvr 8          REV 01   740-047547   XB48FB00W         CXP Module
  Xcvr 10         REV 01   740-047547   XB34FB01S         CXP Module
  Xcvr 12         REV 01   740-047547   XB34FB03H         CXP Module
  Xcvr 14         REV 01   740-047547   XB34FB023         CXP Module
SIB F13 3         REV 01   710-035001   EJ2612            F13 SIB 3D
  B Board         REV 01   711-035082   EJ3815            F13 SIB 3D Mezz
  P Board         REV 01   711-043544   EJ2678            F13 SIB 3D Power
  Xcvr 0          REV 01   740-047547   XB48FB04C         CXP Module
  Xcvr 2          REV 01   740-047547   XB48FB00Z         CXP Module
  Xcvr 4          REV 01   740-047547   XB47FB036         CXP Module
  Xcvr 6          REV 01   740-047547   XB47FB029         CXP Module
  Xcvr 8          REV 01   740-047547   XB48FB02N         CXP Module
  Xcvr 10         REV 01   740-047547   XB42FB0CS         CXP Module
  Xcvr 12         REV 01   740-047547   XB47FB01X         CXP Module
  Xcvr 14         REV 01   740-047547   XB48FB02F         CXP Module
SIB F13 6         REV 05   750-035002   EK2675            F13 SIB 3D
  B Board         REV 03   711-035082   EK2612            F13 SIB 3D Mezz
  P Board         REV 04   711-043544   EK1179            F13 SIB 3D Power
  Xcvr 0          REV 01   740-047547   XB48FB01T         CXP Module
  Xcvr 2          REV 01   740-047547   XB48FB02M         CXP Module
  Xcvr 4          REV 01   740-047547   XB48FB031         CXP Module
  Xcvr 6          REV 01   740-047547   XB48FB04P         CXP Module
  Xcvr 8          REV 01   740-047547   XB48FB02T         CXP Module
  Xcvr 10         REV 01   740-047547   XB34FB01V         CXP Module
  Xcvr 12         REV 01   740-047547   XB48FB02C         CXP Module
  Xcvr 14                  NON-JNPR                       No Module
SIB F13 12        REV 01   710-035001   EJ2631            F13 SIB 3D
  B Board         REV 01   711-035082   EJ3808            F13 SIB 3D Mezz
  P Board         REV 01   711-043544   EJ2676            F13 SIB 3D Power
SIB F2S 0/0       REV 01   711-034977   EH9829            F2S SIB 3D
  B Board         REV 01   711-034979   EH9927            F2S SIB 3D Mezz
SIB F2S 0/2       REV 01   711-034977   EH9791            F2S SIB 3D
  B Board         REV 01   711-034979   EH9852            F2S SIB 3D Mezz
SIB F2S 0/4       REV 01   711-034977   EH9803            F2S SIB 3D
  B Board         REV 01   711-034979   EH9915            F2S SIB 3D Mezz
SIB F2S 0/6       REV 01   711-034977   EH9763            F2S SIB 3D
  B Board         REV 01   711-034979   EH9880            F2S SIB 3D Mezz
SIB F2S 1/0       REV 01   711-034977   EH9757            F2S SIB 3D
  B Board         REV 01   711-034979   EH9889            F2S SIB 3D Mezz
SIB F2S 1/2       REV 01   711-034977   EH9815            F2S SIB 3D
  B Board         REV 01   711-034979   EH9890            F2S SIB 3D Mezz
SIB F2S 1/4       REV 08   750-034978   EN1954            F2S SIB 3D
  B Board         REV 02   711-034979   EN1436            F2S SIB 3D Mezz
SIB F2S 1/6       REV 01   711-034977   EJ7054            F2S SIB 3D
  B Board         REV 01   711-034979   EJ8238            F2S SIB 3D Mezz
SIB F2S 2/0       REV 01   711-034977   EH9830            F2S SIB 3D
  B Board         REV 01   711-034979   EH9844            F2S SIB 3D Mezz
SIB F2S 2/2       REV 01   711-034977   EH9818            F2S SIB 3D
  B Board         REV 01   711-034979   EH9888            F2S SIB 3D Mezz
SIB F2S 2/4       REV 01   711-034977   EH9795            F2S SIB 3D
```

```
  B Board         REV 01    711-034979    EH9869            F2S SIB 3D Mezz
SIB F2S 2/6       REV 01    711-034977    EJ7026            F2S SIB 3D
  B Board         REV 01    711-034979    EJ8273            F2S SIB 3D Mezz
SIB F2S 3/0       REV 01    711-034977    EH9811            F2S SIB 3D
  B Board         REV 01    711-034979    EH9892            F2S SIB 3D Mezz
SIB F2S 3/2       REV 01    711-034977    EH9812            F2S SIB 3D
  B Board         REV 01    711-034979    EH9877            F2S SIB 3D Mezz
SIB F2S 3/4       REV 08    750-034978    EN1947            F2S SIB 3D
  B Board         REV 02    711-034979    EN1471            F2S SIB 3D Mezz
Fan Tray 0        REV 10    760-024497    EH3313            Front Fan Tray
Fan Tray 1        REV 10    760-024497    EH3290            Front Fan Tray
Fan Tray 2        REV 10    760-024502    EH3292            Rear Fan Tray
Fan Tray 3        REV 10    760-024502    EH3287            Rear Fan Tray
Fan Tray 4        REV 10    760-024502    EH3286            Rear Fan Tray
Fan Tray 5        REV 10    760-024502    EH3285            Rear Fan Tray
```

show chassis hardware (16-Port 10-Gigabit Ethernet MPC with SFP+ Optics [MX Series Routers])

```
user@host> show chassis hardware
Hardware inventory:
    Item             Version  Part number  Serial number     Description
    Chassis                                JN112D865AFA      MX960
    Midplane         REV 03   710-013698   TS3339            MX960 Backplane
    FPM Board        REV 03   710-014974   WW6267            Front Panel Display

    PDM              Rev 03   740-013110   QCS12485026       Power Distribution
Module
    PEM 0           Rev 04   740-013682   QCS12434086       PS 1.7kW; 200-240VAC
 in
    PEM 1           Rev 04   740-013682   QCS1243408Z       PS 1.7kW; 200-240VAC
 in
    PEM 2           Rev 04   740-013682   QCS1243407X       PS 1.7kW; 200-240VAC
 in
    Routing Engine 0 REV 07   740-015113   9009009677        RE-S-1300
    Routing Engine 1 REV 07   740-015113   9009011510        RE-S-1300
    CB 0             REV 03   710-021523   XF0394            MX SCB
    CB 1             REV 03   710-021523   XF0550            MX SCB
    CB 2             REV 03   710-021523   XD7455            MX SCB
    FPC 4            REV 02   750-028467   JR6127            MPC M 16x 10GE
      CPU            REV 02   711-029089   JX0129            AS PMB
      PIC 0                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
      PIC 1                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
      PIC 2                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
      PIC 3                   BUILTIN      BUILTIN           4x 10GE(LAN) SFP+
    Fan Tray 0       REV 05   740-014971   TP9990            Fan Tray
    Fan Tray 1       REV 05   740-014971   VS1709            Fan Tray
```

show chassis hardware (MPC3E [MX Series Routers])

```
user@host> show chassis hardware
Hardware inventory:
   Item             Version  Part number   Serial number     Description
   Chassis                                 JN1101AFEAFB      MX480
   Midplane         REV 05   710-017414    TR4444            MX480 Midplane
   FPM Board        REV 02   710-017254    KG6056            Front Panel Display

   PEM 0          Rev 03   740-017330    QCS082090FC      PS 1.2-1.7kW; 100-240V

   PEM 1          Rev 03   740-017330    QCS082090FD      PS 1.2-1.7kW; 100-240V

   Routing Engine 0 REV 07   740-013063    9009004124        RE-S-2000
```



```
  Routing Engine 1 REV 07    740-013063    9009005569        RE-S-2000
  CB 0             REV 07    710-021523    XZ3587            MX SCB
  CB 1             REV 03    710-021523    KH8306            MX SCB
  FPC 1            REV 04.1.07 750-033205  P1240             MPC Type 3
   CPU             REV 01    711-035209    YL0504            HMPC PMB 2G
   MIC 1           REV 10    750-033199    YX4495            1X100GE CFP
    PIC 2                    BUILTIN       BUILTIN           1X100GE CFP
     Xcvr 0        REV 01    740-032210    C22CQNE           CFP-100G-LR4
  FPC 2            REV 26    750-016670    KH0045            DPCE 40x 1GE R EQ
   CPU             REV 07    710-013713    KF5448            DPC PMB
   PIC 0                     BUILTIN       BUILTIN           10x 1GE(LAN) EQ
    Xcvr 0         REV 01    740-011613    PF21JHU           SFP-SX
   PIC 1                     BUILTIN       BUILTIN           10x 1GE(LAN) EQ
    Xcvr 9         REV 01    740-011613    AM0813S8ZL6       SFP-SX
   PIC 2                     BUILTIN       BUILTIN           10x 1GE(LAN) EQ
    Xcvr 0         REV 02    740-011613    PGL2KYF           SFP-SX
    Xcvr 2         REV 01    740-011613    AM0806S8N4P       SFP-SX
   PIC 3                     BUILTIN       BUILTIN           10x 1GE(LAN) EQ
    Xcvr 5         REV 01    740-011613    AM0815S967N       SFP-SX
    Xcvr 7         REV 01    740-011613    AM0806S8N1X       SFP-SX
    Xcvr 8         REV 01    740-011613    AM0815S967J       SFP-SX
    Xcvr 9         REV 01    740-011613    AM0815S967M       SFP-SX
  FPC 3            REV 12.2.09 750-033205  YR9443            MPC Type 3
   CPU             REV 03    711-035209    YL6931            HMPC PMB 2G
   MIC 0           REV 05    750-033199    YR3269            1X100GE CFP
    PIC 0                    BUILTIN       BUILTIN           1X100GE CFP
     Xcvr 0        REV 01    740-032210    ULHOKG3           CFP-100G-LR4
   MIC 1           REV 02    750-033199    YG3245            1X100GE CFP
    PIC 2                    BUILTIN       BUILTIN           1X100GE CFP
     Xcvr 0        REV 01    740-032210    ULHOKGF           CFP-100G-LR4
 FPC 4             REV 12.3.09 750-033205  YR9437            MPC Type 3
  CPU              REV 03    711-035209    YT5857            HMPC PMB 2G
  MIC 0            REV 05    750-033199    YR3295            1X100GE CFP
   PIC 0                     BUILTIN       BUILTIN           1X100GE CFP
    Xcvr 0                   NON-JNPR      X12000187         CFP-100G-SR10
  MIC 1            REV 10    750-033199    YX4518            1X100GE CFP
   PIC 2                     BUILTIN       BUILTIN           1X100GE CFP
    Xcvr 0        REV 01     740-035329    X12J00008         CFP-100G-SR10
 FPC 5            REV 06     750-024884    JW9769            MPC Type 2 3D EQ
 CPU              REV 02     711-028401    JR6158            MPC PMB 2G Proto
 MIC 0            REV 05     750-028387    JR6197            3D 4x 10GE  XFP
  PIC 0                      BUILTIN       BUILTIN           2x 10GE  XFP
   Xcvr 0         REV 01     740-014289    T07M71112         XFP-10G-SR
   Xcvr 1         REV 02     740-014289    T08L85610         XFP-10G-SR
   PIC 1                     BUILTIN       BUILTIN           2x 10GE  XFP
 MIC 1            REV 22     750-028392    YM0053            3D 20x 1GE(LAN) SFP

  PIC 2                      BUILTIN       BUILTIN           10x 1GE(LAN) SFP
   Xcvr 0         REV 01     740-011613    AM0703S005B       SFP-SX
   Xcvr 1         REV 01     740-011613    E07L01352         SFP-SX
  PIC 3                      BUILTIN       BUILTIN           10x 1GE(LAN) SFP
   Xcvr 5         REV 01     740-013111    6500217           SFP-T
   Xcvr 9         REV 02     740-013111    8499527           SFP-T
 Fan Tray                                                    Left Fan Tray
```

The PIC number for MIC 1 always starts from 2 (even if the first MIC is a 1X100GE CFP or a legacy MIC).

show chassis hardware (QFX3500 Switches)

`user@switch>` **show chassis hardware**


```
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                                  QFX3500
Routing Engine 0          BUILTIN      BUILTIN           QFX Routing Engine
FPC 0            REV 04   750-044071   BBAR3902          QFX3500-48S4Q-AFI
  CPU                     BUILTIN      BUILTIN           FPC CPU
  PIC 0                   BUILTIN      BUILTIN           48x 10G-SFP+
  PIC 1                   BUILTIN      BUILTIN           15x 10G-SFP+
  MGMT BRD       REV 02   750-044063   BBAR0398          QFX3500-MGMT-SFP-AFO
    Xcvr 0       REV 01   740-011614   AC0946S0BD1       SFP-LX10
    Xcvr 1       REV 02   740-013111   A281922           SFP-T
Power Supply 0   Rev 04   740-032091   UI00677           JPSU-650W-AC-AFI
Power Supply 1   REV 00   740-041741   VJ00162           JPSU-650W-AC-AFO
Fan Tray 0                                               QFX Fan Tray, Back to
Front Airlfow
Fan Tray 1                                               QFX Fan Tray, Back to
Front Airlfow
Fan Tray 2                                               QFX Fan Tray, Back to
Front Airlfow
```

show chassis hardware detail (QFX3500 Switches)

```
user@switch> show chassis hardware detail
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN000TEST5        QFX3500
Routing Engine 0          BUILTIN      BUILTIN           QFX Routing Engine
FPC 0            REV 05   750-036931   EE0823            QFX3500-48S4Q-AFI


  CPU                     BUILTIN      BUILTIN           FPC CPU
  PIC 0                   BUILTIN      BUILTIN           48x 10G-SFP+
    Xcvr 0       REV 01   740-030589   S99E270079        SFP+-10G-LPBK
    Xcvr 1       REV 01   740-030589   S9AK450099        SFP+-10G-LPBK
    Xcvr 2       REV 01   740-030589   S99E270078        SFP+-10G-LPBK
    Xcvr 3       REV 01   740-030589   S9AK450098        SFP+-10G-LPBK
    Xcvr 4       REV 01   740-030589   S99E270075        SFP+-10G-LPBK
    Xcvr 5       REV 01   740-030589   S9AK450093        SFP+-10G-LPBK
    Xcvr 6       REV 01   740-030589   S9AK450097        SFP+-10G-LPBK
    Xcvr 7       REV 01   740-030589   S9AK450095        SFP+-10G-LPBK
    Xcvr 8       REV 01   740-030589   S99E270072        SFP+-10G-LPBK
    Xcvr 9       REV 01   740-030589   S99E270073        SFP+-10G-LPBK
    Xcvr 10      REV 01   740-030589   S99E270080        SFP+-10G-LPBK
    Xcvr 11      REV 01   740-030589   S9AK450169        SFP+-10G-LPBK
    Xcvr 12      REV 01   740-030589   S99E270076        SFP+-10G-LPBK
    Xcvr 13      REV 01   740-030589   S9AK450167        SFP+-10G-LPBK
    Xcvr 14      REV 01   740-030589   S9AK450170        SFP+-10G-LPBK
    Xcvr 15      REV 01   740-030589   S9AK450166        SFP+-10G-LPBK
    Xcvr 16      REV 01   740-030589   S9AK450092        SFP+-10G-LPBK
    Xcvr 17      REV 01   740-030589   S9AK450163        SFP+-10G-LPBK
    Xcvr 18      REV 01   740-030589   S9AK450094        SFP+-10G-LPBK
    Xcvr 19      REV 01   740-030589   S9AK450100        SFP+-10G-LPBK
    Xcvr 20      REV 01   740-030589   S9AK450168        SFP+-10G-LPBK
    Xcvr 21      REV 01   740-030589   S9AK450165        SFP+-10G-LPBK
    Xcvr 22      REV 01   740-030589   S9AK450073        SFP+-10G-LPBK
    Xcvr 23      REV 01   740-030589   S9AK450164        SFP+-10G-LPBK
    Xcvr 24      REV 01   740-030589   S9AK450074        SFP+-10G-LPBK
    Xcvr 25      REV 01   740-030589   SA62270195        SFP+-10G-LPBK
    Xcvr 26      REV 01   740-030589   S9AK450078        SFP+-10G-LPBK
    Xcvr 27      REV 01   740-030589   S9AK450024        SFP+-10G-LPBK
    Xcvr 28      REV 01   740-030589   S9AK450027        SFP+-10G-LPBK
```

```
    Xcvr 29       REV 01    740-030589    S9AK450080          SFP+-10G-LPBK
    Xcvr 30       REV 01    740-030589    S9AK450030          SFP+-10G-LPBK
    Xcvr 31       REV 01    740-030589    S9AK450025          SFP+-10G-LPBK
    Xcvr 32       REV 01    740-030589    S9AK450023          SFP+-10G-LPBK
    Xcvr 33       REV 01    740-030589    S9AK450075          SFP+-10G-LPBK
    Xcvr 34       REV 01    740-030589    S9AK450161          SFP+-10G-LPBK
    Xcvr 35       REV 01    740-030589    S9AK450071          SFP+-10G-LPBK
    Xcvr 36       REV 01    740-030589    S9AK450072          SFP+-10G-LPBK
    Xcvr 37       REV 01    740-030589    S9AK450022          SFP+-10G-LPBK
    Xcvr 38       REV 01    740-030589    S9AK450021          SFP+-10G-LPBK
    Xcvr 39       REV 01    740-030589    S9AK450175          SFP+-10G-LPBK
    Xcvr 40       REV 01    740-030589    S9AK450162          SFP+-10G-LPBK
    Xcvr 41       REV 01    740-030589    S99E270074          SFP+-10G-LPBK
    Xcvr 42       REV 01    740-030589    S9AK450174          SFP+-10G-LPBK
    Xcvr 43       REV 01    740-030589    S9AK450077          SFP+-10G-LPBK
    Xcvr 44       REV 01    740-030589    S9AK450076          SFP+-10G-LPBK
    Xcvr 45       REV 01    740-030589    S9AK450026          SFP+-10G-LPBK
    Xcvr 46       REV 01    740-030589    S9AK450079          SFP+-10G-LPBK
    Xcvr 47       REV 01    740-030589    S9AK450029          SFP+-10G-LPBK
  PIC 1                     BUILTIN       BUILTIN             15x 10G-SFP+
    Xcvr 1        REV 01    740-032986    QA170087            QSFP+-40G-SR4
    Xcvr 4        REV 01    740-032986    QA360442            QSFP+-40G-SR4
    Xcvr 8        REV 01    740-032986    QA170091            QSFP+-40G-SR4
    Xcvr 12       REV 01    740-032986    QA170042            QSFP+-40G-SR4
MGMT BRD       REV 08    750-036946    EE0731              QFX3500-MB
Power Supply 0    Rev 04    740-032091    UI00690             QFX PS 650W AC
Power Supply 1    Rev 04    740-032091    UI00679             QFX PS 650W AC
Fan Tray 0                                                    QFX Fan Tray
Fan Tray 1                                                    QFX Fan Tray
```

show chassis hardware models (QFX3500 Switches)

```
user@switch> show chassis hardware models
Hardware inventory:
Item              Version   Part number   Serial number       FRU model number
Routing Engine 0            BUILTIN       BUILTIN
FPC 0             REV 02    711-032234    EC4074
Power Supply 0    PSMI 2C   11-d65800     --
```

show chassis hardware clei-models (QFX3500 Switches)

```
user@switch> show chassis hardware clei-models
Hardware inventory:
Item              Version   Part number   CLEI code           FRU model number
Routing Engine 0            BUILTIN
FPC 0             REV 02    711-032234
Power Supply 0    PSMI 2C   11-d65800
```

show chassis hardware clei-models (QFX5100 Switches)

```
user@switch> show chassis hardware clei-models
Hardware inventory:
Item              Version   Part number   CLEI code           FRU model number
Routing Engine 0            BUILTIN       DUMMY_CLEI
FPC 0             REV 01    611-053010    DUMMY_CLEI
  PIC 0                     BUILTIN       DUMMY_CLEI
Power Supply 0    REV 03    740-053352    DUMMY_CLEI          JPSU-850W-AC-AFO
Power Supply 1    REV 03    740-053352    DUMMY_CLEI          JPSU-850W-AC-AFO
Fan Tray 0                                                    QFX5100-96S-FANAFO
Fan Tray 1                                                    QFX5100-96S-FANAFO
Fan Tray 2                                                    QFX5100-96S-FANAFO
```


show chassis hardware interconnect-device (QFabric Systems)

```
user@switch> show chassis hardware interconnect-device interconnect1
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis          REV 07                                  QFX_olive
Midplane         REV 07   750-021261   BH0208188289      QFX Midplane
CB 0             REV 07   750-021261   BH0208188289      QFXIC08-CB4S
```

show chassis hardware node-device (QFabric Systems)

```
user@switch> show chassis hardware node-device node1
Routing Engine 0   BUILTIN      BUILTIN          QFX Routing Engine
node1            REV 05   711-032234   ED3694            QFX3500-48S4Q-AFI


  CPU                     BUILTIN      BUILTIN           FPC CPU
  PIC 0                   BUILTIN      BUILTIN           48x 10G-SFP+
    Xcvr 8       REV 01   740-030658   AD0946A028B       SFP+-10G-USR
...
```

show chassis hardware (PTX5000 Packet Transport Router)

```
user@switch> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11D1FD7AJA      PTX5000
Midplane         REV 03   711-031896   ABAC5589          Midplane-8S
FPM              REV 08   760-030647   EG1679            Front Panel Display
PDU 0            Rev 05   740-032019   ZE00006           DC Power Dist Unit
  PSM 0          Rev 05   740-032022   ZJ00018           DC 12V Power Supply
  PSM 1          Rev 04   740-032022   ZC00052           DC 12V Power Supply
  PSM 2          Rev 04   740-032022   ZD00051           DC 12V Power Supply
  PSM 3          Rev 05   740-032022   ZJ00060           DC 12V Power Supply
CCG 0            REV 04   750-030653   EG3703            Clock Generator
CCG 1            REV 04   750-030653   EG3698            Clock Generator
Routing Engine 0 REV 05   740-026942   P737A-002231      RE-DUO-2600
Routing Engine 1 REV 06   740-026942   P737A-002438      RE-DUO-2600
CB 0             REV 08   750-030625   EG5519            Control Board
CB 1             REV 08   750-030625   EG5516            Control Board
FPC 0            REV 18   750-036844   EJ3080            FPC
  CPU            REV 12   711-030686   EJ3260            SNG PMB
FPC 2            REV 13   750-036844   EG5065            FPC
  CPU            REV 09   711-030686   EG4082            SNG PMB
  PIC 0          REV 14   750-031913   EG5127            24x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   143363A00240      SFP+-10G-SR
    Xcvr 1       REV 01   740-031981   UK90PZ1           SFP+-10G-LR
    Xcvr 2       REV 01   740-031980   AD1141A04XH       SFP+-10G-SR
    Xcvr 3       REV 01   740-031981   UK90Q46           SFP+-10G-LR
    Xcvr 4       REV 01   740-031980   AD1141A04X4       SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   B11H02560         SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   B11C01589         SFP+-10G-SR
    Xcvr 8       REV 01   740-031980   AD1141A04XF       SFP+-10G-SR
    Xcvr 10      REV 01   740-031980   123363A01094      SFP+-10G-SR
    Xcvr 11      REV 01   740-031980   AK80LKF           SFP+-10G-SR
    Xcvr 12      REV 01   740-031980   183363A01528      SFP+-10G-SR
    Xcvr 14      REV 01   740-031980   193363A01079      SFP+-10G-SR
    Xcvr 15      REV 01   740-031980   AK80MC8           SFP+-10G-SR
    Xcvr 16      REV 01   740-031980   AJC0BHC           SFP+-10G-SR
    Xcvr 19      REV 01   740-021309   J08D26856         SFP+-10G-LR
    Xcvr 21      REV 01   740-031980   AK80KCT           SFP+-10G-SR
```

```
    Xcvr 22       REV 01   740-031981   UK90PZL          SFP+-10G-LR
    Xcvr 23       REV 01   740-031980   AK80N1V          SFP+-10G-SR
FPC 3             REV 13   750-036844   EG5074           FPC
  CPU             REV 09   711-030686   EG4064           SNG PMB
  PIC 1           REV 10   750-031903   EG0325           SNG Load
FPC 5             REV 06   750-036844   EH3198           FPC
  CPU
  PIC 0           REV 14   750-031913   EG5134           24x 10GE(LAN) SFP+
    Xcvr 0        REV 01   740-031980   AK80LBH          SFP+-10G-SR
    Xcvr 1        REV 01   740-031980   B11B03724        SFP+-10G-SR
    Xcvr 2        REV 01   740-031980   AK80FMH          SFP+-10G-SR
    Xcvr 5        REV 01   740-031980   B11J00818        SFP+-10G-SR
    Xcvr 6        REV 01   740-031980   193363A00743     SFP+-10G-SR
    Xcvr 7        REV 01   740-031980   B11B06125        SFP+-10G-SR
    Xcvr 10       REV 01   740-031980   B11H02529        SFP+-10G-SR
    Xcvr 11       REV 01   740-031980   AK80LFB          SFP+-10G-SR
    Xcvr 12       REV 01   740-031980   193363A01061     SFP+-10G-SR
    Xcvr 15       REV 01   740-031980   B11J00687        SFP+-10G-SR
    Xcvr 16       REV 01   740-031980   193363A00738     SFP+-10G-SR
    Xcvr 18       REV 01   740-031980   AK80MQX          SFP+-10G-SR
    Xcvr 19       REV 01   740-021309   J08C17257        SFP+-10G-LR
    Xcvr 22       REV 01   740-031980   B11J00730        SFP+-10G-SR
    Xcvr 23       REV 01   740-031980   AK80KEE          SFP+-10G-SR
  PIC 1           REV 08   750-036710   EG3105           2x 40GE CFP
    Xcvr 0        REV 01   740-034554   B260HLT          CFP-40G-LR4
    Xcvr 1        REV 01   740-034554   B11C02847        CFP-40G-LR4
FPC 6             REV 18   750-036844   EJ4391           FPC
  CPU             REV 12   711-030686   EJ3257           SNG PMB
FPC 7             REV 18   750-036844   EJ4382           FPC
  CPU             REV 12   711-030686   EJ3238           SNG PMB
SPMB 0            REV 10   711-030686   EG5418           SNG PMB
SPMB 1            REV 09   711-030686   EG5373           SNG PMB
SIB 0             REV 07   750-030631   EG4858           SIB-I-8S
SIB 1             REV 07   750-030631   EG4872           SIB-I-8S
SIB 2             REV 07   750-030631   EG4866           SIB-I-8S
SIB 3             REV 07   750-030631   EG6011           SIB-I-8S
SIB 4             REV 07   750-030631   EG4907           SIB-I-8S
SIB 5             REV 07   750-030631   EG4879           SIB-I-8S
SIB 6             REV 07   750-030631   EG4864           SIB-I-8S
SIB 7             REV 07   750-030631   EG4899           SIB-I-8S
SIB 8             REV 07   750-030631   EG4880           SIB-I-8S
Fan Tray 0        REV 04   760-032784   EG1496           Vertical Fan Tray
Fan Tray 1        REV 04   760-030642   EG1335           Horizontal Fan Tray
Fan Tray 2        REV 02   760-030642   ED4952           Horizontal Fan Tray
```

show chassis hardware clei-models (PTX5000 Packet Transport Router)

```
user@switch> show chassis hardware clei-models
Hardware inventory:
Item              Version  Part number  CLEI code        FRU model number
FPM               REV 08   760-030647   PROTOXCLEI       CRAFT-PTX5000-S
PDU 0             Rev 05   740-032019   IPUPAHLKAA       PWR-SAN-PDU-DC
  PSM 0           Rev 05   740-032022   IPUPAHNKAA       PSM-PTX-DC-120-S
  PSM 1           Rev 04   740-032022   032022XXXX       PWR-SAN-12-DC
  PSM 2           Rev 04   740-032022   032022XXXX       PWR-SAN-12-DC
  PSM 3           Rev 05   740-032022   IPUPAHNKAA       PSM-PTX-DC-120-S
CCG 0             REV 04   750-030653   PROTOXCLEI       CCG-PTX-S
CCG 1             REV 04   750-030653   PROTOXCLEI       CCG-PTX-S
Routing Engine 0 REV 05    740-026942                    RE-DUO-C2600-16G-S
Routing Engine 1 REV 06    740-026942                    RE-DUO-C2600-16G-S
CB 0              REV 08   750-030625   PROTOXCLEI       CB-PTX-S
```



```
CB 1             REV 08   750-030625   PROTOXCLEI        CB-PTX-S
FPC 0            REV 18   750-036844   PROTOXCLEI        FPC-PTX-P1-A
FPC 2            REV 13   750-036844   PROTOXCLEI        FPC-PTX-P1-A
  PIC 0          REV 14   750-031913   PROTOXCLEI        P1-PTX-24-10GE-SFPP
FPC 3            REV 13   750-036844   PROTOXCLEI        FPC-PTX-P1-A
FPC 5
  PIC 0          REV 14   750-031913   PROTOXCLEI        P1-PTX-24-10GE-SFPP
FPC 6            REV 18   750-036844   PROTOXCLEI        FPC-PTX-P1-A
FPC 7            REV 18   750-036844   PROTOXCLEI        FPC-PTX-P1-A
SIB 0            REV 07   750-030631   PROTOXCLEI        SIB-I-PTX5008
SIB 1            REV 07   750-030631   PROTOXCLEI        SIB-I-PTX5008
SIB 2            REV 07   750-030631   PROTOXCLEI        SIB-I-PTX5008
SIB 3            REV 07   750-030631   PROTOXCLEI        SIB-I-PTX5008
SIB 4            REV 07   750-030631   PROTOXCLEI        SIB-I-PTX5008
SIB 5            REV 07   750-030631   PROTOXCLEI        SIB-I-PTX5008
SIB 6            REV 07   750-030631   PROTOXCLEI        SIB-I-PTX5008
SIB 7            REV 07   750-030631   PROTOXCLEI        SIB-I-PTX5008
SIB 8            REV 07   750-030631   PROTOXCLEI        SIB-I-PTX5008
Fan Tray 1       REV 04   760-030642   PROTOXCLEI        FAN-PTX-H-S
```

show chassis hardware detail (PTX5000 Packet Transport Router)

```
user@switch> show chassis hardware detail
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN11D1FD7AJA      PTX5000
Midplane         REV 03   711-031896   ABAC5589          Midplane-8S
FPM              REV 08   760-030647   EG1679            Front Panel Display
PDU 0            Rev 05   740-032019   ZE00006           DC Power Dist Unit
  PSM 0          Rev 05   740-032022   ZJ00018           DC 12V Power Supply
  PSM 1          Rev 04   740-032022   ZC00052           DC 12V Power Supply
  PSM 2          Rev 04   740-032022   ZD00051           DC 12V Power Supply
  PSM 3          Rev 05   740-032022   ZJ00060           DC 12V Power Supply
CCG 0            REV 04   750-030653   EG3703            Clock Generator
CCG 1            REV 04   750-030653   EG3698            Clock Generator
Routing Engine 0 REV 05   740-026942   P737A-002231      RE-DUO-2600
  ad0     3823 MB  SMART CF            201006190039C02DC02D Compact Flash
  ad1    62720 MB  SMART Lite SATA Drive 2011042300CF4C6B4C6B Disk 1
Routing Engine 1 REV 06   740-026942   P737A-002438      RE-DUO-2600
  ad0     3823 MB  SMART CF            20100619053455F055F0 Compact Flash
  ad1    62720 MB  SMART Lite SATA Drive 20110423000AE8E7E8E7 Disk 1
CB 0             REV 08   750-030625   EG5519            Control Board
CB 1             REV 08   750-030625   EG5516            Control Board
FPC 0            REV 18   750-036844   EJ3080            FPC
  CPU            REV 12   711-030686   EJ3260            SNG PMB
FPC 2            REV 13   750-036844   EG5065            FPC
  CPU            REV 09   711-030686   EG4082            SNG PMB
  PIC 0          REV 14   750-031913   EG5127            24x 10GE(LAN) SFP+
    Xcvr 0       REV 01   740-031980   143363A00240      SFP+-10G-SR
    Xcvr 1       REV 01   740-031981   UK90PZ1           SFP+-10G-LR
    Xcvr 2       REV 01   740-031980   AD1141A04XH       SFP+-10G-SR
    Xcvr 3       REV 01   740-031981   UK90Q46           SFP+-10G-LR
    Xcvr 4       REV 01   740-031980   AD1141A04X4       SFP+-10G-SR
    Xcvr 6       REV 01   740-031980   B11H02560         SFP+-10G-SR
    Xcvr 7       REV 01   740-031980   B11C01589         SFP+-10G-SR
    Xcvr 8       REV 01   740-031980   AD1141A04XF       SFP+-10G-SR
    Xcvr 10      REV 01   740-031980   123363A01094      SFP+-10G-SR
    Xcvr 11      REV 01   740-031980   AK80LKF           SFP+-10G-SR
    Xcvr 12      REV 01   740-031980   183363A01528      SFP+-10G-SR
    Xcvr 14      REV 01   740-031980   193363A01079      SFP+-10G-SR
    Xcvr 15      REV 01   740-031980   AK80MC8           SFP+-10G-SR
```



```
      Xcvr 16       REV 01   740-031980   AJC0BHC          SFP+-10G-SR
      Xcvr 19       REV 01   740-021309   J08D26856        SFP+-10G-LR
      Xcvr 21       REV 01   740-031980   AK80KCT          SFP+-10G-SR
      Xcvr 22       REV 01   740-031981   UK90PZL          SFP+-10G-LR
      Xcvr 23       REV 01   740-031980   AK80N1V          SFP+-10G-SR
FPC 3               REV 13   750-036844   EG5074           FPC
  CPU               REV 09   711-030686   EG4064           SNG PMB
  PIC 1             REV 10   750-031903   EG0325           SNG Load
FPC 5               REV 06   750-036844   EH3198           FPC
  CPU
  PIC 0             REV 14   750-031913   EG5134           24x 10GE(LAN) SFP+
    Xcvr 0          REV 01   740-031980   AK80LBH          SFP+-10G-SR
    Xcvr 1          REV 01   740-031980   B11B03724        SFP+-10G-SR
    Xcvr 2          REV 01   740-031980   AK80FMH          SFP+-10G-SR
    Xcvr 5          REV 01   740-031980   B11J00818        SFP+-10G-SR
    Xcvr 6          REV 01   740-031980   193363A00743     SFP+-10G-SR
    Xcvr 7          REV 01   740-031980   B11B06125        SFP+-10G-SR
    Xcvr 10         REV 01   740-031980   B11H02529        SFP+-10G-SR
    Xcvr 11         REV 01   740-031980   AK80LFB          SFP+-10G-SR
    Xcvr 12         REV 01   740-031980   193363A01061     SFP+-10G-SR
    Xcvr 15         REV 01   740-031980   B11J00687        SFP+-10G-SR
    Xcvr 16         REV 01   740-031980   193363A00738     SFP+-10G-SR
    Xcvr 18         REV 01   740-031980   AK80MQX          SFP+-10G-SR
    Xcvr 19         REV 01   740-021309   J08C17257        SFP+-10G-LR
    Xcvr 22         REV 01   740-031980   B11J00730        SFP+-10G-SR
    Xcvr 23         REV 01   740-031980   AK80KEE          SFP+-10G-SR
  PIC 1             REV 08   750-036710   EG3105           2x 40GE CFP
    Xcvr 0          REV 01   740-034554   B260HLT          CFP-40G-LR4
    Xcvr 1          REV 01   740-034554   B11C02847        CFP-40G-LR4
FPC 6               REV 18   750-036844   EJ4391           FPC
  CPU               REV 12   711-030686   EJ3257           SNG PMB
FPC 7               REV 18   750-036844   EJ4382           FPC
  CPU               REV 12   711-030686   EJ3238           SNG PMB
SPMB 0              REV 10   711-030686   EG5418           SNG PMB
SPMB 1              REV 09   711-030686   EG5373           SNG PMB
SIB 0               REV 07   750-030631   EG4858           SIB-I-8S
SIB 1               REV 07   750-030631   EG4872           SIB-I-8S
SIB 2               REV 07   750-030631   EG4866           SIB-I-8S
SIB 3               REV 07   750-030631   EG6011           SIB-I-8S
SIB 4               REV 07   750-030631   EG4907           SIB-I-8S
SIB 5               REV 07   750-030631   EG4879           SIB-I-8S
SIB 6               REV 07   750-030631   EG4864           SIB-I-8S
SIB 7               REV 07   750-030631   EG4899           SIB-I-8S
SIB 8               REV 07   750-030631   EG4880           SIB-I-8S
Fan Tray 0          REV 04   760-032784   EG1496           Vertical Fan Tray
Fan Tray 1          REV 04   760-030642   EG1335           Horizontal Fan Tray
Fan Tray 2          REV 02   760-030642   ED4952           Horizontal Fan Tray
```

show chassis hardware models (PTX5000 Packet Transport Router)

```
user@switch> show chassis hardware models
Hardware inventory:
Item                Version  Part number  Serial number    FRU model number
FPM                 REV 08   760-030647   EG1679           CRAFT-PTX5000-S
PDU 0               Rev 05   740-032019   ZE00006          PWR-SAN-PDU-DC
  PSM 0             Rev 05   740-032022   ZJ00018          PSM-PTX-DC-120-S
  PSM 1             Rev 04   740-032022   ZC00052          PWR-SAN-12-DC
  PSM 2             Rev 04   740-032022   ZD00051          PWR-SAN-12-DC
  PSM 3             Rev 05   740-032022   ZJ00060          PSM-PTX-DC-120-S
CCG 0               REV 04   750-030653   EG3703           CCG-PTX-S
CCG 1               REV 04   750-030653   EG3698           CCG-PTX-S
```

```
Routing Engine 0 REV 05   740-026942   P737A-002231     RE-DUO-C2600-16G-S
Routing Engine 1 REV 06   740-026942   P737A-002438     RE-DUO-C2600-16G-S
CB 0             REV 08   750-030625   EG5519           CB-PTX-S
CB 1             REV 08   750-030625   EG5516           CB-PTX-S
FPC 0            REV 18   750-036844   EJ3080           FPC-PTX-P1-A
FPC 2            REV 13   750-036844   EG5065           FPC-PTX-P1-A
  PIC 0          REV 14   750-031913   EG5127           P1-PTX-24-10GE-SFPP
FPC 3            REV 13   750-036844   EG5074           FPC-PTX-P1-A
FPC 5
  PIC 0          REV 14   750-031913   EG5134           P1-PTX-24-10GE-SFPP
FPC 6            REV 18   750-036844   EJ4391           FPC-PTX-P1-A
FPC 7            REV 18   750-036844   EJ4382           FPC-PTX-P1-A
SIB 0            REV 07   750-030631   EG4858           SIB-I-PTX5008
SIB 1            REV 07   750-030631   EG4872           SIB-I-PTX5008
SIB 2            REV 07   750-030631   EG4866           SIB-I-PTX5008
SIB 3            REV 07   750-030631   EG6011           SIB-I-PTX5008
SIB 4            REV 07   750-030631   EG4907           SIB-I-PTX5008
SIB 5            REV 07   750-030631   EG4879           SIB-I-PTX5008
SIB 6            REV 07   750-030631   EG4864           SIB-I-PTX5008
SIB 7            REV 07   750-030631   EG4899           SIB-I-PTX5008
SIB 8            REV 07   750-030631   EG4880           SIB-I-PTX5008
Fan Tray 1       REV 04   760-030642   EG1335           FAN-PTX-H-S
```

show chassis hardware extensive (PTX5000 Packet Transport Router)

```
user@switch> show chassis hardware extensive
Hardware inventory:
Item             Version  Part number  Serial number     Description
...............
PDU 0            Rev 04   740-032019   UE0003            DC Power Dist Unit
 Jedec Code:   0x7fb0           EEPROM Version:    0x02
 P/N:          740-032019       S/N:               S/N UE0003
 Assembly ID:  0x043d           Assembly Version:  04.00
 Date:         11-29-2010       Assembly Flags:    0x00
 Version:      Rev 04           CLEI Code:         032022XXXX
 ID: DC Power Dist Unit         FRU Model Number:  PWR-SAN-PDU-DC
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 3d 04 00 52 65 76 20 30 34 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 33 32 30 31 39 00 00
  Address 0x20: 53 2f 4e 20 55 45 30 30 30 33 00 00 00 1d 0b 07
  Address 0x30: da ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 30 33 32 30 32 32 58 58 58 58 50
  Address 0x50: 57 52 2d 53 41 4e 2d 50 44 55 2d 44 43 00 00 00
  Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  Address 0x70: 00 00 00 a3 ff ff ff ff ff ff ff ff ff ff ff ff
  PSM 0          Rev 04   740-032022   YG00065           DC 12V Power Supply
Module
 Jedec Code:   0x7fb0           EEPROM Version:    0x02
 P/N:          740-032022       S/N:               S/N YG00065
 Assembly ID:  0x0440           Assembly Version:  04.00
 Date:         07-30-2010       Assembly Flags:    0x00
 Version:      Rev 04           CLEI Code:         032022XXXX
 ID: DC 12V Power Supply Module FRU Model Number:  PWR-SAN-12-DC
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 04 40 04 00 52 65 76 20 30 34 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 33 32 30 32 32 00 00
  Address 0x20: 53 2f 4e 20 59 47 30 30 30 36 35 00 00 1e 07 07
```



```
 Address 0x30: da ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 Address 0x40: ff ff ff ff 01 30 33 32 30 32 32 58 58 58 58 50
 Address 0x50: 57 52 2d 53 41 4e 2d 31 32 2d 44 43 20 20 20 20
 Address 0x60: 20 20 20 20 20 20 01 00 ff ff ff ff ff ff ff ff
 Address 0x70: ff ff ff 0c ff ff ff ff ff ff ff ff ff ff ff ff
```

show chassis hardware (MX Routers with Media Services Blade [MSB])

```
user@switch> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN1100FB1AFB      MX480
Midplane         REV 05   710-017414   TR3310            MX480 Midplane
FPM Board        REV 02   710-017254   KG1872            Front Panel Display
PEM 2            Rev 02   740-017343   QCS0812A00N       DC Power Entry Module
PEM 3            Rev 02   740-017343   QCS0812A00U       DC Power Entry Module
Routing Engine 0 REV 07   740-015113   1000740938        RE-S-1300
CB 0             REV 03   710-021523   KF4630            MX SCB
FPC 1            REV 11   750-037207   ZW9726            AS-MCC
  CPU            REV 04   711-038173   ZW4819            AS-MCC PMB
  MIC 0          REV 06   750-037214   ZW3574            AS-MSC
    PIC 0                 BUILTIN      BUILTIN           AS-MSC
  MIC 1          REV 00   750-037211                     AS-MXC
    PIC 2                 BUILTIN      BUILTIN           AS-MXC
```

show chassis hardware extensive (MX Routers with Media Services Blade [MSB])

```
user@switch> show chassis hardware extensive
FPC 1            REV 11   750-037207   ZW9726            AS-MCC
 Jedec Code:   0x7fb0           EEPROM Version:    0x02
 P/N:          750-037207       S/N:               S/N ZW9726
 Assembly ID:  0x0b37           Assembly Version:  01.11
 Date:         02-17-2012       Assembly Flags:    0x00
 Version:      REV 11           CLEI Code:         PROTOXCLEI
 ID: AS-MCC          FRU Model Number:  750-037207
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 37 01 0b 52 45 56 20 31 31 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 32 30 37 00 00
  Address 0x20: 53 2f 4e 20 5a 57 39 37 32 36 00 00 00 11 02 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 37
  Address 0x50: 35 30 2d 30 33 37 32 30 37 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 31 31 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 5e ff ff ff ff ff ff ff ff ff ff ff ff
  CPU            REV 04   711-038173   ZW4819            AS-MCC-PMB
 Jedec Code:   0x7fb0           EEPROM Version:    0x02
 P/N:          711-038173       S/N:               S/N ZW4819
 Assembly ID:  0x0b38           Assembly Version:  01.04
 Date:         12-30-2011       Assembly Flags:    0x00
 Version:      REV 04
 ID: AS-MCC PMB
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0b 38 01 04 52 45 56 20 30 34 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 33 38 31 37 33 00 00
  Address 0x20: 53 2f 4e 20 5a 57 34 38 31 39 00 00 00 1e 0c 07
  Address 0x30: db ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
```

```
  Address 0x40: ff ff ff ff 00 50 52 4f 54 4f 58 43 4c 45 49 37
  Address 0x50: 31 31 2d 30 33 38 31 37 33 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 30 34 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 60 00 00 00 00 00 00 00 00 00 00 00 00
  MIC 0          REV 06   750-037214   ZW3574           AS-MSC
 Jedec Code:   0x7fb0            EEPROM Version:    0x02
 P/N:          750-037214        S/N:               S/N ZW3574
 Assembly ID:  0x0a44            Assembly Version:  01.06
 Date:         02-19-2012        Assembly Flags:    0x00
 Version:      REV 06            CLEI Code:         PROTOXCLEI
 ID: AS-MSC          FRU Model Number:  750-037214
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0a 44 01 06 52 45 56 20 30 36 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 32 31 34 00 00
  Address 0x20: 53 2f 4e 20 5a 57 33 35 37 34 00 00 00 13 02 07
  Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 37
  Address 0x50: 35 30 2d 30 33 37 32 31 34 00 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 30 36 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff 60 c0 03 e5 f4 00 00 00 00 00 00 00 00
    PIC 0                BUILTIN      BUILTIN           AS-MSC
  MIC 1          REV 00   750-037211                    AS-MXC
 Jedec Code:   0x7fb0            EEPROM Version:    0x01
 P/N:          750-037211
 Assembly ID:  0x0a43            Assembly Version:  01.00
 Date:         255-255-65535     Assembly Flags:    0x00
 Version:      REV 00
 ID: AS-MXC
 Board Information Record:
  Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
 I2C Hex Data:
  Address 0x00: 7f b0 01 ff 0a 43 01 00 52 45 56 20 30 30 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 32 31 31 00 00
  Address 0x20: 00 00 00 00 00 00 00 00 00 00 00 00 00 ff ff ff
  Address 0x30: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff ff
  Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff c0 02 e6 6c 7f b0 02 ff 0a 44 01 06
    PIC 2                BUILTIN      BUILTIN           AS-MXC
```

show chassis hardware (QFX3500 Switch running Enhanced Layer 2 Software)

```
user@switch> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                P3566             QFX3500
Pseudo CB 0
Routing Engine 0          BUILTIN      BUILTIN           QFX Routing Engine
FPC 0            REV 16   750-036931   P3566-C           QFX3500-48S4Q
  CPU                     BUILTIN      BUILTIN           FPC CPU
  PIC 0                   BUILTIN      BUILTIN           48x 10G-SFP+
    Xcvr 12      REV 01   740-030658   AD1125A0438       SFP+-10G-USR
    Xcvr 13      REV 01   740-030658   AD1125A02GN       SFP+-10G-USR
  PIC 1                   BUILTIN      BUILTIN           4x 40G-QSFP+
  PIC 2
  MGMT BRD       REV 10   750-036946   BBAW0328          QFX3500-MGMT-RJ45-AFI
Power Supply 0   Rev 05   740-032091   WA13035           JPSU-650W-AC-AFI
```



```
Power Supply 1
Fan Tray 0                                          QFX3500 Fan Tray, Front
 to Back Airflow
Fan Tray 1                                          QFX3500 Fan Tray, Front
 to Back Airflow
Fan Tray 2                                          QFX3500 Fan Tray, Front
 to Back Airflow
```

show chassis hardware (QFX5100 Switch running Enhanced Layer 2 Software)

```
user@switch> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                TB3113280048      QFX5100-24Q-2P
Pseudo CB 0
Routing Engine 0          BUILTIN      BUILTIN           QFX Routing Engine
FPC 0            REV 02   650-049942   TB3113280048      QFX5100-24Q-2P
  CPU                     BUILTIN      BUILTIN           FPC CPU
  PIC 0                   BUILTIN      BUILTIN           24x 40G-QSFP
    Xcvr 8       REV 01   740-032986   QA470143          QSFP+-40G-SR4
    Xcvr 14      REV 01   740-032986   QB500525          QSFP+-40G-SR4
  PIC 1          REV 02   611-049555   RR3113310169      QFX-EM-4Q
    Xcvr 0       REV 01   740-032986   QC440904          QSFP+-40G-SR4
    Xcvr 1       REV 01   740-032986   QB240154          QSFP+-40G-SR4
    Xcvr 2       REV 01   740-035085   018110105         QSFP+-40G-LPBK
  PIC 2          REV 02   611-049555   RR3113310209      QFX-EM-4Q
    Xcvr 0       REV 01   740-032986   QB190270          QSFP+-40G-SR4
    Xcvr 1       REV 01   740-035085   018110063         QSFP+-40G-LPBK
    Xcvr 2       REV 01   740-032986   QB210034          QSFP+-40G-SR4
Power Supply 0   REV 03   740-041741   1GA23110973       JPSU-650W-AC-AFO
Power Supply 1   REV 03   740-041741   1GA23090878       JPSU-650W-AC-AFO
Fan Tray 0                                             QFX5100 Fan Tray 0, Front
 to Back Airflow - AFO
Fan Tray 1                                             QFX5100 Fan Tray 1, Front
 to Back Airflow - AFO
Fan Tray 2                                             QFX5100 Fan Tray 2, Front
 to Back Airflow - AFO
Fan Tray 3                                             QFX5100 Fan Tray 3, Front
 to Back Airflow - AFO
Fan Tray 4                                             QFX5100 Fan Tray 4, Front
 to Back Airflow - AFO
```

show chassis in-service-upgrade

Syntax **show chassis in-service-upgrade**

Release Information Command introduced in Junos OS Release 9.0.
Command introduced in Junos OS Release 12.3R2, 13.1R2, and 13.2R1 for TX Matrix Plus routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 13.2 for PTX5000 routers.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Display the status of Flexible PIC Concentrators (FPCs) and their corresponding PICs after the most recent unified in-service software upgrade (ISSU). This command must be issued on the master Routing Engine.

NOTE: Only Intelligent Queuing (IQ) PICs are displayed by this command output. Unified ISSU status for other PIC types is controlled internally by the FPC.

Options This command has no options.

Required Privilege Level view

Related Documentation

- *request system software abort*
- request system software in-service-upgrade on page 406
- *Unified ISSU Concepts*
- *Performing a Unified ISSU*
- Understanding In-Service Software Upgrade (ISSU) on page 40
- Performing an In-Service Software Upgrade (ISSU) on page 106

List of Sample Output
show chassis in-service-upgrade on page 755
show chassis in-service-upgrade (MX2010 Router) on page 755
show chassis in-service-upgrade (MX2020 Router) on page 755
show chassis in-service-upgrade (TX Matrix Plus Router) on page 756
show chassis in-service-upgrade (QFX5100 Switch) on page 757

Output Fields Table 64 on page 755 lists the output fields for the **show chassis in-service-upgrade** command. Output fields are listed in the approximate order in which they appear.

Table 64: show chassis in-service-upgrade Output Fields

Field Name	Field Description
Item	Flexible PIC Concentrator (FPC) slot number.
Status	FPC and corresponding PIC state. State can be either of the follwing: • **Online**—FPC is online and running. • **Offline**—FPC is powered down.
Reason	Reason for the state (if offline).

Sample Output

show chassis in-service-upgrade

```
user@host> show chassis in-service-upgrade
  Item             Status                   Reason
  FPC 0            Online
  FPC 1            Online
  FPC 2            Online
    PIC 0          Online
    PIC 1          Online
  FPC 3            Offline                  Offlined by CLI command

  FPC 4            Online
    PIC 1          Online
  FPC 5            Online
    PIC 0          Online
  FPC 6            Online
    PIC 3          Online
  FPC 7            Online
```

show chassis in-service-upgrade (MX2010 Router)

```
user@host> show chassis in-service-upgrade
Item             Status                   Reason
  FPC 0            Online
  FPC 1            Online
  FPC 8            Online
  FPC 9            Online
```

show chassis in-service-upgrade (MX2020 Router)

```
user@host> show chassis in-service-upgrade
  Item             Status                   Reason
  FPC 0            Online
  FPC 1            Online
  FPC 2            Online
  FPC 3            Online
  FPC 4            Online
  FPC 5            Online
  FPC 6            Online
  FPC 7            Online
  FPC 8            Online
  FPC 9            Online
  FPC 10           Online
  FPC 11           Online
```



```
  FPC 12         Online
  FPC 13         Online
  FPC 14         Online
  FPC 15         Online
  FPC 16         Online
  FPC 17         Online
  FPC 18         Online
  FPC 19         Online
```

show chassis in-service-upgrade (TX Matrix Plus Router)

```
user@host> show chassis in-service-upgrade
lcc0-re0:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 1          Online
    PIC 0        Online
  FPC 2          Online
  FPC 3          Online
    PIC 1        Online
  FPC 4          Online
  FPC 6          Online
  FPC 7          Online

lcc1-re0:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 0          Online
    PIC 3        Online
  FPC 1          Online
  FPC 2          Online
  FPC 4          Online
  FPC 6          Online
  FPC 7          Online

lcc2-re0:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 0          Online
  FPC 2          Online
  FPC 3          Online
    PIC 0        Online
  FPC 4          Online
  FPC 6          Online
  FPC 7          Online
    PIC 1        Online

lcc3-re0:
--------------------------------------------------------------------------
  Item           Status                  Reason
  FPC 0          Online
    PIC 0        Online
  FPC 1          Online
  FPC 2          Online
  FPC 3          Online
    PIC 2        Online
  FPC 4          Online
  FPC 5          Online
  FPC 6          Online
  FPC 7          Online
    PIC 1        Online
```


show chassis in-service-upgrade (QFX5100 Switch)

```
user@switch> show chassis in-service-upgrade
  Item           Status                  Reason
  FPC 0          Online (ISSU)
```

show chassis lcd

show chassis lcd (EX Series)

show chassis lcd
<fpc-slot *fpc-slot-number*>
<menu <(all-members | local | member *member-id*)>>

show chassis lcd (QFX Series and QFabric Systems)

show chassis lcd
<fpc-slot *fpc-slot-number*>
<interconnect-device *device-id*>
<node-device *device-id*>

Release Information

Command introduced in Junos OS Release 9.0 for EX Series switches.
menu option introduced in Junos OS Release 10.2 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 13.1 for QFabric systems.

Description

Display the information that appears on the LCD panel of EX3200, EX3300, EX4200, EX4500, EX6200, and EX8200 switches, XRE200 External Routing Engines, QFX Series standalone switches, and Interconnect devices and Node devices within a QFabric system. Display the status of the currently selected port parameter of the Status LED for each network port on the device.

Options

none—Display the information that appears on the LCD panel (for any EX Series member switch in a Virtual Chassis or for XRE200 External Routing Engines, display the information for all Virtual Chassis members). Display the status of the currently selected port parameter of the Status LED for each network port.

fpc-slot <*fpc-slot-number*>—(Optional) Display the information as follows:

- (EX3200, EX3300, EX4200, and EX4500 switches, or the QFX Series) Display the information that appears on the LCD panel for either an FPC slot with no ***fpc-slot-number*** value specified or for the FPC slot specified by **fpc-slot 0**. **fpc-slot** refers to the switch itself and **0** is the only valid value for ***fpc-slot-number***. Output for these options is the same as for the **none** option.

  Also display the status of the currently selected port parameter of the Status LED for each network port.

- (EX Series Virtual Chassis member switches or XRE200 External Routing Engines) If no ***fpc-slot-number*** value is specified, display the information that appears on the LCD panel for all members of the Virtual Chassis. Output for this option is the same as for the **none** option. If the ***fpc-slot-number*** value is specified (it equals the ***member-id*** value), display the information for the specified member.

  Also display the status of the currently selected port parameter of the Status LED for each network port.

- (EX6200 or EX8200 switches)—Display the information that appears on the LCD panel for the line card in the line-card slot specified by the ***fpc-slot-number*** value.

  Also display the status of the currently selected port parameter of the Status LED for each network port.

interconnect-device ***device-id***—(QFabric systems only) (Optional) Display the front panel contents and LED status of all the ports on the Interconnect device.

menu—(Optional) Display the names of the menus and menu options that are currently enabled on the LCD panel.

menu all-members—(EX Series Virtual Chassis member switches or XRE200 External Routing Engines) (Optional) Display the names of the menus and menu options that are currently enabled on the LCD panel for all Virtual Chassis members.

menu local—(EX Series Virtual Chassis member switches or XRE200 External Routing Engines) (Optional) Display the names of the menus and menu options that are currently enabled on the LCD panel for the Virtual Chassis member from which you issued the command.

menu member ***member-id***—(EX Series Virtual Chassis member switches or XRE200 External Routing Engines) (Optional) Display the names of the menus and menu options that are currently enabled on the LCD panel for the specified Virtual Chassis member.

node-device ***device-id***—(QFabric systems only) (Optional) Display the front panel contents and LED status of all the ports on the Node device.

Required Privilege Level

view

Related Documentation

- *LCD Panel in EX3200 Switches*
- *LCD Panel in EX4200 Switches*
- *LCD Panel in EX4500 Switches*
- *LCD Panel in an EX8200 Switch*
- *LCD Panel in an XRE200 External Routing Engine*
- *Configuring the LCD Panel on EX Series Switches (CLI Procedure)*
- *set chassis display message*

List of Sample Output

Output Fields

Table 65 on page 760 lists the output fields for the **show chassis lcd** command. Output fields are listed in the approximate order in which they appear.

Table 65: show chassis lcd Output Fields

Field Name	Field Description
member*number* (XRE200 External Routing Engine)	Member ID of the device whose content is being displayed.
Front panel contents for slot **Front panel contents** (EX6200, EX8200 switch, XRE200 External Routing Engine, and QFX Series)	FPC slot number of the switch whose content is being displayed. The number is always **0**, except for EX4200 switches in a Virtual Chassis, where it is the member ID value. On EX6200 switches, EX8200 switches, and XRE200 External Routing Engines, no slot number is displayed. On XRE200 External Routing Engines, this field appears under the **member *number*** field for each member device in the EX8200 Virtual Chassis.
LCD screen	The first line displays the hostname (for Virtual Chassis members, displays the member ID, the current role, and hostname; for EX8200 switches, displays **RE** and the hostname). The second line displays the currently selected port parameter of the Status LED and the alarms counter. The Status LED port parameters are: • **ADM**—Administrative • **SPD**—Speed • **DPX**—Duplex • **POE**—Power over Ethernet (EX3200 and EX4200 switches only)
LEDs status	Current state of the Alarms, System, and Master LEDs (chassis status LEDs).
Interface	Names of the interfaces on the switch.
LED (ADM/SPD/DPX/POE)	State of the currently selected port parameter of the Status LED for the interface. The Status LED port parameters are: NOTE: The XRE200 External Routing Engine always displays the **NA** parameter. The QFX Series products do not have any of the port parameters listed below. • **ADM**—Administrative • **SPD**—Speed • **DPX**—Duplex • **NA**—Not applicable. • **POE**—Power over Ethernet
fpc*x*	On standalone EX Series and QFX Series switches, always **0**. On EX Series Virtual Chassis member switches, member ID of the Virtual Chassis member whose LCD menu is displayed.

Sample Output

show chassis lcd (Two-Member EX4200 Virtual Chassis)

```
user@switch> show chassis lcd
Front panel contents for slot: 0
---------------------------------
LCD screen:
    00:BK switch1
    LED:SPD ALARM 00
```



```
LEDs status:
    Alarms LED: Off
    System LED: Green
    Master LED: Off
Interface       LED(ADM/SPD/DPX/POE)
-------------------------------------
ge-0/0/0        Off
ge-0/0/1        Off
ge-0/0/2        Off
ge-0/0/3        Off
ge-0/0/4        Off
ge-0/0/5        Off
ge-0/0/6        Off
ge-0/0/7        Off
ge-0/0/8        Off
ge-0/0/9        Off
ge-0/0/10       Off
ge-0/0/11       Off
ge-0/0/12       Off
ge-0/0/13       Off
ge-0/0/14       Off
ge-0/0/15       Off
ge-0/0/16       Off
ge-0/0/17       Off
ge-0/0/18       Off
ge-0/0/19       Off
ge-0/0/20       Off
ge-0/0/21       Off
ge-0/0/22       Off
ge-0/0/23       Off
Front panel contents for slot: 1
---------------------------------
LCD screen:
    01:RE switch2
    LED:SPD ALARM 01
LEDs status:
    Alarms LED: Yellow
    System LED: Green
    Master LED: Green
Interface       LED(ADM/SPD/DPX/POE)
-------------------------------------
ge-1/0/0        Off
ge-1/0/1        Off
ge-1/0/2        Off
ge-1/0/3        Off
ge-1/0/4        Off
ge-1/0/5        Off
ge-1/0/6        Off
ge-1/0/7        Off
ge-1/0/8        Off
ge-1/0/9        Off
ge-1/0/10       Off
ge-1/0/11       Off
ge-1/0/12       Off
ge-1/0/13       Off
ge-1/0/14       Off
ge-1/0/15       Off
ge-1/0/16       Off
ge-1/0/17       Off
ge-1/0/18       Off
ge-1/0/19       Off
```



```
ge-1/0/20       Off
ge-1/0/21       Off
ge-1/0/22       Off
ge-1/0/23       Off
```

The output for the **show chassis lcd fpc-slot** command is the same as the output for the **show chassis lcd** command.

show chassis lcd fpc-slot 1 (EX4200 Virtual Chassis)

```
user@switch> show chassis lcd fpc-slot 1
Front panel contents for slot: 1
---------------------------------
LCD screen:
    01:RE switch2
    LED:SPD ALARM 01
LEDs status:
    Alarms LED: Yellow
    System LED: Green
    Master LED: Green
Interface       LED(ADM/SPD/DPX/POE)
-------------------------------------
ge-1/0/0        Off
ge-1/0/1        Off
ge-1/0/2        Off
ge-1/0/3        Off
ge-1/0/4        Off
ge-1/0/5        Off
ge-1/0/6        Off
ge-1/0/7        Off
ge-1/0/8        Off
ge-1/0/9        Off
ge-1/0/10       Off
ge-1/0/11       Off
ge-1/0/12       Off
ge-1/0/13       Off
ge-1/0/14       Off
ge-1/0/15       Off
ge-1/0/16       Off
ge-1/0/17       Off
ge-1/0/18       Off
ge-1/0/19       Off
ge-1/0/20       Off
ge-1/0/21       Off
ge-1/0/22       Off
ge-1/0/23       Off
```

show chassis lcd (EX8200 Switch)

```
user@switch> show chassis lcd
Front panel contents:
---------------------
LCD screen:
    RE st-8200-r
    LED:ADM ALARM 01
LEDs status:
    Alarms LED: Yellow
    System LED: Yellow
    Master LED: Green
Interface       LED(ADM/SPD/DPX)
```



```
------------------------------------------
ge-0/0/0         Off
ge-0/0/1         Off
ge-0/0/2         Off
ge-0/0/3         Off
ge-0/0/4         Off
ge-0/0/5         Off
ge-0/0/6         Off
ge-0/0/7         Off
ge-0/0/8         Off
ge-0/0/9         Off
ge-0/0/10        Off
ge-0/0/11        Off
ge-0/0/12        Off
ge-0/0/13        Off
ge-0/0/14        Off
ge-0/0/15        Off
ge-0/0/16        Off
ge-0/0/17        Off
ge-0/0/18        Off
ge-0/0/19        Off
ge-0/0/20        Off
ge-0/0/21        Off
ge-0/0/22        Off
ge-0/0/23        Off
ge-0/0/24        Off
ge-0/0/25        Off
ge-0/0/26        Off
ge-0/0/27        Off
ge-0/0/28        Off
ge-0/0/29        Off
ge-0/0/30        Off
ge-0/0/31        Off
ge-0/0/32        Off
ge-0/0/33        Off
ge-0/0/34        Off
ge-0/0/35        Off
ge-0/0/36        Off
ge-0/0/37        Off
ge-0/0/38        Off
ge-0/0/39        Off
ge-0/0/40        Off
ge-0/0/41        Off
ge-0/0/42        Off
ge-0/0/43        Off
ge-0/0/44        Off
ge-0/0/45        Off
ge-0/0/46        Off
ge-0/0/47        Off
xe-2/0/0         Off
xe-2/0/1         Off
xe-2/0/2         Off
xe-2/0/3         Off
xe-2/0/4         Off
xe-2/0/5         Off
xe-2/0/6         Off
xe-2/0/7         Off
xe-3/0/0         Off
xe-3/0/1         Off
xe-3/0/2         Off
xe-3/0/3         Off
```

```
xe-3/0/4        Off
xe-3/0/5        Off
xe-3/0/6        Off
xe-3/0/7        Off
xe-5/0/0        Off
xe-5/0/1        Off
xe-5/0/2        Off
xe-5/0/3        Off
xe-5/0/4        Off
xe-5/0/5        Off
xe-5/0/6        On
xe-5/0/7        On
xe-7/0/5        Off
```

show chassis lcd fpc-slot 2 (EX8200 Switch)

show chassis lcd fpc-slot 2

```
Interface       LED(ADM/SPD/DPX)
------------------------------------------
xe-2/0/0        Off
xe-2/0/1        Off
xe-2/0/2        Off
xe-2/0/3        Off
xe-2/0/4        Off
xe-2/0/5        Off
xe-2/0/6        Off
xe-2/0/7        Off
```

show chassis lcd menu (EX4200 Switch)

```
user@switch> show chassis lcd menu
fpc0:
--------------------------------------------------------------------------
status-menu
status-menu vcp-status
status-menu power-status
status-menu environ-menu
status-menu show-version
maintenance-menu
maintenance-menu halt-menu
maintenance-menu system-reboot
maintenance-menu rescue-config
maintenance-menu vc-uplink-config
maintenance-menu factory-default
```

On an EX4200 switch in a Virtual Chassis, the output for the **show chassis lcd menu all-members** command is the same as the output for the **show chassis lcd menu** command.

show chassis lcd menu (EX8200 Switch)

```
user@switch> show chassis lcd menu
status-menu
status-menu sf-status1-menu
status-menu sf-status2-menu
status-menu psu-status1-menu
status-menu psu-status2-menu
status-menu environ-menu
status-menu show-version
maintenance-menu
maintenance-menu halt-menu
```



```
maintenance-menu system-reboot
maintenance-menu rescue-config
maintenance-menu factory-default
```

show chassis lcd (QFX3500 Switches)

```
user@switch> show chassis lcd
Front panel contents for slot: 0
---------------------------------
LCD screen:
00:RE switch
ALARM 01
LEDs status:
Status/Beacon LED: Yellow Blinking
Interface STATUS LED ACTIVITY LED
-------------------------------------------
fte-0/1/0 Off Off
```

show chassis lcd (XRE200 External Routing Engine in EX8200 Virtual Chassis)

```
user@external-routing-engine> show chassis lcd
member0:
--------------------------------------------------------------------------
Front panel contents:
---------------------
LCD screen:
    RE ex8200-member0
    LED:ADM ALARM 04
LEDs status:
    Alarms LED: Red
    System LED: Yellow
    Master LED: Green

member1:
--------------------------------------------------------------------------

member8:
--------------------------------------------------------------------------
Front panel contents:
---------------------
LCD screen:
    BACKUP

member9:
--------------------------------------------------------------------------
Front panel contents:
---------------------
LCD screen:
    09:RE xre200-member9
    LED: NA ALARM 01
Interface       LED(ADM/SPD/DPX/POE)
------------------------------------------
ge-0/0/0        On
ge-0/0/1        On
ge-0/0/2        On
ge-0/0/3        On
ge-0/0/4        Off
ge-0/0/5        Off
ge-0/0/6        Off
ge-0/0/7        Off
ge-0/0/8        Off
```

```
ge-0/0/9        Off
ge-0/0/10       On
ge-0/0/11       Off
ge-0/0/12       Off
ge-0/0/13       Off
ge-0/0/14       Off
ge-0/0/15       Off
ge-0/0/16       Off
ge-0/0/17       Off
ge-0/0/18       Off
ge-0/0/19       Off
ge-0/0/20       Off
ge-0/0/21       Off
ge-0/0/22       Off
ge-0/0/23       Off
ge-0/0/24       Off
ge-0/0/25       Off
ge-0/0/26       Off
ge-0/0/27       Off
ge-0/0/28       Off
ge-0/0/29       Off
ge-0/0/30       Off
ge-0/0/31       Off
ge-0/0/32       Off
ge-0/0/33       Off
ge-0/0/34       Off
ge-0/0/35       Off
ge-0/0/36       Off
ge-0/0/37       Off
ge-0/0/38       Off
ge-0/0/39       Off
ge-0/0/40       On
ge-0/0/41       On
ge-0/0/42       On
ge-0/0/43       On
ge-0/0/44       On
ge-0/0/45       On
ge-0/0/46       On
ge-0/0/47       On
ge-16/0/0       On
ge-16/0/1       Off
ge-16/0/2       On
ge-16/0/3       Off
ge-16/0/4       On
ge-16/0/5       Off
ge-16/0/6       On
ge-16/0/7       Off
ge-16/0/8       Off
ge-16/0/9       Off
ge-16/0/10      Off
ge-16/0/11      Off
ge-16/0/12      Off
ge-16/0/13      On
ge-16/0/14      Off
ge-16/0/15      On
ge-16/0/16      Off
ge-16/0/17      On
ge-16/0/18      On
ge-16/0/19      On
ge-16/0/20      On
ge-16/0/21      Off
```



```
ge-16/0/22        On
ge-16/0/23        Off
ge-16/0/24        Off
ge-16/0/25        Off
ge-16/0/26        On
ge-16/0/27        Off
ge-16/0/28        Off
ge-16/0/29        Off
ge-16/0/30        On
ge-16/0/31        Off
ge-16/0/32        On
ge-16/0/33        On
ge-16/0/34        On
ge-16/0/35        Off
ge-16/0/36        On
ge-16/0/37        Off
ge-16/0/38        Off
ge-16/0/39        Off
ge-16/0/40        Off
ge-16/0/41        Off
ge-16/0/42        On
ge-16/0/43        Off
ge-16/0/44        Off
ge-16/0/45        Off
ge-16/0/46        Off
ge-16/0/47        Off
xe-19/0/0         Off
xe-19/0/1         On
xe-19/0/2         On
xe-19/0/3         On
xe-19/0/4         On
xe-19/0/5         On
ge-22/0/0         Off
ge-22/0/1         Off
ge-22/0/2         On
ge-22/0/3         Off
ge-22/0/4         On
ge-22/0/5         On
ge-22/0/6         On
ge-22/0/7         On
ge-22/0/8         Off
ge-22/0/9         Off
ge-22/0/10        Off
ge-22/0/11        Off
ge-22/0/12        Off
ge-22/0/13        Off
ge-22/0/14        Off
ge-22/0/15        Off
ge-22/0/16        On
ge-22/0/17        Off
ge-22/0/18        On
ge-22/0/19        Off
ge-22/0/20        On
ge-22/0/21        Off
ge-22/0/22        On
ge-22/0/23        Off
ge-22/0/24        On
ge-22/0/25        Off
ge-22/0/26        Off
ge-22/0/27        Off
ge-22/0/28        Off
```



```
ge-22/0/29      Off
ge-22/0/30      Off
ge-22/0/31      Off
ge-22/0/32      On
ge-22/0/33      Off
ge-22/0/34      On
ge-22/0/35      Off
ge-22/0/36      Off
ge-22/0/37      Off
ge-22/0/38      Off
ge-22/0/39      Off
ge-22/0/40      Off
ge-22/0/41      Off
ge-22/0/42      Off
ge-22/0/43      Off
ge-22/0/44      Off
ge-22/0/45      Off
ge-22/0/46      Off
ge-22/0/47      Off
```

show chassis lcd interconnect-device (QFabric Systems)

show chassis lcd interconnect-device IC-F1012

```
                Front Panel Module Information
                ---------------------------------
                LCD screen:
                IC-F1012        3 Alarms active
LEDs status:
    Status LED: Green
    Power LED : Green
    Major Alarm LED: off
    Minor Alarm LED: Yellow
    Fan 0 LED : Green
    Fan 1 LED : Green
    Fan 2 LED : Green
    Fan 3 LED : Green
    Fan 4 LED : Green
    Fan 5 LED : Green
    Fan 6 LED : Green
    Fan 7 LED : Green
    Fan 8 LED : Green
    Fan 9 LED : Green
    PEM 0 LED : Green
    PEM 1 LED : Green
    PEM 2 LED : Green
    PEM 3 LED : off
    PEM 4 LED : off
    PEM 5 LED : off

                LED info for: CB - 0
                ---------------------------------
LEDs status:
    Status LED: Green
    Mastership LED: Green

Interface               STATUS LED      LINK/ACTIVITY LED
---------------------------------------------------------
IC-F1012:pme0 :         Green           N/A
IC-F1012:pme1 :         Green           N/A
IC-F1012:pme2 :         off             N/A
IC-F1012:pme3 :         off             N/A
```

```
                LED info for: CB - 1
                ---------------------------------
LEDs status:
    Status LED: Green
    Mastership LED: Amber

Interface                STATUS LED      LINK/ACTIVITY LED
----------------------------------------------------------
IC-F1012:pme0 :          Green           N/A
IC-F1012:pme1 :          Green           N/A
IC-F1012:pme2 :          off             N/A
IC-F1012:pme3 :          off             N/A

                LED info for: FC 0 FPC - 0
                ---------------------------------
LEDs status:
    Status LED: Green

Interface                STATUS LED      LINK/ACTIVITY LED
----------------------------------------------------------
IC-F1012:fte-0/0/0       Green           N/A
IC-F1012:fte-0/0/1       Green           N/A
IC-F1012:fte-0/0/2       Green           N/A
IC-F1012:fte-0/0/3       Green           N/A
IC-F1012:fte-0/0/4       Green           N/A

                LED info for: FC 1 FPC - 1
                ---------------------------------
LEDs status:
    Status LED: Green

Interface                STATUS LED      LINK/ACTIVITY LED
----------------------------------------------------------
IC-F1012:fte-1/0/0       Green           N/A
IC-F1012:fte-1/0/1       Green           N/A
IC-F1012:fte-1/0/2       Green           N/A
IC-F1012:fte-1/0/3       Green           N/A
IC-F1012:fte-1/0/4       Green           N/A

                LED info for: RC 0 FPC - 8
                ---------------------------------
LEDs status:
    Status LED: Green

                LED info for: RC 1 FPC - 9
                ---------------------------------
LEDs status:
    Status LED: Green

                LED info for: RC 2 FPC - 10
                ---------------------------------
LEDs status:
    Status LED: Green

                LED info for: RC 3 FPC - 11
                ---------------------------------
LEDs status:
    Status LED: Green

                LED info for: RC 4 FPC - 12
```

```
                --------------------------------
LEDs status:
    Status LED: Green

                LED info for: RC 5 FPC - 13
                --------------------------------
LEDs status:
    Status LED: Green

                LED info for: RC 6 FPC - 14
                --------------------------------
LEDs status:
    Status LED: Green

                LED info for: RC 7 FPC - 15
                --------------------------------
LEDs status:
    Status LED: Green
```

show chassis lcd node-device (QFabric Systems)

show chassis lcd node-device P3774-C

```
                Front panel contents for: P3774-C
                ----------------------------------
                LCD screen:
                P3774-C
LEDs status:
    Status/Beacon LED: Yellow Blinking

Interface               STATUS LED      LINK/ACTIVITY LED
---------------------------------------------------------
P3774-C:xe-0/0/6        Green           Green
P3774-C:xe-0/0/7        Green           Green
P3774-C:ge-0/0/10       Green           Green
P3774-C:ge-0/0/11       Green           Green Blinking
P3774-C:ge-0/0/12       Green           Off
P3774-C:ge-0/0/13       Green           Green Blinking
P3774-C:ge-0/0/20       Green           Green
P3774-C:ge-0/0/21       Green           Green
P3774-C:ge-0/0/22       Green           Green Blinking
P3774-C:ge-0/0/23       Green           Off
P3774-C:ge-0/0/30       Green           Green
P3774-C:ge-0/0/31       Green           Green
P3774-C:ge-0/0/32       Green           Green Blinking
P3774-C:ge-0/0/33       Green           Green Blinking
P3774-C:fte-0/1/0       Green           Green
P3774-C:fte-0/1/1       Green           Green Blinking
P3774-C:fte-0/1/2       Green           Green Blinking
P3774-C:fte-0/1/3       Green           Green
```


show chassis led

show chassis led (EX Series)

show chassis led
<fpc-slot <*fpc-slot-number*>>

show chassis led (QFX Series)

show chassis led
<fpc-slot <*fpc-slot-number*>>
interconnect-device *name*
node-device *name*

Release Information

Command introduced in Junos OS Release 10.1 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the status and colors of the chassis LEDs on the front panel of the switch. A major alarm (red) indicates a critical error condition that requires immediate action. A minor alarm (yellow) indicates a noncritical condition that requires monitoring or maintenance. A minor alarm that is left unchecked might cause interruption in service or performance degradation.

Options

none—Display the status of the chassis status LEDs (for EX4200 switches configured as a Virtual Chassis, display the information for all Virtual Chassis members).

fpc-slot <*fpc-slot-number*>—(Optional) (Not on EX2200 switches) Display the information as follows:

- (EX3200, standalone EX4200, standalone QFX3500, and EX4500 switches) Display the status of the chassis status LEDs for either an FPC slot with no ***fpc-slot-number*** value specified or for the FPC slot specified by **fpc-slot 0**. **fpc-slot** refers to the switch itself and **0** is the only valid value for ***fpc-slot-number***. Output for these options is the same as for the **none** option.
- (EX4200 switches in a Virtual Chassis with two or more members) If no ***fpc-slot-number*** value is specified, display the status of the chassis status LEDs for all members of the Virtual Chassis. Output for this option is the same as for the **none** option. If the ***fpc-slot-number*** value is specified (it equals the ***member-id*** value), display the status of the chassis status LEDs for the specified member.
- (EX8200 switches)—Display the status of the chassis status LEDs for the line card in the line-card slot specified by the ***fpc-slot-number*** value.

interconnect-device *name*—

— (QFabric systems only) (Optional) Display the status of the chassis and interface status LEDs for the Interconnect device.

node-device *name*— (QFabric systems only) (Optional) Display the status of the chassis and interface status LEDs for the Node device.

Required Privilege Level

view

Related Documentation

- *Chassis Status LEDs in EX2200 Switches*
- *Chassis Status LEDs in EX3200 Switches*
- *Chassis Status LEDs in EX4200 Switches*
- *Chassis Status LEDs in EX4500 Switches*
- *Chassis Status LEDs in an EX8200 Switch*
- *Chassis Status LEDs on a QFX3500 Device*
- *Chassis Status LEDs in the QFX3600 and QFX3600-I Device*
- *Management Port LEDs on a QFX3500 Device*
- *Management Port LEDs in the QFX3600 and QFX3600-I Device*
- *Chassis Status LEDs on a QFX3008-I Interconnect Device*
- *Control Board LEDs on a QFX3008-I Interconnect Device*

List of Sample Output

show chassis led (EX2200 Switch) on page 775
show chassis led on page 776
show chassis led fpc-slot 0 on page 776
show chassis led (EX Series) on page 777
show chassis led node-device (QFabric System Node Device) on page 778
show chassis led interconnect-device (QFabric System - QFX3600-I Interconnect Device) on page 778
show chassis led interconnect-device (QFabric System - QFX3008-I Interconnect Device) on page 779

Output Fields

Table 54 on page 478 lists the output fields for the **show chassis led** command. Output fields are listed in the approximate order in which they appear.

Table 66: show chassis led Output Fields

Field Name	Field Description
Front panel contents for slot **Front panel contents** (EX8200 Switches) **Front Panel Module Information** (QFabric system QFX3008-I Interconnect device) **Front panel contents for** (QFabric system Node devices and QFX3600-I Interconnect devices)	FPC slot number of the device whose content is being displayed. The number is always **0**, except for EX4200 switches in a Virtual Chassis, where it is the member ID value. On EX8200 switches, no slot number is displayed. On QFabric system Node devices, the name of the Node device whose content is being displayed.
Alarms LED	(EX Series switches only) Displays status of the ALM LED: • Off—No alarm has been configured. • Green—No alarm has been triggered. • Red—Major alarm. • Yellow—Minor alarm

Table 66: show chassis led Output Fields *(continued)*

Field Name	Field Description
System LED	(EX Series switches only) Displays status of the SYS LED: • Off—Switch is powered off. • Green—Switch is operating normally. • Yellow—Switch is booting.

Master LED:	Displays status of the MST LED (on EX3200, EX4200, and EX8200 switches):
	• Green—On an EX4200 Virtual Chassis switch, indicates the switch is the master in the Virtual Chassis configuration. On other switches, indicates that the Routing Engine is operational.
	• Off
	  ◦ On an EX4200 Virtual Chassis switch, indicates that this switch is not the master in the Virtual Chassis configuration.
	  ◦ On EX3200, standalone EX4200, and EX8200 switches, indicates that the Routing Engine is not operational.

Mode LED:	(EX Series switches only) On an EX2200 switch only, displays the currently selected port parameter of the Status LED: • **ADM**—Administrative • **SPD**—Speed • **DPX**—Duplex • **POE**—Power over Ethernet
Status/Beacon LED	(QFX Series only) Displays the system status as indicated by the Status LED on the chassis. For more information, see: • *Chassis Status LEDs on a QFX3500 Device* • *Chassis Status LEDs in the QFX3600 and QFX3600-I Device*
LINK/SPEED LED	(QFX Series only) Displays the link status and speed of a management port. For more information, see: • *Management Port LEDs on a QFX3500 Device* • *Management Port LEDs in the QFX3600 and QFX3600-I Device*
ACTIVITY LED	(QFX Series only) Displays the activity status of a management port. For more information, see: • *Management Port LEDs on a QFX3500 Device* • *Management Port LEDs in the QFX3600 and QFX3600-I Device*
STATUS LED	(QFX Series only) Displays the link status of an interface as indicated by the ST LED. For more information, see: • *Control Board LEDs on a QFX3008-I Interconnect Device* • *Access Port and Uplink Port LEDs on a QFX3500 Device* • *Access Port and Uplink Port LEDs on a QFX3600 or QFX3600-I Device*

Table 66: show chassis led Output Fields *(continued)*

Field Name	Field Description
LINK/ACTIVITY LED	(QFX Series only) Displays link activity or faults on an interface as indicated by the LA LED. For more information, see: • *Access Port and Uplink Port LEDs on a QFX3500 Device* • *Access Port and Uplink Port LEDs on a QFX3600 or QFX3600-I Device*
Status LED	(QFX3008-I Interconnect device only) • Displays the system status as indicated by the STATUS LED on the front panel of the chassis. For more information, see *Chassis Status LEDs on a QFX3008-I Interconnect Device*. • Displays the status of a Control Board as indicated by the STATUS LED on the Control Board. For more information, see *Control Board LEDs on a QFX3008-I Interconnect Device*.
Power LED	(QFX3008-I Interconnect device only) Displays the status of system power on the device. For more information, see *Chassis Status LEDs on a QFX3008-I Interconnect Device*.
Major Alarm LED	(QFX3008-I Interconnect device only) Displays whether a critical error condition that requires immediate action exists on the device. For more information, see *Chassis Status LEDs on a QFX3008-I Interconnect Device*.
Minor Alarm LED	(QFX3008-I Interconnect device only) Displays whether a noncritical condition that requires monitoring or maintenance exists on the device. For more information, see *Chassis Status LEDs on a QFX3008-I Interconnect Device*.
Fan 0 LED Fan 1 LED Fan 2 LED Fan 3 LED Fan 4 LED Fan 5 LED Fan 6 LED Fan 7 LED Fan 8 LED	(QFX3008-I Interconnect device only) Displays the status of fan trays on the device. For more information, see *Chassis Status LEDs on a QFX3008-I Interconnect Device*.
PEM 0 LED PEM 1 LED PEM 2 LED PEM 3 LED PEM 4 LED	(QFX3008-I Interconnect device only) Displays the status of power supplies on the device. For more information, see *Chassis Status LEDs on a QFX3008-I Interconnect Device*.

Table 66: show chassis led Output Fields *(continued)*

Field Name	Field Description
LED info for	(QFX3008-I Interconnect device only) Displays the LED information for a Control Board.
Mastership LED	(QFX3008-I Interconnect device only) Displays status of the MASTER LED on a Control Board. For more information, see *Control Board LEDs on a QFX3008-I Interconnect Device*.
Interface	Names of the interfaces on the device.
LED (ADM/SPD/DPX/POE)	(EX Series switches only) State of the currently selected port parameter of the Status LED for the interface. The Status LED port parameters are: NOTE: EX4500 and EX8200 switches do not have the POE port parameter. • **ADM**—Administrative • **SPD**—Speed • **DPX**—Duplex • **POE**—Power over Ethernet

Sample Output

show chassis led (EX2200 Switch)

```
user@switch> show chassis led
Front panel contents for slot: 0
---------------------------------
LEDs status:
    Alarms LED: Amber
    System LED: Green
    Mode LED  : Duplex
Interface    LED(ADM/SPD/DPX/POE)
-------------------------------------
ge-0/0/0        Off
ge-0/0/1        Full Duplex
ge-0/0/2        Full Duplex
ge-0/0/3        Off
ge-0/0/4        Off
ge-0/0/5        Full Duplex
ge-0/0/6        Full Duplex
ge-0/0/7        Full Duplex
ge-0/0/8        Full Duplex
ge-0/0/9        Full Duplex
ge-0/0/10       Full Duplex
ge-0/0/11       Full Duplex
ge-0/0/12       Full Duplex
ge-0/0/13       Full Duplex
ge-0/0/14       Full Duplex
ge-0/0/15       Full Duplex
ge-0/0/16       Full Duplex
ge-0/0/17       Full Duplex
ge-0/0/18       Full Duplex
ge-0/0/19       Full Duplex
ge-0/0/20       Full Duplex
ge-0/0/21       Full Duplex
```

```
ge-0/0/22       Off
ge-0/0/23       Off
ge-0/0/24       Full Duplex
ge-0/0/25       Full Duplex
ge-0/0/26       Off
ge-0/0/27       Off
ge-0/0/28       Full Duplex
ge-0/0/29       Full Duplex
```

show chassis led

```
user@switch> show chassis led

Front panel contents for slot: 0
---------------------------------
LEDs status:
    Alarms LED: Off
    System LED: Green
    Master LED: Green
Interface       LED(ADM/SPD/DPX/POE)
-------------------------------------
ge-0/0/0        Off
ge-0/0/1        Full Duplex
ge-0/0/2        Full Duplex
ge-0/0/3        Off
ge-0/0/4        Off
ge-0/0/5        Full Duplex
ge-0/0/6        Full Duplex
ge-0/0/7        Full Duplex
ge-0/0/8        Full Duplex
ge-0/0/9        Full Duplex
ge-0/0/10       Full Duplex
ge-0/0/11       Full Duplex
ge-0/0/12       Full Duplex
ge-0/0/13       Full Duplex
ge-0/0/14       Full Duplex
ge-0/0/15       Full Duplex
ge-0/0/16       Full Duplex
ge-0/0/17       Full Duplex
ge-0/0/18       Full Duplex
ge-0/0/19       Full Duplex
ge-0/0/20       Full Duplex
ge-0/0/21       Full Duplex
ge-0/0/22       Off
ge-0/0/23       Off
ge-0/0/24       Full Duplex
ge-0/0/25       Full Duplex
ge-0/0/26       Off
ge-0/0/27       Off
ge-0/0/28       Full Duplex
ge-0/0/29       Full Duplex
```

show chassis led fpc-slot 0

```
user@switch> show chassis led fpc-slot 0
Front panel contents for slot: 0
---------------------------------
LEDs status:
    Alarms LED: Red
    System LED: Green
    Master LED: Green
```



```
Interface       LED(ADM/SPD/DPX/POE)
-------------------------------------
ge-0/0/0        Off
ge-0/0/1        Off
ge-0/0/2        Off
ge-0/0/3        Off
ge-0/0/4        Off
ge-0/0/5        Off
ge-0/0/6        Off
ge-0/0/7        Off
ge-0/0/8        Off
ge-0/0/9        Off
ge-0/0/10       Off
ge-0/0/11       Off
ge-0/0/12       Off
ge-0/0/13       Off
ge-0/0/14       Off
ge-0/0/15       Off
ge-0/0/16       Off
ge-0/0/17       Off
ge-0/0/18       Off
ge-0/0/19       Off
ge-0/0/20       Off
ge-0/0/21       Off
ge-0/0/22       Off
ge-0/0/23       Off
```

show chassis led (EX Series)

```
user@switch> show chassis led
Front panel contents for slot: 0
---------------------------------
LEDs status:
Alarms LED: Amber
Status LED: Green
Mode LED : Duplex
Interface LED(ADM/SPD/DPX/POE)
-------------------------------------
ge-0/0/0 Off
ge-0/0/1 Full Duplex
ge-0/0/2 Full Duplex
ge-0/0/3 Off
ge-0/0/4 Off
ge-0/0/5 Full Duplex
ge-0/0/6 Full Duplex
ge-0/0/7 Full Duplex
ge-0/0/8 Full Duplex
ge-0/0/9 Full Duplex
ge-0/0/10 Full Duplex
ge-0/0/11 Full Duplex
ge-0/0/12 Full Duplex
ge-0/0/13 Full Duplex
ge-0/0/14 Full Duplex
ge-0/0/15 Full Duplex
ge-0/0/16 Full Duplex
ge-0/0/17 Full Duplex
ge-0/0/18 Full Duplex
ge-0/0/19 Full Duplex
ge-0/0/20 Full Duplex
ge-0/0/21 Full Duplex
ge-0/0/22 Off
```

```
ge-0/0/23 Off
ge-0/0/24 Full Duplex
ge-0/0/25 Full Duplex
ge-0/0/26 Off
ge-0/0/27 Off
ge-0/0/28 Full Duplex
ge-0/0/29 Full Duplex
```

show chassis led node-device (QFabric System Node Device)

```
user@switch> show chassis led node-device node1
 Front panel contents for: node1
LEDs status:
    Status/Beacon LED: Yellow Blinking

Interface               LINK/SPEED LED      ACTIVITY LED
--------------------------------------------------------
node1:me5               Green               N/A
node1:me6               Green               N/A

Interface               STATUS LED      LINK/ACTIVITY LED
----------------------------------------------------
node1:xe-0/0/8          Green           Green
node1:ge-0/0/10         Green           Green
node1:ge-0/0/12         Green           Green
node1:ge-0/0/24         Green           Green
node1:ge-0/0/25         Green           Green
node1:ge-0/0/26         Green           Green
node1:ge-0/0/27         Green           Green
node1:ge-0/0/28         Green           Green
node1:ge-0/0/29         Green           Green
node1:ge-0/0/30         Green           Green
node1:ge-0/0/31         Green           Green
node1:ge-0/0/32         Green           Green
node1:ge-0/0/33         Green           Green
node1:ge-0/0/34         Green           Green
node1:ge-0/0/35         Green           Green
node1:ge-0/0/36         Green           Green
node1:ge-0/0/37         Green           Green
node1:ge-0/0/38         Green           Green
node1:ge-0/0/39         Green           Green
node1:fte-0/1/0         Green           Green Blinking
node1:fte-0/1/2         Green           Green Blinking
```

show chassis led interconnect-device (QFabric System - QFX3600-I Interconnect Device)

```
user@switch> show chassis led interconnect-device IC-EG0712
                Front panel contents for: FPC 0
                -----------------------------------
LEDs status:
    Status/Beacon LED: Yellow Blinking

Interface                LINK/SPEED LED      ACTIVITY LED
--------------------------------------------------------
IC-EG0712:me5            Green               N/A
IC-EG0712:me6            Green               N/A

Interface                STATUS LED      LINK/ACTIVITY LED
---------------------------------------------------------
IC-EG0712:fte-0/1/0      Green           Green
IC-EG0712:fte-0/1/1      Green           Green Blinking
```



```
IC-EG0712:fte-0/1/2      Green          Green
IC-EG0712:fte-0/1/3      Green          Green Blinking
IC-EG0712:fte-0/1/4      Green          Green
IC-EG0712:fte-0/1/5      Green          Green Blinking
IC-EG0712:fte-0/1/6      Green          Green
IC-EG0712:fte-0/1/7      Green          Green
IC-EG0712:fte-0/1/8      Green          Green Blinking
IC-EG0712:fte-0/1/9      Green          Green Blinking
IC-EG0712:fte-0/1/10     Green          Green Blinking
```

show chassis led interconnect-device (QFabric System - QFX3008-I Interconnect Device)

```
user@switch> show chassis led interconnect-device IC-EG0712
                Front Panel Module Information
                --------------------------------
LEDs status:
    Status LED: Green
    Power LED : Yellow Blinking
    Major Alarm LED: Red
    Minor Alarm LED: Yellow
    Fan 0 LED : Green
    Fan 1 LED : Green
    Fan 2 LED : Green
    Fan 3 LED : Green
    Fan 4 LED : Green
    Fan 5 LED : Green
    Fan 6 LED : Green
    Fan 7 LED : Green
    Fan 8 LED : Green
    Fan 9 LED : Green
    PEM 0 LED : Green
    PEM 1 LED : Green
    PEM 2 LED : Green
    PEM 3 LED : off
    PEM 4 LED : Yellow Blinking
    PEM 5 LED : off

                LED info for: CB - 0
                --------------------------------
LEDs status:
    Status LED: Green
    Mastership LED: Green

Interface                STATUS LED      LINK/ACTIVITY LED
--------------------------------------------------------
IC-F4899:pme0 :          Green           N/A
IC-F4899:pme1 :          off             N/A
IC-F4899:pme2 :          off             N/A
IC-F4899:pme3 :          off             N/A

                LED info for: CB - 1
                --------------------------------
LEDs status:
    Status LED: Green
    Mastership LED: Amber

Interface                STATUS LED      LINK/ACTIVITY LED
--------------------------------------------------------
IC-F4899:pme0 :          Green           N/A
IC-F4899:pme1 :          off             N/A
IC-F4899:pme2 :          off             N/A
```



```
IC-F4899:pme3 :         off             N/A

                LED info for: FC 0 FPC - 0
                ---------------------------------
LEDs status:
    Status LED: Green

Interface               STATUS LED      LINK/ACTIVITY LED
---------------------------------------------------------
IC-F4899:fte-0/0/0      Green           N/A
IC-F4899:fte-0/0/1      Green           N/A
IC-F4899:fte-0/0/2      Green           N/A
IC-F4899:fte-0/0/3      Green           N/A
IC-F4899:fte-0/0/4      Green           N/A
IC-F4899:fte-0/0/5      Green           N/A
IC-F4899:fte-0/0/6      Green           N/A
IC-F4899:fte-0/0/7      Green           N/A
IC-F4899:fte-0/0/8      Green           N/A
IC-F4899:fte-0/0/9      Green           N/A
IC-F4899:fte-0/0/10     Green           N/A
IC-F4899:fte-0/0/11     Green           N/A
IC-F4899:fte-0/0/12     Green           N/A
IC-F4899:fte-0/0/13     Green           N/A
IC-F4899:fte-0/0/14     Green           N/A
IC-F4899:fte-0/0/15     Green           N/A

                LED info for: FC 1 FPC - 1
                ---------------------------------
LEDs status:
    Status LED: Green

Interface               STATUS LED      LINK/ACTIVITY LED
---------------------------------------------------------
IC-F4899:fte-1/0/0      Green           N/A
IC-F4899:fte-1/0/1      Green           N/A

                LED info for: RC 2 FPC - 10
                ---------------------------------
LEDs status:
    Status LED: Green

                LED info for: RC 3 FPC - 11
                ---------------------------------
LEDs status:
    Status LED: Green
```

show chassis location

Syntax

show chassis location

Syntax (TX Matrix Router)

show chassis location
<fpc | interface (by-name *name* | by-slot fpc *number* lcc *number*) | lcc *number* | scc>

Syntax (TX Matrix Plus Router)

show chassis location
<fpc | interface (by-name *name* | by-slot fpc *number* lcc *number*) | lcc *number* | sfc *number*>

Syntax (MX Series Router)

show chassis location
<all-members>
<local>
<member *member-id*>

Syntax (QFX Series)

show chassis location
<interconnect-device *name*>
<node-device *name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the physical location of the chassis. This command can only be used on the master Routing Engine.

Options

none—Display all information about the physical location of the chassis. On a TX Matrix router, display all information about the physical location of the TX Matrix router and its attached T640 routers. On a TX Matrix Plus router, display all information about the physical location of the TX Matrix Plus router and its attached routers.

all-members—(MX Series routers only) (Optional) Display the physical location of the chassis for all the member routers in the Virtual Chassis configuration.

fpc—(TX Matrix router and TX Matrix Plus router only) (Optional) Display the physical location of all Flexible PIC Concentrators (FPCs).

interconnect-device *name*—(QFabric systems only) (Optional) Display the physical location of the Interconnect device.

interface by-name *name*—(TX Matrix and TX Matrix Plus routers only) (Optional) Display the physical location of a specified interface name. On a TX Matrix router, this option displays the FPC number and T640 router (line-card chassis) number associated with the specified interface. On a TX Matrix Plus router, this option displays the FPC number and router (line-card chassis) number associated with the specified interface.

interface by-slot fpc *number* lcc *number*—(TX Matrix and TX Matrix Plus router only) (Optional) On a TX Matrix router, display the global FPC number of an interface by specifying its local FPC number and T640 router (line-card chassis) number. On a

TX Matrix Plus router, display the global FPC number of an interface by specifying its local FPC number and router (line-card chassis) number.

- The global FPC number is the FPC slot number when all the FPC slots in the routing matrix are considered: **0** through **31**. On TX Matrix Plus router with 3D SIBs, the value is **0** through **63**. The local FPC number is the FPC slot number on a particular T640 router.
- For **fpc**, replace ***number*** with a value from **0** through **7**.
- For **lcc**, replace ***number*** with a value from **0** through **7**.

lcc *number*—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display the physical location of a specified T640 router (line-card chassis) that is connected to a TX Matrix router. On a TX Matrix Plus router , display the physical location of a specified router (line-card chassis) that is connected to a TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Display the physical location of the chassis for the local Virtual Chassis member.

member *member-id*—(MX Series routers only) (Optional) Display the physical location of the chassis for the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value of 0 or 1.

node-device *name*—(QFabric systems only) (Optional) Display the physical location of the Node device.

scc—(TX Matrix routers only) (Optional) Display the physical location of the TX Matrix router (switch-card chassis).

sfc—(TX Matrix Plus routers only) (Optional) Display the physical location of the TX Matrix Plus router (or switch-fabric chassis).

Required Privilege Level view

List of Sample Output

show chassis location on page 783
show chassis location fpc (TX Matrix Router) on page 783
show chassis location interface by-slot (TX Matrix Router) on page 783

show chassis location fpc (TX Matrix Plus Router) on page 784
show chassis location interface by-slot (TX Matrix Plus Router) on page 784
show chassis location (QFX3500 Switches) on page 784
show chassis location (QFabric Systems) on page 784

Output Fields

Table 67 on page 783 lists the output fields for the **show chassis location** command. Output fields are listed in the approximate order in which they appear.

Table 67: show chassis location Output Fields

Field Name	Field Description
country-code	Country code information.
postal-code	Postal code information.
Building	Building information.
Floor	Floor information.
Global FPC	Global FPC number. The FPC slot number, when all FPC slots in the routing matrix are considered. The range of values is **0** through **31**. On TX Matrix Plus router with 3D SIBs the value is **0** through **63**.
LCC	Line-card chassis number. On a TX Matrix router, the number of a particular T640 router connected to the TX Matrix router. On a TX Matrix Plus router, the number of a particular router connected to the TX Matrix Plus router.
Local FPC	Local FPC number. On a TX Matrix router, the FPC slot number on a particular T640 router. On a TX Matrix Plus router, the FPC slot number on a particular router.

Sample Output

show chassis location

```
user@host> show chassis location
country-code: US
postal-code: 94404
Building: Building 2, Floor: 2
```

show chassis location fpc (TX Matrix Router)

```
user@host> show chassis location fpc
Global FPC     LCC      Local FPC
    17           2          1
    21           2          5
```

show chassis location interface by-slot (TX Matrix Router)

```
user@host> show chassis location interface by-slot fpc 1 lcc 1
Global FPC: 9
```

show chassis location fpc (TX Matrix Plus Router)

```
user@host> show chassis location fpc
Global FPC    LCC     Local FPC
     0         0          0
     1         0          1
```

show chassis location interface by-slot (TX Matrix Plus Router)

```
user@host> show chassis location interface by-slot fpc 2 lcc 1
Global FPC: 10
```

show chassis location (QFX3500 Switches)

```
user@switch> show chassis location
country-code: US
postal-code: 94404
Building: Building 2, Floor: 2
```

show chassis location (QFabric Systems)

```
user@switch> show chassis location interconnect-device interconnect1
country-code: US
postal-code: 94404
Building: Building 2, Floor: 2
```


show chassis mac-addresses

Syntax

show chassis mac-addresses

Syntax (TX Matrix Router)

show chassis mac-addresses
<lcc *number* | scc>

Syntax (TX Matrix Plus Router)

show chassis mac-addresses
<lcc *number* | sfc *number*>

Syntax (MX Series Router)

show chassis mac-addresses
<all-members>
<local>
<member *member-id*>

Syntax (MX104, MX2010, and MX2020 3D Universal Edge Routers)

show chassis mac-addresses

Syntax (QFX Series)

show chassis mac-addresses
<interconnect-device *name*>
<node-group *name*>

Syntax (ACX Series Universal Access Routers)

show chassis mac-addresses

Release Information

Command introduced before JUNOS Release 7.4.
Command introduced in JUNOS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in JUNOS Release 9.6.
Command introduced in Junos OS Release 11.1 for QFX Series.
Command introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.

Description

Display the media access control (MAC) addresses for the router, switch chassis, or switch.

Options

none—(TX Matrix, TX Matrix Plus routers, and the QFX Series) Display the MAC addresses for the router chassis or switch. On a TX Matrix router, display MAC addresses on the TX Matrix router and its attached T640 routers. On a TX Matrix Plus router, display MAC addresses on the TX Matrix Plus router and its attached routers.

all-members—(MX Series routers only) (Optional) Display the MAC addresses for all the member routers of the Virtual Chassis configuration.

interconnect-device *name*—(QFabric systems only) (Optional) Display the MAC addresses for the Interconnect device.

lcc ***number***—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display MAC addresses for a specified T640 router (line-card chassis) that is connected to the TX Matrix Plus router. On a TX Matrix Plus router, display MAC addresses for a specified router (line-card chassis) that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Display the MAC addresses for the local Virtual Chassis member.

member ***member-id***—(MX Series routers only) (Optional) Display the MAC addresses for the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value of 0 or 1.

node-group ***name***—(QFabric systems only) (Optional) Display the MAC addresses for the specified Node group.

scc—(TX Matrix routers only) (Optional) Display MAC addresses for the TX Matrix router (switch-card chassis).

sfc ***number***—(TX Matrix Plus routers only) (Optional) Display MAC addresses for the TX Matrix Plus router (or switch-fabric chassis).

Required Privilege Level

view

Related Documentation

- *ACX2000 and ACX2100 Routers Hardware and CLI Terminology Mapping*

List of Sample Output

Output Fields Table 68 on page 787 lists the output fields for the **show chassis mac-addresses** command. Output fields are listed in the approximate order in which they appear.

Table 68: show chassis mac-addresses Output Fields

Field Name	Field Description
MAC address information	
Public base address	Base address of the MAC addresses allocated to this router or switch.
Public count	Number of allocated public addresses.
Private base address	Base address of the private MAC addresses allocated to this router or switch.
Private count	Number of allocated private addresses.

Sample Output

show chassis mac-addresses

```
user@host> show chassis mac-addresses
MAC address information
  Public base address   0:90:69:0:4:0
  Public count       1008
  Private base address   0:90:69:0:7:f0
  Private count       16
```

show chassis mac-addresses (MX104 Router)

```
user@host > show chassis mac-addresses
MAC address information:
  Public base address     b0:a8:6e:a1:e8:58
  Public count            2032
  Private base address    b0:a8:6e:a1:f0:48
  Private count           16
```

show chassis mac-addresses (MX2010 Router)

```
user@host> show chassis mac-addresses
MAC address information:
  Public base address     64:87:88:04:50:00
  Public count            1984
  Private base address    64:87:88:04:57:c0
  Private count           64
```

show chassis mac-addresses (MX2020 Router)

```
user@host> show chassis mac-addresses
MAC address information:
  Public base address     2c:21:72:70:20:00
  Public count            4032
  Private base address    2c:21:72:70:2f:c0
  Private count           64
```


show chassis mac-addresses (TX Matrix Router)

```
user@host> show chassis mac-addresses
scc-re0:
--------------------------------------------------------------------------
MAC address information:
  Public base address     00:05:85:9e:cc:00
  Public count            8064
  Private base address    00:05:85:9e:eb:80
  Private count           128
lcc0-re0:
--------------------------------------------------------------------------
MAC address information:
  Public base address     00:05:85:68:98:00
  Public count            2032
  Private base address    00:05:85:68:9f:f0
  Private count           16
lcc2-re0:
--------------------------------------------------------------------------
MAC address information:
  Public base address     00:05:85:68:78:00
  Public count            2032
  Private base address    00:05:85:68:7f:f0
  Private count           16
```

show chassis mac-addresses (TX Matrix Plus Router)

```
user@host> show chassis mac-addresses
sfc0-re0:
--------------------------------------------------------------------------
MAC address information:
  Public base address     00:1d:b5:14:00:00
  Public count            65023
  Private base address    00:1d:b5:14:fd:ff
  Private count           512

lcc0-re0:
--------------------------------------------------------------------------
MAC address information:
  Public base address     00:1f:12:7a:84:00
  Public count            2032
  Private base address    00:1f:12:7a:8b:f0
  Private count           16

lcc1-re0:
--------------------------------------------------------------------------
MAC address information:
  Public base address     00:22:83:42:48:00
  Public count            2032
  Private base address    00:22:83:42:4f:f0
  Private count           16

lcc2-re0:
--------------------------------------------------------------------------
MAC address information:
  Public base address     00:1f:12:c3:58:00
  Public count            2032
  Private base address    00:1f:12:c3:5f:f0
  Private count           16

lcc3-re0:
```



```
---------------------------------------------------------------------------
MAC address information:
  Public base address     00:21:59:ef:b8:00
  Public count            2032
  Private base address    00:21:59:ef:bf:f0
  Private count           16
```

show chassis mac-addresses (QFX3500 Switches)

```
user@switch> show chassis mac-addresses
MAC address information:
Public base address 02:00:08:00:00:00
Public count 512
Private base address 02:00:00:00:00:00
Private count 64
```

show chassis mac-addresses interconnect-device (QFabric Systems)

```
user@switch> show chassis mac-addresses interconnect-device interconnect1
MAC address information:
  Public base address     00:1f:12:30:9c:c0
  Public count            58
  Private base address    00:1f:12:30:9c:fa
  Private count           6
```

show chassis mac-addresses node-group (QFabric Systems)

```
user@switch> show chassis mac-addresses node-group NW-NG-0
MAC address information:
------------------------
RE:
  FC MAC base    00:11:00:00:00:00
  FC MAC count   2
  VLAN MAC       00:11:00:00:00:09
EC6007
  Base address   00:00:01:76:00:00
  Count          64
EC6008
  Base address   00:22:83:22:52:ae
  Count          260
```

show chassis mac-addresses (ACX2000 Universal Access Router)

```
user@switch> show chassis mac-addresses
MAC address information:
  Public base address     84:18:88:c0:2b:00
  Public count            112
  Private base address    84:18:88:c0:2b:70
  Private count           16
```


show chassis pic

Syntax

show chassis pic fpc-slot *slot-number* pic-slot *slot-number*

Syntax (TX Matrix and TX Matrix Plus Routers)

show chassis pic fpc-slot *slot-number* pic-slot *slot-number*
<lcc *number*>

Syntax (MX Series Routers)

show chassis pic fpc-slot *slot-number* pic-slot *slot-number*
<all-members>
<local>
<member *member-id*>

Syntax (MX104, MX2010 and MX2020 3D Universal Edge Routers)

show chassis pic fpc-slot *slot-number* pic-slot *slot-number*

Syntax (PTX Series Packet Transport Router)

show chassis pic transport fpc-slot *slot-number* pic-slot *slot-number*

Syntax (QFX Series)

show chassis pic
<interconnect-device *name* (fpc-slot *slot-number* | pic-slot *slot-number*)>
<node-device *name* pic-slot *slot-number*>

Syntax (ACX Series Universal Access Routers)

show chassis pic fpc-slot *slot-number* pic-slot *slot-number*

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for QFX Series.
Command introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
Command introduced in Junos OS Release 13.2 for PTX Series Packet Transport Routers.
Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.

Description

Display status information about the PIC installed in the specified Flexible PIC Concentrator (FPC) and PIC slot.

Options

fpc-slot *slot-number*—Display information about the PIC in this particular FPC slot:

- On a TX Matrix router, if you specify the number of the T640 router by using the **lcc *number*** option (the recommended method), replace ***slot-number*** with a value from **0** through **7**. Otherwise, replace ***slot-number*** with a value from **0** through **31**.

  Likewise, on a TX Matrix Plus router, if you specify the number of the T1600 router by using the **lcc *number*** option (the recommended method), replace ***slot-number*** with a value from **0** through **7**. Otherwise, replace ***slot-number*** with a value from **0** through **31**. For example, the following commands have the same result:

```
user@host> show chassis pic fpc-slot 1 lcc 1 pic-slot 1
user@host> show chassis pic fpc-slot 9 pic-slot 1
```

- M120 routers only—Replace ***slot-number*** with a value from **0** through **5**.
- MX80 routers only—Replace ***slot-number*** with a value from **0** through **1**.
- MX104 routers only—Replace ***slot-number*** with a value from **0** through **2**.
- MX240 routers only—Replace ***slot-number*** with a value from **0** through **2**.
- MX480 routers only—Replace ***slot-number*** with a value from **0** through **5**.
- MX960 routers only—Replace ***slot-number*** with a value from **0** through **11**.
- MX2010 routers only—Replace ***slot-number*** with a value from **0** through **9**.
- MX2020 routers only—Replace ***slot-number*** with a value from **0** through **19**.
- Other routers—Replace ***slot-number*** with a value from **0** through **7**.
- EX Series switches:
  - EX3200 switches and EX4200 standalone switches—Replace ***slot-number*** with 0.
  - EX4200 switches in a Virtual Chassis configuration—Replace ***slot-number*** with a value from 0 through 9 (switch's member ID).
  - EX8208 switches—Replace ***slot-number*** with a value from 0 through 7 (line card).
  - EX8216 switches—Replace ***slot-number*** with a value from 0 through 15 (line card).
- QFX Series:
  - QFX3500 and QFX5100 standalone switches—Replace ***slot-number*** with 0. In the command output, FPC refers to a line card. The FPC number equals the slot number for the line card.
  - QFabric systems—Replace ***slot-number*** with any number between 0 and 15. In the command output, FPC refers to a line card. The FPC number equals the slot number for the line card.

all-members—(MX Series routers and EX Series switches only) (Optional) Display PIC information for all member routers in the Virtual Chassis configuration.

interconnect-device ***name***—(QFabric systems only) (Optional) Display PIC information for a specified Interconnect device.

lcc ***number***—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display PIC information for a specified T640 router (line-card chassis) that is connected to the TX Matrix router. On a TX Matrix Plus router, display PIC information for a specified router (line-card chassis) that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers and EX Series switches only) (Optional) Display PIC information for the local Virtual Chassis member.

member ***member-id***—(MX Series routers and EX Series switches only) (Optional) Display PIC information for the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value of 0 or 1.

node-device ***name***—(QFabric systems only) (Optional) Display PIC information for a specified Node device.

pic-slot ***slot-number***—Display information about the PIC in this particular PIC slot. For routers, replace ***slot-number*** with a value from **0** through **3**. For EX3200 and EX4200 switches, replace ***slot-number*** with 0 for built-in network interfaces and 1 for interfaces on uplink modules. For EX8208 and EX8216 switches, replace ***slot-number*** with 0. For the QFX3500 standalone switch and the QFabric system, replace ***slot-number*** with 0 or 1.

transport—Display PIC information for optical transport network.

Required Privilege Level

view

Related Documentation

- request chassis pic on page 361
- show chassis hardware on page 628
- *Configuring the PIC Type*
- *100-Gigabit Ethernet Type 4 PIC with CFP Overview*

List of Sample Output

show chassis pic fpc-slot pic-slot on page 795
show chassis pic fpc-slot pic-slot (PIC Offline) on page 795
show chassis pic fpc-slot pic-slot (FPC Offline) on page 796
show chassis pic fpc-slot pic-slot (FPC Not Present) on page 796
show chassis pic fpc-slot pic-slot (PIC Not Present) on page 796
show chassis pic fpc-slot pic-slot (M120 Router) on page 796
show chassis pic fpc-slot pic-slot (MX104 Router) on page 796
show chassis pic fpc-slot pic-slot (MX960 Router Bidirectional Optics) on page 796

Output Fields Table 69 on page 793 lists the output fields for the **show chassis pic** command. Output fields are listed in the approximate order in which they appear.

Table 69: show chassis pic Output Fields

Field Name	Field Description
Type	PIC type. NOTE: On the 1-port OC192/STM64 MICs with the SDH framing mode, the type is displayed as **MIC-3D-1STM64-XFP** and with the SONET framing mode, the type is displayed as **MIC-3D-1OC192-XFP**. By default, the 1-port OC192/STM64 MICs displays the type as **MIC-3D-1OC192-XFP**.

Table 69: show chassis pic Output Fields *(continued)*

Field Name	Field Description
Account Layer2 Overhead	(MX Series routers) Indicates whether functionality to count the Layer 2 overhead bytes in the interface statistics at the PIC level is enabled or disabled.
ASIC type	Type of ASIC on the PIC.
State	Status of the PIC. State is displayed only when a PIC is in the slot. • **Online**— PIC is online and running. • **Offline**—PIC is powered down.
PIC version	PIC hardware version.
Uptime	How long the PIC has been online.
Package	(Multiservices PICs only) Services package supported: **Layer-2** or **Layer-3**.
Port Number	Port number for the PIC.
Cable Type	Type of cable connected to the port: **LH**, **LX**, or **SX.**
PIC Port Information (MX480 Router 100-Gigabit Ethernet CFP)	Port-level information for the PIC. • Port—Port number • Cable type—Type of optical transceiver installed. • Fiber type—Type of fiber. SM is single-mode. • Xcvr vendor—Transceiver vendor name. • Xcvr vendor part number—Transceiver vendor part number. • Wavelength—Wavelength of the transmitted signal. Uplinks and downlinks are always 1550 nm. There is a separate fiber for each direction

PIC Port Information (MX960 Router Bidirectional Optics)	Port-level information for the PIC.
	• Port—Port number
	• Cable type—Type of small form-factor pluggable (SFP) optical transceiver installed. Uplink interfaces display -U. Down link interfaces display -D.
	• Fiber type—Type of fiber. SM is single-mode.
	• Xcvr vendor—Transceiver vendor name.
	• Xcvr vendor part number—Transceiver vendor part number.
	  ◦ BX10-10-km bidirectional optics.
	  ◦ BX40-40-km bidirectional optics.
	  ◦ SFP-LX-40-km SFP optics.
	• Wavelength—Wavelength of the transmitted signal. Uplinks are always 1310 nm. Downlinks are either 1490 nm or 1550 nm.

Table 69: show chassis pic Output Fields *(continued)*

Field Name	Field Description
PIC Port Information (Next-Generation SONET/SDH SFP)	Port-level information for the next-generation SONET/SDH SFP PIC. • Port—Port number. • Cable type—Type of small form-factor pluggable (SFP) optical transceiver installed. • Fiber type—Type of fiber: **SM** (single-mode) or **MM** (multimode). • Xcvr vendor—Transceiver vendor name. • Xcvr vendor part number—Transceiver vendor part number. • Wavelength—Wavelength of the transmitted signal. Next-generation SONET/SDH SFPs use 1310 nm.
Pic port information (MX104 router)	Port-level information for the PIC. • Port—Port number • Cable type—Type of optical transceiver installed. • Fiber type—Type of fiber. SM is single-mode. • Xcvr vendor—Transceiver vendor name. • Xcvr vendor part number—Transceiver vendor part number. • Wavelength—Wavelength of the transmitted signal. • Xcvr Firmware—Firmware version of the transceiver.
Multirate Mode	Rate-selectabilty status for the MIC: **Enabled** or **Disabled**.
Channelization	Indicates whether channelization is enabled or disabled on the DS3/E3 MIC.

Sample Output

show chassis pic fpc-slot pic-slot

```
user@host> show chassis pic fpc-slot 2 pic-slot 0
PIC fpc slot 2 pic slot 0 information:
  Type                             10x 1GE(LAN), 1000 BASE
  ASIC type                        H chip
  State                            Online
  PIC version                      1.1
  Uptime                           1 day, 50 minutes, 58 seconds
PIC Port Information:
  Port         Cable           Xcvr              Xcvr Vendor
  Number       Type            Vendor Name       Part Number
  0            GIGE 1000EX     FINISAR CORP.     FTRJ8519P1BNL-J3
  1            GIGE 1000EX     FINISAR CORP.     FTRJ-8519-7D-JUN
```

show chassis pic fpc-slot pic-slot (PIC Offline)

```
user@host> show chassis pic fpc-slot 1 pic-slot 0
PIC fpc slot 1 pic slot 0 information:
  State                            Offline
```

show chassis pic fpc-slot pic-slot (FPC Offline)

```
user@host> show chassis pic fpc-slot 1 pic-slot 0
FPC 1 is not online
```

show chassis pic fpc-slot pic-slot (FPC Not Present)

```
user@host> show chassis pic fpc-slot 4 pic-slot 0
FPC slot 4 is empty
```

show chassis pic fpc-slot pic-slot (PIC Not Present)

```
user@host> show chassis pic fpc-slot 5 pic-slot 2
FPC 5, PIC 2 is empty
```

show chassis pic fpc-slot pic-slot (M120 Router)

```
user@host> show chassis pic fpc-slot 3 pic-slot 0
PC slot 3, PIC slot 0 information:
  Type                             2x G/E IQ, 1000 BASE
  ASIC type                        IQ GE 2 VLAN-TAG FPGA
  State                            Online
  PIC version                 1.16
  Uptime                         3 hours, 3 minutes

PIC Port Information:
  Port         Cable             Xcvr              Xcvr Vendor
  Number       Type              Vendor Name       Part Number
  0            GIGE 1000SX       FINISAR CORP.     FTRJ8519P1BNL-J3
  1            GIGE 1000SX       FINISAR CORP.     FTRJ-8519-7D-JUN
```

show chassis pic fpc-slot pic-slot (MX104 Router)

```
user@host> show chassis pic fpc-slot 1 pic-slot 1
FPC slot 1, PIC slot 1 information:
  Type                             10x 1GE(LAN) -E  SFP
  State                            Online
  PIC version                  1.1
  Uptime                         1 hour, 30 minutes, 59 seconds

PIC port information:
                        Fiber                    Xcvr vendor       Wave-    Xcvr

  Port Cable type        type  Xcvr vendor        part number       length
Firmware
  3    GIGE 1000T        n/a   Methode Elec.      SP7041-M1-JN      n/a       0.0

  6    GIGE 1000LX10     SM    FINISAR CORP.      FTLF1318P2BTL-J1  1310 nm  0.0

  8    GIGE 1000T        n/a   Methode Elec.      SP7041-M1-JN      n/a       0.0

  9    GIGE 1000T        n/a   Methode Elec.      SP7041-M1-JN      n/a       0.0
```

show chassis pic fpc-slot pic-slot (MX960 Router Bidirectional Optics)

```
user@host> show chassis pic fpc-slot 4 pic-slot 1
FPC slot 4, PIC slot 1 information:
  Type                           10x 1GE(LAN)
  Account Layer2 Overhead        Enabled
  State                          Online
```



```
  PIC version                0.0
  Uptime                     18 days, 5 hours, 41 minutes, 54 seconds

PIC port information:
                          Fiber                    Xcvr vendor
  Port  Cable type        type  Xcvr vendor        part number        Wavelength
  0     SFP-1000BASE-BX10-D SM  SumitomoElectric   SBP6H44-J3-BW-49   1490 nm
  1     SFP-1000BASE-BX10-D SM  SumitomoElectric   SBP6H44-J3-BW-49   1490 nm
  2     SFP-1000BASE-BX10-D SM  SumitomoElectric   SBP6H44-J3-BW-49   1490 nm
  3     SFP-1000BASE-BX10-D SM  OCP                TRXBG1LXDBVM2-JW   1490 nm
  4     SFP-1000BASE-BX10-D SM  OCP                TRXBG1LXDBVM2-JW   1490 nm
  5     SFP-1000BASE-BX10-U SM  SumitomoElectric   SBP6H44-J3-BW-31   1310 nm
  6     SFP-1000BASE-BX10-U SM  SumitomoElectric   SBP6H44-J3-BW-31   1310 nm
  7     SFP-1000BASE-BX10-U SM  OCP                TRXBG1LXDBBMH-J1   1310 nm
  8     SFP-1000BASE-BX10-U SM  OCP                TRXBG1LXDBBMH-J1   1310 nm
  9     SFP-1000BASE-BX10-U SM  SumitomoElectric   SBP6H44-J3-BW-31   1310 nm
```

show chassis pic fpc-slot pic-slot (MX480 Router with 100-Gigabit Ethernet MIC)

```
user@host> show chassis pic fpc-slot 1 pic-slot 2
FPC slot 1, PIC slot 2 information:
  Type                    1X100GE CFP
  State                   Online
  PIC version             2.10
  Uptime                  4 minutes, 48 seconds

PIC port information:
        Fiber                    Xcvr vendor
  Port  Cable type        type  Xcvr vendor        part number        Wavelength
  0     100GBASE LR4      SM    FINISAR CORP.      FTLC1181RDNS-J3    1310 nm

        Xcvr vendor
        firmware version
        1.8
```

show chassis pic fpc-slot pic-slot (MX240, MX480, MX960 Routers with Application Services Modular Line Card)

```
user@host> show chassis pic fpc-slot 1 pic-slot 2
FPC slot 1, PIC slot 2 information:
  Type                             AS-MXC
  State                            Online
  PIC version                  1.0
  Uptime                         11 hours, 18 minutes, 3 seconds
```

show chassis pic fpc-slot pic-slot (MX480 Router with MPC4E)

```
user@host> show chassis pic fpc-slot 3 pic-slot 0
FPC slot 3, PIC slot 0 information:
  Type                             4x10GE SFPP
  State                            Online
  PIC version                  0.0
  Uptime                         41 seconds

PIC port information:
                        Fiber                    Xcvr vendor      Wave-     Xcvr

  Port Cable type        type  Xcvr vendor        part number       length
Firmware
  0    10GBASE SR        MM    OPNEXT, INC.       TRS2001EM-0014    850 nm    0.0
```

```
  1     10GBASE SR         MM     OPNEXT, INC.       TRS2001EM-0014     850 nm    0.0
```

show chassis pic fpc-slot pic-slot (MX2010 Router)

```
user@host> show chassis pic fpc-slot 9 pic-slot 3
FPC slot 9, PIC slot 3 information:
  Type                              1X100GE CFP
  Account Layer2 Overhead           Enabled
  State                             Online
  PIC version                       0.0
  Uptime                            14 hours, 51 seconds
```

show chassis pic fpc-slot pic-slot (MX2020 Router)

```
user@host> show chassis pic fpc-slot 19 pic-slot 3
FPC slot 19, PIC slot 3 information:
  Type                              4x 10GE(LAN) SFP+
  Account Layer2 Overhead           Enabled
  State                             Online
  PIC version                   0.0
  Uptime                          1 day, 11 hours, 26 minutes, 36 seconds

PIC port information:
                         Fiber                    Xcvr vendor       Wave-    Xcvr

  Port Cable type         type  Xcvr vendor        part number       length
Firmware
  0     10GBASE SR         MM     SumitomoElectric   SPP5200SR-J6-M     850 nm    0.0

  1     10GBASE SR         MM     SumitomoElectric   SPP5200SR-J6-M     850 nm    0.0

  2     10GBASE SR         MM     SumitomoElectric   SPP5200SR-J6-M     850 nm    0.0

  3     10GBASE SR         MM     SumitomoElectric   SPP5200SR-J6-M     850 nm    0.0
```

show chassis pic fpc-slot pic-slot (MX2020 Routers with MPC4E)

```
user@host> show chassis pic fpc-slot 14 pic-slot 0
FPC slot 14, PIC slot 2 information:
  Type                              4x10GE SFPP
  State                             Online
  PIC version                   0.0
  Uptime                          1 day, 14 hours, 49 minutes, 9 seconds

PIC port information:
                         Fiber                    Xcvr vendor       Wave-    Xcvr

  Port Cable type         type  Xcvr vendor        part number       length
Firmware
  0     10GBASE SR         MM     SumitomoElectric   SPP5100SR-J3       850 nm    0.0

  1     10GBASE SR         MM     SumitomoElectric   SPP5100SR-J3       850 nm    0.0

  3     10GBASE SR         MM     SumitomoElectric   SPP5100SR-J3       850 nm    0.0
```

show chassis pic fpc-slot pic-slot (T1600 Router with 100-Gigabit Ethernet PIC)

```
user@host> run show chassis pic fpc-slot 3 pic-slot 1
```



```
FPC slot 3, PIC slot 1 information:
  Type                             100GE SLOT1
  ASIC type                        Brooklyn 100GE FPGA
  State                            Online
  PIC version                  1.3
  Uptime                         10 minutes, 44 seconds

PIC port information:
                          Fiber                    Xcvr vendor
  Port  Cable type        type  Xcvr vendor        part number       Wavelength
  0     100GBASE LR4      SM    Opnext Inc.        TRC5E20ENFSF000F  1310 nm
```

show chassis pic fpc-slot pic-slot lcc (TX Matrix Router)

```
user@host> show chassis pic fpc-slot 1 pic-slot 1 lcc 0
lcc0-re0:
--------------------------------------------------------------------------
PIC fpc slot 1 pic slot 1 information:
  Type                             4x OC-3 SONET, SMIR
  ASIC type                        D chip
  State                            Online
  PIC version                  1.2
  Uptime                        5 days, 2 hours, 12 minutes, 8 seconds
```

show chassis pic fpc-slot pic-slot lcc (TX Matrix Plus Router)

```
user@host> show chassis pic pic-slot 0 fpc-slot 8
lcc0-re0:
--------------------------------------------------------------------------
FPC slot 8, PIC slot 0 information:
  Type                             1x 10GE(LAN/WAN)
  State                            Online
  Uptime                         2 hours, 46 minutes, 23 seconds

PIC port information:
                          Fiber
  Port  Cable type        type  Xcvr vendor         part number       Wavelength

  0     10GBASE ZR        SM    Opnext Inc.         TRF7061BN-LF150   1550 nm
  0     10GBASE ZR        SM    FINISAR CORP.       FTRX-1811-3-J2    1550 nm
```

show chassis pic fpc-slot pic-slot (Next-Generation SONET/SDH SFP)

```
user@host> show chassis pic fpc-slot 4 pic-slot 0
FPC slot 4, PIC slot 0 information:
   Type                             4x OC-3 1x OC-12 SFP
   ASIC type                        D FPGA
   State                            Online
   PIC version                  1.3
   Uptime                         1 day, 50 minutes, 4 seconds

 PIC port information:
                          Fiber                    Xcvr vendor
   Port  Cable type       type  Xcvr vendor        part number       Wavelength

   0     OC48 short reach  SM   FINISAR CORP.      FTRJ1321P1BTL-J2  1310 nm
   1     OC3 short reach   MM   OCP                TRPA03MM3BAS-JE   1310 nm
   2     OC3 short reach   MM   OCP                TRXA03MM3BAS-JW   1310 nm
   3     OC12 inter reach  SM   FINISAR CORP.      FTLF1322P1BTR     1310 nm
```

show chassis pic fpc-slot pic-slot (12-Port T1/E1)

```
user@host> show chassis pic fpc-slot 0 pic-slot 3
FPC slot 0, PIC slot 3 information:
  Type                               12x T1/E1 CE
  State                              Online
  PIC version                    1.1
  CPU load average                 1 percent
  Interrupt load average           0 percent
  Total DRAM size                128 MB
  Memory buffer utilization      100 percent
  Memory heap utilization          4 percent
  Uptime                           1 day, 22 hours, 28 minutes, 12 seconds
  Internal Clock Synchronization   Normal
```

show chassis pic fpc-slot pic-slot (4x CHOC3 SONET CE SFP)

```
user@host> show chassis pic fpc-slot 0 pic-slot 1
FPC slot 0, PIC slot 1 information:
  Type                               4x CHOC3 SONET CE SFP
  State                              Online
  PIC version                    1.3
  CPU load average                 1 percent
  Interrupt load average           0 percent
  Total DRAM size                128 MB
  Memory buffer utilization       99 percent
  Memory heap utilization          4 percent
  Uptime                           1 day, 22 hours, 55 minutes, 37 seconds
  Internal Clock Synchronization   Normal

PIC port information:
                          Fiber                        Xcvr vendor
  Port  Cable type        type  Xcvr vendor            part number       Wavelength
  0     OC3 short reach   MM    AVAGO                  HFBR-57E0P-JU2    n/a
  1     OC3 short reach   MM    AVAGO                  HFBR-57E0P-JU2    n/a
  3     OC3 long reach    SM    OPNEXT INC             TRF5456AVLB314    1310 nm
```

show chassis pic fpc-slot pic-slot (SONET/SDH OC3/STM1 [Multi-Rate] MIC with SFP)

```
user@host> show chassis pic fpc-slot 0 pic-slot 0
FPC slot 0, PIC slot 0 information:
  Type                               MIC-3D-8OC3OC12-4OC48
  State                              Online
  PIC version                    1.8
  Uptime                           3 days, 22 hours, 3 minutes, 50 seconds

PIC port information:
                          Fiber                        Xcvr vendor
  Port  Cable type        type  Xcvr vendor            part number       Wavelength
  1     OC12 inter reach   SM   FINISAR CORP           FTRJ1322P1BTR-J3  1310 nm
  7     OC12 inter reach   SM   FINISAR CORP           FTRJ1322P1BTR-J3  1310 nm
Multirate Mode                       Enabled
```

show chassis pic fpc-slot pic-slot (8-port Channelized SONET/SDH OC3/STM1 [Multi-Rate] MIC with SFP)

```
user@host> show chassis pic fpc-slot 3 pic-slot 0
FPC slot 3, PIC slot 0 information:
  Type                               MIC-3D-8CHOC3-4CHOC12
  State                              Online
  PIC version                       1.9
  Uptime                              1 hour, 21 minutes, 24 seconds
```



```
PIC port information:
                           Fiber                      Xcvr vendor
  Port  Cable type         type  Xcvr vendor          part number      Wavelength
  0     OC12 short reach   SM    FINISAR CORP.        FTRJ1322P1BTR-J3  1310 nm
  1     OC12 short reach   SM    FINISAR CORP.        FTRJ1322P1BTR-J3  1310 nm
  2     OC12 inter reach   SM    FINISAR CORP.        FTRJ1322P1BTR-J2  1310 nm
  4     OC12 short reach   SM    FINISAR CORP.        FTRJ1322P1BTR-J3  1310 nm
  5     OC12 short reach   SM    FINISAR CORP.        FTRJ1322P1BTR-J3  1310 nm
  6     OC12 short reach   SM    FINISAR CORP.        FTRJ1322P1BTR-J3  1310 nm
  7     OC12 short reach   SM    FINISAR CORP.        FTRJ1322P1BTR-J3  1310 nm
```

show chassis pic fpc-slot pic-slot (4-port Channelized SONET/SDH OC3/STM1 [Multi-Rate] MIC with SFP)

```
user@host> show chassis pic fpc-slot 5 pic-slot 0
FPC slot 5, PIC slot 0 information:
  Type                             MIC-3D-4CHOC3-2CHOC12
  State                            Online
  PIC version                      1.9
  Uptime                           1 hour, 21 minutes

PIC port information:
                           Fiber                      Xcvr vendor
  Port  Cable type         type  Xcvr vendor          part number      Wavelength
  1     OC12 inter reach   SM    FINISAR CORP.        FTRJ1322P1BTR-J3  1310 nm
  2     OC12 inter reach   SM    FINISAR CORP.        FTRJ1322P1BTR-J3  1310 nm
  3     OC12 short reach   SM    FINISAR CORP.        FTRJ1322P1BTR-J3  1310 nm
```

show chassis pic fpc-slot pic-slot (1-port OC192/STM64 MIC with XFP)

```
user@host> show chassis pic fpc-slot 1 pic-slot 0
FPC slot 1, PIC slot 0 information:
  Type                                 MIC-3D-1OC192-XFP
  State                                Online
  PIC version                          1.2
  Uptime                               1 day, 11 hours, 4 minutes, 6 seconds

PIC port information:
                           Fiber                      Xcvr vendor
  Port  Cable type         type  Xcvr vendor          part number      Wavelength
  0     OC192 short reach  n/a   FINISAR CORP.        FTLX1412M3BCL-J3  1310 nm
```

show chassis pic fpc-slot 1 pic-slot 2 (8-port DS3/E3 MIC)

```
user@host> show chassis pic fpc-slot 1 pic-slot 2
FPC slot 1, PIC slot 2 information:
  Type                                 MIC-3D-8DS3-E3
  State                                Online
  PIC version                          1.10
  Uptime                               4 days, 1 hour, 29 minutes, 19 seconds
  Channelization Mode                  Disabled
```

show chassis pic fpc-slot pic-slot (OTN)

```
user@host> show chassis pic fpc-slot 5 pic-slot 0
PIC fpc slot 5 pic slot 0 information:
     Type                                 1x10GE(LAN),OTN
     ASIC type                            H chip
     State                                Online
     PIC version                       1.0
     Uptime                            5 minutes, 50 seconds
```

show chassis pic fpc-slot pic-slot (QFX3500 Switch)

```
user@switch> show chassis pic fpc-slot 0 pic-slot 0
FPC slot 0, PIC slot 0 information:
Type 48x 10G-SFP+ Builtin
State Online
Uptime 3 days, 3 hours, 5 minutes, 20 seconds
```

show chassis pic fpc-slot pic-slot (QFX5100 Standalone Switch)

```
user@switch> show chassis pic fpc-slot 0 pic-slot 0
FPC slot 0, PIC slot 0 information:
  Type                             Unknown Builtin
  State                            Online
  Uptime                         1 day, 17 hours, 5 minutes, 9 seconds
```

show chassis pic interconnect-device fpc-slot pic-slot (QFabric Systems)

```
user@switch> show chassis pic interconnect-device interconnect1 fpc-slot 9 pic-slot 0
FPC slot 9, PIC slot 0 information:
  Type                             16x 40G-GEBuiltin
  State                            Online
  Uptime                         2 hours, 47 minutes, 40 seconds
```

show chassis pic node-device fpc-slot pic-slot (QFabric System)

```
user@switch> show chassis pic node-device node1 pic-slot 0
FPC slot node1, PIC slot 0 information:
  Type                             48x 10G-SFP+Builtin
  State                            Online
  Uptime                         2 hours, 52 minutes, 37 seconds

PIC port information:
                          Fiber                    Xcvr vendor
  Port  Cable type        type  Xcvr vendor        part number       Wavelength
  0     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  1     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  2     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  3     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  4     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  5     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  6     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  7     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  8     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  9     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  10    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  11    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  12    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  13    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  14    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  15    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  16    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  17    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  18    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  19    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  20    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  21    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  22    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  23    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  24    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
  25    10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
```



```
26     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
27     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
28     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
29     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
30     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
31     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
32     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
33     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
34     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
35     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
36     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
37     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
38     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
39     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
40     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
41     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
42     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
43     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
44     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
45     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
46     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
47     10GBASE SR        MM    SumitomoElectric   SPP5101SR-J3      850 nm
```

show chassis pic fpc-slot pic-slot (ACX2000 Universal Access Router)

```
user@host> show chassis pic fpc-slot 0 pic-slot 1
FPC slot 0, PIC slot 1 information:
  Type                               8x 1GE(LAN) RJ45 Builtin
  State                              Online
  Uptime                           6 days, 2 hours, 51 minutes, 11 seconds
```

show chassis pic fpc-slot pic-slot (MX Routers with Media Services Blade [MSB])

```
user@switch> show chassis pic fpc-slot 1 pic-slot 0
FPC slot 1, PIC slot 0 information:
  Type                               AS-MSC
  State                              Online
  PIC version                    1.6
  Uptime                           11 hours, 17 minutes, 56 seconds
```

show chassis pic FPC slot PIC slot (MX Routers with Media Services Blade [MSB])

```
user@switch> show chassis pic fpc-slot 1 pic-slot 2
Type                               AS-MXC
  State                              Online
  PIC version                    1.0
  Uptime                           11 hours, 18 minutes, 3 seconds
```

show chassis pic transport fpc-slot pic-slot (PTX Series Packet Transport Routers)

```
user@host> show chassis pic transport fpc-slot 2 pic-slot 0
Administrative State:     In Service
Operational    State:     Normal
```

show chassis routing-engine

Syntax

show chassis routing-engine
<bios | *slot*>

Syntax (EX Series Switches)

show chassis routing-engine
<*slot*>

Syntax (T Series routers)

show chassis routing-engine
<bios | *slot*>

Syntax (TX Matrix Routers)

show chassis routing-engine
<bios | *slot*>
<lcc *number* | scc>

Syntax (TX Matrix Plus Routers)

show chassis routing-engine
<bios | *slot*>
<lcc *number* | sfc *number*>

Syntax (QFX Series)

show chassis routing-engine
<interconnect-device *name*>
<node-device *name*>

Syntax (MX Series Routers)

show chassis routing-engine
<bios | *slot*>
<all-members>
<local>
<member *member-id*>

Syntax (MX2010 3D Universal Edge Routers)

show chassis routing-engine
<bios | *slot*>

Syntax (MX2020 3D Universal Edge Routers)

show chassis routing-engine
<bios | *slot*>

Syntax (ACX Series Universal Access Routers)

show chassis routing-engine

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release in 9.6.
Command introduced in Junos OS Release 11.1 for QFX Series.
Command introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.

Description

Display the status of the Routing Engine.

Options

none—Display information about one or more Routing Engines. On a TX Matrix router, display information about all Routing Engines on the TX Matrix router and its attached T640 routers. On a TX Matrix Plus router, display information about all Routing Engines on the TX Matrix Plus router and its attached routers.

all-members—(MX Series routers only) (Optional) Display Routing Engine information for all members of the Virtual Chassis configuration.

bios—(Optional) Display the (BIOS) firmware version.

interconnect-device *number*—(QFabric systems only) (Optional) Display Routing Engine information for a specified Interconnect device.

lcc *number*—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display Routing Engine information for a specified T640 router (line-card chassis) that is connected to the TX Matrix router. On a TX Matrix Plus router, display Routing Engine information for a specified router (line-card chassis) that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Display Routing Engine information for the local Virtual Chassis member.

member *member-id*—(MX Series routers only) (Optional) Display Routing Engine information for the specified member of the Virtual Chassis configuration. For an MX Series Virtual Chassis, replace *member-id* with a value of 0 or 1.

node-device *number*—(QFabric systems only) (Optional) Display Routing Engine information for a specified Node device.

scc—(TX Matrix routers only) (Optional) Display Routing Engine information for the TX Matrix router (switch-card chassis).

sfc *number*—(TX Matrix Plus routers only) (Optional) Display Routing Engine information for the TX Matrix Plus router (or switch-fabric chassis). Replace ***number*** with 0.

slot—(Systems with multiple Routing Engines) (Optional) Display information for an individual Routing Engine. Replace ***slot*** with 0 or 1. For QFX3500 switches, there is only one Routing Engine, so you do not need to specify the slot number.

Required Privilege Level view

Related Documentation

- request chassis routing-engine master on page 365
- *Configuring Routing Engine Redundancy*
- *Switching the Global Master and Backup Roles in a Virtual Chassis Configuration*

List of Sample Output

Output Fields Table 70 on page 806 lists the output fields for the **show chassis routing-engine** command. Output fields are listed in the approximate order in which they appear.

Table 70: show chassis routing-engine Output Fields

Field Name	Field Description
Slot	(Systems with single and multiple Routing Engines) Slot number.
Current state	(Systems with multiple Routing Engines) Current state of the Routing Engine: **Master**, **Backup**, or **Disabled**.
Election priority	(Systems with multiple Routing Engines) Election priority for the Routing Engine: **Master** or **Backup**.
Temperature	Temperature of the air flowing past the Routing Engine.

Table 70: show chassis routing-engine Output Fields *(continued)*

Field Name	Field Description
CPU Temperature	Temperature of the CPU.
DRAM	Total DRAM available to the Routing Engine's processor. Starting with Junos OS Release 12.3R1, the DRAM field displays both available memory and installed memory.
Memory utilization	Percentage of Routing Engine memory being used.
CPU utilization	Information about the Routing Engine's CPU utilization: • **User**—Percentage of CPU time being used by user processes. • **Background**—Percentage of CPU time being used by background processes. • **Kernel**—Percentage of CPU time being used by kernel processes. • **Interrupt**—Percentage of CPU time being used by interrupts. • **Idle**—Percentage of CPU time that is idle.
Model	Routing Engine model number.
Serial ID	(Systems with multiple Routing Engines) Identification number of the Routing Engine in this slot.
Start time	Time at which the Routing Engine started running.
Uptime	How long the Routing Engine has been running.
Routing Engine BIOS Version	BIOS version being run by the Routing Engine.

Table 70: show chassis routing-engine Output Fields *(continued)*

Field Name	Field Description
Last reboot reason	Reason for last reboot, including: • **power cycle/failure**—Halt of the Routing Engine using the **halt** command, powering down using the power button on the chassis or any other method (such as removal of the control board or Routing Engine), and then powering back the Routing Engine. A halt of the operating system also occurs if you enter the **request system halt** command. You can enter this command to halt the system operations on the chassis or specific Routing Engines. To restart the software, press any key on the keyboard. • **watchdog**—Reboot due to a hardware watchdog. A watchdog is a hardware monitoring process that examines the health and performance of the router to enable the device to recover from failures. A watchdog checks for problems at certain intervals, and reboots the routing engine if a problem is encountered. • **reset-button reset**—(Not available on the J Series router or EX Series switch) Reboot due to pressing of the reset button on the Routing Engine. • **power-button hard power off**—Reboot due to pressing of the power button on the chassis. A powering down of the software also occurs if you enter the **request system power-off** command. You can enter this command to power down the chassis or specific Routing Engines; you can then restart the software. • **misc hardware reason**—Reboot due to miscellaneous hardware reasons. • **thermal shutdown**—Reboot due to the router or switch reaching a critical temperature at which point it is unsafe to continue operations. • **hard disk failure**—Reboot due to a hard disk or solid-state drive (SSD) failure. • **reset from debugger**—Reboot due to reset from the debugger. • **chassis control reset**—Restart the chassis process that manages PICs, FPCs, and other hardware components. The chassis control module that runs the Routing Engine performs management and monitoring functions, and it provides a single access point for operational and maintenance functions. A reset of the chassis management process occurs when you enter the **restart chassis-control** command. • **bios auto recovery reset**—Reboot due to a BIOS auto-recovery reset. • **could not be determined**—Reboot due to an undetermined reason. • **Router rebooted after a normal shutdown**—Reboot due to a normal shutdown. This reason is displayed if the Routing Engine is powered down by pushing and holding the online/offline button on the Routing Engine faceplate for 30 seconds, and then powered back. A reboot of the software also occurs if you enter the **request system reboot** command. You can enter this command to reboot the chassis or specific Routing Engines.
Load averages	Routing Engine load averages for the last 1, 5, and 15 minutes.

Sample Output

show chassis routing-engine (M5 Router)

```
user@host> show chassis routing-engine
Routing Engine status:
    Temperature                 25 degrees C / 77 degrees F
    DRAM                       768 MB
    Memory utilization          21 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  0 percent
```



```
      Idle                    100 percent
    Model                         RE-2.0
    Serial ID                     31000007349bf701
    Start time                    2003-12-04 09:42:17 PST
    Uptime                        26 days, 1 hour, 12 minutes, 27 seconds
    Last reboot reason            Router rebooted after a normal shutdown
    Load averages:                1 minute   5 minute  15 minute
                                      0.00       0.01       0.00
```

show chassis routing-engine (M10 Router)

```
user@host> show chassis routing-engine
Routing Engine status:
    Temperature                  25 degrees C / 77 degrees F
    DRAM                        768 MB
    Memory utilization           21 percent
    CPU utilization:
      User                        0 percent
      Background                  0 percent
      Kernel                      0 percent
      Interrupt                   0 percent
      Idle                      100 percent
    Model                         RE-2.0
    Serial ID                     31000007349bf701
    Start time                    2003-12-04 09:42:17 PST
    Uptime                        26 days, 1 hour, 12 minutes, 27 seconds
    Last reboot reason            Router rebooted after a normal shutdown
    Load averages:                1 minute   5 minute  15 minute
                                      0.00       0.01       0.00
```

show chassis routing-engine (M20 Router)

```
user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state                 Master
    Election priority             Master (default)
    Temperature                  29 degrees C / 84 degrees F
    DRAM                        768 MB
    Memory utilization           20 percent
    CPU utilization:
      User                        1 percent
      Background                  0 percent
      Kernel                      2 percent
      Interrupt                   0 percent
      Idle                       97 percent
    Model                         RE-2.0
    Serial ID                     58000007348d9a01
    Start time                    2003-12-30 07:05:47 PST
    Uptime                       3 hours, 41 minutes, 14 seconds
    Last reboot reason            Router rebooted after a normal shutdown
    Load averages:                1 minute   5 minute  15 minute
                                      0.00       0.02       0.00
Routing Engine status:
  Slot 1:
    Current state                 Backup
    Election priority             Backup (default)
    Temperature                  29 degrees C / 84 degrees F
    DRAM                        768 MB
    Memory utilization            0 percent
    CPU utilization:
```



```
      User                       0 percent
      Background                 0 percent
      Kernel                     1 percent
      Interrupt                  0 percent
      Idle                      99 percent
    Model                          RE-2.0
    Serial ID                      d800000734745701
    Start time                     2003-06-17 16:37:33 PDT
    Uptime                        195 days, 18 hours, 47 minutes, 9 seconds
    Last reboot reason             Router rebooted after a normal shutdown
```

show chassis routing-engine (M40 Router)

```
user@host> show chassis routing-engine
Routing Engine status:
    Temperature                 25 degrees C / 77 degrees F
    DRAM                       768 MB
    Memory utilization          21 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  0 percent
      Idle                     100 percent
    Model                          RE-2.0
    Serial ID                      31000007349bf701
    Start time                     2003-12-04 09:42:17 PST
    Uptime                         26 days, 1 hour, 12 minutes, 27 seconds
    Last reboot reason             Router rebooted after a normal shutdown
    Load averages:                 1 minute   5 minute  15 minute
                                       0.00       0.01       0.00
```

show chassis routing-engine (M120 Router)

```
user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 46 degrees C / 114 degrees F
    CPU temperature             44 degrees C / 111 degrees F
    DRAM                      2048 MB
    Memory utilization          18 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     5 percent
      Interrupt                  0 percent
      Idle                      95 percent
    Model                          RE-A-1000
    Serial ID                      1000621154
    Start time                     2006-10-31 17:10:05 PST
    Uptime                         14 minutes, 31 seconds
    Last reboot reason             Router rebooted after a normal shutdown
    Load averages:                 1 minute   5 minute  15 minute
                                       0.02       0.07       0.07
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 45 degrees C / 113 degrees F
```

```
    CPU temperature            42 degrees C / 107 degrees F
    DRAM                     2048 MB
    Memory utilization         15 percent
    CPU utilization:
      User                      0 percent
      Background                0 percent
      Kernel                    0 percent
      Interrupt                 0 percent
      Idle                    100 percent
    Model                          RE-A-1000
    Serial ID                      1000621151
    Start time                     2006-10-31 17:10:04 PST
    Uptime                         14 minutes, 30 seconds
    Last reboot reason             Router rebooted after a normal shutdown
```

show chassis routing-engine (M160 Router)

```
user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                43 degrees C / 109 degrees F
    DRAM                     2048 MB
    Memory utilization         11 percent
    CPU utilization:
      User                      1 percent
      Background                0 percent
      Kernel                    2 percent
      Interrupt                 0 percent
      Idle                     97 percent
    Model                          RE-3.0
    Serial ID                      210865700403
    Start time                     2003-12-23 12:25:55 PST
    Uptime                        6 days, 22 hours, 33 minutes, 24 seconds
    Last reboot reason             Router rebooted after a normal shutdown
    Load averages:                 1 minute   5 minute  15 minute
                                       0.24       0.13       0.04
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                40 degrees C / 104 degrees F
    DRAM                     2048 MB
    Memory utilization          9 percent
    CPU utilization:
      User                      0 percent
      Background                0 percent
      Kernel                    0 percent
      Interrupt                 0 percent
      Idle                    100 percent
    Model                          RE-3.0
    Serial ID                      210865700332
    Start time                     2003-12-23 12:25:55 PST
    Uptime                        6 days, 22 hours, 33 minutes, 21 seconds
    Last reboot reason             Router rebooted after a normal shutdown
```

show chassis routing-engine (MX240 Router)

```
user@host> show chassis routing-engine
```



```
Routing Engine status:
  Slot 0:
    Current state                  Backup
    Election priority              Master (default)
    Temperature                 40 degrees C / 104 degrees F
    CPU temperature             47 degrees C / 116 degrees F
    DRAM                      3584 MB
    Memory utilization           7 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  0 percent
      Idle                     100 percent
    Model                          RE-S-2000
    Serial ID                      1000703522
    Start time                     2007-12-19 10:35:40 PST
    Uptime                         16 days, 3 hours, 15 minutes, 23 seconds
    Last reboot reason             Router rebooted after a normal shutdown
```

show chassis routing-engine (MX480 Router)

```
user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 41 degrees C / 105 degrees F
    CPU temperature             38 degrees C / 100 degrees F
    DRAM                      2048 MB
    Memory utilization          13 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     2 percent
      Interrupt                  0 percent
      Idle                      98 percent
    Model                          RE-S-1300
    Serial ID                      1000697044
    Start time                     2008-01-04 06:46:08 PST
    Uptime                         8 hours, 17 minutes, 16 seconds
    Last reboot reason             Router rebooted after a normal shutdown
```

show chassis routing-engine (MX960 Router)

```
user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 37 degrees C / 98 degrees F
    CPU temperature             37 degrees C / 98 degrees F
    DRAM                      2048 MB
    Memory utilization          18 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     4 percent
      Interrupt                  0 percent
      Idle                      96 percent
    Model                          RE-S-1300
```

```
    Serial ID                      1000617944
    Start time                     2006-10-26 12:37:13 PDT
    Uptime                         6 days, 4 hours, 59 minutes, 40 seconds
    Last reboot reason             Router rebooted after a normal shutdown
    Load averages:                 1 minute   5 minute  15 minute
                                       0.16       0.08       0.02
```

show chassis routing-engine (MX2010 Router)

user@host> **show chassis routing-engine**

```
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 3 degrees C / 37 degrees F
    CPU temperature             3 degrees C / 37 degrees F
    DRAM                     17152 MB
    Memory utilization          13 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     4 percent
      Interrupt                  2 percent
      Idle                      95 percent
    Model                          RE-S-1800x4
    Serial ID                      9009099704
    Start time                     2012-10-02 14:33:32 PDT
    Uptime                         14 hours, 39 minutes, 39 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
    Load averages:                 1 minute   5 minute  15 minute
                                       0.06       0.05       0.01
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 1 degrees C / 33 degrees F
    CPU temperature             2 degrees C / 35 degrees F
    DRAM                     17152 MB
    Memory utilization          11 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  0 percent
      Idle                     100 percent
    Model                          RE-S-1800x4
    Serial ID                      9009099706
    Start time                     2012-10-02 10:36:06 PDT
    Uptime                         18 hours, 36 minutes, 57 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
    Load averages:                 1 minute   5 minute  15 minute
                                       0.01       0.00       0.00
```

show chassis routing-engine (MX2020 Router)

user@host> **show chassis routing-engine**

```
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
```

```
    Temperature                   6 degrees C / 42 degrees F
    CPU temperature               6 degrees C / 42 degrees F
    DRAM                        17152 MB
    Memory utilization            14 percent
    CPU utilization:
      User                         1 percent
      Background                   0 percent
      Kernel                       7 percent
      Interrupt                    2 percent
      Idle                        91 percent
    Model                            RE-S-1800x4
    Serial ID                        9009089704
    Start time                       2012-10-02 11:05:24 PDT
    Uptime                           2 days, 15 hours, 49 minutes, 13 seconds
    Last reboot reason               Router rebooted after a normal shutdown.
    Load averages:                   1 minute   5 minute  15 minute
                                         0.10       0.05       0.01
Routing Engine status:
  Slot 1:
    Current state                    Backup
    Election priority                Backup (default)
    Temperature                   7 degrees C / 44 degrees F
    CPU temperature               5 degrees C / 41 degrees F
    DRAM                        17152 MB
    Memory utilization            12 percent
    CPU utilization:
      User                         0 percent
      Background                   0 percent
      Kernel                       0 percent
      Interrupt                    0 percent
      Idle                        99 percent
    Model                            RE-S-1800x4
    Serial ID                        9009094138
    Start time                       2012-10-02 11:09:57 PDT
    Uptime                           2 days, 15 hours, 44 minutes, 27 seconds
    Last reboot reason               Router rebooted after a normal shutdown.
    Load averages:                   1 minute   5 minute  15 minute
                                         0.00       0.00       0.00
```

show chassis routing-engine (T320 router)

```
user@host> show chassis routing-engine
Slot 0:
    Current state                    Master
    Election priority                Master (default)
    Temperature                   51 degrees C / 123 degrees F
    CPU temperature               55 degrees C / 131 degrees F
    DRAM                        3584 MB
    Memory utilization            11 percent
    CPU utilization:
      User                         0 percent
      Background                   0 percent
      Kernel                       2 percent
      Interrupt                    0 percent
      Idle                        97 percent
    Model                            RE-A-2000
    Serial ID                        9009010618
    Start time                       2012-10-10 01:24:05 PDT
    Uptime                           5 days, 10 hours, 49 minutes, 23 seconds
    Last reboot reason               0x1:power cycle/failure
    Load averages:                   1 minute   5 minute  15 minute
```

```
                                        0.00        0.05        0.04
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 45 degrees C / 113 degrees F
    CPU temperature             48 degrees C / 118 degrees F
    DRAM                      3584 MB
    Memory utilization           9 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  0 percent
      Idle                     100 percent
    Model                          RE-A-2000
    Serial ID                      9009003642
    Start time                     2012-10-10 01:24:04 PDT
    Uptime                         5 days, 10 hours, 49 minutes, 28 seconds
    Last reboot reason             0x1:power cycle/failure
```

show chassis routing-engine (T640 router)

```
user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 50 degrees C / 122 degrees F
    CPU temperature             58 degrees C / 136 degrees F
    DRAM                      3584 MB
    Memory utilization          14 percent
    CPU utilization:
      User                       1 percent
      Background                 0 percent
      Kernel                     4 percent
      Interrupt                  1 percent
      Idle                      95 percent
    Model                          RE-A-2000
    Serial ID                      1000686556
    Start time                     2012-10-10 01:24:02 PDT
    Uptime                         5 days, 10 hours, 50 minutes, 27 seconds
    Last reboot reason             0x1:power cycle/failure
    Load averages:                 1 minute   5 minute  15 minute
                                       1.24       0.33       0.12
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 44 degrees C / 111 degrees F
    CPU temperature             49 degrees C / 120 degrees F
    DRAM                      3584 MB
    Memory utilization          12 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  1 percent
      Idle                      99 percent
    Model                          RE-A-2000
    Serial ID                      1000702739
```



```
    Start time                  2012-10-10 01:24:02 PDT
    Uptime                      5 days, 10 hours, 50 minutes, 26 seconds
    Last reboot reason          0x1:power cycle/failure
```

show chassis routing-engine (T1600 router)

```
user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state               Master
    Election priority           Master (default)
    Temperature              48 degrees C / 118 degrees F
    CPU temperature          58 degrees C / 136 degrees F
    DRAM                   3584 MB
    Memory utilization       13 percent
    CPU utilization:
      User                    0 percent
      Background              0 percent
      Kernel                  3 percent
      Interrupt               1 percent
      Idle                   96 percent
    Model                       RE-A-2000
    Serial ID                   1000704521
    Start time                  2012-10-10 01:23:41 PDT
    Uptime                      5 days, 10 hours, 46 minutes, 56 seconds
    Last reboot reason          0x1:power cycle/failure
    Load averages:              1 minute   5 minute  15 minute
                                    0.05       0.03       0.01
Routing Engine status:
  Slot 1:
    Current state               Backup
    Election priority           Backup (default)
    Temperature              44 degrees C / 111 degrees F
    CPU temperature          48 degrees C / 118 degrees F
    DRAM                   3584 MB
    Memory utilization       12 percent
    CPU utilization:
      User                    0 percent
      Background              0 percent
      Kernel                  0 percent
      Interrupt               0 percent
      Idle                  100 percent
    Model                       RE-A-2000
    Serial ID                   9009006579
    Start time                  2012-10-10 01:23:42 PDT
    Uptime                      5 days, 10 hours, 46 minutes, 54 seconds
    Last reboot reason          0x1:power cycle/failure
```

show chassis routing-engine (T4000 router)

```
user@host> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state               Master
    Election priority           Master (default)
    Temperature              33 degrees C / 91 degrees F
    CPU temperature          50 degrees C / 122 degrees F
    DRAM                   8960 MB
    Memory utilization       18 percent
    CPU utilization:
      User                    0 percent
```



```
      Background                 0 percent
      Kernel                     4 percent
      Interrupt                  1 percent
      Idle                      95 percent
    Model                          RE-DUO-1800
    Serial ID                      P737F-002248
    Start time                     2012-02-09 22:49:53 PST
    Uptime                         2 hours, 21 minutes, 35 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
    Load averages:                 1 minute   5 minute  15 minute
                                       0.00       0.04       0.00
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 32 degrees C / 89 degrees F
    CPU temperature             46 degrees C / 114 degrees F
    DRAM                      8960 MB
    Memory utilization          24 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  0 percent
      Idle                      99 percent
    Model                          RE-DUO-1800
    Serial ID                      P737F-002653
    Start time                     2012-02-08 20:12:51 PST
    Uptime                         1 day, 4 hours, 58 minutes, 28 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
```

show chassis routing-engine (TX Matrix Router)

```
user@host> show chassis routing-engine
scc-re0:
--------------------------------------------------------------------------
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 34 degrees C / 93 degrees F
    CPU temperature             33 degrees C / 91 degrees F
    DRAM                      2048 MB
    Memory utilization          12 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     2 percent
      Interrupt                  0 percent
      Idle                      98 percent
    Model                          RE-4.0
    Serial ID                      P11123900153
    Start time                     2004-08-05 18:42:05 PDT
    Uptime                        9 days, 22 hours, 49 minutes, 50 seconds
    Last reboot reason             Router rebooted after a normal shutdown
    Load averages:                 1 minute   5 minute  15 minute
                                       0.00       0.08       0.07

lcc0-re0:
--------------------------------------------------------------------------
Routing Engine status:
```

```
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 33 degrees C / 91 degrees F
    CPU temperature             30 degrees C / 86 degrees F
    DRAM                      2048 MB
    Memory utilization          12 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     1 percent
      Interrupt                  0 percent
      Idle                      98 percent
    Model                          RE-3.0
    Serial ID                      210865700363
    Start time                     2004-08-05 18:42:05 PDT
    Uptime                        9 days, 22 hours, 48 minutes, 20 seconds
    Last reboot reason             Router rebooted after a normal shutdown
    Load averages:                 1 minute   5 minute  15 minute
                                       0.00       0.02       0.00

lcc2-re0:
--------------------------------------------------------------------------
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 34 degrees C / 93 degrees F
    CPU temperature             35 degrees C / 95 degrees F
    DRAM                      2048 MB
    Memory utilization          12 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     2 percent
      Interrupt                  0 percent
      Idle                      98 percent
    Model                          RE-4.0
    Serial ID                      P11123900126
    Start time                     2004-08-05 18:42:05 PDT
    Uptime                        9 days, 22 hours, 49 minutes, 4 seconds
    Last reboot reason             Router rebooted after a normal shutdown
    Load averages:                 1 minute   5 minute  15 minute
                                       0.01       0.01       0.0
```

show chassis routing-engine lcc (TX Matrix Router)

```
user@host> show chassis routing-engine 0 lcc 0
lcc0-re0:
--------------------------------------------------------------------------------
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 33 degrees C / 91 degrees F
    CPU temperature             30 degrees C / 86 degrees F
    DRAM                      2048 MB
    Memory utilization          12 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
```



```
      Kernel                     1 percent
      Interrupt                  0 percent
      Idle                      98 percent
    Model                          RE-3.0
    Serial ID                      210865700363
    Start time                     2004-08-05 18:42:05 PDT
    Uptime                        7 days, 22 hours, 49 minutes, 6 seconds
    Last reboot reason             Router rebooted after a normal shutdown
    Load averages:                 1 minute   5 minute  15 minute
                                       0.00       0.00       0.00
```

show chassis routing-engine bios (TX Matrix Router)

```
user@host> show chassis routing-engine bios
scc-re0:
--------------------------------------------------------------------------
Routing Engine BIOS Version: V1.0.0
lcc0-re0:
--------------------------------------------------------------------------
Routing Engine BIOS Version: V1.0.17
lcc2-re0:
--------------------------------------------------------------------------
Routing Engine BIOS Version: V1.0.0
```

show chassis routing-engine (TX Matrix Plus Router)

```
user@host> show chassis routing-engine
sfc0-re0:
--------------------------------------------------------------------------
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 27 degrees C / 80 degrees F
    CPU temperature             42 degrees C / 107 degrees F
    DRAM                      3327 MB
    Memory utilization          12 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     2 percent
      Interrupt                  0 percent
      Idle                      98 percent
    Model                          RE-TXP-SFC
    Serial ID                      737A-1024
    Start time                     2009-05-11 17:39:49 PDT
    Uptime                         3 hours, 45 minutes, 25 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
    Load averages:                 1 minute   5 minute  15 minute
                                       0.00       0.00       0.00
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 29 degrees C / 84 degrees F
    CPU temperature             43 degrees C / 109 degrees F
    DRAM                      3327 MB
    Memory utilization          11 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
```



```
      Kernel                       0 percent
      Interrupt                    0 percent
      Idle                       100 percent
    Model                          RE-TXP-SFC
    Serial ID                      737A-1024
    Start time                     2009-05-11 17:08:54 PDT
    Uptime                         4 hours, 16 minutes, 52 seconds
    Last reboot reason             0x1:power cycle/failure

lcc0-re0:
--------------------------------------------------------------------------
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 30 degrees C / 86 degrees F
    CPU temperature             43 degrees C / 109 degrees F
    DRAM                      3327 MB
    Memory utilization           9 percent
    CPU utilization:
      User                         0 percent
      Background                   0 percent
      Kernel                       2 percent
      Interrupt                    0 percent
      Idle                        98 percent
    Model                          RE-TXP-LCC
    Serial ID                      737F-1024
    Start time                     2009-05-11 17:40:32 PDT
    Uptime                         3 hours, 44 minutes, 51 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
    Load averages:                 1 minute   5 minute  15 minute
                                       0.00       0.00       0.00
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 30 degrees C / 86 degrees F
    CPU temperature             43 degrees C / 109 degrees F
    DRAM                      3327 MB
    Memory utilization           9 percent
    CPU utilization:
      User                         0 percent
      Background                   0 percent
      Kernel                       0 percent
      Interrupt                    0 percent
      Idle                       100 percent
    Model                          RE-TXP-LCC
    Serial ID                      737F-1024
    Start time                     2009-05-06 17:31:32 PDT
    Uptime                         5 days, 3 hours, 54 minutes, 19 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
```

show chassis routing-engine lcc (TX Matrix Plus Router)

```
user@host> show chassis routing-engine 0 lcc 0
lcc0-re0:
--------------------------------------------------------------------------
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
```



```
    Temperature                 30 degrees C / 86 degrees F
    CPU temperature             43 degrees C / 109 degrees F
    DRAM                      3327 MB
    Memory utilization           9 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     2 percent
      Interrupt                  0 percent
      Idle                      98 percent
    Model                          RE-TXP-LCC
    Serial ID                      737F-1024
    Start time                     2009-05-11 17:40:32 PDT
    Uptime                         3 hours, 45 minutes, 26 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
    Load averages:                 1 minute   5 minute  15 minute
                                       0.00       0.00       0.00
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 30 degrees C / 86 degrees F
    CPU temperature             43 degrees C / 109 degrees F
    DRAM                      3327 MB
    Memory utilization           9 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  0 percent
      Idle                     100 percent
    Model                          RE-TXP-LCC
    Serial ID                      737F-1024
    Start time                     2009-05-06 17:31:32 PDT
    Uptime                         5 days, 3 hours, 54 minutes, 59 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
```

show chassis routing-engine bios (TX Matrix Plus Router)

```
user@host> show chassis routing-engine bios
sfc0-re0:
--------------------------------------------------------------------------
    Routing Engine BIOS Version: V0.0.Z

lcc0-re0:
--------------------------------------------------------------------------
    Routing Engine BIOS Version: V0.0.N
```

show chassis routing-engine (QFX Series)

```
user@switch> show chassis routing-engine
Routing Engine status:
Slot 0:
Current state Master
Election priority Master (default)
DRAM 2820 MB
Memory utilization 49 percent
CPU utilization:
User 1 percent
Background 0 percent
Kernel 1 percent
```

```
Interrupt 0 percent
Idle 97 percent
Model QFX3500-48S4Q
Serial ID S/N ED3709
Uptime 3 days, 4 hours, 29 minutes, 42 seconds
Last reboot reason 0x200:chassis control reset
Load averages: 1 minute 5 minute 15 minute
0.37 0.26 0.19
```

show chassis routing engine interconnect-device (QFabric systems)

```
user@switch> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 48 degrees C / 118 degrees F
    DRAM                      3312 MB
    Memory utilization          63 percent
    CPU utilization:
      User                      14 percent
      Background                 0 percent
      Kernel                     5 percent
      Interrupt                  0 percent
      Idle                      81 percent
    Model                          RE-QFXC08-CB4S
    Serial ID                      BUILTIN
    Start time                     2011-07-06 13:26:15 UTC
    Uptime                         11 hours, 24 minutes, 57 seconds
    Last reboot reason             0x4:reset-button reset
    Load averages:                 1 minute   5 minute  15 minute
                                       2.62       2.31       2.28
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 39 degrees C / 102 degrees F
    DRAM                      3312 MB
    Memory utilization          59 percent
    CPU utilization:
      User                       9 percent
      Background                 0 percent
      Kernel                     1 percent
      Interrupt                  0 percent
      Idle                      91 percent
    Model                          RE-QFXC08-CB4S
    Serial ID                      BUILTIN
    Start time                     2011-07-06 13:24:58 UTC
    Uptime                         11 hours, 26 minutes, 18 seconds
    Last reboot reason             0x4:reset-button reset
```

show chassis routing-engine (PTX Series Packet Transport Switch)

```
user@switch> show chassis routing-engine
Routing Engine status:
  Slot 0:
    Current state                  Master
    Election priority              Master (default)
    Temperature                 60 degrees C / 140 degrees F
    CPU temperature             76 degrees C / 168 degrees F
```

```
    DRAM                     17152 MB
    Memory utilization          11 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     4 percent
      Interrupt                  0 percent
      Idle                      95 percent
    Model                          RE-DUO-2600
    Serial ID                      P737A-002231
    Start time                     2011-12-21 16:54:37 PST
    Uptime                         25 minutes, 44 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
    Load averages:                 1 minute   5 minute  15 minute
                                       0.01       0.02       0.06
Routing Engine status:
  Slot 1:
    Current state                  Backup
    Election priority              Backup (default)
    Temperature                 50 degrees C / 122 degrees F
    CPU temperature             64 degrees C / 147 degrees F
    DRAM                     17152 MB
    Memory utilization          10 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  0 percent
      Idle                      99 percent
    Model                          RE-DUO-2600
    Serial ID                      P737A-002438
    Start time                     2011-12-21 16:52:26 PST
    Uptime                         27 minutes, 49 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
```

show chassis routing-engine (ACX2000 Universal Access Router)

```
user@host> show chassis routing-engine
Routing Engine status:
    Temperature                 53 degrees C / 127 degrees F
    DRAM                      1536 MB
    Memory utilization          25 percent
    CPU utilization:
      User                       0 percent
      Background                 0 percent
      Kernel                     0 percent
      Interrupt                  1 percent
      Idle                      99 percent
    Model                          RE-ACX-2000
    Start time                     2012-05-09 00:57:07 PDT
    Uptime                         5 days, 3 hours, 16 minutes, 15 seconds
    Last reboot reason             Router rebooted after a normal shutdown.
    Load averages:                 1 minute   5 minute  15 minute
                                       0.00       0.03       0.05
```

show chassis routing-engine (ACX1000 Universal Access Router)

```
user@host> show chassis routing-engine
Routing Engine status:
    Temperature                 36 degrees C / 96 degrees F
    DRAM                       768 MB
```

```
Memory utilization          50 percent
CPU utilization:
  User                       3 percent
  Background                 0 percent
  Kernel                     6 percent
  Interrupt                  0 percent
  Idle                      91 percent
Model                          RE-ACX-1000
Start time                     2012-05-10 07:12:23 PDT
Uptime                         4 days, 10 hours, 46 minutes, 53 seconds
Last reboot reason             Router rebooted after a normal shutdown.
Load averages:                 1 minute   5 minute  15 minute
                                   0.00       0.00       0.00
```

show chassis zones

Syntax

show chassis zones
<detail>

Syntax (QFX Series)

show chassis zones
<detail>
<interconnect-device *name*>

Release Information

Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.

Description

(QFabric systems only) Display the status of the two cooling system zones on the Interconnect device. Zone 1 consists of eight (0 – 7) front cards, which are cooled by two fan trays. Zone 2 consists of two control boards and eight rear cards, which are cooled by eight (0 – 7) fan trays. On MX2010 and MX2020 routers, display the status of the cooling system zones of the chassis. Zone 0 consists of the Control Board, ten (0–9) FPCs, and their respective PICs, Switch Fabric Boards, and Adapter Cards. Zone 1 consists of the Routing Engine, Control Board, and Switch Processor Mezzanine Boards.

Options

detail—(MX2010 and MX2020 routers only) (Optional) Display detailed status of the cooling system zones.

detail ***device-name***— (QFabric systems only) (Optional) Display detailed status of the two cooling systems on the Interconnect device.

interconnect-device ***name***— (QFabric systems only) (Optional) Display the status of the cooling zones on the Interconnect device.

Required Privilege Level

view

Related Documentation

- request chassis beacon on page 355
- show chassis fan on page 573
- *show chassis temperature-thresholds*

List of Sample Output

show chassis zones interconnect-device (QFabric System) on page 826
show chassis zones (MX2010 Router) on page 826
show chassis zones detail (MX2010 Router) on page 827
show chassis zones (MX2020 Router) on page 828
show chassis zones detail (MX2020 Router) on page 828
show chassis beacon interconnect-device (QFabric System) on page 829
show chassis beacon interconnect-device fpc (QFabric System) on page 829
show chassis beacon node-device (QFabric System) on page 830
show chassis beacon node-device fpc (QFabric System) on page 830

Output Fields

Table 54 on page 478 lists the output fields for the **show chassis zones** command. Output fields are listed in the approximate order in which they appear.

Table 71: show chassis zones Output Fields

Field Name	Field Description
Slot	FPC slot number of the device whose content is being displayed. On QFX3500 standalone switches, the number is always **0**.
Beacon State	Status of the beacon state: • Off—The beacon is **OFF**. • On—The beacon is **ON**.
show chassis zones command output fields for MX2020 and MX2010 routers:	
Driving FRU	Field replacable unit (FRU).
Temperature	Temperature of the specified FRU in degrees Celsius and degrees Fahrenheit.
Condition	Condition of the specified FRU. Condition can be **HIGH TEMP**, **WARM TEMP**, **OK**, and **Offline**.
Num Fans Missing	Number of fans or fan trays missing.
Num Fans Failed	Number of fans or fan trays that have failed.
Fan Duty Cycle	Fan duty cycle value.
show chassis zones detail command output fields for MX2020 and MX2010 routers:	
Item	Chassis component: • Information about the chassis, Routing Engines, Control Boards (CBs), Switch Fabric Boards (SFBs), PICs, Flexible PIC Concentrators (FPCs), and Adapter Cards (ADCs).
Measurement	Fan tray speed utilization in percentage.
Status	Status of the specified item. Status can be **OK**, **Absent**, or **Offline**.

Sample Output

show chassis zones interconnect-device (QFabric System)

```
user@switch> show chassis zones interconnect-device interconnect1
Slot                Beacon State
   FPC      0            OFF
```

show chassis zones (MX2010 Router)

```
user@host> show chassis zones
ZONE 0 Status
    Driving FRU                 FPC 6
    Temperature                 81 degrees C / 177 degrees F
    Condition                   HIGH TEMP
    Num Fans Missing            0
```



```
    Num Fans Failed            0
    Fan Duty Cycle             30

ZONE 1 Status
    Driving FRU                SFB 0 Exhaust-Zone1
    Temperature                71 degrees C / 159 degrees F
    Condition                  WARM TEMP
    Num Fans Missing           0
    Num Fans Failed            0
    Fan Duty Cycle             30
```

show chassis zones detail (MX2010 Router)

```
user@host > show chassis zones
ZONE 0 Status
Item                    Status                Measurement
CB 0                    WARM TEMP
CB 1                    WARM TEMP
FPC 0                   HIGH TEMP
FPC 1                   HIGH TEMP
FPC 2                   WARM TEMP
FPC 3                   HIGH TEMP
FPC 4                   HIGH TEMP
FPC 5                   HIGH TEMP
FPC 6                   HIGH TEMP
FPC 7                   HIGH TEMP
FPC 8                   HIGH TEMP
FPC 9                   HIGH TEMP
ADC 0                   WARM TEMP
ADC 1                   WARM TEMP
ADC 2                   WARM TEMP
ADC 3                   WARM TEMP
ADC 4                   WARM TEMP
ADC 5                   WARM TEMP
ADC 6                   WARM TEMP
ADC 7                   WARM TEMP
ADC 8                   WARM TEMP
ADC 9                   WARM TEMP
SFB 0                   WARM TEMP
SFB 1                   WARM TEMP
SFB 2                   WARM TEMP
SFB 3                   Offline
SFB 4                   HIGH TEMP
SFB 5                   WARM TEMP
SFB 6                   HIGH TEMP
SFB 7                   WARM TEMP
Fan Tray 0              OK                    Spinning at 98% fan tray speed
Fan Tray 1              OK                    Spinning at 98% fan tray speed

ZONE 1 Status
Item                    Status                Measurement
CB 0                    WARM TEMP
CB 1                    WARM TEMP
Routing Engine 0        OK
Routing Engine 1        OK
SFB 0                   WARM TEMP
SFB 1                   WARM TEMP
SFB 2                   WARM TEMP
SFB 3                   Offline
SFB 4                   HIGH TEMP
SFB 5                   WARM TEMP
```

```
SFB 6                  HIGH TEMP
SFB 7                  WARM TEMP
SPMB 0                 OK
SPMB 1                 OK
Fan Tray 2             OK                     Spinning at 64% fan tray speed
Fan Tray 3             OK                     Spinning at 64% fan tray speed
```

show chassis zones (MX2020 Router)

```
user@host> show chassis zones
ZONE 0 Status
    Driving FRU                FPC 0
    Temperature                31 degrees C / 87 degrees F
    Condition                  OK
    Num Fans Missing           0
    Num Fans Failed            0
    Fan Duty Cycle             30

ZONE 1 Status
    Driving FRU                FPC 19
    Temperature                32 degrees C / 89 degrees F
    Condition                  OK
    Num Fans Missing           0
    Num Fans Failed            0
    Fan Duty Cycle             30
```

show chassis zones detail (MX2020 Router)

```
user@host> show chassis zones detail
ZONE 0 Status
Item                   Status                 Measurement
CB 0                   OK
CB 1                   OK
FPC 0                  OK
FPC 1                  OK
FPC 2                  OK
FPC 3                  OK
FPC 4                  OK
FPC 5                  OK
FPC 6                  OK
FPC 7                  OK
FPC 8                  OK
FPC 9                  OK
ADC 0                  OK
ADC 1                  OK
ADC 2                  OK
ADC 3                  OK
ADC 4                  OK
ADC 5                  OK
ADC 6                  OK
ADC 7                  OK
ADC 8                  OK
ADC 9                  OK
SFB 0                  OK
SFB 1                  OK
SFB 2                  OK
SFB 3                  OK
SFB 4                  OK
SFB 5                  OK
SFB 6                  OK
SFB 7                  OK
```

```
Fan Tray 0               OK                     Spinning at 38% fan tray speed
Fan Tray 1               OK                     Spinning at 37% fan tray speed

ZONE 1 Status
Item                     Status                 Measurement
CB 0                     OK
CB 1                     OK
Routing Engine 0         OK
Routing Engine 1         OK
FPC 10                   OK
FPC 11                   OK
FPC 12                   OK
FPC 13                   OK
FPC 14                   OK
FPC 15                   OK
FPC 16                   OK
FPC 17                   OK
FPC 18                   OK
FPC 19                   OK
ADC 10                   OK
ADC 11                   OK
ADC 12                   OK
ADC 13                   OK
ADC 14                   OK
ADC 15                   OK
ADC 16                   OK
ADC 17                   OK
ADC 18                   OK
ADC 19                   OK
SFB 0                    OK
SFB 1                    OK
SFB 2                    OK
SFB 3                    OK
SFB 4                    OK
SFB 5                    OK
SFB 6                    OK
SFB 7                    OK
SPMB 0                   OK
SPMB 1                   OK
Fan Tray 2               OK                     Spinning at 38% fan tray speed
Fan Tray 3               OK                     Spinning at 38% fan tray speed
```

show chassis beacon interconnect-device (QFabric System)

```
user@switch> show chassis beacon interconnect-device interconnect1
Chassis                OFF
CB 0                   OFF
CB 1                   OFF
FC 0 FPC 0             OFF
FC 1 FPC 1             OFF
RC 0 FPC 8             OFF
RC 1 FPC 9             OFF
```

show chassis beacon interconnect-device fpc (QFabric System)

```
user@switch> show chassis beacon interconnect-device interconnect1 fpc 0
FPC 0                  ON
```

show chassis beacon node-device (QFabric System)

```
user@switch> show chassis beacon node-device node1
node1               ON
```

show chassis beacon node-device fpc (QFabric System)

```
user@switch> show chassis beacon node-device node1 fpc 0
FPC 0              ON
```


show cli

Syntax show cli

Syntax (QFX Series) show cli
<authorization>
<directory>
<history *count*>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display configured CLI settings.

Options This command has no options.

Required Privilege Level view

List of Sample Output show cli on page 832

Output Fields Table 72 on page 831 lists the output fields for the **show cli** command. Output fields are listed in the approximate order in which they appear.

Table 72: show cli Output Fields

Field Name	Field Description
CLI complete-on-space	Capability to complete a partial command entry when you type a space or a tab: **on** or **off**.
CLI idle-timeout	Maximum time that an individual session can be idle before the user is logged out from the router or switch. When this feature is enabled, the number of minutes is displayed. Otherwise, the state is **disabled**.
CLI restart-on-upgrade	CLI is set to prompt you to restart the router or switch after upgrading the software: **on** or **off**.
CLI screen-length	Number of lines of text that the terminal screen displays.
CLI screen-width	Number of characters in a line on the terminal screen.
CLI terminal	Terminal type.
CLI is operating in	Mode: **enhanced**.
CLI timestamp	Date and time format for the timestamp. If the timestamp is not set, the state is **disabled**.
CLI working directory	Pathname of the working directory.

Sample Output

show cli

```
user@host> show cli
CLI complete-on-space set to on
CLI idle-timeout disabled
CLI restart-on-upgrade set to on
CLI screen-length set to 47
CLI screen-width set to 132
CLI terminal is 'vt100'
CLI is operating in enhanced mode
CLI timestamp disabled
CLI working directory is '/var/home/regress'
```


show cli authorization

Syntax show cli authorization

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the permissions for the current user.

Options This command has no options.

Required Privilege Level view

List of Sample Output show cli authorization on page 835

Output Fields Table 73 on page 833 lists the output fields for the **show cli authorization** command. In the table, all possible permissions are displayed and output fields are listed in alphabetical order.

Table 73: show cli authorization Output Fields

Field Name	Field Description
access	Can view access configuration information.
access-control	Can modify access configuration.
admin	Can view user account information.
admin-control	Can modify user account information.
clear	Can clear learned network information.
configure	Can enter configuration mode.
control	Can modify any configuration.
edit	Can edit configuration files.
field	Reserved for field (debugging) support.
firewall	Can view firewall configuration information.
firewall-control	Can modify firewall configuration information.
floppy	Can read from and write to removable media.
flow-tap	Can view flow-tap configuration information.

Table 73: show cli authorization Output Fields *(continued)*

Field Name	Field Description
flow-tap-control	Can configure flow-tap configuration information.
idp-profiler-operation	Can configure Profiler data.
interface	Can view interface configuration information.
interface-control	Can modify interface configuration information.
maintenance	Can perform system maintenance.
network	Can access the network by entering the **ping**, **ssh**, **telnet**, and **traceroute** commands.
pgcp-session-mirroring	Can view Packet Gateway Control Protocol session mirroring configuration.
pgcp-session-mirroring-control	Can modify Packet Gateway Control Protocol session mirroring configuration all-control.
reset	Can reset or restart interfaces and system processes.
rollback	Can roll back to previous configurations.
routing	Can view routing configuration information.
routing-control	Can modify routing configuration information.
secret	Can view passwords and authentication keys in the configuration.
secret-control	Can modify passwords and authentication keys in the configuration.
security	Can view security configuration information.
security-control	Can modify security configuration information.
shell	Can start a local shell.
snmp	Can view SNMP configuration information.
snmp-control	Can modify SNMP configuration information.
system	Can view system configuration information.
system-control	Can modify system configuration information.
trace	Can view trace file settings information.

Table 73: show cli authorization Output Fields *(continued)*

Field Name	Field Description
trace-control	Can modify trace file settings information.
view	Can view current values and statistics.
view-configuration	Can view all configuration information (not including secrets).

Sample Output

show cli authorization

```
user@host> show cli authorization
Current user: 'remote' login: 'user' class ''
Permissions:
    admin       -- Can view user accounts
    admin-control-- Can modify user accounts
    clear       -- Can clear learned network information
    configure   -- Can enter configuration mode
    control     -- Can modify any configuration
    edit        -- Can edit full files
    field       -- Special for field (debug) support
    floppy      -- Can read and write from the floppy
    interface   -- Can view interface configuration
    interface-control-- Can modify interface configuration
    network     -- Can access the network
    reset       -- Can reset/restart interfaces and daemons
    routing     -- Can view routing configuration
    routing-control-- Can modify routing configuration
    shell       -- Can start a local shell
    snmp        -- Can view SNMP configuration
    snmp-control-- Can modify SNMP configuration
    system      -- Can view system configuration
    system-control-- Can modify system configuration
    trace       -- Can view trace file settings
    trace-control-- Can modify trace file settings
    view        -- Can view current values and statistics
    maintenance -- Can become the super-user
    firewall    -- Can view firewall configuration
    firewall-control-- Can modify firewall configuration
    secret      -- Can view secret configuration
    secret-control-- Can modify secret configuration
    rollback    -- Can rollback to previous configurations
    security    -- Can view security configuration
    security-control-- Can modify security configuration
    access      -- Can view access configuration
    access-control-- Can modify access configuration
    view-configuration-- Can view all configuration (not including secrets)
    flow-tap    -- Can view flow-tap configuration
    flow-tap-control-- Can configure flow-tap service
Individual command authorization:
    Allow regular expression: none
    Deny regular expression: none
    Allow configuration regular expression: none
    Deny configuration regular expression: none
```


show cli directory

Syntax show cli directory

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the current working directory.

Options This command has no options.

Required Privilege Level view

List of Sample Output show cli directory on page 837

Output Fields Table 74 on page 837 lists the output fields for the **show cli directory** command. Output fields are listed in the approximate order in which they appear.

Table 74: show cli directory Output Fields

Field Name	Field Description
Current directory	Pathname of the current working directory.

Sample Output

show cli directory

```
user@host> show cli directory
Current directory: /var/home/regress
```


show cli history

Syntax

show cli history
<*count*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display a list of previous CLI commands.

Options

none—Display all previous CLI commands.

count—(Optional) Maximum number of commands to display.

Required Privilege Level

view

List of Sample Output

show cli history on page 838

Output Fields

Table 75 on page 838 lists the output fields for the **show cli history** command. Output fields are listed in the approximate order in which they appear.

Table 75: show cli history Output Fields

Field Name	Field Description
timestamp	Time at which the command was entered.
command-syntax	Command that was entered.

Sample Output

show cli history

```
user@host> show cli history
  11:14:14 -- show arp
  11:22:10 -- show cli authorization
  11:27:12 -- show cli history
```

show host

Syntax show host *hostname*

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display Domain Name System (DNS) hostname information.

Options ***hostname***—Hostname or address.

Additional Information The **show host** command displays the raw data received from the DNS server.

Required Privilege Level view

List of Sample Output show host on page 839

Sample Output

show host

```
user@host> show host snark
snark.boojum.net has address 192.168.1.254
```

```
user@host> show host 192.168.1.254
Name: snark.boojum.net
Address: 192.168.1.254
Aliases:
```

show interfaces diagnostics optics

Syntax show interfaces diagnostics optics *interface-name*

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display diagnostics data and alarms for Gigabit Ethernet, 10-Gibabit Ethernet, and QSFP+ optical transceivers installed in a QFX Series product. The information provided by this command is known as digital optical monitoring (DOM) information.

Thresholds that trigger a high alarm, low alarm, high warning, or low warning are set by the transponder vendors. Generally, a high alarm or low alarm indicates that the optics module is not operating properly. This information can be used to diagnose why a transceiver is not working.

Options *interface-name*—Name of the interface associated with the port in which the transceiver is installed.

Required Privilege Level view

Related Documentation

- Monitoring Interface Status and Traffic on page 309
- *Installing a Transceiver in a QFX Series Device*
- *Removing a Transceiver from a QFX Series Device*
- *Junos OS Network Interfaces Library for Routing Devices*

List of Sample Output
show interfaces diagnostics optics xe-0/0/1 (SFP+ Transceiver) on page 844
show interfaces diagnostics optics node1:xe-0/0/1 (SFP+ Transceiver) on page 845

Output Fields lists the output fields for the **show interfaces diagnostics optics** command. Output fields are listed in the approximate order in which they appear.

Table 76: show interfaces diagnostics optics Output Fields

Field Name	Field Description
Physical interface	Displays the name of the physical interface.
Laser bias current	Displays the magnitude of the laser bias power setting current, in milliamperes. The laser bias provides direct modulation of laser diodes and modulates currents.
Laser output power	Displays the laser output power, in milliwatts (mW) and decibels referred to 1.0 mW (dBm).
Module temperature	Displays the temperature, in Celsius and Fahrenheit.
Module voltage (Not available for XFP transceivers)	Displays the voltage, in volts.

Table 76: show interfaces diagnostics optics Output Fields *(continued)*

Field Name	Field Description
Laser rx power (Not available for SFP and SFP+ transceivers)	Displays the laser received optical power, in milliwatts (mW) and decibels referred to 1.0 mW (dBm).
Receiver signal average optical power (Not available for XFP transceivers)	Displays the receiver signal average optical power, in milliwatts (mW) and decibels referred to 1.0 mW (dBm).
Laser bias current high alarm	Displays whether the laser bias power setting high alarm is **On** or **Off**.
Laser bias current low alarm	Displays whether the laser bias power setting low alarm is **On** or **Off**.
Laser bias current high warning	Displays whether the laser bias power setting high warning is **On** or **Off**.
Laser bias current low warning	Displays whether the laser bias power setting low warning is **On** or **Off**.
Laser output power high alarm	Displays whether the laser output power high alarm is **On** or **Off**.
Laser output power low alarm	Displays whether the laser output power low alarm is **On** or **Off**.
Laser output power high warning	Displays whether the laser output power high warning is **On** or **Off**.
Laser output power low warning	Displays whether the laser output power low warning is **On** or **Off**.
Module temperature high alarm	Displays whether the module temperature high alarm is **On** or **Off**.
Module temperature low alarm	Displays whether the module temperature low alarm is **On** or **Off**.
Module temperature high warning	Displays whether the module temperature high warning is **On** or **Off**.
Module temperature low warning	Displays whether the module temperature low warning is **On** or **Off**.
Module voltage high alarm (Not available for XFP transceivers)	Displays whether the module voltage high alarm is **On** or **Off**.
Module voltage low alarm (Not available for XFP transceivers)	Displays whether the module voltage low alarm is **On** or **Off**.
Module voltage high warning (Not available for XFP transceivers)	Displays whether the module voltage high warning is **On** or **Off**.
Module voltage low warning (Not available for XFP transceivers)	Displays whether the module voltage low warning is **On** or **Off**.
Laser rx power high alarm	Displays whether the receive laser power high alarm is **On** or **Off**.

Table 76: show interfaces diagnostics optics Output Fields *(continued)*

Field Name	Field Description
Laser rx power low alarm	Displays whether the receive laser power low alarm is **On** or **Off**.
Laser rx power high warning	Displays whether the receive laser power high warning is **On** or **Off**.
Laser rx power low warning	Displays whether the receive laser power low warning is **On** or **Off**.
Laser bias current high alarm threshold	Displays the vendor-specified threshold for the laser bias current high alarm.
Module not ready alarm (Not available for SFP and SFP+ transceivers)	Displays whether the module not ready alarm is **On** or **Off**. When the output is **On**, the module has an operational fault.
Module power down alarm (Not available for SFP and SFP+ transceivers)	Displays whether the module power down alarm is **On** or **Off**. When the output is **On**, the module is in a limited power mode, low for normal operation.
Tx data not ready alarm (Not available for SFP and SFP+ transceivers)	Any condition leading to invalid data on the transmit path. Displays whether the Tx data not ready alarm is **On** or **Off**.
Tx not ready alarm (Not available for SFP and SFP+ transceivers)	Any condition leading to invalid data on the transmit path. Displays whether the Tx not ready alarm is **On** or **Off**.
Tx laser fault alarm (Not available for SFP and SFP+ transceivers)	Laser fault condition. Displays whether the Tx laser fault alarm is **On** or **Off**.
Tx CDR loss of lock alarm (Not available for SFP and SFP+ transceivers)	Transmit clock and data recovery (CDR) loss of lock. Loss of lock on the transmit side of the CDR. Displays whether the Tx CDR loss of lock alarm is **On** or **Off**.
Rx not ready alarm (Not available for SFP and SFP+ transceivers)	Any condition leading to invalid data on the receive path. Displays whether the Rx not ready alarm is **On** or **Off**.
Rx loss of signal alarm (Not available for SFP and SFP+ transceivers)	Receive loss of signal alarm. When **on**, indicates insufficient optical input power to the module. Displays whether the Rx loss of signal alarm is **On** or **Off**.
Rx CDR loss of lock alarm (Not available for SFP and SFP+ transceivers)	Receive CDR loss of lock. Loss of lock on the receive side of the CDR. Displays whether the Rx CDR loss of lock alarm is **On** or **Off**.
Laser bias current low alarm threshold	Displays the vendor-specified threshold for the laser bias current low alarm.
Laser bias current high warning threshold	Displays the vendor-specified threshold for the laser bias current high warning.

Table 76: show interfaces diagnostics optics Output Fields *(continued)*

Field Name	Field Description
Laser bias current low warning threshold	Displays the vendor-specified threshold for the laser bias current low warning.
Laser output power high alarm threshold	Displays the vendor-specified threshold for the laser output power high alarm.
Laser output power low alarm threshold	Displays the vendor-specified threshold for the laser output power low alarm.
Laser output power high warning threshold	Displays the vendor-specified threshold for the laser output power high warning.
Laser output power low warning threshold	Displays the vendor-specified threshold for the laser output power low warning.
Module temperature high alarm threshold	Displays the vendor-specified threshold for the module temperature high alarm.
Module temperature low alarm threshold	Displays the vendor-specified threshold for the module temperature low alarm.
Module temperature high warning threshold	Displays the vendor-specified threshold for the module temperature high warning.
Module temperature low warning threshold	Displays the vendor-specified threshold for the module temperature low warning.
Module voltage high alarm threshold (Not available for XFP transceivers)	Displays the vendor-specified threshold for the module voltage high alarm.
Module voltage low alarm threshold (Not available for XFP transceivers)	Displays the vendor-specified threshold for the module voltage low alarm.
Module voltage high warning threshold (Not available for XFP transceivers)	Displays the vendor-specified threshold for the module voltage high warning.
Module voltage low warning threshold (Not available for XFP transceivers)	Displays the vendor-specified threshold for the module voltage low warning.
Laser rx power high alarm threshold	Displays the vendor-specified threshold for the laser Rx power high alarm.
Laser rx power low alarm threshold	Displays the vendor-specified threshold for the laser Rx power low alarm.
Laser rx power high warning threshold	Displays the vendor-specified threshold for the laser Rx power high warning.

Table 76: show interfaces diagnostics optics Output Fields *(continued)*

Field Name	Field Description
Laser rx power low warning threshold	Displays the vendor-specified threshold for the laser Rx power low warning.

Sample Output

show interfaces diagnostics optics xe-0/0/1 (SFP+ Transceiver)

```
user@host> show interfaces diagnostics optics xe-0/0/1
Physical interface: xe-0/0/1
    Laser bias current                        :  4.968 mA
    Laser output power                        :  0.4940 mW / -3.06 dBm
    Module temperature                        :  27 degrees C / 81 degrees F
    Module voltage                            :  3.2310 V
    Receiver signal average optical power     :  0.0000
    Laser bias current high alarm             :  Off
    Laser bias current low alarm              :  Off
    Laser bias current high warning           :  Off
    Laser bias current low warning            :  Off
    Laser output power high alarm             :  Off
    Laser output power low alarm              :  Off
    Laser output power high warning           :  Off
    Laser output power low warning            :  Off
    Module temperature high alarm             :  Off
    Module temperature low alarm              :  Off
    Module temperature high warning           :  Off
    Module temperature low warning            :  Off
    Module voltage high alarm                 :  Off
    Module voltage low alarm                  :  Off
    Module voltage high warning               :  Off
    Module voltage low warning                :  Off
    Laser rx power high alarm                 :  Off
    Laser rx power low alarm                  :  On
    Laser rx power high warning               :  Off
    Laser rx power low warning                :  On
    Laser bias current high alarm threshold   :  10.500 mA
    Laser bias current low alarm threshold    :  2.000 mA
    Laser bias current high warning threshold :  9.000 mA
    Laser bias current low warning threshold  :  2.500 mA
    Laser output power high alarm threshold   :  1.4120 mW / 1.50 dBm
    Laser output power low alarm threshold    :  0.0740 mW / -11.31 dBm
    Laser output power high warning threshold :  0.7070 mW / -1.51 dBm
    Laser output power low warning threshold  :  0.1860 mW / -7.30 dBm
    Module temperature high alarm threshold   :  75 degrees C / 167 degrees F
    Module temperature low alarm threshold    :  -5 degrees C / 23 degrees F
    Module temperature high warning threshold :  70 degrees C / 158 degrees F
    Module temperature low warning threshold  :  0 degrees C / 32 degrees F
    Module voltage high alarm threshold       :  3.630 V
    Module voltage low alarm threshold        :  2.970 V
    Module voltage high warning threshold     :  3.465 V
    Module voltage low warning threshold      :  3.135 V
    Laser rx power high alarm threshold       :  1.5849 mW / 2.00 dBm
    Laser rx power low alarm threshold        :  0.0407 mW / -13.90 dBm
    Laser rx power high warning threshold     :  0.7943 mW / -1.00 dBm
    Laser rx power low warning threshold      :  0.1023 mW / -9.90 dBm
```


show interfaces diagnostics optics node1:xe-0/0/1 (SFP+ Transceiver)

```
user@host> show interfaces diagnostics optics node1:xe-0/0/1
Physical interface: node1:xe-0/0/1
    Laser bias current                        :  4.968 mA
    Laser output power                        :  0.4940 mW / -3.06 dBm
    Module temperature                        :  27 degrees C / 81 degrees F
    Module voltage                            :  3.2310 V
    Receiver signal average optical power     :  0.0000
    Laser bias current high alarm             :  Off
    Laser bias current low alarm              :  Off
    Laser bias current high warning           :  Off
    Laser bias current low warning            :  Off
    Laser output power high alarm             :  Off
    Laser output power low alarm              :  Off
    Laser output power high warning           :  Off
    Laser output power low warning            :  Off
    Module temperature high alarm             :  Off
    Module temperature low alarm              :  Off
    Module temperature high warning           :  Off
    Module temperature low warning            :  Off
    Module voltage high alarm                 :  Off
    Module voltage low alarm                  :  Off
    Module voltage high warning               :  Off
    Module voltage low warning                :  Off
    Laser rx power high alarm                 :  Off
    Laser rx power low alarm                  :  On
    Laser rx power high warning               :  Off
    Laser rx power low warning                :  On
    Laser bias current high alarm threshold   :  10.500 mA
    Laser bias current low alarm threshold    :  2.000 mA
    Laser bias current high warning threshold :  9.000 mA
    Laser bias current low warning threshold  :  2.500 mA
    Laser output power high alarm threshold   :  1.4120 mW / 1.50 dBm
    Laser output power low alarm threshold    :  0.0740 mW / -11.31 dBm
    Laser output power high warning threshold :  0.7070 mW / -1.51 dBm
    Laser output power low warning threshold  :  0.1860 mW / -7.30 dBm
    Module temperature high alarm threshold   :  75 degrees C / 167 degrees F
    Module temperature low alarm threshold    :  -5 degrees C / 23 degrees F
    Module temperature high warning threshold :  70 degrees C / 158 degrees F
    Module temperature low warning threshold  :  0 degrees C / 32 degrees F
    Module voltage high alarm threshold       :  3.630 V
    Module voltage low alarm threshold        :  2.970 V
    Module voltage high warning threshold     :  3.465 V
    Module voltage low warning threshold      :  3.135 V
    Laser rx power high alarm threshold       :  1.5849 mW / 2.00 dBm
    Laser rx power low alarm threshold        :  0.0407 mW / -13.90 dBm
    Laser rx power high warning threshold     :  0.7943 mW / -1.00 dBm
    Laser rx power low warning threshold      :  0.1023 mW / -9.90 dBm
```


show log

Syntax

show log
<*filename* | user <*username*>>

Syntax (QFabric System)

show log *filename*
<*device-type (device-id* | *device-alias*)>

Syntax (TX Matrix Routers)

show log
<all-lcc | lcc *number* | scc>
<*filename* | user <*username*>>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Option *device-type (device-id* | *device-alias*) is introduced in Junos OS Release 13.1 for the QFX Series.

Description

List log files, display log file contents, or display information about users who have logged in to the router or switch.

Options

none—List all log files.

<all-lcc | lcc *number* | scc>—(TX Matrix routers only) (Optional) Display logging information about all T640 routers (or line-card chassis) or a specific T640 router (replace ***number*** with a value from 0 through 3) connected to a TX Matrix router. Or, display logging information about the TX Matrix router (or switch-card chassis).

device-type—(QFabric system only) (Optional) Display log messages for only one of the following device types:

- **director-device**—Display logs for Director devices.
- **infrastructure-device**—Display logs for the logical components of the QFabric system infrastructure, including the diagnostic Routing Engine, fabric control Routing Engine, fabric manager Routing Engine, and the default network Node group and its backup (NW-NG-0 and NW-NG-0-backup).
- **interconnect-device**—Display logs for Interconnect devices.
- **node-device**—Display logs for Node devices.

NOTE: If you specify the **device-type** optional parameter, you must also specify either the **device-id** or **device-alias** optional parameter.

(*device-id* | *device-alias*)—If a device type is specified, display logs for a device of that type. Specify either the device ID or the device alias (if configured).

filename—(Optional) Display the log messages in the specified log file. For the routing matrix, the filename must include the chassis information.

NOTE: The *filename* parameter is mandatory for the QFabric system. If you did not configure a syslog filename, specify the default filename of messages.

user <*username*>—(Optional) Display logging information about users who have recently logged in to the router or switch. If you include ***username***, display logging information about the specified user.

Required Privilege Level trace

List of Sample Output

show log on page 847
show log filename on page 847
show log filename (QFabric System) on page 848
show log user on page 848

Sample Output

show log

```
user@host> show log
total 57518
-rw-r--r--  1 root  bin      211663 Oct  1 19:44 dcd
-rw-r--r--  1 root  bin      999947 Oct  1 19:41 dcd.0
-rw-r--r--  1 root  bin      999994 Oct  1 17:48 dcd.1
-rw-r--r--  1 root  bin      238815 Oct  1 19:44 rpd
-rw-r--r--  1 root  bin     1049098 Oct  1 18:00 rpd.0
-rw-r--r--  1 root  bin     1061095 Oct  1 12:13 rpd.1
-rw-r--r--  1 root  bin     1052026 Oct  1 06:08 rpd.2
-rw-r--r--  1 root  bin     1056309 Sep 30 18:21 rpd.3
-rw-r--r--  1 root  bin     1056371 Sep 30 14:36 rpd.4
-rw-r--r--  1 root  bin     1056301 Sep 30 10:50 rpd.5
-rw-r--r--  1 root  bin     1056350 Sep 30 07:04 rpd.6
-rw-r--r--  1 root  bin     1048876 Sep 30 03:21 rpd.7
-rw-rw-r--  1 root  bin       19656 Oct  1 19:37 wtmp
```

show log filename

```
user@host> show log rpd
Oct  1 18:00:18 trace_on: Tracing to ?/var/log/rpd? started
Oct  1 18:00:18 EVENT <MTU> ds-5/2/0.0 index 24 <Broadcast PointToPoint Multicast
Oct  1 18:00:18
Oct  1 18:00:19 KRT recv len 56 V9 seq 148 op add Type route/if af 2 addr
13.13.13.21 nhop type local nhop 13.13.13.21
Oct  1 18:00:19 KRT recv len 56 V9 seq 149 op add Type route/if af 2 addr
13.13.13.22 nhop type unicast nhop 13.13.13.22
Oct  1 18:00:19 KRT recv len 48 V9 seq 150 op add Type ifaddr index 24 devindex
43
Oct  1 18:00:19 KRT recv len 144 V9 seq 151 op chnge Type ifdev devindex 44
Oct  1 18:00:19 KRT recv len 144 V9 seq 152 op chnge Type ifdev devindex 45
Oct  1 18:00:19 KRT recv len 144 V9 seq 153 op chnge Type ifdev devindex 46
```

```
Oct  1 18:00:19 KRT recv len 1272 V9 seq 154 op chnge Type ifdev devindex 47
...
```

show log filename (QFabric System)

```
user@qfabric> show log messages
Mar 28 18:00:06 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:06 ED1486
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 1, jnxFruL3Index 0,
jnxFruName PIC: 48x 10G-SFP+ @ 0/0/*, jnxFruType 11, jnxFruSlot 0,
jnxFruOfflineReason 2, jnxFruLastPowerOff 0, jnxFruLastPowerOn 2159)
Mar 28 18:00:07 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:07 ED1486
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 2, jnxFruL3Index 0,
jnxFruName PIC:  @ 0/1/*, jnxFruType 11, jnxFruSlot 0, jnxFruOfflineReason 2,
jnxFruLastPowerOff 0, jnxFruLastPowerOn 2191)
Mar 28 18:00:07 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:07 ED1492
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 1, jnxFruL3Index 0,
jnxFruName PIC: 48x 10G-SFP+ @ 0/0/*, jnxFruType 11, jnxFruSlot 0,
jnxFruOfflineReason 2, jnxFruLastPowerOff 0, jnxFruLastPowerOn 242726)
Mar 28 18:00:07 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:07 ED1492
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 2, jnxFruL3Index 0,
jnxFruName PIC:  @ 0/1/*, jnxFruType 11, jnxFruSlot 0, jnxFruOfflineReason 2,
jnxFruLastPowerOff 0, jnxFruLastPowerOn 242757)
Mar 28 18:00:16 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:16 ED1486
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:00:27 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:27 ED1486
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:00:50 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:50
_DCF_default___NW-INE-0_RE0_ file: UI_COMMIT: User 'root' requested 'commit'
operation (comment: none)
Mar 28 18:00:50 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:50
_DCF_default___NW-INE-0_RE0_ file: UI_COMMIT: User 'root' requested 'commit'
operation (comment: none)
Mar 28 18:00:55 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:55 ED1492
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:01:10 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:01:10 ED1492
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:02:37 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:02:37 ED1491
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 1, jnxFruL3Index 0,
jnxFruName PIC: 48x 10G-SFP+ @ 0/0/*, jnxFruType 11, jnxFruSlot 0,
jnxFruOfflineReason 2, jnxFruLastPowerOff 0, jnxFruLastPowerOn 33809)
```

show log user

```
user@host> show log user
darius   mg2546                   Thu Oct  1 19:37   still logged in
darius   mg2529                   Thu Oct  1 19:08 - 19:36  (00:28)
darius   mg2518                   Thu Oct  1 18:53 - 18:58  (00:04)
root     mg1575                   Wed Sep 30 18:39 - 18:41  (00:02)
root     ttyp2    jun.site.per   Wed Sep 30 18:39 - 18:41  (00:02)
alex     ttyp1    192.168.1.2     Wed Sep 30 01:03 - 01:22  (00:19)
```


show ntp associations

Syntax

show ntp associations
<no-resolve>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Network Time Protocol (NTP) peers and their state.

Options

none—Display NTP peers and their state.

no-resolve—(Optional) Suppress symbolic addressing.

Required Privilege Level

view

Related Documentation

- show ntp status on page 851

List of Sample Output

show ntp associations on page 850

Output Fields

Table 77 on page 849 describes the output fields for the **show ntp associations** command. Output fields are listed in the approximate order in which they appear.

Table 77: show ntp associations Output Fields

Field Name	Field Description
remote	Address or name of the remote NTP peer.
refid	Reference identifier of the remote peer. If the reference identifier is not known, this field shows a value of **0.0.0.0**.
st	Stratum of the remote peer.
t	Type of peer: **b** (broadcast), **l** (local), **m** (multicast), or **u** (unicast).
when	When the last packet from the peer was received.
poll	Polling interval, in seconds.
reach	Reachability register, in octal.
delay	Current estimated delay of the peer, in milliseconds.
offset	Current estimated offset of the peer, in milliseconds.
disp	Current estimated dispersion of the peer, in milliseconds.

Table 77: show ntp associations Output Fields *(continued)*

Field Name	Field Description
peer-name	Peer name and status of the peer in the clock selection process: • space—Discarded because of a high stratum value or failed sanity checks. • **x**—Designated "falseticker" by the intersection algorithm. • **.**—Culled from the end of the candidate list. • **–** —Discarded by the clustering algorithm. • **+**—Included in the final selection set. • **#**—Selected for synchronization, but the distance exceeds the maximum. • *****—Selected for synchronization. • **o**—Selected for synchronization, but the packets-per-second (pps) signal is in use.

Sample Output

show ntp associations

```
user@host> show ntp associations
     remote           refid      st t when poll reach   delay   offset    disp
==============================================================================
*wolfe-gw.junipe tick.ucla.edu    2 u   43   64  377     1.86    0.319    0.08
```


show ntp status

Syntax

show ntp status
<no-resolve>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the values of internal variables returned by Network Time Protocol (NTP) peers.

Options

none—Display the values of internal variables returned by NTP peers.

no-resolve—(Optional) Suppress symbolic addressing.

Required Privilege Level

view

Related Documentation

- show ntp associations on page 849

List of Sample Output

show ntp status on page 852

Output Fields

Table 78 on page 851 describes the output fields for the **show ntp status** command. Output fields are listed in the approximate order in which they appear.

Table 78: show ntp status Output Fields

Field Name	Field Description
status	System status word, a code representing the status items listed.
leap_none	Indicates a normal synchronized state with no leap seconds imminent. Other options could be **leap_add_sec**, **leap_del_sec**, or **leap_alarm**, indicating a leap second will be added, deleted, or a leap second requirement is upcoming.
sync_ntp	Indicates the current synchronization source, in this case, an NTP server. Other options include **sync_alarm** and **sync_unspec**, both indicating that the router has not been synched.
x events	Indicates the number of events that have occurred since that last code change. An event is often the receipt of an NTP polling message.
event_peer/strat_chg	Describes the most recent event, in this case, the stratum of the peer server changed.
version	A detailed description of the version of NTP being used.
processor	Indicates the current hardware platform and version of the processor.
system	Detailed description of the name and version of the operating system in use.
leap	The number of leap seconds in use.

Table 78: show ntp status Output Fields *(continued)*

Field Name	Field Description
stratum	The stratum of the peer server. Anything greater than 1 is a secondary reference source, and the number roughly represents the number of hops away from the stratum 1 server.. Stratum 1 is a primary reference, such as an atomic clock.
precision	The precision of the peer clock, how precisely the frequency and time can be maintained with this particular timekeeping system.
rootdelay	The total roundtrip delay to the primary reference source, in seconds.
rootdispersion	The maximum error relative to the primary reference source, in seconds.
peer	An identification number of the peer in use.
refid	Reference identifier of the remote peer. If the reference identifier is not known, this field shows a value of **0.0.0.0**.
reftime	The local time, in timestamp format, when the local clock was last updated. If the local clock has never been synchronized, the value is zero.
poll	The NTP broadcast message polling interval, in seconds.
clock	The current time on the local router clock.
state	The current mode of NTP operation, where 1 is symmetric active, 2 is symmetric passive, 3 is client, 4 is server, and 5 is broadcast.
offset	Current estimated offset of the peer, in milliseconds. Indicates the time difference between the reference clock and the local clock.
frequency	The frequency of the clock.
jitter	Indicates the magnitude of jitter, in milliseconds, between several time queries.
stability	A measure of how well this clock can maintain a constant frequency.

Sample Output

show ntp status

```
user@host> show ntp status
assID=0 status=0544 leap_none, sync_local_proto, 4 events, event_peer/strat_chg,
version="ntpd 4.2.2p1@1.1570-o Tue May 19 13:57:55 UTC 2009 (1)",
processor="x86_64", system="Linux/2.6.18-164.el5", leap=00, stratum=4,
precision=-10, rootdelay=0.000, rootdispersion=11.974, peer=59475,
refid=LOCAL(0),
reftime=d495c32c.0e71eaf2  Mon, Jan  7 2013 13:57:00.056, poll=10,
clock=d495c32c.cebd43bd  Mon, Jan  7 2013 13:57:00.807, state=4,
offset=0.000, frequency=0.000, jitter=0.977, noise=0.977,
stability=0.000, tai=0
```


show subscribers

Syntax

show subscribers
<detail | extensive | terse>
<aci-interface-set-name *aci-interface-set-name*>
<address *address*>
<agent-circuit-identifier *agent-circuit-identifier-substring*>
<client-type *client-type*>
<count>
<interface *interface*>
<logical-system *logical-system*>
<mac-address *mac-address*>
<physical-interface *physical-interface-name*>
<profile-name *profile-name*>
<routing-instance *routing-instance*>
<stacked-vlan-id *stacked-vlan-id*>
<subscriber-state *subscriber-state*>
<user-name *user-name*>
<vci *vci-identifier*>
<vpi *vpi-identifier*>
<vlan-id *vlan-id*>

Release Information

Command introduced in Junos OS Release 9.3.
Command introduced in Junos OS Release 9.3 for EX Series switches.
client-type, **mac-address**, **subscriber-state**, and **extensive** options introduced in Junos OS Release 10.2.
count option usage with other options introduced in Junos OS Release 10.2.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Options **aci-interface-set-name** and **agent-circuit-identifier** introduced in Junos OS Release 12.2.
The **physical-interface** and **user-name** options introduced in Junos OS Release 12.3.
Options **vci** and **vpi** introduced in Junos OS Release 12.3R3 and supported in later 12.3R*x* releases.
Options **vci** and **vpi** supported in Junos OS Release 13.2 and later releases. (Not supported in Junos OS Release 13.1.)

Description

Display information for active subscribers.

Options

detail | extensive | terse—(Optional) Display the specified level of output.

aci-interface-set-name—(Optional) Display all dynamic subscriber sessions that use the specified agent circuit identifier (ACI) interface set. Use the ACI interface set name generated by the router, such as aci-1003-ge-1/0/0.4001, and not the actual ACI value found in the DHCP or PPPoE control packets.

address—(Optional) Display subscribers whose IP address matches the specified address. You must specify the IPv4 or IPv6 address prefix without a netmask (for example, 192.168.17.1). If you specify the IP address as a prefix with a netmask (for example, 192.168.17.1/32), the router displays a message that the IP address is invalid, and rejects the command.

agent-circuit-identifier-substring—(Optional) Display all dynamic subscriber sessions whose ACI value matches the specified substring.

client-type—(Optional) Display subscribers whose client type matches the specified client type (DHCP, L2TP, PPP, PPPOE, VLAN, or static).

count—(Optional) Display the count of total subscribers and active subscribers for any specified option. You can use the **count** option alone or with the **address**, **client-type**, **interface**, **logical-system**, **mac-address**, **profile-name**, **routing-instance**, **stacked-vlan-id**, **subscriber-state**, or **vlan-id** options.

id—(Optional) Display a specific subscriber session whose session id matches the specified subscriber ID. You can display subscriber IDs by using the **show subscribers extensive** or the **show subscribers interface extensive** commands.

interface—(Optional) Display subscribers whose interface matches the specified interface.

logical-system—(Optional) Display subscribers whose logical system matches the specified logical system.

mac-address—(Optional) Display subscribers whose MAC address matches the specified MAC address.

physical-interface-name—(M120, M320, and MX Series routers only) (Optional) Display subscribers whose physical interface matches the specified physical interface.

profile-name—(Optional) Display subscribers whose dynamic profile matches the specified profile name.

routing-instance—(Optional) Display subscribers whose routing instance matches the specified routing instance.

subscriber-state—(Optional) Display subscribers whose subscriber state matches the specified subscriber state (ACTIVE, CONFIGURED, INIT, TERMINATED, or TERMINATING).

user-name—(M120, M320, and MX Series routers only) (Optional) Display subscribers whose username matches the specified subscriber name.

vci-identifier—(MX Series routers with MPCs and ATM MICs with SFP only) (Optional) Display active ATM subscribers whose ATM virtual circuit identifier (VCI) matches the specified VCI identifier. The range of values is **0** through **255**.

vpi-identifier—(MX Series routers with MPCs and ATM MICs with SFP only) (Optional) Display active ATM subscribers whose ATM virtual path identifier (VPI) matches the specified VPI identifier. The range of values is **0** through **65535**.

vlan-id—(Optional) Display subscribers whose VLAN ID matches the specified VLAN ID.

stacked-vlan-id—(Optional) Display subscribers whose stacked VLAN ID matches the specified stacked VLAN ID.

NOTE: Due to display limitations, logical system and routing instance output values are truncated when necessary.

Required Privilege Level

view

Related Documentation

- *show subscribers summary*
- *Verifying and Managing Agent Circuit Identifier-Based Dynamic VLAN Configuration*

List of Sample Output

show subscribers vlan-id detail on page 871
show subscribers vpi vci extensive (PPPoE-over-ATM Subscriber Session) on page 871

Output Fields Table 79 on page 857 lists the output fields for the **show subscribers** command. Output fields are listed in the approximate order in which they appear.

Table 79: show subscribers Output Fields

Field Name	Field Description
Interface	Interface associated with the subscriber. The router or switch displays subscribers whose interface matches or begins with the specified interface. The * character indicates a continuation of addresses for the same session.
IP Address/VLAN ID	Subscriber IP address or VLAN ID associated with the subscriber in the form *tpid.vlan-id* No IP address or VLAN ID is assigned to an L2TP tunnel-switched session. For these subscriber sessions the value is **Tunnel-switched**.
User Name	Name of subscriber.
LS:RI	Logical system and routing instance associated with the subscriber.
Type	Subscriber client type (DHCP, L2TP, PPP, PPPoE, STATIC-INTERFACE, VLAN).
IP Address	Subscriber IPv4 address.
IP Netmask	Subscriber IP netmask.
Primary DNS Address	IP address of primary DNS server.
Secondary DNS Address	IP address of secondary DNS server.
Primary WINS Address	IP address of primary WINS server.
Secondary WINS Address	IP address of secondary WINS server.
IPv6 Address	Subscriber IPv6 address, or multiple addresses.
IPv6 Prefix	Subscriber IPv6 prefix. If you are using DHCPv6 prefix delegation, this is the delegated prefix.
IPv6 User Prefix	IPv6 prefix obtained through ND/RA.
IPv6 Address Pool	Subscriber IPv6 address pool. The IPv6 address pool is used to allocate IPv6 prefixes to the DHCPv6 clients.
IPv6 Network Prefix Length	Length of the network portion of the IPv6 address.
IPv6 Prefix Length	Length of the subscriber IPv6 prefix.

Table 79: show subscribers Output Fields *(continued)*

Field Name	Field Description
Logical System	Logical system associated with the subscriber.
Routing Instance	Routing instance associated with the subscriber.
Interface Type	Whether the subscriber interface is **Static** or **Dynamic**.
Interface Set	Internally generated name of the dynamic ACI interface set used by the subscriber session.
Interface Set Type	Interface type of the ACI interface set: **Dynamic**. This is the only ACI interface set type currently supported.
Interface Set Session ID	Identifier of the dynamic ACI interface set entry in the session database.
Underlying Interface	Name of the underlying interface for the subscriber session.
Dynamic Profile Name	Dynamic profile used for the subscriber.
Dynamic Profile Version	Version number of the dynamic profile used for the subscriber.
MAC Address	MAC address associated with the subscriber.
State	Current state of the subscriber session (**Init**, **Configured**, **Active**, **Terminating**, **Tunneled**).
L2TP State	Current state of the L2TP session, **Tunneled** or **Tunnel-switched**. When the value is **Tunnel-switched**, two entries are displayed for the subscriber; the first entry is at the LNS interface on the LTS and the second entry is at the LAC interface on the LTS.
Tunnel switch Profile Name	Name of the L2TP tunnel switch profile that initiates tunnel switching.
Local IP Address	IP address of the local gateway (LAC).
Remote IP Address	IP address of the remote peer (LNS).
VLAN Id	VLAN ID associated with the subscriber in the form *tpid.vlan-id*.
Stacked VLAN Id	Stacked VLAN ID associated with the subscriber in the form *tpid.vlan-id*.
RADIUS Accounting ID	RADIUS accounting ID associated with the subscriber.
Agent Circuit ID	Option 82 agent circuit ID associated with the subscriber. The ID is displayed as an ASCII string unless the value has nonprintable characters, in which case it is displayed in hexadecimal format.
Agent Remote ID	Option 82 agent remote ID associated with the subscriber. The ID is displayed as an ASCII string unless the value has nonprintable characters, in which case it is displayed in hexadecimal format.
DHCP Relay IP Address	IP address used by the DHCP relay agent.

Table 79: show subscribers Output Fields *(continued)*

Field Name	Field Description
ATM VPI	(MX Series routers with MPCs and ATM MICs with SFP only) ATM virtual path identifier (VPI) on the subscriber's physical interface.
ATM VCI	(MX Series routers with MPCs and ATM MICs with SFP only) ATM virtual circuit identifier (VCI) for each VPI configured on the subscriber interface.
Login Time	Date and time at which the subscriber logged in.
Effective shaping-rate	Actual downstream traffic shaping rate for the subscriber, in kilobits per second.
IPv4 rpf-check Fail Filter Name	Name of the filter applied by the dynamic profile to IPv4 packets that fail the RPF check.
IPv6 rpf-check Fail Filter Name	Name of the filter applied by the dynamic profile to IPv6 packets that fail the RPF check.
DHCP Options	**len** = number of hex values in the message. The hex values specify the type, length, value (TLV) for DHCP options, as defined in RFC 2132.
Session ID	ID number for a subscriber service session.
Underlying Session ID	For DHCPv6 subscribers on a PPPoE network, displays the session ID of the underlying PPPoE interface.
Service Sessions	Number of service sessions (that is, a service activated using RADIUS CoA) associated with the subscribers.
Service Session Name	Service session profile name.
Session Timeout (seconds)	Number of seconds of access provided to the subscriber before the session is automatically terminated.
Idle Timeout (seconds)	Number of seconds subscriber can be idle before the session is automatically terminated.
IPv6 Delegated Address Pool	Name of the pool used for DHCPv6 prefix delegation.
IPv6 Delegated Network Prefix Length	Length of the prefix configured for the IPv6 delegated address pool.
IPv6 Interface Address	Address assigned by the Framed-Ipv6-Prefix AAA attribute.
IPv6 Framed Interface Id	Interface ID assigned by the Framed-Interface-Id AAA attribute.
ADF IPv4 Input Filter Name	Name assigned to the Ascend-Data-Filter (ADF) interface IPv4 input filter (client or service session). The filter name is followed by the rules (in hexadecimal format) associated with the ADF filter and the decoded rule in Junos OS filter style.

Table 79: show subscribers Output Fields *(continued)*

Field Name	Field Description
ADF IPv4 Output Filter Name	Name assigned to the Ascend-Data-Filter (ADF) interface IPv4 output filter (client or service session). The filter name is followed by the rules (in hexadecimal format) associated with the ADF filter and the decoded rule in Junos OS filter style.
ADF IPv6 Input Filter Name	Name assigned to the Ascend-Data-Filter (ADF) interface IPv6 input filter (client or service session). The filter name is followed by the rules (in hexadecimal format) associated with the ADF filter and the decoded rule in Junos OS filter style.
ADF IPv6 Output Filter Name	Name assigned to the Ascend-Data-Filter (ADF) interface IPv6 output filter (client or service session). The filter name is followed by the rules (in hexadecimal format) associated with the ADF filter and the decoded rule in Junos OS filter style.
IPv4 Input Filter Name	Name assigned to the IPv4 input filter (client or service session).
IPv4 Output Filter Name	Name assigned to the IPv4 output filter (client or service session).
IPv6 Input Filter Name	Name assigned to the IPv6 input filter (client or service session).
IPv6 Output Filter Name	Name assigned to the IPv6 output filter (client or service session).
IFL Input Filter Name	Name assigned to the logical interface input filter (client or service session).
IFL Output Filter Name	Name assigned to the logical interface output filter (client or service session).

Sample Output

show subscribers (IPv4)

```
user@host> show subscribers
Interface               IP Address/VLAN ID   User Name        LS:RI
ge-1/3/0.1073741824     100                                   default:default
demux0.1073741824       100.0.0.10           WHOLESALER-CLIENT default:default
demux0.1073741825       101.0.0.3            RETAILER1-CLIENT  test1:retailer1
demux0.1073741826       102.0.0.3            RETAILER2-CLIENT  test1:retailer2
```

show subscribers (IPv6)

```
user@host> show subscribers
Interface          IP Address/VLAN ID   User Name          LS:RI
ge-1/0/0.0         2001::c0:0:0:0/74    WHOLESALER-CLIENT  default:default
     *             2002::1/128          subscriber-25      default:default
```

show subscribers (IPv4 and IPv6 Dual Stack)

```
user@host> show subscribers
Interface            IP Address/VLAN ID          User Name
LS:RI
demux0.1073741834    0x8100.1002 0x8100.1
default:default
demux0.1073741835    0x8100.1001 0x8100.1
default:default
pp0.1073741836       61.1.1.1                  dualstackuser1@ISP1.com
```



```
default:ASP-1
*                   2041:1:1::/48
*                   2061:1:1:1::/64
pp0.1073741837      23.1.1.3                  dualstackuser2@ISP1.com
default:ASP-1
*                   2001:1:2:5::/64
```

show subscribers (LNS on MX Series Routers)

```
user@host> show subscribers
Interface          IP Address/VLAN ID   User Name         LS:RI
si-4/0/0.1         192.168.4.1          xyz@example.com   default:default
```

show subscribers (L2TP Switched Tunnels)

```
user@host> show subscribers
Interface           IP Address/VLAN ID    User Name              LS:RI
si-2/1/0.1073741842 Tunnel-switched       ap@lts.com        default:default

si-2/1/0.1073741843 Tunnel-switched       ap@lts.com        default:default
```

show subscribers client-type dhcp detail

```
user@host> show subscribers client-type dhcp detail
Type: DHCP
IP Address: 100.20.9.7
IP Netmask: 255.255.0.0
Logical System: default
Routing Instance: default
Interface: demux0.1073744127
Interface type: Dynamic
Dynamic Profile Name: dhcp-demux-prof
MAC Address: 00:10:95:00:00:98
State: Active
Radius Accounting ID: jnpr :2304
Login Time: 2009-08-25 14:43:52 PDT

Type: DHCP
IP Address: 100.20.10.7
IP Netmask: 255.255.0.0
Logical System: default
Routing Instance: default
Interface: demux0.1073744383
Interface type: Dynamic
Dynamic Profile Name: dhcp-demux-prof
MAC Address: 00:10:94:00:01:f3
State: Active
Radius Accounting ID: jnpr :2560
Login Time: 2009-08-25 14:43:56 PDT
```

show subscribers count

```
user@host> show subscribers count
Total Subscribers: 188, Active Subscribers: 188
```

show subscribers address detail (IPv6)

```
user@host> show subscribers address 100.16.12.137 detail
```



```
Type: PPPoE
User Name: pppoeTerV6User1Svc
IP Address: 100.16.12.137
IP Netmask: 255.0.0.0
IPv6 User Prefix: 1016:0:0:c88::/64
Logical System: default
Routing Instance: default
Interface: pp0.1073745151
Interface type: Dynamic
Underlying Interface: demux0.8201
Dynamic Profile Name: pppoe-client-profile
MAC Address: 00:0d:02:01:00:01
Session Timeout (seconds): 31622400
Idle Timeout (seconds): 86400
State: Active
Radius Accounting ID: jnpr demux0.8201:6544
Session ID: 6544
Agent Circuit ID: ifl3720
Agent Remote ID: ifl3720
Login Time: 2012-05-21 13:37:27 PDT
Service Sessions: 1
```

show subscribers detail (IPv4)

```
user@host> show subscribers detail
Type: DHCP
IP Address: 100.20.9.7
IP Netmask: 255.255.0.0
Primary DNS Address: 192.168.17.1
Secondary DNS Address: 192.168.17.2
Primary WINS Address: 192.168.22.1
Secondary WINS Address: 192.168.22.2
Logical System: default
Routing Instance: default
Interface: demux0.1073744127
Interface type: Dynamic
Dynamic Profile Name: dhcp-demux-prof
MAC Address: 00:10:95:00:00:98
State: Active
Radius Accounting ID: jnpr :2304
Session Timeout (seconds): 3600
Idle Timeout (seconds): 600
Login Time: 2009-08-25 14:43:52 PDT
DHCP Options: len 52
35 01 01 39 02 02 40 3d 07 01 00 10 94 00 00 08 33 04 00 00
00 3c 0c 15 63 6c 69 65 6e 74 5f 50 6f 72 74 20 2f 2f 36 2f
33 2d 37 2d 30 37 05 01 06 0f 21 2c
Service Sessions: 2
```

show subscribers detail (IPv6)

```
user@host> show subscribers detail
Type: DHCP
User Name: pd-user1
IPv6 Prefix: 2002:db2:ffff:1::/64
Logical System: default
Routing Instance: default
Interface: ge-3/1/3.2
Interface type: Static
MAC Address: 00:51:ff:ff:00:03
State: Active
```



```
Radius Accounting ID: 1
Session ID: 1
Login Time: 2011-08-25 12:12:26 PDT
DHCP Options: len 42
00 08 00 02 00 00 00 01 00 0a 00 03 00 01 00 51 ff ff 00 03
00 06 00 02 00 19 00 19 00 0c 00 00 00 00 00 00 00 00 00 00
00 00
```

show subscribers detail (IPv6 Static Demux Interface)

```
user@host> show subscribers detail
Type: STATIC-INTERFACE
User Name: demux0.1@jnpr.net
IPv6 Prefix: 1:2:3:4:5:6:7:aa/128
Logical System: default
Routing Instance: default
Interface: demux0.1
Interface type: Static
Dynamic Profile Name: junos-default-profile
State: Active
Radius Accounting ID: 185
Login Time: 2010-05-18 14:33:56 EDT
```

show subscribers detail (L2TP LNS Subscribers on MX Series Routers)

```
user@host> show subscribers detail
Type: L2TP
User Name: user1@jnpr.net
IP Address: 10.1.32.58
IP Netmask: 255.255.0.0
Logical System: default
Routing Instance: default
Interface: si-5/2/0.1073749824
Interface type: Dynamic
Dynamic Profile Name: dyn-lns-profile2
Dynamic Profile Version: 1
State: Active
Radius Accounting ID: 8001
Session ID: 8001
Login Time: 2011-04-25 20:27:50 IST
```

show subscribers detail (L2TP Switched Tunnels)

```
user@host> show subscribers detail
Type: L2TP
User Name: ap@example.com
Logical System: default
Routing Instance: default
Interface: si-2/1/0.1073741842
Interface type: Dynamic
Dynamic Profile Name: dyn-lts-profile
State: Active
L2TP State: Tunnel-switched
Tunnel switch Profile Name: ce-lts-profile
Local IP Address: 10.50.1.1
Remote IP Address: 192.168.20.3
Radius Accounting ID: 21
Session ID: 21
Login Time: 2013-01-18 03:01:11 PST

Type: L2TP
User Name: ap@example.com
```

```
Logical System: default
Routing Instance: default
Interface: si-2/1/0.1073741843
Interface type: Dynamic
Dynamic Profile Name: dyn-lts-profile
State: Active
L2TP State: Tunnel-switched
Tunnel switch Profile Name: ce-lts-profile
Local IP Address: 10.30.1.1
Remote IP Address: 172.20.1.10
Session ID: 22
Login Time: 2013-01-18 03:01:14 PST
```

show subscribers detail (Tunneled Subscriber)

```
user@host> show subscribers detail
Type: PPPoE
User Name: user1@example.com
Logical System: default
Routing Instance: default
Interface: pp0.1
State: Active, Tunneled
Radius Accounting ID: 512
```

show subscribers detail (IPv4 and IPv6 Dual Stack)

```
user@host> show subscribers detail
Type: VLAN
Logical System: default
Routing Instance: default
Interface: demux0.1073741824
Interface type: Dynamic
Dynamic Profile Name: svlanProfile
State: Active
Session ID: 1
Stacked VLAN Id: 0x8100.1001
VLAN Id: 0x8100.1
Login Time: 2011-11-30 00:18:04 PST

Type: PPPoE
User Name: dualstackuser1@ISP1.com
IP Address: 61.1.1.1
IPv6 Prefix: 2041:1:1::/48
IPv6 User Prefix: 2061:1:1:1::/64
Logical System: default
Routing Instance: ASP-1
Interface: pp0.1073741825
Interface type: Dynamic
Dynamic Profile Name: dualStack-Profile1
MAC Address: 00:00:64:03:01:02
State: Active
Radius Accounting ID: 2
Session ID: 2
Login Time: 2011-11-30 00:18:05 PST

Type: DHCP
IPv6 Prefix: 2041:1:1::/48
Logical System: default
Routing Instance: ASP-1
Interface: pp0.1073741825
Interface type: Static
```



```
MAC Address: 00:00:64:03:01:02
State: Active
Radius Accounting ID: jnpr :3
Session ID: 3
Underlying Session ID: 2
Login Time: 2011-11-30 00:18:35 PST
DHCP Options: len 42
00 08 00 02 0b b8 00 01 00 0a 00 03 00 01 00 00 64 03 01 02
00 06 00 02 00 19 00 19 00 0c 00 00 00 00 00 00 00 00 00 00
00 00
```

show subscribers detail (ACI Interface Set Session)

```
user@host> show subscribers detail
Type: VLAN
Logical System: default
Routing Instance: default
Interface: ge-1/0/0
Interface Set: aci-1001-ge-1/0/0.2800
Interface Set Session ID: 0
Underlying Interface: ge-1/0/0.2800
Dynamic Profile Name: aci-vlan-set-profile-2
Dynamic Profile Version: 1
State: Active
Session ID: 1
Agent Circuit ID: aci-ppp-dhcp-20
Login Time: 2012-05-26 01:54:08 PDT
```

show subscribers detail (PPPoE Subscriber Session with ACI Interface Set)

```
user@host> show subscribers detail
Type: PPPoE
User Name: ppphint2
IP Address: 10.10.1.5
Logical System: default
Routing Instance: default
Interface: pp0.1073741825
Interface type: Dynamic
Interface Set: aci-1001-demux0.1073741824
Interface Set Type: Dynamic
Interface Set Session ID: 2
Underlying Interface: demux0.1073741824
Dynamic Profile Name: aci-vlan-pppoe-profile
Dynamic Profile Version: 1
MAC Address: 00:00:64:39:01:02
State: Active
Radius Accounting ID: 3
Session ID: 3
Agent Circuit ID: aci-ppp-dhcp-dvlan-50
Login Time: 2012-03-07 13:46:53 PST
```

show subscribers extensive

```
user@host> show subscribers extensive
Type: DHCP
User Name: pd-user1
IPv6 Prefix: 2002:db2:ffff:1::/64
Logical System: default
Routing Instance: default
Interface: ge-3/1/3.2
Interface type: Static
```

```
MAC Address: 00:51:ff:ff:00:03
State: Active
Radius Accounting ID: 1
Session ID: 1
Login Time: 2011-08-25 12:12:26 PDT
DHCP Options: len 42
00 08 00 02 00 00 00 01 00 0a 00 03 00 01 00 51 ff ff 00 03
00 06 00 02 00 19 00 19 00 0c 00 00 00 00 00 00 00 00 00 00
00 00
IPv6 Address Pool: pd_pool
IPv6 Network Prefix Length: 48
```

show subscribers extensive (RPF Check Fail Filter)

```
user@host> show subscribers extensive
...
Type: VLAN
  Logical System: default
  Routing Instance: default
  Interface: ae0.1073741824
  Interface type: Dynamic
  Dynamic Profile Name: vlan-prof
  State: Active
  Session ID: 9
  VLAN Id: 100
  Login Time: 2011-08-26 08:17:00 PDT
  IPv4 rpf-check Fail Filter Name: rpf-allow-dhcp
  IPv6 rpf-check Fail Filter Name: rpf-allow-dhcpv6
...
```

show subscribers extensive (L2TP LNS Subscribers on MX Series Routers)

```
user@host> show subscribers extensive
Type: L2TP
User Name: user1@jnpr.net
IP Address: 10.1.32.58
IP Netmask: 255.255.0.0
Logical System: default
Routing Instance: default
Interface: si-5/2/0.1073749824
Interface type: Dynamic
Dynamic Profile Name: dyn-lns-profile2
Dynamic Profile Version: 1
State: Active
Radius Accounting ID: 8001
Session ID: 8001
Login Time: 2011-04-25 20:27:50 IST
IPv4 Input Filter Name: classify-si-5/2/0.1073749824-in
IPv4 Output Filter Name: classify-si-5/2/0.1073749824-out
```

show subscribers extensive (IPv4 and IPv6 Dual Stack)

```
user@host> show subscribers extensive
Type: VLAN
Logical System: default
Routing Instance: default
Interface: demux0.1073741824
Interface type: Dynamic
Dynamic Profile Name: svlanProfile
State: Active
Session ID: 1
Stacked VLAN Id: 0x8100.1001
```



```
VLAN Id: 0x8100.1
Login Time: 2011-11-30 00:18:04 PST

Type: PPPoE
User Name: dualstackuser1@ISP1.com
IP Address: 61.1.1.1
IPv6 Prefix: 2041:1:1::/48
IPv6 User Prefix: 2061:1:1:1::/64
Logical System: default
Routing Instance: ASP-1
Interface: pp0.1073741825
Interface type: Dynamic
Dynamic Profile Name: dualStack-Profile1
MAC Address: 00:00:64:03:01:02
State: Active
Radius Accounting ID: 2
Session ID: 2
Login Time: 2011-11-30 00:18:05 PST
IPv6 Delegated Network Prefix Length: 48
IPv6 Interface Address: 2061:1:1:1::1/64
IPv6 Framed Interface Id: 1:1:2:2
IPv4 Input Filter Name: FILTER-IN-pp0.1073741825-in
IPv4 Output Filter Name: FILTER-OUT-pp0.1073741825-out
IPv6 Input Filter Name: FILTER-IN6-pp0.1073741825-in
IPv6 Output Filter Name: FILTER-OUT6-pp0.1073741825-out

Type: DHCP
IPv6 Prefix: 2041:1:1::/48
Logical System: default
Routing Instance: ASP-1
Interface: pp0.1073741825
Interface type: Static
MAC Address: 00:00:64:03:01:02
State: Active
Radius Accounting ID: jnpr :3
Session ID: 3
Underlying Session ID: 2
Login Time: 2011-11-30 00:18:35 PST
DHCP Options: len 42
00 08 00 02 0b b8 00 01 00 0a 00 03 00 01 00 00 64 03 01 02
00 06 00 02 00 19 00 19 00 0c 00 00 00 00 00 00 00 00 00 00
00 00
IPv6 Delegated Network Prefix Length: 48
```

show subscribers extensive (Effective Shaping-Rate)

```
user@host> show subscribers extensive
Type: VLAN
Logical System: default
Routing Instance: default
Interface: demux0.1073741837
Interface type: Dynamic
Interface Set: ifset-1
Underlying Interface: ae1
Dynamic Profile Name: svlan-dhcp-test
State: Active
Session ID: 1
Stacked VLAN Id: 0x8100.201
VLAN Id: 0x8100.201
Login Time: 2011-11-30 00:18:04 PST
```

Effective shaping-rate: 31000000k

```
...
```

show subscribers aci-interface-set-name detail (Subscriber Sessions Using Specified ACI Interface Set)

```
user@host> show subscribers aci-interface-set-name aci-1003-ge-1/0/0.4001 detail
Type: VLAN
Logical System: default
Routing Instance: default
Interface: ge-1/0/0.
Underlying Interface: ge-1/0/0.4001
Dynamic Profile Name: aci-vlan-set-profile
Dynamic Profile Version: 1
State: Active
Session ID: 13
Agent Circuit ID: aci-ppp-vlan-10
Login Time: 2012-03-12 10:41:56 PDT

Type: PPPoE
User Name: ppphint2
IP Address: 10.10.1.7
Logical System: default
Routing Instance: default
Interface: pp0.1073741834
Interface type: Dynamic
Interface Set: aci-1003-ge-1/0/0.4001
Interface Set Type: Dynamic
Interface Set Session ID: 13
Underlying Interface: ge-1/0/0.4001
Dynamic Profile Name: aci-vlan-pppoe-profile
Dynamic Profile Version: 1
MAC Address: 00:00:65:26:01:02
State: Active
Radius Accounting ID: 14
Session ID: 14
Agent Circuit ID: aci-ppp-vlan-10
Login Time: 2012-03-12 10:41:57 PDT
```

show subscribers agent-circuit-identifier detail (Subscriber Sessions Using Specified ACI Substring)

```
user@host> show subscribers agent-circuit-identifier aci-ppp-vlan detail
Type: VLAN
Logical System: default
Routing Instance: default
Interface: ge-1/0/0.
Underlying Interface: ge-1/0/0.4001
Dynamic Profile Name: aci-vlan-set-profile
Dynamic Profile Version: 1
State: Active
Session ID: 13
Agent Circuit ID: aci-ppp-vlan-10
Login Time: 2012-03-12 10:41:56 PDT

Type: PPPoE
User Name: ppphint2
IP Address: 10.10.1.7
Logical System: default
Routing Instance: default
Interface: pp0.1073741834
Interface type: Dynamic
Interface Set: aci-1003-ge-1/0/0.4001
```

```
Interface Set Type: Dynamic
Interface Set Session ID: 13
Underlying Interface: ge-1/0/0.4001
Dynamic Profile Name: aci-vlan-pppoe-profile
Dynamic Profile Version: 1
MAC Address: 00:00:65:26:01:02
State: Active
Radius Accounting ID: 14
Session ID: 14
Agent Circuit ID: aci-ppp-vlan-10
Login Time: 2012-03-12 10:41:57 PDT
```

show subscribers interface extensive

```
user@host> show subscribers interface demux0.1073741826 extensive
Type: VLAN
User Name: test1@test.com
Logical System: default
Routing Instance: testnet
Interface: demux0.1073741826
Interface type: Dynamic
Dynamic Profile Name: profile-vdemux-relay-23qos
MAC Address: 00:00:6e:56:01:04
State: Active
Radius Accounting ID: 12
Session ID: 12
Stacked VLAN Id: 0x8100.1500
VLAN Id: 0x8100.2902
Login Time: 2011-10-20 16:21:59 EST

Type: DHCP
User Name: test1@test.com
IP Address: 172.16.200.6
IP Netmask: 255.255.255.0
Logical System: default
Routing Instance: testnet
Interface: demux0.1073741826
Interface type: Static
MAC Address: 00:00:6e:56:01:04
State: Active
Radius Accounting ID: 21
Session ID: 21
Login Time: 2011-10-20 16:24:33 EST
Service Sessions: 2

Service Session ID: 25
Service Session Name: SUB-QOS
State: Active

Service Session ID: 26
Service Session Name: service-cb-content
State: Active
IPv4 Input Filter Name: content-cb-in-demux0.1073741826-in
IPv4 Output Filter Name: content-cb-out-demux0.1073741826-out
```

show subscribers logical-system terse

```
user@host> show subscribers logical-system test1 terse
Interface            IP Address/VLAN ID   User Name          LS:RI
demux0.1073741825      101.0.0.3            RETAILER1-CLIENT   test1:retailer1
demux0.1073741826      102.0.0.3            RETAILER2-CLIENT   test1:retailer2
```


show subscribers physical-interface count

```
user@host> show subscribers physical-interface ge-1/0/0 count
Total subscribers: 3998, Active Subscribers: 3998
```

show subscribers routing-instance inst1 count

```
user@host> show subscribers routing-instance inst1 count
Total Subscribers: 188, Active Subscribers: 183
```

show subscribers stacked-vlan-id detail

```
user@host> show subscribers stacked-vlan-id 101 detail
Type: VLAN
Interface: ge-1/2/0.1073741824
Interface type: Dynamic
Dynamic Profile Name: svlan-prof
State: Active
Stacked VLAN Id: 0x8100.101
VLAN Id: 0x8100.100
Login Time: 2009-03-27 11:57:19 PDT
```

show subscribers stacked-vlan-id vlan-id detail (Combined Output)

```
user@host> show subscribers stacked-vlan-id 101 vlan-id 100 detail
Type: VLAN
Interface: ge-1/2/0.1073741824
Interface type: Dynamic
Dynamic Profile Name: svlan-prof
State: Active
Stacked VLAN Id: 0x8100.101
VLAN Id: 0x8100.100
Login Time: 2009-03-27 11:57:19 PDT
```

show subscribers stacked-vlan-id vlan-id interface detail (Combined Output for a Specific Interface)

```
user@host> show subscribers stacked-vlan-id 101 vlan-id 100 interface ge-1/2/0.* detail
Type: VLAN
Interface: ge-1/2/0.1073741824
Interface type: Dynamic
Dynamic Profile Name: svlan-prof
State: Active
Stacked VLAN Id: 0x8100.101
VLAN Id: 0x8100.100
Login Time: 2009-03-27 11:57:19 PDT
```

show subscribers user-name detail

```
user@host> show subscribers user-name larry1 detail
Type: DHCP
User Name: larry1
IP Address: 100.0.0.37
IP Netmask: 255.255.0.0
Logical System: default
Routing Instance: default
Interface: ge-1/0/0.1
Interface type: Static
Dynamic Profile Name: foo
MAC Address: 00:10:94:00:00:01
State: Active
Radius Accounting ID: 1
Session ID: 1
```

```
Login Time: 2011-11-07 08:25:59 PST
DHCP Options: len 52
35 01 01 39 02 02 40 3d 07 01 00 10 94 00 00 01 33 04 00 00
00 3c 0c 15 63 6c 69 65 6e 74 5f 50 6f 72 74 20 2f 2f 32 2f
37 2d 30 2d 30 37 05 01 06 0f 21 2c
```

show subscribers vlan-id

```
user@host> show subscribers vlan-id 100
Interface           IP Address                              User Name
ge-1/0/0.1073741824
ge-1/2/0.1073741825
```

show subscribers vlan-id detail

```
user@host> show subscribers vlan-id 100 detail
Type: VLAN
Interface: ge-1/0/0.1073741824
Interface type: Dynamic
Dynamic Profile Name: vlan-prof-tpid
State: Active
VLAN Id: 100
Login Time: 2009-03-11 06:48:54 PDT

Type: VLAN
Interface: ge-1/2/0.1073741825
Interface type: Dynamic
Dynamic Profile Name: vlan-prof-tpid
State: Active
VLAN Id: 100
Login Time: 2009-03-11 06:48:54 PDT
```

show subscribers vpi vci extensive (PPPoE-over-ATM Subscriber Session)

```
user@host> show subscribers vpi 40 vci 50 extensive
Type: PPPoE
User Name: testuser
IP Address: 100.0.0.2
IP Netmask: 255.255.0.0
Logical System: default
Routing Instance: default
Interface: pp0.0
Interface type: Static
MAC Address: 00:00:65:23:01:02
State: Active
Radius Accounting ID: 2
Session ID: 2
ATM VPI: 40
ATM VCI: 50
Login Time: 2012-12-03 07:49:26 PST
IP Address Pool: pool_1
IPv6 Framed Interface Id: 200:65ff:fe23:102
```

show system alarms

Syntax show system alarms

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display active system alarms.

Options This command has no options.

Additional Information System alarms are preset. They include a **configuration** alarm that appears when no rescue configuration alarm is set and a **license** alarm that appears when a software feature is configured and no valid license is configured for the feature. For more information about system alarms, see the *Junos OS Administration Library for Routing Devices*.

In Junos OS release 11.1 and later, alarms for fans also show the slot number of the fans in the CLI output.

Starting with Junos OS Release 13.2, you can view degraded fabric alarms on a routing matrix based on TX Matrix Plus router with 3D SIBs. The alarm indicates that the source FPC is running with a degraded fabric condition. This alarm is an early warning of a possible fabric black-hole condition. When the degraded fabric alarm is raised on the source FPC, you can take remedial action to avoid a fabric black-hole condition. The degraded fabric alarm is raised on the source FPC if both the following conditions are met:

- The active Packet Forwarding Engine destinations are reachable on one or no active switching planes.
- At least one of the inactive switching planes has a fault that causes the destination Packet Forwarding Engine to become unreachable.

Required Privilege Level admin

List of Sample Output show system alarms on page 872
show system alarms (Fan Tray) on page 873
show system alarms (QFX Series) on page 873
show system alarms (TX Matrix Plus router with 3D SIBs) on page 873

Sample Output

show system alarms

```
user@host> show system alarms
2 alarms currently active
Alarm time                 Class     Description
2005-02-24 17:29:34 UTC    Minor     IPsec VPN tunneling usage requires a
license
2005-02-24 17:29:34 UTC    Minor     Rescue configuration is not sent
```


show system alarms (Fan Tray)

```
user@host> show system alarms
4 alarms currently active
Alarm time               Class  Description
2010-11-11 20:27:38 UTC  Major  Side Fan Tray 7 Failure
2010-11-11 20:27:13 UTC  Minor  Side Fan Tray 7 Overspeed
2010-11-11 20:27:13 UTC  Major  Side Fan Tray 5 Failure
2010-11-11 20:27:13 UTC  Major  Side Fan Tray 0 Failure
```

show system alarms (QFX Series)

```
user@switches> show system alarms
2 alarms currently active
Alarm time Class Description
2005-02-24 17:29:34 UTC Minor Rescue configuration is not sent
```

show system alarms (TX Matrix Plus router with 3D SIBs)

```
user@router> show system alarms

sfc0-re0:
--------------------------------------------------------------------------
2 alarms currently active
Alarm time               Class  Description
2013-05-08 18:13:58 UTC  Major  LCC 0 Major Errors
2013-05-08 17:48:46 UTC  Major  LCC 7 Major Errors

lcc0-re1:
--------------------------------------------------------------------------
1 alarm currently active
Alarm time               Class  Description
2013-05-08 18:19:24 UTC  Major  FPC 1 degraded fabric condition detected

lcc7-re0:
--------------------------------------------------------------------------
1 alarm currently active
Alarm time               Class  Description
2013-05-08 18:19:24 UTC  Major  FPC 7 degraded fabric condition detected
```

show system audit

Syntax

show system audit
<root-only>

Syntax (EX Series Switch and MX Series Router)

show system audit
<all-members>
<local>
<member *member-id*>
<root-only>

Syntax (TX Matrix Router)

show system audit
<all-lcc | lcc *number* | scc>
<root-only>

Syntax (TX Matrix Plus Router)

show system audit
<all-chassis | all-lcc | lcc *number* | sfc *number*>
<root-only>

Syntax (QFX Series)

show system audit
<infrastructure *name* | interconnect-device *name* | node-group *name* | root-only>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the state and checksum values for file systems.

Options

none—Display the state and checksum values for all file systems.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Display file system MD5 hash and permissions information for all of the chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display file system MD5 hash and permissions information for all T640 routers connected to the TX Matrix router. On a TX Matrix Plus router, display file system MD5 hash and permissions information for all T1600 or T4000 routers connected to the TX Matrix Plus router.

all-members—(EX4200 switch, QFX Series, and MX Series routers only) (Optional) Display file system MD5 hash and permissions information on all members of the Virtual Chassis configuration.

lcc *number*—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display file system MD5 hash and permissions information for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, display file system MD5 hash and permissions information for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

infrastructure *name*—(QFabric systems only) (Optional) Display file system MD5 hash and permissions information for a fabric control Routing Engine or a fabric control Routing Engine.

interconnect-device *name*—(QFabric systems only) (Optional) Display file system MD5 hash and permissions information for the Interconnect device.

local—(EX4200 switch, QFX Series, and MX Series routers only) (Optional) Display file system MD5 hash and permissions information on the local Virtual Chassis member.

member *member-id*—(EX4200 switch, QFX Series, and MX Series routers only) (Optional) Display file system MD5 hash and permissions information on the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

node-group *name*—(QFabric systems only) (Optional) Display file system MD5 hash and permissions information for the Node group

root-only—(Optional) Check only the root (/) file system. On a QFabric system, you can check the root (/) file system on the infrastructure (fabric manager Routing Engine and fabric control Routing Engine), Interconnect device, or Node group.

scc—(TX Matrix routers only) (Optional) Display file system MD5 hash and permissions information for the TX Matrix router (or switch-card chassis).

sfc *number*—(TX Matrix Plus routers only) (Optional) Display file system MD5 hash and permissions information for the TX Matrix Plus router (or switch-fabric chassis). Replace *number* with **0**.

Additional Information

To redirect the output to a file, issue the following command:

ssh *device-name* 'show system audit root-only' > *output-file*

If you save the output of the **show system audit root-only** command to a file, you can compare it to subsequent output from the command to determine whether anything has changed.

By default, when you issue the **show system audit** command on the master Routing Engine of a TX Matrix router or a TX Matrix Plus router, the command is broadcast to all the master Routing Engines of the LCCs connected to it in the routing matrix. Likewise, if you issue the same command on the backup Routing Engine of a TX Matrix or a TX Matrix Plus router, the command is broadcast to all backup Routing Engines of the LCCs that are connected to it in the routing matrix.

Required Privilege Level admin

List of Sample Output

show system audit root-only on page 876
show system audit lcc (TX Matrix Router) on page 876
show system audit lcc (TX Matrix Plus Router) on page 878
show system audit root-only (QFX3500 Switch) on page 880

Sample Output

show system audit root-only

```
user@host> show system audit root-only
#          user: root
#       machine: my-host
#          tree: /
date: Fri Feb 11 21:21:46 2000

# .
/set type=file uid=0 gid=0 mode=0755 nlink=1
.               type=dir nlink=23 size=1024 time=950252640.0
  .cshrc      uid=3 gid=7 mode=0644 size=177 time=939182975.0 \
                md5digest=f414e06fea6bd646244b98e13d6e6226
  .kernel.jkernel.backup \
                mode=0744 size=1934552 time=944688902.0 \
                md5digest=2c343cf0bd9fea8f04f78604feed7aa4
  .profile    uid=3 gid=7 mode=0644 nlink=2 size=173 time=939182975.0 \
                md5digest=55a1e3c6c67789c9d3a1cce1ea39f670
    COPYRIGHT   uid=3 gid=7 mode=0444 size=3425 time=939182975.0 \
                md5digest=7df8bc77dcee71382ea73eb0ec6a9243
    boot.config mode=0644 size=3 time=945902618.0 \
                md5digest=93d722493ed38477338a1405d7dcbb40
    boot.help   uid=3 gid=7 mode=0444 size=411 time=939182876.0 \
                md5digest=9b7126385734bcae753f4179ab59d8e5
    compat      type=link mode=0777 size=11 time=915149058.0 \
                link=/usr/compat
    kernel      mode=0444 size=1947607 time=950230892.0 \
                md5digest=1a2a8aff2fec678a918ba0d6bf063980
    kernel.avr  uid=1112 size=1947642 time=950252597.0 \
                md5digest=82e1637682d58ec28964dfee7fccb62e
    kernel.config \
                mode=0644 size=0 time=915149058.0 \
                md5digest=d41d8cd98f00b204e9800998ecf8427e
    sys         type=link mode=0777 size=11 time=915149029.0 \
                link=usr/src/sys
```

show system audit lcc (TX Matrix Router)

```
user@host> show system audit lcc 2
lcc2-re0:
--------------------------------------------------------------------------
#          user: root
```



```
#       machine: rodin-lcc2
#          tree: /
#          date: Mon Sep 13 11:55:33 2004

# .
/set type=file uid=0 gid=0 mode=0555 nlink=1 flags=none
.               type=dir nlink=20 size=512 time=1094982121.0
    COPYRIGHT   mode=0644 size=4735 time=986012708.0 \
                md5digest=78396df1404ad742e6eb1be28f0cd63b
    kernel      type=link mode=0700 size=17 time=1090266262.0 \
                link=/packages/jkernel

# ./altconfig
altconfig       type=dir nlink=2 size=512 time=1089801320.0
# ./altconfig
..


# ./altroot
altroot         type=dir nlink=2 size=512 time=1089801320.0
# ./altroot
..

# ./b
b               type=dir mode=0755 nlink=2 size=512 time=1093961429.0
# ./b
..


# ./bin
/set type=file uid=0 gid=0 mode=0700 nlink=1 flags=none
bin             type=dir mode=0755 nlink=2 size=512 time=1089843059.0
    [           type=link size=28 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/test
    cat         type=link size=27 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/cat
    chmod       type=link size=29 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/chmod
    cp          type=link size=26 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/cp
    csh         type=link size=27 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/csh
    date        type=link size=28 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/date
    dd          type=link size=26 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/dd
    df          type=link size=26 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/df
    echo        type=link size=28 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/echo
    ed          type=link size=26 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/ed
    expr        type=link size=28 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/expr
    hostname    type=link size=32 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/hostname
    kill        type=link size=28 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/kill
    ln          type=link size=26 time=1090266270.0 \
                link=/packages/mnt/jbase/bin/ln
    ls          type=link size=26 time=1090266270.0 \
```

```
                  link=/packages/mnt/jbase/bin/ls
    mkdir         type=link size=29 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/mkdir
    mv            type=link size=26 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/mv
    ps            type=link size=26 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/ps
    pwd           type=link size=27 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/pwd
    rcp           type=link size=27 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/rcp
    red           type=link size=26 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/ed
    rm            type=link size=26 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/rm
    rmdir         type=link size=29 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/rmdir
    sh            type=link size=26 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/sh
    sleep         type=link size=29 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/sleep
    stty          type=link size=28 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/stty
    sync          type=link size=28 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/sync
    tcsh          type=link size=27 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/csh
    test          type=link size=28 time=1090266270.0 \
                  link=/packages/mnt/jbase/bin/test
# ./bin
..


# ./boot
/set type=file uid=0 gid=0 mode=0444 nlink=1 flags=none
boot              type=dir mode=0555 nlink=3 size=512 time=1095069935.0
    boot0         size=512 time=1094978286.0 \
                  md5digest=6f780822dd4ae482a20462b66e542cca
    boot1         mode=0555 size=512 time=1094978294.0 \
                  md5digest=8d112b09df342cd0b60fdb9bdcde8e07
    boot2         mode=0555 size=7680 time=1094978294.0 \
                  md5digest=28eb58c4068c6b85717e1484f9e028e4
    cdboot        mode=0555 size=165888 time=1094978298.0 \
                  md5digest=1474c6b800dfc82ba552d7c36116d07d
    kgzldr.o      size=5996 time=1094982121.0 \
                  md5digest=c53dc948eb07e2ea4eb0413e4c4634a3
    loader        mode=0555 size=163840 time=1094978298.0 \
                  md5digest=82d9dc2d31033476bfb61bb7264c4fed
    loader.4th    size=9237 time=986013631.0 \
                  md5digest=43144391465ad50267d31e0a320be1de
...
```

show system audit lcc (TX Matrix Plus Router)

```
user@host> show system audit all-chassis

sfc0-re0:
--------------------------------------------------------------------------
#          user: root
#       machine: finalfive
#          tree: /
```



```
#         date: Mon May 18 00:13:16 2009

# .
/set type=file uid=0 gid=0 mode=0755 nlink=1 flags=none
.               type=dir nlink=23 size=512 time=1242347096.0
    COPYRIGHT   mode=0644 size=6196 time=1168587741.0 \
                md5digest=bbad415e1c29bbedd9b383537100412c
    kernel      type=link size=17 time=1242347011.0 link=/packages/jkernel
    staging     type=link mode=0777 size=8 time=1242346935.0 link=/var/tmp

# ./.snap
.snap           type=dir mode=0775 nlink=2 size=512 time=1242346922.0
# ./.snap
..


# ./altconfig
altconfig       type=dir mode=0500 nlink=2 size=512 time=1242319843.0
# ./altconfig
..


# ./altroot
altroot         type=dir mode=0500 nlink=2 size=512 time=1242319843.0
# ./altroot
..


# ./bin
bin             type=dir nlink=2 size=512 time=1242346944.0
    \133        type=link size=28 time=1242346942.0 \
                link=/packages/mnt/jbase/bin/test
    cat         type=link size=27 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/cat
    chflags     type=link size=31 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/chflags
    chmod       type=link size=29 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/chmod
    cp          type=link size=26 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/cp
    csh         type=link size=27 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/csh
    date        type=link size=28 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/date
    dd          type=link size=26 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/dd
    df          type=link size=26 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/df
    echo        type=link size=28 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/echo
    ed          type=link size=26 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/ed
    expr        type=link size=28 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/expr
    hostname    type=link size=32 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/hostname
    kill        type=link size=28 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/kill
    ln          type=link size=26 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/ln
    ls          type=link size=26 time=1242346941.0 \
```

```
                link=/packages/mnt/jbase/bin/ls
    mkdir       type=link size=29 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/mkdir
    mv          type=link size=26 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/mv
    pax         type=link size=27 time=1242346944.0 \
                link=/packages/mnt/jbase/bin/pax
    ps          type=link size=26 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/ps
    pwd         type=link size=27 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/pwd
    rcp         type=link size=27 time=1242346942.0 \
                link=/packages/mnt/jbase/bin/rcp
    red         type=link size=26 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/ed
    rm          type=link size=26 time=1242346942.0 \
                link=/packages/mnt/jbase/bin/rm
    rmdir       type=link size=29 time=1242346942.0 \
                link=/packages/mnt/jbase/bin/rmdir
    sh          type=link size=26 time=1242346942.0 \
                link=/packages/mnt/jbase/bin/sh
    sleep       type=link size=29 time=1242346942.0 \
                link=/packages/mnt/jbase/bin/sleep
    stty        type=link size=28 time=1242346942.0 \
                link=/packages/mnt/jbase/bin/stty
    sync        type=link size=28 time=1242346942.0 \
                link=/packages/mnt/jbase/bin/sync
    tcsh        type=link size=27 time=1242346941.0 \
                link=/packages/mnt/jbase/bin/csh
    test        type=link size=28 time=1242346942.0 \
                link=/packages/mnt/jbase/bin/test
# ./bin
...
```

show system audit root-only (QFX3500 Switch)

```
user@switch> show system audit root-only
#          user: root
#       machine: my-host
#          tree: /
date: Fri Feb 11 21:21:46 2000

# .
/set type=file uid=0 gid=0 mode=0755 nlink=1
.               type=dir nlink=23 size=1024 time=950252640.0
  .cshrc      uid=3 gid=7 mode=0644 size=177 time=939182975.0 \
                md5digest=f414e06fea6bd646244b98e13d6e6226
  .kernel.jkernel.backup \
                mode=0744 size=1934552 time=944688902.0 \
                md5digest=2c343cf0bd9fea8f04f78604feed7aa4
  .profile    uid=3 gid=7 mode=0644 nlink=2 size=173 time=939182975.0 \
                md5digest=55a1e3c6c67789c9d3a1cce1ea39f670
    COPYRIGHT   uid=3 gid=7 mode=0444 size=3425 time=939182975.0 \
                md5digest=7df8bc77dcee71382ea73eb0ec6a9243
    boot.config mode=0644 size=3 time=945902618.0 \
                md5digest=93d722493ed38477338a1405d7dcbb40
    boot.help   uid=3 gid=7 mode=0444 size=411 time=939182876.0 \
                md5digest=9b7126385734bcae753f4179ab59d8e5
    compat      type=link mode=0777 size=11 time=915149058.0 \
                link=/usr/compat
    kernel      mode=0444 size=1947607 time=950230892.0 \
```



```
            md5digest=1a2a8aff2fec678a918ba0d6bf063980
kernel.avr  uid=1112 size=1947642 time=950252597.0 \
            md5digest=82e1637682d58ec28964dfee7fccb62e
kernel.config \
            mode=0644 size=0 time=915149058.0 \
            md5digest=d41d8cd98f00b204e9800998ecf8427e
sys         type=link mode=0777 size=11 time=915149029.0 \
            link=usr/src/sys
```

show system boot-messages

Syntax

show system boot-messages

Syntax (EX Series Switches)

show system boot-messages
<all-members>
<local>
<member *member-id*>

Syntax (TX Matrix Router)

show system boot-messages
<all-chassis | all-lcc | lcc *number* | scc>

Syntax (TX Matrix Plus Router)

show system boot-messages
<all-chassis | all-lcc | lcc *number* | sfc *number*>

Syntax (MX Series Router)

show system boot-messages
<all-members>
<local>
<member *member-id*>

Syntax (QFX Series)

show system boot-messages
infrastructure *name* | interconnect-device *name* | node-group *name*

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display initial messages generated by the system kernel upon startup. These messages are the contents of **/var/run/dmesg.boot**.

Options

none—Display all boot time messages.

all-chassis—(TX Matrix routers andTX Matrix Plus routers only) (Optional) Display boot time messages for all of the chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display boot time messages for all T640 routers connected to a TX Matrix router. On a TX Matrix Plus router, display boot time messages for all connected T1600 or T4000 LCCs.

all-members—(EX4200 switches and MX Series routers only) (Optional) Display boot time messages on all members of the Virtual Chassis configuration.

infrastructure *name*—(QFabric systems only) (Optional) Display boot time messages on the fabric control Routing Engine or fabric manager Routing engines.

interconnect-device *name*—(QFabric systems only) (Optional) Display boot time messages on the Interconnect device.

lcc *number*—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display boot time messages for a specific T640 router connected to a TX Matrix router. On a TX Matrix Plus router, display boot time messages for a specific router connected to a TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Display boot time messages on the local Virtual Chassis member.

member *member-id*—(EX4200 switches and MX Series routers only) (Optional) Display boot time messages on the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

node-group *name*—(QFabric systems only) (Optional) Display boot time messages on the Node group.

scc—(TX Matrix routers only) (Optional) Display boot time messages for the TX Matrix router (or switch-card chassis).

sfc *number*—(TX Matrix Plus routers only) (Optional) Display boot time messages for the TX Matrix Plus router. Replace *number* with **0**.

Additional Information

By default, when you issue the **show system boot-messages** command on the master Routing Engine of a TX Matrix router or a TX Matrix Plus router, the command is broadcast to all the master Routing Engines of the LCCs connected to it in the routing matrix. Likewise, if you issue the same command on the backup Routing Engine of a TX Matrix or a TX Matrix Plus router, the command is broadcast to all backup Routing Engines of the LCCs that are connected to it in the routing matrix.

Required Privilege Level

view

Related Documentation

- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

show system boot-messages (TX Matrix Router) on page 884
show system boot-messages lcc (TX Matrix Router) on page 885
show system boot-messages (TX Matrix Plus Router) on page 886
show system boot-messages (QFX3500 Switch) on page 886

Sample Output

show system boot-messages (TX Matrix Router)

```
user@host> show system boot-messages
Copyright (c) 1992-1998 FreeBSD Inc.
Copyright (c) 1996-2000 Juniper Networks, Inc.
All rights reserved.
Copyright (c) 1982, 1986, 1989, 1991, 1993
        The Regents of the University of California.  All rights reserved.

JUNOS 4.1-20000216-Zf8469 #0: 2000-02-16 12:57:28 UTC
    tlim@single.juniper.net:/p/build/20000216-0905/4.1/release_kernel/sys/compil
e/GENERIC
CPU: Pentium Pro (332.55-MHz 686-class CPU)
  Origin = "GenuineIntel"  Id = 0x66a  Stepping=10
  Features=0x183f9ff<FPU,VME,DE,PSE,TSC,MSR,PAE,MCE,CX8,SEP,MTRR,PGE,MCA,CMOV,<b
16>,<b17>,MMX,<b24>>
Teknor CPU Card Recognized
real memory  = 805306368 (786432K bytes)
avail memory = 786280448 (767852K bytes)
Probing for devices on PCI bus 0:
chip0 <generic PCI bridge (vendor=8086 device=7192 subclass=0)> rev 3 class 6000
0 on pci0:0:0
chip1 <Intel 82371AB PCI-ISA bridge> rev 1 class 60100 on pci0:7:0
chip2 <Intel 82371AB IDE interface> rev 1 class 10180 on pci0:7:1
chip3 <Intel 82371AB USB interface> rev 1 class c0300 int d irq 11 on pci0:7:2
smb0 <Intel 82371AB SMB controller> rev 1 class 68000 on pci0:7:3
pcic0 <TI PCI-1131 PCI-CardBus Bridge> rev 1 class 60700 int a irq 15 on pci0:13
:0
TI1131 PCI Config Reg: [pci only][FUNC0 pci int]
pcic1 <TI PCI-1131 PCI-CardBus Bridge> rev 1 class 60700 int b irq 12 on pci0:13
:1
TI1131 PCI Config Reg: [pci only][FUNC1 pci int]
fxp0 <Intel EtherExpress Pro 10/100B Ethernet> rev 8 class 20000 int a irq 12 on

 pci0:16:0
chip4 <generic PCI bridge (vendor=1011 device=0022 subclass=4)> rev 4 class 6040
0 on pci0:17:0
fxp1 <Intel EtherExpress Pro 10/100B Ethernet> rev 8 class 20000 int a irq 10 on

 pci0:19:0
Probing for devices on PCI bus 1:
mcs0 <Miscellaneous Control Subsystem> rev 12 class ff0000 int a irq 12 on pci1:
13:0
fxp2 <Intel EtherExpress Pro 10/100B Ethernet> rev 8 class 20000 int a irq 10 on

 pci1:14:0
Probing for devices on the ISA bus:
sc0 at 0x60-0x6f irq 1 on motherboard
sc0: EGA color <16 virtual consoles, flags=0x0>
ed0 not found at 0x300
ed1 not found at 0x280
ed2 not found at 0x340
psm0 not found at 0x60
sio0 at 0x3f8-0x3ff irq 4 flags 0x20010 on isa
sio0: type 16550A, console
sio1 at 0x3e8-0x3ef irq 5 flags 0x20000 on isa
sio1: type 16550A
sio2 at 0x2f8-0x2ff irq 3 flags 0x20000 on isa
sio2: type 16550A
```



```
pcic0 at 0x3e0-0x3e1 on isa
PC-Card ctlr(0) TI PCI-1131 [CardBus bridge mode] (5 mem & 2 I/O windows)
pcic0: slot 0 controller I/O address 0x3e0
npx0 flags 0x1 on motherboard
npx0: INT 16 interface
fdc0: direction bit not set
fdc0: cmd 3 failed at out byte 1 of 3
fdc0 not found at 0x3f0
wdc0 at 0x1f0-0x1f7 irq 14 on isa
wdc0: unit 0 (wd0): <SunDisk SQFXB-80>, single-sector-i/o
wd0: 76MB (156672 sectors), 612 cyls, 8 heads, 32 S/T, 512 B/S
wdc0: unit 1 (wd1): <IBM-DCXA-210000>
wd1: 8063MB (16514064 sectors), 16383 cyls, 16 heads, 63 S/T, 512 B/S
wdc1 not found at 0x170
wdc2 not found at 0x180
ep0 not found at 0x300
fxp0: Ethernet address 00:a0:a5:12:05:5a
fxp1: Ethernet address 00:a0:a5:12:05:59
fxp2: Ethernet address 02:00:00:00:00:01
swapon: adding /dev/wd1s1b as swap device
Automatic reboot in progress...
/dev/rwd0s1a: clean, 16599 free (95 frags, 2063 blocks, 0.1% fragmentation)
/dev/rwd0s1e: clean, 9233 free (9 frags, 1153 blocks, 0.1% fragmentation)
/dev/rwd0s1a: clean, 16599 free (95 frags, 2063 blocks, 0.1% fragmentation)
/dev/rwd1s1f: clean, 4301055 free (335 frags, 537590 blocks, 0.0% fragmentation)
```

show system boot-messages lcc (TX Matrix Router)

```
user@host> show system boot-messages lcc 2
lcc2-re0:
--------------------------------------------------------------------------
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All rights reserved.
Copyright (c) 1992-2001 The FreeBSD Project.
Copyright (c) 1979, 1980, 1983, 1986, 1988, 1989, 1991, 1992, 1993, 1994
        The Regents of the University of California. All rights reserved.
JUNOS 7.0-20040912.0 #0: 2004-09-12 09:16:32 UTC

builder@benten.juniper.net:/build/benten-b/7.0/20040912.0/obj-i386/sys/compile/JUNIPER
Timecounter "i8254"  frequency 1193182 Hz
Timecounter "TSC"  frequency 601368936 Hz
CPU: Pentium III/Pentium III Xeon/Celeron (601.37-MHz 686-class CPU)
  Origin = "GenuineIntel"  Id = 0x68a  Stepping = 10

Features=0x387f9ff<FPU,VME,DE,PSE,TSC,MSR,PAE,MCE,CX8,SEP,MTRR,PGE,MCA,CMOV,PAT,PSE36,PN,MMX,FXSR,SSE>
real memory  = 2147467264 (2097136K bytes)
sio0: gdb debugging port
avail memory = 2084040704 (2035196K bytes)
Preloaded elf kernel "kernel" at 0xc06d9000.
DEVFS: ready for devices
Pentium Pro MTRR support enabled
md0: Malloc disk
DRAM Data Integrity Mode: ECC Mode with h/w scrubbing
npx0: <math processor> on motherboard
npx0: INT 16 interface
pcib0: <ServerWorks NB6635 3.0LE host to PCI bridge> on motherboard
pci0: <PCI bus> on pcib0
pcic-pci0: <TI PCI-1410 PCI-CardBus Bridge> irq 15 at device 1.0 on pci0
pcic-pci0: TI12XX PCI Config Reg: [pwr save][pci only]
fxp0: <Intel Embedded 10/100 Ethernet> port 0x1000-0x103f mem
0xfb800000-0xfb81ffff,0xfb820000-0xfb820fff irq 9 at device 3.0 on pci0
```

```
fxp1: <Intel Embedded 10/100 Ethernet> port 0x1040-0x107f mem
0xfb840000-0xfb85ffff,0xfb821000-0xfb821fff irq 11 at device 4.0 on pci0
...
```

show system boot-messages (TX Matrix Plus Router)

```
user@host> show system boot-messages
sfc0-re0:
--------------------------------------------------------------------------
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All rights reserved.
Copyright (c) 1992-2006 The FreeBSD Project.
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JUNOS 9.6B3.3 #0: 2009-06-17 19:52:08 UTC

builder@lanath.juniper.net:/volume/build/junos/9.6/release/9.6B3.3/obj-i386/bsd/sys/compile/JUNIPER
MPTable:  Timecounter "i8254" frequency 1193182 Hz quality 0 CPU: Intel(R) Xeon(R)
 CPU           L5238  @ 2.66GHz (2660.01-MHz 686-class CPU)   Origin =
"GenuineIntel"  Id = 0x1067a  Stepping = 10   Features=0xbfebfbff
...
lcc1-re0:
--------------------------------------------------------------------------
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JUNOS 9.6-20090617.0 #0: 2009-06-17 04:15:14 UTC

builder@lanath.juniper.net:/volume/build/junos/9.6/production/20090617.0/obj-i386/bsd/sys/compile/JUNIPER
Timecounter "i8254" frequency 1193182 Hz quality 0
CPU: Intel(R) Xeon(R) CPU                 @ 1.86GHz (1862.01-MHz 686-class CPU)

  Origin = "GenuineIntel"  Id = 0x1067a  Stepping = 10
  Features=0xbfebfbff
...
```

show system boot-messages (QFX3500 Switch)

```
user@switch> show sytem boot-messages
getmemsize: msgbufp[size=32768] = 0x81d07fe4

System physical memory distribution:
-------------------------------------------------------------------------------
Total physical memory: 4160749568 (3968 MB)
Physical memory used: 3472883712 (3312 MB)
Physical memory allocated to kernel: 2130706432 (2032 MB)
Physical memory allocated to user BTLB: 1342177280 (1280 MB)
-------------------------------------------------------------------------------

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JUNOS 11.1I #0: 2010-09-17 19:18:07 UTC

ssiano@svl-junos-pool125.juniper.net:/c/ssiano/DEV_QFX_SI_BRANCH/03/20100917.399988/
obj-xlr/bsd/sys/compile/JUNIPER-DCTOR
WARNING: debug.mpsafenet forced to 0 as ipsec requires Giant
```



```
JUNOS 11.1I #0: 2010-09-17 19:18:07 UTC

ssiano@svl-junos-pool125.juniper.net:/c/ssiano/DEV_QFX_SI_BRANCH/03/20100917.399988/
obj-xlr/bsd/sys/compile/JUNIPER-DCTOR
real memory  = 3472883712 (3312MB)
avail memory = 1708171264 (1629MB)
cpuid: 0, btlb_cpumap:0xfffffff8
FreeBSD/SMP: Multiprocessor System Detected: 12 CPUs
ETHERNET SOCKET BRIDGE initialising
Initializing QFX platform properties ..
cpu0 on motherboard
: RMI's XLR CPU Rev. 0.3 with no FPU implemented
        L1 Cache: I size 32kb(32 line), D size 32kb(32 line), eight way.
        L2 Cache: Size 1024kb, eight way
pic_lbus0: <XLR Local Bus>
pic_lbus0: <XLR Local Bus> on motherboard
Enter qfx control ethernet probe addr:0xc5eeec00
gmac4: <XLR GMAC GE Ethernet> on pic_lbus0
me0: Ethernet address 00:1d:b5:f7:68:40
Enter qfx control ethernet probe addr:0xc5eeeb40
gmac5: <XLR GMAC GE Ethernet> on pic_lbus0
me1: Ethernet address 00:1d:b5:f7:68:41
Enter qfx control ethernet probe addr:0xc5eeea80
gmac6: <XLR GMAC GE Ethernet> on pic_lbus0
me1: Ethernet address 00:1d:b5:f7:68:42
sio0 on pic_lbus0
Entering sioattach
sio0: type 16550A, console
xls_setup_intr: skip irq 3, xlr regs are set up somewhere else.
gblmem0 on pic_lbus0
ehci0: <RMI XLS USB 2.0 controller> on pic_lbus0
ehci_bus_attach: allocated resource.  tag=1, base=bef24000
xls_ehci_init: endian hardware swapping NOT enabled.
usb0: EHCI version 1.0
usb0 on ehci0
usb0: USB revision 2.0
uhub0: vendor 0x0000 EHCI root hub, class 9/0, rev 2.00/1.00, addr 1
uhub0: 2 ports with 2 removable, self powered
umass0: USB USBFlashDrive, rev 2.00/11.00, addr 2
pcib0: PCIe link 0 up
pcib0: PCIe link 2 up
pcib0: PCIe link 3 up
pcib0: <XLS PCI Host Controller> on pic_lbus0
pci0: <PCI bus> on pcib0
pcib1: <PCI-PCI bridge> at device 0.0 on pci0
pci1: <PCI bus> on pcib1
pci1: <network, ethernet> at device 0.0 (no driver attached)
pcib2: <PCI-PCI bridge> at device 1.0 on pci0
pcib3: <PCI-PCI bridge> at device 2.0 on pci0
pci2: <PCI bus> on pcib3
pci2: <network, ethernet> at device 0.0 (no driver attached)
pcib4: <PCI-PCI bridge> at device 3.0 on pci0
pci3: <PCI bus> on pcib4
pci3: <network, ethernet> at device 0.0 (no driver attached)
cfi device address space at 0xbc000000
cfi0: <AMD/Fujitsu - 8MB> on pic_lbus0
cfi device address space at 0xbc000000
i2c0: <I2C bus controller> on pic_lbus0
i2c1: <I2C bus controller> on pic_lbus0
qfx_fmn0 on pic_lbus0
pool offset 1503776768
```



```
xlr_lbus0: <XLR Local Bus Controller> on motherboard
qfx_bcpld_probe[124]
qfx_bcpld_probe[138]: dev_type=0x0
qfx_bcpld_probe[124]
qfx_bcpld0: QFX BCPLD probe success
qfx_bcpld0qfx_bcpld_attach[174]
qfx_bcpld_attach[207] : bus_space_tag=0x0, bus_space_handle=0xbd900000
qfx_bcpld_probe[124]
qfx_bcpld1: QFX BCPLD probe success
qfx_bcpld1qfx_bcpld_attach[174]
tor_bcpld_slave_attach[1245] : bus_space_tag=0x0, bus_space_handle=0xbda00000
Initializing product: 96 ..
bmeb: bmeb_lib_init done 0xc60a5000, addr 0x809c99a0
bme0:Virtual BME driver initializing
Timecounter "mips" frequency 1200000000 Hz quality 0
Timecounter "xlr_pic_timer" frequency 66666666 Hz quality 1
Timecounters tick every 1.000 msec
Loading the NETPFE fc module
IPsec: Initialized Security Association Processing.
SMP: AP CPU #3 Launched!
SMP: AP CPU #1 Launched!
SMP: AP CPU #2 Launched!
SMP: AP CPU #4 Launched!
SMP: AP CPU #5 Launched!
SMP: AP CPU #7 Launched!
SMP: AP CPU #6 Launched!
SMP: AP CPU #11 Launched!
SMP: AP CPU #10 Launched!
SMP: AP CPU #9 Launched!
SMP: AP CPU #8 Launched!
da0 at umass-sim0 bus 0 target 0 lun 0
da0: <USB USBFlashDrive 1100> Removable Direct Access SCSI-0 device
da0: 40.000MB/s transfers
da0: 3920MB (8028160 512 byte sectors: 255H 63S/T 499C)
Trying to mount root from ufs:/dev/da0s1a
```

show system buffers

Syntax

show system buffers

Syntax (EX Series)

show system buffers
<all-members>
<local>
<member *member-id*>

Syntax (TX Matrix Router)

show system buffers
<all-chassis | all-lcc | lcc *number* | scc>

Syntax (TX Matrix Plus Router)

show system buffers
<all-chassis | all-lcc | lcc *number* | sfc *number*>

Syntax (MX Series Router)

show system buffers
<all-members>
<local>
<member *member-id*>

Syntax (QFX Series)

show system buffers
<infrastructure *name* | interconnect-device *name* | node-group *name* | root-only (infrastructure *name* | interconnect-device *name* | node-group *name*)>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display information about the buffer pool that the Routing Engine uses for local traffic. Local traffic is the routing and management traffic that is exchanged between the Routing Engine and the Packet Forwarding Engine within the router or switch, as well as the routing and management traffic from IP (that is, from OSPF, BGP, SNMP, ping operations, and so on).

Options

none—Show all buffer statistics.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, show buffer statistics for all T640 routers connected to the TX Matrix router. On a TX Matrix Plus router, show buffer statistics for all routers connected to the TX Matrix Plus router.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Show buffer statistics for all of the chassis.

all-members—(EX4200 switches and MX Series routers only) (Optional) Show buffer statistics for all members of the Virtual Chassis configuration.

infrastructure *name*—(QFabric systems only) (Optional) Show buffer statistics for a fabric control Routing Engine or a fabric control Routing Engine.

interconnect-device *name*—(QFabric systems only) (Optional) Show buffer statistics for the Interconnect device.

lcc *number*—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, show buffer statistics for a specific T640 router (or line-card chassis) that is connected to the TX Matrix router. On a TX Matrix Plus router, show buffer statistics for a specific router (line-card chassis) that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Show buffer statistics for the local Virtual Chassis member.

member *member-id*—(EX4200 switches and MX Series routers only) (Optional) Show buffer statistics for the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

node-group *name*—(QFabric systems only) (Optional) Show buffer statistics for the Node group

sfc—(TX Matrix Plus routers only) (Optional) Show buffer statistics for the TX Matrix Plus router. Replace ***number*** with **0**.

Additional Information

By default, when you issue the **show system buffers** command on the master Routing Engine of a TX Matrix router or a TX Matrix Plus router, the command is broadcast to all the master Routing Engines of the LCCs connected to it in the routing matrix. Likewise, if you issue the same command on the backup Routing Engine of a TX Matrix or a TX Matrix Plus router, the command is broadcast to all backup Routing Engines of the LCCs that are connected to it in the routing matrix.

A special type of memory buffer called a *cluster* is 2 KB in size. For more information, see *The Design and Implementation of the 4.4BSD Operation System* by McKusic, Bostic, Karels, and Quarterman.

Required Privilege Level

view

Related Documentation

- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

show system buffers on page 892
show system buffers scc (TX Matrix Router) on page 893
show system buffers sfc (TX Matrix Plus Router) on page 893
show system buffers all-chassis (TX Matrix Plus Router) on page 893
show system buffers node-group (QFabric System) on page 894

Output Fields

Table 80 on page 892 describes the output fields for the **show system buffers** command. Output fields are listed in the approximate order in which they appear.

Table 80: show system buffers Output Fields

Field Name	Field Description
mbufs in use	Memory buffers (mbufs) are 128-byte buffers that are used for various purposes inside the kernel. Each memory buffer has a type, and the output itemizes the amount allocated for each type. Types with no memory buffers allocated are not displayed.
mbufs allocated to packet headers	Number of memory buffers currently holding packet headers
mbufs allocated to control blocks	Number of memory buffers currently holding the state for sockets.
mbufs allocated to send data	Number of memory buffers currently holding socket send data.
mbufs allocated to pfe refill data	Number of memory buffers currently holding Packet Forwarding Engine refill data.
mbufs allocated to fxp data	Number of memory buffers currently holding fxp data.
mbufs allocated to socket names and addresses	Number of memory buffers currently holding addresses for sockets.
mbuf clusters in use	Allocation statistics for memory buffer clusters.
allocated to network	Total amount of memory in use by the networking and interprocess communication (IPC) code.
requests for memory denied	Number of times a memory allocation request within the IPC and networking code failed.
requests for memory delayed	Number of times a memory allocation request within the IPC and networking code was postponed.
calls to protocol drain routines	Number of times a memory allocation request within the IPC and networking code triggered a memory reclamation attempt.

Sample Output

show system buffers

```
user@host> show system buffers
397/893/1290 mbufs in use (current/cache/total)
395/331/726/30000 mbuf clusters in use (current/cache/total/max)
384/256 mbuf+clusters out of packet secondary zone in use (current/cache)
0/0/0/0 4k (page size) jumbo clusters in use (current/cache/total/max)
0/0/0/0 9k jumbo clusters in use (current/cache/total/max)
0/0/0/0 16k jumbo clusters in use (current/cache/total/max)
889K/885K/1774K bytes allocated to network (current/cache/total)
0/0/0 requests for mbufs denied (mbufs/clusters/mbuf+clusters)
0/0/0 requests for jumbo clusters denied (4k/9k/16k)
0/5/1024 sfbufs in use (current/peak/max)
```



```
0 requests for sfbufs denied
0 requests for sfbufs delayed
0 requests for I/O initiated by sendfile
0 calls to protocol drain routines
```

show system buffers scc (TX Matrix Router)

```
user@host> show system buffers scc
213 mbufs in use:
        11 mbufs allocated to packet headers
        26 mbufs allocated to socket names and addresses
        2 mbufs allocated to socket options
        17 mbufs allocated to socket send data
        2 mbufs allocated to pfe data
        155 mbufs allocated to fxp data (rx)
        511 mbufs allocated to <mbuf type 86>
        256 mbufs allocated to <mbuf type 92>
924/1162 mbuf clusters in use
2788 Kbytes allocated to network (75% in use)
0 requests for memory denied
0 requests for memory delayed
0 calls to protocol drain routines
```

show system buffers sfc (TX Matrix Plus Router)

```
user@host> show system buffers sfc 0

sfc0-re0:
--------------------------------------------------------------------------
4363/2807/7170 mbufs in use (current/cache/total)
4358/1968/6326/30000 mbuf clusters in use (current/cache/total/max)
256/128 mbuf+clusters out of packet secondary zone in use (current/cache)
0/0/0/0 4k (page size) jumbo clusters in use (current/cache/total/max)
0/0/0/0 9k jumbo clusters in use (current/cache/total/max)
0/0/0/0 16k jumbo clusters in use (current/cache/total/max)
9806K/4637K/14444K bytes allocated to network (current/cache/total)
0/0/0 requests for mbufs denied (mbufs/clusters/mbuf+clusters)
0/0/0 requests for jumbo clusters denied (4k/9k/16k)
0/10/1024 sfbufs in use (current/peak/max)
0 requests for sfbufs denied
0 requests for sfbufs delayed
0 requests for I/O initiated by sendfile
0 calls to protocol drain routines
```

show system buffers all-chassis (TX Matrix Plus Router)

```
user@host> show system buffers all-chassis

sfc0-re0:
--------------------------------------------------------------------------
4363/2807/7170 mbufs in use (current/cache/total)
4358/1968/6326/30000 mbuf clusters in use (current/cache/total/max)
256/128 mbuf+clusters out of packet secondary zone in use (current/cache)
0/0/0/0 4k (page size) jumbo clusters in use (current/cache/total/max)
0/0/0/0 9k jumbo clusters in use (current/cache/total/max)
0/0/0/0 16k jumbo clusters in use (current/cache/total/max)
9806K/4637K/14444K bytes allocated to network (current/cache/total)
0/0/0 requests for mbufs denied (mbufs/clusters/mbuf+clusters)
0/0/0 requests for jumbo clusters denied (4k/9k/16k)
0/10/1024 sfbufs in use (current/peak/max)
0 requests for sfbufs denied
0 requests for sfbufs delayed
```

```
0 requests for I/O initiated by sendfile
0 calls to protocol drain routines

lcc0-re0:
--------------------------------------------------------------------------
772/2558/3330 mbufs in use (current/cache/total)
772/598/1370/30000 mbuf clusters in use (current/cache/total/max)
768/512 mbuf+clusters out of packet secondary zone in use (current/cache)
0/0/0/0 4k (page size) jumbo clusters in use (current/cache/total/max)
0/0/0/0 9k jumbo clusters in use (current/cache/total/max)
0/0/0/0 16k jumbo clusters in use (current/cache/total/max)
1737K/1835K/3572K bytes allocated to network (current/cache/total)
0/0/0 requests for mbufs denied (mbufs/clusters/mbuf+clusters)
0/0/0 requests for jumbo clusters denied (4k/9k/16k)
0/4/1024 sfbufs in use (current/peak/max)
0 requests for sfbufs denied
0 requests for sfbufs delayed
0 requests for I/O initiated by sendfile
0 calls to protocol drain routines

lcc1-re0:
--------------------------------------------------------------------------
773/2437/3210 mbufs in use (current/cache/total)
773/453/1226/30000 mbuf clusters in use (current/cache/total/max)
768/384 mbuf+clusters out of packet secondary zone in use (current/cache)
0/0/0/0 4k (page size) jumbo clusters in use (current/cache/total/max)
0/0/0/0 9k jumbo clusters in use (current/cache/total/max)
0/0/0/0 16k jumbo clusters in use (current/cache/total/max)
1739K/1515K/3254K bytes allocated to network (current/cache/total)
0/0/0 requests for mbufs denied (mbufs/clusters/mbuf+clusters)
0/0/0 requests for jumbo clusters denied (4k/9k/16k)
0/7/1024 sfbufs in use (current/peak/max)
0 requests for sfbufs denied
0 requests for sfbufs delayed
0 requests for I/O initiated by sendfile
0 calls to protocol drain routines

lcc2-re0:
--------------------------------------------------------------------------
816/2514/3330 mbufs in use (current/cache/total)
816/554/1370/30000 mbuf clusters in use (current/cache/total/max)
768/512 mbuf+clusters out of packet secondary zone in use (current/cache)
0/0/0/0 4k (page size) jumbo clusters in use (current/cache/total/max)
0/0/0/0 9k jumbo clusters in use (current/cache/total/max)
0/0/0/0 16k jumbo clusters in use (current/cache/total/max)
1836K/1736K/3572K bytes allocated to network (current/cache/total)
0/0/0 requests for mbufs denied (mbufs/clusters/mbuf+clusters)
0/0/0 requests for jumbo clusters denied (4k/9k/16k)
0/4/1024 sfbufs in use (current/peak/max)
0 requests for sfbufs denied
0 requests for sfbufs delayed
0 requests for I/O initiated by sendfile
```

show system buffers node-group (QFabric System)

```
user@switch> show system buffers node-group node1
node-group node1:
--------------------------------------------------------------------------
2/2698/2700 mbufs in use (current/cache/total)
2/1520/1522/30000 mbuf clusters in use (current/cache/total/max)
0/1280 mbuf+clusters out of packet secondary zone in use (current/cache)
```



```
0/0/0/0 4k (page size) jumbo clusters in use (current/cache/total/max)
0/0/0/0 9k jumbo clusters in use (current/cache/total/max)
0/0/0/0 16k jumbo clusters in use (current/cache/total/max)
4K/3714K/3719K bytes allocated to network (current/cache/total)
0/0/0 requests for mbufs denied (mbufs/clusters/mbuf+clusters)
0/0/0 requests for jumbo clusters denied (4k/9k/16k)
0/6/6656 sfbufs in use (current/peak/max)
0 requests for sfbufs denied
0 requests for sfbufs delayed
0 requests for I/O initiated by sendfile
0 calls to protocol drain routines

re0:
--------------------------------------------------------------------------
516/639/1155 mbufs in use (current/cache/total)
515/147/662/30000 mbuf clusters in use (current/cache/total/max)
512/128 mbuf+clusters out of packet secondary zone in use (current/cache)
0/0/0/0 4k (page size) jumbo clusters in use (current/cache/total/max)
0/0/0/0 9k jumbo clusters in use (current/cache/total/max)
0/0/0/0 16k jumbo clusters in use (current/cache/total/max)
1159K/453K/1612K bytes allocated to network (current/cache/total)
0/0/0 requests for mbufs denied (mbufs/clusters/mbuf+clusters)
0/0/0 requests for jumbo clusters denied (4k/9k/16k)
0/4/1024 sfbufs in use (current/peak/max)
0 requests for sfbufs denied
0 requests for sfbufs delayed
0 requests for I/O initiated by sendfile
0 calls to protocol drain routines

re1:
--------------------------------------------------------------------------
519/771/1290 mbufs in use (current/cache/total)
518/176/694/30000 mbuf clusters in use (current/cache/total/max)
512/128 mbuf+clusters out of packet secondary zone in use (current/cache)
0/0/0/0 4k (page size) jumbo clusters in use (current/cache/total/max)
0/0/0/0 9k jumbo clusters in use (current/cache/total/max)
0/0/0/0 16k jumbo clusters in use (current/cache/total/max)
1165K/544K/1710K bytes allocated to network (current/cache/total)
0/0/0 requests for mbufs denied (mbufs/clusters/mbuf+clusters)
0/0/0 requests for jumbo clusters denied (4k/9k/16k)
0/4/1024 sfbufs in use (current/peak/max)
0 requests for sfbufs denied
0 requests for sfbufs delayed
0 requests for I/O initiated by sendfile
0 calls to protocol drain routines
```


show system certificate

Syntax

show system certificate
<*certificate-id*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

(Encryption interface on M Series, T Series routers, and QFX Series switches only) Display installed certificates signed by the Juniper Networks certificate authority.

Options

none—Display all installed certificates signed by the Juniper Networks certificate authority.

certificate-id—(Optional) Display the details of a particular certificate.

Required Privilege Level

maintenance

List of Sample Output

show system certificate on page 897
show system certificate (QFX Series) on page 897

Output Fields

Table 81 on page 896 lists the output fields for the **show system certificate** command. Output fields are listed in the approximate order in which they appear.

Table 81: show system certificate Output Fields

Field Name	Field Description
Certificate identifier	Unique identifier associated with a certificate. The certificate identifier is the common name of the subject.
Issuer **Subject**	Information about the certificate issuer and the distinguished name (**DN**) of the issuer, respectively: • **Organization**—Name of the owner's organization. • **Organizational unit**—Name of the owner's department. • **Country**—Two-character country code in which the owner's system is located. • **State**—State in the USA in which the owner is using the certificate. • **Locality**—City in which the owner's system is located. • **Common name**—Name of the owner of the certificate. • **E-mail address**—E-mail address of the owner of the certificate.
Validity	When a certificate is valid.
Signature algorithm	Encryption algorithm applied to the installed certificate.
Public key algorithm	Encryption algorithm applied to the public key.

Sample Output

show system certificate

```
user@host> show system certificate
Certificate identifier: Dallas-v3
  Issuer:
Organization: Juniper Networks, Organizational unit: Juniper CA,
Country:  US, State: CA, Locality: Sunnyvale, Common name: Dallas CA,
E-mail address:ca@juniper.net
  Subject:
  Organization: Juniper Networks, Organizational unit: Juniper CA,
Country: US, State: CA, Locality: Sunnyvale, Common name: Dallas-v3,
E-mail address:ca@juniper.net
Validity:
 Not before: Mar 13 03:23:25 2004 GMT
  Not after: Mar 24 03:23:25 2014 GMT
Signature algorithm: sha1WithRSAEncryption
Public key algorithm: dsaEncryption
```

show system certificate (QFX Series)

```
user@host> show system certificate
Certificate identifier: Dallas-v3
  Issuer:
Organization: Juniper Networks, Organizational unit: Juniper CA,
Country:  US, State: CA, Locality: Sunnyvale, Common name: Dallas CA,
E-mail address:ca@juniper.net
  Subject:
  Organization: Juniper Networks, Organizational unit: Juniper CA,
Country: US, State: CA, Locality: Sunnyvale, Common name: Dallas-v3,
E-mail address:ca@juniper.net
Validity:
 Not before: Mar 13 03:23:25 2004 GMT
  Not after: Mar 24 03:23:25 2014 GMT
Signature algorithm: sha1WithRSAEncryption
Public key algorithm: dsaEncryption
```


show system commit

Syntax show system commit

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the system commit history and any pending commit operation.

Options This command has no options.

Required Privilege Level view

Related Documentation

- clear system commit on page 328

List of Sample Output

show system commit on page 899
show system commit (At a Particular Time) on page 899
show system commit (At the Next Reboot) on page 899
show system commit (Rollback Pending) on page 899
show system commit (QFX Series) on page 899

Output Fields Table 82 on page 898 describes the output fields for the **show system commit** command. Output fields are listed in the approximate order in which they appear.

Table 82: show system commit Output Fields

Field Name	Field Description
Junos XML protocol	Displays the last 50 commit operations listed, most recent to first. The identifier **Junos XML protocol** designates a configuration created for recovery using the **request system configuration rescue save** command.
Junos XML protocol	Date and time of the commit operation.
Junos XML protocol	User who executed the commit operation.
Junos XML protocol	Method used to execute the commit operation: • **Junos XML protocol**—CLI interactive user performed the commit operation. • **Junos XML protocol**—Junos XML protocol client performed the commit operation. • **synchronize**—The **commit synchronize** command was performed on the other Routing Engine. • **snmp**—An SNMP **set** request caused the commit operation. • **button**—A button on the router or switch was pressed to commit a rescue configuration for recovery. • **autoinstall**—A configuration obtained through autoinstallation was committed. • **other**—When there is no login name associated with the session, the values for user and client default to root and other. For example, during a reboot after package installation, mgd commits the configuration as a system commit, and there is no login associated with the commit.

Sample Output

show system commit

```
user@host> show system commit
0   2003-07-28 19:14:04 PDT by root via other
1   2003-07-25 22:01:36 PDT by regress via cli
2   2003-07-25 22:01:32 PDT by regress via cli
3   2003-07-25 21:30:13 PDT by root via button
4   2003-07-25 13:46:48 PDT by regress via cli
5   2003-07-25 05:33:21 PDT by root via autoinstall
...
rescue  2002-05-10 15:32:03 PDT by root via other
```

show system commit (At a Particular Time)

```
user@host> show system commit
commit requested by root via cli at Tue May  7 15:59:00 2002
```

show system commit (At the Next Reboot)

```
user@host> show system commit
commit requested by root via cli at reboot
```

show system commit (Rollback Pending)

```
user@host> show system commit
0 2005-01-05 15:00:37 PST by root via cli commit confirmed, rollback in 3mins
```

show system commit (QFX Series)

```
user@switch> show system commit
0   2011-11-25 19:17:49 PST by root via cli
```


show system configuration archival

Syntax show system configuration archival

Release Information Introduced in Junos OS Release 7.6.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display directory and number of files queued for archival transfer.

NOTE: The **[edit system configuration]** hierarchy is not available on QFabric systems.

Options This command has no options.

Required Privilege Level maintenance

List of Sample Output show system configuration archival on page 900

Sample Output

show system configuration archival

```
user@host> show system configuration archival

/var/transfer/config/:
total 8
```


show system configuration rescue

Syntax show system configuration rescue

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display a rescue configuration, if one exists.

NOTE: The **[edit system configuration]** hierarchy is not available on QFabric systems.

Options This command has no options.

Required Privilege Level maintenance

Related Documentation

- show system configuration archival on page 900

List of Sample Output show system configuration rescue on page 901

Sample Output

show system configuration rescue

```
user@switch> show system configuration rescue
version "7.3"; groups {
    global {
        system {
            host-name router1;
            domain-name customer.net;
            domain-search [ customer.net ];
            backup-router 192.168.124.254;
            name-server {
                172.17.28.11;
                172.17.28.101;
                172.17.28.100;
                172.17.28.10;
            }
            login {
                user regress {
                    uid 928;
                    class ;
                    shell csh;
                    authentication {
                        encrypted-password "$1$kPU..$w.4FGRAGanJ8U4Yq6sbj7."; ##
 SECRET-DATA
                    }
                }
            }
            services {
```



```
                ftp;
                rlogin;
                rsh;
                telnet;
            }
        }
    }
....
```


show system connections

Syntax

show system connections
<extensive>
<all-chassis | all-lcc | lcc *number* | scc>
<inet | inet6>
<show-routing-instances>

Syntax (EX Series)

show system connections
<extensive>
<all-members>
<inet | inet6>
<local>
<member *member-id*>
<show-routing-instances>

Syntax (TX Matrix Router)

show system connections
<extensive>
<all-chassis | all-lcc | lcc *number* | scc>
<inet | inet6>
<show-routing-instances>

Syntax (TX Matrix Plus Router)

show system connections
<extensive>
<all-chassis | all-lcc | lcc *number* | sfc *number*>
<inet | inet6>
<show-routing-instances>

Syntax (MX Series Router)

show system connections
<extensive>
<all-members>
<inet | inet6>
<local>
<member *member-id*>
<show-routing-instances>

Syntax (QFX Series)

show system connections
<extensive>
<inet>
<infrastructure *name*>
<interconnect-device *name*>
<node-group *name*>
<show-routing-instances>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display information about the active IP sockets on the Routing Engine. Use this command to verify which servers are active on a system and what connections are currently in progress.

Options

none—Display information about all active IP sockets on the Routing Engine.

extensive—(Optional) Display exhaustive system process information, which, for TCP connections, includes the TCP control block. This option is useful for debugging TCP connections.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Display system connection activity for all the routers in the chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display system connection activity for all T640 routers connected to the TX Matrix router. On a TX Matrix Plus router, display system connection activity for all connected T1600 or T4000 LCCs

all-members—(EX4200 switches and MX Series routers only) (Optional) Display system connection activity for all members of the Virtual Chassis configuration.

inet | inet6—(Optional) Display IPv4 connections or IPv6 connections, respectively.

infrastructure *name*—(QFabric systems only) (Optional) Display system connection activity for the fabric control Routing Engines or fabric manager Routing Engines.

interconnect-device *name*—(QFabric systems only) (Optional) Display system connection activity for the Interconnect device.

lcc *number*—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display system connection activity for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, display system connection activity for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Display system connection activity for the local Virtual Chassis member.

member *member-id*—(EX4200 switches and MX Series routers only) (Optional) Display system connection activity for the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

node-group *name*—(QFabric systems only) (Optional) Display system connection activity for the Node group.

scc—(TX Matrix routers only) (Optional) Display system connection activity for the TX Matrix router (or switch-card chassis).

sfc—(TX Matrix routers only) (Optional) Display system connection activity for the TX Matrix Plus router.

show-routing-instances—(Optional) Display routing instances.

Additional Information

By default, when you issue the **show system connections** command on the master Routing Engine of a TX Matrix router or a TX Matrix Plus router, the command is broadcast to all the master Routing Engines of the LCCs connected to it in the routing matrix. Likewise, if you issue the same command on the backup Routing Engine of a TX Matrix or a TX Matrix Plus router, the command is broadcast to all backup Routing Engines of the LCCs that are connected to it in the routing matrix.

Required Privilege Level

view

Related Documentation

- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

Output Fields

Table 83 on page 905 describes the output fields for the **show system connections** command. Output fields are listed in the approximate order in which they appear.

Table 83: show system connections Output Fields

Field Name	Field Description
Proto	Protocol of the socket: **IP**, **TCP**, or **UDP** for IPv4 or IPv6.
Recv-Q	Number of input packets received by the protocol and waiting to be processed by the application.
Send-Q	Number of output packets sent by the application and waiting to be processed by the protocol.
Local Address	Local address and port of the socket, separated by a period. An asterisk (*****) indicates that the bound address is the wildcard address. Server sockets typically have the wildcard address and a well-known port bound to them.
Foreign Address	Foreign address and port of the socket, separated by a period. An asterisk (*****) indicates that the address or port is a wildcard.

Table 83: show system connections Output Fields *(continued)*

Field Name	Field Description
Routing Instance	(Displayed only when the **show-routing-instance** option is used.) Routing instances associated with active IP sockets on the Routing Engine.
(state)	For TCP, the protocol state of the socket.

Sample Output

show system connections

```
user@host> show system connections
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address          Foreign Address        (state)
tcp        0      2  192.168.4.16.513       208.197.169.254.894    ESTABLISHED
tcp        0      0  192.168.4.16.513       208.197.169.195.945    ESTABLISHED
tcp        0      0  *.23                   *.*                    LISTEN
tcp        0      0  *.22                   *.*                    LISTEN
tcp        0      0  *.513                  *.*                    LISTEN
tcp00 *.514      *.*                    LISTEN
tcp 0 0*.21      *.*                    LISTEN
tcp00 *.79     *.*                    LISTEN
tcp 00 *.1023     *.*                    LISTEN
tcp 00 *.111     *.*                    LISTEN
udp00192.168.4.16.1634     208.197.169.249.2049
udp00192.168.4.16.1627     208.197.169.254.2049
udp00192.168.4.16.1371     208.197.169.195.2049
udp00*.*      *.*
udp00*.9999     *.*
udp00 *.161     *.*
udp00192.168.4.16.1039     192.168.4.16.1023
udp00192.168.4.16.1038     192.168.4.16.1023
udp 00 192.168.4.16.1037     192.168.4.16.1023
udp00192.168.4.16.1036     192.168.4.16.1023
udp00*.1022     *.*
udp00*.1023     *.*
udp00*.111     *.*
udp00*.*      *.*
```

show system connections extensive

```
user@host> show system connections extensive

Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address                                 Foreign Address
                               (state)
tcp4       0      6  192.168.187.15.23
172.27.133.138.3013                         ESTABLISHED
   sndsbcc:          6 sndsbmbcnt:       256  sndsbmbmax:     272000
sndsblowat:       2048 sndsbhiwat:     34000
   rcvsbcc:          0 rcvsbmbcnt:         0  rcvsbmbmax:     533120
rcvsblowat:          1 rcvsbhiwat:     66640
   proc id:          0  proc name:
       iss: 2566994072      sndup: 2566994491
    snduna: 2566994491     sndnxt: 2566994494       sndwnd:      64094
    sndmax: 2566994494    sndcwnd:       6589 sndssthresh:        2720
```



```
        irs:  236981199      rcvup:  236981325
     rcvnxt:  236981327     rcvadv:  237046862      rcvwnd:      66640
        rtt:  140058623       srtt:      15519        rttv:        908
     rxtcur:       1200   rxtshift:          0       rtseq: 2566994491
     rttmin:       1000  mss:       1360
      flags: SACK_PERMIT [0x2000200]
tcp4       0      0  10.255.165.93.179
10.255.165.203.65141                          ESTABLISHED
   sndsbcc:          0 sndsbmbcnt:          0  sndsbmbmax:     131072
sndsblowat:       2048 sndsbhiwat:      16384
   rcvsbcc:          0 rcvsbmbcnt:          0  rcvsbmbmax:     131072
rcvsblowat:          1 rcvsbhiwat:      16384
   proc id:          0  proc name:
        iss: 2555961065      sndup: 2555995917
     snduna: 2555995917     sndnxt: 2555995917      sndwnd:      16384
     sndmax: 2555995917    sndcwnd:       1000 sndssthresh: 1073725440
        irs: 2123825753      rcvup: 2123860681
     rcvnxt: 2123860681     rcvadv: 2123877065      rcvwnd:      16384
        rtt:          0       srtt:       3309        rttv:         72
     rxtcur:       1200   rxtshift:          0       rtseq: 2555995898
     rttmin:       1000  mss:        500
      flags: REQ_SCALE RCVD_SCALE REQ_TSTMP RCVD_TSTMP SACK_PERMIT [0x3e0]
tcp4       0      0  10.255.165.203.65141
10.255.165.93.179                             ESTABLISHED
   sndsbcc:          0 sndsbmbcnt:          0  sndsbmbmax:     131072
sndsblowat:       2048 sndsbhiwat:      16384
   rcvsbcc:          0 rcvsbmbcnt:          0  rcvsbmbmax:     131072
rcvsblowat:          1 rcvsbhiwat:      16384
   proc id:       5022  proc name:        rpd
        iss: 2123825753      sndup: 2123860662
     snduna: 2123860681     sndnxt: 2123860681      sndwnd:      16384
     sndmax: 2123860681    sndcwnd:       1000 sndssthresh: 1073725440
        irs: 2555961065      rcvup: 2555995917
     rcvnxt: 2555995917     rcvadv: 2556012301      rcvwnd:      16384
        rtt:          0       srtt:       3279        rttv:         22
     rxtcur:       1200   rxtshift:          0       rtseq: 2123860662
     rttmin:       1000  mss:        500
      flags: REQ_SCALE RCVD_SCALE REQ_TSTMP RCVD_TSTMP SACK_PERMIT [0x100003e0]
tcp4       0      0  10.255.165.203.179
10.255.165.113.52404                          ESTABLISHED
   sndsbcc:          0 sndsbmbcnt:          0  sndsbmbmax:     131072
sndsblowat:       2048 sndsbhiwat:      16384
   rcvsbcc:          0 rcvsbmbcnt:          0  rcvsbmbmax:     131072
rcvsblowat:          1 rcvsbhiwat:      16384
   proc id:          0  proc name:
        iss: 1109297190      sndup: 1109332099
     snduna: 1109332118     sndnxt: 1109332118      sndwnd:      16384
     sndmax: 1109332118    sndcwnd:       1000 sndssthresh: 1073725440
        irs: 1476831634      rcvup: 1476866449
     rcvnxt: 1476866449     rcvadv: 1476882833      rcvwnd:      16384
        rtt:          0       srtt:       3235        rttv:         18
     rxtcur:       1200   rxtshift:          0       rtseq: 1109332099
     rttmin:       1000  mss:        500
      flags: REQ_SCALE RCVD_SCALE REQ_TSTMP RCVD_TSTMP SACK_PERMIT [0x3e0]
```

show system connections lcc (TX Matrix Router)

```
user@host> show system connections lcc 2

lcc2-re0:
--------------------------------------------------------------------------
```

```
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address          Foreign Address        (state)
tcp4       0      0  192.168.66.131.1342    192.168.66.130.23      ESTABLISHED
tcp4       0      0  192.168.66.131.2059    192.168.66.130.23      ESTABLISHED
tcp4       0      0  192.168.66.131.4571    192.168.66.130.23      ESTABLISHED
tcp4       0      0  192.168.66.131.2496    192.168.66.130.23      ESTABLISHED
tcp4       0      0  *.3221                 *.*                    LISTEN
tcp4       0      0  *.23                   *.*                    LISTEN
tcp4       0      0  *.22                   *.*                    LISTEN
tcp4       0      0  *.514                  *.*                    LISTEN
tcp4       0      0  *.513                  *.*                    LISTEN
tcp4       0      0  *.21                   *.*                    LISTEN
tcp4       0      0  *.79                   *.*                    LISTEN
tcp4       0      0  *.6234                 *.*                    LISTEN
udp4       0      0  *.514                  *.*
udp4       0      0  *.6333                 *.*
```

show system connections show-routing-instances

```
user@host> show system connections show-routing-instances
Active Internet connections (including servers) (including routing-instances)
Proto Recv-Q Send-Q  Local Address          Foreign Address        Routing Instance
       (state)
tcp4       0      0  192.168.69.204.23      172.17.28.19.4267      default
          ESTABLISHED
tcp4       0      0  192.168.69.204.58540   10.209.7.138.23        default
          ESTABLISHED
tcp4       0      0  192.168.69.204.23      172.17.28.19.1098      default
          ESTABLISHED
tcp4       0      0  192.168.7.1.57668      192.168.9.1.179        default
          ESTABLISHED
tcp4       0      0  192.168.7.1.179        192.168.8.1.49209      default
          ESTABLISHED
tcp4       0      0  128.0.0.1.6234         128.0.3.17.1024
__juniper_private1__   ESTABLISHED
tcp4       0      0  128.0.0.4.9000         128.0.0.4.59103
__juniper_private1__   ESTABLISHED
tcp4       0      0  128.0.0.4.59103        128.0.0.4.9000
__juniper_private1__   ESTABLISHED
tcp4       0      0  *.32012                *.*
__juniper_private1__   LISTEN
tcp4       0      0  *.9000                 *.*
__juniper_private1__   LISTEN
tcp4       0      0  *.33007                *.*
__juniper_private2__   LISTEN
tcp46      0      0  *.179                  *.*                    default
          LISTEN
tcp4       0      0  *.179                  *.*                    default
          LISTEN
tcp4       0      0  *.6154                 *.*
__juniper_private1__   LISTEN
tcp4       0      0  *.6153                 *.*
__juniper_private1__   LISTEN
tcp4       0      0  *.7000                 *.*
__juniper_private1__   LISTEN
tcp4       0      0  *.6152                 *.*
__juniper_private1__   LISTEN
tcp4       0      0  *.6156                 *.*
__juniper_private1__   LISTEN
tcp4       0      0  *.33005                *.*
__juniper_private2__   LISTEN
```



```
tcp4       0      0  *.31343               *.*
__juniper_private1__    LISTEN
tcp4       0      0  *.31341               *.*
__juniper_private1__    LISTEN
tcp4       0      0  *.32003               *.*
__juniper_private2__    LISTEN
tcp4       0      0  *.666                 *.*
__juniper_private1__    LISTEN
tcp4       0      0  *.38                  *.*
__juniper_private1__    LISTEN
tcp4       0      0  *.3221                *.*                     default
          LISTEN
```

show system connections (TX Matrix Plus Router)

```
user@host> show system connections
sfc0-re0:
--------------------------------------------------------------------------
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address                               Foreign Address
                               (state)
tcp4       0      3  192.168.178.11.23
172.17.28.19.3565                          ESTABLISHED
tcp4       0      0  192.168.178.11.23
172.17.28.204.62719                        ESTABLISHED
tcp4       0      0  192.168.178.11.23
192.168.69.199.51255                       ESTABLISHED
tcp4       0      0  192.168.178.11.23
172.24.26.227.42860                        ESTABLISHED
tcp4       0      0  *.6156                                        *.*
                                 LISTEN
tcp4       0      0  162.0.0.4.32012                             162.0.0.5.58935
                               ESTABLISHED
tcp4       0      0  *.32012                                       *.*
                                 LISTEN
tcp4       0      0  *.33007                                       *.*
                                 LISTEN
tcp4       0      0  *.666                                         *.*
                                 LISTEN
tcp4       0      0  162.0.0.4.6161                              162.0.0.5.62026
                               ESTABLISHED
tcp4       0      0  *.33005                                       *.*
                                 LISTEN
tcp4       0      0  162.0.0.4.9000                              162.0.0.4.51611
                               ESTABLISHED
tcp4       0      0  162.0.0.4.51611                              162.0.0.4.9000
                                ESTABLISHED
tcp4       0      0  *.6151                                        *.*
                                 LISTEN
tcp4       0      0  *.6154                                        *.*
                                 LISTEN
tcp4       0      0  *.6153                                        *.*
                                 LISTEN
tcp4       0      0  *.31343                                       *.*
                                 LISTEN
tcp4       0      0  *.31341                                       *.*
                                 LISTEN
tcp4       0      0  *.9000                                        *.*
                                 LISTEN
tcp4       0      0  *.6152                                        *.*
                                 LISTEN
```

```
tcp4       0      0  *.32003                                              *.*
                                LISTEN
tcp4       0      0  *.33009                                              *.*
                                LISTEN
tcp4       0      0  *.3221                                               *.*
                                LISTEN
tcp4       0      0  *.23                                                 *.*
                                LISTEN
tcp4       0      0  *.22                                                 *.*
                                LISTEN
tcp4       0      0  *.514                                                *.*
                                LISTEN
tcp4       0      0  *.513                                                *.*
                                LISTEN
tcp4       0      0  *.21                                                 *.*
                                LISTEN
tcp4       0      0  *.79                                                 *.*
                                LISTEN
tcp4       0      0  *.514                                                *.*
                                LISTEN
tcp4       0      0  *.513                                                *.*
                                LISTEN
tcp4       0      0  *.6234                                               *.*
                                LISTEN
udp4       0      0  127.0.0.1.123                                        *.*
udp4       0      0  10.255.178.11.123                                    *.*
udp4       0      0  *.123                                                *.*
udp46      0      0  *.514                                                *.*
udp4       0      0  *.514                                                *.*
udp46      0      0  *.62027                                              *.*
udp4       0      0  *.59363                                              *.*
udp4       0      0  *.31342                                              *.*
udp46      0      0  *.161                                                *.*
udp4       0      0  *.161                                                *.*
udp4       0      0  *.31340                                              *.*
udp4       0      0  *.31340                                              *.*
udp46      0      0  *.49152                                              *.*
udp46      0      0  *.4784                                               *.*
udp46      0      0  *.3784                                               *.*
udp4       0      0  *.49152                                              *.*
udp4       0      0  *.4784                                               *.*
udp4       0      0  *.3784                                               *.*
udp4       0      0  *.6333                                               *.*
ip4        0      0  *.*                                                  *.*
ip4        0      0  *.*                                                  *.*

lcc0-re0:
--------------------------------------------------------------------------
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address                                Foreign Address
                               (state)
tcp4       0      0  192.168.178.3.23
172.24.26.227.50399                           ESTABLISHED
tcp4       0      0  *.6234                                               *.*
                                LISTEN
tcp4       0      0  *.7000                                               *.*
                                LISTEN
tcp4       0      0  *.9000                                               *.*
                                LISTEN
tcp4       0      0  *.33009                                              *.*
                                LISTEN
```



```
tcp4       0      0  *.3221                                             *.*
                                LISTEN
tcp4       0      0  *.23                                               *.*
                                LISTEN
tcp4       0      0  *.22                                               *.*
                                LISTEN
tcp4       0      0  *.514                                              *.*
                                LISTEN
tcp4       0      0  *.513                                              *.*
                                LISTEN
tcp4       0      0  *.21                                               *.*
                                LISTEN
tcp4       0      0  *.79                                               *.*
                                LISTEN
tcp4       0      0  *.514                                              *.*
                                LISTEN
tcp4       0      0  *.513                                              *.*
                                LISTEN
udp46      0      0  *.514                                              *.*
udp4       0      0  *.514                                              *.*
udp46      0      0  *.59924                                            *.*
udp4       0      0  *.59412                                            *.*
udp46      0      0  *.161                                              *.*
udp4       0      0  *.161                                              *.*
udp4       0      0  *.31342                                            *.*
udp4       0      0  *.6333                                             *.*

lcc1-re0:
--------------------------------------------------------------------------
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address                              Foreign Address
                              (state)
tcp4       0      0  *.6234                                             *.*
                                LISTEN
tcp4       0      0  *.7000                                             *.*
                                LISTEN
tcp4       0      0  *.9000                                             *.*
                                LISTEN
tcp4       0      0  *.3221                                             *.*
                                LISTEN
tcp4       0      0  *.23                                               *.*
                                LISTEN
tcp4       0      0  *.22                                               *.*
                                LISTEN
tcp4       0      0  *.514                                              *.*
                                LISTEN
tcp4       0      0  *.513                                              *.*
                                LISTEN
tcp4       0      0  *.21                                               *.*
                                LISTEN
tcp4       0      0  *.79                                               *.*
                                LISTEN
tcp4       0      0  *.514                                              *.*
                                LISTEN
tcp4       0      0  *.513                                              *.*
                                LISTEN
tcp4       0      0  *.33009                                            *.*
                                LISTEN
udp46      0      0  *.514                                              *.*
udp4       0      0  *.514                                              *.*
udp46      0      0  *.59924                                            *.*
```



```
udp4       0      0  *.59412                                *.*
udp4       0      0  *.31342                                *.*
udp46      0      0  *.161                                  *.*
udp4       0      0  *.161                                  *.*
udp4       0      0  *.6333                                 *.*

lcc2-re0:
--------------------------------------------------------------------------
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address                           Foreign Address
                               (state)
tcp4       0      0  *.6234                                 *.*
                                 LISTEN
tcp4       0      0  *.7000                                 *.*
                                 LISTEN
tcp4       0      0  *.9000                                 *.*
                                 LISTEN
tcp4       0      0  *.33009                                *.*
                                 LISTEN
tcp4       0      0  *.3221                                 *.*
                                 LISTEN
tcp4       0      0  *.23                                   *.*
                                 LISTEN
tcp4       0      0  *.22                                   *.*
                                 LISTEN
tcp4       0      0  *.514                                  *.*
...
```

show system connections sfc (TX Matrix Plus Router)

```
user@host> show system connections sfc 0
sfc0-re0:
--------------------------------------------------------------------------
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address                           Foreign Address
                               (state)
tcp4       0      0  162.0.0.4.514                          132.0.0.4.952
                                 TIME_WAIT
tcp4       0      0  162.0.0.4.514                          131.0.0.4.694
                                 TIME_WAIT
tcp4       0      0  162.0.0.4.514                          130.0.0.4.860
                                 TIME_WAIT
tcp4       0      0  162.0.0.4.514                          129.0.0.4.716
                                 TIME_WAIT
tcp4       0      0  162.0.0.4.996                          132.0.0.4.514
                                 TIME_WAIT
tcp4       0      0  162.0.0.4.798                          131.0.0.4.514
                                 TIME_WAIT
tcp4       0      0  162.0.0.4.995                          130.0.0.4.514
                                 TIME_WAIT
tcp4       0      0  162.0.0.4.895                          129.0.0.4.514
                                 TIME_WAIT
tcp4       0      0  192.168.178.11.21
172.17.28.204.64662                         TIME_WAIT
tcp4       0      0  192.168.178.11.21
172.17.28.204.51612                         TIME_WAIT
tcp4       0      0  *.6156                                 *.*
                                 LISTEN
tcp4       0      0  *.9000                                 *.*
                                 LISTEN
tcp4       0      0  *.666                                  *.*
```



```
                                LISTEN
tcp4       0      2  192.168.178.11.23
172.17.28.19.3565                          ESTABLISHED
tcp4       0      0  192.168.178.11.23
172.17.28.204.62719                        ESTABLISHED
tcp4       0      0  192.168.178.11.23
192.168.69.199.51255                       ESTABLISHED
tcp4       0      0  192.168.178.11.23
172.24.26.227.42860                        ESTABLISHED
tcp4       0      0  162.0.0.4.32012                       162.0.0.5.58935
                              ESTABLISHED
tcp4       0      0  *.32012                                  *.*
                                LISTEN
tcp4       0      0  *.33007                                  *.*
                                LISTEN
tcp4       0   1432  162.0.0.4.6161                        162.0.0.5.62026
                              ESTABLISHED
tcp4       0      0  *.33005                                  *.*
                                LISTEN
tcp4       0      0  162.0.0.4.9000                        162.0.0.4.51611
                              FIN_WAIT_2
tcp4       0      0  162.0.0.4.51611                        162.0.0.4.9000
                               CLOSE_WAIT
tcp4       0      0  *.6151                                   *.*
                                LISTEN
tcp4       0      0  *.6154                                   *.*
                                LISTEN
tcp4       0      0  *.6153                                   *.*
                                LISTEN
tcp4       0      0  *.31343                                  *.*
                                LISTEN
tcp4       0      0  *.31341                                  *.*
                                LISTEN
tcp4       0      0  *.6152                                   *.*
                                LISTEN
tcp4       0      0  *.32003                                  *.*
                                LISTEN
tcp4       0      0  *.33009                                  *.*
                                LISTEN
tcp4       0      0  *.3221                                   *.*
                                LISTEN
tcp4       0      0  *.23                                     *.*
                                LISTEN
tcp4       0      0  *.22                                     *.*
                                LISTEN
tcp4       0      0  *.514                                    *.*
                                LISTEN
tcp4       0      0  *.513                                    *.*
                                LISTEN
tcp4       0      0  *.21                                     *.*
                                LISTEN
tcp4       0      0  *.79                                     *.*
                                LISTEN
tcp4       0      0  *.514                                    *.*
                                LISTEN
tcp4       0      0  *.513                                    *.*
                                LISTEN
tcp4       0      0  *.6234                                   *.*
                                LISTEN
udp4       0      0  127.0.0.1.123                            *.*
udp4       0      0  10.255.178.11.123                        *.*
```



```
udp4        0      0  *.123                                                *.*
udp46       0      0  *.514                                                *.*
udp4        0      0  *.514                                                *.*
udp46       0      0  *.50895                                              *.*
udp4        0      0  *.50794                                              *.*
udp4        0      0  *.31342                                              *.*
udp46       0      0  *.161                                                *.*
udp4        0      0  *.161                                                *.*
udp4        0      0  *.31340                                              *.*
udp4        0      0  *.31340                                              *.*
udp46       0      0  *.49152                                              *.*
udp46       0      0  *.4784                                               *.*
udp46       0      0  *.3784                                               *.*
udp4        0      0  *.49152                                              *.*
udp4        0      0  *.4784                                               *.*
udp4        0      0  *.3784                                               *.*
udp4        0      0  *.6333                                               *.*
ip4       104      0  *.*                                                  *.*
ip4         0      0  *.*                                                  *.*
ip4         0      0  *.*                                                  *.*
```

show system connections show-routing-instances (TX Matrix Plus Router)

```
user@host> show system connections show-routing-instances
sfc0-re0:
--------------------------------------------------------------------------
Active Internet connections (including servers) (including routing-instances)
Proto Recv-Q Send-Q  Local Address                               Foreign Address
                               Routing Instance       (state)
tcp4        0      0  *.6156                                       *.*
                                 __juniper_private1__   LISTEN
tcp4        0      0  *.9000                                       *.*
                                 __juniper_private1__   LISTEN
tcp4        0      0  *.666                                        *.*
                                 __juniper_private1__   LISTEN
tcp4        0      2  192.168.178.11.23
172.17.28.19.3565                        default                ESTABLISHED
tcp4        0      0  192.168.178.11.23
172.17.28.204.62719                      default                ESTABLISHED
tcp4        0      0  192.168.178.11.23
192.168.69.199.51255                     default                ESTABLISHED
tcp4        0      0  192.168.178.11.23
172.24.26.227.42860                      default                ESTABLISHED
tcp4       0      0  162.0.0.4.32012                             162.0.0.5.58935
                               __juniper_private1__   ESTABLISHED
tcp4        0      0  *.32012                                      *.*
                                 __juniper_private1__   LISTEN
tcp4        0      0  *.33007                                      *.*
                                 __juniper_private2__   LISTEN
tcp4       0      0  162.0.0.4.6161                              162.0.0.5.62026
                               __juniper_private1__   ESTABLISHED
tcp4        0      0  *.33005                                      *.*
                                 __juniper_private2__   LISTEN
tcp4       0      0  162.0.0.4.9000                              162.0.0.4.51611
                               __juniper_private1__   FIN_WAIT_2
tcp4        0      0  162.0.0.4.51611                              162.0.0.4.9000
                                __juniper_private1__   CLOSE_WAIT
tcp4        0      0  *.6151                                       *.*
                                 __juniper_private1__   LISTEN
tcp4        0      0  *.6154                                       *.*
                                 __juniper_private1__   LISTEN
```



```
tcp4       0      0  *.6153                                        *.*
                           __juniper_private1__   LISTEN
tcp4       0      0  *.31343                                       *.*
                           __juniper_private1__   LISTEN
tcp4       0      0  *.31341                                       *.*
                           __juniper_private1__   LISTEN
tcp4       0      0  *.6152                                        *.*
                           __juniper_private1__   LISTEN
tcp4       0      0  *.32003                                       *.*
                           __juniper_private2__   LISTEN
tcp4       0      0  *.33009                                       *.*
                           __juniper_private2__   LISTEN
tcp4       0      0  *.3221                                        *.*
                           default                LISTEN
tcp4       0      0  *.23                                          *.*
                           default                LISTEN
tcp4       0      0  *.22                                          *.*
                           default                LISTEN
tcp4       0      0  *.514                                         *.*
                           default                LISTEN
tcp4       0      0  *.513                                         *.*
                           default                LISTEN
tcp4       0      0  *.21                                          *.*
                           default                LISTEN
tcp4       0      0  *.79                                          *.*
                           default                LISTEN
tcp4       0      0  *.514                                         *.*
                           __juniper_private1__   LISTEN
tcp4       0      0  *.513                                         *.*
                           __juniper_private1__   LISTEN
tcp4       0      0  *.6234                                        *.*
                           __juniper_private1__   LISTEN
udp4       0      0  127.0.0.1.123                                 *.*
                           default
udp4       0      0  10.255.178.11.123                             *.*
                           default
udp4       0      0  *.123                                         *.*
                           default
udp46      0      0  *.514                                         *.*
                           default
udp4       0      0  *.514                                         *.*
                           default
udp46      0      0  *.50895                                       *.*
                           default
udp4       0      0  *.50794                                       *.*
                           default
udp4       0      0  *.31342                                       *.*
                           __juniper_private1__
udp46      0      0  *.161                                         *.*
                           default
udp4       0      0  *.161                                         *.*
                           default
udp4       0      0  *.31340                                       *.*
                           __juniper_private2__
udp4       0      0  *.31340                                       *.*
                           __juniper_private1__
udp46      0      0  *.49152                                       *.*
                           default
udp46      0      0  *.4784                                        *.*
                           default
udp46      0      0  *.3784                                        *.*
```



```
                                default
udp4       0      0  *.49152                                      *.*
                                default
udp4       0      0  *.4784                                       *.*
                                default
udp4       0      0  *.3784                                       *.*
                                default
udp4       0      0  *.6333                                       *.*
                                __juniper_private1__
ip4        0      0  *.*                                          *.*
                                default
ip4        0      0  *.*                                          *.*
                                default
ip4        0      0  *.*                                          *.*
                                default

lcc0-re0:
--------------------------------------------------------------------------
Active Internet connections (including servers) (including routing-instances)
Proto Recv-Q Send-Q  Local Address                               Foreign Address
                              Routing Instance       (state)
tcp4       0      0  *.7000                                       *.*
                                __juniper_private1__   LISTEN
tcp4       0      0  192.168.178.3.23
172.24.26.227.50399                         default                ESTABLISHED
tcp4       0      0  *.6234                                       *.*
                                __juniper_private1__   LISTEN
tcp4       0      0  *.9000                                       *.*
                                __juniper_private1__   LISTEN
tcp4       0      0  *.33009                                      *.*
                                __juniper_private2__   LISTEN
tcp4       0      0  *.3221                                       *.*
                                default                LISTEN
tcp4       0      0  *.23                                         *.*
                                default                LISTEN
tcp4       0      0  *.22                                         *.*
                                default                LISTEN
tcp4       0      0  *.514                                        *.*
                                default                LISTEN
tcp4       0      0  *.513                                        *.*
                                default                LISTEN
tcp4       0      0  *.21                                         *.*
                                default                LISTEN
tcp4       0      0  *.79                                         *.*
                                default                LISTEN
tcp4       0      0  *.514                                        *.*
                                __juniper_private1__   LISTEN
tcp4       0      0  *.513                                        *.*
                                __juniper_private1__   LISTEN
udp46      0      0  *.514                                        *.*
                                default
udp4       0      0  *.514                                        *.*
                                default
udp46      0      0  *.59924                                      *.*
                                default
udp4       0      0  *.59412                                      *.*
                                default
udp46      0      0  *.161                                        *.*
                                default
udp4       0      0  *.161                                        *.*
                                default
```



```
udp4       0      0  *.31342                                    *.*
                          __juniper_private1__
udp4       0      0  *.6333                                     *.*
                          __juniper_private1__

lcc1-re0:
--------------------------------------------------------------------------
Active Internet connections (including servers) (including routing-instances)
Proto Recv-Q Send-Q  Local Address                            Foreign Address
                        Routing Instance      (state)
tcp4       0      0  *.7000                                     *.*
                          __juniper_private1__   LISTEN
tcp4       0      0  *.6234                                     *.*
                          __juniper_private1__   LISTEN
tcp4       0      0  *.9000                                     *.*
                          __juniper_private1__   LISTEN
tcp4       0      0  *.3221                                     *.*
                          default                LISTEN
tcp4       0      0  *.23                                       *.*
                          default                LISTEN
tcp4       0      0  *.22                                       *.*
                          default                LISTEN
tcp4       0      0  *.514                                      *.*
                          default                LISTEN
tcp4       0      0  *.513                                      *.*
                          default                LISTEN
tcp4       0      0  *.21                                       *.*
                          default                LISTEN
tcp4       0      0  *.79                                       *.*
                          default                LISTEN
tcp4       0      0  *.514                                      *.*
                          __juniper_private1__   LISTEN
tcp4       0      0  *.513                                      *.*
                          __juniper_private1__   LISTEN
tcp4       0      0  *.33009                                    *.*
                          __juniper_private2__   LISTEN
udp46      0      0  *.514                                      *.*
                          default
udp4       0      0  *.514                                      *.*
                          default
udp46      0      0  *.59924                                    *.*
                          default
udp4       0      0  *.59412                                    *.*
                          default
udp4       0      0  *.31342                                    *.*
                          __juniper_private1__
udp46      0      0  *.161                                      *.*
                          default
udp4       0      0  *.161                                      *.*
                          default
udp4       0      0  *.6333                                     *.*
                          __juniper_private1__

lcc2-re0:
--------------------------------------------------------------------------
Active Internet connections (including servers) (including routing-instances)
Proto Recv-Q Send-Q  Local Address                            Foreign Address
                        Routing Instance      (state)
tcp4       0      0  *.7000                                     *.*
                          __juniper_private1__   LISTEN
tcp4       0      0  *.6234                                     *.*
```

```
                                __juniper_private1__   LISTEN
tcp4       0      0  *.9000                                       *.*
                                __juniper_private1__   LISTEN
tcp4       0      0  *.33009                                      *.*
                                __juniper_private2__   LISTEN
tcp4       0      0  *.3221                                       *.*
                                default                LISTEN
tcp4       0      0  *.23                                         *.*
                                default                LISTEN
tcp4       0      0  *.22                                         *.*
                                default                LISTEN
tcp4       0      0  *.514                                        *.*
                                default                LISTEN
tcp4       0      0  *.513                                        *.*
                                default                LISTEN
tcp4       0      0  *.21                                         *.*
                                default                LISTEN
tcp4       0      0  *.79                                         *.*
                                default                LISTEN
tcp4       0      0  *.514                                        *.*
                                __juniper_private1__   LISTEN
tcp4       0      0  *.513                                        *.*
                                __juniper_private1__   LISTEN
udp46      0      0  *.514                                        *.*
                                default
udp4       0      0  *.514                                        *.*
                                default
udp4       0      0  *.31342                                      *.*
                                __juniper_private1__
udp46      0      0  *.62103                                      *.*
                                default
udp4       0      0  *.59924                                      *.*
                                default
udp46      0      0  *.161                                        *.*
                                default
udp4       0      0  *.161                                        *.*
                                default
udp4       0      0  *.6333                                       *.*
                                __juniper_private1__

lcc3-re0:
--------------------------------------------------------------------------
Active Internet connections (including servers) (including routing-instances)
Proto Recv-Q Send-Q  Local Address                               Foreign Address
                              Routing Instance       (state)
tcp4       0      0  *.7000                                       *.*
                                __juniper_private1__   LISTEN
tcp4       0      0  *.6234                                       *.*
                                __juniper_private1__   LISTEN
tcp4       0      0  *.9000                                       *.*
                                __juniper_private1__   LISTEN
tcp4       0      0  *.33009                                      *.*
                                __juniper_private2__   LISTEN
tcp4       0      0  *.3221                                       *.*
                                default                LISTEN
tcp4       0      0  *.23                                         *.*
                                default                LISTEN
tcp4       0      0  *.22                                         *.*
                                default                LISTEN
tcp4       0      0  *.514                                        *.*
                                default                LISTEN
```



```
tcp4        0      0  *.513                                          *.*
                                 default              LISTEN
tcp4        0      0  *.21                                           *.*
                                 default              LISTEN
tcp4        0      0  *.79                                           *.*
                                 default              LISTEN
tcp4        0      0  *.514                                          *.*
                                 __juniper_private1__ LISTEN
tcp4        0      0  *.513                                          *.*
                                 __juniper_private1__ LISTEN
udp46       0      0  *.514                                          *.*
                                 default
udp4        0      0  *.514                                          *.*
                                 default
udp46       0      0  *.62103                                        *.*
                                 default
udp4        0      0  *.59924                                        *.*
                                 default
udp4        0      0  *.31342                                        *.*
                                 __juniper_private1__
udp46       0      0  *.161                                          *.*
                                 default
udp4        0      0  *.161                                          *.*
                                 default
udp4        0      0  *.6333                                         *.*
                                 __juniper_private1__
```

show system connections (QFX3500 Switch)

```
user@switch> show system connections
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address                              Foreign Address
                               (state)
tcp4        0      0  10.94.204.110.23
172.17.28.19.1308                            ESTABLISHED
tcp4        0      0  128.0.0.1.6234                             128.0.0.1.65142
                               ESTABLISHED
tcp4        0      0  128.0.0.1.65142                             128.0.0.1.6234
                                ESTABLISHED
tcp4        0      0  128.0.0.1.33003                            128.0.0.1.61441
                               ESTABLISHED
tcp4        0      0  128.0.0.1.61441                            128.0.0.1.33003
                               ESTABLISHED
tcp46       0      0  *.179                                          *.*
                                 LISTEN
tcp4        0      0  *.179                                          *.*
                                 LISTEN
tcp4        0      0  128.0.0.16.9000                           128.0.0.16.50970
                              ESTABLISHED
tcp4        0      0  128.0.0.16.50970                           128.0.0.16.9000
                               ESTABLISHED
tcp4        0      0  *.38                                           *.*
                                 LISTEN
tcp4        0      0  *.3491                                         *.*
                                 LISTEN
tcp4        0      0  *.6156                                         *.*
                                 LISTEN
tcp4        0      0  128.0.0.1.33001                            128.0.0.1.59437
                               ESTABLISHED
tcp4        0      0  128.0.0.1.59437                            128.0.0.1.33001
                               ESTABLISHED
```

```
tcp4       0      0  128.0.0.1.33023                              128.0.0.1.63605
                               ESTABLISHED
tcp4       0      0  128.0.0.1.63605                              128.0.0.1.33023
                               ESTABLISHED
tcp4       0      0  128.0.0.1.33001                              128.0.0.1.63830
                               ESTABLISHED
tcp4       0      0  128.0.0.1.63830                              128.0.0.1.33001
                               ESTABLISHED
tcp4       0      0  *.667                                        *.*
                                 LISTEN
tcp4       0      0  *.6156                                       *.*
                                 LISTEN
tcp4       0      0  128.0.0.1.7000                               128.0.0.1.51580
                               ESTABLISHED
tcp4       0      0  128.0.0.1.51580                              128.0.0.1.7000
                                ESTABLISHED
tcp4       0      0  128.0.0.1.6234                               128.0.0.1.53646
                               ESTABLISHED
tcp4       0      0  *.33001                                      *.*
                                 LISTEN
tcp4       0      0  *.33003                                      *.*
                                 LISTEN
tcp4       0      0  128.0.0.1.53646                              128.0.0.1.6234
                                ESTABLISHED
tcp4       0      0  128.0.0.16.9000                             128.0.0.16.63454
                              ESTABLISHED
tcp4       0      0  128.0.0.16.63454                             128.0.0.16.9000
                               ESTABLISHED
tcp4       0      0  *.666                                        *.*
                                 LISTEN
tcp4       0      0  *.7000                                       *.*
                                 LISTEN
tcp4       0      0  *.51627                                      *.*
                                 LISTEN
tcp4       0      0  *.3492                                       *.*
                                 LISTEN
tcp4       0      0  *.33023                                      *.*
                                 LISTEN
tcp4       0      0  *.33013                                      *.*
                                 LISTEN
tcp4       0      0  *.7202                                       *.*
                                 LISTEN
tcp4       0      0  *.6151                                       *.*
                                 LISTEN
tcp4       0      0  *.9000                                       *.*
                                 LISTEN
tcp4       0      0  *.6161                                       *.*
                                 LISTEN
tcp4       0      0  *.6011                                       *.*
                                 LISTEN
tcp4       0      0  *.3221                                       *.*
                                 LISTEN
tcp4       0      0  *.23                                         *.*
                                 LISTEN
tcp4       0      0  *.22                                         *.*
                                 LISTEN
tcp4       0      0  *.514                                        *.*
                                 LISTEN
tcp4       0      0  *.513                                        *.*
                                 LISTEN
tcp4       0      0  *.21                                         *.*
```



```
                                   LISTEN
tcp4       0      0  *.79                                              *.*
                                   LISTEN
tcp4       0      0  *.514                                             *.*
                                   LISTEN
tcp4       0      0  *.513                                             *.*
                                   LISTEN
tcp4       0      0  *.1127                                            *.*
                                   LISTEN
tcp4       0      0  *.1129                                            *.*
                                   LISTEN
tcp4       0      0  *.1128                                            *.*
                                   LISTEN
tcp4       0      0  *.6234                                            *.*
                                   LISTEN
udp46      0      0  *.514                                             *.*
udp4       0      0  *.514                                             *.*
udp4       0      0  128.0.0.1.123                                     *.*
udp46      0      0  *.53344                                           *.*
udp4       0      0  *.54261                                           *.*
udp46      0      0  *.161                                             *.*
udp4       0      0  *.161                                             *.*
udp4       0      0  *.31342                                           *.*
udp4       0      0  *.59137                                           *.*
udp4       0      0  *.*                                               *.*
udp46      0      0  *.49152                                           *.*
udp46      0      0  *.4784                                            *.*
udp46      0      0  *.3784                                            *.*
udp4       0      0  *.49152                                           *.*
udp4       0      0  *.4784                                            *.*
udp4       0      0  *.3784                                            *.*
udp4       0      0  10.255.204.110.123                                *.*
udp4       0      0  *.123                                             *.*
udp4       0      0  *.67                                              *.*
udp4       0      0  *.6333                                            *.*
udp4       0      0  *.2293                                            *.*
ip4        0      0  *.*                                               *.*
ip4        0      0  *.*                                               *.*
ip4        0      0  *.*                                               *.*
```


show system core-dumps

Syntax

show system core-dumps
<brief | detail>
<*core-filename*>
<core-file-info>

Syntax (EX Series Switches)

show system core-dumps
<all-members>
<brief | detail>
<*core-filename*>
<core-file-info>
<local>
<member *member-id*>

Syntax (TX Matrix Router)

show system core-dumps
<all-chassis | all-lcc | lcc *number* | scc>
<brief | detail>
<*core-filename*>
<core-file-info>

Syntax (TX Matrix Plus Router)

show system core-dumps
<all-chassis | all-lcc | lcc *number* | sfc *number*>
<brief | detail>
<*core-filename*>
<core-file-info>

Syntax (QFX Series)

show system core-dumps
<brief | detail>
<component (*UUID* | *serial number* | all)>
<core-file-info component (*UUID* | *serial number*) *core-file-name*>
<display-period (*hours* | *minutes* | *seconds*)>
<display-order>
<kernel-crashinfo component (*UUID* | *serial number*)>
<repository (core | log)>

Release Information

Command introduced before Junos OS Release 8.5.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Show core files on all routers or switches running Junos OS. You can use the **show system core-dumps** command to show a list of system core files created when the router or switch has failed. This command can be useful for diagnostic purposes. Each list item includes the file permissions, number of links, owner, group, size, modification date, and path and filename. On a QFabric system, you can view core-dump files on individual QFabric system devices as well as on the entire QFabric system.

You can use the option ***core-filename*** and its options **core-file-info**, **brief**, and **detai**l to display more information about the specified core-dump files.

Options

none—Display a list of all existing core-dump files.

all-chassis—(TX Matrix and TX Matrix Plus routers only) (Optional) On a routing matrix based on a TX Matrix router, display system core files for the TX Matrix router switch-card chassis [SCC] and all the T640 routers [LCCs] connected to the TX Matrix router.

On a routing matrix based on a TX Matrix Plus router, display system core files for the TX Matrix Plus router (switch-fabric chassis [SFC]) and all the T1600 routers [LCCs] connected to the TX Matrix Plus router.

<all-lcc | lcc *number*>—(TX Matrix and TX Matrix Plus routers only) (Optional) On a routing matrix based on the TX Matrix router, display core dump files for all T640 routers (line-card chassis [LCCs]) or a specific T640 router [LCC] connected to the TX Matrix router.

On a routing matrix based on the TX Matrix Plus router, display logging information for all T1600 routers (line-card chassis [LCCs]) or a specific T1600 router (LCC) connected to the TX Matrix Plus router. When using the **lcc *number*** option, replace ***number*** with a value from **0** through **3**.

NOTE: **The all-chassis option displays system core files for the SCC or SFC and the LCCs connected to the SCC or SFC in the routing matrix while the all-lcc option only displays system core files for the LCCs in the routing matrix.**

all-members—(EX4200 switches) (Optional) Display system core files on all members of the Virtual Chassis configuration.

brief—(Optional) View details of a binary file.

component (*UUID* | *serial number* |*all*)—(QFabric systems only) (Optional) Display a list of core-dump files located on individual QFabric system device or on the entire QFabric system.

core-file-info—(Optional) Display the stack trace of a core file.

core-filename—(Optional) Name of a specific core file to display.

detail—(Optional) View stack trace with details of the binary file.

display-order (timestamp-sort | alphanumeric-sort)—(QFabric systems only) (Optional) Display list of debug artifacts generated within the specified period—for example, within the last hour, within the last 20 minutes, or within the last 32 seconds—or according to their filename.

display-period (*hours* | *minutes* | *seconds*)—(QFabric systems only) (Optional) Display core-dump files generated within the specified period—for example, within the last hour, within the last 20 minutes, or within the last 32 seconds.

kernel-crashinfo component (*UUID* | *serial number*)—(QFabric systems only) (Optional) Display kernel crash information from the EEPROM on a QFabric system device.

local—(EX4200 switches only) (Optional) Display system core files on the local Virtual Chassis member.

member *member-id*—(EX4200 switches only) (Optional) Display system core files on the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value from 0 through 9.

repository (core | log)—(QFabric systems only) (Optional) Specify either the core or log repository in which to view core-dump files.

scc—(TX Matrix routers only) (Optional) Display system core files on the TX Matrix router (or switch-card chassis).

sfc—(TX Matrix Plus routers only) (Optional) Display system core files on the TX Matrix Plus router (or switch-fabric chassis).

Required Privilege Level

view

List of Sample Output

Output Fields

Table 84 on page 924 describes the output fields for the **show system core-dumps** command. Output fields are listed in the approximate order in which they appear.

Table 84: show system core-dumps Output Fields

Field Name	Field Description
Permissions	Read/write permissions for the file named.
Links	Number of links to the file.
Owner	Name of the file owner.
Group	Name of the group with file access.
File size	File size in bytes.
Modified	Last file modification date and time.

Table 84: show system core-dumps Output Fields *(continued)*

Field Name	Field Description
Path/filename	File path where the file resides and the filename.
Repository scope:	Repository where core-dump files and log files are stored. The core-dump files are located in the **core** repository, and the log files are located in the **log** repository. The default **Repository scope** is shared since both the **core** and **log** repositories are shared by all of the QFabric system devices.
Repository head:	Path to the top-level repository location.
Repository name:	Name of the repository: **core** or **log**.
List of nodes for core repository:	List of core-dump files associated with a particular QFabric system device located in the core repository.
Node Group	Name of the QFabric system device.
Node Identifier	UUID or serial number of the QFabric system device.
Num	Number of core-dump and log files.
Model	Model number of the QFabric system device.
Usage	Usage of the repository in megabytes.
Total usage of core repository:	Total usage of core-dump files associated with a particular QFabric system device located in the core repository. Usage is specified in megabytes and as a percentage.
Total usage of log repository:	Total usage of log files associated with a particular QFabric system device located in the log repository. Usage is specified in megabytes and as a percentage.
List of nodes for core repository:	List of core-dump files associated with a particular QFabric system device located in the core repository.
List of nodes for log repository:	List of log files associated with a particular QFabric system device located in the log repository.
Filename	Name of the core-dump file.
Date	Last core-dump file modification date and time.
Size	Size of the core-dump file.
Core filename	Filename of the core-dump file.
Process name	Name of the process that is generating a core-dump file or log file.

Table 84: show system core-dumps Output Fields *(continued)*

Field Name	Field Description
Release	Junos OS release.
Build server	Junos OS build server.
Build date	Junos OS build date.
Stack trace	Stack trace of the core-dump file.

Sample Output

show system core-dumps

This example shows the command output if core files exist.

```
user@switcht> show system core-dumps
-rw------- 1 root wheel 268369920 Jun 18 17:59 /var/crash/vmcore.0
-rw-rw---- 1 root field 3371008 Jun 18 17:53 /var/tmp/rpd.core.0
-rw-r--r-- 1 root wheel 27775914 Jun 18 17:59 /var/crash/kernel.0
```

show system core-dumps

This example shows the command output if core files do not exist.

```
user@host> show system core-dumps
/var/crash/*core*: No such file or directory
/var/tmp/*core*: No such file or directory
/var/crash/kernel.*: No such file or directory
```

show system core-dumps (TX Matrix Plus Router)

```
user@host> show system core-dumps
sfc0-re0:
--------------------------------------------------------------------------
/var/crash/kernel.*: No such file or directory
/tftpboot/corefiles/*core*: No such file or directory

/var/crash/cores:
total 8

/var/tmp/cores:
total 1627592
-rw-r--r--  1 root  field  535346090 May 15 07:36
rpd.core-tarball.0.090515.0736.tgz
-rw-r--r--  1 root  field  105632057 May 15 07:37
rpd.core-tarball.1.090515.0737.tgz
-rw-r--r--  1 root  field  101981681 May 15 07:38
rpd.core-tarball.2.090515.0738.tgz
-rw-r--r--  1 root  field   85854573 May 15 07:40
rpd.core-tarball.3.090515.0740.tgz
-rw-r--r--  1 root  field    4157845 May 15 08:18
rpd.core-tarball.4.090515.0818.tgz

lcc0-re0:
--------------------------------------------------------------------------
```



```
/var/crash/kernel.*: No such file or directory
/tftpboot/corefiles/*core*: No such file or directory

/var/crash/cores:
total 8

/var/tmp/cores:
total 12

lcc1-re0:
--------------------------------------------------------------------------
/var/crash/kernel.*: No such file or directory
/tftpboot/corefiles/*core*: No such file or directory

/var/crash/cores:
total 8

/var/tmp/cores:
total 10024
-rw-r--r--  1 root  field    1875794 Apr 22 15:47
chassisd.core-tarball.0.090422.1547.tgz
-rw-r--r--  1 root  field    1894183 Apr 22 19:02
chassisd.core-tarball.0.090422.1902.tgz
-rw-r--r--  1 root  field    1290240 Apr 26 16:01 ksyncd_1558.core.0.090426.1601

lcc2-re0:
--------------------------------------------------------------------------
/var/crash/kernel.*: No such file or directory
/tftpboot/corefiles/*core*: No such file or directory

/var/crash/cores:
total 21124008
-rw-r--r--  1 root  wheel  1022376528 May 2  06:43
core-LCC2-EGFPC7.core.0.090502.0643
-rw-r--r--  1 root  wheel  1022376528 May 2  08:13
core-LCC2-EGFPC7.core.0.090502.0813
-rw-r--r--  1 root  wheel  1022376544 May 5  06:15
core-LCC2-EGFPC7.core.0.090505.0615
-rw-r--r--  1 root  wheel  1022376544 May 6  10:59
core-LCC2-EGFPC7.core.0.090506.1059
-rw-r--r--  1 root  wheel  1022376528 May 2  06:58
core-LCC2-EGFPC7.core.1.090502.0658
-rw-r--r--  1 root  wheel  754271232 May 5  06:33
core-LCC2-EGFPC7.core.1.090505.0633
-rw-r--r--  1 root  wheel  264897536 May 6  11:12
core-LCC2-EGFPC7.core.1.090506.1112
-rw-r--r--  1 root  wheel  1022376528 May 2  07:22
core-LCC2-EGFPC7.core.2.090502.0722
-rw-r--r--  1 root  wheel  163633152 May 5  06:52
core-LCC2-EGFPC7.core.2.090505.0652
-rw-r--r--  1 root  wheel  171312128 May 6  12:13
core-LCC2-EGFPC7.core.2.090506.1213
-rw-r--r--  1 root  wheel  1022376528 May 2  07:39
core-LCC2-EGFPC7.core.3.090502.0739
-rw-r--r--  1 root  wheel  1022376528 May 2  07:55
core-LCC2-EGFPC7.core.4.090502.0755
-rw-r--r--  1 root  wheel  427277312 May 7  04:47
core-LCC2-STFPC4.core.0.090507.0447
-rw-r--r--  1 root  wheel  419609600 May 7  04:47
core-LCC2-STFPC5.core.0.090507.0447
-rw-r--r--  1 root  wheel  432356352 May 7  04:47
```

```
core-LCC2-STFPC6.core.0.090507.0447

/var/tmp/cores:
total 2568
-rw-r--r--  1 root  field    1290240 May 14 14:26 ksyncd_1540.core.0.090514.1426
...
```

show system core-dumps (QFX3500 Switch)

```
user@switch> show system core-dumps
/var/crash/*core*: No such file or directory
-rw-rw----  1 root  field    1545143 Jun 4   2012 /var/tmp/pafxpc.core.0.gz
-rw-rw----  1 root  field    1545146 Jun 4   2012 /var/tmp/pafxpc.core.1.gz
-rw-rw----  1 root  field    1545141 Jun 4   2012 /var/tmp/pafxpc.core.2.gz
-rw-rw----  1 root  field    1545146 Jun 4   2012 /var/tmp/pafxpc.core.3.gz
-rw-rw----  1 root  field    1545142 Jun 5   2012 /var/tmp/pafxpc.core.4.gz
/var/tmp/pics/*core*: No such file or directory
/var/crash/kernel.*: No such file or directory
/tftpboot/corefiles/*core*: No such file or directory
total 5
```

show system core-dumps (QFabric Systems)

```
user@switch> show system core-dumps
Repository scope: shared
Repository head: /pbdata/export
List of nodes for core repository: /pbdata/export/rdumps/
Node Group      Node Identifier                        Num  Model        Usage

DG-0            BCF7208D-E44F-E011-802F-4171BAAC781D   0    qfx3100      0M
FM-0            73747cd8-0710-11e1-b6a4-00e081c5297e   0    fx-jvre      0M
DRE-0           77116f18-0710-11e1-a2a0-00e081c5297e   0    fx-jvre      0M
NW-NG-0         BBAK0394                               0    qfx3500      0M
NW-NG-0         cd78871a-0710-11e1-878e-00e081c5297e   0    fx-jvre      0M
NW-NG-0         d0afda1e-0710-11e1-a1d0-00e081c5297e   0    fx-jvre      0M
FC-0            d31ab7a6-0710-11e1-ad1b-00e081c5297e   0    fx-jvre      0M
FC-1            d4d0f254-0710-11e1-90c3-00e081c5297e   0    fx-jvre      0M
IC-WS001        WS001                                  0    -            -
IC-WS001        WS001/YW3803                           0    qfxc08-3008  0M
IC-WS001        WS001/YN5999                           0    qfxc08-3008  0M
node-device1    BBAK0372                               0    qfx3500      0M
node-device1    EE3093                                 0    qfx3500      0M
Total usage of core repository:0M of 70000M (0.0%)

List of nodes for log repository: /pbdata/export/rlogs/
Node Group      Node Identifier                        Num  Model        Usage

DG-0            BCF7208D-E44F-E011-802F-4171BAAC781D   0    qfx3100      0M
FM-0            73747cd8-0710-11e1-b6a4-00e081c5297e   1    fx-jvre      0M
DRE-0           77116f18-0710-11e1-a2a0-00e081c5297e   1    fx-jvre      0M
NW-NG-0         BBAK0394                               1    qfx3500      0M
NW-NG-0         cd78871a-0710-11e1-878e-00e081c5297e   1    fx-jvre      0M
NW-NG-0         d0afda1e-0710-11e1-a1d0-00e081c5297e   3    fx-jvre      0M
FC-0            d31ab7a6-0710-11e1-ad1b-00e081c5297e   1    fx-jvre      0M
FC-1            d4d0f254-0710-11e1-90c3-00e081c5297e   1    fx-jvre      0M
IC-WS001        WS001                                  0    -            -
IC-WS001        WS001/YN5999                           1    qfxc08-3008  0M
IC-WS001        WS001/YW3803                           1    qfxc08-3008  0M
node-device1    BBAK0372                               1    qfx3500      0M
node-device1    EE3093                                 1    qfx3500      0M
Total usage of log repository:0M of 70000M (0.0%)
```

show system core-dumps core-file-info component serial number core-file-name (QFabric Systems)

user@switch> **show system core-dumps core-file-info component e8ff4b3e-7d92-11e0-be5d-00e081c1fe0e cosd.core.0.1519.05162011131846.gz**

```
Repository scope: shared
Repository head: /pbstorage
Repository name: core
Core filename: /pbstorage/rdumps/e8ff4b3e-7d92-11e0-be5d-
00e081c1fe0e/5658.cosd.core.0.1519.05162011131846
Process name: cosd
Release: 11.3I0
Build server: /c/ssengupta/dfx_ha_v1/obj-i386-dcp/dcp/usr.sbin/cosd
Build date: 2011-05-14 01:11:44 UTC
Stack trace:
#0 0x8885d183 in select () from /usr/lib/libc.so.6
#0 0x8885d183 in select () from /usr/lib/libc.so.6
#1 0x887d4a45 in pselect () from /usr/lib/libc.so.6
#2 0x88774719 in pselect () from /usr/lib/libthr.so.2
#3 0x885de5db in __evGetNext () from /usr/lib/libisc.so.2
#4 0x885debf0 in __evMainLoop () from /usr/lib/libisc.so.2
#5 0x081125b2 in cosd_loop ()
#6 0x0812e19a in main ()
```

show system core-dumps component serial number display-order alphanumeric-sort repository core (QFabric Systems)

user@switch> **show system core-dumps component BBAK8891 display-order alphanumeric-sort repository core**

```
Repository scope: shared
Repository head: /pbdata/export
Repository name: core
List of core dumps for component BBAK8891
Repository location: /pbdata/export/rdumps/BBAK8891
Filename                                    Date                      Size

eswd.core.0.1361.11172011214257.gz          Nov 17 21:43:10 2011      4779553
eswd.core.1.80267.11172011214514.gz         Nov 17 21:45:19 2011      3541648
eswd.core.2.80682.11172011214535.gz         Nov 17 21:45:43 2011      2156683
vccpd.core.0.1195.11182011151131.gz         Nov 18 15:11:35 2011      375617
Number of core dumps in repository:4
```

show system core-dumps display-period (QFabric Systems)

user@switch> **show system core-dumps display-period 24h**

```
 show system core-dumps display-period 24h
Repository scope: shared
Repository head: /pbdata/export
List of core dumps at repository: /pbdata/export/rdumps
Delta timespec: Last 24h
Component: BBAK8273
Filename                                    Size                      Date

vccpd.core.0.1195.11182011151131.gz         Nov 18 15:11:35 2011      375794
Component: cedb7b0e-0025-11e1-9a5f-00e081c52990
Filename                                    Size                      Date

vccpd.core.0.1461.11182011151131.gz         Nov 18 15:11:31 2011      120951
Component: ee19c4f8-0025-11e1-aef6-00e081c52990
Filename                                    Size                      Date

vccpd.core.0.1462.11182011151131.gz         Nov 18 15:11:31 2011      109420
```

```
Component: BBAK8281
Filename                                   Size                     Date

vccpd.core.0.1196.11182011151131.gz        Nov 18 15:11:36 2011     375373
Component: BBAK8891
Filename                                   Size                     Date

vccpd.core.0.1195.11182011151131.gz        Nov 18 15:11:35 2011     375617
Component: BBAK8276
Filename                                   Size                     Date

vccpd.core.0.1196.11182011151131.gz        Nov 18 15:11:35 2011     375350
Component: BBAK8868
Filename                                   Size                     Date

vccpd.core.0.1196.11182011151130.gz        Nov 18 15:11:34 2011     376211
Component: BBAK8835
Filename                                   Size                     Date

vccpd.core.0.1195.11182011151130.gz        Nov 18 15:11:35 2011     375700
Component: BBAK8283
Filename                                   Size                     Date

vccpd.core.0.1195.11182011151131.gz        Nov 18 15:11:36 2011     368298
Component: YW3781/YW3781
Filename                                   Size                     Date

vccpd.core.0.1220.11182011151131.gz        Nov 18 15:11:38 2011     380002
Component: 09726be2-0026-11e1-82d9-00e081c52990
Filename                                   Size                     Date

vccpd.core.0.1461.11182011151130.gz        Nov 18 15:11:31 2011     119965
Component: BBAK8309
Filename                                   Size                     Date

vccpd.core.0.1196.11182011151131.gz        Nov 18 15:11:36 2011     378930
Component: 303d476a-0026-11e1-abf4-00e081c52990
Filename                                   Size                     Date

vccpd.core.0.1460.11182011151131.gz        Nov 18 15:11:31 2011     118385
Component: YW3798/YW3798
Filename                                   Size                     Date

vccpd.core.0.1219.11182011151131.gz        Nov 18 15:11:36 2011     380455
List of log dumps at repository: /pbdata/export/rlogs
Delta timespec: Last 24h
Component: BBAK8273
Filename                                   Size                     Date

vccpd.tarball.0.1195.11182011151138.tgz    Nov 18 15:11:39 2011     20415
Component: cedb7b0e-0025-11e1-9a5f-00e081c52990
Filename                                   Size                     Date

vccpd.tarball.0.1461.11182011151131.tgz    Nov 18 15:11:33 2011     19651
Component: ee19c4f8-0025-11e1-aef6-00e081c52990
Filename                                   Size                     Date

vccpd.tarball.0.1462.11182011151133.tgz    Nov 18 15:11:36 2011     24650
Component: BBAK8281
Filename                                   Size                     Date
```



```
vccpd.tarball.0.1196.11182011151137.tgz    Nov 18 15:11:41 2011      19445
Component: BBAK8891
Filename                                   Size                      Date

vccpd.tarball.0.1195.11182011151138.tgz    Nov 18 15:11:41 2011      21916
Component: BBAK8276
Filename                                   Size                      Date

vccpd.tarball.0.1196.11182011151137.tgz    Nov 18 15:11:39 2011      20461
Component: BBAK8868
Filename                                   Size                      Date

vccpd.tarball.0.1196.11182011151137.tgz    Nov 18 15:11:41 2011      21924
Component: BBAK8835
Filename                                   Size                      Date

vccpd.tarball.0.1195.11182011151137.tgz    Nov 18 15:11:39 2011      19424
Component: BBAK8283
Filename                                   Size                      Date

vccpd.tarball.0.1195.11182011151138.tgz    Nov 18 15:11:42 2011      31186
Component: YW3781/YW3781
Filename                                   Size                      Date

vccpd.tarball.0.1220.11182011151141.tgz    Nov 18 15:11:45 2011      27565
Component: 09726be2-0026-11e1-82d9-00e081c52990
Filename                                   Size                      Date

vccpd.tarball.0.1461.11182011151130.tgz    Nov 18 15:11:34 2011      19613
Component: BBAK8309
Filename                                   Size                      Date

vccpd.tarball.0.1196.11182011151138.tgz    Nov 18 15:11:46 2011      50362
Component: 303d476a-0026-11e1-abf4-00e081c52990
Filename                                   Size                      Date

vccpd.tarball.0.1460.11182011151133.tgz    Nov 18 15:11:33 2011      19360
Component: YW3798/YW3798
Filename                                   Size                      Date

vccpd.tarball.0.1219.11182011151140.tgz    Nov 18 15:11:49 2011      24473
```

show system core-dumps kernel-crashinfo component serial number (QFabric Systems)

```
user@switch> show system core-dumps kernel-crashinfo component A0001/YA0197
Node: A0001/YA0197

Information about previous kernel crash:

-- Kernel panic data --

Panic string: kdb_sysctl_panic
System uptime: 3 day 20 hr 59 min 40 sec Kernel crash time: 2011-11-15 Wed 15:25:17
 Kernel build linkstamp: JUNOS 11.3I #0: 2011-11-10 20:42:27 UTC

-- Stacktrace of panicing context --
Processor 1 (crash monarch):
savectx+0x0 (c9552800,80214efc,802a7fbc,c88ad05c) ra 801b93a8 sz 0
kdm_kcore_save_crashinfo+0x254 (c9552800,0,802a7fbc,c88ad05c) ra 801b9f44 sz 784
 kdm_kcore_kern_panic_event_handler+0x4b0 (c9552800,0,802a7fbc,c88ad05c) ra
8022a9b8 sz 88
```

```
panic+0x1d0 (c9552800,0,4,77fed534) ra 802540c0 sz 56
kdb_sysctl_panic+0x70 (c9552800,0,4,77fed534) ra 80237e58 sz 40 sysctl_root+0x12c
 (c9552800,0,4,e8bc5cf8) ra 80238e50 sz 48
userland_sysctl+0x164 (c9552800,0,4,e8bc5cf8) ra 8023956c sz 104
__sysctl+0xe4 (c9552800,0,4,e8bc5cf8) ra 806d62e8 sz 160
trap+0xe1c (c9552800,0,4,e8bc5cf8) ra 80896e68 sz 128
MipsUserGenException+0x1a4 (c9552800,0,4,405cd12c) ra 0 sz 0
pid 82340, process: sysctl

Processor 0:
restoreintr+0x14 (1,81bca820,3,0) ra 806cdc3c sz 0
spinlock_exit+0x30 (1,81bca820,3,0) ra 8025d354 sz 24
sleepq_release+0x64 (1,81bca820,3,0) ra 8025e670 sz 24
sleepq_timeout+0x224 (1,81bca820,3,0) ra 80240294 sz 48
softclock+0x434 (1,81bca820,3,0) ra 802067f8 sz 80
ithread_loop+0x244 (1,81bca820,3,0) ra 80200e28 sz 64 fork_exit+0xc0
(1,81bca820,3,0) ra 80897c28 sz 48
MipsNMIException+0x34 (1,81bca820,3,0) ra 0 sz 0
pid 82340, process: sysctl

Processor 2:
cpu_idle+0x20 (80960000,51bbc,2031df,81bca1b8) ra 80204948 sz 24 idle_proc+0x130
 (80960000,51bbc,2031df,81bca1b8) ra 80200e28 sz 56 fork_exit+0xc0
(80960000,51bbc,2031df,81bca1b8) ra 80897c28 sz 48
MipsNMIException+0x34 (80960000,51bbc,2031df,81bca1b8) ra 0 sz 0
pid 82340, process: sysctl

Processor 3:
cpu_idle+0x20 (80960000,51bbc,2038df,81bca300) ra 80204948 sz 24 idle_proc+0x130
 (80960000,51bbc,2038df,81bca300) ra 80200e28 sz 56 fork_exit+0xc0
(80960000,51bbc,2038df,81bca300) ra 80897c28 sz 48
MipsNMIException+0x34 (80960000,51bbc,2038df,81bca300) ra 0 sz 0
pid 82340, process: sysctl

Processor 4:
cpu_idle+0x20 (80960000,51bbc,2037df,81bca448) ra 80204948 sz 24 idle_proc+0x130
 (80960000,51bbc,2037df,81bca448) ra 80200e28 sz 56 fork_exit+0xc0
(80960000,51bbc,2037df,81bca448) ra 80897c28 sz 48
MipsNMIException+0x34 (80960000,51bbc,2037df,81bca448) ra 0 sz 0
pid 82340, process: sysctl

Processor 5:
restoreintr+0x14 (1,51bbc,203edf,81bca590) ra 806cdc3c sz 0
spinlock_exit+0x30 (1,51bbc,203edf,81bca590) ra 80204a34 sz 24 idle_proc+0x21c
(1,51bbc,203edf,81bca590) ra 80200e28 sz 56 fork_exit+0xc0
(1,51bbc,203edf,81bca590) ra 80897c28 sz 48
MipsNMIException+0x34 (1,51bbc,203edf,81bca590) ra 0 sz 0
pid 82340, process: sysctl

Processor 6:
cpu_idle+0x20 (80960000,51bbc,205cdf,81bca6d8) ra 80204948 sz 24 idle_proc+0x130
 (80960000,51bbc,205cdf,81bca6d8) ra 80200e28 sz 56 fork_exit+0xc0
(80960000,51bbc,205cdf,81bca6d8) ra 80897c28 sz 48
MipsNMIException+0x34 (80960000,51bbc,205cdf,81bca6d8) ra 0 sz 0
pid 82340, process: sysctl

Processor 7:
lockmgr+0x5ac (c97e8484,c8dd9800,0,c8dd9800) ra 8c11c81c sz 48
sal_sem_take+0x134 (c97e8484,c8dd9800,0,c8dd9800) ra 8c351108 sz 56
_bcm_esw_linkscan_thread+0x45c (c97e8484,c8dd9800,0,c8dd9800) ra 8c11cdb4 sz 104
sal_thread_start_wrap+0x74 (c97e8484,c8dd9800,0,c8dd9800) ra 80200e28 sz 32
```

```
fork_exit+0xc0 (c97e8484,c8dd9800,0,c8dd9800) ra 80897c28 sz 48
MipsNMIException+0x34 (c97e8484,c8dd9800,0,c8dd9800) ra 0 sz 0
pid 82340, process: sysctl
-- End of stacktrace --
```

show system core-dumps repository core (QFabric Systems)

```
user@switch> show system core-dumps repository core
Repository scope: shared
Repository head: /pbdata/export
Repository name: core
List of nodes for core repository: /pbdata/export/rdumps/
Node Group       Node Identifier                         Num  Model        Usage

DG-0             BCF7208D-E44F-E011-802F-4171BAAC781D    0    qfx3100      0M
FM-0             73747cd8-0710-11e1-b6a4-00e081c5297e    0    fx-jvre      0M
DRE-0            77116f18-0710-11e1-a2a0-00e081c5297e    0    fx-jvre      0M
NW-NG-0          BBAK0394                                0    qfx3500      0M
NW-NG-0          cd78871a-0710-11e1-878e-00e081c5297e    0    fx-jvre      0M
NW-NG-0          d0afda1e-0710-11e1-a1d0-00e081c5297e    0    fx-jvre      0M
FC-0             d31ab7a6-0710-11e1-ad1b-00e081c5297e    0    fx-jvre      0M
FC-1             d4d0f254-0710-11e1-90c3-00e081c5297e    0    fx-jvre      0M
IC-WS001         WS001                                   0    -            -
IC-WS001         WS001/YW3803                            0    qfxc08-3008  0M
IC-WS001         WS001/YN5999                            0    qfxc08-3008  0M
node-device1     BBAK0372                                0    qfx3500      0M
node-device1     EE3093                                  0    qfx3500      0M
Total usage of core repository:0M of 70000M (0.0%)
```

show system core-dumps repository log (QFabric Systems)

```
user@switch> show system core-dumps repository log
Repository scope: shared
Repository head: /pbdata/export
Repository name: log
List of nodes for log repository: /pbdata/export/rlogs/
Node Group       Node Identifier                         Num  Model        Usage

DG-0             BCF7208D-E44F-E011-802F-4171BAAC781D    0    qfx3100      0M
FM-0             73747cd8-0710-11e1-b6a4-00e081c5297e    1    fx-jvre      0M
DRE-0            77116f18-0710-11e1-a2a0-00e081c5297e    1    fx-jvre      0M
NW-NG-0          BBAK0394                                1    qfx3500      0M
NW-NG-0          cd78871a-0710-11e1-878e-00e081c5297e    1    fx-jvre      0M
NW-NG-0          d0afda1e-0710-11e1-a1d0-00e081c5297e    3    fx-jvre      0M
FC-0             d31ab7a6-0710-11e1-ad1b-00e081c5297e    1    fx-jvre      0M
FC-1             d4d0f254-0710-11e1-90c3-00e081c5297e    1    fx-jvre      0M
IC-WS001         WS001                                   0    -            -
IC-WS001         WS001/YN5999                            1    qfxc08-3008  0M
IC-WS001         WS001/YW3803                            1    qfxc08-3008  0M
node-device1     BBAK0372                                1    qfx3500      0M
node-device1     EE3093                                  1    qfx3500      0M
Total usage of log repository:0M of 70000M (0.0%)
```

show system directory-usage

Syntax

show system directory-usage
<depth *number*>
<*path*>

Syntax (EX Series)

show system directory-usage
<all-members>
<depth *number*>
<local>
<member *member-id*>
<*path*>

Syntax (TX Matrix Router)

show system directory-usage
<all-chassis | all-lcc | lcc *number* | scc>
<depth *number*>
<*path*>

Syntax (TX Matrix Plus Router)

show system directory-usage
<all-chassis | all-lcc | lcc *number* | sfc *number*>
<depth *number*>
<*path*>

Syntax (MX Series Router)

show system directory-usage
<all-members>
<depth *number*>
<local>
<member *member-id*>
<*path*>

Syntax (QFX Series)

show system directory-usage
<depth *number*>
<*path*>
<infrastructure *name*>
<interconnect-device *name*>
<node-group *name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display directory usage information.

Options

none—Display all directory usage information.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Display directory usage information about all the T640 routers (in a routing matrix based on a TX Matrix router). Display directory usage information about all the T1600 or T4000 routers (in a routing matrix based on a TX Matrix Plus router) in the chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display directory information for all T640 routers (or line-card chassis) connected to the TX Matrix router. On a TX Matrix Plus router, display directory information for all connected T1600 or T4000 LCCs.

all-members—(EX4200 switches and MX Series routers only) (Optional) Display directory information for all members of the Virtual Chassis configuration.

depth ***number***—(Optional) Depth of the directory to traverse. This option is useful when you want to limit the output shown for a large file system.

infrastructure ***name***— (QFabric systems only) (Optional) Display directory information for the fabric control Routing Engines and fabric manager Routing Engines.

interconnect-device ***name***— (QFabric systems only) (Optional) Display directory information for the Interconnect device.

node-group ***name***— (QFabric systems only) (Optional) Display directory information for the Node group.

lcc ***number***—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display directory information for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, display directory information for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Display directory information for the local Virtual Chassis member.

member ***member-id***—(EX4200 switches and MX Series routers only) (Optional) Display directory information for the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

path—(Optional) Path or root directory to traverse.

scc—(TX Matrix router only) (Optional) Display directory information for the TX Matrix router (or switch-card chassis).

sfc ***number***—(TX Matrix Plus routers only) (Optional) Display directory information for the TX Matrix Plus router. Replace *number* with **0**.

Required Privilege Level

view

Related Documentation

- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

show system directory-usage scc (TX Matrix Router) on page 937
show system directory-usage sfc (TX Matrix Plus Router) on page 937
show system directory-usage (QFX3500 Switch) on page 937

Output Fields

Table 85 on page 936 describes the output fields for the **show system directory-usage** command. Output fields are listed in the approximate order in which they appear.

Table 85: show system directory-usage Output Fields

Field Name	Field Description
bytes	Number of bytes used by files in a directory.
directory-name	Name of the directory.

Sample Output

show system directory-usage scc (TX Matrix Router)

```
user@host> show system directory-usage /var/tmp scc
          /var/tmp
1.0K      /var/tmp/vi.recover
2.0K      /var/tmp/instmp.tPMk8u
1.0K      /var/tmp/install
          /var/tmp/instmp.GUMpur
4.8M      /var/tmp/instmp.GUMpur/packages
6.4M      /var/tmp/troy1
297M      /var/tmp/dsw
          /var/tmp/pkg_tmp.2073
83K       /var/tmp/pkg_tmp.2073/bin
          /var/tmp/instmp.oMIDbl
89K       /var/tmp/instmp.oMIDbl/bin
          /var/tmp/instmp.byhMjR
4.6M      /var/tmp/instmp.byhMjR/packages
          /var/tmp/instmp.6fqHf3
1.7M      /var/tmp/instmp.6fqHf3/packages
          /var/tmp/instmp.mljECe
4.6M      /var/tmp/instmp.mljECe/packages
```

show system directory-usage sfc (TX Matrix Plus Router)

```
user@switch> show system directory-usage /var/tmp sfc 0
sfc0-re0:
--------------------------------------------------------------------------
          /var/tmp
46K       /var/tmp/gres-tp
          /var/tmp/sec-download
2.0K      /var/tmp/sec-download/sub-download
2.0K      /var/tmp/vi.recover
2.0K      /var/tmp/install
795M      /var/tmp/cores
766K      /var/tmp/pr440594
```

show system directory-usage (QFX3500 Switch)

```
user@switch> show system directory-usage
          /var/tmp
30K       /var/tmp/gres-tp
2.0K      /var/tmp/rtsdb
2.0K      /var/tmp/vi.recover
2.0K      /var/tmp/install
2.0K      /var/tmp/pics
```

show system license

Syntax

show system license
<installed | keys | usage>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display licenses and information about how they are used.

Options

none—Display all license information.

installed—(Optional) Display installed licenses only.

keys—(Optional) Display a list of license keys. Use this information to verify that each expected license key is present.

usage—(Optional) Display the state of licensed features.

Required Privilege Level

maintenance

List of Sample Output

show system license on page 939
show system license installed on page 939
show system license keys on page 940
show system license usage on page 940
show system license (QFX Series) on page 940

Output Fields

Table 86 on page 938 lists the output fields for the **show system license** command. Output fields are listed in the approximate order in which they appear.

Table 86: show system license Output Fields

Field Name	Field Description
Feature name	Name assigned to the configured feature. You use this information to verify that all the features for which you installed licenses are present.
Licenses used	Number of licenses used by a router or switch. You use this information to verify that the number of licenses used matches the number configured. If a licensed feature is configured, the feature is considered used. NOTE: In Junos OS Release 10.1 and later, the **Licenses used** column displays the actual usage count based on the number of active sessions or connections as reported by the corresponding feature daemons. This is applicable for scalable license-based features such as Subscriber Access (**scale-subscriber**), L2TP (**scale-l2tp**), Mobile IP (**scale-mobile-ip**), and so on.

Table 86: show system license Output Fields *(continued)*

Field Name	Field Description
Licenses installed	Information about the installed license key: • **License identifier**—Identifier associated with a license key. • **State**—State of the license key:**valid** or **invalid**. An **invalid** state indicates that the key was entered incorrectly or is not valid for the specific device. • **License version**—Version of a license. The version indicates how the license is validated, the type of signature, and the signer of the license key. • **Valid for device**—Device that can use a license key. • **Group defined**—Group membership of a device. • **Features**—Feature associated with a license, such as data link switching (DLSw).
Licenses needed	Number of licenses required for features being used but not yet properly licensed.
Expiry	Amount of time left within the grace period before a license is required for a feature being used.

Sample Output

show system license

```
user@host> show system license

License usage:
                                 Licenses     Licenses    Licenses    Expiry
  Feature name                       used    installed      needed
  subscriber-accounting                 2            2           0    permanent
  subscriber-authentication             1            2           0    permanent
  subscriber-address-assignment         2            2           0    permanent
  subscriber-vlan                       2            2           0    permanent
  subscriber-ip                         0            2           0    permanent
  scale-subscriber                      2            3           0    permanent
  scale-l2tp                            4            5           0    permanent
  scale-mobile-ip                       1            2           0    permanent

Licenses installed:
  License identifier: XXXXXXXXXX
  License version: 2
  Features:
    subscriber-accounting - Per Subscriber Radius Accounting
      permanent
    subscriber-authentication - Per Subscriber Radius Authentication
      permanent
    subscriber-address-assignment - Radius/SRC Address Pool Assignment
      permanent
    subscriber-vlan  - Dynamic Auto-sensed Vlan
      permanent
    subscriber-ip    - Dynamic and Static IP
      permanent
```

show system license installed

```
user@host> show system license installed
  License identifier: XXXXXXXXXX
  License version: 2
```



```
  Features:
    subscriber-accounting - Per Subscriber Radius Accounting
      permanent
    subscriber-authentication - Per Subscriber Radius Authentication
      permanent
    subscriber-address-assignment - Radius/SRC Address Pool Assignment
      permanent
    subscriber-vlan  - Dynamic Auto-sensed Vlan
      permanent
    subscriber-ip    - Dynamic and Static IP
      permanent
```

show system license keys

```
user@host> show system license keys
XXXXXXXXXX xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx
         xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx
         xxxxxx xxxxxx xxx
```

show system license usage

```
user@host> show system license usage
License usage:
                                 Licenses     Licenses    Licenses    Expiry
  Feature name                       used    installed      needed
  subscriber-accounting                 2            2           0    permanent
  subscriber-authentication             1            2           0    permanent
  subscriber-address-assignment         2            2           0    permanent
  subscriber-vlan                       2            2           0    permanent
  subscriber-ip                         0            2           0    permanent
  scale-subscriber                      2            3           0    permanent
  scale-l2tp                            4            5           0    permanent
  scale-mobile-ip                       1            2           0    permanent
```

show system license (QFX Series)

```
user@switch> show system license
License usage:
                   Licenses     Licenses    Licenses    Expiry
  Feature name         used    installed      needed
  qfx-edge-fab            1            1           1    permanent
Licenses installed:
  License identifier: JUNOS417988
  License version: 1
  Features:
    qfx-edge-fab  -        QFX3000 Series QF/Node feature license
      permanent
```


show system processes

Syntax

show system processes
<brief | detail | extensive | summary>
<health (pid *process-identifer* | process-name *process-name*)>
<providers>
<resource-limits (brief | detail) *process-name*>
<wide>

Syntax (EX Series Switches)

show system processes
<all-members>
<brief | detail | extensive | summary>
<health (pid *process-identifer* | process-name *process-name*)>
<local>
<member *member-id*>
<providers>
<resource-limits (brief | detail) *process-name*>
<wide>

Syntax (MX Series Routers)

show system processes
<all-members>
<brief | detail | extensive | summary>
<health (pid *process-identifer* | process-name *process-name*)>
<local>
<member *member-id*>
<providers>
<resource-limits (brief | detail) *process-name*>
<wide>

Syntax (QFX Series)

show system processes
<brief | detail | extensive | summary >
<health (pid *process-identifer* | process-name *process-name*)>
<interconnect-device *name*>
<node-group *name*>
<providers>
<resource-limits>
<wide>

Syntax (TX Matrix Routers)

show system processes
<brief | detail | extensive | summary>
<all-chassis| all-lcc | lcc *number* | scc>
<wide>

Syntax (TX Matrix Plus Router)

show system processes
<brief | detail | extensive | summary>
<all-chassis| all-lcc | lcc *number* | sfc *number*>
<wide>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Option **sfc** introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display information about software processes that are running on the router or switch and that have controlling terminals.

Options **none**—Display standard information about system processes.

brief | detail | extensive | summary—(Optional) Display the specified level of detail.

adaptive-services—(Optional) Display the configuration management process that manages the configuration for stateful firewall, Network Address Translation (NAT), intrusion detection services (IDS), and IP Security (IPsec) services on the Adaptive Services PIC.

alarm-control—(Optional) Display the process to configure the system alarm.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Display standard system process information about all the T640 routers (in a routing matrix based on the TX Matrix router) or all the T1600 or T4000 routers (in a routing matrix based on the TX Matrix Plus router) in the chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus router only) (Optional) Display standard system process information for all T640 routers (or line-card chassis) connected to the TX Matrix router. Display standard system process information for all connected T1600 or T4000 LCCs.

all-members—(EX4200 switches and MX Series routers only) (Optional) Display standard system process information for all members of the Virtual Chassis configuration.

ancpd-service—Display the Access Node Control Protocol (ANCP) process, which works with a special Internet Group Management Protocol (IGMP) session to collect outgoing interface mapping events in a scalable manner.

application-identification—Display the process that identifies an application using intrusion detection and prevention (IDP) to allow or deny traffic based on applications running on standard or nonstandard ports.

audit-process—(Optional) Display the RADIUS accounting process.

auto-configuration—Display the Interface Auto-Configuration process.

bootp—Display the process that enables a router, switch, or interface to act as a Dynamic Host Configuration Protocol (DHCP) or bootstrap protocol (BOOTP) relay agent. DHCP relaying is disabled.

captive-portal-content-delivery—Display the HTTP redirect service by specifying the location to which a subscriber's initial Web browser session is redirected, enabling initial provisioning and service selection for the subscriber.

ce-l2tp-service—(Optional) (M10, M10i, M7i, and MX Series routers only) Display the Universal Edge Layer 2 Tunneling Protocol (L2TP) process, which establishes L2TP tunnels and Point-to-Point Protocol (PPP) sessions through L2TP tunnels.

cfm—Display Ethernet Operations, Administration, and Maintenance (OAM) connectivity fault management (CFM) process, which can be used to monitor the physical link between two switches.

chassis-control—(Optional) Display the chassis management process.

class-of-service—(Optional) Display the class-of-service (CoS) process, which controls the router's or switch's CoS configuration.

clksyncd-service—Display the external clock synchronization process, which uses synchronous Ethernet (SyncE).

craft-control—Display the process for the I/O of the craft interface.

database-replication—(EX Series switches and MX Series routers only) (Optional) Display the database replication process.

datapath-trace-service—Display the packet path tracing process.

dhcp-service—(EX Series switches and MX Series routers only) (Optional) Display the Dynamic Host Configuration Protocol process, which enables a DHCP server to allocate network IP addresses and deliver configuration settings to client hosts without user intervention.

diameter-service—(Optional) Display the diameter process.

disk-monitoring—(Optional) Display the disk monitoring process, which checks the health of the hard disk drive on the Routing Engine.

dynamic-flow-capture—(Optional) Display the dynamic flow capture (DFC) process, which controls DFC configurations on Monitoring Services III PICs.

ecc-error-logging—(Optional) Display the error checking and correction (ECC) process, which logs ECC parity errors in memory on the Routing Engine.

ethernet-connectivity-fault-management— Display the process that provides IEEE 802.1ag OAM connectivity fault management (CFM) database information for CFM maintenance association end points (MEPs) in a CFM session.

ethernet-link-fault-management—(EX Series switches and MX Series routers only) (Optional) Display the process that provides the OAM link fault management (LFM) information for Ethernet interfaces.

event-processing—(Optional) Display the event process (eventd).

firewall—(Optional) Display the firewall management process, which manages the firewall configuration and enables accepting or rejecting packets that are transiting an interface on a router or switch.

general-authentication-service—(EX Series switches and MX Series routers only) (Optional) Display the general authentication process.

health (pid *process-identifer* | process-name *process-name*)—(Optional) Display process health information, either by process id (PID) or by process name.

iccp-service—Display the Inter-Chassis Communication Protocol (ICCP) process.

idp-policy—Display the intrusion detection and prevention (IDP) protocol process.

ilmi—Display the Integrated Local Management Interface (ILMI) protocol process, which provides bidirectional exchange of management information between two ATM interfaces across a physical connection.

inet-process—Display the IP multicast family process.

init—Display the process that initializes the USB modem.

interface-control—(Optional) Display the interface process, which controls the router's or switch's physical interface devices and logical interfaces.

kernel-replication—(Optional) Display the kernel replication process, which replicates the state of the backup Routing Engine when graceful Routing Engine switchover (GRES) is configured.

l2-learning—(Optional) Display the Layer 2 address flooding and learning process.

l2cpd-service—Display the Layer 2 Control Protocol process, which enables features such as Layer 2 protocol tunneling and nonstop bridging.

lacp—(Optional) Display the Link Aggregation Control Protocol (LACP)process. LACP provides a standardized means for exchanging information between partner systems on a link to allow their link aggregation control instances to reach agreement on the identity of the LAG to which the link belongs, and then to move the link to that LAG, and to enable the transmission and reception processes for the link to function in an orderly manner.

lcc *number*—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display standard system process information for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, display standard system process information for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Display standard system process information for the local Virtual Chassis member.

local-policy-decision-function—Display the process for the Local Policy Decision Function, which regulates collection of statistics related to applications and application groups and tracking of information about dynamic subscribers and static interfaces.

logical-system-mux—Display the logical router multiplexer process (lrmuxd), which manages the multiple instances of the routing protocols process (rpd) on a machine running logical routers.

mac-validation—Display the MAC validation process, which configures MAC address validation for subscriber interfaces created on demux interfaces in dynamic profiles on MX Series routers.

member *member-id*—(EX4200 switches and MX Series routers only) (Optional) Display standard system process information for the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

mib-process—(Optional) Display the MIB II process, which provides the router's MIB II agent.

mobile-ip—(Optional) Display the Mobile IP process, which configures Junos OS Mobile IP features.

mountd-service—(EX Series switches and MX Series routers only) (Optional) Display the service for NFS mounts requests.

mpls-traceroute—(Optional) Display the MPLS Periodic Traceroute process.

mspd—(Optional) Display the Multiservice process.

multicast-snooping—(EX Series switches and MX Series routers only) (Optional) Display the multicast snooping process, which makes Layer 2 devices such as VLAN switches aware of Layer 3 information, such as the media access control (MAC) addresses of members of a multicast group.

named-service—(Optional) Display the DNS Server process, which is used by a router or a switch to resolve hostnames into addresses.

neighbor-liveness—Display the process, which specifies the maximum length of time that the router waits for its neighbor to re-establish an LDP session.

nfsd-service—(Optional) Display the Remote NFS Server process, which provides remote file access for applications that need NFS-based transport.

ntp—Display the Network Time Protocol (NTP) process, which provides the mechanisms to synchronize time and coordinate time distribution in a large, diverse network.

packet-triggered-subscribers—Display the packet-triggered subcribers and policy control (PTSP) process, which allows the application of policies to dynamic subscribers that are controlled by a subscriber termination device.

peer-selection-service—(Optional) Display the Peer Selection Service process.

periodic-packet-services—Display the Periodic packet management process, which is responsible for processing a variety of time-sensitive periodic tasks so that other processes can more optimally direct their resources.

pfe—Display the Packet Forwarding Engine management process.

pgcp-service—(Optional) Display the pgcpd service process running on the Routing Engine.

pgm—Display the Pragmatic General Multicast (PGM) protocol process, which enables a reliable transport layer for multicast applications.

pic-services-logging—(Optional) Display the logging process for some PICs. With this process, also known as fsad (the file system access daemon), PICs send special logging information to the Routing Engine for archiving on the hard disk.

ppp—(Optional) Display the Point-to-Point Protocol (PPP) process, which is the encapsulation protocol process for transporting IP traffic across point-to-point links.

ppp-service—Display the Universal edge PPP process, which is the encapsulation protocol process for transporting IP traffic across universal edge routers.

pppoe—(Optional) Display the Point-to-Point Protocol over Ethernet (PPPoE) process, which combines PPP that typically runs over broadband connections with the Ethernet link-layer protocol that allows users to connect to a network of hosts over a bridge or access concentrator.

process-monitor—Display the process health monitor process (pmond).

providers—(Optional) Display provider processes.

redundancy-interface-process—(Optional) Display the ASP redundancy process.

remote-operations—(Optional) Display the remote operations process, which provides the ping and traceroute MIBs.

resource-cleanup—Display the resource cleanup process.

resource-limits (brief | detail) ***process-name***—(Optional) Display process resource limits.

routing—(Optional) Display the routing protocol process.

sampling—(Optional) Display the sampling process, which performs packet sampling based on particular input interfaces and various fields in the packet header.

sbc-configuration-process—Display the session border controller (SBC) process of the border signaling gateway (BSG).

scc—(TX Matrix routers only) (Optional) Display standard system process information for the TX Matrix router (or switch-card chassis).

sdk-service—Display the SDK Service process, which runs on the Routing Engine and is responsible for communications between the SDK application and Junos OS. Although the SDK Service process is present on the router, it is turned off by default.

secure-neighbor-discovery—(EX Series switches and MX Series routers only) (Optional) Display the secure Neighbor Discovery Protocol (NDP) process, which provides support for protecting NDP messages.

send—(Optional) Display the Secure Neighbor Discovery Protocol (SEND) process, which provides support for protecting Neighbor Discovery Protocol (NDP) messages.

service-deployment—(Optional) Display the service deployment process, which enables Junos OS to work with the Session and Resource Control (SRC) software.

sfc *number*—(TX Matrix Plus routers only) (Optional) Display system process information for the TX Matrix Plus router. Replace ***number*** with 0.

snmp—Display the SNMP process, which enables the monitoring of network devices from a central location and provides the router's or switch's SNMP master agent.

sonet-aps—Display the SONET Automatic Protection Switching (APS) process, which monitors any SONET interface that participates in APS.

static-subscribers—(Optional) Display the Static subscribers process, which associates subscribers with statically configured interfaces and provides dynamic service activation and activation for these subscribers.

tunnel-oamd—(Optional) Display the Tunnel OAM process, which enables the Operations, Administration, and Maintenance of Layer 2 tunneled networks. Layer 2 protocol tunneling (L2PT) allows service providers to send Layer 2 protocol data units (PDUs) across the provider's cloud and deliver them to Juniper Networks EX Series Ethernet Switches that are not part of the local broadcast domain.

vrrp—(EX Series switches and MX Series routers only) (Optional) Display the Virtual Router Redundancy Protocol (VRRP) process, which enables hosts on a LAN to make use of redundant routing platforms on that LAN without requiring more than the static configuration of a single default route on the hosts.

watchdog—Display the watchdog timer process, which enables the watchdog timer when Junos OS encounters a problem.

wide—(Optional) Display process information that might be wider than 80 columns.

Additional Information

By default, when you issue the **show system processes** command on the master Routing Engine of a TX Matrix router or a TX Matrix Plus router, the command is broadcast to all the master Routing Engines of the LCCs connected to it in the routing matrix. Likewise, if you issue the same command on the backup Routing Engine of a TX Matrix or a TX Matrix Plus router, the command is broadcast to all backup Routing Engines of the LCCs that are connected to it in the routing matrix.

Required Privilege Level

view

Related Documentation

- *List of Junos OS Processes*
- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

Output Fields

Table 87 on page 948 describes the output fields for the **show system processes** command. Output fields are listed in the approximate order in which they appear.

Table 87: show system processes Output Fields

Field Name	Field Description	Level of Output
last pid	Last process identifier assigned to the process.	**brief extensive summary**
load averages	Three load averages followed by the current time.	**brief extensive summary**
processes	Number of existing processes and the number of processes in each state (**sleeping, running, starting, zombies**, and **stopped**).	**brief extensive summary**
Mem	Information about physical and virtual memory allocation.	**brief extensive summary**
Swap	Information about physical and virtual memory allocation.	**brief extensive summary**
PID	Process identifier.	**detail extensive summary**
TT	Control terminal name.	none **detail**

Table 87: show system processes Output Fields *(continued)*

Field Name	Field Description	Level of Output
STAT	Symbolic process state. The state is given by a sequence of letters. The first letter indicates the run state of the process: • **D**—In disk or other short-term, uninterruptible wait • **I**—Idle (sleeping longer than about 20 seconds) • **R**—Runnable • **S**—Sleeping for less than 20 seconds • **T**—Stopped • **Z**—Dead (zombie) • **+** —The process is in the foreground process group of its control terminal. • **<**—The process has raised CPU scheduling priority. • **>**—The process has specified a soft limit on memory requirements and is currently exceeding that limit; such a process is not swapped. • **A**—The process requested random page replacement. • **E**—The process is trying to exit. • **L**—The process has pages locked in core. • **N**—The process has reduced CPU scheduling priority. • **S**—The process requested first-in, first-out (FIFO) page replacement. • **s**—The process is a session leader. • **V**—The process is temporarily suspended. • **W**—The process is swapped out. • **X**—The process is being traced or debugged.	none **detail**
UID	User identifier.	**detail**
USERNAME	Process owner.	**extensive summary**
PPID	Parent process identifier.	**detail**
CPU	(D)—Short-term CPU usage. (E and S)—Raw (unweighted) CPU usage. The value of this field is used to sort the processes in the output.	**detail extensive summary**
RSS	Resident set size.	**detail**
WCHAN	Symbolic name of the wait channel.	**detail**
STARTED	Local time when the process started running.	**detail**
PRI	Current priority of the process. A lower number indicates a higher priority.	**detail extensive summary**
NI or NICE	UNIX "niceness" value. A lower number indicates a higher priority.	**detail extensive summary**
SIZE	Total size of the process (text, data, and stack), in kilobytes.	**extensive summary**

Table 87: show system processes Output Fields *(continued)*

Field Name	Field Description	Level of Output
RES	Current amount of resident memory, in kilobytes.	**extensive summary**
STATE	Current state of the process (for example, **sleep**, **wait**, **run**, **idle**, **zombie**, or **stop**).	**extensive summary**
TIME	(S)—Number of system and user CPU seconds that the process has used. (None, D, and E)—Total amount of time that the command has been running.	**detail extensive summary**
WCPU	Weighted CPU usage.	**extensive summary**
COMMAND	Command that is currently running.	**detail extensive summary**
THR	Number of threads in the process	extensive

Sample Output

show system processes

```
user@host> show system processes
PID  TT  STAT      TIME COMMAND
    0  ??  DLs     0:00.70  (swapper)
    1  ??  Is      0:00.35 /sbin/init --
    2  ??  DL      0:00.00  (pagedaemon)
    3  ??  DL      0:00.00  (vmdaemon)
    4  ??  DL      0:42.37  (update)
    5  ??  DL      0:00.00  (if_jnx)
   80  ??  Ss      0:14.66 syslogd -s
   96  ??  Is      0:00.01 portmap
  128  ??  Is      0:02.70 cron
  173  ??  Is      0:02.24 /usr/local/sbin/sshd (sshd1)
  189  ??  S       0:03.80 /sbin/watchdog -t180
  190  ??  I       0:00.03 /usr/sbin/tnetd -N
  191  ??  S       2:24.76 /sbin/ifd -N
  192  ??  S<      0:55.44 /usr/sbin/xntpd -N
  195  ??  S       0:53.11 /usr/sbin/snmpd -N
  196  ??  S       1:15.73 /usr/sbin/mib2d -N
  198  ??  I       0:00.75 /usr/sbin/inetd -N
 2677  ??  I       0:00.01 /usr/sbin/mgd -N
 2712  ??  Ss      0:00.24 rlogind
 2735  ??  R       0:00.00 /bin/ps -ax
 1985  p0- S       0:07.41 ./rpd -N
 2713  p0  Is      0:00.24 -tcsh (tcsh)
 2726  p0  S+      0:00.07 cli
```

show system processes brief

```
user@host> show system processes brief
last pid:   543;  load averages:  0.00,  0.00,  0.00    18:29:47
37 processes:  1 running, 36 sleeping

Mem: 25M Active, 3976K Inact, 19M Wired, 8346K Buf, 202M Free
Swap: 528M Total, 64K Used, 528M Free
```

show system processes detail

```
user@host> show system processes detail
PID   UID  PPID CPU PRI NI  RSS WCHAN  STARTED   TT  STAT      TIME COMMAND
 3151  1049  3129   2  28  0  672 -       1:13PM  p0  R+     0:00.00 ps -ax -r
    1     0     0   0  10  0  376 wait    1:51PM  ??  Is     0:00.29 /sbin/ini
    2     0     0   0 -18  0   12 psleep  1:51PM  ??  DL     0:00.00  (pagedae
    3     0     0   0  28  0   12 psleep  1:51PM  ??  DL     0:00.00  (vmdaemo
    4     0     0   0  28  0   12 update  1:51PM  ??  DL     0:07.15  (update)
    5     0     0   0   2  0   12 pfesel  1:51PM  ??  IL     0:02.90  (if_pfe)
   27     0     1   0  10  0 17936 mfsidl  1:51PM  ??  Is     0:00.46 mfs /dev/
   81     0     1   0   2  0  496 select  1:52PM  ??  Ss     0:31.21 syslogd -
  119     1     1   0   2  0  492 select  1:52PM  ??  Is     0:00.00 portmap
  134     0     1   0   2  0  580 select  1:52PM  ??  S      0:02.95 amd -p -a
  151     0     1   0  18  0  532 pause   1:52PM  ??  Is     0:00.34 cron
  183     0     1   0   2  0  420 select  1:52PM  ??  Ss     0:00.07 /usr/loca
  206     0     1   0  18  0   72 pause   1:52PM  ??  S      0:00.51 /sbin/wat
  207     0     1   0   2  0  520 select  1:52PM  ??  I      0:00.16 /usr/sbin
  208     0     1   0   2  0  536 select  1:52PM  ??  S      0:08.21 /sbin/dcd
  210     0     1 255   2 -12  740 select  1:52PM  ??  S<     0:05.83 /usr/sbin
  211     0     1   0   2  0  376 select  1:52PM  ??  S      0:00.03 /usr/sbin
  215     0     1   0   2  0  548 select  1:52PM  ??  I      0:00.50 /usr/sbin
  219     0     1   0   3  0  540 ttyin   1:52PM  v0  Is+    0:00.02 /usr/libe
  220     0     1   0   3  0  540 ttyin   1:52PM  v1  Is+    0:00.01 /usr/libe
  221     0     1   0   3  0  540 ttyin   1:52PM  v2  Is+    0:00.01 /usr/libe
  222     0     1   0   3  0  540 ttyin   1:52PM  v3  Is+    0:00.01 /usr/libe
  735     0     1   0   2  0  468 select  2:47PM  ??  S      0:19.14 /usr/sbin
  736     0     1   0   2  0  212 select  2:47PM  ??  S      0:14.13 /usr/sbin
 1380     0     1   0   3  0  888 ttyin   7:32PM  d0  Is+    0:00.46 bash
 3019     0   207   0   2  0  636 select 10:49AM  ??  Ss     0:02.93 tnp.chass
 3122     0  1380   0   2  0 1764 select 12:33PM  d0  S      0:00.77 ./rpd -N
 3128     0   215   0   2  0  580 select 12:45PM  ??  Ss     0:00.12 rlogind
 3129  1049  3128   0  18  0  944 pause  12:45PM  p0  Ss     0:00.14 -tcsh (tc
    0     0     0   0 -18  0    0 sched   1:51PM  ??  DLs    0:00.10  (swapper
```

show system processes extensive

```
user@host> show system processes extensive
Mem: 241M Active, 99M Inact, 78M Wired, 325M Cache, 69M Buf, 1251M Free
Swap: 2048M Total, 2048M Free


  PID USERNAME   THR PRI NICE   SIZE    RES STATE    TIME   WCPU COMMAND
   11 root         1 171   52     0K    12K RUN    807.5H 98.73% idle
   13 root         1 -20 -139     0K    12K WAIT    36:17  0.00% swi7: clock sio
 1499 root         1  96    0  7212K  3040K select  34:01  0.00% license-check
 1621 root         1  96    0 20968K 11216K select  20:25  0.00% mib2d
 1465 root         2   8  -88   115M 11748K nanslp  14:32  0.00% chassisd
 1478 root         1  96    0  6336K  3816K select  11:28  0.00% ppmd
   20 root         1 -68 -187     0K    12K WAIT    10:28  0.00% irq10: em0 em1+++*

 1490 root         1  96    0 11792K  4336K select   9:44  0.00% shm-rtsdbd
 1618 root         1  96    0 39584K  7464K select   8:47  0.00% pfed
 1622 root         1  96    0 15268K 10988K select   6:16  0.00% snmpd
 1466 root         1  96    0  7408K  2896K select   5:44  0.00% alarmd
    7 root         1 -16    0     0K    12K client   5:09  0.00% ifstate notify
 1480 root         1  96    0  5388K  2660K select   4:29  0.00% ksyncd
   12 root         1 -40 -159     0K    12K WAIT     4:15  0.00% swi2: netisr 0
 1462 root         1  96    0  1836K  1240K select   3:57  0.00% bslockd
   55 root         1 -16    0     0K    12K -        3:44  0.00% schedcpu
 1392 root         1  16    0     0K    12K bcmsem   3:37  0.00% bcmLINK.0
```

```
   47 root        1 -16    0     0K    12K psleep   3:25  0.00% vmkmemdaemon
   36 root        1  20    0     0K    12K syncer   2:46  0.00% syncer
 1484 root        1  96    0  7484K  3428K select   2:38  0.00% clksyncd
 1616 root        1  96    0  4848K  2848K select   2:18  0.00% irsd
 1487 root        1  96    0 32800K  6992K select   2:10  0.00% smid
 1623 root        1  96    0 34616K  5464K select   2:01  0.00% dcd
   15 root        1 -16    0     0K    12K -        1:59  0.00% yarrow
   49 root        1 -16    0     0K    12K .        1:51  0.00% ddostasks
```

show system processes lcc wide (TX Matrix Routing Matrix)

```
user@host> show system processes lcc 2 wide
lcc2-re0:
--------------------------------------------------------------------------
  PID  TT  STAT      TIME COMMAND
    0  ??  DLs    0:00.00  (swapper)
    1  ??  ILs    0:00.10 /sbin/preinit -- (init)
    2  ??  DL     0:00.00  (pagedaemon)
    3  ??  DL     0:00.00  (vmdaemon)
    4  ??  DL     0:00.00  (bufdaemon)
    5  ??  DL     0:00.04  (syncer)
    6  ??  DL     0:00.00  (netdaemon)
    7  ??  IL     0:00.00  (if_pic_listen)
    8  ??  IL     0:00.00  (scs_housekeeping)
    9  ??  IL     0:00.00  (if_pfe_listen)
   10  ??  DL     0:00.00  (vmuncachedaemon)
   11  ??  SL     0:00.02  (cb_poll)
  172  ??  ILs    0:00.21 mfs -o noauto /dev/ad1s1b /tmp (newfs)
 2909  ??  Is     0:00.00 pccardd
 2932  ??  Ss     0:00.07 syslogd -r -s
 3039  ??  Is     0:00.00 cron
 3217  ??  I      0:00.00 /sbin/watchdog -d
 3218  ??  I      0:00.02 /usr/sbin/tnetd -N
 3221  ??  S      0:00.11 /usr/sbin/alarmd -N
 3222  ??  S      0:00.85 /usr/sbin/craftd -N
 3223  ??  S      0:00.05 /usr/sbin/mgd -N
 3224  ??  I      0:00.02 /usr/sbin/inetd -N
 3225  ??  I      0:00.00 /usr/sbin/tnp.sntpd -N
 3226  ??  I      0:00.01 /usr/sbin/tnp.sntpc -N
 3228  ??  I      0:00.01 /usr/sbin/smartd -N
 3231  ??  I      0:00.01 /usr/sbin/eccd -N
 3425  ??  S      0:00.09 /usr/sbin/dfwd -N
 3426  ??  S      0:00.19 /sbin/dcd -N
 3427  ??  I      0:00.04 /usr/sbin/pfed -N
 3430  ??  S      0:00.10 /usr/sbin/ksyncd -N
 3482  ??  S      1:53.63 /usr/sbin/chassisd -N
 4285  ??  SL     0:00.01  (peer proxy)
 4286  ??  SL     0:00.00  (peer proxy)
 4303  ??  Ss     0:00.00 mgd: (mgd) (root) (mgd)
 4304  ??  R      0:00.00 /bin/ps -ax -ww
 3270  d0  Is+    0:00.00 /usr/libexec/getty std.9600 ttyd0
```

show system processes summary

```
user@host> show system processes summary
last pid:    543;  load averages:  0.00,  0.00,  0.00    18:29:47
37 processes:  1 running, 36 sleeping

Mem: 25M Active, 3976K Inact, 19M Wired, 8346K Buf, 202M Free
Swap: 528M Total, 64K Used, 528M Free
```

```
  PID USERNAME PRI NICE SIZE    RES STATE    TIME   WCPU    CPU COMMAND
  527 root       2    0  176K   580K select  0:00  0.04%  0.04% rlogind
  543 root      30    0  604K   768K RUN     0:00  0.00%  0.00% top
```

show system processes (TX Matrix Plus Router)

```
user@host> show system processes
sfc0-re0:
--------------------------------------------------------------------------
  PID  TT  STAT      TIME COMMAND
    0  ??  WLs    0:00.00 [swapper]
    1  ??  ILs    0:00.18 /packages/mnt/jbase/sbin/init --
    2  ??  DL     0:00.20 [g_event]
    3  ??  DL     0:00.39 [g_up]
    4  ??  DL     0:00.32 [g_down]
    5  ??  DL     0:00.00 [thread taskq]
    6  ??  DL     0:00.09 [kqueue taskq]
    7  ??  DL     0:00.01 [pagedaemon]
    8  ??  DL     0:00.00 [vmdaemon]
    9  ??  DL     0:06.63 [pagezero]
   10  ??  DL     0:00.00 [ktrace]
   11  ??  RL   310:52.98 [idle]
   12  ??  WL     0:11.03 [swi2: net]
   13  ??  WL     0:27.58 [swi7: clock sio]
   14  ??  WL     0:00.00 [swi6: vm]
   15  ??  DL     0:03.02 [yarrow]
   16  ??  WL     0:00.00 [swi9: +]
   17  ??  WL     0:00.00 [swi8: +]
   18  ??  WL     0:00.00 [swi5: cambio]
   19  ??  WL     0:00.00 [swi9: task queue]
   20  ??  WL     0:11.41 [irq16: uhci0 uhci*]
   21  ??  DL     0:00.00 [usb0]
   22  ??  DL     0:00.00 [usbtask]
   23  ??  WL     0:39.51 [irq17: uhci1 uhci*]
   24  ??  DL     0:00.00 [usb1]
   25  ??  WL     0:00.00 [irq18: uhci2 uhci*]
   26  ??  DL     0:00.83 [usb2]
   27  ??  DL     0:00.00 [usb3]
   28  ??  DL     0:00.00 [usb4]
   29  ??  DL     0:00.00 [usb5]
   30  ??  DL     0:00.73 [usb6]
   31  ??  DL     0:00.00 [usb7]
   32  ??  WL     0:00.00 [irq14: ata0]
   33  ??  WL     0:00.00 [irq15: ata1]
   34  ??  WL     0:00.00 [irq1: atkbd0]
   35  ??  WL     0:00.00 [swi0: sio]
   36  ??  WL     0:00.00 [irq11: isab0]
   37  ??  WL     0:00.00 [swi3: ip6opt ipopt]
   38  ??  WL     0:00.00 [swi4: ip6mismatch+]
   39  ??  WL     0:00.00 [swi1: ipfwd]
   40  ??  DL     0:00.02 [bufdaemon]
   41  ??  DL     0:00.02 [vnlru]
   42  ??  DL     0:00.39 [syncer]
   43  ??  DL     0:00.05 [softdepflush]
   44  ??  DL     0:00.00 [netdaemon]
   45  ??  DL     0:00.02 [vmuncachedaemon]
   46  ??  DL     0:00.00 [if_pic_listen]
   47  ??  DL     0:00.35 [vmkmemdaemon]
   48  ??  DL     0:00.00 [cb_poll]
   49  ??  DL     0:00.06 [if_pfe_listen]
   50  ??  DL     0:00.00 [scs_housekeeping]
```



```
   51  ??  IL     0:00.00 [kern_dump_proc]
   52  ??  IL     0:00.00 [nfsiod 0]
   53  ??  IL     0:00.00 [nfsiod 1]
   54  ??  IL     0:00.00 [nfsiod 2]
   55  ??  IL     0:00.00 [nfsiod 3]
   56  ??  DL     0:00.37 [schedcpu]
   57  ??  DL     0:00.56 [md0]
   79  ??  DL     0:02.58 [md1]
  100  ??  DL     0:00.03 [md2]
  118  ??  DL     0:00.01 [md3]
  139  ??  DL     0:00.95 [md4]
  160  ??  DL     0:00.12 [md5]
  181  ??  DL     0:00.00 [md6]
  217  ??  DL     0:00.02 [md7]
  227  ??  DL     0:00.05 [md8]
 1341  ??  SL     0:01.34 [bcmTX]
 1342  ??  SL     0:01.68 [bcmXGS3AsyncTX]
 1343  ??  SL     0:41.40 [bcmLINK.0]
 1345  ??  SL     0:33.83 [bcmLINK.1]
 1350  ??  Is     0:00.01 /usr/sbin/cron
 1502  ??  S      0:00.01 /sbin/watchdog -t-1
 1503  ??  S      0:00.86 /usr/libexec/bslockd -mp -N
 1504  ??  S      0:00.01 /usr/sbin/tnetd -N
 1507  ??  S      0:01.32 /usr/sbin/alarmd -N
 1508  ??  S      0:14.54 /usr/sbin/craftd -N
 1509  ??  S      0:01.19 /usr/sbin/mgd -N
 1512  ??  I      0:00.05 /usr/sbin/inetd -N
 1513  ??  S      0:00.10 /usr/sbin/tnp.sntpd -N
 1517  ??  S      0:00.11 /usr/sbin/smartd -N
 1525  ??  S      0:01.10 /usr/sbin/idpd -N
 1526  ??  S      0:01.43 /usr/sbin/license-check -U -M -p 10 -i 10
 1527  ??  I      0:00.01 /usr/libexec/getty Pc ttyv0
 1616  ??  DL     0:00.30 [peer proxy]
 1617  ??  DL     0:00.32 [peer proxy]
 1618  ??  DL     0:00.34 [peer proxy]
 1619  ??  DL     0:00.30 [peer proxy]
 2391  ??  Is     0:00.01 telnetd
 7331  ??  Ss     0:00.03 telnetd
 9538  ??  DL     0:01.16 [jsr_kkcm]
 9613  ??  DL     0:00.18 [peer proxy]
23781  ??  Ss     0:00.01 telnetd
23926  ??  Ss     0:00.01 mgd: (mgd) (regress)/dev/ttyp2 (mgd)
36867  ??  S      0:03.14 /usr/sbin/rpd -N
36874  ??  S      0:00.08 /usr/sbin/lmpd
36876  ??  S      0:00.17 /usr/sbin/lacpd -N
36877  ??  S      0:00.15 /usr/sbin/bfdd -N
36878  ??  S      0:05.05 /usr/sbin/ppmd -N
36907  ??  S      0:25.07 /usr/sbin/chassisd -N
37775  ??  S      0:00.01 /usr/sbin/bdbrepd -N
45727  ??  S      0:00.02 /usr/sbin/xntpd -j -N -g (ntpd)
45729  ??  S      0:00.38 /usr/sbin/l2ald -N
45730  ??  S<     0:00.12 /usr/sbin/apsd -N
45731  ??  SN     0:00.10 /usr/sbin/sampled -N
45732  ??  S      0:00.03 /usr/sbin/ilmid -N
45733  ??  S      0:00.09 /usr/sbin/rmopd -N
45734  ??  S      0:00.30 /usr/sbin/cosd
45735  ??  I      0:00.00 /usr/sbin/rtspd -N
45736  ??  S      0:00.06 /usr/sbin/fsad -N
45737  ??  S      0:00.05 /usr/sbin/rdd -N
45738  ??  S      0:00.10 /usr/sbin/pppd -N
45739  ??  S      0:00.05 /usr/sbin/dfcd -N
```



```
45740  ??  S      0:00.07 /usr/sbin/lfmd -N
45741  ??  S      0:00.01 /usr/sbin/mplsoamd -N
45742  ??  I      0:00.01 /usr/sbin/sendd -N
45743  ??  S      0:00.08 /usr/sbin/appidd -N
45744  ??  S      0:00.05 /usr/sbin/mspd -N
45745  ??  S      0:00.25 /usr/sbin/jdiameterd -N
45746  ??  S      0:00.10 /usr/sbin/pfed -N
45747  ??  S      0:00.19 /usr/sbin/lpdfd -N
45748  ??  S      0:00.63 /sbin/dcd -N
45750  ??  S      0:00.45 /usr/sbin/mib2d -N
45751  ??  S      0:00.15 /usr/sbin/dfwd -N
45752  ??  S      0:00.15 /usr/sbin/irsd -N
45764  ??  S      0:20.59 /usr/sbin/snmpd -N
56479  ??  Ss     0:00.00 mgd: (mgd) (root) (mgd)
56480  ??  R      0:00.00 /bin/ps -ax
 1142  d0- I      0:00.01 /usr/sbin/usbd -N
 1160  d0- S      0:29.17 /usr/sbin/eventd -N -r -s -A
 6527  d0  Is+    0:00.00 /usr/libexec/getty std.9600 ttyd0
 2392  p1  Is     0:00.00 login [pam] (login)
 2393  p1  I      0:00.00 -csh (csh)
 2394  p1  I      0:00.00 su -
 2395  p1  I+     0:00.01 -su (csh)
23782  p2  Is     0:00.00 login [pam] (login)
23881  p2  I      0:00.00 -csh (csh)
23925  p2  S+     0:00.03 cli
 7332  p3  Is     0:00.00 login [pam] (login)
 7333  p3  I      0:00.00 -csh (csh)
23780  p3  S+     0:00.02 telnet aj

lcc0-re0:
--------------------------------------------------------------------------
  PID  TT  STAT      TIME COMMAND
    0  ??  WLs    0:00.00 [swapper]
    1  ??  ILs    0:00.16 /packages/mnt/jbase/sbin/init --
    2  ??  DL     0:00.01 [g_event]
    3  ??  DL     0:00.16 [g_up]
    4  ??  DL     0:00.11 [g_down]
    5  ??  DL     0:00.00 [thread taskq]
    6  ??  DL     0:00.00 [kqueue taskq]
    7  ??  DL     0:00.00 [pagedaemon]
    8  ??  DL     0:00.00 [vmdaemon]
    9  ??  DL     0:01.77 [pagezero]
   10  ??  DL     0:00.00 [ktrace]
   11  ??  RL    17:22.31 [idle]
   12  ??  WL     0:00.32 [swi2: net]
   13  ??  WL     0:01.21 [swi7: clock sio]
   14  ??  WL     0:00.00 [swi6: vm]
   15  ??  DL     0:00.10 [yarrow]
   16  ??  WL     0:00.00 [swi9: +]
   17  ??  WL     0:00.00 [swi8: +]
   18  ??  WL     0:00.00 [swi5: cambio]
   19  ??  WL     0:00.00 [swi9: task queue]
   20  ??  WL     0:02.73 [irq10: bcm0 uhci1*]
   21  ??  WL     0:00.02 [irq11: cb0 uhci0+*]
   22  ??  DL     0:00.00 [usb0]
   23  ??  DL     0:00.00 [usbtask]
   24  ??  DL     0:00.00 [usb1]
   25  ??  DL     0:00.05 [usb2]
   26  ??  DL     0:00.00 [usb3]
   27  ??  DL     0:00.00 [usb4]
   28  ??  DL     0:00.00 [usb5]
```

```
   29  ??  DL      0:00.04 [usb6]
   30  ??  DL      0:00.00 [usb7]
   31  ??  WL      0:00.00 [irq14: ata0]
   32  ??  WL      0:00.00 [irq15: ata1]
   33  ??  WL      0:00.00 [irq1: atkbd0]
   34  ??  WL      0:00.00 [swi0: sio]
   35  ??  WL      0:00.00 [swi3: ip6opt ipopt]
   36  ??  WL      0:00.00 [swi4: ip6mismatch+]
   37  ??  WL      0:00.00 [swi1: ipfwd]
   38  ??  DL      0:00.00 [bufdaemon]
   39  ??  DL      0:00.00 [vnlru]
   40  ??  DL      0:00.01 [syncer]
   41  ??  DL      0:00.00 [softdepflush]
   42  ??  DL      0:00.00 [netdaemon]
   43  ??  DL      0:00.00 [vmuncachedaemon]
   44  ??  DL      0:00.00 [if_pic_listen]
   45  ??  DL      0:00.02 [vmkmemdaemon]
   46  ??  DL      0:00.01 [cb_poll]
   47  ??  DL      0:00.00 [if_pfe_listen]
   48  ??  DL      0:00.00 [scs_housekeeping]
   49  ??  IL      0:00.00 [kern_dump_proc]
   50  ??  IL      0:00.00 [nfsiod 0]
   51  ??  IL      0:00.00 [nfsiod 1]
   52  ??  IL      0:00.00 [nfsiod 2]
   53  ??  IL      0:00.00 [nfsiod 3]
   54  ??  DL      0:00.01 [schedcpu]
   55  ??  DL      0:00.73 [md0]
   77  ??  DL      0:03.54 [md1]
   98  ??  DL      0:00.37 [md2]
  116  ??  DL      0:00.02 [md3]
  137  ??  DL      0:00.56 [md4]
  158  ??  DL      0:00.15 [md5]
  179  ??  DL      0:00.00 [md6]
  215  ??  DL      0:00.03 [md7]
  225  ??  DL      0:00.03 [md8]
 1078  ??  DL      0:00.00 [jsr_kkcm]
 1363  ??  SL      0:00.09 [bcmTX]
 1364  ??  SL      0:00.10 [bcmXGS3AsyncTX]
 1365  ??  SL      0:03.08 [bcmLINK.0]
 1370  ??  Is      0:00.00 /usr/sbin/cron
 1522  ??  S       0:00.00 /sbin/watchdog -t-1
 1523  ??  S       0:00.05 /usr/libexec/bslockd -mp -N
 1524  ??  I       0:00.01 /usr/sbin/tnetd -N
 1526  ??  S       0:04.98 /usr/sbin/chassisd -N
 1527  ??  S       0:00.04 /usr/sbin/alarmd -N
 1528  ??  I       0:00.40 /usr/sbin/craftd -N
 1529  ??  S       0:00.08 /usr/sbin/mgd -N
 1532  ??  I       0:00.04 /usr/sbin/inetd -N
 1533  ??  I       0:00.00 /usr/sbin/tnp.sntpd -N
 1534  ??  I       0:00.00 /usr/sbin/tnp.sntpc -N
 1536  ??  S       0:00.01 /usr/sbin/smartd -N
 1540  ??  I       0:00.07 /usr/sbin/jcsd -N
 1541  ??  S       0:00.11 /usr/sbin/idpd -N
 1542  ??  I       0:00.00 /usr/libexec/getty Pc ttyv0
 2089  ??  DL      0:00.01 [peer proxy]
 2090  ??  DL      0:00.01 [peer proxy]
 2091  ??  DL      0:00.01 [peer proxy]
 2657  ??  S       0:00.02 /usr/sbin/dfwd -N
 2658  ??  S       0:00.02 /sbin/dcd -N
 2659  ??  S       0:00.05 /usr/sbin/snmpd -N
 2660  ??  S       0:00.01 /usr/sbin/mib2d -N
```



```
 2661  ??  S      0:00.01 /usr/sbin/pfed -N
 2662  ??  S      0:00.01 /usr/sbin/irsd -N
 2667  ??  S      0:00.13 /usr/sbin/ksyncd -N
 2690  ??  Ss     0:00.00 mgd: (mgd) (root) (mgd)
 2691  ??  R      0:00.00 /bin/ps -ax
 1164  d0- S      0:00.00 /usr/sbin/usbd -N
 1182  d0- S      0:00.34 /usr/sbin/eventd -N -r -s -A
 1543  d0  Is+    0:00.00 /usr/libexec/getty std.9600 ttyd0

lcc1-re0:
--------------------------------------------------------------------------
  PID  TT  STAT      TIME COMMAND
    0  ??  WLs    0:00.00 [swapper]
    1  ??  ILs    0:00.17 /packages/mnt/jbase/sbin/init --
    2  ??  DL     0:00.01 [g_event]
    3  ??  DL     0:00.16 [g_up]
    4  ??  DL     0:00.11 [g_down]
    5  ??  DL     0:00.00 [thread taskq]
    6  ??  DL     0:00.00 [kqueue taskq]
    7  ??  DL     0:00.00 [pagedaemon]
    8  ??  DL     0:00.00 [vmdaemon]
    9  ??  DL     0:01.77 [pagezero]
   10  ??  DL     0:00.00 [ktrace]
   11  ??  RL    17:22.83 [idle]
   12  ??  WL     0:00.35 [swi2: net]
   13  ??  WL     0:01.20 [swi7: clock sio]
   14  ??  WL     0:00.00 [swi6: vm]
   15  ??  DL     0:00.10 [yarrow]
   16  ??  WL     0:00.00 [swi9: +]
   17  ??  WL     0:00.00 [swi8: +]
   18  ??  WL     0:00.00 [swi5: cambio]
   19  ??  WL     0:00.00 [swi9: task queue]
   20  ??  WL     0:02.87 [irq10: bcm0 uhci1*]
   21  ??  WL     0:00.02 [irq11: cb0 uhci0+*]
   22  ??  DL     0:00.00 [usb0]
   23  ??  DL     0:00.00 [usbtask]
   24  ??  DL     0:00.00 [usb1]
   25  ??  DL     0:00.05 [usb2]
   26  ??  DL     0:00.00 [usb3]
   27  ??  DL     0:00.00 [usb4]
   28  ??  DL     0:00.00 [usb5]
   29  ??  DL     0:00.04 [usb6]
   30  ??  DL     0:00.00 [usb7]
   31  ??  WL     0:00.00 [irq14: ata0]
   32  ??  WL     0:00.00 [irq15: ata1]
   33  ??  WL     0:00.00 [irq1: atkbd0]
   34  ??  WL     0:00.00 [swi0: sio]
   35  ??  WL     0:00.00 [swi3: ip6opt ipopt]
   36  ??  WL     0:00.00 [swi4: ip6mismatch+]
   37  ??  WL     0:00.00 [swi1: ipfwd]
   38  ??  DL     0:00.00 [bufdaemon]
   39  ??  DL     0:00.00 [vnlru]
   40  ??  DL     0:00.01 [syncer]
   41  ??  DL     0:00.00 [softdepflush]
   42  ??  DL     0:00.00 [netdaemon]
   43  ??  DL     0:00.00 [vmuncachedaemon]
   44  ??  DL     0:00.00 [if_pic_listen]
   45  ??  DL     0:00.02 [vmkmemdaemon]
   46  ??  DL     0:00.01 [cb_poll]
   47  ??  DL     0:00.00 [if_pfe_listen]
   48  ??  DL     0:00.00 [scs_housekeeping]
```

```
   49  ??  IL      0:00.00 [kern_dump_proc]
   50  ??  IL      0:00.00 [nfsiod 0]
   51  ??  IL      0:00.00 [nfsiod 1]
   52  ??  IL      0:00.00 [nfsiod 2]
   53  ??  IL      0:00.00 [nfsiod 3]
   54  ??  DL      0:00.02 [schedcpu]
   55  ??  DL      0:00.75 [md0]
   77  ??  DL      0:03.40 [md1]
   98  ??  DL      0:00.37 [md2]
  116  ??  DL      0:00.02 [md3]
  137  ??  DL      0:00.56 [md4]
  158  ??  DL      0:00.15 [md5]
  179  ??  DL      0:00.00 [md6]
  215  ??  DL      0:00.03 [md7]
  225  ??  DL      0:00.03 [md8]
 1052  ??  DL      0:00.00 [jsr_kkcm]
 1337  ??  SL      0:00.09 [bcmTX]
 1338  ??  SL      0:00.10 [bcmXGS3AsyncTX]
 1339  ??  SL      0:03.10 [bcmLINK.0]
 1344  ??  Is      0:00.00 /usr/sbin/cron
 1496  ??  S       0:00.00 /sbin/watchdog -t-1
 1497  ??  S       0:00.05 /usr/libexec/bslockd -mp -N
 1498  ??  I       0:00.01 /usr/sbin/tnetd -N
 1500  ??  S       0:04.97 /usr/sbin/chassisd -N
 1501  ??  S       0:00.04 /usr/sbin/alarmd -N
 1502  ??  I       0:00.40 /usr/sbin/craftd -N
 1503  ??  S       0:00.08 /usr/sbin/mgd -N
 1506  ??  I       0:00.04 /usr/sbin/inetd -N
 1507  ??  I       0:00.00 /usr/sbin/tnp.sntpd -N
 1508  ??  I       0:00.00 /usr/sbin/tnp.sntpc -N
 1510  ??  S       0:00.01 /usr/sbin/smartd -N
 1514  ??  I       0:00.07 /usr/sbin/jcsd -N
 1515  ??  S       0:00.18 /usr/sbin/idpd -N
 1516  ??  I       0:00.00 /usr/libexec/getty Pc ttyv0
 2068  ??  DL      0:00.01 [peer proxy]
 2069  ??  DL      0:00.01 [peer proxy]
 2070  ??  DL      0:00.01 [peer proxy]
 2666  ??  S       0:00.02 /sbin/dcd -N
 2667  ??  S       0:00.01 /usr/sbin/irsd -N
 2668  ??  S       0:00.01 /usr/sbin/pfed -N
 2669  ??  S       0:00.05 /usr/sbin/snmpd -N
 2670  ??  S       0:00.01 /usr/sbin/mib2d -N
 2671  ??  S       0:00.02 /usr/sbin/dfwd -N
 2675  ??  S       0:00.13 /usr/sbin/ksyncd -N
 2699  ??  Ss      0:00.00 mgd: (mgd) (root) (mgd)
 2700  ??  R       0:00.00 /bin/ps -ax
 1138  d0- S       0:00.00 /usr/sbin/usbd -N
 1156  d0- S       0:00.37 /usr/sbin/eventd -N -r -s -A
 1517  d0  Is+     0:00.00 /usr/libexec/getty std.9600 ttyd0

lcc2-re0:
--------------------------------------------------------------------------
  PID  TT  STAT      TIME COMMAND
    0  ??  WLs     0:00.00 [swapper]
    1  ??  ILs     0:00.18 /packages/mnt/jbase/sbin/init --
    2  ??  DL      0:00.01 [g_event]
    3  ??  DL      0:00.17 [g_up]
    4  ??  DL      0:00.12 [g_down]
    5  ??  DL      0:00.00 [thread taskq]
    6  ??  DL      0:00.00 [kqueue taskq]
    7  ??  DL      0:00.00 [pagedaemon]
```



```
   8  ??  DL      0:00.00 [vmdaemon]
   9  ??  DL      0:01.77 [pagezero]
  10  ??  DL      0:00.00 [ktrace]
  11  ??  RL     17:19.13 [idle]
  12  ??  WL      0:00.36 [swi2: net]
  13  ??  WL      0:01.20 [swi7: clock sio]
  14  ??  WL      0:00.00 [swi6: vm]
  15  ??  DL      0:00.13 [yarrow]
  16  ??  WL      0:00.00 [swi9: +]
  17  ??  WL      0:00.00 [swi8: +]
  18  ??  WL      0:00.00 [swi5: cambio]
  19  ??  WL      0:00.00 [swi9: task queue]
  20  ??  WL      0:03.03 [irq10: bcm0 uhci1*]
  21  ??  WL      0:00.02 [irq11: cb0 uhci0+*]
  22  ??  DL      0:00.00 [usb0]
  23  ??  DL      0:00.00 [usbtask]
  24  ??  DL      0:00.00 [usb1]
  25  ??  DL      0:00.05 [usb2]
  26  ??  DL      0:00.00 [usb3]
  27  ??  DL      0:00.00 [usb4]
  28  ??  DL      0:00.00 [usb5]
  29  ??  DL      0:00.04 [usb6]
  30  ??  DL      0:00.00 [usb7]
  31  ??  WL      0:00.00 [irq14: ata0]
  32  ??  WL      0:00.00 [irq15: ata1]
  33  ??  WL      0:00.00 [irq1: atkbd0]
  34  ??  WL      0:00.00 [swi0: sio]
  35  ??  WL      0:00.00 [swi3: ip6opt ipopt]
  36  ??  WL      0:00.00 [swi4: ip6mismatch+]
  37  ??  WL      0:00.00 [swi1: ipfwd]
  38  ??  DL      0:00.00 [bufdaemon]
  39  ??  DL      0:00.00 [vnlru]
  40  ??  DL      0:00.01 [syncer]
  41  ??  DL      0:00.00 [softdepflush]
  42  ??  DL      0:00.00 [netdaemon]
  43  ??  DL      0:00.00 [vmuncachedaemon]
  44  ??  DL      0:00.00 [if_pic_listen]
  45  ??  DL      0:00.02 [vmkmemdaemon]
  46  ??  DL      0:00.01 [cb_poll]
  47  ??  DL      0:00.00 [if_pfe_listen]
  48  ??  DL      0:00.00 [scs_housekeeping]
  49  ??  IL      0:00.00 [kern_dump_proc]
  50  ??  IL      0:00.00 [nfsiod 0]
  51  ??  IL      0:00.00 [nfsiod 1]
  52  ??  IL      0:00.00 [nfsiod 2]
  53  ??  IL      0:00.00 [nfsiod 3]
  54  ??  DL      0:00.02 [schedcpu]
  55  ??  DL      0:00.75 [md0]
  77  ??  DL      0:03.48 [md1]
  98  ??  DL      0:00.59 [md2]
 116  ??  DL      0:00.02 [md3]
 137  ??  DL      0:00.56 [md4]
 158  ??  DL      0:00.15 [md5]
 179  ??  DL      0:00.00 [md6]
 215  ??  DL      0:00.03 [md7]
 225  ??  DL      0:00.03 [md8]
1052  ??  DL      0:00.00 [jsr_kkcm]
1337  ??  SL      0:00.09 [bcmTX]
1338  ??  SL      0:00.10 [bcmXGS3AsyncTX]
1339  ??  SL      0:03.22 [bcmLINK.0]
1344  ??  Is      0:00.00 /usr/sbin/cron
```

```
 1496  ??  S       0:00.00 /sbin/watchdog -t-1
 1497  ??  S       0:00.05 /usr/libexec/bslockd -mp -N
 1498  ??  S       0:00.01 /usr/sbin/tnetd -N
 1500  ??  R       0:05.17 /usr/sbin/chassisd -N
 1501  ??  S       0:00.04 /usr/sbin/alarmd -N
 1502  ??  I       0:00.39 /usr/sbin/craftd -N
 1503  ??  S       0:00.08 /usr/sbin/mgd -N
 1506  ??  I       0:00.05 /usr/sbin/inetd -N
 1507  ??  I       0:00.00 /usr/sbin/tnp.sntpd -N
 1508  ??  I       0:00.00 /usr/sbin/tnp.sntpc -N
 1510  ??  S       0:00.01 /usr/sbin/smartd -N
 1514  ??  I       0:00.07 /usr/sbin/jcsd -N
 1515  ??  S       0:00.17 /usr/sbin/idpd -N
 1516  ??  I       0:00.00 /usr/libexec/getty Pc ttyv0
 2591  ??  DL      0:00.01 [peer proxy]
 2592  ??  DL      0:00.01 [peer proxy]
 2593  ??  DL      0:00.01 [peer proxy]
 2597  ??  DL      0:00.00 [peer proxy]
 3192  ??  S       0:00.01 /usr/sbin/irsd -N
 3193  ??  S       0:00.05 /usr/sbin/snmpd -N
 3194  ??  S       0:00.02 /sbin/dcd -N
 3195  ??  S       0:00.01 /usr/sbin/pfed -N
 3196  ??  S       0:00.01 /usr/sbin/mib2d -N
 3197  ??  S       0:00.02 /usr/sbin/dfwd -N
 3198  ??  S       0:00.13 /usr/sbin/ksyncd -N
 3228  ??  Ss      0:00.00 mgd: (mgd) (root) (mgd)
 3229  ??  R       0:00.00 /bin/ps -ax
 1138  d0- S       0:00.00 /usr/sbin/usbd -N
 1156  d0- S       0:00.42 /usr/sbin/eventd -N -r -s -A
 1517  d0  Is+     0:00.00 /usr/libexec/getty std.9600 ttyd0
...
```

show system processes sfc (TX Matrix Plus Router)

```
user@host> show system processes sfc 0
sfc0-re0:
--------------------------------------------------------------------------
  PID  TT  STAT      TIME COMMAND
    0  ??  WLs     0:00.00 [swapper]
    1  ??  SLs     0:00.18 /packages/mnt/jbase/sbin/init --
    2  ??  DL      0:00.20 [g_event]
    3  ??  DL      0:00.39 [g_up]
    4  ??  DL      0:00.32 [g_down]
    5  ??  DL      0:00.00 [thread taskq]
    6  ??  DL      0:00.09 [kqueue taskq]
    7  ??  DL      0:00.01 [pagedaemon]
    8  ??  DL      0:00.00 [vmdaemon]
    9  ??  DL      0:06.63 [pagezero]
   10  ??  DL      0:00.00 [ktrace]
   11  ??  RL    312:09.00 [idle]
   12  ??  WL      0:11.07 [swi2: net]
   13  ??  WL      0:27.70 [swi7: clock sio]
   14  ??  WL      0:00.00 [swi6: vm]
   15  ??  DL      0:03.03 [yarrow]
   16  ??  WL      0:00.00 [swi9: +]
   17  ??  WL      0:00.00 [swi8: +]
   18  ??  WL      0:00.00 [swi5: cambio]
   19  ??  WL      0:00.00 [swi9: task queue]
   20  ??  WL      0:11.46 [irq16: uhci0 uhci*]
   21  ??  DL      0:00.00 [usb0]
   22  ??  DL      0:00.00 [usbtask]
```



```
   23  ??  WL      0:39.63 [irq17: uhci1 uhci*]
   24  ??  DL      0:00.00 [usb1]
   25  ??  WL      0:00.00 [irq18: uhci2 uhci*]
   26  ??  DL      0:00.84 [usb2]
   27  ??  DL      0:00.00 [usb3]
   28  ??  DL      0:00.00 [usb4]
   29  ??  DL      0:00.00 [usb5]
   30  ??  DL      0:00.73 [usb6]
   31  ??  DL      0:00.00 [usb7]
   32  ??  WL      0:00.00 [irq14: ata0]
   33  ??  WL      0:00.00 [irq15: ata1]
   34  ??  WL      0:00.00 [irq1: atkbd0]
   35  ??  WL      0:00.00 [swi0: sio]
   36  ??  WL      0:00.00 [irq11: isab0]
   37  ??  WL      0:00.00 [swi3: ip6opt ipopt]
   38  ??  WL      0:00.00 [swi4: ip6mismatch+]
   39  ??  WL      0:00.00 [swi1: ipfwd]
   40  ??  DL      0:00.02 [bufdaemon]
   41  ??  DL      0:00.02 [vnlru]
   42  ??  DL      0:00.39 [syncer]
   43  ??  DL      0:00.05 [softdepflush]
   44  ??  DL      0:00.00 [netdaemon]
   45  ??  DL      0:00.02 [vmuncachedaemon]
   46  ??  DL      0:00.00 [if_pic_listen]
   47  ??  DL      0:00.35 [vmkmemdaemon]
   48  ??  DL      0:00.00 [cb_poll]
   49  ??  DL      0:00.06 [if_pfe_listen]
   50  ??  DL      0:00.00 [scs_housekeeping]
   51  ??  IL      0:00.00 [kern_dump_proc]
   52  ??  IL      0:00.00 [nfsiod 0]
   53  ??  IL      0:00.00 [nfsiod 1]
   54  ??  IL      0:00.00 [nfsiod 2]
   55  ??  IL      0:00.00 [nfsiod 3]
   56  ??  DL      0:00.37 [schedcpu]
   57  ??  DL      0:00.56 [md0]
   79  ??  DL      0:02.58 [md1]
  100  ??  DL      0:00.03 [md2]
  118  ??  DL      0:00.01 [md3]
  139  ??  DL      0:00.95 [md4]
  160  ??  DL      0:00.12 [md5]
  181  ??  DL      0:00.00 [md6]
  217  ??  DL      0:00.02 [md7]
  227  ??  DL      0:00.05 [md8]
 1341  ??  SL      0:01.35 [bcmTX]
 1342  ??  SL      0:01.69 [bcmXGS3AsyncTX]
 1343  ??  SL      0:41.57 [bcmLINK.0]
 1345  ??  SL      0:33.97 [bcmLINK.1]
 1350  ??  Is      0:00.01 /usr/sbin/cron
 1502  ??  S       0:00.01 /sbin/watchdog -t-1
 1503  ??  S       0:00.86 /usr/libexec/bslockd -mp -N
 1504  ??  I       0:00.01 /usr/sbin/tnetd -N
 1507  ??  S       0:01.32 /usr/sbin/alarmd -N
 1508  ??  S       0:14.54 /usr/sbin/craftd -N
 1509  ??  S       0:01.20 /usr/sbin/mgd -N
 1512  ??  S       0:00.05 /usr/sbin/inetd -N
 1513  ??  S       0:00.10 /usr/sbin/tnp.sntpd -N
 1517  ??  S       0:00.11 /usr/sbin/smartd -N
 1525  ??  S       0:01.11 /usr/sbin/idpd -N
 1526  ??  S       0:01.43 /usr/sbin/license-check -U -M -p 10 -i 10
 1527  ??  I       0:00.01 /usr/libexec/getty Pc ttyv0
 1616  ??  DL      0:00.30 [peer proxy]
```

```
 1617  ??  DL     0:00.32 [peer proxy]
 1618  ??  DL     0:00.34 [peer proxy]
 1619  ??  DL     0:00.30 [peer proxy]
 2391  ??  Is     0:00.01 telnetd
 7331  ??  Ss     0:00.03 telnetd
 9538  ??  DL     0:01.16 [jsr_kkcm]
 9613  ??  DL     0:00.18 [peer proxy]
23781  ??  Ss     0:00.01 telnetd
23926  ??  Ss     0:00.03 mgd: (mgd) (regress)/dev/ttyp2 (mgd)
36867  ??  S      0:03.14 /usr/sbin/rpd -N
36874  ??  S      0:00.08 /usr/sbin/lmpd
36876  ??  S      0:00.17 /usr/sbin/lacpd -N
36877  ??  S      0:00.15 /usr/sbin/bfdd -N
36878  ??  S      0:05.05 /usr/sbin/ppmd -N
36907  ??  S      0:26.63 /usr/sbin/chassisd -N
37775  ??  S      0:00.01 /usr/sbin/bdbrepd -N
45727  ??  S      0:00.02 /usr/sbin/xntpd -j -N -g (ntpd)
45729  ??  S      0:00.40 /usr/sbin/l2ald -N
45730  ??  S<     0:00.13 /usr/sbin/apsd -N
45731  ??  SN     0:00.10 /usr/sbin/sampled -N
45732  ??  S      0:00.03 /usr/sbin/ilmid -N
45733  ??  S      0:00.09 /usr/sbin/rmopd -N
45734  ??  S      0:00.31 /usr/sbin/cosd
45735  ??  I      0:00.00 /usr/sbin/rtspd -N
45736  ??  S      0:00.06 /usr/sbin/fsad -N
45737  ??  S      0:00.05 /usr/sbin/rdd -N
45738  ??  S      0:00.10 /usr/sbin/pppd -N
45739  ??  S      0:00.05 /usr/sbin/dfcd -N
45740  ??  S      0:00.08 /usr/sbin/lfmd -N
45741  ??  S      0:00.01 /usr/sbin/mplsoamd -N
45742  ??  I      0:00.01 /usr/sbin/sendd -N
45743  ??  S      0:00.08 /usr/sbin/appidd -N
45744  ??  S      0:00.05 /usr/sbin/mspd -N
45745  ??  S      0:00.27 /usr/sbin/jdiameterd -N
45746  ??  S      0:00.10 /usr/sbin/pfed -N
45747  ??  S      0:00.19 /usr/sbin/lpdfd -N
45748  ??  S      0:00.64 /sbin/dcd -N
45750  ??  S      0:00.46 /usr/sbin/mib2d -N
45751  ??  S      0:00.16 /usr/sbin/dfwd -N
45752  ??  S      0:00.15 /usr/sbin/irsd -N
45764  ??  S      0:20.60 /usr/sbin/snmpd -N
56481  ??  Ss     0:00.02 telnetd
56548  ??  Rs     0:00.19 mgd: (mgd) (regress)/dev/ttyp0 (mgd)
56577  ??  Ss     0:00.00 mgd: (mgd) (root) (mgd)
56578  ??  R      0:00.00 /bin/ps -ax
 1142  d0- S      0:00.01 /usr/sbin/usbd -N
 1160  d0- S      0:29.71 /usr/sbin/eventd -N -r -s -A
 6527  d0  Is+    0:00.00 /usr/libexec/getty std.9600 ttyd0
56482  p0  Is     0:00.00 login [pam] (login)
56483  p0  S      0:00.01 -csh (csh)
56547  p0  S+     0:00.02 cli
 2392  p1  Is     0:00.00 login [pam] (login)
 2393  p1  I      0:00.00 -csh (csh)
 2394  p1  I      0:00.00 su -
 2395  p1  I+     0:00.01 -su (csh)
23782  p2  Is     0:00.00 login [pam] (login)
23881  p2  I      0:00.00 -csh (csh)
23925  p2  S+     0:00.03 cli
 7332  p3  Is     0:00.00 login [pam] (login)
 7333  p3  I      0:00.00 -csh (csh)
23780  p3  S+     0:00.02 telnet aj
```


show system processes lcc wide (TX Matrix Plus Routing Matrix)

```
user@host> show system processes lcc 2 wide
lcc2-re0:
--------------------------------------------------------------------------
  PID  TT  STAT      TIME PROVIDER COMMAND
    0  ??  WLs    0:00.00 (null)   [swapper]
    1  ??  ILs    0:00.19          /packages/mnt/jbase/sbin/init --
    2  ??  DL     0:00.02          [g_event]
    3  ??  DL     0:00.19          [g_up]
    4  ??  DL     0:00.13          [g_down]
    5  ??  DL     0:00.00          [thread taskq]
    6  ??  DL     0:00.00          [kqueue taskq]
    7  ??  DL     0:00.00          [pagedaemon]
    8  ??  DL     0:00.00          [vmdaemon]
    9  ??  DL     0:01.77          [pagezero]
   10  ??  DL     0:00.00          [ktrace]
   11  ??  RL    20:33.81          [idle]
   12  ??  WL     0:00.38          [swi2: net]
   13  ??  WL     0:01.43          [swi7: clock sio]
   14  ??  WL     0:00.00          [swi6: vm]
   15  ??  DL     0:00.14          [yarrow]
   16  ??  WL     0:00.00          [swi9: +]
   17  ??  WL     0:00.00          [swi8: +]
   18  ??  WL     0:00.00          [swi5: cambio]
   19  ??  WL     0:00.00          [swi9: task queue]
   20  ??  WL     0:03.18          [irq10: bcm0 uhci1*]
   21  ??  WL     0:00.03          [irq11: cb0 uhci0+*]
   22  ??  DL     0:00.00          [usb0]
   23  ??  DL     0:00.00          [usbtask]
   24  ??  DL     0:00.00          [usb1]
   25  ??  DL     0:00.06          [usb2]
   26  ??  DL     0:00.00          [usb3]
   27  ??  DL     0:00.00          [usb4]
   28  ??  DL     0:00.00          [usb5]
   29  ??  DL     0:00.05          [usb6]
   30  ??  DL     0:00.00          [usb7]
   31  ??  WL     0:00.00          [irq14: ata0]
   32  ??  WL     0:00.00          [irq15: ata1]
   33  ??  WL     0:00.00          [irq1: atkbd0]
   34  ??  WL     0:00.00          [swi0: sio]
   35  ??  WL     0:00.00          [swi3: ip6opt ipopt]
   36  ??  WL     0:00.00          [swi4: ip6mismatch+]
   37  ??  WL     0:00.00          [swi1: ipfwd]
   38  ??  DL     0:00.00          [bufdaemon]
   39  ??  DL     0:00.00          [vnlru]
   40  ??  DL     0:00.02          [syncer]
   41  ??  DL     0:00.01          [softdepflush]
   42  ??  DL     0:00.00          [netdaemon]
   43  ??  DL     0:00.00          [vmuncachedaemon]
   44  ??  DL     0:00.00          [if_pic_listen]
   45  ??  DL     0:00.03          [vmkmemdaemon]
   46  ??  DL     0:00.01          [cb_poll]
   47  ??  DL     0:00.00          [if_pfe_listen]
   48  ??  DL     0:00.00          [scs_housekeeping]
   49  ??  IL     0:00.00          [kern_dump_proc]
   50  ??  IL     0:00.00          [nfsiod 0]
   51  ??  IL     0:00.00          [nfsiod 1]
   52  ??  IL     0:00.00          [nfsiod 2]
   53  ??  IL     0:00.00          [nfsiod 3]
   54  ??  DL     0:00.02          [schedcpu]
```

```
   55  ??  DL      0:00.75          [md0]
   77  ??  DL      0:03.84          [md1]
   98  ??  DL      0:00.59          [md2]
  116  ??  DL      0:00.02          [md3]
  137  ??  DL      0:00.72          [md4]
  158  ??  DL      0:00.15          [md5]
  179  ??  DL      0:00.00          [md6]
  215  ??  DL      0:00.03          [md7]
  225  ??  DL      0:00.03          [md8]
 1052  ??  DL      0:00.00          [jsr_kkcm]
 1337  ??  SL      0:00.11          [bcmTX]
 1338  ??  SL      0:00.12          [bcmXGS3AsyncTX]
 1339  ??  SL      0:03.82          [bcmLINK.0]
 1344  ??  Is      0:00.00          /usr/sbin/cron
 1496  ??  I       0:00.00          /sbin/watchdog -t-1
 1497  ??  S       0:00.06          /usr/libexec/bslockd -mp -N
 1498  ??  I       0:00.01          /usr/sbin/tnetd -N
 1500  ??  S       0:09.93          /usr/sbin/chassisd -N
 1501  ??  S       0:00.05          /usr/sbin/alarmd -N
 1502  ??  I       0:00.39          /usr/sbin/craftd -N
 1503  ??  S       0:00.09          /usr/sbin/mgd -N
 1506  ??  I       0:00.05          /usr/sbin/inetd -N
 1507  ??  I       0:00.00          /usr/sbin/tnp.sntpd -N
 1508  ??  I       0:00.00          /usr/sbin/tnp.sntpc -N
 1510  ??  S       0:00.01          /usr/sbin/smartd -N
 1514  ??  I       0:00.07          /usr/sbin/jcsd -N
 1515  ??  S       0:00.17          /usr/sbin/idpd -N
 1516  ??  I       0:00.00          /usr/libexec/getty Pc ttyv0
 2591  ??  DL      0:00.01          [peer proxy]
 2592  ??  DL      0:00.01          [peer proxy]
 2593  ??  DL      0:00.01          [peer proxy]
 2597  ??  DL      0:00.01          [peer proxy]
 3192  ??  S       0:00.02          /usr/sbin/irsd -N
 3193  ??  S       0:00.05          /usr/sbin/snmpd -N
 3194  ??  S       0:00.04          /sbin/dcd -N
 3195  ??  I       0:00.01          /usr/sbin/pfed -N
 3196  ??  S       0:00.02          /usr/sbin/mib2d -N
 3197  ??  I       0:00.03          /usr/sbin/dfwd -N
 3198  ??  S       0:00.15          /usr/sbin/ksyncd -N
 3559  ??  Ss      0:00.00          mgd: (mgd) (root) (mgd)
 3560  ??  R       0:00.00          /bin/ps -ax -Jpww
 1138  d0- S       0:00.00          /usr/sbin/usbd -N
 1156  d0- S       0:00.50          /usr/sbin/eventd -N -r -s -A
 1517  d0  Is+     0:00.00          /usr/libexec/getty std.9600 ttyd0
```

show system processes (QFX Series)

```
user@switch> show system processes
PID  TT  STAT       TIME COMMAND
    0  ??  WLs  -2341043:-31.01 [swapper]
    1  ??  SLs     0:01.34 /packages/mnt/jbase/sbin/init --
    2  ??  DL      2:48.31 [g_event]
    3  ??  DL      1:47.44 [g_up]
    4  ??  DL      1:37.82 [g_down]
    5  ??  DL      0:00.00 [kdm_tcp_poller]
    6  ??  DL      0:00.00 [thread taskq]
    7  ??  DL      0:04.86 [kqueue taskq]
    9  ??  DL      0:03.94 [pagedaemon]
   10  ??  DL      0:00.00 [ktrace]
   11  ??  RL      0:00.00 [idle: cpu31]
   12  ??  RL      0:00.00 [idle: cpu30]
```



```
13  ??  RL      0:00.00 [idle: cpu29]
14  ??  RL      0:00.00 [idle: cpu28]
15  ??  RL      0:00.00 [idle: cpu27]
16  ??  RL      0:00.00 [idle: cpu26]
17  ??  RL      0:00.00 [idle: cpu25]
18  ??  RL      0:00.00 [idle: cpu24]
19  ??  RL      0:00.00 [idle: cpu23]
20  ??  RL      0:00.00 [idle: cpu22]
21  ??  RL      0:00.00 [idle: cpu21]
22  ??  RL      0:00.00 [idle: cpu20]
23  ??  RL      0:00.00 [idle: cpu19]
24  ??  RL      0:00.00 [idle: cpu18]
25  ??  RL      0:00.00 [idle: cpu17]
26  ??  RL      0:00.00 [idle: cpu16]
27  ??  RL      0:00.00 [idle: cpu15]
28  ??  RL      0:00.00 [idle: cpu14]
29  ??  RL      0:00.00 [idle: cpu13]
30  ??  RL      0:00.00 [idle: cpu12]
31  ??  RL      0:00.00 [idle: cpu11]
32  ??  RL      0:00.00 [idle: cpu10]
33  ??  RL      0:00.00 [idle: cpu9]
34  ??  RL    18184:07.25 [idle: cpu8]
35  ??  RL      0:00.00 [idle: cpu7]
36  ??  RL    17862:11.31 [idle: cpu6]
37  ??  RL    19343:45.16 [idle: cpu5]
38  ??  RL    5192:38.30 [idle: cpu4]
39  ??  RL      0:00.00 [idle: cpu3]
40  ??  RL    19278:02.24 [idle: cpu2]
41  ??  RL    19291:00.72 [idle: cpu1]
42  ??  RL    18910:31.21 [idle: cpu0]
43  ??  WL     19:03.74 [swi2: net]
44  ??  WL    261:43.82 [swi7: clock sio]
45  ??  WL      0:00.00 [swi6: vm]
46  ??  DL      2:18.57 [yarrow]
47  ??  WL      0:00.00 [swi9: +]
48  ??  WL      0:00.00 [swi8: +]
49  ??  WL      0:12.36 [swi5: cambio]
50  ??  WL      0:00.00 [swi9: task queue]
51  ??  WL      0:00.00 [swi0: sio]
52  ??  WL      0:32.40 [irq39: ehci0]
53  ??  DL      0:00.21 [usb0]
54  ??  DL      0:00.00 [usbtask]
55  ??  WL      0:00.00 [irq22: xlr_lbus0]
56  ??  WL      0:00.00 [irq38: xlr_lbus0]
57  ??  WL      0:00.00 [swi3: ip6opt ipopt]
58  ??  WL      0:00.00 [swi4: ip6mismatch+]
59  ??  WL      0:00.00 [swi1: ipfwd]
60  ??  DL      0:18.65 [pagezero]
61  ??  DL      0:18.59 [bufdaemon]
62  ??  DL      1:10.44 [vnlru_mem]
63  ??  DL      1:51.66 [syncer]
64  ??  DL      0:20.22 [vnlru]
65  ??  DL      0:40.48 [softdepflush]
66  ??  DL      0:00.00 [netdaemon]
67  ??  DL     20:47.67 [vmkmemdaemon]
68  ??  DL      0:00.00 [if_pfe_listen]
69  ??  SL      0:02.80 [kdm_checkkcore]
70  ??  SL      0:03.34 [kdm_savekcore]
71  ??  SL      0:04.31 [kdm_livekcore]
72  ??  SL      0:06.14 [kdm_logger]
73  ??  SL      0:04.31 [kdm_kdb]
```

```
   74  ??  SL     0:00.02 [devrt_kernel_thread]
   75  ??  DL     0:21.54 [vmuncachedaemon]
   76  ??  DL     0:00.00 [if_pic_listen0]
   77  ??  SL     0:00.00 [nfsiod 0]
   78  ??  SL     0:00.00 [nfsiod 1]
   79  ??  SL     0:00.00 [nfsiod 2]
   80  ??  SL     0:00.00 [nfsiod 3]
   81  ??  WL     5:59.98 [irq13: +]
   82  ??  RL   105:06.81 [pkt_sender: cpu0]
   83  ??  DL     0:03.62 [md0]
   95  ??  DL     0:37.04 [md1]
  115  ??  DL     0:06.01 [md2]
  135  ??  DL     0:00.75 [md3]
  155  ??  DL     0:21.17 [md4]
  175  ??  DL     0:01.90 [md5]
  195  ??  DL     0:06.26 [md6]
  231  ??  DL     0:00.01 [md7]
  755  ??  Ss     0:04.17 /usr/sbin/cron
  847  ??  S      0:00.10 /usr/sbin/tnetd -N
  849  ??  S      0:06.82 /usr/sbin/mgd -N
  850  ??  S      0:00.32 /usr/sbin/inetd -N
  852  ??  S      1:05.34 /usr/sbin/dhcpd -N
  853  ??  S      0:00.18 /usr/sbin/inetd -p /var/run/inetd_4.pid -N -JU __juni
  855  ??  L   1181:02.21 /usr/sbin/dc-pfe -N (pafxpc)
  857  ??  S     17:55.86 /usr/sbin/vccpd -N
  896  ??  S     93:43.45 /usr/sbin/chassism -N
  953  ??  S      0:02.89 /sbin/watchdog -t-1
  954  ??  S      3:34.00 /sbin/dcd -N
  955  ??  S     10:30.13 /usr/sbin/chassisd -N
  956  ??  DL     0:00.21 [peer proxy]
  957  ??  S      4:07.43 /usr/sbin/alarmd -N
  958  ??  S      0:31.69 /usr/sbin/craftd -N
  959  ??  S      0:55.16 /usr/sbin/mib2d -N
  960  ??  S      3:40.64 /usr/sbin/rpd -N
  961  ??  S      0:00.03 /usr/sbin/tnp.sntpd -N
  962  ??  S      0:51.94 /usr/sbin/pfed -N
  963  ??  S      0:47.31 /usr/sbin/rmopd -N
  964  ??  S      0:33.65 /usr/sbin/cosd
  965  ??  S      1:48.41 /usr/sbin/ppmd -N
  966  ??  S      0:07.18 /usr/sbin/dfwd -N
  967  ??  S      1:02.56 /usr/sbin/bfdd -N
  968  ??  S      0:00.63 /usr/sbin/rdd -N
  969  ??  S      0:40.61 /usr/sbin/dfcd -N
  971  ??  S      0:07.81 /usr/sbin/bdbrepd -N
  972  ??  S      0:00.28 /usr/sbin/sendd -N
  973  ??  S      1:37.69 /usr/sbin/xntpd -j -N -g -JU __juniper_private4__ (nt
  974  ??  S      5:56.28 /usr/sbin/snmpd -N -JU __juniper_private4__
  975  ??  S     16:46.82 /usr/sbin/jdiameterd -N
  976  ??  S      2:34.13 /usr/sbin/eswd -N
  977  ??  S      1:03.05 /usr/sbin/sflowd -N
  978  ??  S      0:22.30 /usr/sbin/fcd -N
  979  ??  S      1:07.01 /usr/sbin/vccpdf -N
  982  ??  S      0:25.25 /usr/sbin/mcsnoopd -N
  983  ??  S      3:45.68 /usr/sbin/rpdf -N
 1043  ??  S      0:37.87 /usr/sbin/lacpd -N
 1048  ??  DL     0:01.29 [peer proxy]
 1111  ??  WL     0:00.00 [swi2: FMNITHRD+]
 1112  ??  DL     0:00.03 [peer proxy]
12816  ??  S     15:35.32 /usr/sbin/sfid -N
30893  ??  Ss     0:00.65 sshd: tlewis@ttyp0 (sshd)
30897  ??  Ss     0:00.15 mgd: (mgd) (tlewis)/dev/ttyp0 (mgd)
```



```
30905  ??  Ss     0:00.64 sshd: tlewis@ttyp1 (sshd)
30909  ??  Ss     0:00.15 mgd: (mgd) (tlewis)/dev/ttyp1 (mgd)
30910  ??  Ss     0:01.26 sshd: tcheng@ttyp2 (sshd)
30914  ??  Ss     0:00.80 mgd: (mgd) (tcheng)/dev/ttyp2 (mgd)
30937  ??  R      0:00.03 /bin/ps -ax
  661  d0- S      0:21.24 /usr/sbin/eventd -N -r -s -A
  860  d0  Ss+    0:00.07 /usr/libexec/getty std.9600 ttyd0
30896  p0  Ss+    0:00.55 -cli (cli)
30908  p1  Ss+    0:00.50 -cli (cli)
30913  p2  Ss+    0:00.85 -cli (cli)
```

show system reboot

Syntax

show system reboot
<both-routing-engines>

Syntax (EX Series Switches)

show system reboot
<all-members>
<both-routing-engines>
<local>
<member *member-id*>

Syntax (TX Matrix Router)

show system reboot
<all-chassis | all-lcc | lcc *number* | scc>
<both-routing-engines>

Syntax (TX Matrix Plus Router)

show system reboot
<all-chassis| all-lcc | lcc *number* | sfc *number*>
<both-routing-engines>

Syntax (MX Series Router)

show system reboot
<all-members>
<both-routing-engines>
<local>
<member *member-id*>

Syntax (QFX Series)

show system reboot
<both-routing-engines>
<infrastructure *name*>
<interconnect-device *name*>
<node-device *name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display pending system reboots or halts.

Options

none—Display pending reboots or halts on the active Routing Engine.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display halt or reboot request information for all the T640 routers in the chassis that are connected to the TX Matrix router. On a TX Matrix router, display halt or reboot request information for all the T1600 or T4000 routers in the chassis that are connected to the TX Matrix Plus router.

all-members—(EX4200 switches and MX Series routers only) (Optional) Display halt or reboot request information for all members of the Virtual Chassis configuration.

all-lcc—(TX Matrix routers and TX Matrix Plus router only) (Optional) On a TX Matrix router, display system halt or reboot request information for all T640 routers connected to the TX Matrix router. On a TX Matrix Plus router, display halt or reboot request information for all connected T1600 or T4000 LCCs.

both-routing-engines—(Systems with multiple Routing Engines) (Optional) Display halt or reboot request information on both Routing Engines.

infrastructure *name*—(QFabric systems only) (Optional) Display reboot request information on the fabric manager Routing Engines and fabric control Routing Engines.

interconnect-device *name*—(QFabric systems only) (Optional) Display reboot request information on the Interconnect device.

lcc *number*—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display halt or reboot request information for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, display halt or reboot request information for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Display halt or reboot request information for the local Virtual Chassis member.

member *member-id*—(EX4200 switches and MX Series routers only) (Optional) Display halt or reboot request information for the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

node-group *name*—(QFabric systems only) (Optional) Display reboot request information on the Node group.

scc—(TX Matrix router only) (Optional) Display halt or reboot request information for the TX Matrix router (or switch-card chassis).

sfc—(TX Matrix Plus router only) (Optional) Display halt or reboot request information for the TX Matrix Plus router.

Additional Information

By default, when you issue the **show system reboot** command on a TX Matrix or TX Matrix Plus master Routing Engine, the command is broadcast to all the T640 (in a routing matrix based on the TX Matrix router) or T1600 (in a routing matrix based on the TX Matrix Plus router) master Routing Engines connected to it. Likewise, if you issue the same command on the TX Matrix or TX Matrix Plus backup Routing Engine, the command is broadcast to all the T640 (in a routing matrix based on the TX Matrix router) or T1600 (in a routing matrix based on the TX Matrix Plus router) backup Routing Engines that are connected to it.

Required Privilege Level

maintenance

Related Documentation

- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

show system reboot on page 970
show system reboot all-lcc (TX Matrix Router) on page 970
show system reboot sfc (TX Matrix Plus Router) on page 970
show system reboot (QFX3500 Switch) on page 970

Sample Output

show system reboot

```
user@host> show system reboot
reboot requested by root at Wed Feb 10 17:40:46 1999
[process id 17885]
```

show system reboot all-lcc (TX Matrix Router)

```
user@host> show system reboot all-lcc
lcc0-re0:
--------------------------------------------------------------------------
No shutdown/reboot scheduled.

lcc2-re0:
--------------------------------------------------------------------------
No shutdown/reboot scheduled.
```

show system reboot sfc (TX Matrix Plus Router)

```
user@host> show system sfc 0
No shutdown/reboot scheduled.
```

show system reboot (QFX3500 Switch)

```
user@switch> show system reboot
No shutdown/reboot scheduled.
```


show system resource-cleanup processes

Syntax

show system resource-cleanup processes
<detail>
<pid *number*>
<process-name *name*>

Release Information

Command introduced in Junos OS Release 9.3.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the list of processes that have been registered for resource cleanup services.

Options

detail—(Optional) Display the list of processes that have been registered for resource cleanup services, along with the resources that have been requested for cleanup.

pid ***number***—(Optional) Display a process that has been registered for resource cleanup services by specifying the Process Identifier number.

process-name ***name***—(Optional) Display a process that has been registered for resource cleanup services by name of the process.

Required Privilege Level

view

Related Documentation

- *resource-cleanup*
- *traceoptions (Resource Cleanup)*

List of Sample Output

show system resource-cleanup processes on page 971
show system resource-cleanup processes detail on page 972

Output Fields

For a description of the output fields, see Table 88 on page 971. Output fields are listed in the approximate order in which they appear.

Table 88: show system resource-cleanup processes Output Fields

Field Name	Field Description
PID	Process ID, a number that identifies a process.
Process name	String that identifies the process.
Resources to clean	Resources that have been registered to be cleaned up.

Sample Output

show system resource-cleanup processes

```
user@host> show system resource-cleanup processes
PID     Process name          Resources to clean
420     jnx-exampled          GENCFG, SYSV shared memory
```

show system resource-cleanup processes detail

```
user@host> show system resource-cleanup processes detail
PID     Process name          Resources to clean
420     jnx-exampled          GENCFG blob major ID 0x8000, minor ID 0x0000
                              SYSV shared memory ID 65536, key 1108955839
                              SYSV shared memory ID 65537, key 1108955837
```

show system rollback

Syntax

show system rollback *number*
<compare *number*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the contents of a previously committed configuration, or the differences between two previously committed configurations.

NOTE: **The show system rollback command is a purely operational mode command and cannot be issued with run from the configuration mode.**

Options

number—Number of a configuration to view. The output displays the configuration. The range of values is 0 through 49.

compare *number* —(Optional) Number of another previously committed (rollback) configuration to compare to rollback ***number***. The output displays the differences between the two configurations. The range of values is 0 through 49.

Required Privilege Level

view

List of Sample Output

show system rollback compare on page 973

Sample Output

show system rollback compare

```
user@host> show system rollback 3 compare 1
[edit]
+  interfaces {
+      ge-1/1/1 {
+          unit 0 {
+              family inet {
+                  filter {
+                      input mf_plp;
+                  }
+                  address 14.1.1.1/30;
+              }
+          }
+      }
+      ge-1/2/1 {
+          unit 0 {
+              family inet {
+                  filter {
+                      input mf_plp;
+                  }
+                  address 13.1.1.1/30;
+              }
```



```
+           }
+       }
+       ge-1/3/0 {
+           unit 0 {
+               family inet {
+                   filter {
+                       input mf_plp;
+                   }
+                   address 12.1.1.1/30;
+               }
+           }
+       }
+}
```


show system services service-deployment

Syntax show system services service-deployment

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display information about a Session and Resource Control (SRC) client.

Options This command has no options.

Required Privilege Level system
view

List of Sample Output show system services service-deployment on page 975

Output Fields Table 89 on page 975 lists the output fields for the **show system services service-deployment** command. Output fields are listed in the approximate order in which they appear.

Table 89: show system services service-deployment Output Fields

Field Name	Field Description
PDT Keepalive settings	Configured PDT keepalive interval, in seconds.
Keepalives sent	Number of keepalives sent.
Notifications sent	Number of notifications sent.
Last update from peer	Time at which the last update from a peer was received.

Sample Output

show system services service-deployment

```
user@host> show system services service-deployment
Connected to 192.4.4.4 port 10288 since 2004-05-03 11:04:34 PDT Keepalive settings:
 Interval 15 seconds Keepalives sent: 750 Notifications sent: 0 Last update from
 peer: 00:00:06 ago
```


show system software

Syntax

show system software
<detail>

Syntax (EX Series Switches)

show system software
<all-members>
<detail>
<local>
<member *member-id*>

Syntax (TX Matrix Router)

show system software
<all-chassis | all-lcc | lcc *number* | scc>
<detail>

Syntax (TX Matrix Plus Router)

show system software
<all-chassis | all-lcc | lcc *number* | sfc *number*>
<detail>

Syntax (J Series Routers)

show system software
<backup>
<detail>

Syntax (QFX Series)

show system software
<detail>
<infrastructure *name*>
<interconnect-device *name*>
<node-group *name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the Junos OS extensions loaded on your router or switch.

Options

none—Display standard information about all loaded Junos OS extensions.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Display system software information for all the T640 routers (TX Matrix Router) or all the routers (TX Matrix Plus Router) in the chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display system software information for all T640 routers connected to the TX Matrix router. On a TX Matrix Plus router, display system software information for all connected T1600 or T4000 LCCs.

all-members—(EX4200 switches only) (Optional) Display the system software running on all members of the Virtual Chassis configuration.

backup—(J Series routers only) (Optional) Display the status of old system software packages only.

detail—(Optional) Display detailed information about available Junos OS extensions.

infrastructure ***name***—(QFabric systems only) (Optional) Display the system software running on the fabric control Routing Engine and the fabric manager Routing Engine.

interconnect-device ***name***—(QFabric systems only) (Optional) Display the system software running on the Interconnect device.

lcc ***number***—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display system software information for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, display system software information for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches only) (Optional) Display the system software running on the local Virtual Chassis member.

member ***member-id***—(EX4200 switches only) (Optional) Display the system software running on the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value from 0 through 9.

node-group ***name***—(QFabric systems only) (Optional) Display the system software running on the Node group.

scc—(Routing matrix only) (Optional) Display the system software running on a TX Matrix router (or switch-card chassis).

sfc—(TX Matrix Plus routers only) (Optional) Display system software information for the TX Matrix Plus router.

Required Privilege Level maintenance

Related Documentation

- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

show system software on page 978
show system software (TX Matrix Plus Router) on page 978
show system software (QFX Series) on page 982

Output Fields When you enter this command, you are provided a list of Junos OS packages installed on the router and their corresponding Junos OS release number.

Sample Output

show system software

```
user@host> show system software
Information for jbase:

Comment:
JUNOS Base OS Software Suite [7.2R1.7]


Information for jcrypto:

Comment:
JUNOS Crypto Software Suite [7.2R1.7]
Information for jdocs:

Comment:
JUNOS Online Documentation [7.2R1.7]


Information for jkernel:

Comment:
JUNOS Kernel Software Suite [7.2R1.7]


Information for jpfe:

Comment:
JUNOS Packet Forwarding Engine Support (M20/M40) [7.2R1.7]


Information for jroute:

Comment:
JUNOS Routing Software Suite [7.2R1.7]


Information for junos:

Comment:
JUNOS Base OS boot [7.2R1.7]
```

show system software (TX Matrix Plus Router)

```
user@host> show system software
sfc0-re0:
--------------------------------------------------------------------------
Information for jbase:

Comment:
JUNOS Base OS Software Suite [9.6-20090515.0]



Information for jcrypto:
```

```
Comment:
JUNOS Crypto Software Suite [9.6-20090515.0]



Information for jdocs:

Comment:
JUNOS Online Documentation [9.6-20090515.0]
Information for jkernel:

Comment:
JUNOS Kernel Software Suite [9.6-20090515.0]



Information for jpfe:

Comment:
JUNOS Packet Forwarding Engine Support (T-Series) [9.6-20090515.0]



Information for jpfe-common:

Comment:
JUNOS Packet Forwarding Engine Support (M/T Common) [9.6-20090515.0]



Information for jroute:Comment:
JUNOS Routing Software Suite [9.6-20090515.0]



Information for jservices-aacl:

Comment:
JUNOS Services AACL Container package [9.6-20090515.0]



Information for jservices-appid:

Comment:
JUNOS AppId Services [9.6-20090515.0]



Information for jservices-bgf:

Comment:
JUNOS Border Gateway Function package [9.6-20090515.0]
Information for jservices-idp:

Comment:
JUNOS IDP Services [9.6-20090515.0]
```

```
Information for jservices-llpdf:

Comment:
JUNOS Services LL-PDF Container package [9.6-20090515.0]



Information for jservices-sfw:

Comment:
JUNOS Services Stateful Firewall [9.6-20090515.0]
Information for jservices-voice:

Comment:
JUNOS Voice Services Container package [9.6-20090515.0]



Information for junos:

Comment:
JUNOS Base OS boot [9.6-20090515.0]
...
lcc0-re0:
--------------------------------------------------------------------------
Information for jbase:

Comment:
JUNOS Base OS Software Suite [9.6-20090515.0]



Information for jcrypto:

Comment:
JUNOS Crypto Software Suite [9.6-20090515.0]



Information for jdocs:

Comment:
JUNOS Online Documentation [9.6-20090515.0]



Information for jkernel:

Comment:
JUNOS Kernel Software Suite [9.6-20090515.0]



Information for jpfe:

Comment:
JUNOS Packet Forwarding Engine Support (T-Series) [9.6-20090515.0]



Information for jpfe-common:
```



```
Comment:
JUNOS Packet Forwarding Engine Support (M/T Common) [9.6-20090515.0]


Information for jroute:

Comment:
JUNOS Routing Software Suite [9.6-20090515.0]


Information for jservices-aacl:

Comment:
JUNOS Services AACL Container package [9.6-20090515.0]


Information for jservices-appid:

Comment:
JUNOS AppId Services [9.6-20090515.0]


Information for jservices-bgf:

Comment:
JUNOS Border Gateway Function package [9.6-20090515.0]


Information for jservices-idp:

Comment:
JUNOS IDP Services [9.6-20090515.0]


Information for jservices-llpdf:

Comment:
JUNOS Services LL-PDF Container package [9.6-20090515.0]


Information for jservices-sfw:

Comment:
JUNOS Services Stateful Firewall [9.6-20090515.0]


Information for jservices-voice:

Comment:
JUNOS Voice Services Container package [9.6-20090515.0]
```



```
Information for junos:

Comment:
JUNOS Base OS boot [9.6-20090515.0]


lcc1-re0:
--------------------------------------------------------------------------
Information for jbase:

Comment:
JUNOS Base OS Software Suite [9.6-20090515.0]


Information for jcrypto:

Comment:
JUNOS Crypto Software Suite [9.6-20090515.0]
...
```

show system software (QFX Series)

```
user@switch> show system software
Information for jbase:

Comment:
JUNOS Base OS Software Suite [11.3-20110730.0]


Information for jcrypto:

Comment:
JUNOS Crypto Software Suite [11.3-20110730.0]


Information for jdocs:

Comment:
JUNOS Online Documentation [11.3-20110730.0]


Information for jkernel:

Comment:
JUNOS Kernel Software Suite [11.3-20110730.0]


Information for jpfe:

Comment:
JUNOS Packet Forwarding Engine Support (QFX) [11.3-20110730.0]
```



```
Information for jroute:

Comment:
JUNOS Routing Software Suite [11.3-20110730.0]


Information for jswitch:

Comment:
JUNOS Enterprise Software Suite [11.3-20110730.0]


Information for junos:

Comment:
JUNOS Base OS boot [11.3-20110730.0]


Information for jweb:

Comment:
JUNOS Web Management [11.3-20110730.0]
```

show system statistics

Syntax

show system statistics

Syntax (EX Series Switches)

show system statistics
<all-members>
<local>
<member *member-id*>

Syntax (TX Matrix Router)

show system statistics
<all-chassis | all-lcc | lcc *number* | scc>

Syntax (TX Matrix Plus Router)

show system statistics
<all-chassis | all-lcc | lcc *number* | sfc *number*>

Syntax (MX Series Router)

show system statistics
<all-members>
<local>
<member *member-id*>

Syntax (QFX Series)

show system statistics

Release Information

Command introduced before JUNOS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in JUNOS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display system-wide protocol-related statistics.

Options

none—Display system statistics for all the following protocols:

- **arp**—Address Resolution Protocol
- **bridge**—IEEE 802.1 Bridging
- **clns**—Connectionless Network Service
- **esis**—End System-to-Intermediate System
- **ethoamcfm**—Ethernet OAM protocol for connectivity fault management
- **ethoamlfm**—Ethernet OAM protocol for link fault management
- **icmp**—Internet Control Message Protocol
- **icmp6**—Internet Control Message Protocol version 6
- **igmp**—Internet Group Management Protocol
- **ip**—Internet Protocol version 4
- **ip6**—Internet Protocol version 6
- **mpls**—Multiprotocol Label Switching
- **rdp**—Reliable Datagram Protocol

- **tcp**—Transmission Control Protocol
- **tnp**—Trivial Network Protocol
- **ttp**—TNP Tunneling Protocol
- **tudp**—Trivial User Datagram Protocol
- **udp**—User Datagram Protocol
- **vpls**—Virtual Private LAN Service

all-chassis—(TX Matrix and TX Matrix Plus routers only) (Optional) Display system statistics for a protocol for all the routers in the chassis.

all-lcc—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display system statistics for a protocol for all T640 routers (or line-card chassis) connected to the TX Matrix router. On a TX Matrix Plus router, display system statistics for a protocol for all routers (line-card chassis) connected to the TX Matrix Plus router

all-members—(EX4200 switches and MX Series routers only) (Optional) Display system statistics for a protocol for all members of the Virtual Chassis configuration.

lcc *number*—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display system statistics for a protocol for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, display system statistics for a protocol for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Display system statistics for a protocol for the local Virtual Chassis member.

member *member-id*—(EX4200 switches and MX Series routers only) (Optional) Display system statistics for a protocol for the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

scc—(TX Matrix routers only) (Optional) Display system statistics for a protocol for the TX Matrix router (or switch-card chassis).

sfc *number*—(TX Matrix Plus routers only) (Optional) Display system statistics for a protocol for the TX Matrix Plus router (or switch-fabric chassis). Replace ***number*** with 0.

Additional Information

By default, when you issue the **show system statistics** command on a TX Matrix or TX Matrix Plus master Routing Engine, the command is broadcast to all the T640 (in a routing matrix based on the TX Matrix router) or T1600 (in a routing matrix based on the TX Matrix Plus router) master Routing Engines connected to it. Likewise, if you issue the same command on the TX Matrix or TX Matrix Plus backup Routing Engine, the command is broadcast to all the T640 (in a routing matrix based on the TX Matrix router) or T1600 (in a routing matrix based on the TX Matrix Plus router) backup Routing Engines that are connected to it.

Required Privilege Level

view

List of Sample Output

show system statistics on page 986
show system statistics (EX Series Switches) on page 993
show system statistics (TX Matrix Router) on page 1002
show system statistics (QFX Series) on page 1009

Sample Output

show system statistics

```
user@host> show system statistics
ip:
        3682087 total packets received
        0 bad header checksums
        0 with size smaller than minimum
        0 with data size < data length
        0 with header length < data size
        0 with data length < header length
        0 with incorrect version number
        0 packets destined to dead next hop
        0 fragments received
        0 fragments dropped (dup or out of space)
        0 fragments dropped (queue overflow)
        0 fragments dropped after timeout
        0 fragments dropped due to over limit
        0 packets reassembled ok
        3664774 packets for this host
        17316 packets for unknown/unsupported protocol
        0 packets forwarded
        0 packets not forwardable
        0 redirects sent
        6528 packets sent from this host
        0 packets sent with fabricated ip header
        0 output packets dropped due to no bufs
        0 output packets discarded due to no route
        0 output datagrams fragmented
        0 fragments created
        0 datagrams that can't be fragmented
        0 packets with bad options
        1123 packets with options handled without error
        0 strict source and record route options
        0 loose source and record route options
```

```
        0 record route options
        0 timestamp options
        0 timestamp and address options
        0 timestamp and prespecified address options
        0 option packets dropped due to rate limit
        1123 router alert options
        0 multicast packets dropped (no iflist)
        0 packets dropped (src and int don't match)
icmp:
        0 drops due to rate limit
        0 calls to icmp_error
        0 errors not generated because old message was icmp
        Output histogram:
                echo reply: 75
        0 messages with bad code fields
        0 messages less than the minimum length
        0 messages with bad checksum
        0 messages with bad source address
        0 messages with bad length
        0 echo drops with broadcast or multicast destination address
        0 timestamp drops with broadcast or multicast destination address
        Input histogram:
                echo: 75
                router advertisement: 130
        75 message responses generated
tcp:
        3844 packets sent
                3618 data packets (1055596 bytes)
                0 data packets (0 bytes) retransmitted
                0 resends initiated by MTU discovery
                205 ack-only packets (148 packets delayed)
                0 URG only packets
                0 window probe packets
                0 window update packets
                1079 control packets
        5815 packets received
                3377 acks (for 1055657 bytes)
                24 duplicate acks
                0 acks for unsent data
                2655 packets (15004 bytes) received in-sequence
                1 completely duplicate packet  (0 bytes)
                0 old duplicate packets
                0 packets with some dup. data (0 bytes duped)
                0 out-of-order packets (0 bytes)
                0 packets (0 bytes) of data after window
                0 window probes
                7 window update packets
                0 packets received after close
                0 discarded for bad checksums
                0 discarded for bad header offset fields
                0 discarded because packet too short
        1 connection request
        32 connection accepts
        0 bad connection attempts
        0 listen queue overflows
        33 connections established (including accepts)
        30 connections closed (including 0 drops)
                27 connections updated cached RTT on close
                27 connections updated cached RTT variance on close
                0 connections updated cached ssthresh on close
        0 embryonic connections dropped
```

```
                3374 segments updated rtt (of 3220 attempts)
                0 retransmit timeouts
                        0 connections dropped by rexmit timeout
                0 persist timeouts
                        0 connections dropped by persist timeout
                344 keepalive timeouts
                        0 keepalive probes sent
                        0 connections dropped by keepalive
                1096 correct ACK header predictions
                1314 correct data packet header predictions
                32 syncache entries added
                        0 retransmitted
                        0 dupsyn
                        0 dropped
                        32 completed
                        0 bucket overflow
                        0 cache overflow
                        0 reset
                        0 stale
                        0 aborted
                        0 badack
                        0 unreach
                        0 zone failures
                0 cookies sent
                0 cookies received
                0 ACKs sent in response to in-window but not exact RSTs
                0 ACKs sent in response to in-window SYNs on established connections
                0 rcv packets dropped by TCP due to bad address
                0 out-of-sequence segment drops due to insufficient memory
                1058 RST packets
                0 ICMP packets ignored by TCP
                0 send packets dropped by TCP due to auth errors
                0 rcv packets dropped by TCP due to auth errors
        udp:
                3658884 datagrams received
                0 with incomplete header
                0 with bad data length field
                0 with bad checksum
                3657342 dropped due to no socket
                3657342 broadcast/multicast datagrams dropped due to no socket
                0 dropped due to full socket buffers
                0 not for hashed pcb
                4291311496 delivered
                1551 datagrams output
        ipsec:
                0 inbound packets processed successfully
                0 inbound packets violated process security policy
                0 inbound packets with no SA available
                0 invalid inbound packets
                0 inbound packets failed due to insufficient memory
                0 inbound packets failed getting SPI
                0 inbound packets failed on AH replay check
                0 inbound packets failed on ESP replay check
                0 inbound AH packets considered authentic
                0 inbound AH packets failed on authentication
                0 inbound ESP packets considered authentic
                0 inbound ESP packets failed on authentication
                0 outbound packets processed successfully
                0 outbound packets violated process security policy
                0 outbound packets with no SA available
                0 invalid outbound packets
```



```
        0 outbound packets failed due to insufficient memory
        0 outbound packets with no route
igmp:
        17186 messages received
        0 messages received with too few bytes
        0 messages received with bad checksum
        0 membership queries received
        0 membership queries received with invalid field(s)
        0 membership reports received
        0 membership reports received with invalid field(s)
        0 membership reports received for groups to which we belong
        0 membership reports sent
arp:
        44181302 datagrams received
        2 ARP requests received
        2028 ARP replies received
        3156 resolution requests received
        0 unrestricted proxy requests
        0 received proxy requests
        0 proxy requests not proxied
        0 with bogus interface
        787 with incorrect length
        712 for non-IP protocol
        0 with unsupported op code
        0 with bad protocol address length
        0 with bad hardware address length
        0 with multicast source address
        7611 with multicast target address
        0 with my own hardware address
        14241699 for an address not on the interface
        0 with a broadcast source address
        0 with source address duplicate to mine
        29929250 which were not for me
        0 packets discarded waiting for resolution
        6 packets sent after waiting for resolution
        17812 ARP requests sent
        2 ARP replies sent
        0 requests for memory denied
        0 requests dropped on entry
        0 requests dropped during retry
ip6:
        0 total packets received
        0 with size smaller than minimum
        0 with data size < data length
        0 with bad options
        0 with incorrect version number
        0 fragments received
        0 fragments dropped (dup or out of space)
        0 fragments dropped after timeout
        0 fragments that exceeded limit
        0 packets reassembled ok
        0 packets for this host
        0 packets forwarded
        0 packets not forwardable
        0 redirects sent
        0 packets sent from this host
        0 packets sent with fabricated ip header
        0 output packets dropped due to no bufs, etc.
        0 output packets discarded due to no route
        0 output datagrams fragmented
        0 fragments created
```

```
        0 datagrams that can't be fragmented
        0 packets that violated scope rules
        0 multicast packets which we don't join
        Mbuf statistics:
        0 packets whose headers are not continuous
        0 tunneling packets that can't find gif
        0 packets discarded due to too may headers
        0 failures of source address selection
        0 forward cache hit
        0 forward cache miss
        0 packets destined to dead next hop
        0 option packets dropped due to rate limit
        0 packets dropped (src and int don't match)
        0 packets dropped due to bad protocol
icmp6:
        0 calls to icmp_error
        0 errors not generated because old message was icmp error or so
        0 errors not generated because rate limitation
        0 messages with bad code fields
        0 messages < minimum length
        0 bad checksums
        0 messages with bad length
        Histogram of error messages to be generated:
                0 no route
                0 administratively prohibited
                0 beyond scope
                0 address unreachable
                0 port unreachable
                0 packet too big
                0 time exceed transit
                0 time exceed reassembly
                0 erroneous header field
                0 unrecognized next header
                0 unrecognized option
                0 redirect
                0 unknown
        0 message responses generated
        0 messages with too many ND options
ipsec6:
        0 inbound packets processed successfully
        0 inbound packets violated process security policy
        0 inbound packets with no SA available
        0 invalid inbound packets
        0 inbound packets failed due to insufficient memory
        0 inbound packets failed getting SPI
        0 inbound packets failed on AH replay check
        0 inbound packets failed on ESP replay check
        0 inbound AH packets considered authentic
        0 inbound AH packets failed on authentication
        0 inbound ESP packets considered authentic
        0 inbound ESP packets failed on authentication
        0 outbound packets processed successfully
        0 outbound packets violated process security policy
        0 outbound packets with no SA available
        0 invalid outbound packets
        0 outbound packets failed due to insufficient memory
        0 outbound packets with no route
clnl:
        0 total packets received
        0 packets delivered
        0 too small
```



```
        0 bad header length
        0 bad checksum
        0 bad version
        0 unknown or unsupported protocol
        0 bogus sdl size
        0 no free memory in socket buffer
        0 send packets discarded
        0 sbappend failure
        0 mcopy failure
        0 address fields were not reasonable
        0 segment information forgotten
        0 forwarded packets
        0 total packets sent
        0 output packets discarded
        0 non-forwarded packets
        0 packets fragmented
        0 fragments sent
        0 fragments discarded
        0 fragments timed out
        0 fragmentation prohibited
        0 packets reconstructed
        0 packets destined to dead nexthop
        0 packets discarded due to no route
        0 Error pdu rate drops
        0 ER pdu generation failure
esis:
        0 total pkts received
        0 total packets consumed by protocol
        0 pdus received with bad checksum
        0 pdus received with bad version number
        0 pdus received with bad type field
        0 short pdus received
        0 bogus sdl size
        0 bad header length
        0 unknown or unsupported protocol
        0 no free memory in socket buffer
        0 send packets discarded
        0 sbappend failure
        0 mcopy failure
        0 ISO family not configured
tnp:
        146776365 unicast packets received
        0 broadcast packets received
        0 fragmented packets received
        0 hello packets dropped
        0 fragments dropped
        0 fragment reassembly queue flushes
        0 hello packets received
        0 control packets received
        49681642 rdp packets received
        337175 udp packets received
        96757548 tunnel packets received
        0 input packets discarded with no protocol
        98397591 unicast packets sent
        0 broadcast packets sent
        0 fragmented packets sent
        0 hello packets dropped
        0 fragments dropped
        0 hello packets sent
        0 control packets sent
        49681642 rdp packets sent
```

```
        337175 udp packets sent
        48378774 tunnel packets sent
        0 packets sent with unknown protocol
rdp:
        49681642 input packets
        0 discards for bad checksum
        0 discards bad sequence number
        0 refused connections
        2031964 acks received
        0 dropped due to full socket buffers
        49692 retransmits
        49681642 output packets
        24815968 acks sent
        28 connects
        0 closes
        22783990 keepalives received
        22783990 keepalives sent
tudp:
        337175 datagrams received
        0 with incomplete header
        0 with bad data length field
        0 with bad checksum
        0 dropped due to no socket
        0 broadcast/multicast datagrams dropped due to no socket
        0 dropped due to full socket buffers
        337175 delivered
        337175 datagrams output
ttp:
        398749 packets sent
        0 packets sent while unconnected
        0 packets sent while interface down
        0 packets sent couldn't get buffer
        0 packets sent couldn't find neighbor
        44696687 L2 packets received
        0 unknown L3 packets received
        3682087 IPv4 L3 packets received
        0 MPLS L3 packets received
        0 MPLS->IPv4 L3 packets received
        0 IPv4->MPLS L3 packets received
        0 IPv6 L3 packets received
        0 ARP L3 packets received
        0 CLNP L3 packets received
        0 TNP L3 packets received
        0 NULL L3 packets received
        0 cyclotron cycle L3 packets received
        0 cyclotron send L3 packets received
        0 packets received while unconnected
        0 packets received from unknown ifl
        0 input packets couldn't get buffer
        0 input packets with bad type
        0 input packets with discard type
        0 Input packets with too many tlvs
        0 Input packets with bad tlv header
        70633 Input packets with bad tlv type
        68877 Input packets dropped based on tlv result
        0 input packets for which rt lookup is bypassed
mpls:
        0 total mpls packets received
        0 packets forwarded
        0 packets dropped
        0 with header too small
```



```
        0 after tagging, can't fit link MTU
        0 with IPv4 explicit NULL tag
        0 with IPv4 explicit NULL cksum errors
        0 with router alert tag
        0 lsp ping packets (ttl-expired/router alert)
        0 with ttl expired
        0 with tag encoding error
        0 packets discarded, no route
vpls:
        0 total packets received
        0 with size smaller than minimum
        0 with incorrect version number
        0 packets for this host
        0 packets with no logical interface
        0 packets with no family
        0 packets with no route table
        0 packets with no auxiliary table
        0 packets with no corefacing entry
        0 packets with no CE-facing entry
        0 mac route learning requests
        0 mac routes learnt
        0 requests to learn an existing route
        0 learning requests while learning disabled on interface
        0 learning requests over capacity
        0 mac routes moved
        0 requests to move static route
        0 mac route aging requests
        0 mac routes aged
        0 bogus address in aging requests
        0 requests to age static route
        0 requests to re-ageout aged route
        0 requests involving multiple peer FEs
        0 aging acks from PFE
        0 aging non-acks from PFE
        0 aging requests timed out waiting on FEs
        0 aging requests over max-rate
        0 errors finding peer FEs
```

show system statistics (EX Series Switches)

```
user@host> show system statistics
Tcp:
         571779 packets sent
                 21517 data packets (1797102 bytes)
                 2 data packets retransmitted (20 bytes)
                 0 resends initiated by MTU discovery
                 3708 ack only packets (531 packets delayed)
                 0 URG only packets
                 1 window probe packets
                 1 window update packets
                 1093063 control packets
         1132541 packets received
                 20961 acks(for 1796102 bytes)
                 5861 duplicate acks
                 0 acks for unsent data
                 19556  packets received in-sequence(232079 bytes)
                 3018 completely duplicate packets(0 bytes)
                 0 old duplicate packets
                 4 packets with some duplicate data(4 bytes duped)
                 2 out-of-order packets(2 bytes)
                 0 packets of data after window(0 bytes)
```

```
                0 window probes
                39 window update packets
                0 packets received after close
                0 discarded for bad checksums
                0 discarded for bad header offset fields
                0 discarded because packet too short
        546519 connection requests
        78 connection accepts
        0 bad connection attempts
        0 listen queue overflows
        100 connections established (including accepts)
        546596 connections closed (including 6 drops)
                47 connections updated cached RTT on close
                47 connections updated cached RTT variance on close
                0 connections updated cached ssthresh on close
        546497 embryonic connections dropped
        20453 segments updated rtt(of 566914 attempts)
        2 retransmit timeouts
                0 connections dropped by retransmit timeout
        0 persist timeouts
                0 connections dropped by persist timeout
        3028 keepalive timeouts
                3027 keepalive probes sent
                1 connections dropped by keepalive
        7515 correct ACK header predictions
        12258 correct data packet header predictions
        78 syncache entries added
                0 retransmitted
                0 dupsyn
                4 dropped
                78 completed
                0 bucket overflow
                0 cache overflow
                0 reset
                0 stale
                0 aborted
                0 badack
                0 unreach
                0 zone failures
        0 cookies sent
        0 cookies received
        1 SACK recovery episodes
        1 segment retransmits in SACK recovery episodes
        1 byte retransmits in SACK recovery episodes
        71 SACK options (SACK blocks) received
        1 SACK options (SACK blocks) sent
        0 SACK scoreboard overflow
        0 ACKs sent in response to in-window but not exact RSTs
        0 ACKs sent in response to in-window SYNs on established connections
        0 rcv packets dropped by TCP due to bad address
        0 out-of-sequence segment drops due to insufficient memory
        546544 RST packets
        0 ICMP packets ignored by TCP
        0 send packets dropped by TCP due to auth errors
        0 rcv packets dropped by TCP due to auth errors
        0 outgoing segments dropped due to policing
udp:
        147 datagrams received
        0 with incomplete header
        0 with bad data length field
        0 with bad checksum
```



```
        9 dropped due to no socket
        0 broadcast/multicast datagrams dropped due to no socket
        0 dropped due to full socket buffers
        0 not for hashed pcb
        138 delivered
        0 datagrams output
ip:
        73704 total packets received
        0 bad header checksums
        0 with size smaller than minimum
        0 with data size < data length
        0 with header length < data size
        0 with data length < header length
        0 with incorrect version number
        0 packets destined to dead next hop
        0 fragments received
        0 fragments dropped (dup or out of space)
        0 fragments dropped (queue overflow)
        0 fragments dropped after timeout
        0 fragments dropped due to over limit
        0 packets reassembled ok
        1133057 packets for this host
        0 packets for unknown/unsupported protocol
        40146 packets forwarded
        0 packets not forwardable
        40146 redirects sent
        1121700 packets sent from this host
        0 packets sent with fabricated ip header
        0 output packets dropped due to no bufs
        0 output packets discarded due to no route
        0 output datagrams fragmented
        0 fragments created
        0 datagrams that can't be fragmented
        0 packets with bad options
        0 packets with options handled without error
        0 strict source and record route options
        0 loose source and record route options
        0 record route options
        0 timestamp options
        0 timestamp and address options
        0 timestamp and prespecified address options
        0 option packets dropped due to rate limit
        0 router alert options
        0 multicast packets dropped (no iflist)
        0 packets dropped (src and int don't match)
        0 transit re packets dropped on mgmt i/f
        0 packets used first nexthop in ecmp unilist
        0 incoming ttpoip packets received
        0 incoming ttpoip packets dropped
         0 outgoing TTPoIP packets sent
        0 outgoing TTPoIP packets dropped
icmp:
        0 drops due to rate limit
        9 calls to icmp_error
        0 errors not generated because old message was icmp
        Output histogram:
                295 echo reply
                9 destination unreachable
        0 messages with bad code fields
        0 messages less than the minimum length
        0 messages with bad checksum
```

```
        0 messages with bad source address
        0 messages with bad length
        0 echo drops with broadcast or multicast destinaton address
        0 timestamp drops with broadcast or multicast destination address
        Input histogram:
                295 echo
        295 message responses generated
igmp:
        0 messages received
        0 messages received with too few bytes
        0 messages received with bad checksum
        0 membership queries received
        0 membership queries received with invalid fields
        0 membership reports received
        0 membership reports received with invalid fields
        0 membership reports received for groups to which we belong
        0 Membership reports sent
raw_if:
        0 RAW packets transmitted
        0 PPPOE packets transmitted
        0 ISDN packets transmitted
        0 DIALER packets transmitted
        0 PPP packets transmitted to pppd
        0 PPP packets transmitted to jppd
        0 IGMPL2 packets transmitted
        13 output drops due to tx error
        0 MPU packets transmitted
        0 PPPOE packets received
        0 ISDN packets received
        0 DIALER packets received
        0 PPP packets received from pppd
        0 MPU packets received
        0 PPP packets received from jppd
        0 IGMPL2 packets received
        0 Input drops due to bogus protocol
        0 input drops due to no mbufs available
        0 input drops due to no space in socket
        0 input drops due to no socket
arp:
        186413 datagrams received
        88 ARP requests received
        88 ARP replies received
        0 resolution request  received
        0 unrestricted proxy requests
        0 restricted proxy requests
        0 received proxy requests
        0 proxy requests not proxied
        0 restricted proxy requests not proxied
        0 datagrams with bogus interface
        0 datagrams with incorrect length
        0 datagrams for non-IP protocol
        0 datagrams with unsupported op code
        0 datagrams with bad protocol address length
         0 datagrams with bad hardware address length
        0 datagrams with multicast source address
        0 datagrams with multicast source address
        0 datagrams with my own hardware address
        164 datagrams for an address not on the interface
        0 datagrams with a broadcast source address
        0 datagrams with source address duplicate to mine
        186065 datagrams which were not for me
```

```
            0 packets discarded waiting for resolution
            0 packets sent after waiting for resolution
            50 ARP requests sent
            88 ARP replies sent
            0 requests for memory denied
            0 requests dropped on entry
            0 requests dropped during retry
            0 requests dropped due to interface deletion
            0 requests on unnumbered interfaces
            0 new requests on unnumbered interfaces
            0 replies for from unnumbered interfaces
            0 requests on unnumbered interface with non-subnetted donor
            0 replies from unnumbered interface with non-subnetted donor
ip6:
            0 total packets received
            0 packets with size smaller than minimum
            0 packets with data size < data length
            0 packets with bad options
            0 packets with incorrect version number
            0 fragments received
            0 fragments dropped (dup or out of space)
            0 fragments dropped after timeout
            0 fragments that exceeded limit
            0 packets reassembled ok
            0 packets for this host
            0 packets forwarded
            0 packets not forwardable
            0 redirects sent
            0 packets sent from this host
            0 packets sent with fabricated ip header
            0 output packets dropped due to no bufs, etc.
            0 output datagrams fragmented
            0 fragments created
            0 datagrams that can't be fragmented
            0 packets that violated scope rules
            0 multicast packets which we don't join
            0 packets whose headers are not continuous
            0 tunneling packets that can't find gif
            0 packets discarded due to too may headers
            0 failures of source address selection
            0 forward cache hit
            0 forward cache miss
            0 Packets destined to dead next hop
            0 option packets dropped due to rate limit
            0 Packets dropped (src and int don't match)
            0 packets dropped due to bad protocol
            0 transit re packet(null) dropped on mgmt i/f
icmp6:
            0 Calls to icmp_error
            0 Errors not generated because old message was icmp error
            0 Errors not generated because rate limitation
            0 Messages with bad code fields
            0 Messages < minimum length
            0 Bad checksums
            0 Messages with bad length
                    0 No route
                    0 Administratively prohibited
                     0 Beyond scope
                    0 Address unreachable
                    0 Port unreachable
                    0 packet too big
```

```
                0 Time exceed transit
                0 Time exceed reassembly
                0 Erroneous header field
                0 Unrecognized next header
                0 Unrecognized option
                0 redirect
                0 Unknown
        0 Message responses generated
        0 Messages with too many ND options
pfkey:
        0 Requests sent from userland
        0 Bytes sent from userland
        histogram by message type:
                0 reserved
                0 dump
        0 Messages with invalid length field
        0 Messages with invalid version field
        0 Messages with invalid message type field
        0 Messages too short
        0 Messages with memory allocation failure
        0 Messages with duplicate extension
        0 Messages with invalid extension type
        0 Messages with invalid sa type
        0 Messages with invalid address extension
        0 Requests sent to userland
        0 Bytes sent to userland
        histogram by message type:
                0 reserved
                0 dump
        0 Messages toward single socket
        0 Messages toward all sockets
        0 Messages toward registered sockets
        0 Messages with memory allocation failure
clnl:
        0 Total packets received
        0 Packets delivered
        0 Too small packets
        0 Packets with bad header length
        0 Packets with bad checksum
        0 Bad version packets
        0 Unknown or unsupported protocol packets
        0 Packets with bogus sdl size
        0 No free memory in socket buffer
        0 Send packets discarded
        0 Sbappend failure
        0 Mcopy failure
        0 Address fields were not reasonable
        0 Segment information forgotten
        0 Forwarded packets
        0 Total packets sent
        0 Output packets discarded
        0 Non-forwarded packets
        0 Packets fragmented
        0 Fragments sent
        0 Fragments discarded
        0 Fragments timed out
        0 Fragmentation prohibited
        0 Packets reconstructed
        0 Packets destined to dead nexthop
        0 Packets discarded due to no route
        0 Error pdu rate drops
```



```
          0 ER pdu generation failure
esis:
         0 Total pkts received
         0 Total packets consumed by protocol
         0 Pdus received with bad checksum
         0 Pdus received with bad version number
         0 Pdus received with bad type field
         0 Short pdus received
         0 Pdus withbogus sdl size
         0 Pdus with bad header length
         0 Pdus with unknown or unsupport protocol
         0 No free memory in socket buffer
         0 Send packets discarded
         0 Sbappend failure
         0 Mcopy failure
         0 ISO family not configured
tnp:
         0 Unicast packets received
         0 Broadcast packets received
         0 Fragmented packets received
         0 Hello packets dropped
         0 Fragments dropped
         0 Fragment reassembly queue flushes
         0 Packets with tnp src address collision received
         0 Hello packets received
         0 Control packets received
         0 Rdp packets received
         0 Udp packets received
         0 Tunnel packets received
         0 Input packets discarded with no protocol
         0 Packets of version unspecified received
         0 Packets of version 1 received
         0 Packets of version 2 received
         0 Packets of version 3 received
         0 Unicast packets sent
         0 Broadcast packets sent
         0 Fragmented packets sent
         0 Hello packets dropped
         0 Fragments dropped
         0 Hello packets sent
         0 Control packets sent
         0 Rdp packets sent
         0 Udp packets sent
         0 Tunnel packets sent
         0 Packets sent with unknown protocol
         0 Packets of version unspecified sent
         0 Packets of version 1 sent
         0 Packets of version 2 sent
         0 Packets of version 3 sent
rdp:
         0 Input packets
         0 Packets discarded for bad checksum
         0 Packets discarded due to bad sequence number
         0 Refused connections
         0 Acks received
         0 Packets dropped due to full socket buffers
         0 Retransmits
         0 Output packets
         0 Acks sent
         0 Connects
         0 Closes
```

```
        0 Keepalives received
        0 Keepalives sent
tudp:
        67 Datagrams received
        0 Datagrams with incomplete header
        0 Datagrams with bad data length field
        0 Datagrams with bad checksum
        0 Datagrams dropped due to no socket
        0 Broadcast/multicast datagrams dropped due to no socket
        0 Datagrams dropped due to full socket buffers
        67 Delivered
        68 Datagrams output
ttp:
        0 Packets sent
        0 Packets sent while unconnected
        0 Packets sent while interface down
        0 Packets sent couldn't get buffer
        0 Packets sent couldn't find neighbor
        0 L2 packets received
        0 Unknown L3 packets received
        0 IPv4 L3 packets received
        0 MPLS L3 packets received
        0 MPLS->IPV4 L3 packets received
        0 IPv4->MPLS L3 packets received
        0 IPv6 L3 packets received
        0 ARP L3 packets received
        0 CLNP L3 packets received
        0 TNP L3 packets received
        0 NULL L3 packets received
        0 Cyclotron cycle L3 packets received
        0 Cyclotron send L3 packets received
        0 Packets received while unconnected
        0 Packets received from unknown ifl
        0 Input packets couldn't get buffer
        0 Input packets with bad type
        0 Input packets with discard type
        0 Input packets with too many tlvs
        0 Input packets with bad tlv header
        70633 Input packets with bad tlv type
        68877 Input packets dropped based on tlv result
        0 Input packets for which rt lookup is bypassed
mpls:
        0 Total MPLS packets received
        0 Packets forwarded
        0 Packets dropped
        0 Packets with header too small
        0 After tagging, packets can't fit link MTU
        0 Packets with IPv4 explicit NULL tag
        0 Packets with IPv4 explicit NULL cksum errors
        0 Packets with router alert tag
        0 LSP ping packets (ttl-expired/router alert)
        0 Packets with ttl expired
        0 Packets with tag encoding error
        0 Packets discarded due to no route
        0 Packets used first nexthop in ecmp unilist
vpls:
        0 Total packets received
        0 Packets with size smaller than minimum
        0 Packets with incorrect version number
        0 Packets for this host
        0 Packets with no logical interface
```



```
            0 Packets with no family
            0 Packets with no route table
            0 Packets with no auxiliary table
            0 Packets with no corefacing entry
            0 packets with no CE-facing entry
            0 MAC route learning requests
            0 MAC routes learnt
            0 Requests to learn an existing route
            0 Learning requests while learning disabled on interface
            0 Learning requests over capacity
            0 MAC routes moved
            0 Requests to move static route
            0 MAC route aging requests
            0 MAC routes aged
            0 Bogus address in aging requests
            0 Requests to age static route
            0 Requests to re-ageout aged route
            0 Requests involving multiple peer FEs
            0 Aging acks from PFE
            0 Aging non-acks from PFE
            0 Aging requests timed out waiting on FEs
            0 Aging requests over max-rate
            0 Errors finding peer FEs
            0 Unsupported platform
            0 Packets dropped due to no l3 route table
            0 Packets dropped due to no local ifl
            0 Packets punted
            0 Packets dropped due to no socket
bridge:
            Input:
            0 packets received
            0 packets forwarded
            0 packets failed to forward
            0 packets dropped
            0 packets with vmember lookup failures
            0 packets with vlan lookup failures
            0 packets with stp state lookup failures
            0 packets dropped due to stp blocked/listening
            0 packets dropped due to stp learning
            0 packets with src MAC learning failures
            0 packets with input control processing failures
            Forward:
            0 packets sent successfully
            0 packets with send failures
            0 packets forwarded to l3 interface
            0 packets with l3 send failures
            0 packets discarded
            0 packets with l2ifl store failures
            0 packets with ifl mismatch failures
            0 packets with packet duplication failures
            0 packets with tag lookup failures
            0 packets with no route for DMAC
            0 packets with no route table
            0 packets with no nexthop
            0 packets with dead nexthop
            0 packets with eof reached error
            Learning:
            0 MACs learned
            0 packets sent to l3 interface
            0 packets with l3 send failures
            0 packets hit holdq while learning
```

```
0 MAC moves
0 packets discarded
0 packets with no route for SMAC
0 packets with no nexthop
0 packets with dead nexthop
0 packets dropped due to no resolve route
0 packets with l3 ifd lookup failures
0 packets with l3 ifl lookup failures
0 packets with l3 invalid rnh
0 packets with no route for SMAC in clone learning
0 packets with no nexhop in clone learning
0 packets with dead nexthop in clone learning
0 packets dropped due to no resolve nh in clone learning
Output:
0 packets forwarded
0 packets failed to forward
0 packets with vmember lookup failures
 0 packets with vlan lookup failures
0 packets with input control processing failures
Send:
0 packets sent successfully
0 packets with send failures
0 packets dropped due to interface down
0 packets with dev output failures
0 blocked ifl discards
0 packets with tag lookup failures
0 packets with stp state lookup failures
0 packets with tag insertion failures
0 packets with tag removal failures
Flood:
0 packets flooded
0 flood failures
IGMP:
0 packets sent successfully
0 packets with send failures
0 packets forwarded
0 packets failed to forward
0 packets with mpull failures
0 packets with vmember lookup failures
0 packets with vlan lookup failures
0 packets with ifl lookup failures
0 packets with tag lookup failures
Misc:
0 packets with size smaller than minimum
0 packets with double tags
0 packets with no ifl
0 packets with no family
0 packets with no route table
```

show system statistics (TX Matrix Router)

```
user@host> show system statistics
sfc0-re0:
--------------------------------------------------------------------------
Tcp:
         361694 packets sent
                 326507 data packets (103237236 bytes)
                 2343 data packets retransmitted (2673324 bytes)
                 0 resends initiated by MTU discovery
                 33857 ack only packets (31613 packets delayed)
                 0 URG only packets
```



```
        14 window probe packets
        387 window update packets
        1108 control packets
345879 packets received
        298207 acks(for 103141728 bytes)
        438 duplicate acks
        0 acks for unsent data
        204578  packets received in-sequence(13820995 bytes)
        6 completely duplicate packets(18 bytes)
        0 old duplicate packets
        0 packets with some duplicate data(0 bytes duped)
        0 out-of-order packets(0 bytes)
        0 packets of data after window(0 bytes)
        0 window probes
        899 window update packets
        166 packets received after close
        0 discarded for bad checksums
        0 discarded for bad header offset fields
        0 discarded because packet too short
406 connection requests
233 connection accepts
0 bad connection attempts
0 listen queue overflows
616 connections established (including accepts)
911 connections closed (including 41 drops)
        346 connections updated cached RTT on close
        346 connections updated cached RTT variance on close
        200 connections updated cached ssthresh on close
23 embryonic connections dropped
298155 segments updated rtt(of 287216 attempts)
1163 retransmit timeouts
        27 connections dropped by retransmit timeout
0 persist timeouts
        0 connections dropped by persist timeout
5 keepalive timeouts
        5 keepalive probes sent
        0 connections dropped by keepalive
69922 correct ACK header predictions
34993 correct data packet header predictions
233 syncache entries added
        0 retransmitted
        0 dupsyn
        0 dropped
        233 completed
        0 bucket overflow
        0 cache overflow
        0 reset
        0 stale
        0 aborted
        0 badack
        0 unreach
        0 zone failures
0 cookies sent
0 cookies received
23 SACK recovery episodes
68 segment retransmits in SACK recovery episodes
71542 byte retransmits in SACK recovery episodes
158 SACK options (SACK blocks) received
0 SACK options (SACK blocks) sent
0 SACK scoreboard overflow
0 ACKs sent in response to in-window but not exact RSTs
```

```
        0 ACKs sent in response to in-window SYNs on established connections
        0 rcv packets dropped by TCP due to bad address
        0 out-of-sequence segment drops due to insufficient memory
        259 RST packets
        0 ICMP packets ignored by TCP
        0 send packets dropped by TCP due to auth errors
        0 rcv packets dropped by TCP due to auth errors
        0 outgoing segments dropped due to policing

lcc0-re0:
--------------------------------------------------------------------------
Tcp:
        346 packets sent
                222 data packets (22894 bytes)
                0 data packets retransmitted (0 bytes)
                0 resends initiated by MTU discovery
                80 ack only packets (12 packets delayed)
                0 URG only packets
                0 window probe packets
                5 window update packets
                42 control packets
        358 packets received
                268 acks(for 22939 bytes)
                9 duplicate acks
                0 acks for unsent data
                203  packets received in-sequence(33820 bytes)
                0 completely duplicate packets(0 bytes)
                0 old duplicate packets
                0 packets with some duplicate data(0 bytes duped)
                0 out-of-order packets(0 bytes)
                0 packets of data after window(0 bytes)
                0 window probes
                6 window update packets
                0 packets received after close
                0 discarded for bad checksums
                0 discarded for bad header offset fields
                0 discarded because packet too short
        13 connection requests
        18 connection accepts
        0 bad connection attempts
        0 listen queue overflows
        31 connections established (including accepts)
        35 connections closed (including 2 drops)
                3 connections updated cached RTT on close
                3 connections updated cached RTT variance on close
                0 connections updated cached ssthresh on close
        0 embryonic connections dropped
        268 segments updated rtt(of 247 attempts)
        0 retransmit timeouts
                0 connections dropped by retransmit timeout
        0 persist timeouts
                0 connections dropped by persist timeout
        0 keepalive timeouts
                0 keepalive probes sent
                0 connections dropped by keepalive
        0 correct ACK header predictions
        42 correct data packet header predictions
        18 syncache entries added
                0 retransmitted
                0 dupsyn
                0 dropped
```



```
                18 completed
                0 bucket overflow
                0 cache overflow
                0 reset
                0 stale
                0 aborted
                0 badack
                0 unreach
                0 zone failures
        0 cookies sent
        0 cookies received
        0 SACK recovery episodes
        0 segment retransmits in SACK recovery episodes
        0 byte retransmits in SACK recovery episodes
        0 SACK options (SACK blocks) received
        0 SACK options (SACK blocks) sent
        0 SACK scoreboard overflow
        0 ACKs sent in response to in-window but not exact RSTs
        0 ACKs sent in response to in-window SYNs on established connections
        0 rcv packets dropped by TCP due to bad address
        0 out-of-sequence segment drops due to insufficient memory
        5 RST packets
        0 ICMP packets ignored by TCP
        0 send packets dropped by TCP due to auth errors
        0 rcv packets dropped by TCP due to auth errors
        0 outgoing segments dropped due to policing

lcc1-re0:
--------------------------------------------------------------------------
Tcp:
        348 packets sent
                223 data packets (22895 bytes)
                0 data packets retransmitted (0 bytes)
                0 resends initiated by MTU discovery
                81 ack only packets (13 packets delayed)
                0 URG only packets
                0 window probe packets
                5 window update packets
                42 control packets
        360 packets received
                269 acks(for 22940 bytes)
                9 duplicate acks
                0 acks for unsent data
                203  packets received in-sequence(33820 bytes)
                0 completely duplicate packets(0 bytes)
                0 old duplicate packets
                0 packets with some duplicate data(0 bytes duped)
                0 out-of-order packets(0 bytes)
                0 packets of data after window(0 bytes)
                0 window probes
                6 window update packets
                0 packets received after close
                0 discarded for bad checksums
                0 discarded for bad header offset fields
                0 discarded because packet too short
        13 connection requests
        18 connection accepts
        0 bad connection attempts
        0 listen queue overflows
        31 connections established (including accepts)
        36 connections closed (including 2 drops)
```



```
                3 connections updated cached RTT on close
                3 connections updated cached RTT variance on close
                0 connections updated cached ssthresh on close
        0 embryonic connections dropped
        269 segments updated rtt(of 248 attempts)
        0 retransmit timeouts
                0 connections dropped by retransmit timeout
        0 persist timeouts
                0 connections dropped by persist timeout
        0 keepalive timeouts
                0 keepalive probes sent
                0 connections dropped by keepalive
        0 correct ACK header predictions
        43 correct data packet header predictions
        18 syncache entries added
                0 retransmitted
                0 dupsyn
                0 dropped
                18 completed
                0 bucket overflow
                0 cache overflow
                0 reset
                0 stale
                0 aborted
                0 badack
                0 unreach
                0 zone failures
        0 cookies sent
        0 cookies received
        0 SACK recovery episodes
        0 segment retransmits in SACK recovery episodes
        0 byte retransmits in SACK recovery episodes
        0 SACK options (SACK blocks) received
        0 SACK options (SACK blocks) sent
        0 SACK scoreboard overflow
        0 ACKs sent in response to in-window but not exact RSTs
        0 ACKs sent in response to in-window SYNs on established connections
        0 rcv packets dropped by TCP due to bad address
        0 out-of-sequence segment drops due to insufficient memory
        5 RST packets
        0 ICMP packets ignored by TCP
        0 send packets dropped by TCP due to auth errors
        0 rcv packets dropped by TCP due to auth errors
        0 outgoing segments dropped due to policing

lcc2-re0:
--------------------------------------------------------------------------
Tcp:
        405 packets sent
                271 data packets (23926 bytes)
                0 data packets retransmitted (0 bytes)
                0 resends initiated by MTU discovery
                86 ack only packets (13 packets delayed)
                0 URG only packets
                0 window probe packets
                5 window update packets
                46 control packets
        418 packets received
                321 acks(for 23975 bytes)
                9 duplicate acks
                0 acks for unsent data
```

```
        234  packets received in-sequence(34403 bytes)
        0 completely duplicate packets(0 bytes)
        0 old duplicate packets
        0 packets with some duplicate data(0 bytes duped)
        0 out-of-order packets(0 bytes)
        0 packets of data after window(0 bytes)
        0 window probes
        7 window update packets
        0 packets received after close
        0 discarded for bad checksums
        0 discarded for bad header offset fields
        0 discarded because packet too short
15 connection requests
19 connection accepts
0 bad connection attempts
0 listen queue overflows
34 connections established (including accepts)
39 connections closed (including 2 drops)
        4 connections updated cached RTT on close
        4 connections updated cached RTT variance on close
        0 connections updated cached ssthresh on close
0 embryonic connections dropped
321 segments updated rtt(of 299 attempts)
0 retransmit timeouts
        0 connections dropped by retransmit timeout
0 persist timeouts
        0 connections dropped by persist timeout
0 keepalive timeouts
        0 keepalive probes sent
        0 connections dropped by keepalive
0 correct ACK header predictions
48 correct data packet header predictions
19 syncache entries added
        0 retransmitted
        0 dupsyn
        0 dropped
        19 completed
        0 bucket overflow
        0 cache overflow
        0 reset
        0 stale
        0 aborted
        0 badack
        0 unreach
        0 zone failures
0 cookies sent
0 cookies received
0 SACK recovery episodes
0 segment retransmits in SACK recovery episodes
0 byte retransmits in SACK recovery episodes
0 SACK options (SACK blocks) received
0 SACK options (SACK blocks) sent
0 SACK scoreboard overflow
0 ACKs sent in response to in-window but not exact RSTs
0 ACKs sent in response to in-window SYNs on established connections
0 rcv packets dropped by TCP due to bad address
0 out-of-sequence segment drops due to insufficient memory
5 RST packets
0 ICMP packets ignored by TCP
0 send packets dropped by TCP due to auth errors
0 rcv packets dropped by TCP due to auth errors
```



```
        0 outgoing segments dropped due to policing

lcc3-re0:
--------------------------------------------------------------------------
Tcp:
        346 packets sent
                221 data packets (22895 bytes)
                0 data packets retransmitted (0 bytes)
                0 resends initiated by MTU discovery
                81 ack only packets (13 packets delayed)
                0 URG only packets
                0 window probe packets
                5 window update packets
                42 control packets
        360 packets received
                267 acks(for 22940 bytes)
                9 duplicate acks
                0 acks for unsent data
                203  packets received in-sequence(33820 bytes)
                0 completely duplicate packets(0 bytes)
                0 old duplicate packets
                0 packets with some duplicate data(0 bytes duped)
                0 out-of-order packets(0 bytes)
                0 packets of data after window(0 bytes)
                0 window probes
                6 window update packets
                0 packets received after close
                0 discarded for bad checksums
                0 discarded for bad header offset fields
                0 discarded because packet too short
        13 connection requests
        18 connection accepts
        0 bad connection attempts
        0 listen queue overflows
        31 connections established (including accepts)
        35 connections closed (including 2 drops)
                3 connections updated cached RTT on close
                3 connections updated cached RTT variance on close
                0 connections updated cached ssthresh on close
        0 embryonic connections dropped
        267 segments updated rtt(of 246 attempts)
        0 retransmit timeouts
                0 connections dropped by retransmit timeout
        0 persist timeouts
                0 connections dropped by persist timeout
        0 keepalive timeouts
                0 keepalive probes sent
                0 connections dropped by keepalive
        0 correct ACK header predictions
        43 correct data packet header predictions
        18 syncache entries added
                0 retransmitted
                0 dupsyn
                0 dropped
                18 completed
                0 bucket overflow
                0 cache overflow
                0 reset
                0 stale
                0 aborted
                0 badack
```



```
        0 unreach
        0 zone failures
0 cookies sent
0 cookies received
0 SACK recovery episodes
0 segment retransmits in SACK recovery episodes
0 byte retransmits in SACK recovery episodes
0 SACK options (SACK blocks) received
0 SACK options (SACK blocks) sent
0 SACK scoreboard overflow
0 ACKs sent in response to in-window but not exact RSTs
0 ACKs sent in response to in-window SYNs on established connections
0 rcv packets dropped by TCP due to bad address
0 out-of-sequence segment drops due to insufficient memory
5 RST packets
0 ICMP packets ignored by TCP
0 send packets dropped by TCP due to auth errors
0 rcv packets dropped by TCP due to auth errors
0 outgoing segments dropped due to policing
```

show system statistics (QFX Series)

```
user@switch> show system statistics
Tcp:
571779 packets sent
21517 data packets (1797102 bytes)
2 data packets retransmitted (20 bytes)
0 resends initiated by MTU discovery
3708 ack only packets (531 packets delayed)
0 URG only packets
1 window probe packets
1 window update packets
1093063 control packets
1132541 packets received
20961 acks(for 1796102 bytes)
5861 duplicate acks
0 acks for unsent data
19556 packets received in-sequence(232079 bytes)
3018 completely duplicate packets(0 bytes)
0 old duplicate packets
4 packets with some duplicate data(4 bytes duped)
2 out-of-order packets(2 bytes)
0 packets of data after window(0 bytes)
0 window probes
39 window update packets
0 packets received after close
0 discarded for bad checksums
0 discarded for bad header offset fields
0 discarded because packet too short
546519 connection requests
78 connection accepts
0 bad connection attempts
0 listen queue overflows
100 connections established (including accepts)
546596 connections closed (including 6 drops)
47 connections updated cached RTT on close
47 connections updated cached RTT variance on close
0 connections updated cached ssthresh on close
546497 embryonic connections dropped
20453 segments updated rtt(of 566914 attempts)
2 retransmit timeouts
```

```
0 connections dropped by retransmit timeout
0 persist timeouts
0 connections dropped by persist timeout
3028 keepalive timeouts
3027 keepalive probes sent
1 connections dropped by keepalive
7515 correct ACK header predictions
12258 correct data packet header predictions
78 syncache entries added
0 retransmitted
0 dupsyn
4 dropped
78 completed
0 bucket overflow
0 cache overflow
0 reset
0 stale
0 aborted
0 badack
0 unreach
0 zone failures
0 cookies sent
0 cookies received
1 SACK recovery episodes
1 segment retransmits in SACK recovery episodes
1 byte retransmits in SACK recovery episodes
71 SACK options (SACK blocks) received
1 SACK options (SACK blocks) sent
0 SACK scoreboard overflow
0 ACKs sent in response to in-window but not exact RSTs
0 ACKs sent in response to in-window SYNs on established connections
0 rcv packets dropped by TCP due to bad address
0 out-of-sequence segment drops due to insufficient memory
546544 RST packets
0 ICMP packets ignored by TCP
0 send packets dropped by TCP due to auth errors
0 rcv packets dropped by TCP due to auth errors
0 outgoing segments dropped due to policing
udp:
147 datagrams received
0 with incomplete header
0 with bad data length field
0 with bad checksum
9 dropped due to no socket
0 broadcast/multicast datagrams dropped due to no socket
0 dropped due to full socket buffers
0 not for hashed pcb
138 delivered
0 datagrams output
ip:
73704 total packets received
0 bad header checksums
0 with size smaller than minimum
0 with data size < data length
0 with header length < data size
0 with data length < header length
0 with incorrect version number
0 packets destined to dead next hop
0 fragments received
0 fragments dropped (dup or out of space)
0 fragments dropped (queue overflow)
```



```
0 fragments dropped after timeout
0 fragments dropped due to over limit
0 packets reassembled ok
1133057 packets for this host
0 packets for unknown/unsupported protocol
40146 packets forwarded
0 packets not forwardable
40146 redirects sent
1121700 packets sent from this host
0 packets sent with fabricated ip header
0 output packets dropped due to no bufs
0 output packets discarded due to no route
0 output datagrams fragmented
0 fragments created
0 datagrams that can't be fragmented
0 packets with bad options
0 packets with options handled without error
0 strict source and record route options
0 loose source and record route options
0 record route options
0 timestamp options
0 timestamp and address options
0 timestamp and prespecified address options
0 option packets dropped due to rate limit
0 router alert options
0 multicast packets dropped (no iflist)
0 packets dropped (src and int don't match)
0 transit re packets dropped on mgmt i/f
0 packets used first nexthop in ecmp unilist
0 incoming ttpoip packets received
0 incoming ttpoip packets dropped
0 outgoing TTPoIP packets sent
0 outgoing TTPoIP packets dropped
icmp:
0 drops due to rate limit
9 calls to icmp_error
0 errors not generated because old message was icmp
Output histogram:
295 echo reply
9 destination unreachable
0 messages with bad code fields
0 messages less than the minimum length
0 messages with bad checksum
0 messages with bad source address
0 messages with bad length
0 echo drops with broadcast or multicast destinaton address
0 timestamp drops with broadcast or multicast destination address
Input histogram:
295 echo
295 message responses generated
igmp:
0 messages received
0 messages received with too few bytes
0 messages received with bad checksum
0 membership queries received
0 membership queries received with invalid fields
0 membership reports received
0 membership reports received with invalid fields
0 membership reports received for groups to which we belong
0 Membership reports sent
raw_if:
```



```
0 RAW packets transmitted
0 PPPOE packets transmitted
0 ISDN packets transmitted
0 DIALER packets transmitted
0 PPP packets transmitted to pppd
0 PPP packets transmitted to jppd
0 IGMPL2 packets transmitted
13 output drops due to tx error
0 MPU packets transmitted
0 PPPOE packets received
0 ISDN packets received
0 DIALER packets received
0 PPP packets received from pppd
0 MPU packets received
0 PPP packets received from jppd
0 IGMPL2 packets received
0 Input drops due to bogus protocol
0 input drops due to no mbufs available
0 input drops due to no space in socket
0 input drops due to no socket
arp:
186413 datagrams received
88 ARP requests received
88 ARP replies received
0 resolution request received
0 unrestricted proxy requests
0 restricted proxy requests
0 received proxy requests
0 proxy requests not proxied
0 restricted proxy requests not proxied
0 datagrams with bogus interface
0 datagrams with incorrect length
0 datagrams for non-IP protocol
0 datagrams with unsupported op code
0 datagrams with bad protocol address length
0 datagrams with bad hardware address length
0 datagrams with multicast source address
0 datagrams with multicast source address
0 datagrams with my own hardware address
164 datagrams for an address not on the interface
0 datagrams with a broadcast source address
0 datagrams with source address duplicate to mine
186065 datagrams which were not for me
0 packets discarded waiting for resolution
0 packets sent after waiting for resolution
50 ARP requests sent
88 ARP replies sent
0 requests for memory denied
0 requests dropped on entry
0 requests dropped during retry
0 requests dropped due to interface deletion
0 requests on unnumbered interfaces
0 new requests on unnumbered interfaces
0 replies for from unnumbered interfaces
0 requests on unnumbered interface with non-subnetted donor
0 replies from unnumbered interface with non-subnetted donor
ip6:
0 total packets received
0 packets with size smaller than minimum
0 packets with data size < data length
0 packets with bad options
```



```
0 packets with incorrect version number
0 fragments received
0 fragments dropped (dup or out of space)
0 fragments dropped after timeout
0 fragments that exceeded limit
0 packets reassembled ok
0 packets for this host
0 packets forwarded
0 packets not forwardable
0 redirects sent
0 packets sent from this host
0 packets sent with fabricated ip header
0 output packets dropped due to no bufs, etc.
0 output datagrams fragmented
0 fragments created
0 datagrams that can't be fragmented
0 packets that violated scope rules
0 multicast packets which we don't join
0 packets whose headers are not continuous
0 tunneling packets that can't find gif
0 packets discarded due to too may headers
0 failures of source address selection
0 forward cache hit
0 forward cache miss
0 Packets destined to dead next hop
0 option packets dropped due to rate limit
0 Packets dropped (src and int don't match)
0 packets dropped due to bad protocol
0 transit re packet(null) dropped on mgmt i/f
icmp6:
0 Calls to icmp_error
0 Errors not generated because old message was icmp error
0 Errors not generated because rate limitation
0 Messages with bad code fields
0 Messages < minimum length
0 Bad checksums
0 Messages with bad length
0 No route
0 Administratively prohibited
0 Beyond scope
0 Address unreachable
0 Port unreachable
0 packet too big
0 Time exceed transit
0 Time exceed reassembly
0 Erroneous header field
0 Unrecognized next header
0 Unrecognized option
0 redirect
0 Unknown
0 Message responses generated
0 Messages with too many ND options
pfkey:
0 Requests sent from userland
0 Bytes sent from userland
histogram by message type:
0 reserved
0 dump
0 Messages with invalid length field
0 Messages with invalid version field
0 Messages with invalid message type field
```

```
0 Messages too short
0 Messages with memory allocation failure
0 Messages with duplicate extension
0 Messages with invalid extension type
0 Messages with invalid sa type
0 Messages with invalid address extension
0 Requests sent to userland
0 Bytes sent to userland
histogram by message type:
0 reserved
0 dump
0 Messages toward single socket
0 Messages toward all sockets
0 Messages toward registered sockets
0 Messages with memory allocation failure
clnl:
0 Total packets received
0 Packets delivered
0 Too small packets
0 Packets with bad header length
0 Packets with bad checksum
0 Bad version packets
0 Unknown or unsupported protocol packets
0 Packets with bogus sdl size
0 No free memory in socket buffer
0 Send packets discarded
0 Sbappend failure
0 Mcopy failure
0 Address fields were not reasonable
0 Segment information forgotten
0 Forwarded packets
0 Total packets sent
0 Output packets discarded
0 Non-forwarded packets
0 Packets fragmented
0 Fragments sent
0 Fragments discarded
0 Fragments timed out
0 Fragmentation prohibited
0 Packets reconstructed
0 Packets destined to dead nexthop
0 Packets discarded due to no route
0 Error pdu rate drops
0 ER pdu generation failure
esis:
0 Total pkts received
0 Total packets consumed by protocol
0 Pdus received with bad checksum
0 Pdus received with bad version number
0 Pdus received with bad type field
0 Short pdus received
0 Pdus withbogus sdl size
0 Pdus with bad header length
0 Pdus with unknown or unsupport protocol
0 No free memory in socket buffer
0 Send packets discarded
0 Sbappend failure
0 Mcopy failure
0 ISO family not configured
tnp:
0 Unicast packets received
```



```
0 Broadcast packets received
0 Fragmented packets received
0 Hello packets dropped
0 Fragments dropped
0 Fragment reassembly queue flushes
0 Packets with tnp src address collision received
0 Hello packets received
0 Control packets received
0 Rdp packets received
0 Udp packets received
0 Tunnel packets received
0 Input packets discarded with no protocol
0 Packets of version unspecified received
0 Packets of version 1 received
0 Packets of version 2 received
0 Packets of version 3 received
0 Unicast packets sent
0 Broadcast packets sent
0 Fragmented packets sent
0 Hello packets dropped
0 Fragments dropped
0 Hello packets sent
0 Control packets sent
0 Rdp packets sent
0 Udp packets sent
0 Tunnel packets sent
0 Packets sent with unknown protocol
0 Packets of version unspecified sent
0 Packets of version 1 sent
0 Packets of version 2 sent
0 Packets of version 3 sent
rdp:
0 Input packets
0 Packets discarded for bad checksum
0 Packets discarded due to bad sequence number
0 Refused connections
0 Acks received
0 Packets dropped due to full socket buffers
0 Retransmits
0 Output packets
0 Acks sent
0 Connects
0 Closes
0 Keepalives received
0 Keepalives sent
tudp:
67 Datagrams received
0 Datagrams with incomplete header
0 Datagrams with bad data length field
0 Datagrams with bad checksum
0 Datagrams dropped due to no socket
0 Broadcast/multicast datagrams dropped due to no socket
0 Datagrams dropped due to full socket buffers
67 Delivered
68 Datagrams output
ttp:
0 Packets sent
0 Packets sent while unconnected
0 Packets sent while interface down
0 Packets sent couldn't get buffer
0 Packets sent couldn't find neighbor
```

```
0 L2 packets received
0 Unknown L3 packets received
0 IPv4 L3 packets received
0 MPLS L3 packets received
0 MPLS->IPV4 L3 packets received
0 IPv4->MPLS L3 packets received
0 IPv6 L3 packets received
0 ARP L3 packets received
0 CLNP L3 packets received
0 TNP L3 packets received
0 NULL L3 packets received
0 Cyclotron cycle L3 packets received
0 Cyclotron send L3 packets received
0 Packets received while unconnected
0 Packets received from unknown ifl
0 Input packets couldn't get buffer
0 Input packets with bad type
0 Input packets with discard type
0 Input packets with too many tlvs
0 Input packets with bad tlv header
70633 Input packets with bad tlv type
68877 Input packets dropped based on tlv result0 Input packets for which rt lookup
 is bypassed
mpls:
0 Total MPLS packets received
0 Packets forwarded
0 Packets dropped
0 Packets with header too small
0 After tagging, packets can't fit link MTU
0 Packets with IPv4 explicit NULL tag
0 Packets with IPv4 explicit NULL cksum errors
0 Packets with router alert tag
0 LSP ping packets (ttl-expired/router alert)
0 Packets with ttl expired
0 Packets with tag encoding error
0 Packets discarded due to no route
0 Packets used first nexthop in ecmp unilist
vpls:
0 Total packets received
0 Packets with size smaller than minimum
0 Packets with incorrect version number
0 Packets for this host
0 Packets with no logical interface
0 Packets with no family
0 Packets with no route table
582 Copyright © 2010, Juniper Networks, Inc.
0 Packets with no auxiliary table
0 Packets with no corefacing entry
0 packets with no CE-facing entry
0 MAC route learning requests
0 MAC routes learnt
0 Requests to learn an existing route
0 Learning requests while learning disabled on interface
0 Learning requests over capacity
0 MAC routes moved
0 Requests to move static route
0 MAC route aging requests
0 MAC routes aged
0 Bogus address in aging requests
0 Requests to age static route
0 Requests to re-ageout aged route
```



```
0 Requests involving multiple peer FEs
0 Aging acks from PFE
0 Aging non-acks from PFE
0 Aging requests timed out waiting on FEs
0 Aging requests over max-rate
0 Errors finding peer FEs
0 Unsupported platform
0 Packets dropped due to no l3 route table
0 Packets dropped due to no local ifl
0 Packets punted
0 Packets dropped due to no socket
bridge:
Input:
0 packets received
0 packets forwarded
0 packets failed to forward
0 packets dropped
0 packets with vmember lookup failures
0 packets with vlan lookup failures
0 packets with stp state lookup failures
0 packets dropped due to stp blocked/listening
0 packets dropped due to stp learning
0 packets with src MAC learning failures
0 packets with input control processing failures
Forward:
0 packets sent successfully
0 packets with send failures
0 packets forwarded to l3 interface
0 packets with l3 send failures
0 packets discarded
0 packets with l2ifl store failures
0 packets with ifl mismatch failures
0 packets with packet duplication failures
0 packets with tag lookup failures
0 packets with no route for DMAC
0 packets with no route table
0 packets with no nexthop
0 packets with dead nexthop
0 packets with eof reached error
Learning:
0 MACs learned
0 packets sent to l3 interface
0 packets with l3 send failures
0 packets hit holdq while learning
0 MAC moves
0 packets discarded
0 packets with no route for SMAC
0 packets with no nexthop
0 packets with dead nexthop
0 packets dropped due to no resolve route
0 packets with l3 ifd lookup failures
0 packets with l3 ifl lookup failures
0 packets with l3 invalid rnh
0 packets with no route for SMAC in clone learning
0 packets with no nexhop in clone learning
0 packets with dead nexthop in clone learning
0 packets dropped due to no resolve nh in clone learning
Output:
0 packets forwarded
0 packets failed to forward
0 packets with vmember lookup failures
```

```
0 packets with vlan lookup failures
0 packets with input control processing failures
Send:
0 packets sent successfully
0 packets with send failures
0 packets dropped due to interface down
0 packets with dev output failures
0 blocked ifl discards
0 packets with tag lookup failures
0 packets with stp state lookup failures
0 packets with tag insertion failures
0 packets with tag removal failures
Flood:
0 packets flooded
0 flood failures
IGMP:
0 packets sent successfully
0 packets with send failures
0 packets forwarded
0 packets failed to forward
0 packets with mpull failures
0 packets with vmember lookup failures
0 packets with vlan lookup failures
0 packets with ifl lookup failures
0 packets with tag lookup failures
Misc:
0 packets with size smaller than minimum
0 packets with double tags
0 packets with no ifl
0 packets with no family
0 packets with no route table
```


show system storage

Syntax

show system storage
<detail>

Syntax (EX Series Switches)

show system storage
<detail>
<all-members>
<local>
<member *member-id*>

Syntax (MX Series Router)

show system storage
<detail>
<all-members>
<local>
<member *member-id*>

Syntax (QFX Series)

show system storage
<detail>
<infrastructure *name*>
<interconnect-device *name*>
<node-group *name*>

Syntax (SRX Series)

show system storage
<detail>
<partitions>

For more information, see **show system storage partitions (View SRX Series)**.

Syntax (TX Matrix Router)

show system storage
<detail>
<all-chassis | all-lcc | lcc *number* | scc>

Syntax (TX Matrix Plus Router and TX Matrix Plus Router with 3D SIBs)

show system storage
<detail>
<all-chassis | all-lcc | lcc *number* | sfc *number*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in JUNOS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display statistics about the amount of free disk space in the router's or switch’s file systems.

Options

none—Display standard information about the amount of free disk space in the router's or switch’s file systems.

detail—(Optional) Display detailed output.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Display system storage statistics for all the routers in the chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display system storage statistics for all T640 routers connected to the TX Matrix router. On a TX Matrix Plus router, display system storage statistics for all routers connected to the TX Matrix Plus router.

all-members—(EX4200 switches and MX Series routers only) (Optional) Display system storage statistics for all members of the Virtual Chassis configuration.

infrastructure ***name***—(QFabric systems only) (Optional) Display system storage statistics for the fabric control Routing Engines or fabric manager Routing Engines.

interconnect-device ***name***—(QFabric systems only) (Optional) Display system storage statistics for the Interconnect device.

lcc ***number***—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display system storage statistics for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, display system storage statistics for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Display system storage statistics for the local Virtual Chassis member.

member ***member-id***—(EX4200 switches and MX Series routers only) (Optional) Display system storage statistics for the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

node-group ***name***—(QFabric systems only) (Optional) Display system storage statistics for the Node group.

scc—(TX Matrix routers only) (Optional) Display system storage statistics for the TX Matrix router (or switch-card chassis).

sfc ***number***—(TX Matrix Plus routers only) (Optional) Display system storage statistics for the TX Matrix Plus router. Replace ***number*** with 0.

Additional Information By default, when you issue the **show system storage** command on the master Routing Engine of a TX Matrix router or a TX Matrix Plus router, the command is broadcast to all the master Routing Engines of the LCCs connected to it in the routing matrix. Likewise, if you issue the same command on the backup Routing Engine of a TX Matrix or a TX Matrix Plus router, the command is broadcast to all backup Routing Engines of the LCCs that are connected to it in the routing matrix.

Required Privilege Level view

Related Documentation

- *Routing Matrix with a TX Matrix Plus Router Solutions Page*
- *show system storage partitions (View SRX Series)*

List of Sample Output

show system storage on page 1021
show system storage (TX Matrix Plus Router) on page 1022
show system storage (QFX3500 Switch) on page 1024

Output Fields Table 90 on page 1021 describes the output fields for the **show system storage** command. Output fields are listed in the approximate order in which they appear.

Table 90: show system storage Output Fields

Field Name	Field Description
Filesystem	Name of the filesystem.
Size	Size of the filesystem.
Used	Amount of space used in the filesystem.
Avail	Amount of space available in the filesystem.
Capacity	Percentage of the filesystem space that is being used.
Mounted on	Directory in which the filesystem is mounted.

Sample Output

show system storage

```
user@host> show system storage
Filesystem               Size        Used       Avail  Capacity   Mounted on
/dev/ad0s1a               77M         37M         34M       52%  /
devfs                     16K         16K          0B      100%  /dev/
/dev/vn0                 12M         12M         0B      100%  /packages/mnt/jbase
/dev/vn1                  39M         39M          0B      100%
/packages/mnt/jkernel-7.2R1.7
/dev/vn2                  12M         12M          0B      100%
/packages/mnt/jpfe-M40-7.2R1.7
/dev/vn3                 2.3M        2.3M          0B      100%
/packages/mnt/jdocs-7.2R1.7
/dev/vn4                  14M         14M          0B      100%
```



```
/packages/mnt/jroute-7.2R1.7
/dev/vn5                 4.5M       4.5M         0B       100%
/packages/mnt/jcrypto-7.2R1.7
mfs:172                  1.5G       4.0K       1.3G         0%  /tmp
/dev/ad0s1e               12M        20K        11M         0%  /config
procfs                   4.0K       4.0K         0B       100%  /proc
/dev/ad1s1f              9.4G       4.9G       3.7G        57%  /var
```

show system storage (TX Matrix Plus Router)

```
user@host> show system storage
sfc0-re0:
--------------------------------------------------------------------------
Filesystem               Size       Used      Avail  Capacity   Mounted on
/dev/ad0s1a              3.4G       178M       2.9G         6%  /
devfs                    1.0K       1.0K         0B       100%  /dev
devfs                    1.0K       1.0K         0B       100%  /dev/
/dev/md0                  33M        33M        0B       100%  /packages/mnt/jbase
/dev/md1                 216M       216M         0B       100%
/packages/mnt/jkernel-9.6-20090519.0
/dev/md2                  66M        66M         0B       100%
/packages/mnt/jpfe-T-9.6-20090519.0
/dev/md3                 4.1M       4.1M         0B       100%
/packages/mnt/jdocs-9.6-20090519.0
/dev/md4                  57M        57M         0B       100%
/packages/mnt/jroute-9.6-20090519.0
/dev/md5                  15M        15M         0B       100%
/packages/mnt/jcrypto-9.6-20090519.0
/dev/md6                  34M        34M         0B       100%
/packages/mnt/jpfe-common-9.6-20090519.0
/dev/md7                 2.0G      10.0K       1.8G         0%  /tmp
/dev/md8                 2.0G       1.0M       1.8G         0%  /mfs
/dev/ad0s1e              383M        82K       352M         0%  /config
procfs                   4.0K       4.0K         0B       100%  /proc
/dev/ad1s1f               52G       7.5G        40G        16%  /var

lcc0-re0:
--------------------------------------------------------------------------
Filesystem               Size       Used      Avail  Capacity   Mounted on
/dev/ad0s1a              3.4G       178M       2.9G         6%  /
devfs                    1.0K       1.0K         0B       100%  /dev
devfs                    1.0K       1.0K         0B       100%  /dev/
/dev/md0                  33M        33M        0B       100%  /packages/mnt/jbase
/dev/md1                 216M       216M         0B       100%
/packages/mnt/jkernel-9.6-20090519.0
/dev/md2                  66M        66M         0B       100%
/packages/mnt/jpfe-T-9.6-20090519.0
/dev/md3                 4.1M       4.1M         0B       100%
/packages/mnt/jdocs-9.6-20090519.0
/dev/md4                  57M        57M         0B       100%
/packages/mnt/jroute-9.6-20090519.0
/dev/md5                  15M        15M         0B       100%
/packages/mnt/jcrypto-9.6-20090519.0
/dev/md6                  34M        34M         0B       100%
/packages/mnt/jpfe-common-9.6-20090519.0
/dev/md7                 2.0G      10.0K       1.8G         0%  /tmp
/dev/md8                 2.0G       540K       1.8G         0%  /mfs
/dev/ad0s1e              383M        88K       352M         0%  /config
procfs                   4.0K       4.0K         0B       100%  /proc
/dev/ad1s1f               52G       6.3G        41G        13%  /var
```

```
lcc1-re0:
--------------------------------------------------------------------------
Filesystem              Size       Used      Avail  Capacity   Mounted on
/dev/ad0s1a             3.4G       178M       2.9G        6%  /
devfs                   1.0K       1.0K         0B      100%  /dev
devfs                   1.0K       1.0K         0B      100%  /dev/
/dev/md0                 33M        33M        0B      100%  /packages/mnt/jbase
/dev/md1                216M       216M         0B      100%
/packages/mnt/jkernel-9.6-20090519.0
/dev/md2                 66M        66M         0B      100%
/packages/mnt/jpfe-T-9.6-20090519.0
/dev/md3                4.1M       4.1M         0B      100%
/packages/mnt/jdocs-9.6-20090519.0
/dev/md4                 57M        57M         0B      100%
/packages/mnt/jroute-9.6-20090519.0
/dev/md5                 15M        15M         0B      100%
/packages/mnt/jcrypto-9.6-20090519.0
/dev/md6                 34M        34M         0B      100%
/packages/mnt/jpfe-common-9.6-20090519.0
/dev/md7                2.0G      10.0K       1.8G        0%  /tmp
/dev/md8                2.0G       540K       1.8G        0%  /mfs
/dev/ad0s1e             383M        88K       352M        0%  /config
procfs                  4.0K       4.0K         0B      100%  /proc
/dev/ad1s1f              23G        13G       7.7G       64%  /var

lcc2-re0:
--------------------------------------------------------------------------
Filesystem              Size       Used      Avail  Capacity   Mounted on
/dev/ad0s1a             3.4G       178M       2.9G        6%  /
devfs                   1.0K       1.0K         0B      100%  /dev
devfs                   1.0K       1.0K         0B      100%  /dev/
/dev/md0                 33M        33M        0B      100%  /packages/mnt/jbase
/dev/md1                216M       216M         0B      100%
/packages/mnt/jkernel-9.6-20090519.0
/dev/md2                 66M        66M         0B      100%
/packages/mnt/jpfe-T-9.6-20090519.0
/dev/md3                4.1M       4.1M         0B      100%
/packages/mnt/jdocs-9.6-20090519.0
/dev/md4                 57M        57M         0B      100%
/packages/mnt/jroute-9.6-20090519.0
/dev/md5                 15M        15M         0B      100%
/packages/mnt/jcrypto-9.6-20090519.0
/dev/md6                 34M        34M         0B      100%
/packages/mnt/jpfe-common-9.6-20090519.0
/dev/md7                2.0G      10.0K       1.8G        0%  /tmp
/dev/md8                2.0G       540K       1.8G        0%  /mfs
/dev/ad0s1e             383M        64K       352M        0%  /config
procfs                  4.0K       4.0K         0B      100%  /proc
/dev/ad1s1f              23G       3.7G        17G       18%  /var

lcc3-re0:
--------------------------------------------------------------------------
Filesystem              Size       Used      Avail  Capacity   Mounted on
/dev/ad0s1a             3.4G       178M       2.9G        6%  /
devfs                   1.0K       1.0K         0B      100%  /dev
devfs                   1.0K       1.0K         0B      100%  /dev/
/dev/md0                 33M        33M        0B      100%  /packages/mnt/jbase
/dev/md1                216M       216M         0B      100%
/packages/mnt/jkernel-9.6-20090519.0
/dev/md2                 66M        66M         0B      100%
/packages/mnt/jpfe-T-9.6-20090519.0
```

```
/dev/md3                4.1M      4.1M        0B     100%
/packages/mnt/jdocs-9.6-20090519.0
/dev/md4                 57M       57M        0B     100%
/packages/mnt/jroute-9.6-20090519.0
/dev/md5                 15M       15M        0B     100%
/packages/mnt/jcrypto-9.6-20090519.0
/dev/md6                 34M       34M        0B     100%
/packages/mnt/jpfe-common-9.6-20090519.0
/dev/md7                2.0G     10.0K      1.8G       0%  /tmp
/dev/md8                2.0G      540K      1.8G       0%  /mfs
/dev/ad0s1e             383M       34K      352M       0%  /config
procfs                  4.0K      4.0K        0B     100%  /proc
/dev/ad1s1f              23G       18G      3.5G      84%  /var
```

show system storage (QFX3500 Switch)

```
user@switch> show system storage
Filesystem              Size      Used      Avail  Capacity   Mounted on
/dev/da0s2a             343M      192M      123M      61%  /
devfs                   1.0K      1.0K        0B     100%  /dev
/dev/md0               119M      119M       0B      100%  /packages/mnt/jbase
/dev/md1                513M      513M        0B     100%
/packages/mnt/jkernel-qfx-11.1R1.5
/dev/md2                 37M       37M        0B     100%
/packages/mnt/jpfe-qfx-e9xxx-11.1R1.5
/dev/md3                6.0M      6.0M        0B     100%
/packages/mnt/jdocs-qfx-11.1R1.5
/dev/md4                216M      216M        0B     100%
/packages/mnt/jroute-qfx-11.1R1.5
/dev/md5                 59M       59M        0B     100%
/packages/mnt/jcrypto-qfx-11.1R1,5
/dev/md6                 85M       85M        0B     100%
/packages/mnt/jswitch-qfx-11.1R1.5
/dev/md7                 63M      8.0K       58M       0%  /tmp
/dev/da0s2f             228M       14M      196M       7%  /var
/dev/da0s3d             590M      3.0M      540M       1%  /var/tmp
/dev/da0s3e             104M      162K       95M       0%  /config
procfs                  4.0K      4.0K        0B     100%  /proc
```


show system uptime

Syntax

show system uptime

Syntax (EX Series Switches)

show system uptime
<all-members>
<local>
<member *member-id*>

Syntax (QFX Series)

show system uptime
<director-group *name*>
<infrastructure *name*>
<interconnect-device *name*>
<node-group *name*>

Syntax (TX Matrix Router)

show system uptime
<all-chassis | all-lcc | lcc *number* | scc>

Syntax (TX Matrix Plus Router)

show system uptime
<detail>
<all-chassis | all-lcc | lcc *number* | sfc *number*>

Syntax (MX Series Router)

show system uptime
<all-members>
<invoke-on>
<local>
<member *member-id*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in JUNOS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the current time and information about how long the router or switch, router or switch software, and routing protocols have been running.

Options

none—Show time since the system rebooted and processes started.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Show time since the system rebooted and processes started on all the routers in the chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, show time since the system rebooted and processes started for all T640 routers (or line-card chassis) connected to the TX Matrix router. On a TX Matrix Plus router, show time since the system rebooted and processes started for all connected T1600 or T4000 LCCs.

all-members—(EX4200 switches and MX Series routers only) (Optional) Show time since the system rebooted and processes started on all members of the Virtual Chassis configuration.

director-group *name*—(QFabric systems only) (Optional) Show time since the system rebooted and processes started on the Director group.

infrastructure *name*—(QFabric systems only) (Optional) Show time since the system rebooted and processes started on the fabric control Routing Engine and fabric manager Routing Engine.

interconnect-device *name*—(QFabric systems only) (Optional) Show time since the system rebooted and processes started on the Interconnect device.

invoke-on—(MX Series routers only) (Optional) Display the time since the system rebooted and processes started on the master Routing Engine, backup Routing Engine, or both, on a router with two Routing Engines.

lcc *number*—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, show time since the system rebooted and processes started for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, show time since the system rebooted and processes started for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Show time since the system rebooted and processes started on the local Virtual Chassis member.

member *member-id*—(EX4200 switches and MX Series routers only) (Optional) Show time since the system rebooted and processes started on the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

node-group *name*—(QFabric systems only) (Optional) Show time since the system rebooted and processes started on the Node group.

scc—(TX Matrix routers only) (Optional) Show time since the system rebooted and processes started for the TX Matrix router (or switch-card chassis).

sfc *number*—(TX Matrix Plus routers only) (Optional) Show time since the system rebooted and processes started for the TX Matrix Plus router. Replace *number* with 0.

Additional Information By default, when you issue the **show system uptime** command on the master Routing Engine of a TX Matrix router or a TX Matrix Plus router, the command is broadcast to all the master Routing Engines of the LCCs connected to it in the routing matrix. Likewise, if you issue the same command on the backup Routing Engine of a TX Matrix or a TX Matrix Plus router, the command is broadcast to all backup Routing Engines of the LCCs that are connected to it in the routing matrix.

Required Privilege Level view

Related Documentation

- Monitoring System Process Information on page 307
- Monitoring System Properties on page 308
- *10-Gigabit Ethernet LAN/WAN PIC with XFP (T640 Router)*
- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

show system uptime on page 1027
show system uptime all-lcc (TX Matrix Router) on page 1028
show system uptime all-lcc (TX Matrix Plus Router) on page 1028
show system uptime (QFX Series) on page 1029

Output Fields Table 91 on page 1027 describes the output fields for the **show system uptime** command. Output fields are listed in the approximate order in which they appear.

Table 91: show system uptime Output Fields

Field Name	Field Description
Current time	Current system time in UTC.
System booted	Date and time when the Routing Engine on the router or switch was last booted and how long it has been running.
Protocols started	Date and time when the routing protocols were last started and how long they have been running.
Last configured	Date and time when a configuration was last committed. Also shows the name of the user who issued the last **commit** command.
***time* and up**	Current time, in the local time zone, and how long the router or switch has been operational.
users	Number of users logged in to the router or switch.
load averages	Load averages for the last 1 minute, 5 minutes, and 15 minutes.

Sample Output

show system uptime

```
user@host> show system uptime
Current time:      1998-10-13 19:45:47 UTC
System booted:     1998-10-12 20:51:41 UTC (22:54:06 ago)
```



```
Protocols started: 1998-10-13 19:33:45 UTC (00:12:02 ago)
Last configured:   1998-10-13 19:33:45 UTC (00:12:02 ago) by abc
12:45PM  up 22:54, 2 users, load averages: 0.07, 0.02, 0.01
```

show system uptime all-lcc (TX Matrix Router)

```
user@host> show system uptime all-lcc
lcc0-re0:
--------------------------------------------------------------------------
Current time: 2004-09-13 09:55:35 PDT
System booted: 2004-09-13 03:13:55 PDT (06:41:40 ago)
Last configured: 2004-09-13 03:17:48 PDT (06:37:47 ago) by root
9:55AM PDT up 6:42, 1 user, load averages: 0.02, 0.03, 0.00
lcc2-re0:
--------------------------------------------------------------------------
Current time: 2004-09-13 09:55:35 PDT
System booted: 2004-09-12 03:23:43 PDT (1d 06:31 ago)
Last configured: 2004-09-13 03:05:36 PDT (06:49:59 ago) by root
9:55AM PDT up 1 day,  6:32, 1 user, load averages: 0.02, 0.01, 0.00
```

show system uptime all-lcc (TX Matrix Plus Router)

```
user@host> show system uptime all-lcc
sfc0-re0:
--------------------------------------------------------------------------
Current time: 2009-05-25 00:24:30 PDT
System booted: 2009-05-24 06:39:33 PDT (17:44:57 ago)
Protocols started: 2009-05-24 06:40:30 PDT (17:44:00 ago)
Last configured: 2009-05-24 06:33:27 PDT (17:51:03 ago) by gregdo
12:24AM  up 17:45, 2 users, load averages: 0.07, 0.05, 0.01

lcc0-re0:
--------------------------------------------------------------------------
Current time: 2009-05-25 00:24:30 PDT
System booted: 2009-05-24 06:39:46 PDT (17:44:44 ago)
error: the routing subsystem is not running
Last configured: 2009-05-24 06:40:47 PDT (17:43:43 ago) by root
12:24AM  up 17:45, 0 users, load averages: 0.00, 0.00, 0.00

lcc1-re0:
--------------------------------------------------------------------------
Current time: 2009-05-25 00:24:30 PDT
System booted: 2009-05-24 06:39:38 PDT (17:44:52 ago)
error: the routing subsystem is not running
Last configured: 2009-05-24 06:40:18 PDT (17:44:12 ago) by root
12:24AM  up 17:45, 0 users, load averages: 0.00, 0.00, 0.00

lcc2-re0:
--------------------------------------------------------------------------
Current time: 2009-05-25 00:24:30 PDT
System booted: 2009-05-24 06:39:48 PDT (17:44:42 ago)
error: the routing subsystem is not running
Last configured: 2009-05-24 06:40:44 PDT (17:43:46 ago) by root
12:24AM  up 17:45, 0 users, load averages: 0.00, 0.00, 0.00

lcc3-re0:
--------------------------------------------------------------------------
Current time: 2009-05-25 00:24:30 PDT
System booted: 2009-05-24 06:39:44 PDT (17:44:46 ago)
error: the routing subsystem is not running
```



```
Last configured: 2009-05-24 06:40:08 PDT (17:44:22 ago) by root
12:24AM  up 17:45, 0 users, load averages: 0.00, 0.00, 0.00
```

show system uptime (QFX Series)

```
user@switch> show system uptime
Current time: 2010-08-27 03:12:30 PDT
System booted: 2010-08-13 17:11:54 PDT (1w6d 10:00 ago)
Protocols started: 2010-08-13 17:13:56 PDT (1w6d 09:58 ago)
Last configured: 2010-08-26 05:54:00 PDT (21:18:30 ago) by regress
 3:12AM  up 13 days, 10:01, 3 users, load averages: 0.00, 0.00, 0.00
```

show system users

Syntax

show system users
<no-resolve>

Syntax (TX Matrix Router)

show system users
<all-chassis | all-lcc | lcc *number* | scc>
<no-resolve>

Syntax (TX Matrix Plus Router)

show system users
<detail>
<all-chassis | all-lcc | lcc *number* | sfc *number*> <no-resolve>

Syntax (MX Series Router)

show system users
<all-members>
<local>
<member *member-id*>
<no-resolve>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in JUNOS OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

List information about the users who are currently logged in to the router or switch.

NOTE: The show system users command lists the information about administrative users that are logged in to a router or switch using the CLI, J-Web, or an SSH client. The output does not list information about web users or automated users that are logged in from a remote client application using Junos XML APIs, such as NETCONF.

Options

none—List information about the users who are currently logged in to the router or switch.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Show users currently logged in to all the routers in the chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, show users currently logged in to all T640 routers (or line-card chassis) connected to the TX Matrix router. On a TX Matrix Plus router, show users currently logged in to all connected T1600 or T4000 LCCs.

all-members—(MX Series routers only) (Optional) Display users currently logged in to all members of the Virtual Chassis configuration.

lcc *number*—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, show users currently logged in to a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, show users currently logged in to a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Display users currently logged in to the local Virtual Chassis member.

member *member-id*—(MX Series routers only) (Optional) Display users currently logged in to the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value of 0 or 1.

no-resolve—(Optional) Do not attempt to resolve IP addresses to hostnames.

scc—(TX Matrix routers only) (Optional) Show users currently logged in to the TX Matrix router (or switch-card chassis).

sfc *number*—(TX Matrix Plus routersonly) (Optional) Show users currently logged in to the TX Matrix Plus router. Replace ***number*** with 0.

Additional Information

By default, when you issue the **show system users** command on the master Routing Engine of a TX Matrix router or a TX Matrix Plus router, the command is broadcast to all the master Routing Engines of the LCCs connected to it in the routing matrix. Likewise, if you issue the same command on the backup Routing Engine of a TX Matrix or a TX Matrix Plus router, the command is broadcast to all backup Routing Engines of the LCCs that are connected to it in the routing matrix.

Required Privilege Level

view

Related Documentation

- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

show system users on page 1032
show system users lcc no-resolve (TX Matrix, TX Matrix Plus Router) on page 1032
show system users (TX Matrix Plus Router) on page 1032
show system users (QFX Series) on page 1033
show system users no-resolve (QFX Series) on page 1033

Output Fields

Table 92 on page 1032 describes the output fields for the **show system users** command. Output fields are listed in the approximate order in which they appear.

Table 92: show system users Output Fields

Field Name	Field Description
time and up	Current time, in the local time zone, and how long the router or switch has been operational.
users	Number of users logged in to the router or switch.
load averages	Load averages for the last 1 minute, 5 minutes, and 15 minutes.
USER	Username.
TTY	Terminal through which the user is logged in.
FROM	System from which the user has logged in. A hyphen indicates that the user is logged in through the console.
LOGIN@	Time when the user logged in.
IDLE	How long the user has been idle.
WHAT	Processes that the user is running.

Sample Output

show system users

```
user@host> show system users
 7:30PM  up 4 days,  2:26, 2 users, load averages: 0.07, 0.02, 0.01
USER     TTY FROM              LOGIN@  IDLE WHAT
root     d0  -                Fri05PM 4days -csh (csh)
blue   p0 test.company.net 7:30PM     - cli
```

show system users lcc no-resolve (TX Matrix, TX Matrix Plus Router)

```
user@host> show system users lcc 2 no-resolve

lcc2-re0:
--------------------------------------------------------------------------
10:34AM PDT up 1 day,  7:11, 5 users, load averages: 0.03, 0.01, 0.00
USER     TTY      FROM                              LOGIN@  IDLE WHAT
root     d0       -                                3:21AM   7:12 /bin/csh
user     p0       scc-re0                          10:15AM     - telnet hostA
user     p1       scc-re0                          10:16AM     - telnet hostA
user     p2       scc-re0                          10:19AM     - telnet hostA
user     p3       scc-re0                          10:24AM     - telnet hostA
```

show system users (TX Matrix Plus Router)

```
user@host> show system users
sfc0-re0:
--------------------------------------------------------------------------
 1:41AM  up 26 mins, 3 users, load averages: 0.08, 0.04, 0.03
USER     TTY      FROM                              LOGIN@  IDLE WHAT
user     p0       10.209.208.123                   1:18AM     21 cli
user     p1       172.17.29.207                    1:37AM      2 cli
```

```
user     p2       172.17.28.19                     1:40AM      - cli

lcc0-re0:
--------------------------------------------------------------------------
 1:41AM  up 26 mins, 0 users, load averages: 0.00, 0.00, 0.03

lcc1-re0:
--------------------------------------------------------------------------
 1:41AM  up 26 mins, 0 users, load averages: 0.00, 0.02, 0.03

lcc2-re0:
--------------------------------------------------------------------------
 1:41AM  up 26 mins, 0 users, load averages: 0.16, 0.06, 0.02

lcc3-re0:
--------------------------------------------------------------------------
 1:41AM  up 26 mins, 0 users, load averages: 0.12, 0.04, 0.04

user@host> show system users
sfc0-re0:
--------------------------------------------------------------------------
 1:42AM  up 28 mins, 4 users, load averages: 0.02, 0.03, 0.02
USER     TTY      FROM                              LOGIN@  IDLE WHAT
user  p0      device.test.net              1:18AM     22 cli
user  p1      device.test1.net             1:37AM      - cli
user  p2      device.test2.net             1:40AM      - cli
user  p3      device.test3.net             1:42AM     - -csh (csh)

lcc0-re0:
--------------------------------------------------------------------------
 1:42AM  up 28 mins, 0 users, load averages: 0.02, 0.01, 0.03

lcc1-re0:
--------------------------------------------------------------------------
 1:42AM  up 28 mins, 0 users, load averages: 0.07, 0.04, 0.03

lcc2-re0:
--------------------------------------------------------------------------
 1:42AM  up 27 mins, 0 users, load averages: 0.07, 0.06, 0.02

lcc3-re0:
--------------------------------------------------------------------------
 1:42AM  up 28 mins, 0 users, load averages: 0.05, 0.04, 0.04
```

show system users (QFX Series)

```
user@switch> show system users
USER     TTY      FROM                              LOGIN@  IDLE WHAT
user0    p0      172.22.18.117                    2:54AM     39 -cli (cli)
user1    p1      172.22.18.117                    3:01AM      - -cli (cli)
user2    p2      172.22.17.197                    3:08AM     11 -cli (cli)
```

show system users no-resolve (QFX Series)

```
user@switch> show system users no-resolve
USER     TTY      FROM                              LOGIN@  IDLE WHAT
user0    p0      172.22.18.117                    2:54AM     39 -cli (cli)
user1    p1      172.22.18.117                    3:01AM      - -cli (cli)
user2    p2      172.22.17.197                    3:08AM     11 -cli (cli)
```


show system virtual-memory

Syntax

show system virtual-memory

Syntax (EX Series)

show system virtual-memory
<all-members>
<local>
<member *member-id*>

Syntax (TX Matrix Router)

show system virtual-memory
<all-chassis | all-lcc | lcc *number* | scc>

Syntax (TX Matrix Plus Router)

show system virtual-memory
<all-chassis | all-lcc | lcc *number* | sfc *number*>

Syntax (MX Series Router)

show system virtual-memory
<all-members>
<local>
<member *member-id*>

Syntax (QFX Series)

show system virtual-memory
<infrastructure *name*>
<interconnect-device *name*>
<node-group *name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the usage of Junos OS kernel memory listed first by size of allocation and then by type of usage. Use the **show system virtual-memory** command for troubleshooting with Juniper Networks Customer Support.

Options

none—Display kernel dynamic memory usage information.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Display kernel dynamic memory usage information for all chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display kernel dynamic memory usage information for all T640 routers connected to the TX Matrix router. On a TX Matrix Plus router, display kernel dynamic memory usage information for all connected T1600 or T4000 LCCs.

all-members—(EX4200 switches and MX Series routers only) (Optional) Display kernel dynamic memory usage information for all members of the Virtual Chassis configuration.

infrastructure ***name***—(QFabric systems only) (Optional) Display kernel dynamic memory usage information for the fabric control Routing Engine and fabric manager Routing Engine.

interconnect-device ***name***—(QFabric systems only) (Optional) Display kernel dynamic memory usage information for the Interconnect device.

lcc ***number***—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display kernel dynamic memory usage information for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, display kernel dynamic memory usage information for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches and MX Series routers only) (Optional) Display kernel dynamic memory usage information for the local Virtual Chassis member.

member ***member-id***—(EX4200 switches and MX Series routers only) (Optional) Display kernel dynamic memory usage information for the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

node-group ***name***—(QFabric systems only) (Optional) Display kernel dynamic memory usage information for the Node group.

scc—(TX Matrix routers only) (Optional) Display kernel dynamic memory usage information for the TX Matrix router (or switch-card chassis).

sfc ***number***—(TX Matrix Plus routers only) (Optional) Display kernel dynamic memory usage information for the TX Matrix Plus router. Replace ***number*** with 0.

Additional Information

By default, when you issue the **show system virtual-memory** command on the master Routing Engine of a TX Matrix router or a TX Matrix Plus router, the command is broadcast to all the master Routing Engines of the LCCs connected to it in the routing matrix. Likewise, if you issue the same command on the backup Routing Engine of a TX Matrix or a TX Matrix Plus router, the command is broadcast to all backup Routing Engines of the LCCs that are connected to it in the routing matrix.

NOTE: The **show system virtual-memory** command with the **| display XML** pipe option now displays XML output for the command in the parent tags: **<vmstat-memstat-malloc>**, **<vmstat-memstat-zone>**, **<vmstat-sumstat>**, **<vmstat-intr>**, and **<vmstat-kernel-state>** with each child element as a separate XML tag. In Junos OS Releases 10.1 and earlier, the **| display XML** option for this command does not have an XML API element and the entire output is displayed in a single **<output>** tag element.

Required Privilege Level view

Related Documentation

- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

show system virtual-memory on page 1038
show system virtual-memory scc (TX Matrix Router) on page 1042
show system virtual-memory sfc (TX Matrix Plus Router) on page 1043
show system virtual-memory | display xml on page 1046
show system virtual-memory (QFX Series) on page 1069

Output Fields Table 93 on page 1037 lists the output fields for the **show system virtual-memory** command. Output fields are listed in the approximate order in which they appear.

Table 93: show system virtual-memory Output Fields

Field Name	Field Description
Memory statistics by bucket size	
Size	Memory block size (bytes). The kernel memory allocator appropriates blocks of memory whose size is exactly a power of 2.
In Use	Number of memory blocks of this size that are in use (bytes).
Free	Number of memory blocks of this size that are free (bytes).
Requests	Number of memory allocation requests made.
HighWater	Maximum value the free list can have. Once the system starts reclaiming physical memory, it continues until the free list is increased to this value.
Couldfree	Total number of times that the free elements for a bucket size exceed the high-water mark for that bucket size.
Memory usage type by bucket size	
Size	Memory block size (bytes).
Type(s)	Kernel modules that are using these memory blocks. For a definition of each type, refer to a FreeBSD book.
Memory statistics by type	
Type	Kernel module that is using dynamic memory.
InUse	Number of memory blocks used by this type. The number is rounded up.
MemUse	Amount of memory in use, in kilobytes (KB).
HighUse	Maximum memory ever used by this type.
Limit	Maximum memory that can be allocated to this type.
Requests	Total number of dynamic memory allocation requests this type has made.
Type Limit	Number of times requests were blocked for reaching the maximum limit.
Kern Limit	Number of times requests were blocked for the kernel map.
Size(s)	Memory block sizes this type is using.
Memory Totals	
In Use	Total kernel dynamic memory in use (bytes, rounded up).
Free	Total kernel dynamic memory free (bytes, rounded up).

Table 93: show system virtual-memory Output Fields *(continued)*

Field Name	Field Description
Requests	Total number of memory allocation requests.
ITEM	Kernel module that is using memory.
Size	Memory block size (bytes).
LImit	Maximum memory that can be allocated to this type.
Used	Number of memory blocks used by this type. The number is rounded up.
Free	Number of memory blocks available to this type.
Requests	Total number of memory allocation requests this type has made.
interrupt	Timer events and scheduling interruptions.
total	Total number of interruptions for each type.
rate	Interruption rate.
Total	Total for all interruptions.

Sample Output

show system virtual-memory

```
user@host> show system virtual-memory
Memory statistics by bucket size
Size   In Use   Free   Requests  HighWater  Couldfree
  16      906    118     154876     1280          0
  32      455    313     209956      640          0
  64     4412    260      75380      320         20
 128     3200     32      19361      160         81
 256     1510     10       8844       80          4
 512      446      2       5085       40          0
  1K       18      2       5901       20          0
  2K     1128      2       4445       10       1368
  4K      185      1        456        5          0
  8K        5      1       2653        5          0
 16K      181      0        233        5          0
 32K        2      0       1848        5          0
 64K       20      0         22        5          0
128K        5      0          5        5          0
256K        2      0          2        5          0
512K        1      0          1        5          0

Memory usage type by bucket size
Size  Type(s)
  16  uc_devlist, nexusdev, iftable, temp, devbuf, atexit, COS, BPF,
          DEVFS mount, DEVFS node, vnodes, mount, pcb, soname, proc-args, kld,
          MD disk, rman, ATA generic, bus, sysctl, ippool, pfestat, ifstate,
```



```
        pfe_ipc, mkey, rtable, ifmaddr, ipfw, rnode
  32  atkbddev, dirrem, mkdir, diradd, freefile, freefrag, indirdep,
        bmsafemap, newblk, temp, devbuf, COS, vnodes, cluster_save buffer,
        pcb, soname, proc-args, sigio, kld, Gzip trees, taskqueue, SWAP,
        eventhandler, bus, sysctl, uidinfo, subproc, pgrp, pfestat, itable32,
        ifstate, pfe_ipc, mkey, rtable, ifmaddr, ipfw, rnode, rtnexthop
  64  isadev, iftable, MFS node, allocindir, allocdirect, pagedep, temp,
        devbuf, lockf, COS, NULLFS hash, DEVFS name, vnodes,
        cluster_save buffer, vfscache, pcb, soname, proc-args, file,
        AR driver, AD driver, Gzip trees, rman, eventhandler, bus, sysctl,
        subproc, pfestat, pic, ifstate, pfe_ipc, mkey, ifaddr, rtable, ipfw
 128  ZONE, freeblks, inodedep, temp, devbuf, zombie, COS, DEVFS node,
        vnodes, mount, vfscache, pcb, soname, proc-args, ttys, dev_t,
        timecounter, kld, Gzip trees, ISOFS node, bus, uidinfo, cred,
        session, pic, itable16, ifstate, pfe_ipc, rtable, ifstat, metrics,
        rtnexthop, iffamily
 256  iflogical, iftable, MFS node, FFS node, newblk, temp, devbuf,
        NFS daemon, vnodes, proc-args, kqueue, file desc, Gzip trees, bus,
        subproc, itable16, ifstate, pfe_ipc, sysctl, rtnexthop
 512  UFS mount, temp, devbuf, mount, BIO buffer, ptys, ttys, AR driver,
        Gzip trees, ISOFS mount, msg, ioctlops, ATA generic, bus, proc,
        pfestat, lr, ifstate, pfe_ipc, rtable, ipfw, ifstat, rtnexthop
  1K  iftable, temp, devbuf, NQNFS Lease, kqueue, kld, AD driver,
        Gzip trees, sem, MD disk, bus, ifstate, pfe_ipc, ipfw
  2K  uc_devlist, UFS mount, temp, devbuf, BIO buffer, pcb, AR driver,
        Gzip trees, ioctlops, bus, ipfw, ifstat, rcache
  4K  memdesc, iftable, UFS mount, temp, devbuf, kld, Gzip trees, sem, msg
  8K  temp, devbuf, syncache, Gzip trees
 16K  indirdep, temp, devbuf, shm, msg
 32K  pagedep, kld, Gzip trees
 64K  VM pgdata, devbuf, MSDOSFS mount
128K  UFS ihash, inodedep, NFS hash, kld, ISOFS mount
256K  mbuf, vfscache
512K  SWAP

Memory statistics by type                          Type  Kern
        Type  InUse MemUse HighUse  Limit Requests Limit Limit Size(s)
      isadev    13     1K      1K127753K       13    0     0  64
    atkbddev     2     1K      1K127753K        2    0     0  32
  uc_devlist    24     3K      3K127753K       24    0     0  16,2K
    nexusdev     3     1K      1K127753K        3    0     0  16
     memdesc     1     4K      4K127753K        1    0     0  4K
        mbuf     1   152K    152K127753K        1    0     0  256K
   iflogical     6     2K      2K127753K        6    0     0  256
     iftable    17     9K      9K127753K       18    0     0  16,64,256,1K,4K
        ZONE    15     2K      2K127753K       15    0     0  128
   VM pgdata     1    64K     64K127753K        1    0     0  64K
   UFS mount    12    26K     26K127753K       12    0     0  512,2K,4K
   UFS ihash     1   128K    128K127753K        1    0     0  128K
    MFS node     6     2K      3K127753K       35    0     0  64,256
    FFS node   906   227K    227K127753K     1352    0     0  256
      dirrem     0     0K      4K127753K      500    0     0  32
       mkdir     0     0K      1K127753K       38    0     0  32
      diradd     0     0K      6K127753K      521    0     0  32
    freefile     0     0K      4K127753K      374    0     0  32
    freeblks     0     0K      8K127753K      219    0     0  128
    freefrag     0     0K      1K127753K      193    0     0  32
  allocindir     0     0K     25K127753K     1518    0     0  64
    indirdep     0     0K     17K127753K       76    0     0  32,16K
 allocdirect     0     0K     10K127753K      760    0     0  64
   bmsafemap     0     0K      1K127753K       72    0     0  32
```



```
         newblk     1     1K      1K127753K     2279    0      0  32,256
       inodedep     1   128K    175K127753K     2367    0      0  128,128K
        pagedep     1    32K     33K127753K       47    0      0  64,32K
           temp  1239    92K     96K127753K     8364    0      0  16,32,64K
         devbuf  1413  5527K   5527K127753K     1535    0      0  16,32,64,128,256
          lockf    38     3K      3K127753K     2906    0      0  64
         atexit     1     1K      1K127753K        1    0      0  16
         zombie     0     0K      2K127753K     3850    0      0  128
       NFS hash     1   128K    128K127753K        1    0      0  128K
    NQNFS Lease     1     1K      1K127753K        1    0      0  1K
     NFS daemon     1     1K      1K127753K        1    0      0  256
       syncache     1     8K      8K127753K        1    0      0  8K
            COS   353    44K     44K127753K      353    0      0  16,32,64,128
            BPF   189     3K      3K127753K      189    0      0  16
  MSDOSFS mount     1    64K     64K127753K        1    0      0  64K
    NULLFS hash     1     1K      1K127753K        1    0      0  64
    DEVFS mount     2     1K      1K127753K        2    0      0  16
     DEVFS name   487    31K     31K127753K      487    0      0  64
     DEVFS node   471    58K     58K127753K      479    0      0  16,128
         vnodes    28     7K      7K127753K      429    0      0  16,32,64,128,256
          mount    15     8K      8K127753K       18    0      0  16,128,512
cluster_save buffer     0     0K      1K127753K       55    0      0  32,64
       vfscache  1898   376K    376K127753K     3228    0      0  64,128,256K
     BIO buffer    49    98K    398K127753K      495    0      0  512,2K
            pcb   159    16K     17K127753K      399    0      0  16,32,64,128,2K
         soname    82    10K     10K127753K    42847    0      0  16,32,64,128
      proc-args    57     2K      3K127753K     2105    0      0  16,32,64,128,256
           ptys    32    16K     16K127753K       32    0      0  512
           ttys   254    33K     33K127753K      522    0      0  128,512
         kqueue     5     3K      4K127753K       23    0      0  256,1K
          sigio     1     1K      1K127753K       27    0      0  32
           file   383    24K     24K127753K    16060    0      0  64
      file desc    76    19K     20K127753K     3968    0      0  256
            shm     1    12K     12K127753K        1    0      0  16K
          dev_t   286    36K     36K127753K      286    0      0  128
    timecounter    10     2K      2K127753K       10    0      0  128
            kld    11   117K    122K127753K       34    0      0  16,32,128,1K,4K
      AR driver     1     1K      3K127753K        5    0      0  64,512,2K
      AD driver     2     2K      3K127753K     2755    0      0  64,1K
     Gzip trees     0     0K     46K127753K   133848    0      0  32,64,128,256
     ISOFS node  1136   142K    142K127753K     1189    0      0  128
    ISOFS mount     9   132K    132K127753K       10    0      0  512,128K
            sem     3     6K      6K127753K        3    0      0  1K,4K
        MD disk     2     2K      2K127753K        2    0      0  16,1K
            msg     4    25K     25K127753K        4    0      0  512,4K,16K
           rman    59     4K      4K127753K      461    0      0  16,64
       ioctlops     0     0K      2K127753K      992    0      0  512,2K
      taskqueue     2     1K      1K127753K        2    0      0  32
           SWAP     2   413K    413K127753K        2    0      0  32,512K
    ATA generic     6     3K      3K127753K        6    0      0  16,512
   eventhandler    17     1K      1K127753K       17    0      0  32,64
            bus   340    30K     31K127753K      794    0      0  16,32,64,128,256
         sysctl     0     0K      1K127753K   130262    0      0  16,32,64
        uidinfo     4     1K      1K127753K       10    0      0  32,128
           cred    22     3K      3K127753K     3450    0      0  128
        subproc   156    10K     10K127753K     7882    0      0  32,64,256
           proc     2     1K      1K127753K        2    0      0  512
        session    12     2K      2K127753K       34    0      0  128
           pgrp    16     1K      1K127753K       45    0      0  32
         ippool     1     1K      1K127753K        1    0      0  16
        pfestat     0     0K      1K127753K    47349    0      0  16,32,64,512
```

```
           pic     5     1K      1K127753K        5    0      0  64,128
            lr     1     1K      1K127753K        1    0      0  512
     itable32    110     4K      4K127753K      110    0      0  32
     itable16    161    26K     26K127753K      161    0      0  128,256
      ifstate    694   159K    160K127753K     1735    0      0  16,32,64,128,1K
      pfe_ipc      0     0K      1K127753K    56218    0      0  16,32,64,128,1K
         mkey    250     4K      4K127753K      824    0      0  16,32,64
       ifaddr      9     1K      1K127753K        9    0      0  64
       sysctl      0     0K      1K127753K       30    0      0  256
       rtable     49     6K      6K127753K      307    0      0  16,32,64,128,512
      ifmaddr     22     1K      1K127753K       22    0      0  16,32
         ipfw     23    10K     10K127753K       48    0      0  16,32,64,512,2K
       ifstat    698   805K    805K127753K      698    0      0  128,512,2K
       rcache      4     8K      8K127753K        4    0      0  2K
        rnode     27     1K      1K127753K      285    0      0  16,32
      metrics      1     1K      1K127753K        3    0      0  128
    rtnexthop     57     9K      9K127753K      312    0      0  32,128,256,512
     iffamily     12     2K      2K127753K       12    0      0  128

Memory Totals:  In Use       Free    Requests
                 9311K        54K      489068

ITEM            SIZE     LIMIT    USED    FREE  REQUESTS
PIPE:            192,        0,      4,     81,     4422
SWAPMETA:        160,    95814,      0,      0,        0
unpcb:           160,        0,    114,     36,      279
ripcb:           192,    25330,      5,     37,        5
syncache:        128,    15359,      0,     64,        5
tcpcb:           576,    25330,     23,     12,       32
udpcb:           192,    25330,     14,     28,      255
socket:          256,    25330,    246,     26,      819
KNOTE:            96,        0,     27,     57,       71
NFSNODE:         352,        0,      0,      0,        0
NFSMOUNT:        544,        0,      0,      0,        0
VNODE:           224,        0,   2778,     43,     2778
NAMEI:          1024,        0,      0,      8,    40725
VMSPACE:         192,        0,     57,     71,     3906
PROC:            448,        0,     73,     17,     3923
DP fakepg:        64,        0,      0,      0,        0
PV ENTRY:         28,   499566,  44530, 152053,  1525141
MAP ENTRY:        48,        0,   1439,    134,   351075
KMAP ENTRY:       48,    35645,    179,    119,    10904
MAP:             108,        0,      7,      3,        7
VM OBJECT:        92,        0,   2575,    109,    66912

   792644 cpu context switches
  9863474 device interrupts
   286510 software interrupts
   390851 traps
  3596829 system calls
       16 kernel threads created
     3880  fork() calls
       27 vfork() calls
        0 rfork() calls
        0 swap pager pageins
        0 swap pager pages paged in
        0 swap pager pageouts
        0 swap pager pages paged out
      380 vnode pager pageins
      395 vnode pager pages paged in
      122 vnode pager pageouts
```

```
     1476 vnode pager pages paged out
        0 page daemon wakeups
        0 pages examined by the page daemon
      101 pages reactivated
   161722 copy-on-write faults
        0 copy-on-write optimized faults
    84623 zero fill pages zeroed
    83063 zero fill pages prezeroed
        7 intransit blocking page faults
   535606 total VM faults taken
        0 pages affected by kernel thread creation
   238254 pages affected by  fork()
     2535 pages affected by vfork()
        0 pages affected by rfork()
   283379 pages freed
        0 pages freed by daemon
   190091 pages freed by exiting processes
    17458 pages active
    29166 pages inactive
        0 pages in VM cache
    10395 pages wired down
   134610 pages free
     4096 bytes per page
   183419 total name lookups
          cache hits (90% pos + 7% neg) system 0% per-directory
          deletions 0%, falsehits 0%, toolong 0%

interrupt                   total       rate
ata0 irq14                 113338          3
mux irq7                   727643         21
fxp1 irq10                1178671         34
sio0 irq4                     833          0
clk irq0                  3439769         99
rtc irq8                  4403221        127
Total                     9863475        286

Kernel direct memory map:
        4423  pages used
     4057340  pages maximum
```

Note: **Kernel direct memory map** only displays for 64 bit platform.

show system virtual-memory scc (TX Matrix Router)

user@host> **show system virtual-memory scc**

```
Memory statistics by bucket size
Size   In Use   Free   Requests  HighWater  Couldfree
  16      898    126     749493     1280          0
  32     2018   1310     980643      640        632
  64     3490  13342     935420      320       5365
...

Memory usage type by bucket size
Size  Type(s)
  16  uc_devlist, COS, BPF, DEVFS mount, DEVFS node, vnodes, mount, pcb,
          soname, rman, bus, sysctl, ifstate, pfe_ipc, mkey, socket, rtable,
          ifmaddr, ipfw, rnode, iftable, temp, devbuf, atexit, proc-args, kld,
          MD disk
  32  atkbddev, Gzip trees, dirrem, mkdir, diradd, freefile, freefrag,
          indirdep, bmsafemap, newblk, tseg_qent, COS, vnodes,
```



```
...

Memory statistics by type                          Type  Kern
        Type  InUse MemUse HighUse  Limit Requests Limit Limit Size(s)
       isadev    12     1K      1K166400K       12     0     0  64
     atkbddev     2     1K      1K166400K        2     0     0  32
   uc_devlist    24     3K      3K166400K       24     0     0  16,2K
....

Memory Totals:  In Use    Free    Requests
                 6091K   1554K     2897122
```

show system virtual-memory sfc (TX Matrix Plus Router)

```
user@host> show system virtual-memory sfc 0
sfc0-re0:
--------------------------------------------------------------------------
         Type InUse MemUse HighUse Requests  Size(s)
CAM dev queue     1     1K       -        1  64
      entropy  1024    64K       -     1024  64
       linker   487  6272K       -     1163  16,32,64,4096,32768,131072
          USB   127    10K       -      127  16,32,64,128,256,1024,2048
        lockf    46     3K       -    98418  64
       USBdev    10     2K       -       34  16,128,2048,16384
ifstateSLLNode     0     0K       -     1096 16
       devbuf 21243 15683K       -    21810
16,32,64,128,256,512,1024,2048,4096,8192,16384,32768,65536,131072
         temp  1283   151K       -  2483472
16,32,64,128,256,512,2048,4096,8192,16384,32768,65536,131072
       ip6ndp     0     0K       -        4  64
   in6ifmulti     1     1K       -        1  64
   in6grentry     1     1K       -        1  64
    iflogical    20     5K       -       29  2048
     iffamily    45     6K       -       69  32,1024,2048
    rtnexthop   266    46K       -   608013  32,256,512,1024,2048,4096
      metrics    31     4K       -       54  256
        rnode   212     4K       -   607848  16,32
       rcache     4     8K       -        4  65536
       iflist     0     0K       -        6  16,64
     ifdevice    11     8K       -       17  16,32768
       ifstat   424   472K       -      427  512,16384,65536
         ipfw    42    23K       -      145
16,32,64,128,256,512,1024,16384,32768,65536,131072
      ifmaddr   415    11K       -      415  16,32
       rtable   329    28K       -   608066  16,32,64,128,1024,16384
       sysctl     0     0K       -   887976  16,32,64,4096,16384,32768
       ifaddr    64     5K       -       70  32,64,128
         mkey   331     6K       -    12528  16,128
      pfe_ipc     0     0K       -  7299115
16,32,64,128,256,512,1024,2048,4096,8192,16384,32768,65536,131072
      ifstate 1245054 70088K       -  3040437
16,32,64,128,256,512,1024,2048,4096,8192,16384,32768
    idxbucket     1     1K       -        1  16
     itable16  5069  1250K       -     5103  1024,4096
     itable32   157    10K       -      157  64
     itable64     2     1K       -        2  128
           lr     1     1K       -        4  16384
          pic    37     6K       -       37  64,16384
      pfestat     0     0K       -     6220  32,64,128,256,131072
       gencfg  1486   424K       -     2614  16,32,64,256,512,16384,32768,65536
```



```
          jsr     2     1K       -       22  16
          idl     1     4K       -      165
32,64,128,256,512,1024,2048,8192,16384,32768,65536,131072
       rtsmsg     0     0K       -       16  131072
       module   250    16K       -      250  64,128
     mtx_pool     1     8K       -        1  64,128
       DEVFS3   113    13K       -      114  256
       DEVFS1   106    24K       -      106  2048
         pgrp    15     1K       -     8600  64
      session    11     2K       -     2829  512
         proc     2     1K       -        2  16384
      subproc   296   572K       -    24689  2048,131072
         cred    38     5K       -   619244  256
       plimit    18     4K       -    21311  2048
      uidinfo     3     1K       -       10  32,512
    sysctloid  2701    82K       -     2701  16,32,64
    sysctltmp     0     0K       -    15572  16,32,64,1024
         umtx   171    11K       -      171  64
         SWAP     2   277K       -        2  64
          bus   779   125K       -     3072  16,32,64,128,32768
       bus-sc    67    62K       -     1477
16,32,64,512,1024,2048,8192,16384,65536,131072
      devstat     8    17K       -        8  16,131072
 eventhandler    46     2K       -       47  32,128
         kobj    93   186K       -      111  65536
        DEVFS     8     1K       -        9  16,64
         rman   106     7K       -      490  16,32,64
         sbuf     0     0K       -    28234  16,32,32768,131072
...
lcc0-re0:
--------------------------------------------------------------------------
         Type InUse MemUse HighUse Requests  Size(s)
CAM dev queue     1     1K       -        1  64
      entropy  1024    64K       -     1024  64
       linker   487  6272K       -     1163  16,32,64,4096,32768,131072
          USB   127    10K       -      127  16,32,64,128,256,1024,2048
        lockf    23     2K       -   169585  64
       USBdev    10     2K       -       34  16,128,2048,16384
       devbuf  5128 10760K       -     5310
16,32,64,128,256,512,1024,2048,4096,8192,16384,32768,65536,131072
         temp  1285   151K       -    10770
16,32,64,128,256,512,2048,4096,8192,16384,32768,65536,131072
       ip6ndp     0     0K       -        4  64
    iflogical    20     5K       -       29  2048
     iffamily    45     6K       -       69  32,1024,2048
    rtnexthop   189    29K       -  1211988  32,256,512,1024,2048,4096
      metrics    11     2K       -       16  256
        rnode   135     3K       -   606391  16,32
       rcache     4     8K       -        4  65536
       iflist     0     0K       -        6  16,64
     ifdevice    11     8K       -       17  16,32768
       ifstat   412   471K       -      415  512,16384,65536
         ipfw    42    23K       -       91
16,32,64,128,256,512,1024,16384,32768,65536,131072
      ifmaddr   415    11K       -      415  16,32
       rtable   225    20K       -   606584  16,32,64,128,1024,16384
       sysctl     0     0K       -  2302479  16,32,64
       ifaddr    53     4K       -       69  32,64,128
         mkey   133     3K       -     8974  16,128
      pfe_ipc     0     0K       - 19035108
16,32,64,128,512,1024,2048,8192,16384,32768,65536,131072
```



```
      ifstate 710270 42176K       -  9583703
16,32,64,128,256,512,1024,2048,8192,16384,32768
    idxbucket     1     1K       -        1  16
     itable16  5045  1245K       -  1825178  1024,4096
     itable32   157    10K       -      157  64
     itable64     2     1K       -        2  128
           lr     1     1K       -        4  16384
          pic    37     6K       -       37  64,16384
      pfestat     0     0K       -     1682  32,64,128,256,131072
       gencfg  1486   424K       -     2812  16,32,64,256,512,16384,32768,65536
          jsr     0     0K       -       22  16
          idl     0     0K       -        4  32768,131072
       rtsmsg     0     0K       -        3  131072
       module   250    16K       -      250  64,128
     mtx_pool     1     8K       -        1  64,128
       DEVFS3   108    12K       -      109  256
       DEVFS1   101    23K       -      101  2048
         pgrp     5     1K       -      917  64
      session     5     1K       -      917  512
         proc     2     1K       -        2  16384
      subproc   217   441K       -     4867  2048,131072
         cred    21     3K       -    48719  256
       plimit     9     2K       -     5255  2048
      uidinfo     2     1K       -        2  32,512
    sysctloid  2786    85K       -     2786  16,32,64
    sysctltmp     0     0K       -     1833  16,32,64,1024
         umtx   126     8K       -      126  64
         SWAP     2   277K       -        2  64
          bus   780   125K       -     2734  16,32,64,128,32768
       bus-sc    69    69K       -     1194
16,32,64,512,1024,2048,8192,16384,65536,131072
      devstat     8    17K       -        8  16,131072
 eventhandler    45     2K       -       46  32,128
         kobj    93   186K       -      111  65536
        DEVFS     8     1K       -        9  16,64
         rman    94     6K       -      477  16,32,64
         sbuf     0     0K       -      532  16,32,32768,131072
  NULLFS hash     1     1K       -        1  64
    taskqueue     5     1K       -        5  64
   turnstiles   127     8K       -      127  64
       Unitno     6     1K       -       44  16,64
     ioctlops     0     0K       -  1771718  16,32,64,128,8192,16384,65536,131072

          iov     0     0K       -    79425  16,64,128,256,512,1024,2048,131072
          msg     4    25K       -        4  32768,131072
          sem     4     7K       -        4  16384,32768,131072
          shm     2    13K       -        4  32768
         ttys    93    16K       -      195  512,32768
       soname    31     3K       -   389284  16,32,64,256
          pcb   101    16K       -     4374
16,32,64,128,1024,2048,4096,16384,65536
   BIO buffer    40    80K       -      750  65536
     vfscache     1   512K       -        1  65536
cluster_save buffer      0     0K       -        55 32,64
     VFS hash     1   256K       -        1  32,64
       vnodes     1     1K       -        1  512
        mount   266    21K       -      481  16,32,64,128,256,4096,32768
  vnodemarker     0     0K       -     2497  16384
    pfs_nodes    25     3K       -       25  128
  pfs_vncache   144     5K       -      386  32
          STP     1     1K       -        1  64
```

```
         GEOM   173    15K       -     1068
16,32,64,128,256,512,2048,16384,32768,131072
     syncache     1     8K       -        1
16,32,64,128,256,512,2048,16384,32768,131072
     tlv_stat     0     0K       -      223
16,32,64,128,256,512,2048,16384,32768,131072
   NFS daemon     1     8K       -        1
16,32,64,128,256,512,2048,16384,32768,131072
     p1003.1b     1     1K       -        1  16
      MD disk     9    18K       -        9  65536
  ata_generic     2     2K       -       25  16,16384,32768
  ISOFS mount     7     1K       -       13  512
   ISOFS node  1439   135K       -     1453  128
      CAM SIM     1     1K       -        1  64
      CAM XPT     6     1K       -        9  16,64,16384
   CAM periph     1     1K       -        1  128
    ad_driver     2     1K       -        2  256
      pagedep     1    64K       -      105  64
     inodedep     1   256K       -      552  256
       newblk     1     1K       -      327  64,4096
    bmsafemap     0     0K       -       19  64
  allocdirect     0     0K       -      326  128
     freefrag     0     0K       -       31  32
     freeblks     0     0K       -      103  2048
     freefile     0     0K       -      175  32
       diradd     0     0K       -      590  64
        mkdir     0     0K       -      166  32
       dirrem     0     0K       -      382  32
     savedino     0     0K       -      283  512
    UFS mount    15    36K       -       15  2048,65536,131072
      ata_dma     6     1K       -        6  256
      UMAHash     1     4K       -        5  4096,16384,32768,65536,131072
         cdev    26     3K       -       26  256
    file desc   111    25K       -     5199  16,1024,2048,16384
    VM pgdata     2    65K       -        2  64
        sigio     1     1K       -       27  32
         kenv    30     5K       -       33  16,32,64,131072
     atkbddev     2     1K       -        2  32
       kqueue     0     0K       -       88  1024,4096,32768
    proc-args    28     2K       -     3970  32,64,128,256,512,1024
       isadev    23     2K       -       23  64
       zombie     1     1K       -     4651  128
      ithread    92     7K       -       92  16,64,256
    legacydrv     3     1K       -        3  16
      memdesc     1     4K       -        1  131072
     nexusdev     2     1K       -        2  16
    CAM queue     3     1K       -        3  16
       KTRACE   100    10K       -      100  128
       kbdmux     5     9K       -        5  128,2048,65536,131072
ITEM            SIZE     LIMIT     USED     FREE  REQUESTS
UMA Kegs:        136,        0,      71,       1,       71
...
```

show system virtual-memory | display xml

```
user@host> show system virtual-memory | display xml
<rpc-reply xmlns:junos="http://xml.juniper.net/junos/10.2R1/junos">
    <system-virtual-memory-information>
        <vmstat-memstat-malloc>
            <memstat-name>CAM dev queue</memstat-name>
            <inuse>1</inuse>
```

```
&lt;memuse&gt;1&lt;/memuse&gt;
&lt;high-use&gt;-&lt;/high-use&gt;
&lt;memstat-req&gt;1&lt;/memstat-req&gt;
&lt;memstat-size&gt;64&lt;/memstat-size&gt;
&lt;memstat-name&gt;entropy&lt;/memstat-name&gt;
&lt;inuse&gt;1024&lt;/inuse&gt;
&lt;memuse&gt;64&lt;/memuse&gt;
&lt;high-use&gt;-&lt;/high-use&gt;
&lt;memstat-req&gt;1024&lt;/memstat-req&gt;
&lt;memstat-size&gt;64&lt;/memstat-size&gt;
&lt;memstat-name&gt;linker&lt;/memstat-name&gt;
&lt;inuse&gt;481&lt;/inuse&gt;
&lt;memuse&gt;1871&lt;/memuse&gt;
&lt;high-use&gt;-&lt;/high-use&gt;
&lt;memstat-req&gt;1145&lt;/memstat-req&gt;
&lt;memstat-size&gt;16,32,64,4096,32768,131072&lt;/memstat-size&gt;
&lt;memstat-name&gt;lockf&lt;/memstat-name&gt;
&lt;inuse&gt;56&lt;/inuse&gt;
&lt;memuse&gt;4&lt;/memuse&gt;
&lt;high-use&gt;-&lt;/high-use&gt;
&lt;memstat-req&gt;5998&lt;/memstat-req&gt;
&lt;memstat-size&gt;64&lt;/memstat-size&gt;
&lt;memstat-name&gt;devbuf&lt;/memstat-name&gt;
&lt;inuse&gt;2094&lt;/inuse&gt;
&lt;memuse&gt;3877&lt;/memuse&gt;
&lt;high-use&gt;-&lt;/high-use&gt;
&lt;memstat-req&gt;2099&lt;/memstat-req&gt;

&lt;memstat-size&gt;16,32,64,128,512,1024,4096,8192,16384,32768,65536,131072&lt;/memstat-size&gt;

&lt;memstat-name&gt;temp&lt;/memstat-name&gt;
&lt;inuse&gt;21&lt;/inuse&gt;
&lt;memuse&gt;66&lt;/memuse&gt;
&lt;high-use&gt;-&lt;/high-use&gt;
&lt;memstat-req&gt;3127&lt;/memstat-req&gt;

&lt;memstat-size&gt;16,32,64,128,256,512,2048,4096,8192,16384,32768,65536,131072&lt;/memstat-size&gt;

&lt;memstat-name&gt;ip6ndp&lt;/memstat-name&gt;
&lt;inuse&gt;0&lt;/inuse&gt;
&lt;memuse&gt;0&lt;/memuse&gt;
&lt;high-use&gt;-&lt;/high-use&gt;
&lt;memstat-req&gt;4&lt;/memstat-req&gt;
&lt;memstat-size&gt;64&lt;/memstat-size&gt;
&lt;memstat-name&gt;in6ifmulti&lt;/memstat-name&gt;
&lt;inuse&gt;1&lt;/inuse&gt;
&lt;memuse&gt;1&lt;/memuse&gt;
&lt;high-use&gt;-&lt;/high-use&gt;
&lt;memstat-req&gt;1&lt;/memstat-req&gt;
&lt;memstat-size&gt;64&lt;/memstat-size&gt;
&lt;memstat-name&gt;in6grentry&lt;/memstat-name&gt;
&lt;inuse&gt;1&lt;/inuse&gt;
&lt;memuse&gt;1&lt;/memuse&gt;
&lt;high-use&gt;-&lt;/high-use&gt;
&lt;memstat-req&gt;1&lt;/memstat-req&gt;
&lt;memstat-size&gt;64&lt;/memstat-size&gt;
&lt;memstat-name&gt;iflogical&lt;/memstat-name&gt;
&lt;inuse&gt;13&lt;/inuse&gt;
&lt;memuse&gt;3&lt;/memuse&gt;
&lt;high-use&gt;-&lt;/high-use&gt;
&lt;memstat-req&gt;13&lt;/memstat-req&gt;
```

```
<memstat-size>64,2048</memstat-size>
<memstat-name>iffamily</memstat-name>
<inuse>28</inuse>
<memuse>4</memuse>
<high-use>-</high-use>
<memstat-req>28</memstat-req>
<memstat-size>32,1024,2048</memstat-size>
<memstat-name>rtnexthop</memstat-name>
<inuse>127</inuse>
<memuse>18</memuse>
<high-use>-</high-use>
<memstat-req>129</memstat-req>
<memstat-size>32,256,512,1024,2048,4096</memstat-size>
<memstat-name>metrics</memstat-name>
<inuse>3</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>5</memstat-req>
<memstat-size>256</memstat-size>
<memstat-name>inifmulti</memstat-name>
<inuse>3</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>3</memstat-req>
<memstat-size>64</memstat-size>
<memstat-name>ingrentry</memstat-name>
<inuse>6</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>6</memstat-req>
<memstat-size>64</memstat-size>
<memstat-name>rnode</memstat-name>
<inuse>68</inuse>
<memuse>2</memuse>
<high-use>-</high-use>
<memstat-req>76</memstat-req>
<memstat-size>16,32</memstat-size>
<memstat-name>rcache</memstat-name>
<inuse>4</inuse>
<memuse>8</memuse>
<high-use>-</high-use>
<memstat-req>4</memstat-req>
<memstat-size>65536</memstat-size>
<memstat-name>ifdevice</memstat-name>
<inuse>4</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>4</memstat-req>
<memstat-size>16</memstat-size>
<memstat-name>ifstat</memstat-name>
<inuse>40</inuse>
<memuse>22</memuse>
<high-use>-</high-use>
<memstat-req>40</memstat-req>
<memstat-size>512,16384,32768</memstat-size>
<memstat-name>ipfw</memstat-name>
<inuse>42</inuse>
<memuse>23</memuse>
<high-use>-</high-use>
<memstat-req>91</memstat-req>
```



```
<memstat-size>16,32,64,128,256,512,1024,16384,32768,65536,131072</memstat-size>
            <memstat-name>ifmaddr</memstat-name>
            <inuse>103</inuse>
            <memuse>3</memuse>
            <high-use>-</high-use>
            <memstat-req>103</memstat-req>
            <memstat-size>16,32</memstat-size>
            <memstat-name>rtable</memstat-name>
            <inuse>129</inuse>
            <memuse>14</memuse>
            <high-use>-</high-use>
            <memstat-req>139</memstat-req>
            <memstat-size>16,32,64,128,1024,16384</memstat-size>
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                <intr-rate>127</intr-rate>
                <intr-name>irq9: cbb1 fxp0    </intr-name>
                <intr-cnt>28490</intr-cnt>
                <intr-rate>22</intr-rate>
                <intr-name>irq10: fxp1        </intr-name>
                <intr-cnt>20593</intr-cnt>
                <intr-rate>16</intr-rate>
                <intr-name>irq14: ata0        </intr-name>
                <intr-cnt>5031</intr-cnt>
                <intr-rate>4</intr-rate>
                <intr-name>Total</intr-name>
                <intr-cnt>1457873</intr-cnt>
                <intr-rate>1171</intr-rate>
            </vmstat-intr>
            <vm-kernel-state>
                <vm-kmem-map-free>248524800</vm-kmem-map-free>
            </vm-kernel-state>
            <kernel-direct-mm-size-information>
                <vm-directmm-size-used>4644</vm-directmm-size-used>
                <vm-directmm-size-max>4057334</vm-directmm-size-max>
            </kernel-direct-mm-size-information>
        </system-virtual-memory-information>
        <cli>
            <banner></banner>
        </cli>
    </rpc-reply>
```

Note: <kernel-direct-mm-size-information> only displays for 64 bit platform.

show system virtual-memory (QFX Series)

```
user@switch> show system virtual-memory | display xml
<rpc-reply xmlns:junos="http://xml.juniper.net/junos/11.1R1/junos">
    <system-virtual-memory-information>
        <vmstat-memstat-malloc>
            <memstat-name>CAM dev queue</memstat-name>
            <inuse>1</inuse>
            <memuse>1</memuse>
            <high-use>-</high-use>
            <memstat-req>1</memstat-req>
            <memstat-size>64</memstat-size>
            <memstat-name>entropy</memstat-name>
            <inuse>1024</inuse>
            <memuse>64</memuse>
            <high-use>-</high-use>
            <memstat-req>1024</memstat-req>
            <memstat-size>64</memstat-size>
            <memstat-name>linker</memstat-name>
            <inuse>481</inuse>
            <memuse>1871</memuse>
            <high-use>-</high-use>
            <memstat-req>1145</memstat-req>
            <memstat-size>16,32,64,4096,32768,131072</memstat-size>
            <memstat-name>lockf</memstat-name>
            <inuse>56</inuse>
            <memuse>4</memuse>
            <high-use>-</high-use>
            <memstat-req>5998</memstat-req>
            <memstat-size>64</memstat-size>
            <memstat-name>devbuf</memstat-name>
            <inuse>2094</inuse>
            <memuse>3877</memuse>
            <high-use>-</high-use>
            <memstat-req>2099</memstat-req>

<memstat-size>16,32,64,128,512,1024,4096,8192,16384,32768,65536,131072</memstat-size>

            <memstat-name>temp</memstat-name>
            <inuse>21</inuse>
            <memuse>66</memuse>
            <high-use>-</high-use>
            <memstat-req>3127</memstat-req>

<memstat-size>16,32,64,128,256,512,2048,4096,8192,16384,32768,65536,131072</memstat-size>

            <memstat-name>ip6ndp</memstat-name>
            <inuse>0</inuse>
            <memuse>0</memuse>
            <high-use>-</high-use>
            <memstat-req>4</memstat-req>
            <memstat-size>64</memstat-size>
            <memstat-name>in6ifmulti</memstat-name>
            <inuse>1</inuse>
            <memuse>1</memuse>
            <high-use>-</high-use>
            <memstat-req>1</memstat-req>
            <memstat-size>64</memstat-size>
            <memstat-name>in6grentry</memstat-name>
            <inuse>1</inuse>
            <memuse>1</memuse>
```



```
<high-use>-</high-use>
<memstat-req>1</memstat-req>
<memstat-size>64</memstat-size>
<memstat-name>iflogical</memstat-name>
<inuse>13</inuse>
<memuse>3</memuse>
<high-use>-</high-use>
<memstat-req>13</memstat-req>
<memstat-size>64,2048</memstat-size>
<memstat-name>iffamily</memstat-name>
<inuse>28</inuse>
<memuse>4</memuse>
<high-use>-</high-use>
<memstat-req>28</memstat-req>
<memstat-size>32,1024,2048</memstat-size>
<memstat-name>rtnexthop</memstat-name>
<inuse>127</inuse>
<memuse>18</memuse>
<high-use>-</high-use>
<memstat-req>129</memstat-req>
<memstat-size>32,256,512,1024,2048,4096</memstat-size>
<memstat-name>metrics</memstat-name>
<inuse>3</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>5</memstat-req>
<memstat-size>256</memstat-size>
<memstat-name>inifmulti</memstat-name>
<inuse>3</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>3</memstat-req>
<memstat-size>64</memstat-size>
<memstat-name>ingrentry</memstat-name>
<inuse>6</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>6</memstat-req>
<memstat-size>64</memstat-size>
<memstat-name>rnode</memstat-name>
<inuse>68</inuse>
<memuse>2</memuse>
<high-use>-</high-use>
<memstat-req>76</memstat-req>
<memstat-size>16,32</memstat-size>
<memstat-name>rcache</memstat-name>
<inuse>4</inuse>
<memuse>8</memuse>
<high-use>-</high-use>
<memstat-req>4</memstat-req>
<memstat-size>65536</memstat-size>
<memstat-name>ifdevice</memstat-name>
<inuse>4</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>4</memstat-req>
<memstat-size>16</memstat-size>
<memstat-name>ifstat</memstat-name>
<inuse>40</inuse>
<memuse>22</memuse>
<high-use>-</high-use>
```



```
            <memstat-req>40</memstat-req>
            <memstat-size>512,16384,32768</memstat-size>
            <memstat-name>ipfw</memstat-name>
            <inuse>42</inuse>
            <memuse>23</memuse>
            <high-use>-</high-use>
            <memstat-req>91</memstat-req>

<memstat-size>16,32,64,128,256,512,1024,16384,32768,65536,131072</memstat-size>
            <memstat-name>ifmaddr</memstat-name>
            <inuse>103</inuse>
            <memuse>3</memuse>
            <high-use>-</high-use>
            <memstat-req>103</memstat-req>
            <memstat-size>16,32</memstat-size>
            <memstat-name>rtable</memstat-name>
            <inuse>129</inuse>
            <memuse>14</memuse>
            <high-use>-</high-use>
            <memstat-req>139</memstat-req>
            <memstat-size>16,32,64,128,1024,16384</memstat-size>
            <memstat-name>sysctl</memstat-name>
            <inuse>0</inuse>
            <memuse>0</memuse>
            <high-use>-</high-use>
            <memstat-req>14847</memstat-req>
            <memstat-size>16,32,64,4096,16384,32768</memstat-size>
            <memstat-name>ifaddr</memstat-name>
            <inuse>29</inuse>
            <memuse>3</memuse>
            <high-use>-</high-use>
            <memstat-req>29</memstat-req>
            <memstat-size>64,128</memstat-size>
            <memstat-name>mkey</memstat-name>
            <inuse>345</inuse>
            <memuse>6</memuse>
            <high-use>-</high-use>
            <memstat-req>2527</memstat-req>
            <memstat-size>16,128</memstat-size>
            <memstat-name>pfe_ipc</memstat-name>
            <inuse>0</inuse>
            <memuse>0</memuse>
            <high-use>-</high-use>
            <memstat-req>1422</memstat-req>

<memstat-size>16,32,64,128,512,1024,2048,8192,16384,32768,65536,131072</memstat-size>

            <memstat-name>ifstate</memstat-name>
            <inuse>594</inuse>
            <memuse>51</memuse>
            <high-use>-</high-use>
            <memstat-req>655</memstat-req>

<memstat-size>16,32,64,128,256,1024,2048,4096,16384,32768</memstat-size>
            <memstat-name>itable16</memstat-name>
            <inuse>276</inuse>
            <memuse>52</memuse>
            <high-use>-</high-use>
            <memstat-req>294</memstat-req>
            <memstat-size>1024,4096</memstat-size>
            <memstat-name>itable32</memstat-name>
```

```
 <inuse>160</inuse>
 <memuse>10</memuse>
 <high-use>-</high-use>
 <memstat-req>160</memstat-req>
 <memstat-size>64</memstat-size>
 <memstat-name>itable64</memstat-name>
 <inuse>2</inuse>
 <memuse>1</memuse>
 <high-use>-</high-use>
 <memstat-req>2</memstat-req>
 <memstat-size>128</memstat-size>
 <memstat-name>lr</memstat-name>
 <inuse>1</inuse>
 <memuse>1</memuse>
 <high-use>-</high-use>
 <memstat-req>1</memstat-req>
 <memstat-size>16384</memstat-size>
 <memstat-name>pic</memstat-name>
 <inuse>5</inuse>
 <memuse>1</memuse>
 <high-use>-</high-use>
 <memstat-req>5</memstat-req>
 <memstat-size>64,512</memstat-size>
 <memstat-name>pfestat</memstat-name>
 <inuse>0</inuse>
 <memuse>0</memuse>
 <high-use>-</high-use>
 <memstat-req>162</memstat-req>
 <memstat-size>16,32,128,256,16384</memstat-size>
 <memstat-name>gencfg</memstat-name>
 <inuse>224</inuse>
 <memuse>56</memuse>
 <high-use>-</high-use>
 <memstat-req>540</memstat-req>
 <memstat-size>16,32,64,256,512,32768,65536</memstat-size>
 <memstat-name>jsr</memstat-name>
 <inuse>2</inuse>
 <memuse>1</memuse>
 <high-use>-</high-use>
 <memstat-req>4</memstat-req>
 <memstat-size>16</memstat-size>
 <memstat-name>idl</memstat-name>
 <inuse>0</inuse>
 <memuse>0</memuse>
 <high-use>-</high-use>
 <memstat-req>13</memstat-req>
<memstat-size>16,32,64,128,256,4096,16384,32768,131072</memstat-size>

 <memstat-name>rtsmsg</memstat-name>
 <inuse>0</inuse>
 <memuse>0</memuse>
 <high-use>-</high-use>
 <memstat-req>2</memstat-req>
 <memstat-size>131072</memstat-size>
 <memstat-name>module</memstat-name>
 <inuse>249</inuse>
 <memuse>16</memuse>
 <high-use>-</high-use>
 <memstat-req>249</memstat-req>
 <memstat-size>64,128</memstat-size>
 <memstat-name>mtx_pool</memstat-name>
```



```
<inuse>1</inuse>
<memuse>8</memuse>
<high-use>-</high-use>
<memstat-req>1</memstat-req>
<memstat-size>64,128</memstat-size>
<memstat-name>DEVFS3</memstat-name>
<inuse>109</inuse>
<memuse>12</memuse>
<high-use>-</high-use>
<memstat-req>117</memstat-req>
<memstat-size>256</memstat-size>
<memstat-name>DEVFS1</memstat-name>
<inuse>102</inuse>
<memuse>23</memuse>
<high-use>-</high-use>
<memstat-req>109</memstat-req>
<memstat-size>2048</memstat-size>
<memstat-name>pgrp</memstat-name>
<inuse>12</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>21</memstat-req>
<memstat-size>64</memstat-size>
<memstat-name>session</memstat-name>
<inuse>8</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>15</memstat-req>
<memstat-size>512</memstat-size>
<memstat-name>proc</memstat-name>
<inuse>2</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>2</memstat-req>
<memstat-size>16384</memstat-size>
<memstat-name>subproc</memstat-name>
<inuse>244</inuse>
<memuse>496</memuse>
<high-use>-</high-use>
<memstat-req>1522</memstat-req>
<memstat-size>2048,131072</memstat-size>
<memstat-name>cred</memstat-name>
<inuse>30</inuse>
<memuse>4</memuse>
<high-use>-</high-use>
<memstat-req>11409</memstat-req>
<memstat-size>256</memstat-size>
<memstat-name>plimit</memstat-name>
<inuse>17</inuse>
<memuse>4</memuse>
<high-use>-</high-use>
<memstat-req>133</memstat-req>
<memstat-size>2048</memstat-size>
<memstat-name>uidinfo</memstat-name>
<inuse>3</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>6</memstat-req>
<memstat-size>32,512</memstat-size>
<memstat-name>sysctloid</memstat-name>
<inuse>1117</inuse>
```

```
<memuse>34</memuse>
<high-use>-</high-use>
<memstat-req>1117</memstat-req>
<memstat-size>16,32,64</memstat-size>
<memstat-name>sysctltmp</memstat-name>
<inuse>0</inuse>
<memuse>0</memuse>
<high-use>-</high-use>
<memstat-req>743</memstat-req>
<memstat-size>16,32,64,1024</memstat-size>
<memstat-name>umtx</memstat-name>
<inuse>144</inuse>
<memuse>9</memuse>
<high-use>-</high-use>
<memstat-req>144</memstat-req>
<memstat-size>64</memstat-size>
<memstat-name>SWAP</memstat-name>
<inuse>2</inuse>
<memuse>209</memuse>
<high-use>-</high-use>
<memstat-req>2</memstat-req>
<memstat-size>64</memstat-size>
<memstat-name>bus</memstat-name>
<inuse>496</inuse>
<memuse>55</memuse>
<high-use>-</high-use>
<memstat-req>1196</memstat-req>
<memstat-size>16,32,64,128,32768</memstat-size>
<memstat-name>bus-sc</memstat-name>
<inuse>23</inuse>
<memuse>33</memuse>
<high-use>-</high-use>
<memstat-req>335</memstat-req>

<memstat-size>16,32,64,512,1024,2048,8192,16384,65536,131072</memstat-size>
<memstat-name>devstat</memstat-name>
<inuse>10</inuse>
<memuse>21</memuse>
<high-use>-</high-use>
<memstat-req>10</memstat-req>
<memstat-size>16,131072</memstat-size>
<memstat-name>eventhandler</memstat-name>
<inuse>35</inuse>
<memuse>2</memuse>
<high-use>-</high-use>
<memstat-req>36</memstat-req>
<memstat-size>32,128</memstat-size>
<memstat-name>kobj</memstat-name>
<inuse>93</inuse>
<memuse>186</memuse>
<high-use>-</high-use>
<memstat-req>111</memstat-req>
<memstat-size>65536</memstat-size>
<memstat-name>DEVFS</memstat-name>
<inuse>8</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>9</memstat-req>
<memstat-size>16,64</memstat-size>
<memstat-name>rman</memstat-name>
<inuse>71</inuse>
```

```
<memuse>5</memuse>
<high-use>-</high-use>
<memstat-req>433</memstat-req>
<memstat-size>16,32,64</memstat-size>
<memstat-name>sbuf</memstat-name>
<inuse>0</inuse>
<memuse>0</memuse>
<high-use>-</high-use>
<memstat-req>522</memstat-req>
<memstat-size>16,32,32768,131072</memstat-size>
<memstat-name>NULLFS hash</memstat-name>
<inuse>1</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>1</memstat-req>
<memstat-size>64</memstat-size>
<memstat-name>taskqueue</memstat-name>
<inuse>5</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>5</memstat-req>
<memstat-size>64</memstat-size>
<memstat-name>turnstiles</memstat-name>
<inuse>145</inuse>
<memuse>10</memuse>
<high-use>-</high-use>
<memstat-req>145</memstat-req>
<memstat-size>64</memstat-size>
<memstat-name>Unitno</memstat-name>
<inuse>8</inuse>
<memuse>1</memuse>
<high-use>-</high-use>
<memstat-req>44</memstat-req>
<memstat-size>16,64</memstat-size>
<memstat-name>ioctlops</memstat-name>
<inuse>0</inuse>
<memuse>0</memuse>
<high-use>-</high-use>
<memstat-req>27622</memstat-req>
<memstat-size>16,64,8192,16384,131072</memstat-size>
<memstat-name>iov</memstat-name>
<inuse>0</inuse>
<memuse>0</memuse>
<high-use>-</high-use>
<memstat-req>18578</memstat-req>
<memstat-size>16,64,128,256,512,1024,2048,131072</memstat-size>
<memstat-name>msg</memstat-name>
<inuse>4</inuse>
<memuse>25</memuse>
<high-use>-</high-use>
<memstat-req>4</memstat-req>
<memstat-size>32768,131072</memstat-size>
<memstat-name>sem</memstat-name>
<inuse>4</inuse>
<memuse>7</memuse>
<high-use>-</high-use>
<memstat-req>4</memstat-req>
<memstat-size>16384,32768,131072</memstat-size>
<memstat-name>shm</memstat-name>
<inuse>9</inuse>
<memuse>20</memuse>
```

```
            <high-use>-</high-use>
            <memstat-req>14</memstat-req>
            <memstat-size>32768</memstat-size>
            <memstat-name>ttys</memstat-name>
            <inuse>321</inuse>
            <memuse>61</memuse>
            <high-use>-</high-use>
            <memstat-req>528</memstat-req>
            <memstat-size>512,32768</memstat-size>
            <memstat-name>ptys</memstat-name>
            <inuse>1</inuse>
            <memuse>1</memuse>
            <high-use>-</high-use>
            <memstat-req>1</memstat-req>
            <memstat-size>128</memstat-size>
            <memstat-name>mbuf_tag</memstat-name>
            <inuse>0</inuse>
            <memuse>0</memuse>
            <high-use>-</high-use>
            <memstat-req>23383</memstat-req>
            <memstat-size>16</memstat-size>
            <memstat-name>soname</memstat-name>
            <inuse>115</inuse>
            <memuse>12</memuse>
            <high-use>-</high-use>
            <memstat-req>24712</memstat-req>
            <memstat-size>16,32,64,256</memstat-size>
            <memstat-name>pcb</memstat-name>
            <inuse>216</inuse>
            <memuse>33</memuse>
            <high-use>-</high-use>
            <memstat-req>484</memstat-req>

<memstat-size>16,32,64,128,1024,2048,4096,16384,32768,65536</memstat-size>
            <memstat-name>BIO buffer</memstat-name>
            <inuse>43</inuse>
            <memuse>86</memuse>
            <high-use>-</high-use>
            <memstat-req>405</memstat-req>
            <memstat-size>65536</memstat-size>
            <memstat-name>vfscache</memstat-name>
            <inuse>1</inuse>
            <memuse>256</memuse>
            <high-use>-</high-use>
            <memstat-req>1</memstat-req>
            <memstat-size>65536</memstat-size>
            <memstat-name>cluster_save buffer</memstat-name>
            <inuse>0</inuse>
            <memuse>0</memuse>
            <high-use>-</high-use>
            <memstat-req>2</memstat-req>
            <memstat-size>32,64</memstat-size>
            <memstat-name>VFS hash</memstat-name>
            <inuse>1</inuse>
            <memuse>128</memuse>
            <high-use>-</high-use>
            <memstat-req>1</memstat-req>
            <memstat-size>32,64</memstat-size>
            <memstat-name>vnodes</memstat-name>
            <inuse>1</inuse>
            <memuse>1</memuse>
```



```
            <high-use>-</high-use>
            <memstat-req>1</memstat-req>
            <memstat-size>512</memstat-size>
            <memstat-name>mount</memstat-name>
            <inuse>290</inuse>
            <memuse>23</memuse>
            <high-use>-</high-use>
            <memstat-req>535</memstat-req>
            <memstat-size>16,32,64,128,256,4096,32768</memstat-size>
            <memstat-name>vnodemarker</memstat-name>
            <inuse>0</inuse>
            <memuse>0</memuse>
            <high-use>-</high-use>
            <memstat-req>498</memstat-req>
            <memstat-size>16384</memstat-size>
            <memstat-name>pfs_nodes</memstat-name>
            <inuse>25</inuse>
            <memuse>3</memuse>
            <high-use>-</high-use>
            <memstat-req>25</memstat-req>
            <memstat-size>128</memstat-size>
            <memstat-name>pfs_vncache</memstat-name>
            <inuse>27</inuse>
            <memuse>1</memuse>
            <high-use>-</high-use>
            <memstat-req>53</memstat-req>
            <memstat-size>32</memstat-size>
            <memstat-name>STP</memstat-name>
            <inuse>1</inuse>
            <memuse>1</memuse>
            <high-use>-</high-use>
            <memstat-req>1</memstat-req>
            <memstat-size>64</memstat-size>
            <memstat-name>GEOM</memstat-name>
            <inuse>146</inuse>
            <memuse>11</memuse>
            <high-use>-</high-use>
            <memstat-req>1042</memstat-req>

<memstat-size>16,32,64,128,256,512,2048,16384,32768,131072</memstat-size>
            <memstat-name>syncache</memstat-name>
            <inuse>1</inuse>
            <memuse>8</memuse>
            <high-use>-</high-use>
            <memstat-req>1</memstat-req>

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<zone-req>0</zone-req>
<zone-name>PIPE:</zone-name>
<zone-size>404</zone-size>
```

```
<count-limit>0</count-limit>
<used>27</used>
<free>9</free>
<zone-req>717</zone-req>
<zone-name>KNOTE:</zone-name>
<zone-size>72</zone-size>
<count-limit>0</count-limit>
<used>42</used>
<free>64</free>
<zone-req>3311</zone-req>
<zone-name>socket:</zone-name>
<zone-size>412</zone-size>
<count-limit>25191</count-limit>
<used>343</used>
<free>8</free>
<zone-req>2524</zone-req>
<zone-name>unpcb:</zone-name>
<zone-size>140</zone-size>
<count-limit>25200</count-limit>
<used>170</used>
<free>26</free>
<zone-req>2157</zone-req>
<zone-name>ipq:</zone-name>
<zone-size>52</zone-size>
<count-limit>216</count-limit>
<used>0</used>
<free>0</free>
<zone-req>0</zone-req>
<zone-name>udpcb:</zone-name>
<zone-size>232</zone-size>
<count-limit>25194</count-limit>
<used>19</used>
<free>32</free>
<zone-req>31</zone-req>
<zone-name>inpcb:</zone-name>
<zone-size>232</zone-size>
<count-limit>25194</count-limit>
<used>40</used>
<free>28</free>
<zone-req>105</zone-req>
<zone-name>tcpcb:</zone-name>
<zone-size>520</zone-size>
<count-limit>25193</count-limit>
<used>40</used>
<free>16</free>
<zone-req>105</zone-req>
<zone-name>tcptw:</zone-name>
<zone-size>56</zone-size>
<count-limit>5092</count-limit>
<used>0</used>
<free>0</free>
<zone-req>0</zone-req>
<zone-name>syncache:</zone-name>
<zone-size>128</zone-size>
<count-limit>15360</count-limit>
<used>0</used>
<free>60</free>
<zone-req>55</zone-req>
<zone-name>tcpreass:</zone-name>
<zone-size>20</zone-size>
<count-limit>1690</count-limit>
```



```
        <used>0</used>
        <free>0</free>
        <zone-req>0</zone-req>
        <zone-name>sackhole:</zone-name>
        <zone-size>20</zone-size>
        <count-limit>0</count-limit>
        <used>0</used>
        <free>0</free>
        <zone-req>0</zone-req>
        <zone-name>ripcb:</zone-name>
        <zone-size>232</zone-size>
        <count-limit>25194</count-limit>
        <used>5</used>
        <free>29</free>
        <zone-req>5</zone-req>
        <zone-name>SWAPMETA:</zone-name>
        <zone-size>276</zone-size>
        <count-limit>94948</count-limit>
        <used>0</used>
        <free>0</free>
        <zone-req>0</zone-req>
        <zone-name>FFS inode:</zone-name>
        <zone-size>132</zone-size>
        <count-limit>0</count-limit>
        <used>1146</used>
        <free>72</free>
        <zone-req>1306</zone-req>
        <zone-name>FFS1 dinode:</zone-name>
        <zone-size>128</zone-size>
        <count-limit>0</count-limit>
        <used>1146</used>
        <free>24</free>
        <zone-req>1306</zone-req>
        <zone-name>FFS2 dinode:</zone-name>
        <zone-size>256</zone-size>
        <count-limit>0</count-limit>
        <used>0</used>
        <free>0</free>
        <zone-req>0</zone-req>
    </vmstat-memstat-zone>
    <vmstat-sumstat>
        <cpu-context-switch>934906</cpu-context-switch>
        <dev-intr>1707986</dev-intr>
        <soft-intr>33819</soft-intr>
        <traps>203604</traps>
        <sys-calls>1200636</sys-calls>
        <kernel-thrds>60</kernel-thrds>
        <fork-calls>1313</fork-calls>
        <vfork-calls>21</vfork-calls>
        <rfork-calls>0</rfork-calls>
        <swap-pageins>0</swap-pageins>
        <swap-pagedin>0</swap-pagedin>
        <swap-pageouts>0</swap-pageouts>
        <swap-pagedout>0</swap-pagedout>
        <vnode-pageins>23094</vnode-pageins>
        <vnode-pagedin>23119</vnode-pagedin>
        <vnode-pageouts>226</vnode-pageouts>
        <vnode-pagedout>3143</vnode-pagedout>
        <page-daemon-wakeup>0</page-daemon-wakeup>
        <page-daemon-examined-pages>0</page-daemon-examined-pages>
        <pages-reactivated>8821</pages-reactivated>
```

```
            <copy-on-write-faults>48364</copy-on-write-faults>
            <copy-on-write-optimized-faults>31</copy-on-write-optimized-faults>
            <zero-fill-pages-zeroed>74665</zero-fill-pages-zeroed>
            <zero-fill-pages-prezeroed>70061</zero-fill-pages-prezeroed>
            <transit-blocking-page-faults>85</transit-blocking-page-faults>
            <total-vm-faults>191824</total-vm-faults>

<pages-affected-by-kernel-thrd-creat>0</pages-affected-by-kernel-thrd-creat>
            <pages-affected-by-fork>95343</pages-affected-by-fork>
            <pages-affected-by-vfork>3526</pages-affected-by-vfork>
            <pages-affected-by-rfork>0</pages-affected-by-rfork>
            <pages-freed>221502</pages-freed>
            <pages-freed-by-deamon>0</pages-freed-by-deamon>
            <pages-freed-by-exiting-proc>75630</pages-freed-by-exiting-proc>
            <pages-active>45826</pages-active>
            <pages-inactive>13227</pages-inactive>
            <pages-in-vm-cache>49278</pages-in-vm-cache>
            <pages-wired-down>10640</pages-wired-down>
            <pages-free>70706</pages-free>
            <bytes-per-page>4096</bytes-per-page>
            <swap-pages-used>0</swap-pages-used>
            <peak-swap-pages-used>0</peak-swap-pages-used>
            <total-name-lookups>214496</total-name-lookups>
            <positive-cache-hits>92</positive-cache-hits>
            <negative-cache-hits>5</negative-cache-hits>
            <pass2>0</pass2>
            <cache-deletions>0</cache-deletions>
            <cache-falsehits>0</cache-falsehits>
            <toolong>0</toolong>
        </vmstat-sumstat>
        <vmstat-intr>
            <intr-name>irq0: clk          </intr-name>
            <intr-cnt>1243455</intr-cnt>
            <intr-rate>999</intr-rate>
            <intr-name>irq4: sio0         </intr-name>
            <intr-cnt>1140</intr-cnt>
            <intr-rate>0</intr-rate>
            <intr-name>irq8: rtc          </intr-name>
            <intr-cnt>159164</intr-cnt>
            <intr-rate>127</intr-rate>
            <intr-name>irq9: cbb1 fxp0    </intr-name>
            <intr-cnt>28490</intr-cnt>
            <intr-rate>22</intr-rate>
            <intr-name>irq10: fxp1        </intr-name>
            <intr-cnt>20593</intr-cnt>
            <intr-rate>16</intr-rate>
            <intr-name>irq14: ata0        </intr-name>
            <intr-cnt>5031</intr-cnt>
            <intr-rate>4</intr-rate>
            <intr-name>Total</intr-name>
            <intr-cnt>1457873</intr-cnt>
            <intr-rate>1171</intr-rate>
        </vmstat-intr>
        <vm-kernel-state>
            <vm-kmem-map-free>248524800</vm-kmem-map-free>
        </vm-kernel-state>
    </system-virtual-memory-information>
    <cli>
        <banner></banner>
    </cli>
</rpc-reply>
```

show version

Syntax

show version
<brief | detail>

Syntax (EX Series Switches)

show version
<all-members>
<brief | detail>
<local>
<member *member-id*>

Syntax (TX Matrix Router)

show version
<brief | detail>
<all-chassis | all-lcc | lcc *number* | scc>

Syntax (TX Matrix Plus Router)

show version
<all-chassis | all-lcc | lcc *number* | sfc *number*>
<brief | detail>

Syntax (MX Series Router)

show version
<brief | detail>
<all-members>
<local>
<member *member-id*>

Syntax (QFX Series)

show version
<brief | detail>
<component *component-name* | all>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the hostname and version information about the software running on the router or switch.

Options

none—Display standard information about the hostname and version of the software running on the router or switch.

brief | detail—(Optional) Display the specified level of output.

all-members—(EX4200 switches and MX Series routers only) (Optional) Display standard information about the hostname and version of the software running on all members of the Virtual Chassis configuration.

component all—(QFabric systems only) (Optional) Display the host name and version information about the software running on all the components on the QFabric system.

component *component-name*—(QFabric systems only) (Optional) Display the host name and version information about the software running on a specific QFabric system component. Replace *component-name* with the name of the QFabric system component. The *component-name* can be the name of a diagnostics Routing Engine, Director group, fabric control Routing Engine, fabric manager Routing Engine, Interconnect device, or Node group.

local—(EX4200 switches and MX Series routers only) (Optional) Display standard information about the hostname and version of the software running on the local Virtual Chassis member.

member ***member-id***—(EX4200 switches and MX Series routers only) (Optional) Display standard information about the hostname and version of the software running on the specified member of the Virtual Chassis configuration. For EX4200 switches, replace ***member-id*** with a value from 0 through 9. For an MX Series Virtual Chassis, replace ***member-id*** with a value of 0 or 1.

scc—(TX Matrix routers only) (Optional) Display the hostname and version information about the software running on the TX Matrix router (or switch-card chassis).

lcc ***number***—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display the host name and version information about the software running on for a specified T640 router (line-card chassis or LCC) that is connected to the TX Matrix router. On a TX Matrix Plus router, display the host name and version information about the software running for a specified T1600 or T4000 router (LCC) that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

sfc ***number***—(TX Matrix Plus routers only) (Optional) Display the hostname and version information about the software running on the TX Matrix Plus router (or switch-fabric chassis). Replace *number* with 0.

Additional Information

By default, when you issue the **show version** command on a TX Matrix or TX Matrix Plus master Routing Engine, the command is broadcast to all the T640 (in a routing matrix based on a TX Matrix router) or T1600 or T4000 (in a routing matrix based on a TX Matrix Plus router) master Routing Engines connected to it. Likewise, if you issue the same command on the TX Matrix or TX Matrix Plus backup Routing Engine, the command is broadcast to all the T640 (in a routing matrix based on a TX Matrix router) or T1600 or T4000 (in a routing matrix based on a TX Matrix Plus router) backup Routing Engines that are connected to it.

Required Privilege Level view

List of Sample Output

Sample Output

show version

```
user@host> show version
Hostname: router1
Model: m20
JUNOS Base OS boot [7.2-20050312.0]
JUNOS Base OS Software Suite [7.2-20050312.0]
JUNOS Kernel Software Suite [7.2R1.7]
JUNOS Packet Forwarding Engine Support (M20/M40) [7.2R1.7]
JUNOS Routing Software Suite [7.2R1.7]
JUNOS Online Documentation [7.2R1.7]
JUNOS Crypto Software Suite [7.2R1.7]

{master}

user@host> show version psd 1
psd1-re0:
--------------------------------------------------------------------------
Hostname: china
Model: t640
JUNOS Base OS boot [9.1I20080311_1959_builder]
JUNOS Base OS Software Suite [9.1-20080321.0]
JUNOS Kernel Software Suite [9.1-20080321.0]
JUNOS Crypto Software Suite [9.1-20080321.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [9.1-20080321.0]
JUNOS Packet Forwarding Engine Support (T-series) [9.1-20080321.0]
JUNOS Online Documentation [9.1-20080321.0]
JUNOS Routing Software Suite [9.1-20080321.0]
labpkg [7.0]
```

show version (TX Matrix Plus Router)

```
user@host> show version
sfc0-re0:
--------------------------------------------------------------------------
Hostname: host
Model: txp
JUNOS Base OS boot [12.3-20121019.0]
JUNOS Base OS Software Suite [12.3-20121019.0]
JUNOS Kernel Software Suite [12.3-20121019.0]
JUNOS Crypto Software Suite [12.3-20121019.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [12.3-20121019.0]
JUNOS Packet Forwarding Engine Support (T-Series) [12.3-20121019.0]
JUNOS Online Documentation [12.3-20121019.0]
JUNOS Services AACL Container package [12.3-20121019.0]
JUNOS Services Application Level Gateways [12.3-20121019.0]
JUNOS AppId Services [12.3-20121019.0]
JUNOS Border Gateway Function package [12.3-20121019.0]
JUNOS Services Captive Portal and Content Delivery Container package
[12.3-20121019.0]
JUNOS Services HTTP Content Management package [12.3-20121019.0]
JUNOS IDP Services [12.3-20121019.0]
JUNOS Services LL-PDF Container package [12.3-20121019.0]
JUNOS Services NAT [12.3-20121019.0]
JUNOS Services PTSP Container package [12.3-20121019.0]
JUNOS Services RPM [12.3-20121019.0]
JUNOS Services Stateful Firewall [12.3-20121019.0]
JUNOS Voice Services Container package [12.3-20121019.0]
JUNOS Services Example Container package [12.3-20121019.0]
```



```
JUNOS Services Crypto [12.3-20121019.0]
JUNOS Services SSL [12.3-20121019.0]
JUNOS Services IPSec [12.3-20121019.0]
JUNOS Runtime Software Suite [12.3-20121019.0]
JUNOS Routing Software Suite [12.3-20121019.0]

lcc0-re0:
--------------------------------------------------------------------------
Hostname: host1
Model: t1600
JUNOS Base OS boot [12.3-20121019.0]
JUNOS Base OS Software Suite [12.3-20121019.0]
JUNOS Kernel Software Suite [12.3-20121019.0]
JUNOS Crypto Software Suite [12.3-20121019.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [12.3-20121019.0]
JUNOS Packet Forwarding Engine Support (T-Series) [12.3-20121019.0]
JUNOS Online Documentation [12.3-20121019.0]
JUNOS Services AACL Container package [12.3-20121019.0]
JUNOS Services Application Level Gateways [12.3-20121019.0]
JUNOS AppId Services [12.3-20121019.0]
JUNOS Border Gateway Function package [12.3-20121019.0]
JUNOS Services Captive Portal and Content Delivery Container package
[12.3-20121019.0]
JUNOS Services HTTP Content Management package [12.3-20121019.0]
JUNOS IDP Services [12.3-20121019.0]
JUNOS Services LL-PDF Container package [12.3-20121019.0]
JUNOS Services NAT [12.3-20121019.0]
JUNOS Services PTSP Container package [12.3-20121019.0]
JUNOS Services RPM [12.3-20121019.0]
JUNOS Services Stateful Firewall [12.3-20121019.0]
JUNOS Voice Services Container package [12.3-20121019.0]
JUNOS Services Example Container package [12.3-20121019.0]
JUNOS Services Crypto [12.3-20121019.0]
JUNOS Services SSL [12.3-20121019.0]
JUNOS Services IPSec [12.3-20121019.0]
JUNOS Runtime Software Suite [12.3-20121019.0]
JUNOS Routing Software Suite [12.3-20121019.0]

lcc1-re0:
--------------------------------------------------------------------------
Hostname: host2
Model: t1600
JUNOS Base OS boot [12.3-20121019.0]
JUNOS Base OS Software Suite [12.3-20121019.0]
JUNOS Kernel Software Suite [12.3-20121019.0]
JUNOS Crypto Software Suite [12.3-20121019.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [12.3-20121019.0]
JUNOS Packet Forwarding Engine Support (T-Series) [12.3-20121019.0]
JUNOS Online Documentation [12.3-20121019.0]
JUNOS Services AACL Container package [12.3-20121019.0]
JUNOS Services Application Level Gateways [12.3-20121019.0]
JUNOS AppId Services [12.3-20121019.0]
JUNOS Border Gateway Function package [12.3-20121019.0]
JUNOS Services Captive Portal and Content Delivery Container package
[12.3-20121019.0]
JUNOS Services HTTP Content Management package [12.3-20121019.0]
JUNOS IDP Services [12.3-20121019.0]
JUNOS Services LL-PDF Container package [12.3-20121019.0]
JUNOS Services NAT [12.3-20121019.0]
JUNOS Services PTSP Container package [12.3-20121019.0]
JUNOS Services RPM [12.3-20121019.0]
```

```
JUNOS Services Stateful Firewall [12.3-20121019.0]
JUNOS Voice Services Container package [12.3-20121019.0]
JUNOS Services Example Container package [12.3-20121019.0]
JUNOS Services Crypto [12.3-20121019.0]
JUNOS Services SSL [12.3-20121019.0]
JUNOS Services IPSec [12.3-20121019.0]
JUNOS Runtime Software Suite [12.3-20121019.0]
JUNOS Routing Software Suite [12.3-20121019.0]

lcc2-re0:
--------------------------------------------------------------------------
Hostname: host3
Model: t1600
JUNOS Base OS boot [12.3-20121019.0]
JUNOS Base OS Software Suite [12.3-20121019.0]
JUNOS Kernel Software Suite [12.3-20121019.0]
JUNOS Crypto Software Suite [12.3-20121019.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [12.3-20121019.0]
JUNOS Packet Forwarding Engine Support (T-Series) [12.3-20121019.0]
JUNOS Online Documentation [12.3-20121019.0]
JUNOS Services AACL Container package [12.3-20121019.0]
JUNOS Services Application Level Gateways [12.3-20121019.0]
JUNOS AppId Services [12.3-20121019.0]
JUNOS Border Gateway Function package [12.3-20121019.0]
JUNOS Services Captive Portal and Content Delivery Container package
[12.3-20121019.0]
JUNOS Services HTTP Content Management package [12.3-20121019.0]
JUNOS IDP Services [12.3-20121019.0]
JUNOS Services LL-PDF Container package [12.3-20121019.0]
JUNOS Services NAT [12.3-20121019.0]
JUNOS Services PTSP Container package [12.3-20121019.0]
JUNOS Services RPM [12.3-20121019.0]
JUNOS Services Stateful Firewall [12.3-20121019.0]
JUNOS Voice Services Container package [12.3-20121019.0]
JUNOS Services Example Container package [12.3-20121019.0]
JUNOS Services Crypto [12.3-20121019.0]
JUNOS Services SSL [12.3-20121019.0]
JUNOS Services IPSec [12.3-20121019.0]
JUNOS Runtime Software Suite [12.3-20121019.0]
JUNOS Routing Software Suite [12.3-20121019.0]

lcc3-re0:
--------------------------------------------------------------------------
Hostname: host4
Model: t1600
JUNOS Base OS boot [12.3-20121019.0]
JUNOS Base OS Software Suite [12.3-20121019.0]
JUNOS Kernel Software Suite [12.3-20121019.0]
JUNOS Crypto Software Suite [12.3-20121019.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [12.3-20121019.0]
JUNOS Packet Forwarding Engine Support (T-Series) [12.3-20121019.0]
JUNOS Online Documentation [12.3-20121019.0]
JUNOS Services AACL Container package [12.3-20121019.0]
JUNOS Services Application Level Gateways [12.3-20121019.0]
JUNOS AppId Services [12.3-20121019.0]
JUNOS Border Gateway Function package [12.3-20121019.0]
JUNOS Services Captive Portal and Content Delivery Container package
[12.3-20121019.0]
JUNOS Services HTTP Content Management package [12.3-20121019.0]
JUNOS IDP Services [12.3-20121019.0]
JUNOS Services LL-PDF Container package [12.3-20121019.0]
```

```
JUNOS Services NAT [12.3-20121019.0]
JUNOS Services PTSP Container package [12.3-20121019.0]
JUNOS Services RPM [12.3-20121019.0]
JUNOS Services Stateful Firewall [12.3-20121019.0]
JUNOS Voice Services Container package [12.3-20121019.0]
JUNOS Services Example Container package [12.3-20121019.0]
JUNOS Services Crypto [12.3-20121019.0]
JUNOS Services SSL [12.3-20121019.0]
JUNOS Services IPSec [12.3-20121019.0]
JUNOS Runtime Software Suite [12.3-20121019.0]
JUNOS Routing Software Suite [12.3-20121019.0]
```

show version (TX Matrix Plus Router with 3D SIBs)

```
user@host>show version
sfc0-re0:
--------------------------------------------------------------------------
Hostname: sfc0
Model: txp
JUNOS Base OS boot [13.1-20130306.0]
JUNOS Base OS Software Suite [13.1-20130306.0]
JUNOS Kernel Software Suite [13.1-20130306.0]
JUNOS Crypto Software Suite [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (T-Series) [13.1-20130306.0]
JUNOS Online Documentation [13.1-20130306.0]
JUNOS Services AACL Container package [13.1-20130306.0]
JUNOS Services Application Level Gateways [13.1-20130306.0]
JUNOS AppId Services [13.1-20130306.0]
JUNOS Border Gateway Function package [13.1-20130306.0]
JUNOS Services Captive Portal and Content Delivery Container package
[13.1-20130306.0]
JUNOS Services HTTP Content Management package [13.1-20130306.0]
JUNOS IDP Services [13.1-20130306.0]
JUNOS Services Jflow Container package [13.1-20130306.0]
JUNOS Services LL-PDF Container package [13.1-20130306.0]
JUNOS Services MobileNext Software package [13.1-20130306.0]
JUNOS Services Mobile Subscriber Service Container package [13.1-20130306.0]
JUNOS Services NAT [13.1-20130306.0]
JUNOS Services PTSP Container package [13.1-20130306.0]
JUNOS Services RPM [13.1-20130306.0]
JUNOS Services Stateful Firewall [13.1-20130306.0]
JUNOS Voice Services Container package [13.1-20130306.0]
JUNOS Services Example Container package [13.1-20130306.0]
JUNOS Services Crypto [13.1-20130306.0]
JUNOS Services SSL [13.1-20130306.0]
JUNOS Services IPSec [13.1-20130306.0]
JUNOS Runtime Software Suite [13.1-20130306.0]
JUNOS Routing Software Suite [13.1-20130306.0]

lcc0-re0:
--------------------------------------------------------------------------
Hostname: lcc0
Model: t4000
JUNOS Base OS boot [13.1-20130306.0]
JUNOS Base OS Software Suite [13.1-20130306.0]
JUNOS Kernel Software Suite [13.1-20130306.0]
JUNOS Crypto Software Suite [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (T-Series) [13.1-20130306.0]
JUNOS Online Documentation [13.1-20130306.0]
```



```
JUNOS Services AACL Container package [13.1-20130306.0]
JUNOS Services Application Level Gateways [13.1-20130306.0]
JUNOS AppId Services [13.1-20130306.0]
JUNOS Border Gateway Function package [13.1-20130306.0]
JUNOS Services Captive Portal and Content Delivery Container package
[13.1-20130306.0]
JUNOS Services HTTP Content Management package [13.1-20130306.0]
JUNOS IDP Services [13.1-20130306.0]
JUNOS Services Jflow Container package [13.1-20130306.0]
JUNOS Services LL-PDF Container package [13.1-20130306.0]
JUNOS Services MobileNext Software package [13.1-20130306.0]
JUNOS Services Mobile Subscriber Service Container package [13.1-20130306.0]
JUNOS Services NAT [13.1-20130306.0]
JUNOS Services PTSP Container package [13.1-20130306.0]
JUNOS Services RPM [13.1-20130306.0]
JUNOS Services Stateful Firewall [13.1-20130306.0]
JUNOS Voice Services Container package [13.1-20130306.0]
JUNOS Services Example Container package [13.1-20130306.0]
JUNOS Services Crypto [13.1-20130306.0]
JUNOS Services SSL [13.1-20130306.0]
JUNOS Services IPSec [13.1-20130306.0]
JUNOS Runtime Software Suite [13.1-20130306.0]
JUNOS Routing Software Suite [13.1-20130306.0]

lcc2-re0:
--------------------------------------------------------------------------
Hostname: lcc2
Model: t4000
JUNOS Base OS boot [13.1-20130306.0]
JUNOS Base OS Software Suite [13.1-20130306.0]
JUNOS Kernel Software Suite [13.1-20130306.0]
JUNOS Crypto Software Suite [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (T-Series) [13.1-20130306.0]
JUNOS Online Documentation [13.1-20130306.0]
JUNOS Services AACL Container package [13.1-20130306.0]
JUNOS Services Application Level Gateways [13.1-20130306.0]
JUNOS AppId Services [13.1-20130306.0]
JUNOS Border Gateway Function package [13.1-20130306.0]
JUNOS Services Captive Portal and Content Delivery Container package
[13.1-20130306.0]
JUNOS Services HTTP Content Management package [13.1-20130306.0]
JUNOS IDP Services [13.1-20130306.0]
JUNOS Services Jflow Container package [13.1-20130306.0]
JUNOS Services LL-PDF Container package [13.1-20130306.0]
JUNOS Services MobileNext Software package [13.1-20130306.0]
JUNOS Services Mobile Subscriber Service Container package [13.1-20130306.0]
JUNOS Services NAT [13.1-20130306.0]
JUNOS Services PTSP Container package [13.1-20130306.0]
JUNOS Services RPM [13.1-20130306.0]
JUNOS Services Stateful Firewall [13.1-20130306.0]
JUNOS Voice Services Container package [13.1-20130306.0]
JUNOS Services Example Container package [13.1-20130306.0]
JUNOS Services Crypto [13.1-20130306.0]
JUNOS Services SSL [13.1-20130306.0]
JUNOS Services IPSec [13.1-20130306.0]
JUNOS Runtime Software Suite [13.1-20130306.0]
JUNOS Routing Software Suite [13.1-20130306.0]


lcc4-re0:
```

```
--------------------------------------------------------------------------
Hostname: lcc4
Model: t4000
JUNOS Base OS boot [13.1-20130306.0]
JUNOS Base OS Software Suite [13.1-20130306.0]
JUNOS Kernel Software Suite [13.1-20130306.0]
JUNOS Crypto Software Suite [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (T-Series) [13.1-20130306.0]
JUNOS Online Documentation [13.1-20130306.0]
JUNOS Services AACL Container package [13.1-20130306.0]
JUNOS Services Application Level Gateways [13.1-20130306.0]
JUNOS AppId Services [13.1-20130306.0]
JUNOS Border Gateway Function package [13.1-20130306.0]
JUNOS Services Captive Portal and Content Delivery Container package
[13.1-20130306.0]
JUNOS Services HTTP Content Management package [13.1-20130306.0]
JUNOS IDP Services [13.1-20130306.0]
JUNOS Services Jflow Container package [13.1-20130306.0]
JUNOS Services LL-PDF Container package [13.1-20130306.0]
JUNOS Services MobileNext Software package [13.1-20130306.0]
JUNOS Services Mobile Subscriber Service Container package [13.1-20130306.0]
JUNOS Services NAT [13.1-20130306.0]
JUNOS Services PTSP Container package [13.1-20130306.0]
JUNOS Services RPM [13.1-20130306.0]
JUNOS Services Stateful Firewall [13.1-20130306.0]
JUNOS Voice Services Container package [13.1-20130306.0]
JUNOS Services Example Container package [13.1-20130306.0]
JUNOS Services Crypto [13.1-20130306.0]
JUNOS Services SSL [13.1-20130306.0]
JUNOS Services IPSec [13.1-20130306.0]
JUNOS Runtime Software Suite [13.1-20130306.0]
JUNOS Routing Software Suite [13.1-20130306.0]

lcc6-re0:
--------------------------------------------------------------------------
Hostname: lcc6
Model: t1600
JUNOS Base OS boot [13.1-20130306.0]
JUNOS Base OS Software Suite [13.1-20130306.0]
JUNOS Kernel Software Suite [13.1-20130306.0]
JUNOS Crypto Software Suite [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (T-Series) [13.1-20130306.0]
JUNOS Online Documentation [13.1-20130306.0]
JUNOS Services AACL Container package [13.1-20130306.0]
JUNOS Services Application Level Gateways [13.1-20130306.0]
JUNOS AppId Services [13.1-20130306.0]
JUNOS Border Gateway Function package [13.1-20130306.0]
JUNOS Services Captive Portal and Content Delivery Container package
[13.1-20130306.0]
JUNOS Services HTTP Content Management package [13.1-20130306.0]
JUNOS IDP Services [13.1-20130306.0]
JUNOS Services Jflow Container package [13.1-20130306.0]
JUNOS Services LL-PDF Container package [13.1-20130306.0]
JUNOS Services MobileNext Software package [13.1-20130306.0]
JUNOS Services Mobile Subscriber Service Container package [13.1-20130306.0]
JUNOS Services NAT [13.1-20130306.0]
JUNOS Services PTSP Container package [13.1-20130306.0]
JUNOS Services RPM [13.1-20130306.0]
JUNOS Services Stateful Firewall [13.1-20130306.0]
```

```
JUNOS Voice Services Container package [13.1-20130306.0]
JUNOS Services Example Container package [13.1-20130306.0]
JUNOS Services Crypto [13.1-20130306.0]
JUNOS Services SSL [13.1-20130306.0]
JUNOS Services IPSec [13.1-20130306.0]
JUNOS Runtime Software Suite [13.1-20130306.0]
JUNOS Routing Software Suite [13.1-20130306.0]


lcc7-re0:
--------------------------------------------------------------------------
Hostname: lcc7
Model: t1600
JUNOS Base OS boot [13.1-20130306.0]
JUNOS Base OS Software Suite [13.1-20130306.0]
JUNOS Kernel Software Suite [13.1-20130306.0]
JUNOS Crypto Software Suite [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (M/T Common) [13.1-20130306.0]
JUNOS Packet Forwarding Engine Support (T-Series) [13.1-20130306.0]
JUNOS Online Documentation [13.1-20130306.0]
JUNOS Services AACL Container package [13.1-20130306.0]
JUNOS Services Application Level Gateways [13.1-20130306.0]
JUNOS AppId Services [13.1-20130306.0]
JUNOS Border Gateway Function package [13.1-20130306.0]
JUNOS Services Captive Portal and Content Delivery Container package
[13.1-20130306.0]
JUNOS Services HTTP Content Management package [13.1-20130306.0]
JUNOS IDP Services [13.1-20130306.0]
JUNOS Services Jflow Container package [13.1-20130306.0]
JUNOS Services LL-PDF Container package [13.1-20130306.0]
JUNOS Services MobileNext Software package [13.1-20130306.0]
JUNOS Services Mobile Subscriber Service Container package [13.1-20130306.0]
JUNOS Services NAT [13.1-20130306.0]
JUNOS Services PTSP Container package [13.1-20130306.0]
JUNOS Services RPM [13.1-20130306.0]
JUNOS Services Stateful Firewall [13.1-20130306.0]
JUNOS Voice Services Container package [13.1-20130306.0]
JUNOS Services Example Container package [13.1-20130306.0]
JUNOS Services Crypto [13.1-20130306.0]
JUNOS Services SSL [13.1-20130306.0]
JUNOS Services IPSec [13.1-20130306.0]
JUNOS Runtime Software Suite [13.1-20130306.0]
JUNOS Routing Software Suite [13.1-20130306.0]
```

show version (MX Series Router)

```
user@host5> show version
Hostname: host5
Model: mx80
JUNOS Base OS boot [11.3-20110717.0]
JUNOS Base OS Software Suite [11.3-20110717.0]
JUNOS Kernel Software Suite [11.3-20110717.0]
JUNOS Crypto Software Suite [11.3-20110717.0]
JUNOS Packet Forwarding Engine Support (MX80) [11.3-20110717.0]
JUNOS Online Documentation [11.3-20110717.0]
JUNOS Routing Software Suite [11.3-20110717.0]
```

show version (QFX3500 Switch)

```
user@switch> show version
```

```
Hostname: switch
Model: qfx_s3500
JUNOS Base OS boot [11.1R1]
JUNOS Base OS Software Suite [11.1R1]
JUNOS Kernel Software Suite [11.1R1]
JUNOS Crypto Software Suite [11.1R1
JUNOS Online Documentation [11.1R1]
JUNOS Enterprise Software Suite [11.1R1]
JUNOS Packet Forwarding Engine Support (QFX) [11.1R1]
JUNOS Routing Software Suite [11.1R1]
```

show version (QFabric System)

```
user@qfabric> show version
Hostname: qfabric
Model: qfx3000-g
Serial Number: qfsn-0123456789
QFabric System ID: f158527a-f99e-11e0-9fbd-00e081c57cda
JUNOS Base Version [12.2I20111018_0215_dc-builder]
```

show version component all (QFabric System)

```
user@switch> show version component all
dg1:
-
Hostname: qfabric
Model: qfx3100
JUNOS Base Version [11.3R1.6]

dg0:
-
Hostname: qfabric
Model: qfx3100
JUNOS Base Version [11.3R1.6]

NW-NG-0:
-
Hostname: qfabric
Model: qfx-jvre
JUNOS Base OS boot [11.3R1.6]
JUNOS Base OS Software Suite [11.3R1.6]
JUNOS Kernel Software Suite [11.3R1.6]
JUNOS Crypto Software Suite [11.3R1.6]
JUNOS Online Documentation [11.3R1.6]
JUNOS Enterprise Software Suite [11.3R1.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3R1.6]
JUNOS Routing Software Suite [11.3R1.6]

FC-0:
-
Hostname: qfabric
Model: qfx-jvre
JUNOS Base OS boot [11.3R1.6]
JUNOS Base OS Software Suite [11.3R1.6]
JUNOS Kernel Software Suite [11.3R1.6]
JUNOS Crypto Software Suite [11.3R1.6]
JUNOS Online Documentation [11.3R1.6]
JUNOS Enterprise Software Suite [11.3R1.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3R1.6]
JUNOS Routing Software Suite [11.3R1.6]
```

```
FC-1:
Hostname: qfabric
Model: qfx-jvre
JUNOS Base OS boot [11.3R1.6]
JUNOS Base OS Software Suite [11.3R1.6]
JUNOS Kernel Software Suite [11.3R1.6]
JUNOS Crypto Software Suite [11.3R1.6]
JUNOS Online Documentation [11.3R1.6]
JUNOS Enterprise Software Suite [11.3R1.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3R1.6]
JUNOS Routing Software Suite [11.3R1.6]

DRE-0:
-
Hostname: dre-0
Model: qfx-jvre
JUNOS Base OS boot [11.3R1.6]
JUNOS Base OS Software Suite [11.3R1.6]
JUNOS Kernel Software Suite [11.3R1.6]
JUNOS Crypto Software Suite [11.3R1.6]
JUNOS Online Documentation [11.3R1.6]
JUNOS Enterprise Software Suite [11.3R1.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3R1.6]
JUNOS Routing Software Suite [11.3R1.6]

FM-0:
-
Hostname: qfabric
Model: qfx-jvre
JUNOS Base OS boot [11.3R1.6]
JUNOS Base OS Software Suite [11.3R1.6]
JUNOS Kernel Software Suite [11.3R1.6]
JUNOS Crypto Software Suite [11.3R1.6]
JUNOS Online Documentation [11.3R1.6]
JUNOS Enterprise Software Suite [11.3R1.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3R1.6]
JUNOS Routing Software Suite [11.3R1.6]

nodedevice1:
-
Hostname: qfabric
Model: QFX3500
JUNOS Base OS boot [11.3R1.6]
JUNOS Base OS Software Suite [11.3R1.6]
JUNOS Kernel Software Suite [11.3R1.6]
JUNOS Crypto Software Suite [11.3R1.6]
JUNOS Online Documentation [11.3R1.6]
JUNOS Enterprise Software Suite [11.3R1.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3R1.6]
JUNOS Routing Software Suite [11.3R1.6]

interconnectdevice1:
-
Hostname: qfabric
Model: QFX3108
JUNOS Base OS boot [11.3R1.6]
JUNOS Base OS Software Suite [11.3R1.6]
JUNOS Kernel Software Suite [11.3R1.6]
JUNOS Crypto Software Suite [11.3R1.6]
JUNOS Online Documentation [11.3R1.6]
JUNOS Enterprise Software Suite [11.3R1.6]
```

```
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3R1.6]
JUNOS Routing Software Suite [11.3R1.6]
warning:  from interconnectdevice0: Disconnected
```


start shell

Syntax

start shell (csh | sh)
<user *username*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Exit from the CLI environment and create a UNIX-level shell. To return to the CLI, type **exit** from the shell.

NOTE:

- To issue this command, the user must have the required login access privileges configured by including the **permissions** statement at the **[edit system login class *class-name*]** hierarchy level.
- UNIX wheel group membership or permissions are no longer required to issue this command.

Options

csh—Create a UNIX C shell.

sh—Create a UNIX Bourne shell.

user *username*—(Optional) Start the shell as another user.

Additional Information

When you are in the shell, the shell prompt has the following format:

username@hostname%

An example of the prompt is:

root@host%

Required Privilege Level

shell and maintenance

List of Sample Output

start shell csh on page 1105

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

start shell csh

```
user@host> start shell csh
%
exit
%
```

```
username@hostname% start shell sh
%
```

exit

```
user@host>
```


test configuration

Syntax test configuration *filename*

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Verify that the syntax of a configuration file is correct. If the configuration contains any syntax or commit check errors, a message is displayed to indicate the line number and column number in which the error was found.

Options *filename*—Name of the configuration file.

syntax-only—Check the syntax of a partial configuration file, without checking for commit errors. This option introduced in Junos OS Release 12.1.

Required Privilege Level view

List of Sample Output test configuration on page 1107

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

test configuration

```
user@host> test configuration terminal
[Type ^D to end input]
system {
host-name bluesky;
paris-23;
login;
}
terminal:3:(8) syntax error: paris
  [edit system]
    'paris-23;'
      syntax error
terminal:4:(11) statement must contain additional statements: ;
  [edit system login]
    'login ;'
      statement must contain additional statements
configuration syntax failed
```


traceroute

Syntax

traceroute *host*
<as-number-lookup>
<bypass-routing>
<clns>
<gateway *address*>
<inet | inet6>
<interface *interface-name*>
<logical system *logical-system-name*>
<monitor *host*>
<mpls (ldp *FEC address* | rsvp *label-switched-path-name*)>
<no-resolve>
<propagate-ttl>
<routing-instance *routing-instance-name*>
<source *source-address*>
<tos *value*>
<ttl *value*>
<wait *seconds*>

Syntax (QFX Series)

traceroute *host*
<as-number-lookup>
<bypass-routing>
<gateway *address*>
<inet>
<interface *interface-name*>
<monitor *host*>
<no-resolve>
<routing-instance *routing-instance-name*>
<source *source-address*>
<tos *value*>
<ttl *value*>
<wait *seconds*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
mpls option introduced in Junos OS Release 9.2.
Command introduced in Junos OS Release 11.1 for the QFX Series.
propagate-ttl option introduced in Junos OS Release 12.1.

Description

Display the route that packets take to a specified network host. Use **traceroute** as a debugging tool to locate points of failure in a network.

Options

host—IP address or name of remote host.

as-number-lookup—(Optional) Display the autonomous system (AS) number of each intermediate hop on the path from the host to the destination.

bypass-routing—(Optional) Bypass the normal routing tables and send requests directly to a system on an attached network. If the system is not on a directly attached network, an error is returned. Use this option to display a route to a local system through an interface that has no route through it.

clns—(Optional) Trace the route belonging to the Connectionless Network Service (CLNS).

gateway ***address***—(Optional) Address of a router or switch through which the route transits.

inet | inet6—(Optional) Trace the route belonging to IPv4 or IPv6, respectively.

interface ***interface-name***—(Optional) Name of the interface over which to send packets.

logical-system ***logical-system-name***—(Optional) Perform this operation on all logical systems or on a particular logical system.

monitor ***host***—(Optional) Display real-time monitoring information for the specified host.

mpls (ldp ***FEC address*** **| rsvp** ***label-switched-path name*****)**—(Optional) See traceroute mpls ldp and traceroute mpls rsvp.

no-resolve—(Optional) Do not attempt to determine the hostname that corresponds to the IP address.

propagate-ttl—(Optional) On the PE routing device, use this option to view locally generated Routing Engine transit traffic. This is applicable for MPLS L3VPN traffic only.

Use for troubleshooting, when you want to view hop-by-hop information from the local provider router to the remote provider router, when TTL decrementing is disabled on the core network using the **no-proagate-ttl** configuration statement.

NOTE: **Using propagate-ttl with traceroute on the CE router does not show hop-by-hop information.**

routing-instance ***routing-instance-name***—(Optional) Name of the routing instance for the traceroute attempt.

source ***source-address***—(Optional) Source address of the outgoing traceroute packets.

tos ***value***—(Optional) Value to include in the IP type-of-service (ToS) field. The range of values is **0** through **255**.

ttl ***value***—(Optional) Maximum time-to-live value to include in the traceroute request. The range of values is **0** through **128**.

wait ***seconds***—(Optional) Maximum time to wait for a response to the traceroute request.

Required Privilege Level

network

Related Documentation

- traceroute monitor on page 1112

List of Sample Output

traceroute on page 1110

traceroute as-number-lookup host on page 1110
traceroute no-resolve on page 1110
traceroute propogate-ttl on page 1111
traceroute (Between CE Routers, Layer 3 VPN) on page 1111
traceroute (Through an MPLS LSP) on page 1111

Output Fields

Table 94 on page 1110 describes the output fields for the **traceroute** command. Output fields are listed in the approximate order in which they appear.

Table 94: traceroute Output Fields

Field Name	Field Description
traceroute to	IP address of the receiver.
hops max	Maximum number of hops allowed.
byte packets	Size of packets being sent.
number-of-hops	Number of hops from the source to the named router or switch.
router-name	Name of the router or switch for this hop.
address	Address of the router or switch for this hop.
Round trip time	Average round-trip time, in milliseconds (ms).

Sample Output

traceroute

```
user@host> traceroute santacruz
traceroute to green.company.net (10.156.169.254), 30 hops max, 40 byte packets
 1  blue23 (10.168.1.254)    2.370 ms  2.853 ms  0.367 ms
 2  red14  (10.168.255.250)  0.778 ms  2.937 ms  0.446 ms
 3  yellow (10.156.169.254)  7.737 ms  89.905 ms  0.834 ms
```

traceroute as-number-lookup host

```
user@host> traceroute as-number-lookup 10.100.1.1
traceroute to 10.100.1.1 (10.100.1.1), 30 hops max, 40 byte packets
 1  10.39.1.1 (10.39.1.1)  0.779 ms  0.728 ms  0.562 ms
 2  10.39.1.6 (10.39.1.6) [AS  32]  0.657 ms  0.611 ms  0.617 ms
 3  10.100.1.1 (10.100.1.1) [AS  10, 40, 50]  0.880 ms  0.808 ms  0.774 ms
```

traceroute no-resolve

```
user@host> traceroute santacruz no-resolve
traceroute to green.company.net (10.156.169.254), 30 hops max, 40 byte packets
 1  10.168.1.254  0.458 ms  0.370 ms  0.365 ms
 2  10.168.255.250  0.474 ms  0.450 ms  0.444 ms
 3  10.156.169.254  0.931 ms  0.876 ms  0.862 ms
```

traceroute propogate-ttl

```
user@host> traceroute propagate-ttl 100.200.2.2 routing-instance VPN-A
traceroute to 100.200.2.2 (100.200.2.2) from 1.1.0.2, 30 hops max, 40 byte packets

 1  1.2.0.2 (1.2.0.2)  2.456 ms  1.753 ms  1.672 ms
     MPLS Label=299776 CoS=0 TTL=1 S=0
     MPLS Label=299792 CoS=0 TTL=1 S=1
 2  1.3.0.2 (1.3.0.2)  1.213 ms  1.225 ms  1.166 ms
     MPLS Label=299792 CoS=0 TTL=1 S=1
 3  100.200.2.2 (100.200.2.2)  1.422 ms  1.521 ms  1.443 ms
```

traceroute (Between CE Routers, Layer 3 VPN)

```
user@host> traceroute vpn09
traceroute to vpn09.skybank.net (10.255.14.179), 30 hops max, 40
      byte packets
       1  10.39.10.21 (10.39.10.21)  0.598 ms  0.500 ms  0.461 ms
       2  10.39.1.13 (10.39.1.13)  0.796 ms  0.775 ms  0.806 ms
           MPLS Label=100006 CoS=0 TTL=1 S=1
       3  vpn09.skybank.net (10.255.14.179)  0.783 ms  0.716 ms  0.686
```

traceroute (Through an MPLS LSP)

```
user@host> traceroute mpls1
traceroute to 10.168.1.224 (10.168.1.224), 30 hops max, 40 byte packets
 1  mpls1-sr0.company.net (10.168.200.101)  0.555 ms  0.393 ms  0.367 ms
     MPLS Label=1024 CoS=0 TTL=1
 2  mpls5-lo0.company.net (10.168.1.224)  0.420 ms  0.394 ms  0.401 ms
```

traceroute monitor

Syntax

traceroute monitor *host*
<count *value*>
<inet | inet 6>
<interval *seconds*>
<no resolve>
<size *value*>
<source *source-address*>
<summary>

Syntax (QFX Series)

traceroute monitor *host*
<count *value*>
<inet>
<interval *seconds*>
<no resolve>
<size *value*>
<source *source-address*>
<summary>

Release Information

Command introduced in Junos OS Release 8.0
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display live monitoring of each hop in the route that packets take to a specified network host. Use as a debugging tool to locate points of failure in a network.

Options

host—IP address or name of remote host.

count *value*—Number of ping requests, in packets, to send in summary mode. The default value is **10**.

inet | inet6—(Optional) Trace the route belonging to IPv4 or IPv6, respectively.

interval *seconds*—(Optional) Number of seconds to wait before sending ping requests. The default value is **1**.

no resolve—(Optional) Do not attempt to display addresses symbolically.

size *value*—(Optional) Receive the specified number of bytes for each packet. The range is **0** through **65468** bytes. The default value is **64**.

source *source-address*—(Optional) Source address of the outgoing ping packets.

summary—(Optional) Generate and display a summary of live monitoring of each hop on the route that packets take to a specified network host.

Required Privilege Level

network

List of Sample Output

traceroute monitor on page 1113

Output Fields

Table 95 on page 1113 describes the output fields for the **traceroute monitor** command. Output fields are listed in the approximate order in which they appear.

Table 95: traceroute monitor Output Fields

Field Name	Field Description
Host	Hostname or IP address of the router at each hop.
Loss%	Percent of packet loss. The number of ping responses divided by the number of ping requests, specified as a percentage.
Snt	Number of ping requests sent to the routerat this hop.
Last	Most recent round-trip time, in milliseconds, to the router at this hop.
Avg	Average round-trip time, in milliseconds, to the router at this hop.
Best	Shortest round-trip time, in milliseconds, to the router at this hop.
Wrst	Longest round-trip time, in milliseconds, to the router at this hop.
StDev	Standard deviation of round-trip times, in milliseconds, to the router at this hop.

Sample Output

traceroute monitor

```
user@host> traceroute monitor 10.16.0.1

                                     Loss%   Snt   Last   Avg  Best  Wrst StDev
Host
1. 10.17.41.254                      0.0%    17    0.7   1.0   0.6   5.4   1.2
2. secret.net                        0.0%    17    0.6   1.0   0.6   6.6   1.4
3. top-secret.net                    0.0%    17    0.6   0.6   0.6   0.6   0.0
```


CHAPTER 7

Troubleshooting

Troubleshooting Procedures

Rebooting and Halting a QFX Series Product

To reboot the switch, issue the **request system reboot** command.

```
user@switch> request system reboot ?
Possible completions:
  <[Enter]>              Execute this command
  at                     Time at which to perform the operation
  in                     Number of minutes to delay before operation
  media                  Boot media for next boot
  message                Message to display to all users
  |                      Pipe through a command
```

```
user@switch>  request system reboot
Reboot the system ? [yes,no] (no) yes
Rebooting switch
```

Similarly, to halt the switch, issue the **request system halt** command.

CAUTION: Before entering this command, you must have access to the switch's console port in order to bring up the Routing Engine.

```
user@switch> request system halt ?
Possible completions:
  <[Enter]>              Execute this command
  at                     Time at which to perform the operation
  in                     Number of minutes to delay before operation
  media                  Boot media for next boot
  message                Message to display to all users
  |                      Pipe through a command
```

NOTE: When you issue this command on an individual component in a QFabric system, you will receive a warning that says "Hardware-based members will halt, Virtual Junos Routing Engines will reboot." If you want to halt only one member, use the **member** option. You cannot issue this command from the QFabric CLI.

Issuing the **request system halt** command on the switch halts the Routing Engine. To reboot a Routing Engine that has been halted, you must connect through the console.

Related Documentation

- clear system reboot on page 329
- request system reboot on page 387
- request system halt on page 373
- request system power-off on page 383
- *Connecting a QFX Series Device to a Management Console*

Recovering from a Failed Software Installation

Problem If the Junos OS appears to have been installed but the CLI does not work, or if the switch has no software installed, you can use this recovery installation procedure to install the Junos OS.

Solution If a Junos OS image already exists on the switch, you can either install the new Junos OS package in a separate partition, in which case both Junos OS images remain on the switch, or you can remove the existing Junos OS image before you start the new installation process.

To perform a recovery installation:

1. Power on the switch. The loader script starts.
2. After the message **Loading /boot/defaults/loader.conf** appears, you are prompted with the following message:

   Hit [Enter] to boot immediately, or space bar for command prompt.

   Press the Spacebar to enter the manual loader. The **loader>** prompt appears.
3. Enter the following command:

   `loader>` **install [– –format] [– –external]** ***source***
   where:

   - **format**—Enables you to erase the installation media before installing the installation package. If you do not include this option, the system installs the new Junos OS in a different partition from that of the most recently installed Junos OS.
   - **external**—Installs the installation package onto external media (a USB stick, for example).

- *source*—Represents the name and location of the Junos OS package, either on a server on the network or as a file on an external media, as shown in the following two examples:
  - Network address of the server and the path on the server; for example, **tftp://192.17.1.28/junos/jinstall-qfx-11.1R1.5-domestic-signed.tgz**
  - Junos OS package on a USB device (commonly stored in the root drive as the only file), for example, **file:///jinstall-qfx-11.1R1.5-domestic-signed.tgz**).

The installation now proceeds normally and ends with a login prompt.

Recovering the Root Password

If you forget the root password for the QFX3500 switch, you can use the password recovery procedure to reset the root password.

NOTE: The root password cannot be recovered on a QFabric system.

NOTE: You need console access to the switch to recover the root password.

To recover the root password:

1. Power off the switch by switching off the AC power outlet of the device or, if necessary, by pulling the power cords out of the QFX3500 switch power supplies.
2. Turn off the power to the management device, such as a PC or laptop computer, that you want to use to access the CLI.
3. Plug one end of the Ethernet rollover cable supplied with the switch into the RJ-45–to–DB-9 serial port adapter supplied with the switch.
4. Plug the RJ-45–to–DB-9 serial port adapter into the serial port on the management device.
5. Connect the other end of the Ethernet rollover cable to the console port on the switch.
6. Turn on the power to the management device.
7. On the management device, start your asynchronous terminal emulation application (such as Microsoft Windows Hyperterminal) and select the appropriate **COM** port to use (for example, **COM1**).
8. Configure the port settings as follows:
   - Bits per second: 9600
   - Data bits: 8
   - Parity: None

- Stop bits: 1
- Flow control: None

9. Power on the switch by (if necessary) plugging the power cords into the QFX3500 switch power supply, or turning on the power to the device or switch by switching on the AC power outlet the device is plugged into

   The terminal emulation screen on your management device displays the switch's boot sequence.

10. When the following prompt appears, press the Spacebar to access the switch's bootstrap loader command prompt:

```
Hit [Enter] to boot immediately, or space bar for command prompt.
Booting [kernel] in 9 seconds...
```

11. At the following prompt, enter **boot -s** to start up the system in single-user mode.

```
ok boot -s
```

12. At the following prompt, enter **recovery** to start the root password recovery procedure.

```
Enter full pathname of shell or 'recovery' for root password recovery or RETURN
for /bin/sh: recovery
```

13. Enter configuration mode in the CLI.

14. Set the root password. For example:

```
user@switch# set system root-authentication plain-text-password
```

15. At the following prompt, enter the new root password. For example:

```
New password: juniper1
Retype new password:
```

16. At the second prompt, reenter the new root password.

17. After you have finished configuring the password, commit the configuration.

```
root@host# commit
commit complete
```

18. Exit configuration mode in the CLI.

19. Exit operational mode in the CLI.

20. At the prompt, enter **y** to reboot the switch.

```
Reboot the system? [y/n] y
```

Related Documentation

- Configuring the Root Password on page 1236

Troubleshooting Network Interfaces

The interface on the port in which an SFP or SFP+ transceiver is installed in an SFP or SFP+ module is down

Problem The QFX Series has an SFP or SFP+ module installed. The interface on the port in which an SFP or SFP+ transceiver is installed is down.

When you check the status with the CLI command **show interfaces *interface-name***, the disabled port is not listed.

Cause By default, the SFP or SFP+ module operates in the 10-Gigabit Ethernet mode and supports only SFP or SFP+ transceivers. The operating mode for the module is incorrectly set.

Solution Only SFP or SFP+ transceivers can be installed in SFP or SFP+ modules. You must configure the operating mode of the SFP or SFP+ module to match the type of transceiver you want to use. For SFP+ transceivers, configure 10-Gigabit Ethernet operating mode.

Troubleshooting an Aggregated Ethernet Interface

Problem The **show interfaces terse** command shows that the LAG is down.

Solution Check the following:

- Verify that there is no configuration mismatch.
- Verify that all member ports are up.
- Verify that a LAG is part of family ethernet-switching (Layer 2 LAG) or family inet (Layer 3 LAG).
- Verify that the LAG member is connected to the correct LAG at the other end.
- Verify that the LAG members belong to the same switch.

Related Documentation

- Verifying the Status of a LAG Interface on page 2148
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896

PART 4

Configuration and File Management

CHAPTER 8

Overview

Configuration Files Overview

Configuration File Terms

Table 31 on page 26 lists the various configuration file terms used for the QFX Series and their definitions.

Table 96: Configuration File Terms

Term	Definition
active configuration	Current committed configuration of a switch.
candidate configuration	Working copy of the configuration that allows users to make configurational changes without causing any operational changes until this copy is committed.
configuration group	Group of configuration statements that can be inherited by the rest of the configuration.
commit a configuration	Check configuration for proper syntax, activate and mark as the current configuration file running on the switching platform.
configuration hierarchy	Junos OS configuration consists of a hierarchy of statements. There are two types of statements: container statements, which contain other statements, and leaf statements, which do not contain other statements. All the container and leaf statements together form the configuration hierarchy.
default configuration	Default configuration contains the initial values set for each configuration parameter when a switch is shipped.
rescue configuration	Well-known configuration that recovers a switch from a configuration that denies management access. You set a current committed configuration to be the rescue configuration through the CLI.
roll back a configuration	Return to a previously committed configuration.

Related Documentation

- Loading a Previous Configuration File on page 1136
- Reverting to the Rescue Configuration on page 165
- Understanding Configuration Files on page 1126

Software Overview

Forms of the configure Command

The Junos OS supports three forms of the **configure** command: **configure**, **configure private**, and **configure exclusive**. These forms control how users edit and commit configurations and can be useful when multiple users configure the software. See Table 97 on page 1124.

Table 97: Forms of the configure Command

Command	Edit Access	Commit Access
configure	• No one can lock the configuration. All users can make configuration changes. When you enter configuration mode, the CLI displays the following information: ◦ A list of other users editing the configuration. ◦ Hierarchy levels the users are viewing or editing. ◦ Whether the configuration has been changed, but not committed. ◦ When multiple users enter conflicting configurations, the most recent change to be entered takes precedence.	• No one can lock the configuration. All users can commit all changes to the configuration. • If you and another user make changes and the other user commits changes, your changes are committed as well.

Table 97: Forms of the configure Command *(continued)*

Command	Edit Access	Commit Access
configure exclusive	• One user locks the configuration and makes changes without interference from other users. • Other users can enter and exit configuration mode, but they cannot commit the configuration. • If you enter configuration mode while another user has locked the configuration (with the **configure exclusive** command), the CLI displays the user and the hierarchy level the user is viewing or editing. • If you enter configuration mode while another user has locked the configuration, you can forcibly log out that user with the **request system logout** operational mode command. For details, see the CLI Explorer.	
configure private	• Multiple users can edit the configuration at the same time. • Each user has a private candidate configuration to edit independently of other users. • When multiple users enter conflicting configurations, the first commit operation takes precedence over subsequent commit operations.	• When you commit the configuration, the router verifies that the operational (running) configuration has not been modified by another user before accepting your private candidate configuration as the new operational configuration. • If the configuration has been modified by another user, you can merge the modifications into your private candidate configuration and attempt to commit again.

Related Documentation

- *Committing a Junos OS Configuration*
- *Example: Using the configure Command*
- *Displaying Users Currently Editing the Configuration*
- *Using the configure exclusive Command*
- *Updating the configure private Configuration*
- *Displaying set Commands from the Junos OS Configuration*

Junos OS Commit Model for Router or Switch Configuration

The router or switch configuration is saved using a commit model—a candidate configuration is modified as desired and then committed to the system. When a configuration is committed, the router or switch checks the configuration for syntax errors, and if no errors are found, the configuration is saved as **juniper.conf.gz** and activated. The formerly active configuration file is saved as the first rollback configuration file (**juniper.conf.1.gz**), and any other rollback configuration files are incremented by 1. For example, **juniper.conf.1.gz** is incremented to **juniper.conf.2.gz**, making it the second rollback configuration file. The router or switch can have a maximum of 49 rollback configurations (numbered 1 through 49) saved on the system.

On the router or switch, the active configuration file and the first three rollback files (**juniper.conf.gz.1, juniper.conf.gz.2, juniper.conf.gz.3**) are located in the **/config** directory. If the file **rescue.conf.gz** is saved on the system, this file should also be saved in the **/config** directory. The factory default files are located in the **/etc/config** directory.

There are two mechanisms used to propagate the configurations between Routing Engines within a router or switch:

- Synchronization—Propagates a configuration from one Routing Engine to a second Routing Engine within the same router or switch chassis.

  NOTE: The QFX3500 switch has only one Routing Engine.

  To synchronize configurations, use the **commit synchronize** CLI command. If one of the Routing Engines is locked, the synchronization fails. If synchronization fails because of a locked configuration file, you can use the **commit synchronize force** command. This command overrides the lock and synchronizes the configuration files.

- Distribution—Propagates a configuration across the routing plane on a multichassis router or switch. Distribution occurs automatically. There is no user command available to control the distribution process. If a configuration is locked during a distribution of a configuration, the locked configuration does not receive the distributed configuration file, so the synchronization fails. You need to clear the lock before the configuration and resynchronize the routing planes.

  NOTE: When you use the **commit synchronize force** CLI command on a multichassis platform, the forced synchronization of the configuration files does not affect the distribution of the configuration file across the routing plane. If a configuration file is locked on a router or switch remote from the router or switch where the command was issued, the synchronization fails on the remote router or switch. You need to clear the lock and reissue the synchronization command.

Related Documentation

- *Configuring Junos OS for the First Time on a Router or Switch with a Single Routing Engine*
- commit on page 319

Understanding Configuration Files

A configuration file stores the complete configuration of a switch. The current configuration of a switch is called the active configuration. You can alter this current configuration and you can also return to a previous configuration or to a rescue configuration.

Juniper Networks Junos OS saves the 50 most recently committed configuration files on a switch so that you can return to a previous configuration. The configuration files are named:

- **juniper.conf.gz**—The current active configuration.
- **juniper.conf.1.gz** to **juniper.conf.49.gz**—Rollback configurations.

To make changes to the configuration file, you have to work in the configuration mode in the CLI. When making changes to a configuration file, you are viewing and changing the candidate configuration file. The candidate configuration allows you to make configuration changes without causing operational changes to the active configuration or causing potential damage to your current network operations. Once you commit the changes made to the candidate configuration, the system updates the active configuration.

Related Documentation

- Uploading a Configuration File on page 1145
- Loading a Previous Configuration File on page 1136
- Reverting to the Rescue Configuration on page 165
- Configuration File Terms on page 26

Understanding How the Junos Configuration Is Stored

When you edit a configuration, you work in a copy of the current configuration to create a candidate configuration. The changes you make to the candidate configuration are visible in the CLI immediately, so if multiple users are editing the configuration at the same time, all users can see all changes.

To have a candidate configuration take effect, you *commit* the changes. At this point, the candidate file is checked for proper syntax, activated, and marked as the current, operational software configuration file. If multiple users are editing the configuration, when you commit the candidate configuration, all changes made by all the users take effect.

In addition to saving the current configuration, the CLI saves the current operational version and the previous 49 versions of committed configurations. The most recently committed configuration is version 0, which is the current operational version and the default configuration that the system returns to if you roll back to a previous configuration. The oldest saved configuration is version 49.

The currently operational Junos OS configuration is stored in the file **juniper.conf** and the last three committed configurations are stored in the files **juniper.conf.1**, **juniper.conf.2**, and **juniper.conf.3**. These four files are located in the directory **/config**, which is on the switch's hard disk. The remaining 46 previous versions of committed configurations, the files **juniper.conf.4** through **juniper.conf.49**, are stored in the directory **/var/db/config** on the hard disk.

Related Documentation

- Returning to the Most Recently Committed Junos Configuration on page 1136
- Returning to a Previously Committed Junos OS Configuration on page 1137
- Loading a Configuration from a File on page 1133

CHAPTER 9

Configuration

Configuration Tasks

Comparing Configuration Changes with a Prior Version

In configuration mode only, when you have made changes to the configuration and want to compare the candidate configuration with a prior version, you can use the **compare** command to display the configuration. The **compare** command compares the candidate configuration with either the current committed configuration or a configuration file and displays the differences between the two configurations. To compare configurations, specify the **compare** command after the pipe:

```
[edit]
```

user@host# **show | compare (*filename*| rollback *n*)**

filename is the full path to a configuration file. The file must be in the proper format: a hierarchy of statements.

n is the index into the list of previously committed configurations. The most recently saved configuration is number 0, and the oldest saved configuration is number 49. If you do not specify arguments, the candidate configuration is compared against the active configuration file (**/config/juniper.conf**).

The comparison output uses the following conventions:

- Statements that are only in the candidate configuration are prefixed with a plus sign (+).
- Statements that are only in the comparison file are prefixed with a minus sign (-).
- Statements that are unchanged are prefixed with a single blank space ( ).

The following example shows various changes, then a comparison of the candidate configuration with the active configuration, showing only the changes made at the **[edit protocols bgp]** hierarchy level:

```
[edit]
user@host# edit protocols bgp
[edit protocols bgp]
user@host# show
group my-group {
   type internal;
   hold-time 60;
   advertise-inactive;
   allow 1.1.1.1/32;
}
group fred {
   type external;
   peer-as 33333;
   allow 2.2.2.2/32;
}
group test-peers {
   type external;
   allow 3.3.3.3/32;
}
[edit protocols bgp]
user@host# set group my-group hold-time 90
[edit protocols bgp]
user@host# delete group my-group advertise-inactive
[edit protocols bgp]
user@host# set group fred advertise-inactive
[edit protocols bgp]
user@host# delete group test-peers
[edit protocols bgp]
user@host# show | compare
[edit protocols bgp group my-group]
-hold-time 60;
+hold-time 90;
-advertise-inactive;
```



```
[edit protocols bgp group fred]
+advertise-inactive;
[edit protocols bgp]
-group test-peers {
   -type external;
   -allow 3.3.3.3/32;
}
[edit protocols bgp]
user@host# show
group my-group {
   type internal;
   hold-time 90;
   allow 1.1.1.1/32;
}
group fred {
   type external;
   advertise-inactive;
   peer-as 3333;
   allow 2.2.2.2/32;
}
```

Related Documentation

- Creating and Returning to a Rescue Configuration on page 1132

Compressing the Current Configuration File

By default, the current operational configuration file is compressed, and is stored in the file **juniper.conf.gz**, in the **/config** file system, along with the last three committed versions of the configuration. If you have large networks, the current configuration file might exceed the available space in the **/config** file system. Compressing the current configuration file enables the file to fit in the file system, typically reducing the size of the file by 90 percent. You might want to compress your current operation configuration files when they reach 3 megabytes (MB) in size.

When you compress the current configuration file, the names of the configuration files change. To determine the size of the files in the **/config** file system, issue the **file list /config detail** command.

NOTE: **We recommend that you compress the configuration files (this is the default) to minimize the amount of disk space that they require.**

- If you want to compress the current configuration file, include the **compress-configuration-files** statement at the **[edit system]** hierarchy level:

  ```
  [edit system]
  compress-configuration-files;
  ```

  Commit the current configuration file to include the **compression-configuration-files** statement. Commit the configuration again to compress the current configuration file:

  ```
  [edit system]
  user@host# set compress-configuration-files
  user@host# commit
  ```



```
commit complete
user@host# commit
commit complete
```

- If you do not want to compress the current operational configuration file, include the **no-compress-configuration-files** statement at the **[edit system]** hierarchy level:

```
[edit system]
no-compression-configuration-files;
```

Commit the current configuration file to include the **no-compress-configuration-files** statement. Commit the configuration again to uncompress the current configuration file:

```
[edit system]
user@host# commit
commit complete
user@host# commit
commit complete
```

Related Documentation

- Junos OS Commit Model for Router or Switch Configuration on page 29
- compress-configuration-files on page 239

Creating and Returning to a Rescue Configuration

A *rescue configuration* allows you to define a known working configuration or a configuration with a known state that you can roll back to at any time. This alleviates the necessity of having to remember the rollback number with the **rollback** command. You use the rescue configuration when you need to roll back to a known configuration or as a last resort if your router or switch configuration and the backup configuration files become damaged beyond repair.

To save the most recently committed configuration as the rescue configuration so that you can return to it at any time, issue the **request system configuration rescue save** command:

```
user@host> request system configuration rescue save
```

To return to the rescue configuration, use the **rollback rescue** configuration mode command:

```
[edit]
user@host# rollback rescue
load complete
```

NOTE: If the rescue configuration does not exist, or if the rescue configuration is not a complete, viable configuration, the **rollback** command fails, an error message appears, and the current configuration remains active.

To activate the rescue configuration that you have loaded, use the **commit** command:

```
[edit]
user@host# rollback rescue
```

```
load complete
[edit]
user@host# commit
```

To delete an existing rescue configuration, issue the **request system configuration rescue delete** command:

```
user@host> request system configuration rescue delete
user@host>
```

For more information about the **request system configuration rescue delete** and **request system configuration rescue save** commands, see the CLI Explorer.

Related Documentation

- Comparing Configuration Changes with a Prior Version on page 1129
- Saving a Configuration to a File on page 1141

Loading a Configuration from a File

You can create a file, copy the file to the local router, and then load the file into the CLI. After you have loaded the file, you can commit it to activate the configuration on the router, or you can edit the configuration interactively using the CLI and commit it at a later time.

You can also create a configuration while typing at the terminal and then load it. Loading a configuration from the terminal is generally useful when you are cutting existing portions of the configuration and pasting them elsewhere in the configuration.

To load an existing configuration file that is located on the router, use the **load** configuration mode command:

```
[edit]
user@host# load (factory-default | merge | override | patch | replace | set | update)
  filename <relative>
```

For information about specifying the filename, see *Viewing Files and Directories on a Device Running Junos OS*.

To load a configuration from the terminal, use the following version of the **load** configuration mode command. Press Ctrl-d to end input.

```
[edit]
user@host# load (factory-default | merge | override | patch | replace | set | update)
terminal <relative>
```

To replace an entire configuration, specify the **override** option at any level of the hierarchy. A **load override** operation completely replaces the current candidate configuration with the file you are loading. Thus, if you saved a complete configuration, use this option.

An **override** operation discards the current candidate configuration and loads the configuration in ***filename*** or the configuration that you type at the terminal. When you use the **override** option and commit the configuration, all system processes reparse the configuration. For an example, see Figure 11 on page 1161.

To replace portions of a configuration, specify the **replace** option. The **load replace** operation looks for **replace:** tags that you added to the loaded file, and replaces the parts of the candidate configuration with whatever is specified after the tag. This is useful when you want more control over exactly what is being changed. For this operation to work, you must include **replace:** tags in the file or configuration you type at the terminal. The software searches for the **replace:** tags, deletes the existing statements of the same name, if any, and replaces them with the incoming configuration. If there is no existing statement of the same name, the **replace** operation adds to the configuration the statements marked with the **replace:** tag. For an example, see Figure 12 on page 1162.

If, in an **override** or **merge** operation, you specify a file or type text that contains **replace:** tags, the **replace:** tags are ignored and the **override** or **merge** operation is performed.

If you are performing a **replace** operation and the file you specify or text you type does not contain any **replace:** tags, the **replace** operation is effectively equivalent to a **merge** operation. This might be useful if you are running automated scripts and cannot know in advance whether the scripts need to perform a **replace** or a **merge** operation. The scripts can use the **replace** operation to cover either case.

The **load merge** operation adds the saved file to the existing candidate configuration. This is useful if you are adding new configuration sections. For example, suppose that you are adding a BGP configuration to the **[edit protocols]** hierarchy level, where there was no BGP configuration before, you can use the **load merge** operation to combine the saved file configuration to the existing candidate configuration. If the existing configuration and the incoming configuration contain conflicting statements, the statements in the incoming configuration override those in the existing configuration.

To replace only the configuration that has changed, specify the **update** option at any level of the hierarchy. The **load update** operation compares the candidate configuration and the file you are loading, and only changes the parts of the candidate configuration that are different from the new configuration. You would use this, for example, if there is an existing BGP configuration and the file you are loading changes it in some way.

To change part of the configuration with a patch file, specify the **patch** option. The **load patch** operation loads a file or terminal input that contains configuration changes. First, on a device that already has the configuration changes, you type the **show | compare** command to output the differences between two configurations. Then you can load the differences on another router. The advantage of the **load patch** command is that it saves you from having to copy snippets from different hierarchy levels into a text file prior to loading them into the target device. This might be a useful time saver if you are configuring several devices with the same options. For example, suppose that you configure a routing policy on Device router1 and you want to replicate the policy configuration on Device router2, router3, and router4, you can use the **load patch** operation.

First, run the **show | compare** command.

```
user@router1# show | compare rollback 3
[edit protocols ospf]
+   export default-static;
-   export static-default
[edit policy-options]
+   policy-statement default-static {
```



```
+        from protocol static;
+        then accept;
+    }
```

Copy the output of the **show | compare** command to the clipboard, making sure to include the hierarchy levels. On Device router2, router3, and router4, type **load patch terminal** and paste the output. Press Enter and then press Ctrl-d to end the operation. If the patch input specifies different values for an existing statement, the patch input overrides the existing statement.

To use the **merge**, **replace**, **set**, or **update** option without specifying the full hierarchy level, specify the **relative** option. For example:

[edit system]
user@host# **show static-host-mapping**
bob sysid 987.654.321ab
[edit system]
user@host# **load replace terminal relative**
[Type ^D at a new line to end input]
replace: static-host-mapping {
  bob sysid 0123.456.789bc;
}
load complete
[edit system]
user@host# **show static-host-mapping**
bob sysid 0123.456.789bc;

To load a configuration that contains the **set** configuration mode command, specify the **set** option. This option executes the configuration instructions line by line as they are stored in a file or from a terminal. The instructions can contain any configuration mode command, such as **set**, **edit**, **exit**, and **top**. For an example, see Figure 15 on page 1163.

To copy a configuration file from another network system to the local router, you can use the SSH and Telnet utilities, as described in the CLI Explorer.

NOTE: If you are using Junos OS in a Common Criteria environment, system log messages are created whenever a secret attribute is changed (for example, password changes or changes to the RADIUS shared secret). These changes are logged during the following configuration load operations:

```
load merge
load replace
load override
load update
```

For more information, see the *Secure Configuration Guide for Common Criteria and Junos-FIPS*.

Related Documentation

- Examples: Loading a Configuration from a File on page 1161

Loading a Previous Configuration File

You can use the **rollback** <*number* command to return to a previously committed configuration file. A switch saves the last 50 committed configurations, including the rollback number, date, time, and name of the user who issued the **commit** configuration command.

Syntax

rollback <*number*>

Options

- **none**— Return to the most recently saved configuration.
- *number*—Configuration to return to.
  - **Range**: 0 through 49. The most recently saved configuration is number 0, and the oldest saved configuration is number 49.
  - **Default**: 0

To return to a configuration prior to the most recently committed one:

1. Specify the rollback number (here, 1 is entered and the configuration returns to the previously committed configuration):

   ```
   [edit]
   user@switch# rollback 1
   load complete
   ```

2. Activate the configuration you have loaded:

   ```
   [edit]
   user@switch# commit
   ```

Related Documentation

- Configuration File Terms on page 26

Returning to the Most Recently Committed Junos Configuration

To return to the most recently committed configuration and load it into configuration mode without activating it, use the **rollback** configuration mode command:

```
[edit]
user@host# rollback
```

```
load complete
```

To activate the configuration to which you rolled back, use the **commit** command:

```
[edit]
user@host# rollback
load complete
[edit]
user@host# commit
```


Related Documentation

- Rolling Back Junos OS Configuration Changes on page 1143
- Returning to a Previously Committed Junos OS Configuration on page 1137
- Understanding How the Junos Configuration Is Stored on page 1127

Returning to a Previously Committed Junos OS Configuration

This topic explains how you can return to a configuration prior to the most recently committed one, and contains the following sections:

Returning to a Configuration Prior to the One Most Recently Committed

To return to a configuration prior to the most recently committed one, include the configuration number, 0 through 49, in the **rollback** command. The most recently saved configuration is number 0 (which is the default configuration to which the system returns), and the oldest saved configuration is number 49.

```
[edit]
user@host# rollback number
load complete
```

Displaying Previous Configurations

To display previous configurations, including the rollback number, date, time, the name of the user who committed changes, and the method of commit, use the **rollback ?** command.

```
[edit]
user@host# rollback ?
Possible completions:
<[Enter]> Execute this command
<number> Numeric argument
0         2005-02-27 12:52:10 PST by abc via cli
1         2005-02-26 14:47:42 PST by def via cli
2         2005-02-14 21:55:45 PST by ghi via cli
3         2005-02-10 16:11:30 PST by jkl via cli
4         2005-02-10 16:02:35 PST by mno via cli
5         2005-03-16 15:10:41 PST by pqr via cli
6         2005-03-16 14:54:21 PST by stu via cli
7         2005-03-16 14:51:38 PST by vwx via cli
8         2005-03-16 14:43:29 PST by yzz via cli
9         2005-03-16 14:15:37 PST by abc via cli
10        2005-03-16 14:13:57 PST by def via cli
11        2005-03-16 12:57:19 PST by root via other
12        2005-03-16 10:45:23 PST by root via other
13        2005-03-16 10:08:13 PST by root via other
```



```
14          2005-03-16 01:20:56 PST by root via other
15          2005-03-16 00:40:37 PST by ghi via cli
16          2005-03-16 00:39:29 PST by jkl via cli
17          2005-03-16 00:32:36 PST by mno via cli
18          2005-03-16 00:31:17 PST by pqr via cli
19          2005-03-15 19:59:00 PST by stu via cli
20          2005-03-15 19:53:39 PST by vwx via cli
21          2005-03-15 18:07:19 PST by yzz via cli
22          2005-03-15 17:59:03 PST by abc via cli
23          2005-03-15 15:05:14 PST by def via cli
24          2005-03-15 15:04:51 PST by ghi via cli
25          2005-03-15 15:03:42 PST by jkl via cli
26          2005-03-15 15:01:52 PST by mno via cli
27          2005-03-15 14:58:34 PST by pqr via cli
28          2005-03-15 13:09:37 PST by root via other
29          2005-03-12 11:01:20 PST by stu via cli
30          2005-03-12 10:57:35 PST by vwx via cli
31          2005-03-11 10:25:07 PST by yzz via cli
32          2005-03-10 23:40:58 PST by abc via cli
33          2005-03-10 23:40:38 PST by def via cli
34          2005-03-10 23:14:27 PST by ghi via cli
35          2005-03-10 23:10:16 PST by jkl via cli
36          2005-03-10 23:01:51 PST by mno via cli
37          2005-03-10 22:49:57 PST by pqr via cli
38          2005-03-10 22:24:07 PST by stu via cli
39          2005-03-10 22:20:14 PST by vwx via cli
40          2005-03-10 22:16:56 PST by yzz via cli
41          2005-03-10 22:16:41 PST by abc via cli
42          2005-03-10 20:44:00 PST by def via cli
43          2005-03-10 20:43:29 PST by ghi via cli
44          2005-03-10 20:39:14 PST by jkl via cli
45          2005-03-10 20:31:30 PST by root via other
46          2005-03-10 18:57:01 PST by mno via cli
47          2005-03-10 18:56:18 PST by pqr via cli
48          2005-03-10 18:47:49 PST by stu via cli
49          2005-03-10 18:47:34 PST by vw via cli
|Pipe through a command
[edit]
```

Comparing Configuration Changes with a Prior Version

In configuration mode only, when you have made changes to the configuration and want to compare the candidate configuration with a prior version, you can use the **compare** command to display the configuration. The **compare** command compares the candidate configuration with either the current committed configuration or a configuration file and displays the differences between the two configurations. To compare configurations, specify the **compare** command after the pipe:

[edit]
user@host# **show | compare (*filename*| rollback *n*)**

filename is the full path to a configuration file. The file must be in the proper format: a hierarchy of statements.

n is the index into the list of previously committed configurations. The most recently saved configuration is number 0, and the oldest saved configuration is number 49. If you do not specify arguments, the candidate configuration is compared against the active configuration file (**/config/juniper.conf**).

The comparison output uses the following conventions:

- Statements that are only in the candidate configuration are prefixed with a plus sign (+).
- Statements that are only in the comparison file are prefixed with a minus sign (-).
- Statements that are unchanged are prefixed with a single blank space ( ).

The following example shows various changes, then a comparison of the candidate configuration with the active configuration, showing only the changes made at the **[edit protocols bgp]** hierarchy level:

```
[edit]
user@host# edit protocols bgp
[edit protocols bgp]
user@host# show
group my-group {
   type internal;
   hold-time 60;
   advertise-inactive;
   allow 1.1.1.1/32;
}
group fred {
   type external;
   peer-as 33333;
   allow 2.2.2.2/32;
}
group test-peers {
   type external;
   allow 3.3.3.3/32;
}
[edit protocols bgp]
user@host# set group my-group hold-time 90
[edit protocols bgp]
user@host# delete group my-group advertise-inactive
[edit protocols bgp]
user@host# set group fred advertise-inactive
[edit protocols bgp]
user@host# delete group test-peers
[edit protocols bgp]
user@host# show | compare
[edit protocols bgp group my-group]
-hold-time 60;
+hold-time 90;
-advertise-inactive;
[edit protocols bgp group fred]
+advertise-inactive;
[edit protocols bgp]
-group test-peers {
```

```
    -type external;
    -allow 3.3.3.3/32;
}
[edit protocols bgp]
user@host# show
group my-group {
    type internal;
    hold-time 90;
    allow 1.1.1.1/32;
}
group fred {
    type external;
    advertise-inactive;
    peer-as 3333;
    allow 2.2.2.2/32;
}
```

Creating and Returning to a Rescue Configuration

A *rescue configuration* allows you to define a known working configuration or a configuration with a known state that you can roll back to at any time. This alleviates the necessity of having to remember the rollback number with the **rollback** command. You use the rescue configuration when you need to roll back to a known configuration or as a last resort if your router or switch configuration and the backup configuration files become damaged beyond repair.

To save the most recently committed configuration as the rescue configuration so that you can return to it at any time, issue the **request system configuration rescue save** command:

```
user@host> request system configuration rescue save
```

To return to the rescue configuration, use the **rollback rescue** configuration mode command:

```
[edit]
user@host# rollback rescue
load complete
```

NOTE: If the rescue configuration does not exist, or if the rescue configuration is not a complete, viable configuration, the **rollback** command fails, an error message appears, and the current configuration remains active.

To activate the rescue configuration that you have loaded, use the **commit** command:

```
[edit]
user@host# rollback rescue
load complete
[edit]
user@host# commit
```

To delete an existing rescue configuration, issue the **request system configuration rescue delete** command:


```
user@host> request system configuration rescue delete
user@host>
```

For more information about the **request system configuration rescue delete** and **request system configuration rescue save** commands, see the CLI Explorer.

Saving a Configuration to a File

Save the Junos OS configuration to a file so that you can edit it with a text editor of your choice. You can save your current configuration to an ASCII file, which saves the configuration in its current form, including any uncommitted changes. If more than one user is modifying the configuration, all changes made by all users are saved.

To save software configuration changes to an ASCII file, use the **save** configuration mode command:

```
[edit]
user@host# save filename
[edit]
user@host#
```

The contents of the current level of the statement hierarchy (and below) are saved, along with the statement hierarchy containing it. This allows a section of the configuration to be saved, while fully specifying the statement hierarchy.

By default, the configuration is saved to a file in your home directory, which is on the flash drive.

When you issue this command from anywhere in the hierarchy (except the top level), a **replace** tag is automatically included at the beginning of the file. You can use the **replace** tag to control how a configuration is loaded from a file.

```
user@host> file show /var/home/user/myconf
replace:
protocols {
  bgp {
    disable;
    group int {
      type internal;
    }
  }
  isis {
    disable;
    interface all {
      level 1 disable;
    }
    interface fxp0.0 {
      disable;
    }
  }
  ospf {
    traffic-engineering;
    reference-bandwidth 4g;
    ...
  }
}
```

Related Documentation

- Returning to the Most Recently Committed Junos Configuration on page 1136
- Loading a Configuration from a File on page 1133
- *Viewing Files and Directories on a Device Running Junos OS*

Reverting to the Default Factory Configuration

If for any reason the current active configuration fails, you can revert to the default factory configuration. The default factory configuration contains the basic configuration settings. This is the first configuration of the switch, and it is loaded when the switch is first installed and powered on.

The **load factory default** command is a standard Junos OS configuration command. This configuration command replaces the current active configuration with the default factory configuration.

To revert the switch to the rescue configuration:

1. [edit]
   user@switch# **load factory-default**
   [edit]
   user@switch# **delete system commit factory-settings**
   [edit]
   user@switch# **commit**

Related Documentation

- Understanding Configuration Files on page 1126
- Loading a Previous Configuration File on page 1136
- Reverting to the Rescue Configuration on page 165

Reverting to the Rescue Configuration

If someone inadvertently commits a configuration that denies management access to a QFX Series product and the console port is not accessible, you can overwrite the invalid configuration and replace it with the rescue configuration. The rescue configuration is a previously committed, valid configuration.

To revert the switch to the rescue configuration:

1. Enter the **load override** command.

   [edit]
   user@switch# **load override** *filename*

2. Commit your changes.

   [edit]
   user@switch# **commit** *filename*

Related Documentation

- Setting or Deleting the Rescue Configuration on page 1145
- Reverting to the Default Factory Configuration on page 163

• Configuration File Terms on page 26

Rolling Back Junos OS Configuration Changes

This topic shows how to use the **rollback** command to return to the most recently committed Junos OS configuration. The **rollback** command is useful if you make configuration changes and then decide not to keep the changes.

The following procedure shows how to configure an SNMP health monitor on a device running Junos OS and then return to the most recently committed configuration that does not include the health monitor. When configured, the SNMP health monitor provides the network management system (NMS) with predefined monitoring for file system usage, CPU usage, and memory usage on the device.

1. Enter configuration mode:

   ```
   user@host> configure
   entering configuration mode
   [edit]
   user@host#
   ```

2. Show the current configuration (if any) for SNMP:

   ```
   [edit]
   user@host# show snmp
   ```

   No **snmp** statements appear because SNMP has not been configured on the device.

3. Configure the health monitor:

   ```
   [edit]
   user@host# set snmp health-monitor
   ```

4. Show the new configuration:

   ```
   [edit]
   user@host# show snmp
   health-monitor;
   ```

   The **health-monitor** statement indicates that SNMP health monitoring is configured on the device.

5. Enter the **rollback** configuration mode command to return to the most recently committed configuration:

   ```
   [edit]
   user@host# rollback
   load complete
   ```

6. Show the configuration again to make sure your change is no longer present:

   ```
   [edit]
   user@host# show snmp
   ```

   No **snmp** configuration statements appear. The health monitor is no longer configured.

7. Enter the **commit** command to activate the configuration to which you rolled back:

   ```
   [edit]
   ```



```
user@host# commit
```

8. Exit configuration mode:

```
[edit]
user@host# exit
Exiting configuration mode
```

You can also use the **rollback** command to return to earlier configurations.

Related Documentation

- Returning to the Most Recently Committed Junos Configuration on page 1136

Saving a Configuration to a File

Save the Junos OS configuration to a file so that you can edit it with a text editor of your choice. You can save your current configuration to an ASCII file, which saves the configuration in its current form, including any uncommitted changes. If more than one user is modifying the configuration, all changes made by all users are saved.

To save software configuration changes to an ASCII file, use the **save** configuration mode command:

```
[edit]
user@host# save filename
[edit]
user@host#
```

The contents of the current level of the statement hierarchy (and below) are saved, along with the statement hierarchy containing it. This allows a section of the configuration to be saved, while fully specifying the statement hierarchy.

By default, the configuration is saved to a file in your home directory, which is on the flash drive.

When you issue this command from anywhere in the hierarchy (except the top level), a **replace** tag is automatically included at the beginning of the file. You can use the **replace** tag to control how a configuration is loaded from a file.

```
user@host> file show /var/home/user/myconf
replace:
protocols {
  bgp {
    disable;
    group int {
      type internal;
    }
  }
  isis {
    disable;
    interface all {
      level 1 disable;
    }
    interface fxp0.0 {
      disable;
    }
```



```
  }
  ospf {
    traffic-engineering;
    reference-bandwidth 4g;
    ...
  }
}
```

Setting or Deleting the Rescue Configuration

A rescue configuration is user-defined configuration that restores connectivity to switch. You set a current committed configuration to be the rescue configuration through the CLI. If someone inadvertently commits a configuration that denies management access to a QFX Series product and the console port is not accessible, you can overwrite the invalid configuration and replace it with the rescue configuration. The rescue configuration is a previously committed, valid configuration. We recommend that the rescue configuration include the IP address (accessible from the network) for the management port.

To set the current active configuration as the rescue configuration:

user@switch> **request system configuration rescue save**

To delete an existing rescue configuration:

user@switch> **request system configuration rescue delete**

Related Documentation

- Reverting to the Default Factory Configuration on page 163
- Loading a Previous Configuration File on page 1136
- Configuration File Terms on page 26
- CLI Explorer

Uploading a Configuration File

You can create a configuration file on your local system, copy the file to the switch, and then load the file into the CLI. After you have loaded the configuration file, you can commit it to activate the configuration on the switch. You can also edit the configuration interactively using the CLI and commit it at a later time.

To upload a configuration file from your local system:

1. Create the configuration file using a text editor such as Notepad, making sure that the syntax of the configuration file is correct. For more information about testing the syntax of a configuration file see the *Junos OS System Basics and Services Command Reference* at http://www.juniper.net/techpubs/software/junos/index.html.
2. In the configuration text file, use an option to perform the required action when the file is loaded. Table 98 on page 1146 lists and describes some options for the **load** command.

Table 98: Options for the load Command

Options	Description
merge	Combines the current active configuration and the configuration in the filename you specify or the one that you type at the terminal. A **merge** operation is useful when you are adding a new section to an existing configuration. If the active configuration and the incoming configuration contain conflicting statements, the statements in the incoming configuration override those in the active configuration.
override	Discards the current candidate configuration and loads the configuration in the filename you specify or the one that you type at the terminal. When you use the **override** option and commit the configuration, all system processes reparse the configuration. You can use the **override** option at any level of the hierarchy.
replace	Searches for the **replace** tags, deletes the existing statements of the same name, if any, and replaces them with the incoming configuration. If there is no existing statement of the same name, the **replace** operation adds the statements marked with the **replace** tag to the active configuration. NOTE: For this operation to work, you must include **replace** tags in the text file or in the configuration you type at the terminal.

3. Press Ctrl+a to select all the text in the configuration file.
4. Press Ctrl+c to copy the contents of the configuration text file to the Clipboard.
5. Log in to the switch using your username and password.
6. To enter configuration mode:
   user@switch> **configure**

   You will see this output, with the hash or pound mark indicating configuration mode.
   Entering configuration mode
   [edit]
   user@switch#
7. Load the configuration file:
   [edit]
   user@switch# **load merge terminal**
8. At the cursor, paste the contents of the Clipboard using the mouse and the Paste icon:
   [edit]
   user@switch# **load merge terminal**
   [Type ^D at a new line to end input]
   >Cursor is here. Paste the contents of the clipboard here<
9. Press Enter.
10. Press Ctrl+d to set the end-of-file marker.

To view results of the configuration steps before committing the configuration, type the **show** command at the user prompt.

To commit these changes to the active configuration, type the **commit** command at the user prompt. You can also edit the configuration interactively using the CLI and commit it at a later time.

Related Documentation

- Understanding Configuration Files on page 1126

Using Junos OS to Configure a Router or Switch to Transfer Its Configuration to an Archive Site

You can configure a router or switch to transfer its configuration to an archive file periodically. The following tasks describe how to transfer the configuration to an archive site:

Configuring the Router or Switch to Transfer Its Currently Active Configuration to an Archive

If you want to back up your device's current configuration to an archive site, you can configure the router or switch to transfer its currently active configuration by FTP or secure copy (SCP) periodically or after each commit.

To configure the router or switch to transfer its currently active configuration to an archive site, include statements at the **[edit system archival configuration]** hierarchy level:

```
[edit system archival configuration]
archive-sites {
  ftp://username<:password>@host-address<:port>/url-path;
  scp://username<:password>@host-address<:port>/url-path;
}
transfer-interval interval;
transfer-on-commit;
```

NOTE: When specifying a URL in a Junos OS statement using an IPv6 host address, you must enclose the entire URL in quotation marks ("") and enclose the IPv6 host address in brackets ([ ]). For example, "ftp://*username*<:*password*>@[*ipv6-host-address*]<:*port*>/*url-path*"

Configuring the Transfer Interval for Periodic Transfer of the Active Configuration to an Archive Site

To configure the router or switch to periodically transfer its currently active configuration to an archive site, include the **transfer-interval** statement at the **[edit system archival configuration]** hierarchy level:

```
[edit system archival configuration]
transfer-interval interval;
```

The ***interval*** is a period of time ranging from 15 through 2880 minutes.

Configuring Transfer of the Current Active Configuration When a Configuration Is Committed

To configure the router or switch to transfer its currently active configuration to an archive site each time you commit a candidate configuration, include the **transfer-on-commit** statement at the **[edit system archival configuration]** hierarchy level:

```
[edit system archival configuration]
transfer-on-commit;
```

NOTE: When specifying a URL in a Junos OS statement using an IPv6 host address, you must enclose the entire URL in quotation marks ("") and enclose the IPv6 host address in brackets ([ ]). For example, "scp://*username*<:*password*>@[*ipv6-host-address*]<:*port*>/*url-path*"

Configuring Archive Sites for Transfer of Active Configuration Files

When you configure the router or switch to transfer its configuration files, you specify an archive site to which the files are transferred. If you specify more than one archive site, the router or switch attempts to transfer files to the first archive site in the list, moving to the next site only if the transfer fails.

When you use the **archive-sites** statement, you can specify a destination as an FTP URL, or SCP-style remote file specification. The URL type **file://** is also supported.

To configure the archive site, include the **archive-sites** statement at the **[edit system archival configuration]** hierarchy level:

```
[edit system archival configuration]
archive-sites {
  ftp://username@host:<port>url-path password password;
  scp://username@host:<port>url-path password password;
  file://<path>/<filename>;
}
```

NOTE: When specifying a URL in a Junos OS statement using an IPv6 host address, you must enclose the entire URL in quotation marks ("") and enclose the IPv6 host address in brackets ([ ]). For example, "scp://*username*<:*password*>@[*ipv6-host-address*]<:*port*>/*url-path*"

When you specify the archive site, do not add a forward slash (/) to the end of the URL.

The destination filename is saved in the following format, where *n* corresponds to the number of the compressed configuration rollback file that has been archived:

```
<router-name>_juniper.conf.n.gz_YYYYMMDD_HHMMSS
```

NOTE: The time included in the destination filename is always in Coordinated Universal Time (UTC) regardless of whether the time on the router is configured as UTC or the local time zone. The default time zone on the router or switch is UTC.

Configuration Statements

archival

Syntax

```
archival {
  configuration {
    archive-sites {
      file://<path>/<filename>;
      ftp://username@host:<port>url-path password password;
      http://username@host:<port>url-path password password;
      pasvftp://username@host:<port>url-path password password;
      scp://username@host:<port>url-path password password;
    }
    transfer-interval interval;
    transfer-on-commit;
  }
}
```

Hierarchy Level [edit system]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure copying of the currently active configuration to an archive site. An archive site can be a file, or an FTP or SCP location.

NOTE: The **edit system archival** hierarchy is not available on QFabric systems.

Options The remaining statements are explained separately.

NOTE: The **[edit system archival]** hierarchy is not available on QFabric systems.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Using Junos OS to Configure a Router or Switch to Transfer Its Configuration to an Archive Site on page 1147

archive-sites (Configuration File)

Syntax

```
archive-sites {
  file://<path>/<filename>;
  ftp://username@host:<port>url-path password password;
  http://username@host:<port>url-path password password;
  pasvftp://username@host:<port>url-path password password;
  scp://username@host:<port>url-path password password;
}
```

Hierarchy Level [edit system archival configuration]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify where to transfer the current configuration files. When specifying a URL in a Junos OS statement using an IPv6 host address, you must enclose the entire URL in quotation marks (" ") and enclose the IPv6 host address in brackets ([ ]). For example, **"scp://*username*<:*password*>@[*ipv6-host-address*]<:*port*>/*url-path*"**

If you specify more than one archive site, the router or switch attempts to transfer the configuration files to the first archive site in the list, moving to the next only if the transfer fails.

The destination filename is saved in the following format, where *n* corresponds to the number of the compressed configuration rollback file that has been archived:

*router-name*_juniper.conf.*n*.gz_*YYYYMMDD*_*HHMMSS*.

NOTE: The time included in the destination filename is always in Coordinated Universal Time (UTC) regardless of whether the time on the router or switch is configured as UTC or the local time zone. The default time zone on the router or switch is UTC.

NOTE: The [edit system archival] hierarchy is not available on QFabric systems.

Options The prefix used in the configuration statement determines the form of transfer:

file:// —transfer on a path to a named file

ftp:// —transfer using active FTP server

pasvftp:// —transfer to a device that only accepts passive FTP services

scp:// —transfer to a known host using background SCP file transfers

Required Privilege Level
system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation
- Configuring Archive Sites for Transfer of Active Configuration Files on page 1148
- Junos OS Commit Model for Router or Switch Configuration on page 29
- **configuration on page 1153**
- **transfer-on-commit on page 1155**

configuration

Syntax

```
configuration {
  transfer-interval interval;
  transfer-on-commit;
  archive-sites {
    file://<path>/<filename>;
    ftp://username@host:<port>url-path password password;
    http://username@host:<port>url-path password password;
    pasvftp://username@host:<port>url-path password password;
    scp://username@host:<port>url-path password password;
  }
}
```

Hierarchy Level [edit system archival]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the router or switch to periodically transfer its currently active configuration (or after each commit).

NOTE: The [edit system archival] hierarchy is not available on QFabric systems.

Options The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Using Junos OS to Configure a Router or Switch to Transfer Its Configuration to an Archive Site on page 1147
- archive on page 6299
- archive-sites on page 1151
- transfer-interval on page 1154
- transfer-on-commit on page 1155

transfer-interval (Configuration)

Syntax transfer-interval *interval*;

Hierarchy Level [edit system archival configuration]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the router or switch to periodically transfer its currently active configuration to an archive site.

NOTE: The edit system archival hierarchy is not available on QFabric systems.

Options *interval*—Interval at which to transfer the current configuration to an archive site.

Range: 15 through 2880 minutes

NOTE: The [edit system archival] hierarchy is not available on QFabric systems.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Transfer Interval for Periodic Transfer of the Active Configuration to an Archive Site on page 1147
- archive on page 6299
- configuration on page 1153
- transfer-on-commit on page 1155

transfer-on-commit

Syntax transfer-on-commit;

Hierarchy Level [edit system archival configuration]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the router or switch to transfer its currently active configuration to an archive site each time you commit a candidate configuration.

NOTE: When specifying a URL in a Junos OS statement using an IPv6 host address, you must enclose the entire URL in quotation marks (" ") and enclose the IPv6 host address in brackets ([ ]). For example, "ftp://*username*<:*password*>@[*ipv6-host-address*]<:*port*>/*url-path*" .

NOTE: The **[edit system archival]** hierarchy is not available on QFabric systems.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring Transfer of the Current Active Configuration When a Configuration Is Committed on page 1148
- archive on page 6299
- configuration on page 1153
- transfer-interval on page 1154

Default Configurations

QFX3500 Switch Default Configuration

Each QFX Series product is programmed with a factory default configuration that contains the values set for each configuration parameter when a switch is shipped. The default configuration file sets values for system parameters such as **syslog** and **commit**, configures storm control and Ethernet switching on all interfaces, and enables IGMP snooping, RSTP, and LLDP protocols.

When you commit changes to the configuration, a new configuration file is created, which becomes the active configuration. You can always revert to the factory default configuration if you need to.

The following factory default configuration file is for a QFX3500 switch with 48 ports:

NOTE: In this example, xe-0/0/0 through xe-0/0/47 are the network interface ports.

```
protocols {
  igmp-snooping {
    vlan all;
  }
  rstp;
    lldp {
    interface all;
  }
}
interfaces {
  xe-0/0/0 {
    unit 0 {
      family ethernet-switching;
    }
  }
  xe-0/0/1 {
    unit 0 {
      family ethernet-switching;
    }
  }
  xe-0/0/2 {
    unit 0 {
      family ethernet-switching;
    }
  }
  xe-0/0/3 {
    unit 0 {
      family ethernet-switching;
    }
  }
  xe-0/0/4 {
    unit 0 {
      family ethernet-switching;
    }
  }
  xe-0/0/5 {
    unit 0 {
      family ethernet-switching;
    }
  }
  xe-0/0/6 {
    unit 0 {
      family ethernet-switching;
    }
```

```
}
xe-0/0/7 {
  unit 0 {
    family ethernet-switching;
  }
}
xe-0/0/8 {
  unit 0 {
    family ethernet-switching;
  }
}
xe-0/0/9 {
  unit 0 {
    family ethernet-switching;
  }
}
xe-0/0/10 {
  unit 0 {
    family ethernet-switching;
  }
}
xe-0/0/11 {
  unit 0 {
    family ethernet-switching;
  }
}
xe-0/0/12 {
  unit 0 {
    family ethernet-switching;
  }
}
xe-0/0/13 {
  unit 0 {
    family ethernet-switching;
  }
}
xe-0/0/14 {
  unit 0 {
    family ethernet-switching;
  }
}
xe-0/0/15 {
  unit 0 {
    family ethernet-switching;
  }
}
xe-0/0/16 {
  unit 0 {
    family ethernet-switching;
  }
}
xe-0/0/17 {
  unit 0 {
    family ethernet-switching;
  }
}
```

```
xe-0/0/18 {
   unit 0 {
      family ethernet-switching;
   }
}
xe-0/0/19 {
   unit 0 {
      family ethernet-switching;
   }
}
xe-0/0/20 {
   unit 0 {
      family ethernet-switching;
   }
}
xe-0/0/21 {
   unit 0 {
      family ethernet-switching;
   }
}
xe-0/0/22 {
   unit 0 {
      family ethernet-switching;
   }
}
xe-0/0/23 {
   unit 0 {
      family ethernet-switching;
   }
}
xe-0/0/24 {
   unit 0 {
      family ethernet-switching;
   }
}
xe-0/0/25 {
   unit 0 {
      family ethernet-switching;
   }
}
xe-0/0/26 {
   unit 0 {
      family ethernet-switching;
   }
}
xe-0/0/27 {
   unit 0 {
      family ethernet-switching;
   }
}
xe-0/0/28 {
   unit 0 {
      family ethernet-switching;
   }
}
xe-0/0/29 {
```

```
    unit 0 {
        family ethernet-switching;
    }
}
xe-0/0/30 {
    unit 0 {
        family ethernet-switching;
    }
}
xe-0/0/31 {
    unit 0 {
        family ethernet-switching;
    }
}
xe-0/0/32 {
    unit 0 {
        family ethernet-switching;
    }
}
xe-0/0/33 {
    unit 0 {
        family ethernet-switching;
    }
}
xe-0/0/34 {
    unit 0 {
        family ethernet-switching;
    }
}
xe-0/0/35 {
    unit 0 {
        family ethernet-switching;
    }
}
xe-0/0/36 {
    unit 0 {
        family ethernet-switching;
    }
}
xe-0/0/37 {
    unit 0 {
        family ethernet-switching;
    }
}
xe-0/0/38 {
    unit 0 {
        family ethernet-switching;
    }
}
xe-0/0/39 {
    unit 0 {
        family ethernet-switching;
    }
}
xe-0/0/40 {
    unit 0 {
```

```
            family ethernet-switching;
        }
    }
    xe-0/0/41 {
        unit 0 {
            family ethernet-switching;
        }
    }
    xe-0/0/42 {
        unit 0 {
            family ethernet-switching;
        }
    }
    xe-0/0/43 {
        unit 0 {
            family ethernet-switching;
        }
    }
    xe-0/0/44 {
        unit 0 {
            family ethernet-switching;
        }
    }
    xe-0/0/45 {
        unit 0 {
            family ethernet-switching;
        }
    }
    xe-0/0/46 {
        unit 0 {
            family ethernet-switching;
        }
    }
    xe-0/0/47 {
        unit 0 {
            family ethernet-switching;
        }
    }
}
ethernet-switching-options {
    storm-control {
        interface all;
    }
}
system {
    syslog {
        archive size 256k;
        file default-log-messages {
            structured-data;
        }
        user * {
            any emergency;
        }
        file messages {
            any notice;
            authorization info;
```

```
        }
        file interactive-commands {
            interactive-commands any;
        }
    }
    ports {
        console type vt100;
    }
    compress-configuration-files;
    login {
        password {
            minimum-length 6;
            minimum-changes 1;
            change-type set transitions;
            format md5;
        }
    }
    commit {
        factory-settings {
            reset-chassis-lcd-menu;
        }
    }
}
```

Related Documentation

- Reverting to the Default Factory Configuration on page 163
- Configuring a QFX3500 Device as a Standalone Switch on page 151
- Understanding Configuration Files on page 1126
- Interfaces Overview on page 1839

Configuration Examples

- Examples: Loading a Configuration from a File on page 1161

Examples: Loading a Configuration from a File

Figure 11: Overriding the Current Configuration

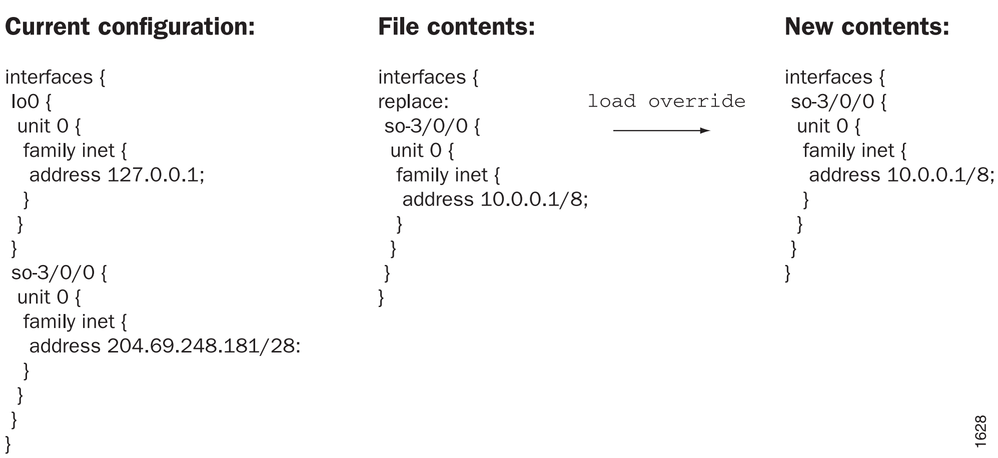

Figure 12: Using the replace Option

Current configuration:

```
interfaces {
 lo0 {
  unit 0 {
   family inet {
    address 127.0.0.1;
   }
  }
 }
 so-3/0/0 {
  unit 0 {
   family inet {
    address 204.69.248.181/28:
   }
  }
 }
}
```

File contents:

```
interfaces {
replace:
 so-3/0/0 {
  unit 0 {
   family inet {
    address 10.0.0.1/8;
   }
  }
 }
}
```

load replace →

New contents:

```
interfaces {
 lo0 {
  unit 0 {
   family inet {
    address 127.0.0.1;
   }
  }
 }
so-3/0/0 {
 unit 0 {
  family inet {
   address 10.0.0.1/8;
   }
  }
 }
}
```

h1629

Figure 13: Using the merge Option

Current configuration:

```
interfaces {
 lo0 {
  unit 0 {
   family inet {
    address 127.0.0.1;
   }
  }
 }
 so-3/0/0 {
  unit 0 {
   family inet {
    address 204.69.248.181/28;
   }
  }
 }
}
```

File contents:

```
interfaces {
replace:
 so-3/0/0 {
  unit 0 {
   family inet {
    address 10.0.0.1/8;
   }
  }
 }
}
```

load merge →

New contents:

```
interfaces {
 lo0 {
  unit 0 {
   family inet {
    address 127.0.0.1;
   }
  }
 }
 so-3/0/0 {
  unit 0 {
   family inet {
    address 10.0.0.1/8;
    address 204.69.248.181/28;
   }
  }
 }
}
```

1705

Figure 14: Using a Patch File

Current configuration:

```
interfaces {
 fxp0 {
  unit 0 {
   family inet {
    address 192.168.6.193/24;
   }
  }
 }
lo0 {
  unit 0 {
   family inet {
    address 127.0.0.1/32;
   }
  }
 }
}
```

File contents:

```
{edit interfaces}
+ so-0/0/0 {
+  unit 0 {
+   family inet {
+    address 10.0.0.1/8;
+   }
+  }
+ }
```

load patch →

New contents:

```
interfaces {
 so-0/0/0 {
  unit 0 {
   family inet {
    address 10.0.0.1/8;
   }
  }
 }
fxp0 {
  unit 0 {
   family inet {
    address 192.168.6.193/24;
   }
  }
 }
lo0 {
 unit 0 {
  family inet {
   address 127.0.0.1/32;
   }
  }
 }
}
```

h1969

Figure 15: Using the set Option

File contents:

```
edit access
set profile p1 client cl ike
edit profile p1 client cl ike
set pre-shared-key ascii-text "abcd"
set allowed-proxy-pair local 1.1.1.1 remote 2.2.2.2
exit
deactivate profile p1
top
edit system
set radius-server 1.1.1.1
```

load set ↓

New contents:

```
system {
   radius-server {
      1.1.1.1;
   }
}
access {
   inactive: profile p1 {
      client cl {
         ike {
            allowed-proxy-pair local 1.1.1.1/32 remote 2.2.2.2/32;
            pre-shared-key ascii-text "$9$Ydg4ZDjqf5FVw"; ## SECRET-DATA
         }
      }
   }
}
```

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Related Documentation

- Loading a Configuration from a File on page 1133

CHAPTER 10

Administration

Operational Commands

- clear log
- clear system commit
- file archive
- file checksum md5
- file checksum sha1
- file checksum sha-256
- file compare
- file delete
- file list
- file rename
- file show
- request system configuration rescue delete
- request system configuration rescue save
- show system commit
- show system configuration archival
- show system configuration rescue
- show system rollback
- test configuration

clear log

Syntax

clear log *filename*
<all>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Remove contents of a log file.

Options

filename—Name of the specific log file to delete.

all—(Optional) Delete the specified log file and all archived versions of it.

Required Privilege Level

clear

Related Documentation

• show log on page 846

List of Sample Output

clear log on page 1166

Output Fields

See file list for an explanation of output fields.

Sample Output

clear log

The following sample commands list log file information, clear the contents of a log file, and then display the updated log file information:

```
user@host> file list lcc0-re0:/var/log/sampled detail
lcc0-re0:
--------------------------------------------------------------------------
-rw-r-----  1 root  wheel      26450 Jun 23 18:47 /var/log/sampled
total 1

user@host> clear log lcc0-re0:sampled
lcc0-re0:
--------------------------------------------------------------------------

user@host> file list lcc0-re0:/var/log/sampled detail
lcc0-re0:
--------------------------------------------------------------------------
-rw-r-----  1 root  wheel         57 Sep 15 03:44 /var/log/sampled
total 1
```

clear system commit

Syntax clear system commit

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear any pending commit operation.

Options This command has no options.

Required Privilege Level maintenance (or the actual user who scheduled the commit)

Related Documentation

- show system commit on page 898

List of Sample Output

clear system commit on page 1167
clear system commit (None Pending) on page 1167
clear system commit (User Does Not Have Required Privilege Level) on page 1167

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear system commit

```
user@host> clear system commit
Pending commit cleared.
```

clear system commit (None Pending)

```
user@host> clear system commit
No commit scheduled.
```

clear system commit (User Does Not Have Required Privilege Level)

```
user@host> clear system commit
error: Permission denied
```

file archive

Syntax

```
file archive destination destination source source
<compress>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Archive, and optionally compress, one or multiple local system files as a single file, locally or at a remote location.

Options

destination ***destination***—Destination of the archived file or files. Specify the destination as a URL or filename. The Junos OS adds one of the following suffixes if the destination filename does not already have it:

- For archived files—The suffix **.tar**
- For archived and compressed files—The suffix **.tgz**

source ***source***—Source of the original file or files. Specify the source as a URL or filename.

compress—(Optional) Compress the archived file with the GNU zip (gzip) compression utility. The compressed files have the suffix **.tgz**.

Required Privilege Level

maintenance

Related Documentation

- Format for Specifying Filenames and URLs in Junos OS CLI Commands on page 57

List of Sample Output

file archive (Multiple Files) on page 1168
file archive (Single File) on page 1168
file archive (with Compression) on page 1169

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

file archive (Multiple Files)

The following sample command archives all message files in the local directory **/var/log/messages** as the single file **messages-archive.tar**.

```
user@host> file archive source /var/log/messages* destination /var/log/messages-archive.tar
/usr/bin/tar: Removing leading / from absolute path names in the archive.

user@host>
```

file archive (Single File)

The following sample command archives one message file in the local directory **/var/log/messages** as the single file **messages-archive.tar**.

```
user@host> file archive source /var/log/messages destination /var/log/messages-archive.tar
/usr/bin/tar: Removing leading / from absolute path names in the archive.
user@host
```

file archive (with Compression)

The following sample command archives and compresses all message files in the local directory **/var/log/messages** as the single file **messages-archive.tgz**.

```
user@host> file archive compress source /var/log/messages* destination
/var/log/messages-archive.tgz
/usr/bin/tar: Removing leading / from absolute path names in the archive.
```


file checksum md5

Syntax file checksum md5 <*pathname*> *filename*

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Calculate the Message Digest 5 (MD5) checksum of a file.

Options ***pathname***—(Optional) Path to a filename.

filename—Name of a local file for which to calculate the MD5 checksum.

Required Privilege Level maintenance

Related Documentation

- *Configuring Checksum Hashes for a Commit Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Event Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Op Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Executing an Op Script from a Remote Site* in the *Junos OS Configuration and Operations Automation Guide*
- file checksum sha-256 on page 338
- file checksum sha1 on page 337
- *op*

List of Sample Output file checksum md5 on page 1170

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

file checksum md5

```
user@host> file checksum md5 jbundle-5.3R2.4-export-signed.tgz
MD5 (jbundle-5.3R2.4-export-signed.tgz) = 2a3b69e43f9bd4893729cc16f505a0f5
```

file checksum sha1

Syntax file checksum sha1 <*pathname*> *filename*

Release Information Command introduced in Junos OS Release 9.5.
Command introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Calculate the Secure Hash Algorithm (SHA-1) checksum of a file.

Options ***pathname***—(Optional) Path to a filename.

filename—Name of a local file for which to calculate the SHA-1 checksum.

Required Privilege Level maintenance

Related Documentation

- *Configuring Checksum Hashes for a Commit Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Event Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Op Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Executing an Op Script from a Remote Site* in the *Junos OS Configuration and Operations Automation Guide*
- file checksum md5 on page 336
- file checksum sha-256 on page 338
- *op*

List of Sample Output file checksum sha1 on page 1171

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

file checksum sha1

```
user@host> file checksum sha1 /var/db/scripts/opscript.slax

SHA1 (/var/db/scripts/commitscript.slax) = ba9e47120c7ce55cff29afd73eacd370e162c676
```


file checksum sha-256

Syntax file checksum sha-256 <*pathname*> *filename*

Release Information Command introduced in Junos OS Release 9.5.
Command introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Calculate the Secure Hash Algorithm 2 family (SHA-256) checksum of a file.

Options ***pathname***—(Optional) Path to a filename.

filename—Name of a local file for which to calculate the SHA-256 checksum.

Required Privilege Level maintenance

Related Documentation

- *Configuring Checksum Hashes for a Commit Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Event Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Configuring Checksum Hashes for an Op Script* in the *Junos OS Configuration and Operations Automation Guide*
- *Executing an Op Script from a Remote Site* in the *Junos OS Configuration and Operations Automation Guide*
- file checksum md5 on page 336
- file checksum sha1 on page 337
- *op*

List of Sample Output file checksum sha-256 on page 1172

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

file checksum sha-256

```
user@host> file checksum sha-256 /var/db/scripts/commitscript.slax

SHA256 (/var/db/scripts/commitscript.slax) =
94c2b061fb55399e15babd2529453815601a602b5c98e5c12ed929c9d343dd71
```


file compare

Syntax

file compare (files *filename filename*)
<context | unified>
<ignore-white-space>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Compare two local files and describe the differences between them in default, context, or unified output styles:

- **Default**—In the first line of output, **c** means lines were changed between the two files, **d** means lines were deleted between the two files, and **a** means lines were added between the two files. The numbers preceding this alphabetical marker represent the first file, and the lines after the alphabetical marker represent the second file. A left angle bracket (**<**) in front of output lines refers to the first file. A right angle bracket (**>**) in front of output lines refers to the second file.
- **Context**—The display is divided into two parts. The first part is the first file; the second part is the second file. Output lines preceded by an exclamation point (**!**) have changed. Additions are marked with a plus sign (**+**), and deletions are marked with a minus sign (**-**).
- **Unified**—The display is preceded by the line number from the first and the second file (*xx*,*xxx*,*x*). Before the line number, additions to the file are marked with a plus sign (**+**), and deletions to the file are marked with a minus sign (**-**). The body of the output contains the affected lines. Changes are viewed as additions plus deletions.

Options

files *filename*—Names of two local files to compare.

context—(Optional) Display output in context format.

ignore-white-space—(Optional) Ignore changes in the amount of white space.

unified—(Optional) Display output in unified format.

Required Privilege Level

none

Related Documentation

- Format for Specifying Filenames and URLs in Junos OS CLI Commands on page 57
- Viewing Core Files from Junos OS Processes on page 171

List of Sample Output

file compare files on page 1174
file compare files context on page 1174
file compare files unified on page 1174
file compare files unified ignore-white-space on page 1174

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

file compare files

```
user@host> file compare files /tmp/one /tmp/two
100c100
<              full-name "File 1";
---
>              full-name "File 2";
102c102
<              class foo; # 'foo' is not defined
---
>              class super-user;
```

file compare files context

```
user@host> file compare files /tmp/one /tmp/two context
*** /tmp/one    Wed Dec  3 17:12:50 2003
--- /tmp/two    Wed Dec  3 09:13:14 2003
***************
*** 97,104 ****
              }
          }
          user bill {
!             full-name "Bill Smith";
!             class foo; # 'foo' is not defined
              authentication {
                  encrypted-password SECRET;
              }
--- 97,105 ----
              }
          }
          user bill {
!             full-name "Bill Smith";
!             uid 1089;
!             class super-user;
              authentication {
                  encrypted-password SECRET;
              }
```

file compare files unified

```
user@host> file compare files /tmp/one /tmp/two unified
--- /tmp/one    Wed Dec  3 17:12:50 2003
+++ /tmp/two    Wed Dec  3 09:13:14 2003
@@ -97,8 +97,9 @@
             }
         }
         user bill {
-            full-name "Bill Smith";
-            class foo; # 'foo' is not defined
+            full-name "Bill Smith";
+            uid 1089;
+            class super-user;
             authentication {
                 encrypted-passwordSECRET;
             }
```

file compare files unified ignore-white-space

```
user@host> file compare files /tmp/one /tmp/two unified ignore-white-space
```



```
--- /tmp/one    Wed Dec  3 09:13:10 2003
+++ /tmp/two    Wed Dec  3 09:13:14 2003
@@ -99,7 +99,7 @@
         user bill {
             full-name "Bill Smith";
             uid 1089;
-            class foo; # 'foo' is not defined
+            class super-user;
             authentication {
                  encrypted-password <SECRET>; # SECRET-DATA
             }
```


file delete

Syntax file delete *filename*
<purge>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Delete a file on the local router or switch.

Options ***filename***—Name of the file to delete. For a routing matrix, include chassis information in the filename if the file to be deleted is not local to the Routing Engine from which the command is issued.

purge—(Optional) Overwrite regular files before deleting them.

Required Privilege Level maintenance

List of Sample Output file delete on page 1176
file delete (Routing Matrix) on page 1176

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

file delete

```
user@host> file list /var/tmp
dcd.core
rpd.core
snmpd.core

user@host> file delete /var/tmp/snmpd.core
user@host> file list /var/tmp
dcd.core
rpd.core
```

file delete (Routing Matrix)

```
user@host> file list lcc0-re0:/var/tmp
dcd.core
rpd.core
snmpd.core

user@host> file delete lcc0-re0:/var/tmp/snmpd.core
user@host> file list /var/tmp
dcd.core
rpd.core
```

file list

Syntax

file list
<detail | recursive>
<*filename*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display a list of files on the local router or switch.

Options

none—Display a list of all files for the current directory.

detail | recursive—(Optional) Display detailed output or descend recursively through the directory hierarchy, respectively.

filename—(Optional) Display a list of files. For a routing matrix, the filename must include the chassis information.

Additional Information

The default directory is the home directory of the user logged in to the router or switch. To view available directories, enter a space and then a backslash (/) after the **file list** command. To view files within a specific directory, include a backslash followed by the directory and, optionally, subdirectory name after the **file list** command.

Required Privilege Level

maintenance

List of Sample Output

file list on page 1177
file list (Routing Matrix) on page 1177

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

file list

```
user@host> file list /var/tmp
dcd.core
rpd.core
snmpd.core
```

file list (Routing Matrix)

```
user@host> file list lcc0-re0:var/tmp
lcc0-re0:
--------------------------------------------------------------------------
/var/tmp/:
.gdbinit
.pccardd
Test/
chassisd*
chassisd.nathan*
check_time*
```



```
cores/
diagTestPrep*
diagtest*
diagtest.regress*
do_switchovers*
dump_test*
err.manoj.log
esw_clearstats*
esw_counter*
esw_debug*
esw_debug_ge*
esw_filt_test*
esw_filter_tnp_addr*
esw_getstats*
esw_phy*
esw_stats*
```


file rename

Syntax file rename *source destination*

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Rename a file on the local router or switch.

Options ***destination***—New name for the file.

source—Original name of the file. For a routing matrix, the filename must include the chassis information.

Required Privilege Level maintenance

List of Sample Output file rename on page 1179
file rename (Routing Matrix) on page 1179

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

file rename

The following example lists the files in **/var/tmp**, renames one of the files, and then displays the list of files again to reveal the newly named file.

```
user@host> file list /var/tmp
dcd.core
rpd.core
snmpd.core

user@host> file rename /var/tmp/dcd.core /var/tmp/dcd.core.990413
user@host> file list /var/tmp
dcd.core.990413
rpd.core
snmpd.core
```

file rename (Routing Matrix)

The following example lists the files in **/var/tmp**, renames one of the files, and then displays the list of files again to reveal the newly named file.

```
user@host> file list lcc0-re1:/var/tmp
lcc0-re1:
--------------------------------------------------------------------------

/var/tmp:
.pccardd
sartre.conf
snmpd
syslogd.core-tarball.0.tgz
```



```
user@host> file rename lcc0-re0:/var/tmp/snmpd /var/tmp/snmpd.rr
user@host> file list lcc0-re1:/var/tmp
lcc0-re1:
--------------------------------------------------------------------------

/var/tmp:
.pccardd
sartre.conf
snmpd.rr
syslogd.core-tarball.0.tgz
```

file show

Syntax

file show *filename*
<encoding (base64 | raw)>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the contents of a file.

Options

filename—Name of a file. For a routing matrix, the filename must include the chassis information.

encoding (base64 | raw)—(Optional) Encode file contents with base64 encoding or show raw text.

Required Privilege Level

maintenance

List of Sample Output

file show on page 1181
file show (Routing Matrix) on page 1181

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

file show

```
user@host> file show /var/log/messages
Apr 13 21:00:08 romney /kernel: so-1/1/2: loopback suspected; going to standby.
Apr 13 21:00:40 romney /kernel: so-1/1/2: loopback suspected; going to standby.
Apr 13 21:02:48 romney last message repeated 4 times
Apr 13 21:07:04 romney last message repeated 8 times
Apr 13 21:07:13 romney /kernel: so-1/1/0: Clearing SONET alarm(s) RDI-P
Apr 13 21:07:29 romney /kernel: so-1/1/0: Asserting SONET alarm(s) RDI-P
...
```

file show (Routing Matrix)

```
user@host> file show lcc0-re0:/var/tmp/.gdbinit
lcc0-re0:
--------------------------------------------------------------------------
####################################################################
# Settings
####################################################################

set print pretty

####################################################################
# Basic stuff
####################################################################

define msgbuf
        printf "%s", msgbufp->msg_ptr
end
```



```
# hex dump of a block of memory
# usage: dump address length
define dump
   p $arg0, $arg1
   set $ch = $arg0
   set $j = 0
   set $n = $arg1
   while ($j < $n)
        #printf "%x %x ",&$ch[$j],$ch[$j]
        printf "%x ",$ch[$j]
        set $j = $j + 1
        if (!($j % 16))
                printf "\n"
        end
   end
end
```


request system configuration rescue delete

Syntax request system configuration rescue delete

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Delete an existing rescue configuration.

NOTE: The **[edit system configuration]** hierarchy is not available on QFabric systems.

Options This command has no options.

Required Privilege Level maintenance

Related Documentation

- request system configuration rescue save on page 372
- request system software rollback on page 428
- show system commit on page 898

List of Sample Output request system configuration rescue delete on page 1183

Output Fields This command produces no output.

Sample Output

request system configuration rescue delete

```
user@host> request system configuration rescue delete
```

request system configuration rescue save

Syntax
request system configuration rescue save

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description
Save the most recently committed configuration as the rescue configuration so that you can return to it at any time by using the **rollback** command.

NOTE: The **[edit system configuration]** hierarchy is not available on QFabric systems.

Options
This command has no options.

Required Privilege Level
maintenance

Related Documentation

- request system software delete on page 400
- request system software rollback on page 428
- show system commit on page 898

List of Sample Output
request system configuration rescue save on page 1184

Output Fields
This command produces no output.

Sample Output

request system configuration rescue save

```
user@host> request system configuration rescue save
```

show system commit

Syntax	show system commit
Release Information	Command introduced before Junos OS Release 7.4. Command introduced in Junos OS Release 9.0 for EX Series switches. Command introduced in Junos OS Release 11.1 for the QFX Series.
Description	Display the system commit history and any pending commit operation.
Options	This command has no options.
Required Privilege Level	view
Related Documentation	• clear system commit on page 328
List of Sample Output	show system commit on page 1186 show system commit (At a Particular Time) on page 1186 show system commit (At the Next Reboot) on page 1186 show system commit (Rollback Pending) on page 1186 show system commit (QFX Series) on page 1186
Output Fields	Table 82 on page 898 describes the output fields for the **show system commit** command. Output fields are listed in the approximate order in which they appear.

Table 99: show system commit Output Fields

Field Name	Field Description
Junos XML protocol	Displays the last 50 commit operations listed, most recent to first. The identifier **Junos XML protocol** designates a configuration created for recovery using the **request system configuration rescue save** command.
Junos XML protocol	Date and time of the commit operation.
Junos XML protocol	User who executed the commit operation.
Junos XML protocol	Method used to execute the commit operation: • **Junos XML protocol**—CLI interactive user performed the commit operation. • **Junos XML protocol**—Junos XML protocol client performed the commit operation. • **synchronize**—The **commit synchronize** command was performed on the other Routing Engine. • **snmp**—An SNMP **set** request caused the commit operation. • **button**—A button on the router or switch was pressed to commit a rescue configuration for recovery. • **autoinstall**—A configuration obtained through autoinstallation was committed. • **other**—When there is no login name associated with the session, the values for user and client default to root and other. For example, during a reboot after package installation, mgd commits the configuration as a system commit, and there is no login associated with the commit.

Sample Output

show system commit

```
user@host> show system commit
0   2003-07-28 19:14:04 PDT by root via other
1   2003-07-25 22:01:36 PDT by regress via cli
2   2003-07-25 22:01:32 PDT by regress via cli
3   2003-07-25 21:30:13 PDT by root via button
4   2003-07-25 13:46:48 PDT by regress via cli
5   2003-07-25 05:33:21 PDT by root via autoinstall
...
rescue  2002-05-10 15:32:03 PDT by root via other
```

show system commit (At a Particular Time)

```
user@host> show system commit
commit requested by root via cli at Tue May  7 15:59:00 2002
```

show system commit (At the Next Reboot)

```
user@host> show system commit
commit requested by root via cli at reboot
```

show system commit (Rollback Pending)

```
user@host> show system commit
0 2005-01-05 15:00:37 PST by root via cli commit confirmed, rollback in 3mins
```

show system commit (QFX Series)

```
user@switch> show system commit
0   2011-11-25 19:17:49 PST by root via cli
```

show system configuration archival

Syntax show system configuration archival

Release Information Introduced in Junos OS Release 7.6.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display directory and number of files queued for archival transfer.

NOTE: The **[edit system configuration]** hierarchy is not available on QFabric systems.

Options This command has no options.

Required Privilege Level maintenance

List of Sample Output show system configuration archival on page 1187

Sample Output

show system configuration archival

```
user@host> show system configuration archival

/var/transfer/config/:
total 8
```

show system configuration rescue

Syntax show system configuration rescue

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display a rescue configuration, if one exists.

NOTE: The [edit system configuration] hierarchy is not available on QFabric systems.

Options This command has no options.

Required Privilege Level maintenance

Related Documentation

- show system configuration archival on page 900

List of Sample Output show system configuration rescue on page 1188

Sample Output

show system configuration rescue

```
user@switch> show system configuration rescue
version "7.3"; groups {
    global {
        system {
            host-name router1;
            domain-name customer.net;
            domain-search [ customer.net ];
            backup-router 192.168.124.254;
            name-server {
                172.17.28.11;
                172.17.28.101;
                172.17.28.100;
                172.17.28.10;
            }
            login {
                user regress {
                    uid 928;
                    class ;
                    shell csh;
                    authentication {
                        encrypted-password "$1$kPU..$w.4FGRAGanJ8U4Yq6sbj7."; ##
 SECRET-DATA
                    }
                }
            }
            services {
```

```
                    ftp;
                    rlogin;
                    rsh;
                    telnet;
                }
            }
        }
....
```

show system rollback

Syntax

show system rollback *number*
<compare *number*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the contents of a previously committed configuration, or the differences between two previously committed configurations.

NOTE: **The show system rollback command is a purely operational mode command and cannot be issued with run from the configuration mode.**

Options

number—Number of a configuration to view. The output displays the configuration. The range of values is 0 through 49.

compare *number* —(Optional) Number of another previously committed (rollback) configuration to compare to rollback ***number***. The output displays the differences between the two configurations. The range of values is 0 through 49.

Required Privilege Level

view

List of Sample Output

show system rollback compare on page 1190

Sample Output

show system rollback compare

```
user@host> show system rollback 3 compare 1
[edit]
+  interfaces {
+      ge-1/1/1 {
+          unit 0 {
+              family inet {
+                  filter {
+                      input mf_plp;
+                  }
+                  address 14.1.1.1/30;
+              }
+          }
+      }
+      ge-1/2/1 {
+          unit 0 {
+              family inet {
+                  filter {
+                      input mf_plp;
+                  }
+                  address 13.1.1.1/30;
+              }
```

```
+           }
+       }
+       ge-1/3/0 {
+           unit 0 {
+               family inet {
+                   filter {
+                       input mf_plp;
+                   }
+                   address 12.1.1.1/30;
+               }
+           }
+       }
+}
```

test configuration

Syntax test configuration *filename*

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Verify that the syntax of a configuration file is correct. If the configuration contains any syntax or commit check errors, a message is displayed to indicate the line number and column number in which the error was found.

Options *filename*—Name of the configuration file.

syntax-only—Check the syntax of a partial configuration file, without checking for commit errors. This option introduced in Junos OS Release 12.1.

Required Privilege Level view

List of Sample Output test configuration on page 1192

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

test configuration

```
user@host> test configuration terminal
[Type ^D to end input]
system {
host-name bluesky;
paris-23;
login;
}
terminal:3:(8) syntax error: paris
  [edit system]
    'paris-23;'
      syntax error
terminal:4:(11) statement must contain additional statements: ;
  [edit system login]
    'login ;'
      statement must contain additional statements
configuration syntax failed
```


CHAPTER 11

Troubleshooting

Troubleshooting Procedures

Loading a Previous Configuration File

You can use the **rollback** <*number* command to return to a previously committed configuration file. A switch saves the last 50 committed configurations, including the rollback number, date, time, and name of the user who issued the **commit** configuration command.

Syntax

rollback <*number*>

Options

- **none**— Return to the most recently saved configuration.
- *number*—Configuration to return to.
  - **Range**: 0 through 49. The most recently saved configuration is number 0, and the oldest saved configuration is number 49.
  - **Default**: 0

To return to a configuration prior to the most recently committed one:

1. Specify the rollback number (here, 1 is entered and the configuration returns to the previously committed configuration):

   ```
   [edit]
   user@switch# rollback 1
   load complete
   ```

2. Activate the configuration you have loaded:

   ```
   [edit]
   ```

```
user@switch# commit
```

Related Documentation

- Configuration File Terms on page 26

Reverting to the Default Factory Configuration

If for any reason the current active configuration fails, you can revert to the default factory configuration. The default factory configuration contains the basic configuration settings. This is the first configuration of the switch, and it is loaded when the switch is first installed and powered on.

The **load factory default** command is a standard Junos OS configuration command. This configuration command replaces the current active configuration with the default factory configuration.

To revert the switch to the rescue configuration:

1.
```
[edit]
user@switch# load factory-default
[edit]
user@switch# delete system commit factory-settings
[edit]
user@switch# commit
```

Related Documentation

- Understanding Configuration Files on page 1126
- Loading a Previous Configuration File on page 1136
- Reverting to the Rescue Configuration on page 165

Reverting to the Rescue Configuration

If someone inadvertently commits a configuration that denies management access to a QFX Series product and the console port is not accessible, you can overwrite the invalid configuration and replace it with the rescue configuration. The rescue configuration is a previously committed, valid configuration.

To revert the switch to the rescue configuration:

1. Enter the **load override** command.

```
[edit]
user@switch# load override filename
```

2. Commit your changes.

```
[edit]
user@switch# commit filename
```

Related Documentation

- Setting or Deleting the Rescue Configuration on page 1145
- Reverting to the Default Factory Configuration on page 163
- Configuration File Terms on page 26

PART 5

User and Access Management

CHAPTER 12

Overview

Software Overview

Understanding Software Infrastructure and Processes

The QFX Series products run the Juniper Networks Junos OS. Junos OS includes processes for Internet Protocol (IP) routing and for managing interfaces, networks, and the switch.

Junos OS runs on the Routing Engine. The Routing Engine kernel coordinates communication among the Junos OS processes and provides a link to the Packet Forwarding Engine.

Using the Junos OS command-line interface (CLI), you configure switching features and set the properties of network interfaces. After activating a software configuration, use either the Junos Space or CLI user interface to monitor, manage operations, and diagnose protocol and network connectivity problems.

Routing Engine and Packet Forwarding Engine

A switch has two primary software processing components:

- Packet Forwarding Engine—Processes packets; applies filters, routing policies, and other features; and forwards packets to the next hop along the route to their final destination.
- Routing Engine—Provides three main functions:
  - Creates the packet forwarding switch , which provides route lookup, filtering, and switching on incoming data packets, and then directs outbound packets to the appropriate interface for transmission to the network.
  - Maintains the routing tables used by the switch and controls the routing protocols that run on the switch.

- Provides control and monitoring functions for the switch, including controlling power and monitoring system status.

Junos OS Processes

Junos OS running on the Routing Engine and Packet Forwarding Engine consists of multiple processes that are responsible for individual functions.

The separation of functions provides operational stability, because each process accesses its own protected memory space. In addition, because each process is a separate software package, you can selectively upgrade all or part of the Junos OS for added flexibility.

Table 35 on page 45 describes the primary Junos OS processes.

Table 100: Junos OS Processes

Process	Name	Description
Chassis process	chassisd	Detects hardware on the system that is used to configure network interfaces. Monitors the physical status of hardware components and field-replaceable units (FRUs), detecting when environment sensors such as temperature sensors are triggered. Relays signals and interrupts—for example, when devices are taken offline, so that the system can close sessions and shut down gracefully.
DNS Server process	named-service	Resolves hostnames into addresses.
Dynamic Host Configuration Protocol (DHCP) process	dhcp-service	Enables a DHCP server to allocate network IP addresses and deliver configuration settings to client hosts without user intervention.
Ethernet switching process	eswd	Handles Layer 2 switching functionality such as MAC address learning, Spanning Tree Protocol, and access port security. Manages Ethernet switching interfaces, VLANs, and VLAN interfaces.
Firewall management process	firewall	Manages the firewall configuration and helps accept or reject packets that are transiting an interface on a switch.
Forwarding process	pfem	Defines how routing protocols operate on the partition. The overall performance of the partition is largely determined by the effectiveness of the forwarding process.
Interface process	dcd	Configures and monitors network interfaces by defining physical characteristics such as link encapsulation, hold times, and keepalive timers.
Integrated Local Management Interface (ILMI) process	ilmi	Provides bidirectional exchange of management information between two ATM interfaces across a physical connection.
Link Management Protocol (LMP) process	link-management	Establishes and maintains LMP control channels.

Table 100: Junos OS Processes *(continued)*

Process	Name	Description
Management process	mgd	Provides communication between the other processes and an interface to the configuration database. Populates the configuration database with configuration information and retrieves the information when queried by other processes to ensure that the system operates as configured. Interacts with the other processes when commands are issued through one of the user interfaces on the partition. If a process terminates or fails to start when called, the management process attempts to restart it a limited number of times to prevent thrashing and logs any failure information for further investigation.
Multicast snooping process	multicast-snooping	Makes Layer 2 devices, such as VLAN switches, aware of Layer 3 information, such as the media access control (MAC) addresses of members of a multicast group.
Secure Neighbor Discovery (SEND) Protocol process	send	Protects Neighbor Discovery Protocol (NDP) messages.
Simple Network Management Protocol (SNMP) process	snmp	Enables the monitoring of network devices from a central location and provides the switch's SNMP master agent.
Tunnel OAM process	tunnel-oamd	Enables the Operations, Administration, and Maintenance of Layer 2 tunneled networks. Layer 2 protocol tunneling (L2PT) allows service providers to send Layer 2 protocol data units (PDUs) across the provider's cloud and deliver them to Juniper Networks EX Series Ethernet Switches that are not part of the local broadcast domain.
Virtual Router Redundancy Protocol (VRRP) process	vrrp	Enables hosts on a LAN to make use of redundant routing platforms on that LAN without requiring more than the static configuration of a single default route on the hosts.

Related Documentation

- *Junos OS Baseline Network Operations Guide*
- *Junos OS Administration Library for Routing Devices*

Access Control Overview

Overview of Template Accounts for RADIUS and TACACS+ Authentication

When you use local password authentication, you must create a local user account for every user who wants to access the system. However, when you are using RADIUS or TACACS+ authentication, you can create single accounts (for authorization purposes) that are shared by a set of users. You create these accounts using the remote and local user template accounts. When a user is using a template account, the command-line interface (CLI) username is the login name; however, the privileges, file ownership, and effective user ID are inherited from the template account.

Related Documentation

- Configuring Remote Template Accounts for User Authentication on page 1235
- Configuring Local User Template Accounts for User Authentication on page 1229

Understanding Login Authentication

You can control access to your network through the Juniper Networks QFX Series using several different authentication methods—media access control (MAC) RADIUS, for example. Authentication prevents unauthorized devices and users from gaining access to your LAN. For MAC RADIUS authentication, end devices must be authenticated before they receive an IP address from a DHCP server.

You can enable end devices to access the network without authenticating on the RADIUS server by configuring the MAC address of the end device in the static MAC bypass list by configuring the MAC address using the **authentication-whitelist** statement.

You can configure one or more authentication methods on a single interface and thereby enable fallback to the next method if the first or second method is unsuccessful.

On a single interface you can configure one or a combination of several authentication methods.

This topic covers:

MAC RADIUS Authentication

You can configure MAC RADIUS authentication on interfaces that are connected to end devices.

The EAP method supported for MAC RADIUS authentication on the QFX Series is EAP-MD5.

When you configure the **mac-radius restrict** option, the switch immediately attempts a MAC- RADIUS authentication by sending a request to the RADIUS server for authentication of the MAC address of the end device. If MAC address of the end device is configured for RADIUS authentication, LAN access between the two switches is created.

Related Documentation

- Configuring RADIUS Authentication on page 1233

Understanding LLDP

The QFX Series product uses Link Layer Discovery Protocol (LLDP) to learn and distribute device information on network links. The information enables the switch to identify a variety of devices quickly. This quick identification results in a LAN that interoperates smoothly and efficiently.

LLDP-capable devices transmit information in type, length, and value (TLV) messages to neighbor devices. Device information can include specifics, such as chassis and port identification and system name and system capabilities. The TLVs leverage this information from parameters that have already been configured in Junos OS.

The QFX Series products support the following basic TLVs:

- **Chassis Identifier**—The MAC address associated with the local system.
- **Port Identifier**—The port identification for the specified port in the local system.
- **Port Description**—The user-configured port description. The port description can be a maximum of 256 characters.
- **System Name**—The user-configured name of the local system. The system name can be a maximum of 256 characters.
- **System Description**—The system description containing information about the software and current image running on the system. This information cannot be configured, but is taken from the software.
- **System Capabilities**—The primary function performed by the system. The capabilities that system supports are defined; for example, bridge or router. This information cannot be configured, but is based on the model of the product.
- **Management Address**—The IP management address of the local system.

The QFX Series products support the following 802.3 TLVs:

- **Power via MDI**—A TLV that advertises media dependent interface (MDI) power support, power source equipment (PSE) power pair, and power class information.
- **MAC/PHY Configuration Status**—A TLV that advertises information about the physical interface, such as autonegotiation status and support and MAU type. The information cannot be configured, but is based on the physical interface structure.
- **Link Aggregation**—A TLV that advertises whether the port is aggregated and its aggregated port ID.
- **Maximum Frame Size**—A TLV that advertises the Maximum Transmission Unit (MTU) of the interface sending LLDP frames.
- **Port Vlan**—A TLV that advertises the VLAN name configured on the interface.

Related Documentation

- Configuring LLDP on page 1227

Understanding RADIUS Accounting

Juniper Networks QFX Series products support IETF RFC 2866, *RADIUS Accounting*. Configuring RADIUS accounting on the QFX Series supports collecting statistical data about users logging in to or out from a LAN and sending the data to a RADIUS accounting server. The statistical data gathered can be used for general network monitoring, analyzing and tracking usage patterns, or billing a user based upon the amount of time or type of services accessed.

To configure RADIUS accounting, specify one or more RADIUS accounting servers to receive the statistical data from the switch, and select the type of accounting data to be collected.

The RADIUS accounting server you specify can be the same server used for RADIUS authentication, or it can be a separate RADIUS server. You can specify a list of RADIUS accounting servers. If the primary server (the first one configured) is unavailable, each RADIUS server in the list is tried in the order in which they are configured in the Junos OS.

The RADIUS accounting process between the switch and a RADIUS server works like this:

1. A RADIUS accounting server listens for User Datagram Protocol (UDP) packets on a specific port. For example, on FreeRADIUS, the default port is 1813.
2. The switch forwards an *accounting-request* packet containing an event record to the accounting server. The event record associated with this supplicant contains an *Acct-Status-Type* attribute whose value indicates the beginning of user service for this supplicant. When the supplicant's session ends, the accounting request contains an *Acct-Status-Type* attribute value indicating the end of user service. The RADIUS accounting server records this as a stop-accounting record containing session information and the length of the session.
3. The RADIUS accounting server logs these events in a file as start-accounting or stop-accounting records. On FreeRADIUS, the filename is the server's address; for example, 122.69.1.250.

4. The accounting server sends an *accounting-response* packet back to the switch confirming it has received the accounting request.
5. If the switch does not receive a response from the server, it continues to send accounting requests until an accounting response is returned from the accounting server.

The statistics collected through this process can be displayed from the RADIUS server; to see those statistics, the user accesses the log file configured to receive them.

Related Documentation

- Configuring RADIUS System Accounting on page 1231

Understanding VSAs on the QFX Series

The Juniper Networks QFX Series products support the configuration of RADIUS server attributes specific to Juniper Networks. These attributes are known as vendor-specific attributes (VSAs) and are described in RFC 2138, *Remote Authentication Dial In User Service* (RADIUS).

Through VSAs, you can configure port-filtering attributes on the RADIUS server. VSAs are cleartext fields sent from the RADIUS server to the switch as a result of authentication success or failure. Authentication prevents unauthorized user access by blocking a supplicant at the port until the device is authenticated by the RADIUS server. The VSA attributes are interpreted by the switch during authentication, and the switch takes appropriate actions. Implementing port-filtering attributes with authentication on the RADIUS server provides a central location for controlling LAN access for supplicants.

These port-filtering attributes specific to Juniper Networks are encapsulated in a RADIUS server VSA with the vendor ID set to the Juniper Networks ID number, 2636.

As well as configuring port-filtering attributes through VSAs, you can apply a port firewall filter that has already been configured on the switch directly to the RADIUS server. Like port-filtering attributes, the filter is applied during the authentication process, and its actions are applied at the switch port. Adding a port firewall filter to a RADIUS server eliminates the need to add the filter to multiple ports and switches.

Related Documentation

- Configuring Firewall Filters on page 4531
- Configuring RADIUS Authentication on page 1233
- VSA Match Conditions and Actions on page 1258

Juniper Networks Vendor-Specific RADIUS Attributes

Junos OS supports the configuration of Juniper Networks RADIUS vendor-specific attributes (VSAs). These VSAs are encapsulated in a RADIUS vendor-specific attribute with the vendor ID set to the Juniper Networks ID number, 2636. Table 101 on page 1204 lists the Juniper Networks VSAs you can configure.

Table 101: Juniper Networks Vendor-Specific RADIUS Attributes

Name	Description	Type	Length	String
Juniper-Local-User-Name	Indicates the name of the user template used by this user when logging in to a device. This attribute is used only in Access-Accept packets.	1	≥3	One or more octets containing printable ASCII characters.
Juniper-Allow-Commands	Contains an extended regular expression that enables the user to run operational mode commands in addition to the commands authorized by the user's login class permission bits. This attribute is used only in Access-Accept packets.	2	≥3	One or more octets containing printable ASCII characters, in the form of an extended regular expression. See "Regular Expressions for Allowing and Denying Junos OS Operational Mode Commands" on page 1220.
Juniper-Deny-Commands	Contains an extended regular expression that denies the user permission to run operation mode commands authorized by the user's login class permission bits. This attribute is used only in Access-Accept packets.	3	≥3	One or more octets containing printable ASCII characters, in the form of an extended regular expression. See "Regular Expressions for Allowing and Denying Junos OS Operational Mode Commands" on page 1220.
Juniper-Allow-Configuration	Contains an extended regular expression that enables the user to run configuration mode commands in addition to the commands authorized by the user's login class permission bits. This attribute is used only in Access-Accept packets.	4	≥3	One or more octets containing printable ASCII characters, in the form of an extended regular expression. See "Regular Expressions for Allowing and Denying Junos OS Configuration Mode Hierarchies" on page 1219.
Juniper-Deny-Configuration	Contains an extended regular expression that denies the user permission to run configuration commands authorized by the user's login class permission bits. This attribute is used only in Access-Accept packets.	5	≥3	One or more octets containing printable ASCII characters, in the form of an extended regular expression. See "Regular Expressions for Allowing and Denying Junos OS Configuration Mode Hierarchies" on page 1219.
Juniper-Interactive-Command	Indicates the interactive command entered by the user. This attribute is used only in Accounting-Request packets.	8	≥3	One or more octets containing printable ASCII characters.

Table 101: Juniper Networks Vendor-Specific RADIUS Attributes *(continued)*

Name	Description	Type	Length	String
Juniper-Configuration-Change	Indicates the interactive command that results in a configuration (database) change. This attribute is used only in Accounting-Request packets.	9	≥3	One or more octets containing printable ASCII characters.
Juniper-User-Permissions	Contains information the server uses to specify user permissions. This attribute is used only in Access-Accept packets. NOTE: When the **Juniper-User-Permissions** attribute is configured to grant the Junos OS **maintenance** or **all** permissions on a RADIUS server, the UNIX wheel group membership is not automatically added to a user's list of group memberships. Some operations such as running the **su root** command from a local shell require wheel group membership permissions. However, when a user is configured locally with the permissions **maintenance** or **all**, the user is automatically granted membership to the UNIX wheel group. Therefore, we recommend that you create a template user account with the required permissions and associate individual user accounts with the template user account.	10	≥3	One or more octets containing printable ASCII characters. The string is a list of permission flags separated by a space. The exact name of each flag must be specified in its entirety. See Table 103 on page 1207.

For more information about the VSAs, see RFC 2138, *Remote Authentication Dial In User Service (RADIUS)*.

Related Documentation

- *Configuring RADIUS Authentication*
- Configuring RADIUS Authentication on page 1233

Juniper Networks Vendor-Specific TACACS+ Attributes

Junos OS supports the configuration of Juniper Networks TACACS+ vendor-specific attributes (VSAs). These VSAs are encapsulated in a TACACS+ vendor-specific attribute with the vendor ID set to the Juniper Networks ID number, 2636. Table 102 on page 1206 lists the Juniper Networks VSAs you can configure.

Table 102: Juniper Networks Vendor-Specific TACACS+ Attributes

Name	Description	Length	String
local-user-name	Indicates the name of the user template used by this user when logging in to a device.	≥3	One or more octets containing printable ASCII characters.
allow-commands	Contains an extended regular expression that enables the user to run operational mode commands in addition to those commands authorized by the user's login class permission bits.	≥3	One or more octets containing printable ASCII characters, in the form of an extended regular expression. See Table 107 on page 1220.
allow-configuration	Contains an extended regular expression that enables the user to run configuration mode commands in addition to those commands authorized by the user's login class permission bits.	≥3	One or more octets containing printable ASCII characters, in the form of an extended regular expression. See "Regular Expressions for Allowing and Denying Junos OS Configuration Mode Hierarchies" on page 1219.
deny-commands	Contains an extended regular expression that denies the user permission to run operational mode commands authorized by the user's login class permission bits.	≥3	One or more octets containing printable ASCII characters, in the form of an extended regular expression. See Table 107 on page 1220.
deny-configuration	Contains an extended regular expression that denies the user permission to run configuration mode commands authorized by the user's login class permission bits.	≥3	One or more octets containing printable ASCII characters, in the form of an extended regular expression. See Table 106 on page 1219.
user-permissions	Contains information the server uses to specify user permissions. NOTE: When the **user-permissions** attribute is configured to grant the Junos OS **maintenance** or **all** permissions on a TACACS+ server, the UNIX wheel group membership is not automatically added to a user's list of group memberships. Some operations such as running the **su root** command from a local shell require wheel group membership permissions. However, when a user is configured locally with the permissions **maintenance** or **all**, the user is automatically granted membership to the UNIX wheel group. Therefore, we recommend that you create a template user account with the required permissions and associate individual user accounts with the template user account.	≥3	One or more octets containing printable ASCII characters. See Table 103 on page 1207.

Related Documentation

- *Configuring TACACS+ Authentication*
- Configuring TACACS+ Authentication on page 1245

Understanding Junos OS Access Privilege Levels

Each top-level command-line interface (CLI) command and each configuration statement have an access privilege level associated with them. Users can execute only those commands and configure and view only those statements for which they have access privileges. The access privileges for each login class are defined by one or more *permission flags*.

For each login class, you can explicitly deny or allow the use of operational and configuration mode commands that would otherwise be permitted or not allowed by a privilege level specified in the **permissions** statement.

The following sections provide additional information about permissions:

Junos OS Login Class Permission Flags

The **permissions** statement specifies one or more of the permission flags listed in Table 103 on page 1207. Permission flags are not cumulative, so for each class you must list all the permission flags needed, including **view** to display information and **configure** to enter configuration mode. Two forms of permissions control for individual parts of the configuration are:

- "Plain" form—Provides read-only capability for that permission type. An example is **interface**.
- Form that ends in **-control**—Provides read and write capability for that permission type. An example is **interface-control**.

Table 103 on page 1207 lists the Junos® operating system (Junos OS) login class permission flags that you can configure by including the **permissions** statement at the **[edit system login class *class-name*]** hierarchy level.

Table 103: Login Class Permission Flags

Permission Flag	Description
access	Can view the access configuration in configuration mode and with the **show configuration** operational mode command.
access-control	Can view and configure access information at the **[edit access]** hierarchy level.
admin	Can view user account information in configuration mode and with the **show configuration** operational mode command.
admin-control	Can view user accounts and configure them at the **[edit system login]** hierarchy level.

Table 103: Login Class Permission Flags *(continued)*

Permission Flag	Description
all-control	Can access all operational mode commands and configuration mode commands. Can modify configuration in all the configuration hierarchy levels.
clear	Can clear (delete) information learned from the network that is stored in various network databases by using the **clear** commands.
configure	Can enter configuration mode by using the **configure** command.
control	Can perform all control-level operations—all operations configured with the **-control** permission flags.
field	Can view field debug commands. Reserved for debugging support.
firewall	Can view the firewall filter configuration in configuration mode.
firewall-control	Can view and configure firewall filter information at the **[edit firewall]** hierarchy level.
floppy	Can read from and write to the removable media.
flow-tap	Can view the flow-tap configuration in configuration mode.
flow-tap-control	Can view the flow-tap configuration in configuration mode and can configure flow-tap configuration information at the **[edit services flow-tap]** hierarchy level.
flow-tap-operation	Can make flow-tap requests to the router or switch. For example, a Dynamic Tasking Control Protocol (DTCP) client must authenticate itself to the Junos OS as an administrative user. That account must have **flow-tap-operation** permission. NOTE: The **flow-tap-operation** option is not included in the **all-control** permissions flag.
idp-profiler-operation	Can view profiler data.
interface	Can view the interface configuration in configuration mode and with the **show configuration** operational mode command.

Table 103: Login Class Permission Flags *(continued)*

Permission Flag	Description
interface-control	Can view chassis, class of service (CoS), groups, forwarding options, and interfaces configuration information. Can edit configuration at the following hierarchy levels: • **[edit chassis]** • **[edit class-of-service]** • **[edit groups]** • **[edit forwarding-options]** • **[edit interfaces]**
maintenance	Can perform system maintenance, including starting a local shell on the router and becoming the superuser in the shell by using the **su root** command, and can halt and reboot the router by using the **request system** commands.
network	Can access the network by using the **ping**, **ssh**, **telnet**, and **traceroute** commands.
pgcp-session-mirroring	Can view the **pgcp** session mirroring configuration.
pgcp-session-mirroring-control	Can modify the **pgcp** session mirroring configuration.
reset	Can restart software processes by using the **restart** command and can configure whether software processes are enabled or disabled at the **[edit system processes]** hierarchy level.
rollback	Can use the **rollback** command to return to a previously committed configuration other than the most recently committed one.
routing	Can view general routing, routing protocol, and routing policy configuration information in configuration and operational modes.
routing-control	Can view general routing, routing protocol, and routing policy configuration information and can configure general routing at the **[edit routing-options]** hierarchy level, routing protocols at the **[edit protocols]** hierarchy level, and routing policy at the **[edit policy-options]** hierarchy level.
secret	Can view passwords and other authentication keys in the configuration.
secret-control	Can view passwords and other authentication keys in the configuration and can modify them in configuration mode.
security	Can view security configuration in configuration mode and with the **show configuration** operational mode command.

Table 103: Login Class Permission Flags *(continued)*

Permission Flag	Description
security-control	Can view and configure security information at the **[edit security]** hierarchy level.
shell	Can start a local shell on the router or switch by using the **start shell** command.
snmp	Can view Simple Network Management Protocol (SNMP) configuration information in configuration and operational modes.
snmp-control	Can view SNMP configuration information and can modify SNMP configuration at the **[edit snmp]** hierarchy level.
system	Can view system-level information in configuration and operational modes.
system-control	Can view system-level configuration information and configure it at the **[edit system]** hierarchy level.
trace	Can view trace file settings and configure trace file properties.
trace-control	Can modify trace file settings and configure trace file properties.
view	Can use various commands to display current system-wide, routing table, and protocol-specific values and statistics. Cannot view the secret configuration.
view-configuration	Can view all of the configuration excluding secrets, system scripts, and event options. NOTE: Only users with the **maintenance** permission can view commit script, op script, or event script configuration.

Allowing or Denying Individual Commands for Junos OS Login Classes

By default, all top-level CLI commands have associated access privilege levels. Users can execute only those commands and view only those statements for which they have access privileges. For each login class, you can explicitly deny or allow the use of operational and configuration mode commands that would otherwise be permitted or not allowed by a privilege level specified in the **permissions** statement.

- The **all** login class permission bits take precedence over extended regular expressions when a user with **rollback** permission issues the **rollback** command.
- Expressions used to allow and deny commands for users on RADIUS and TACACS+ servers have been simplified. Instead of a single, long expression with multiple commands (**allow-commands=cmd1 cmd2 ... cmd*n***), you can specify each command as a separate expression. This new syntax is valid for **allow-configuration** and

deny-configuration, **allow-commands** and **deny-commands**, and all user permission bits.

- Users cannot issue the **load override** command when specifying an extended regular expression. Users can only issue the **merge**, **replace**, and **patch** configuration commands.
- If you allow and deny the same commands, the **allow-commands** permissions take precedence over the permissions specified by the **deny-commands**. For example, if you include **allow-commands "request system software add"** and **deny-commands "request system software add"**, the login class user is allowed to install software using the **request system software add** command.
- Regular expressions for **allow-commands** and **deny-commands** can also include the **commit**, **load**, **rollback**, **save**, **status**, and **update** commands.
- If you specify a regular expression for **allow-commands** and **deny-commands** with two different variants of a command, the longest match is always executed.

  For example, if you specify a regular expression for **allow-commands** with the **commit-synchronize** command and a regular expression for **deny-commands** with the **commit** command, users assigned to such a login class would be able to issue the **commit synchronize** command, but not the **commit** command. This is because **commit-synchronize** is the longest match between **commit** and **commit-synchronize** and it is specified for **allow-commands**.

  Likewise, if you specify a regular expression for **allow-commands** with the **commit** command and a regular expression for **deny-commands** with the **commit-synchronize** command, users assigned to such a login class would be able to issue the **commit** command, but not the **commit-synchronize** command. This is because **commit-synchronize** is the longest match between **commit** and **commit-synchronize** and it is specified for **deny-commands**.

Related Documentation

- Configuring Access Privilege Levels on page 1226

Junos OS Authentication Order for RADIUS, TACACS+, and Password Authentication

Using the **authentication-order** statement, you can prioritize the order in which the Junos OS tries the different authentication methods when verifying user access to a router or switch.

If the **authentication-order** is remote-server then local, Junos OS will retry the local server if the remote-server is unreachable or has timed out. However; if the remote-server rejects the authentication, Junos OS will not retry the authentication.

If none of the configured authentication methods accept the login credentials and if a reject response is received, the login attempt fails. If no response is received from any configured authentication method, the Junos OS consults local password authentication as a last resort.

Using RADIUS or TACACS+ Authentication

You can configure the Junos OS to be both a RADIUS and TACACS+ authentication client.

If an authentication method included in the **[authentication-order]** statement is not available, or if the authentication is available but returns a reject response, the Junos OS tries the next authentication method included in the **authentication-order** statement.

The RADIUS or TACACS+ server authentication might fail because of the following reasons:

- The authentication method is configured, but the corresponding authentication servers are not configured. For instance, the RADIUS and TACACS+ authentication methods are included in the **authentication-order** statement, but the corresponding RADIUS or TACACS+ servers are not configured at the respective **[edit system radius-server]** and **[edit system tacplus-server]** hierarchy levels.
- The RADIUS or TACACS+ server does not respond within the timeout period configured at the **[edit system radius-server]** or **[edit system tacplus-server]** hierarchy levels.
- The RADIUS or TACACS+ server is not reachable because of a network problem.

The RADIUS or TACACS+ server authentication might return a reject response because of the following reasons:

- The user profiles of users accessing a router or switch might not be configured on the RADIUS or TACACS+ server.
- The user enters incorrect logon credentials.

Using Local Password Authentication

You can explicitly configure the password authentication method or use this method as a fallback mechanism when remote authentication servers fail. The password authentication method consults the local user profiles configured at the **[edit system login]** hierarchy level. Users can log in to a router or switch using their local username and password in the following scenarios:

- The password authentication method (password) is explicitly configured as one of the authentication methods in the **[authentication-order *authentication-methods*]** statement. In this case, the password authentication method is tried if no previous authentication accepts the logon credentials. This is true whether the previous authentication method fails to respond or returns a reject response because of an incorrect username or password.
- The password authentication method is not explicitly configured as one of the authentication methods in the **authentication-order *authentication-methods*** statement. In this case, the password authentication method is tried only if all configured authentication methods fail to respond. It is not consulted if any configured authentication method returns a reject response because of an incorrect username or password.

Order of Authentication Attempts

Table 104 on page 1213 describes how the **authentication-order** statement at the **[edit system]** hierarchy level determines the procedure that the Junos OS uses to authenticate users for access to a router or switch.

Table 104: Order of Authentication Attempts

Syntax	Order of Authentication Attempts
authentication-order radius;	1. Try configured RADIUS authentication servers. 2. If RADIUS server is available and authentication is accepted, grant access. 3. If RADIUS server is available but authentication is rejected, deny access. 4. If RADIUS servers are not available, try password authentication. NOTE: If a RADIUS server is available, password authentication is not attempted, because it is not explicitly configured in the authentication order.
authentication-order [radius password];	1. Try configured RADIUS authentication servers. 2. If RADIUS servers fail to respond or return a reject response, try password authentication, because it is explicitly configured in the authentication order.
authentication-order [radius tacplus];	1. Try configured RADIUS authentication servers. 2. If RADIUS server is available and authentication is accepted, grant access. 3. If RADIUS servers fail to respond or return a reject response, try configured TACACS+ servers. 4. If TACACS+ server is available and authentication is accepted, grant access. 5. If TACACS+ server is available but authentication is rejected, deny access. 6. If both RADIUS and TACACS+ servers are not available, try password authentication. NOTE: If either RADIUS or TACACS+ servers are available, password authentication is not attempted, because it is not explicitly configured in the authentication order.
authentication-order [radius tacplus password];	1. Try configured RADIUS authentication servers. 2. If RADIUS server is available and authentication is accepted, grant access. 3. If RADIUS servers fail to respond or return a reject response, try configured TACACS+ servers. 4. If TACACS+ server is available and authentication is accepted, grant access. 5. If TACACS+ servers fail to respond or return a reject response, try password authentication, because it is explicitly configured in the authentication order.

Table 104: Order of Authentication Attempts *(continued)*

Syntax	Order of Authentication Attempts
authentication-order tacplus;	1. Try configured TACACS+ authentication servers. 2. If TACACS+ server is available and authentication is accepted, grant access. 3. If TACACS+ server is available but authentication is rejected, deny access. 4. If TACACS+ servers are not available, try password authentication. NOTE: If a TACACS+ server is available, password authentication is not attempted, because it is not explicitly configured in the authentication order.
authentication-order [tacplus password];	1. Try configured TACACS+ authentication servers. 2. If TACACS+ servers fail to respond or return a reject response, try password authentication, because it is explicitly configured in the authentication order.
authentication-order [tacplus radius];	1. Try configured TACACS+ authentication servers. 2. If TACACS+ server is available and authentication is accepted, grant access. 3. If TACACS+ servers fail to respond or return a reject response, try configured RADIUS servers. 4. If RADIUS server is available and authentication is accepted, grant access. 5. If RADIUS server is available but authentication is rejected, deny access. 6. If both TACACS+ and RADIUS servers are not available, try password authentication. NOTE: If either TACACS+ or RADIUS servers are available, password authentication is not attempted, because it is not explicitly configured in the authentication order.
authentication-order [tacplus radius password];	1. Try configured TACACS+ authentication servers. 2. If TACACS+ server is available and authentication is accepted, grant access. 3. If TACACS+ servers fail to respond or return a reject response, try configured RADIUS servers. 4. If RADIUS server is available and authentication is accepted, grant access. 5. If RADIUS servers fail to respond or return a reject response try password authentication, because it is explicitly configured in the authentication order.

Table 104: Order of Authentication Attempts *(continued)*

Syntax	Order of Authentication Attempts
authentication-order password;	1. Try to authenticate the user, using the password configured at the **[edit system login]** hierarchy level. 2. If the authentication is accepted, grant access. 3. If the authentication is rejected, deny access.

NOTE: If SSH public keys are configured, SSH user authentication first tries to perform public key authentication before using the authentication methods configured in the **authentication-order** statement. If you want SSH logins to use the authentication methods configured in the authentication-order statement without first trying to perform public key authentication, do not configure SSH public keys.

In a routing matrix based on a TX Matrix router, the authentication order must be configured only at the configuration groups **re0** and **re1**. The authentication order must not be configured at the **[edit system]** hierarchy. This is because the authentication order for the routing matrix is controlled on the switch-card chassis (or TX Matrix router) or switch-fabric chassis (for TX Matrix Plus router) only.

In Junos OS Release 10.0 and later, the superuser (belonging to the super-user login class) is also authenticated based on the authentication order that is configured for TACACS+, RADIUS, or password authentication using the **authentication-order** statement. For example, if the only configured authentication order is TACACS+, the superuser can only be authenticated by the TACACS+ server and password authentication cannot be used as an alternative. However, in Junos OS Release 9.6 and earlier, the superuser can use password authentication to login, even if password authentication is not configured explicitly using the **authentication-order** statement.

Related Documentation

- Overview of Template Accounts for RADIUS and TACACS+ Authentication on page 1200
- Configuring the Junos OS Authentication Order for RADIUS, TACACS+, and Local Password Authentication on page 1228
- *Limiting the Number of User Login Attempts for SSH and Telnet Sessions*
- Limiting the Number of User Login Attempts for SSH and Telnet Sessions on page 1250
- Example: Configuring System Authentication for RADIUS, TACACS+, and Password Authentication on page 1267

Junos OS User Authentication Methods

The Junos OS supports three methods of user authentication: local password authentication, Remote Authentication Dial-In User Service (RADIUS), and Terminal Access Controller Access Control System Plus (TACACS+).

With local password authentication, you configure a password for each user allowed to log in to the router or switch.

RADIUS and TACACS+ are authentication methods for validating users who attempt to access the router or switch using telnet. They are both distributed client-server systems—the RADIUS and TACACS+ clients run on the router or switch, and the server runs on a remote network system.

You can configure the router or switch to be both a RADIUS and TACACS+ client, and you can also configure authentication passwords in the Junos OS configuration file. You can prioritize the methods to configure the order in which the software tries the different authentication methods when verifying user access.

Related Documentation

- *Configuring RADIUS Authentication*
- *Configuring TACACS+ Authentication*
- Junos OS Authentication Order for RADIUS, TACACS+, and Password Authentication on page 1211
- Configuring RADIUS Authentication on page 1233
- Configuring TACACS+ Authentication on page 1245

Junos OS User Accounts Overview

User accounts provide one way for users to access the switch. (Users can access the switch without accounts if you configured RADIUS or TACACS+ servers, as described in "Junos OS User Authentication Methods" on page 1216.) For each account, you define the login name for the user and, optionally, information that identifies the user. After you have created an account, the software creates a home directory for the user.

For each user account, you can define the following:

- Username—(Optional) Name that identifies the user. It must be unique within the switch. Do not include spaces, colons, or commas in the username. The username can be up to 64 characters long.
- User's full name—(Optional) If the full name contains spaces, enclose it in quotation marks. Do not include colons or commas.
- User identifier (UID)—(Optional) Numeric identifier that is associated with the user account name. The identifier must be in the range from 100 through 64,000 and must

be unique within the switch. If you do not assign a UID to a username, the software assigns one when you commit the configuration, preferring the lowest available number.

- You must ensure that the UID is unique. However, it is possible to assign the same UID to different users. If you do this, the CLI displays a warning when you commit the configuration and then assigns the duplicate UID.

- User's access privilege—(Required) One of the login classes you defined in the **class** statement at the **[edit system login]** hierarchy level, or one of the default classes listed in "Regular Expressions for Allowing and Denying Junos OS Configuration Mode Hierarchies" on page 1219.
- Authentication method or methods and passwords that the user can use to access the switch—(Optional) You can use SSH or a Message Digest 5 (MD5) password, or you can enter a plain-text password that Junos OS encrypts using MD5-style encryption before entering it in the password database. For each method, you can specify the user's password. If you configure the **plain-text-password** option, you are prompted to enter and confirm the password:

  [edit system login user *user-name*]
  user@switch# **set authentication plain-text-password**
  New password: *type password here*
  Retype new password: *retype password here*

  The default requirements for plain-text passwords are:

  - The password must be between 6 and 128 characters long
    - You can include most character classes in a password (uppercase letters, lowercase letters, numbers, punctuation marks, and other special characters). Control characters are not recommended.
    - Valid passwords must contain at least one change of case or character class.

For each user account and for root logins, you can configure more than one public RSA or DSA key for user authentication. When a user logs in using a user account or as root, the configured public keys are referenced to determine whether the private key matches any of them.

For SSH authentication, you can also copy the contents of an SSH key file into the configuration.

To load an SSH key file, use the **load-key-file** statement. This statement loads RSA (SSH version 1 and SSH version 2) and DSA (SSH version 2) public keys.

If you load the SSH keys file, the contents of the file are copied into the configuration immediately after you enter the **load-key-file** statement. To view the SSH key entries, use the configuration mode **show** command. For example:

[edit system login user boojum]
user@switch# **set authentication load-key-file my-host:.ssh/identity.pub**
.file.19692 | 0 KB | 0.3 kB/s | ETA: 00:00:00 | 100%
[edit system]
user@switch# **show**
root-authentication {


```
  ssh-rsa "1024 35 9727638204084251055468226757249864241630322
    2074049625283903820386901415845349641700196106083587229615638
    4757849182736033612764418742659468932077391083448131259577222
    6254616679992783161235004386609158662838224897467326056611922
    1814895398138629403276878065381696020274916416373591326939632
    44008443 boojum@juniper.net"; # SECRET-DATA
}
```

An account for the user **root** is always present in the configuration. You configure the password for **root** using the **root-authentication** statement, as described in "Configuring the Root Password" on page 1236.

Junos-FIPS and Common Criteria have special password requirements. FIPS and Common Criteria passwords must be between 10 and 20 characters in length. Passwords must use at least three of the five defined character sets (uppercase letters, lowercase letters, digits, punctuation marks, and other special characters). If Junos-FIPS is installed on the switch, you cannot configure passwords unless they meet this standard.

Related Documentation

- Configuring Junos OS User Accounts on page 1226
- Junos OS Login Classes Overview on page 1218

Junos OS Login Classes Overview

All users who can log in to the router or switch must be in a login class. With login classes, you define the following:

- Access privileges that users have when they are logged in to the router or switch
- Commands and statements that users can and cannot specify
- How long a login session can be idle before it times out and the user is logged out

You can define any number of login classes and then apply one login class to an individual user account.

The Junos operating system (Junos OS) contains a few predefined login classes, which are listed in Table 105 on page 1218. The predefined login classes cannot be modified.

Table 105: Predefined System Login Classes

Login Class	Permission Flag Set
operator	clear, network, reset, trace, and view
read-only	view
superuser or **super-user**	all
unauthorized	None

NOTE:

- You cannot modify a predefined login class name. If you issue the **set** command on a predefined class name, the Junos OS appends **-local** to the login class name. The following message also appears:

  warning: '<*class-name*>' is a predefined class name; changing to '<*class-name*>-local'

- You cannot issue the **rename** or **copy** command on a predefined login class. Doing so results in the following error message:

  error: target '<*class-name*>' is a predefined class

Related Documentation

- *Defining Junos OS Login Classes*
- Defining Junos OS Login Classes on page 1250
- *Understanding QFabric System Login Classes*

Regular Expressions for Allowing and Denying Junos OS Configuration Mode Hierarchies

Use extended regular expressions to specify which configuration mode hierarchies are denied or allowed. You specify these regular expressions in the **allow/deny-configuration-regexps** and **allow/deny-configuration** statements at the **[edit system login class]** hierarchy level, or by specifying Juniper Networks vendor-specific TACACS+ or RADIUS attributes in your authentication server’s configuration. If regular expressions are received during TACACS+ or RADIUS authentication, they merge with any regular expressions configured on the local router or switch.

Table 106 on page 1219 lists common regular expression operators that you can use for allowing or denying configuration mode .

Command regular expressions implement the extended (modern) regular expressions, as defined in POSIX 1003.2.

Table 106: Configuration Mode Hierarchies—Common Regular Expression Operators

Operator	Match
|	One of two or more terms separated by the pipe. Each term must be a complete standalone expression enclosed in parentheses ( ), with no spaces between the pipe and the adjacent parentheses. For example, (**show system alarms**)|(**show system software**).
^	At the beginning of an expression, used to denote where the command begins, where there might be some ambiguity.

Table 106: Configuration Mode Hierarchies—Common Regular Expression Operators *(continued)*

Operator	Match
$	Character at the end of a command. Used to denote a command that must be matched exactly up to that point. For example, **allow-commands "show interfaces$"** means that the user can issue the **show interfaces** command but cannot issue **show interfaces detail** or **show interfaces extensive**.
[ ]	Range of letters or digits. To separate the start and end of a range, use a hyphen (-).
( )	A group of commands, indicating a complete, standalone expression to be evaluatedhe result is then evaluated as part of the overall expression. Parentheses must be used in conjunction with pipe operators as explained .
*	Zero or more terms.
+	One or more terms.
.	Any character except for a space " ".

Related Documentation

- *Specifying Access Privileges for Junos OS Configuration Mode Hierarchies*
- Specifying Access Privileges for Junos OS Configuration Mode Hierarchies on page 1253

Regular Expressions for Allowing and Denying Junos OS Operational Mode Commands

Use extended regular expressions to specify which operational mode commands are denied or allowed. Table 107 on page 1220 lists common regular expression operators that can be used in the operational mode commands. Command regular expressions implement the extended (modern) regular expressions as defined in POSIX 1003.2.

Table 107: Common Regular Expression Operators to Allow or Deny Operational Mode Commands

Operator	Match
|	One of two or more terms separated by the pipe (|) symbol. Each term must be a complete standalone expression enclosed in parentheses ( ), with no spaces between the pipe and the adjacent parentheses. For example, (**show system alarms**)|(**show system software**).
^	At the beginning of an expression, used to denote where the command begins, and where there might be some ambiguity.
$	Character at the end of a command. Used to denote a command that must be matched exactly up to that point. For example, **allow-commands "show interfaces$"** means that the user can issue the **show interfaces** command but cannot issue the **show interfaces detail** or **show interfaces extensive** command.

Table 107: Common Regular Expression Operators to Allow or Deny Operational Mode Commands *(continued)*

Operator	Match
[ ]	Range of letters or digits. To separate the start and end of a range, use a hyphen (-).
( )	A group of commands, indicating a complete, standalone expression to be evaluated; the result is then evaluated as part of the overall expression. Parentheses must always be used in conjunction with pipe operators as explained above.

If a regular expression contains a syntax error, it becomes invalid, and although the user can log in, the permission granted or denied by the regular expression does not take effect. When regular expressions configured on TACACS+ or RADIUS servers merge with regular expressions configured on the router or switch, if the final expression has a syntax error, the overall result is an invalid regular expression. If a regular expression does not contain any operators, all varieties of the command are allowed. For example, if the following statement is included in the configuration, the user can issue the commands **show interfaces detail** and **show interfaces extensive** in addition to showing an individual interface:

```
allow-commands "show interfaces";
```

Related Documentation

- Specifying Access Privileges for Junos OS Operational Mode Commands on page 168

Special Requirements for Junos OS Plain-Text Passwords

Junos OS has special requirements when you create plain-text passwords on a router or switch. Table 108 on page 1221 shows the default requirements.

Table 108: Special Requirements for Plain-Text Passwords

Junos OS	Junos-FIPS
The password must be between 6 and 128 characters long.	FIPS passwords must be between 10 and 20 characters long
You can include most character classes in a password (uppercase letters, lowercase letters, numbers, punctuation marks, and other special characters). Control characters are not recommended.	You can include most character classes in a password (uppercase letters, lowercase letters, numbers, punctuation marks, and other special characters). Control characters are not recommended.
Valid passwords must contain at least one change of case or character class.	Passwords must use at least three of the five defined character classes (uppercase letters, lowercase letters, numbers, punctuation marks, and other special characters).

You can change the requirements for plain-text passwords.

Junos OS supports the following five character classes for plain-text passwords:

- Lowercase letters
- Uppercase letters
- Numbers
- Punctuation
- Special characters: ! @ # $ % ^ & * , +< > : ;

Control characters are not recommended.

You can include the **plain-text-password** statement at the following hierarchy levels:

- **[edit system diag-port-authentication]**
- **[edit system pic-console-authentication]**
- **[edit system root-authentication]**
- **[edit system login user *username* authentication]**

  The **change-type** statement specifies whether the password is checked for the following:

  - The total number of character sets used (**character-set**)
  - The total number of character set changes (**set-transitions**)

  For example, the following password:

  MyPassWd@2

  has four character sets (uppercase letters, lowercase letters, special characters, and numbers) and seven character set changes (**M–y**, **y–P**, **P–a**, **s–W**, **W–d**, **d–@**, and **@–2**).

  The **change-type** statement is optional. If you omit the **change-type** option, Junos-FIPS plain-text passwords are checked for character sets, and Junos OS plain-text passwords are checked for character set changes.

  The **minimum-changes** statement specifies how many character sets or character set changes are required for the password. This statement is optional. If you do not use the **minimum-changes** statement, character sets are not checked for Junos OS. If the **change-type** statement is configured for the **character-set** option, then the **minimum-changes** value must be **5** or less, because Junos OS only supports five character sets.

  The **format** statement specifies the hash algorithm (**md5**, **sha1** or **des**) for authenticating plain-text passwords. This statement is optional. For Junos OS, the default format is **md5**. For Junos-FIPS, only **sha1** is supported.

  The **maximum-length** statement specifies the maximum number of characters allowed in a password. This statement is optional. By default, Junos OS passwords have no maximum; however, only the first 128 characters are significant. Junos-FIPS passwords must be 20 characters or less. The range for Junos OS maximum-length passwords is from 20 to 128 characters.

  The **minimum-length** statement specifies the minimum number of characters required for a password. This statement is optional. By default, Junos OS passwords must be at least 6 characters long, and Junos-FIPS passwords must be at least 10 characters long. The range is from 6 to 20 characters.

Changes to password requirements do not take effect until the configuration is committed. When requirements change, only newly created, plain-text passwords are checked; existing passwords are not checked against the new requirements.

The default configuration for Junos OS plain-text passwords is:

```
[edit system login]
passwords {
   change-type character-sets;
   format md5;
   minimum-changes 1;
   minimum-length 6;
}
```

The default configuration for Junos-FIPS plain-text passwords is:

```
[edit system login]
passwords {
   change-type set-transitions;
   format sha1;
   maximum-length 20;
   minimum-changes 3;
   minimum-length 10;
}
```

Related Documentation

- *Changing the Requirements for Junos OS Plain-Text Passwords*
- Configuring the Root Password on page 146
- *Changing the Requirements for Junos OS Plain-Text Passwords*
- Configuring the Root Password on page 1236

CHAPTER 13

Configuration

Configuration Tasks

- Using Regular Expressions on a RADIUS or TACACS+ Server to Allow or Deny Access to Commands on page 1256
- VSA Match Conditions and Actions on page 1258

Configuring Access Privilege Levels

Each top-level command-line interface (CLI) command and each configuration statement have an access privilege level associated with it. Users can execute only those commands and configure and view only those statements for which they have access privileges.

To configure access privilege levels, include the **permissions** statement at the **[edit system login class *class-name*]** hierarchy level:

```
[edit system login class class-name]
permissions [ permissions ];
```

Related Documentation

- Example: Configuring Access Privilege Levels on page 1263
- Understanding Junos OS Access Privilege Levels on page 1207
- Specifying Access Privileges for Junos OS Operational Mode Commands on page 168
- *permissions*

Configuring CLI Tips

The Junos OS CLI provides the option of configuring CLI tips for the user. By default, the **tip** command is not enabled when a user logs in.

- To enable tips, include the **login-tip** statement at the **[edit system login class *class-name*]** hierarchy level:

```
[edit system login class class-name]
login-tip;
```

Adding this statement enables the **tip** command for the class specified, provided the user logs in using the CLI.

Related Documentation

- CLI User Interface Overview on page 54
- *Defining Junos OS Login Classes*
- **login-tip on page 255**

Configuring Junos OS User Accounts

User accounts provide one way for users to access the router or switch. For each account, you define the login name for the user and, optionally, information that identifies the user. After you have created an account, the software creates a home directory for the user.

To create user accounts, include the **user** statement at the **[edit system login]** hierarchy level:


```
[edit system login]
user username {
  class class-name;
    class {
    (encrypted-password "password" | plain-text-password);
    ssh-rsa "public-key";
    ssh-dsa "public-key";
  }
  full-name complete-name;
  uid uid-value;
  class class-name;
}
```

Related Documentation

- Example: Configuring User Accounts on page 1266
- Example: Configuring User Login Accounts on page 1270
- Junos OS User Accounts Overview on page 1216
- Limiting the Number of User Login Attempts for SSH and Telnet Sessions on page 1250

Configuring LLDP

QFX Series products use Link Layer Discovery Protocol (LLDP) and Link Layer Discovery Protocol Media Endpoint Discovery (LLDP-MED) to learn and distribute device information on network links. The information allows the switch to identify a variety of devices quickly. The result is a LAN that interoperates smoothly and efficiently.

The LLDP protocol cannot be enabled by issuing the **set protocols lldp** statement at the **[edit]** hierarchy level. Enable the LLDP protocol by configuring it on all interfaces or on specific interfaces.

To configure basic LLDP options using the CLI:

1. Configure the advertisement interval in seconds:

   ```
   [edit protocols lldp]
   user@switch# set advertisement-interval 45
   ```
2. Specify the multiplier used in combination with the **advertisement-interval** value to determine the length of time LLDP information is held before it is discarded:

   ```
   [edit protocols lldp]
   user@switch# set hold-multiplier 5
   ```
3. Configure LLDP on all interfaces or on a specific interface:

   ```
   [edit protocols lldp]
   user@switch# set interface (LLDP) all
   ```
4. Configure tracing operations for the LLDP protocol:

   ```
   [edit protocols lldp]
   user@switch# set traceoptions file lldptrace
   ```

Related Documentation

Configuring the Junos OS Authentication Order for RADIUS, TACACS+, and Local Password Authentication

Using the **authentication-order** statement, you can prioritize the order in which the Junos OS tries the different authentication methods when verifying user access to a router or switch.

To configure the authentication order, include the **authentication-order** statement at the **[edit system]** hierarchy level:

```
[edit system]
authentication-order [ authentication-methods ];
```

Specify one or more of the following authentication methods in the preferred order, from first tried to last tried:

- **radius**—Verify the user using RADIUS authentication services
- **tacplus**—Verify the user using TACACS+ authentication services.
- **password**—Verify the user using the username and password configured locally by including the authentication statement at the **[edit system login user]** hierarchy level.

The CHAP authentication sequence cannot take more than 30 seconds. If it takes longer to authenticate a client, the authentication is abandoned and a new sequence is initiated.

For example, if you configure three RADIUS servers so that the router or switch attempts to contact each server three times, and with each retry the server times out after 3 seconds, then the maximum time given to the RADIUS authentication method before CHAP considers it a failure is 27 seconds. If you add more RADIUS servers to this configuration, they might not be contacted because the authentication process might be abandoned before these servers are tried.

The Junos OS enforces a limit on the number of standing authentication server requests that the CHAP authentication can have at one time. Thus, an authentication server method—RADIUS, for example—might fail to authenticate a client when this limit is exceeded. If it fails, the authentication sequence is reinitiated by the router or switch until authentication succeeds and the link is brought up. However, if the RADIUS servers are not available and if additional authentication methods such as **tacplus** or **password** are configured along with **radius**, the next authentication method is tried.

The following example shows how to configure **radius** and **password** authentication:

```
[edit system]
user@switch# authentication-order [ radius password ];
```

The following example shows how to delete the **radius** statement from the authentication order:

```
[edit system]
user@switch# delete authentication-order radius
```

The following example shows how to insert the **tacplus** statement after the **radius** statement:

```
[edit system]
user@switch# insert authentication-order tacplus after radius
```

Related Documentation

- Junos OS Authentication Order for RADIUS, TACACS+, and Password Authentication on page 1211
- Using Regular Expressions on a RADIUS or TACACS+ Server to Allow or Deny Access to Commands on page 1256
- Example: Configuring System Authentication for RADIUS, TACACS+, and Password Authentication on page 1267
- *authentication-order*

Configuring Local User Template Accounts for User Authentication

You use local user template accounts when you need different types of templates for authentication. Each template can define a different set of permissions appropriate for the group of users who use that template. These templates are defined locally on the router and referenced by the TACACS+ and RADIUS authentication servers.

When you configure local user templates and a user logs in, the Junos OS issues a request to the authentication server to authenticate the user's login name. If a user is authenticated, the server returns the local username to the Junos OS, which then determines whether a local username is specified for that login name (**local-username** for TACACS+, **Juniper-Local-User** for RADIUS). If so, the Junos OS selects the appropriate local user template locally configured on the router. If a local user template does not exist for the authenticated user, the router defaults to the **remote** template.

To configure different access privileges for users who share the local user template account, include the **allow-commands** and **deny-commands** commands in the authentication server configuration file.

To configure a local user template, include the **user** ***local-username*** statement at the **[edit system login]** hierarchy level and specify the privileges you want to grant to the local users to whom the template applies:

```
[edit system login]
user local-username {
  full-name "Local user account";
  uid uid-value;
  class class-name;
}
```

This example configures the **sales** and **engineering** local user templates:

```
[edit]
system {
  login {
    user sales {
      uid uid-value;
```

```
            class class-name;
        }
        user engineering {
            uid uid-value;
            class class-name;
        }
    }
}
user = simon {
    ...
    service = junos-exec {
        local-user-name = sales
        allow-commands = "configure"
        deny-commands = "shutdown"
    }
}
user = rob {
    ...
    service = junos-exec {
        local-user-name = sales
        allow-commands = "(request system) | (show rip neighbor)"
        deny-commands = "clear"
    }
}
user = harold {
    ...
    service = junos-exec {
        local-user-name = engineering
        allow-commands = "monitor | help | show | ping | traceroute"
        deny-commands = "configure"
    }
}
user = jim {
    ...
    service = junos-exec {
        local-user-name = engineering
        allow-commands = "show bgp neighbor"
        deny-commands = "telnet | ssh"
    }
}
```

When the login users Simon and Rob are authenticated, the switch applies the sales local user template. When login users Harold and Jim are authenticated, the switch applies the engineering local user template.

Related Documentation

- Overview of Template Accounts for RADIUS and TACACS+ Authentication on page 1200
- *user (Access)*
- user (Access) on page 306

Configuring Management Access

To define the management access settings for the routing platform:

1. Next to Allow Telnet Access, select the check box to allow remote Telnet access to the routing platform.
2. Next to Allow SSH Access, selected the check box to allow remote SSH access to the routing platform.
3. Click **Apply** to apply the configuration.

Related Documentation

- Configuring Junos OS User Accounts on page 1226
- Specifying Access Privileges for Junos OS Operational Mode Commands on page 168
- Example: Configuring Access Privilege Levels on page 1263

Configuring RADIUS System Accounting

With RADIUS accounting enabled, Juniper Networks routers or switches, acting as RADIUS clients, can notify the RADIUS server about user activities such as software logins, configuration changes, and interactive commands. The framework for RADIUS accounting is described in RFC 2866.

Tasks for configuring RADIUS system accounting are:

1. Configuring Auditing of User Events on a RADIUS Server on page 1231
2. Specifying RADIUS Server Accounting and Auditing Events on page 1232
3. Configuring RADIUS Server Accounting on page 1232

Configuring Auditing of User Events on a RADIUS Server

To audit user events, include the following statements at the **[edit system accounting]** hierarchy level:

```
[edit system accounting]
events [ events ];
destination {
  radius {
    server {
      server-address {
        accounting-port port-number;
        secret password;
        source-address address;
        retry number;
        timeout seconds;
      }
    }
  }
}
```

Specifying RADIUS Server Accounting and Auditing Events

To specify the events you want to audit when using a RADIUS server for authentication, include the **events** statement at the **[edit system accounting]** hierarchy level:

```
[edit system accounting]
events [ events ];
```

events is one or more of the following:

- **login**—Audit logins
- **change-log**—Audit configuration changes
- **interactive-commands**—Audit interactive commands (any command-line input)

Configuring RADIUS Server Accounting

To configure RADIUS server accounting, include the **server** statement at the **[edit system accounting destination radius]** hierarchy level:

```
server {
  server-address {
    accounting-port port-number;
    secret password;
    source-address address;
    retry number;
    timeout seconds;
  }
}
```

server-address specifies the address of the RADIUS server. To configure multiple RADIUS servers, include multiple **server** statements.

NOTE: If no RADIUS servers are configured at the **[edit system accounting destination radius]** statement hierarchy level, the Junos OS uses the RADIUS servers configured at the **[edit system radius-server]** hierarchy level.

accounting-port *port-number* specifies the RADIUS server accounting port number.

The default port number is 1813.

NOTE: If you enable RADIUS accounting at the **[edit access profile *profile-name* accounting-order]** hierarchy level, accounting is triggered on the default port of 1813 even if you do not specify a value for the **accounting-port** statement.

You must specify a secret (password) that the local router or switch passes to the RADIUS client by including the **secret** statement. If the password contains spaces, enclose the entire password in quotation marks (“ “).

In the **source-address** statement, specify a source address for the RADIUS server. Each RADIUS request sent to a RADIUS server uses the specified source address. The source address is a valid IPv4 address configured on one of the router or switch interfaces.

Optionally, you can specify the number of times that the router or switch attempts to contact a RADIUS authentication server by including the **retry** statement. By default, the router or switch retries three times. You can configure the router or switch to retry from 1 through 10 times.

Optionally, you can specify the length of time that the local router or switch waits to receive a response from a RADIUS server by including the **timeout** statement. By default, the router or switch waits 3 seconds. You can configure the timeout to be from 1 through 90 seconds.

Configuring RADIUS Authentication

RADIUS authentication is a method of authenticating users who attempt to access the router or switch. Tasks to configure RADIUS authentication are:

Configuring RADIUS Server Details

To use RADIUS authentication on the router or switch, configure information about one or more RADIUS servers on the network by including one **radius-server** statement at the **[edit system]** hierarchy level for each RADIUS server:

```
[edit system]
radius-server server-address {
  accounting-port port-number;
  port number;
  retry number;
  secret password;
  source-address source-address;
  timeout seconds;
}
```

server-address is the address of the RADIUS server.

You can specify a port on which to contact the RADIUS server. By default, port number **1812** is used (as specified in RFC 2865). You can also specify an accounting port to send accounting packets. The default is **1813** (as specified in RFC 2866).

You must specify a password in the **secret *password*** statement. If the password contains spaces, enclose it in quotation marks. The secret used by the local router or switch must match that used by the server.

Optionally, you can specify the amount of time that the local router or switch waits to receive a response from a RADIUS server (in the **timeout** statement) and the number of times that the router or switch attempts to contact a RADIUS authentication server (in the **retry** statement). By default, the router or switch waits 3 seconds. You can configure this to be a value from 1 through 90 seconds. By default, the router or switch retries connecting to the server three times. You can configure this to be a value from 1 through 10 times.

You can use the **source-address** statement to specify a logical address for individual or multiple RADIUS servers.

To configure multiple RADIUS servers, include multiple **radius-server** statements.

To configure a set of users that share a single account for authorization purposes, you create a template user. To do this, include the **user** statement at the **[edit system login]** hierarchy level, as described in "Overview of Template Accounts for RADIUS and TACACS+ Authentication" on page 1200.

You can also configure RADIUS authentication at the **[edit access]** and **[edit access profile]** hierarchy level. Junos OS uses the following search order to determine which set of servers are used for authentication:

1. **[edit access profile *profile-name* radius-server *server-address*]**
2. **[edit access radius-server *server-address*]**
3. **[edit system radius-server *server-address*]**

Configuring MS-CHAPv2 for Password-Change Support

You can configure the Microsoft implementation of the Challenge Handshake Authentication Protocol version 2 (MS-CHAPv2) on the router or switch to support changing of passwords. This feature provides users accessing a router or switch the option of changing the password when the password expires, is reset, or is configured to be changed at the next login.

Before you configure MS-CHAPv2 for password-change support, ensure that you:

- Configure the RADIUS server authentication parameters
- Set the **authentication-order** to use the RADIUS server for the initial password attempt

To configure MS-CHAP-v2, include the following statements at the **[edit system radius-options]** hierarchy level:

```
[edit system radius-options]
password-protocol mschap-v2;
```

The following example shows statements for configuring the MS-CHAPv2 password protocol, password authentication order, and user accounts:

```
[edit]
system {
  authentication-order [ radius password ];
  radius-server {
    192.168.69.149 secret "$9$G-j.5Qz6tpBk.1hrlXxUjiq5Qn/C"; ## SECRET-DATA
  }
  radius-options {
```



```
    password-protocol mschap-v2;
  }
  login {
    user bob {
      class operator;
    }
  }
}
```

Specifying a Source Address for the Junos OS to Access External RADIUS Servers

You can specify which source address Junos OS uses when accessing your network to contact an external RADIUS server for authentication. You can also specify which source address Junos OS uses when contacting a RADIUS server for sending accounting information.

To specify a source address for a RADIUS server, include the **source-address** statement at the **[edit system radius-server *server-address*]** hierarchy level:

```
[edit system radius-server server-address]
source-address source-address;
```

source-address is a valid IP address configured on one of the router or switch interfaces.

Related Documentation

- Example: Configuring RADIUS Authentication on page 1264
- Example: Configuring System Authentication for RADIUS, TACACS+, and Password Authentication on page 1267
- Juniper Networks Vendor-Specific RADIUS Attributes on page 1203
- Overview of Template Accounts for RADIUS and TACACS+ Authentication on page 1200
- Example: Configuring RADIUS Template Accounts on page 1270
- Using Regular Expressions on a RADIUS or TACACS+ Server to Allow or Deny Access to Commands on page 1256
- Junos OS User Authentication Methods on page 1216

Configuring Remote Template Accounts for User Authentication

By default, the Junos OS uses remote template accounts for user authentication when:

- The authenticated user does not exist locally on the router or switch.
- The authenticated user's record in the authentication server specifies local user, or the specified local user does not exist locally on the router or switch.

To configure the remote template account, include the **user remote** statement at the **[edit system login]** hierarchy level and specify the privileges you want to grant to remote users:

```
[edit system login]
user remote {
  full-name "All remote users";
  uid uid-value;
```

```
    class class-name;
  }
```

To configure different access privileges for users who share the remote template account, include the **allow-commands** and **deny-commands** statements in the authentication server configuration file.

Related Documentation

- Overview of Template Accounts for RADIUS and TACACS+ Authentication on page 1200
- *user (Access)*
- user (Access) on page 306

Configuring the Root Password

Junos OS is preinstalled on the router or switch. When the router or switch is powered on, it is ready to be configured. Initially, you log in as the user "root" with no password.

NOTE: If you configure a blank password using the **encrypted-password** statement at the **[edit system root-authentication]** hierarchy level for root authentication, you can commit a configuration, but you are *not* able to log in as superuser and gain root level access to the router or switch.

After you log in, you should configure the root (superuser) password by including the **root-authentication** statement at the **[edit system]** hierarchy level:

```
[edit system]
root-authentication {
  (encrypted-password "password" | load-key-password URL | plain-text-password);
  ssh-dsa "public-key";
  ssh-rsa "public-key";
}
```

If you configure the **plain-text-password** option, you are prompted to enter and confirm the password:

```
[edit system]
user@switch# set root-authentication plain-text-password
New password: type password here
Retype new password: retype password here
```

To load an SSH key file, enter the **load-key-file** statement. This statement loads RSA (SSH version 1 and SSH version 2) and DSA (SSH version 2) public keys.

You can also configure SSH RSA keys and SSH DSA keys to authenticate root logins. You can configure more than one public RSA or DSA key for SSH authentication of root logins as well as for user accounts. When a user logs in as root, the public keys are referenced to determine whether the private key matches any of them.

If you load the SSH keys file, the contents of the file are copied into the configuration immediately after you enter the **load-key-file** statement. To view the SSH keys entries, use the configuration mode **show** command. For example:

```
[edit system]
user@switch# set root-authentication load-key-file my-host:.ssh/identity.pub
.file.19692 | 0 KB | 0.3 kB/s | ETA: 00:00:00 | 100%
[edit system]
user@switch# show
root-authentication {
  ssh-rsa "1024 35 9727638204084251055468226757249864241630322
    207404962528390382038690141584534964170019610608358722 96
    1563475749182736033612764418742659468932077391083448 1012
    683125957722625461667999278316123500438660915866283822 48
    974673260566119214895398139655615637862119403276878065 38
    1696020274916416373591326939634400 8443 boojum@juniper.net"; #
    SECRET-DATA
}
```

Junos-FIPS software has special password requirements. FIPS passwords must be between 10 and 20 characters in length. Passwords must use at least three of the five defined character sets (uppercase letters, lowercase letters, digits, punctuation marks, and other special characters). If Junos-FIPS is installed on the router or switch, you cannot configure passwords unless they meet this standard. If you use the **encrypted-password** option, then a null-password (empty) is not permitted.

You cannot configure a blank password for **encrypted-password** using blank quotation marks (" "). You must configure a password whose number of characters range from 1 through 128 characters and enclose the password in quotation marks.

Related Documentation

- Recovering the Root Password on page 1117
- Example: Configuring the Root Password on page 1266
- Example: Configuring a Plain-Text Password for Root Logins on page 1264
- Example: Configuring SSH Authentication for Root Logins on page 1266

Configuring SNMP

SNMP is implemented in the Junos OS Software running on the QFX Series products. By default, SNMP is not enabled. To enable SNMP, you must include the SNMP configuration statements at the **[edit]** hierarchy level.

To configure the minimum requirements for SNMP, include the following statements at the **[edit]** hierarchy level of the configuration:

```
[edit]
snmp {
  community public;
}
```

To configure complete SNMP features, include the following statements at the **[edit]** hierarchy level of the configuration:

```
snmp {
  client-list client-list-name {
    ip-addresses;
  }
```

```
community community-name {
  authorization authorization;
  client-list-name client-list-name;
  clients {
    address restrict;
  }
  logical-system logical-system-name {
    routing-instance routing-instance-name {
      clients {
      addresses;
      }
    }
  }
  routing-instance routing-instance-name {
    clients {
    addresses;
    }
  }
  view view-name;
}
contact contact;
description description;
filter-duplicates;
filter-interfaces;
health-monitor {
  falling-threshold integer;
  interval seconds;
  rising-threshold integer;
}
interface [ interface-names ];
location location;
name name;
nonvolatile {
  commit-delay seconds;
}
rmon {
  alarm index {
    description description;
    falling-event-index index;
    falling-threshold integer;
    falling-threshold-interval seconds;
    interval seconds;
    request-type;
    rising-event-index index;
    rising-threshold integer;
    sample-type (absolute-value | delta-value);
    startup-alarm (falling-alarm | rising-alarm | rising-or-falling alarm);
    syslog-subtag syslog-subtag;
    variable oid-variable;
  }
  event index {
    community community-name;
    description description;
    type type;
  }
  history history-index {
```



```
      bucket-size number;
      interface interface-name;
      interval seconds;
      owner owner-name;
    }
  }
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable> <match
      regular-expression>;
    flag flag;
  }
  trap-group group-name {
    categories {
      category;
    }
    destination-port port-number;
    routing-instance routing-instance-name;
    targets {
      address;
    }
    version (all | v1 | v2);
  }
  trap-options {
    agent-address outgoing-interface;
    source-address address;
  }
  v3 {
    notify name {
      tag tag-name;
      type trap;
    }
    notify-filter profile-name {
      oid object-identifier (include | exclude);
    }
    snmp-community community-index {
      community-name community-name;
      security-name security-name;
      tag tag-name;
    }
    target-address target-address-name {
      address address;
      address-mask address-mask;
      logical-system logical-system;
      port port-number;
      retry-count number;
      routing-instance routing-instance-name;
      tag-list tag-list;
      target-parameters target-parameters-name;
      timeout seconds;
    }
    target-parameters target-parameters-name {
      notify-filter profile-name;
      parameters {
        message-processing-model (v1 | v2c | V3);
        security-level (authentication | none | privacy);
        security-model (usm | v1 | v2c);
```



```
        security-name security-name;
      }
    }
    usm {
      local-engine {
        user username {
          authentication-sha {
            authentication-password authentication-password;
          }
          authentication-md5 {
            authentication-password authentication-password;
          }
          authentication-none;
          privacy-aes128 {
            privacy-password privacy-password;
          }
          privacy-des {
            privacy-password privacy-password;
          }
          privacy-3des {
            privacy-password privacy-password;
          }
          privacy-none;
        }
      }
      remote-engine engine-id {
        user username {
          authentication-sha {
            authentication-password authentication-password;
          }
          authentication-md5 {
            authentication-password authentication-password;
          }
          authentication-none;
          privacy-aes128 {
            privacy-password privacy-password;
          }
          privacy-des {
            privacy-password privacy-password;
          }
          privacy-3des {
            privacy-password privacy-password;
          }
          privacy-none {
            privacy-password privacy-password;
          }
        }
      }
    }
    vacm {
      access {
        group group-name {
          (default-context-prefix | context-prefix context-prefix) {
            security-model (any | usm | v1 | v2c) {
              security-level (authentication | none | privacy) {
                notify-view view-name;
```



```
                        read-view view-name;
                        write-view view-name;
                    }
                }
            }
        }
    }
    security-to-group {
        security-model (usm | v1 | v2c) {
            security-name security-name {
                group group-name;
            }
        }
    }
}
}
view view-name {
    oid object-identifier (include | exclude);
}
}
```

Related Documentation

- Understanding the Implementation of SNMP on page 6021
- snmp on page 1334

Configuring SSH Host Keys for Secure Copying of Data

Secure Shell (SSH) uses encryption algorithms to generate a host, server, and session key system that ensures secure data transfer. You can configure SSH host keys to support secure copy (SCP) as an alternative to FTP for the background transfer of data such as configuration archives and event logs. To configure SSH support for SCP, you must complete the following tasks:

- Specify SSH known hosts by including hostnames and host key information in the Routing Engine configuration hierarchy.
- Set an SCP URL to specify the host from which to receive data. Setting this attribute automatically retrieves SSH host key information from the SCP server.
- Verify that the host key is authentic.
- Accept the secure connection. Accepting this connection automatically stores host key information in the local host key database. Storing host key information in the configuration hierarchy automates the secure handshake and allows background data transfer using SCP.

Tasks to configure SSH host keys for secure copying of data are:

1. Configuring SSH Known Hosts on page 1242
2. Configuring Support for SCP File Transfer on page 1242
3. Updating SSH Host Key Information on page 1243

Configuring SSH Known Hosts

To configure SSH known hosts, include the **host** statement, and specify hostname and host key options for trusted servers at the **[edit security ssh-known-hosts]** hierarchy level:

```
[edit security ssh-known-hosts]
host corporate-archive-server, ip-address {
  dsa-key key;
}
host archive-server-url {
  rsa-key key;
}
host server-with-ssh-version-1, ip-address {
  rsa1-key key;
}
```

Host keys are one of the following:

- **dsa-key**—Base64 encoded Digital Signature Algorithm (DSA) key.
- **rsa-key**—Base64 encoded RSA public key algorithm, which supports encryption and digital signatures.
- **rsa1-key**—Base64 encoded RSA public key algorithm, which supports encryption and digital signatures for SSH version 1 and SSH version 2.

Configuring Support for SCP File Transfer

To configure a known host to support background SCP file transfers, include the **archive-sites** statement at the **[edit system archival configuration]** hierarchy level.

```
[edit system archival configuration]
archive-sites {
  scp://username<:password>@host<:port>/url-path;
}
```

NOTE: When specifying a URL in a Junos OS statement using an IPv6 host address, you must enclose the entire URL in quotation marks (" ") and enclose the IPv6 host address in brackets ([ ]). For example, **“scp://*username*<:*password*>@[*host*]<:*port*>/*url-path*”;**

Setting the **archive-sites** statement to point to an SCP URL triggers automatic host key retrieval. At this point, Junos OS connects to the SCP host to fetch the SSH public key, displays the host key message digest or fingerprint as output to the console, and terminates the connection to the server.

```
user@switch# set system archival configuration archive-sites “<scp-url-path>”
The authenticity of host <my-archive-server (<server-ip-address>)> can’t be established.
  RSA key fingerprint is <ascii-text key>. Are you sure you want to continue connecting
  (yes/no)?
```

To verify that the host key is authentic, compare this fingerprint with a fingerprint that you obtain from the same host using a trusted source. If the fingerprints are identical, accept the host key by entering **yes** at the prompt. The host key information is then stored in the Routing Engine configuration and supports background data transfers using SCP.

Updating SSH Host Key Information

Typically, SSH host key information is automatically retrieved when you set a URL attribute for SCP using the **archival configuration archive-sites** statement at the **[edit system]** hierarchy level. However, if you need to manually update the host key database, use one of the following methods.

1. Retrieving Host Key Information Manually on page 1243
2. Importing Host Key Information from a File on page 1243

Retrieving Host Key Information Manually

To manually retrieve SSH public host key information, use the **fetch-from-server** option with the **set security ssh-known-hosts** command. You must include a hostname attribute with the **set security ssh-known-hosts fetch-from-server** command to specify the host from which to retrieve the SSH public key.

```
user@switch# set security ssh-known-hosts fetch-from-server <hostname>
```

Importing Host Key Information from a File

To manually import SSH host key information from the known-hosts file located at **/var/tmp/known-hosts** on the server, include the **load-key-file** option with the **set security ssh-known-hosts** command. You must include the path to the **known-hosts** file with the **set security ssh-known-hosts load-key-file** command to specify the location from which to import host key information.

```
user@switch# set security ssh-known-hosts load-key-file /var/tmp/known-hosts
```

Configuring SSH Service for Remote Access to the Router or Switch

To configure the router or switch to accept SSH as an access service, include the **ssh** statement at the **[edit system services]** hierarchy level:

```
[edit system services]
ssh {
  ciphers [ cipher-1 cipher-2 cipher-3 ...]
  client-alive-count-max number;
  client-alive-interval seconds;
  connection-limit limit;
  hostkey-algorithm <algorithm | no-algorithm>;
  key-exchange algorithm;
  macs algorithm;
  max-sessions-per-connection number;
  no-tcp-forwarding;
  protocol-version [v1 v2] ;
  rate-limit limit;
  root-login <allow | deny | deny-password>;
}
```

By default, the router or switch supports a limited number of simultaneous SSH sessions and connection attempts per minute. Use the following statements to change the defaults:

- **connection-limit** *limit*—Maximum number of simultaneous connections per protocol (IPV4 and IPv6). The range is a value from 1 through 250. The default is 75. When you configure a connection limit, the limit is applicable to the number of SSH sessions per protocol (IPv4 and IPv6). For example, a connection limit of 10 allows 10 IPv6 SSH sessions and 10 IPv4 SSH sessions.
- **max-sessions-per-connection** *number*—Include this statement to specify the maximum number of SSH sessions allowed per single SSH connection. This allows you to limit the number of cloned sessions tunneled within a single SSH connection. The default value is 10.
- **rate-limit** *limit*—Maximum number of connection attempts accepted per minute (a value from 1 through 250). The default is 150. When you configure a rate limit, the limit is applicable to the number of connection attempts per protocol (IPv4 and IPv6). For example, a rate limit of 10 allows 10 IPv6 SSH session connection attempts per minute and 10 IPv4 SSH session connection attempts per minute.

For information about other configuration settings, see the following topics:

- Configuring the Root Login Through SSH on page 1244
- Configuring the SSH Protocol Version on page 1244
- Configuring the Client Alive Mechanism on page 1245

Configuring the Root Login Through SSH

By default, users are allowed to log in to the router or switch as **root** through SSH. To control user access through SSH, include the **root-login** statement at the **[edit systems services ssh]** hierarchy level:

```
[edit system services ssh]
root-login (allow | deny | deny-password);
```

allow—Allows users to log in to the router or switch as root through SSH. The default is **allow**.

deny—Disables users from logging in to the router or switch as root through SSH.

deny-password—Allows users to log in to the router or switch as root through SSH when the authentication method (for example, RSA) does not require a password.

Configuring the SSH Protocol Version

By default, both version 1 and version 2 of the SSH protocol are enabled. To configure the router or switch to use only version 1 of the SSH protocol, include the **protocol-version** statement and specify **v1** at the **[edit system services ssh]** hierarchy level:

```
[edit system services ssh]
protocol-version [ v1 ];
```

To configure the router or switch to use only version 2 of the SSH protocol, include the **protocol-version** statement and specify **v2** at the **[edit system services ssh]** hierarchy level:

```
[edit system services ssh]
protocol-version [ v2 ];
```

To explicitly configure the router or switch to use version 1 and 2 of the SSH protocol, include the **protocol-version** statement and specify **v1** and **v2** at the **[edit system services ssh]** hierarchy level:

```
[edit system services ssh]
protocol-version [ v1 v2 ];
```

For J Series Services Routers, the export license software supports SSH version 1 only.

Configuring the Client Alive Mechanism

The client alive mechanism is valuable when the client or server depends on knowing when a connection has become inactive. It differs from the standard keepalive mechanism because the client alive messages are sent through the encrypted channel. The client alive mechanism is not enabled at default. To enable it, configure the **client-alive-count-max** and the **client-alive-interval**. This option applies to SSH protocol version 2 only.

In the following example, unresponsive SSH clients will be disconnected after approximately 100 seconds (20 x 5).

```
[edit system services ssh]
client-alive-count-max 5;
client-alive-interval 20;
```

Configuring TACACS+ Authentication

TACACS+ authentication is a method of authenticating users who attempt to access the router or switch. Tasks to configure TACACS+ configuration are:

Configuring TACACS+ Server Details

To use TACACS+ authentication on the router or switch, configure information about one or more TACACS+ servers on the network by including the **tacplus-server** statement at the **[edit system]** hierarchy level:

```
[edit system]
tacplus-server server-address {
  port port-number;
  secret password;
  single-connection;
```

```
    timeout seconds;
}
```

server-address is the address of the TACACS+ server.

port-number is the TACACS+ server port number.

You must specify a secret (password) by using the **secret** statement. The local router or switch passes the **secret** to the TACACS+ client. If the password included spaces, enclose the password in quotation marks. The secret used by the local router or switch must match that used by the server.

Optionally, you can specify the length of time that the local router or switch waits to receive a response from a TACACS+ server by including the **timeout** statement. By default, the router or switch waits 3 seconds. You can configure this to be a value in the range from 1 through 90 seconds.

Optionally, you can use the **single-connection** statement to have the software maintain one open Transmission Control Protocol (TCP) connection to the server for multiple requests, rather than opening a connection for each connection attempt.

NOTE: Early versions of the TACACS+ server do not support the single-connection option. If you specify this option and the server does not support it, Junos OS will be unable to communicate with that TACACS+ server.

To configure multiple TACACS+ servers, include multiple **tacplus-server** statements.

On a TX Matrix router, TACACS+ accounting should be configured only under the groups **re0** and **re1**.

NOTE: Accounting should not be configured at the [edit system] hierarchy level; on a TX Matrix router, control is done under the switch-card chassis only.

To configure a set of users that share a single account for authorization purposes, you create a template user. To do this, include the **user** statement at the **[edit system login]** hierarchy level.

Specifying a Source Address for the Junos OS to Access External TACACS+ Servers

You can specify which source address Junos OS uses when accessing your network to contact an external TACACS+ server for authentication. You can also specify which source address Junos OS uses when contacting a TACACS+ server for sending accounting information.

To specify a source address for a TACACS+ server for authentication, include the **source-address** statement at the **[edit system tacplus-server *server-address*]** hierarchy level:


```
[edit system tacplus-server server-address]
source-address source-address;
```

source-address is a valid IP address configured on one of the router or switch interfaces.

To specify a source address for a TACACS+ server for system accounting, include the **source-address** statement at the **[edit system accounting destination tacplus server *server-address*]** hierarchy level:

```
[edit system accounting destination tacplus server server-address]
source-address source-address;
```

source-address is a valid IP address configured on one of the router or switch interfaces.

Configuring the Same Authentication Service for Multiple TACACS+ Servers

To configure the same authentication service for multiple TACACS+ servers, include statements at the **[edit system tacplus-server]** and **[edit system tacplus-options]** hierarchy levels. For information about how to configure a TACACS+ server at the **[edit system tacplus-server]** hierarchy level.

To assign the same authentication service to multiple TACACS+ servers, include the **service-name** statement at the **[edit system tacplus-options]** hierarchy level:

```
[edit system tacplus-options]
service-name service-name;
```

service-name is the name of the authentication service. By default, the service name is set to **junos-exec**.

The following example shows how to configure the same authentication service for multiple TACACS+ servers:

```
[edit system]
tacplus-server {
  10.2.2.2 secret "$9$2dgoJGDiqP5ZG9A"; ## SECRET-DATA
  10.3.3.3 secret "$9$2dgoJGDiqP5ZG9A";## SECRET-DATA
}
tacplus-options {
  service-name bob;
}
```

Configuring Juniper Networks Vendor-Specific TACACS+ Attributes

The Juniper Networks vendor-specific TACACS+ attributes enable you to configure access privileges for users on a TACACS+ server. They are specified in the TACACS+ server configuration file on a per-user basis. Junos OS retrieves these attributes through an authorization request of the TACACS+ server after authenticating a user. You do not need to configure these attributes to run Junos OS with TACACS+.

To specify these attributes, include a **service** statement of the following form in the TACACS+ server configuration file:

```
service = junos-exec {
  local-user-name = <username-local-to-router>
  allow-commands = "<allow-commands-regex>"
```

```
    allow-configuration = "<allow-configuration-regex>"
    deny-commands = "<deny-commands-regex>"
    deny-configuration = "<deny-configuration-regex>"
}
```

This **service** statement can appear in a **user** or **group** statement.

Related Documentation

- Using Regular Expressions on a RADIUS or TACACS+ Server to Allow or Deny Access to Commands on page 1256
- Example: Configuring System Authentication for RADIUS, TACACS+, and Password Authentication on page 1267
- Juniper Networks Vendor-Specific TACACS+ Attributes on page 1205
- Overview of Template Accounts for RADIUS and TACACS+ Authentication on page 1200
- Junos OS User Authentication Methods on page 1216

Configuring TACACS+ System Accounting

You can use TACACS+ to track and log software logins, configuration changes, and interactive commands. To audit these events, include the following statements at the **[edit system accounting]** hierarchy level:

```
[edit system accounting]
events [ events ];
destination {
    tacplus {
        server {
            server-address {
                port port-number;
                secret password;
                single-connection;
                timeout seconds;
            }
        }
    }
}
```

Tasks for configuring TACACS+ system accounting are:

1. Specifying TACACS+ Auditing and Accounting Events on page 1248
2. Configuring TACACS+ Server Accounting on page 1249

Specifying TACACS+ Auditing and Accounting Events

To specify the events you want to audit when using a TACACS+ server for authentication, include the **events** statement at the **[edit system accounting]** hierarchy level:

```
[edit system accounting]
events [ events ];
```

events is one or more of the following:

- **login**—Audit logins

- **change-log**—Audit configuration changes
- **interactive-commands**—Audit interactive commands (any command-line input)

Configuring TACACS+ Server Accounting

To configure TACACS+ server accounting, include the **server** statement at the **[edit system accounting destination tacplus]** hierarchy level:

```
[edit system accounting destination tacplus]
server {
  server-address {
    port port-number;
    secret password;
    single-connection;
    timeout seconds;
  }
}
```

server-address specifies the address of the TACACS+ server. To configure multiple TACACS+ servers, include multiple **server** statements.

NOTE: If no TACACS+ servers are configured at the **[edit system accounting destination tacplus]** statement hierarchy level, Junos OS uses the TACACS+ servers configured at the **[edit system tacplus-server]** hierarchy level.

port-number specifies the TACACS+ server port number.

You must specify a secret (password) by using the **secret** statement. The local router or switch passes the **secret** to the TACACS+ client. If the password contains spaces, enclose the entire password in quotation marks (“ ”). The password used by the local router or switch must match that used by the server.

Optionally, you can specify the length of time that the local router or switch waits to receive a response from a TACACS+ server by including the **timeout** statement. By default, the router or switch waits 3 seconds. You can configure this to be a value in the range from 1 through 90 seconds.

Optionally, you can maintain one open TCP connection to the server for multiple requests, rather than opening a connection for each connection attempt, by including the **single-connection** statement.

To ensure that start and stop requests for accounting of login events are correctly logged in the Accounting file instead of the Administration log file on a TACACS+ server, include either the **no-cmd-attribute-value** statement or the **exclude-cmd-attribute** at the **[edit system tacplus-options]** hierarchy level.

If you use the **no-cmd-attribute-value** statement, the value of the **cmd** attribute is set to a null string in the start and stop requests. If you use the **exclude-cmd-attribute** statement, the **cmd** attribute is totally excluded from the start and stop requests. Both statements support the correct logging of accounting requests in the Accounting file, instead of the Administration file.

```
[edit system tacplus-options]
(no-cmd-attribute-value | exclude-cmd-attribute);
```

Related Documentation

- Configuring TACACS+ Authentication on page 1245

Defining Junos OS Login Classes

To define a login class and its access privileges, include the **class** statement at the **[edit system login]** hierarchy level:

```
[edit system login]
class class-name {
  allow-commands "regular-expression";
  allow-configuration "regular-expression";
  deny-commands "regular-expression";
  deny-configuration "regular-expression";
  idle-timeout minutes;
  permissions [ permissions ];
}
```

Related Documentation

- Junos OS Login Classes Overview on page 1218
- Junos OS User Accounts Overview on page 1216
- Example: Creating Login Classes with Specific Privileges on page 1269
- Configuring the Junos OS to Display a System Login Announcement on page 139

Limiting the Number of User Login Attempts for SSH and Telnet Sessions

You can limit the number of times a user can attempt to enter a password while logging in through SSH or Telnet. The connection is terminated if a user fails to log in after the number of attempts specified. You can also specify a delay, in seconds, before a user can try to enter a password after a failed attempt. In addition, you can specify the threshold for the number of failed attempts before the user experiences a delay in being able to enter a password again.

To specify the number of times a user can attempt to enter a password while logging in, include the **retry-options** statement at the **[edit system login]** hierarchy level:

```
[edit system login]
retry-options {
  tries-before-disconnect number;
  backoff-threshold number;
  backoff-factor seconds;
  maximum-time seconds
  minimum-time seconds;
}
```

You can configure the following options:

- **tries-before-disconnect**—Number of times a user can attempt to enter a password when logging in. The connection closes if a user fails to log in after the number specified. The range is from 1 through 10, and the default is 10.
- **backoff-threshold**—Threshold for the number of failed login attempts before the user experiences a delay in being able to enter a password again. Use the **backoff-factor** option to specify the length of the delay in seconds. The range is from 1 through 3, and the default is 2.
- **backoff-factor**—Length of time, in seconds, before a user can attempt to log in after a failed attempt. The delay increases by the value specified for each subsequent attempt after the threshold. The range is from 5 through 10, and the default is 5 seconds.
- **maximum-time *seconds***—Maximum length of time, in seconds, that the connection remains open for the user to enter a username and password to log in. If the user remains idle and does not enter a username and password within the **maximum-time** value, the connection is closed. The range is from 20 through 300 seconds, and the default is 120 seconds.
- **minimum-time**—Minimum length of time, in seconds, that a connection remains open while a user is attempting to enter a correct password. The range is from 20 through 60, and the default is 40.

Related Documentation

- Example: Limiting the Number of Login Attempts for SSH and Telnet Sessions on page 1271
- Configuring Junos OS User Accounts on page 1226

Recovering the Root Password

If you forget the root password for the QFX3500 switch, you can use the password recovery procedure to reset the root password.

NOTE: The root password cannot be recovered on a QFabric system.

NOTE: You need console access to the switch to recover the root password.

To recover the root password:

1. Power off the switch by switching off the AC power outlet of the device or, if necessary, by pulling the power cords out of the QFX3500 switch power supplies.
2. Turn off the power to the management device, such as a PC or laptop computer, that you want to use to access the CLI.
3. Plug one end of the Ethernet rollover cable supplied with the switch into the RJ-45–to–DB-9 serial port adapter supplied with the switch.
4. Plug the RJ-45–to–DB-9 serial port adapter into the serial port on the management device.

5. Connect the other end of the Ethernet rollover cable to the console port on the switch.
6. Turn on the power to the management device.
7. On the management device, start your asynchronous terminal emulation application (such as Microsoft Windows Hyperterminal) and select the appropriate **COM** port to use (for example, **COM1**).
8. Configure the port settings as follows:
   - Bits per second: 9600
   - Data bits: 8
   - Parity: None
   - Stop bits: 1
   - Flow control: None
9. Power on the switch by (if necessary) plugging the power cords into the QFX3500 switch power supply, or turning on the power to the device or switch by switching on the AC power outlet the device is plugged into

   The terminal emulation screen on your management device displays the switch's boot sequence.
10. When the following prompt appears, press the Spacebar to access the switch's bootstrap loader command prompt:

    ```
    Hit [Enter] to boot immediately, or space bar for command prompt.
    Booting [kernel] in 9 seconds...
    ```
11. At the following prompt, enter **boot -s** to start up the system in single-user mode.

    ```
    ok boot -s
    ```
12. At the following prompt, enter **recovery** to start the root password recovery procedure.

    ```
    Enter full pathname of shell or 'recovery' for root password recovery or RETURN
    for /bin/sh: recovery
    ```
13. Enter configuration mode in the CLI.
14. Set the root password. For example:

    ```
    user@switch# set system root-authentication plain-text-password
    ```
15. At the following prompt, enter the new root password. For example:

    ```
    New password: juniper1
    Retype new password:
    ```
16. At the second prompt, reenter the new root password.
17. After you have finished configuring the password, commit the configuration.

    ```
    root@host# commit
    commit complete
    ```
18. Exit configuration mode in the CLI.
19. Exit operational mode in the CLI.
20. At the prompt, enter **y** to reboot the switch.

    ```
    Reboot the system? [y/n] y
    ```


Related Documentation

- Configuring the Root Password on page 1236

Specifying Access Privileges for Junos OS Configuration Mode Hierarchies

You can specify extended regular expressions with the **allow-configuration** and **deny-configuration** statements to define user access privileges to parts of the configuration hierarchy. Doing so overrides login class permission bits set for a user. You can also use wildcards to restrict access. When you define access privileges to parts of the configuration hierarchy, do the following tasks:

- Specify the full paths in the extended regular expressions with the **allow-configuration** and **deny-configuration** statements.
- Put parentheses around an extended regular expression that connects two or more expressions with the pipe | symbol. For example:

  [edit system login class *class-name*]
  user@switch# **set deny-configuration "(system login class) | (system services)"**

NOTE: Each expression separated by a pipe (|) symbol must be a complete standalone expression, and must be enclosed in parentheses ( ). Do not use spaces between regular expressions separated with parentheses and connected with the pipe (|) symbol. You cannot define access to keywords such as **set**, **edit**, or **activate**.

When you explicitly provide access to configuration mode hierarchies or regular expressions using the **allow-configuration** statement, you add to the regular permissions set with the **permissions** statement. If you explicitly deny access to configuration mode hierarchies or regular expressions using the **deny-configuration** statement, you remove permissions for the specified configuration mode hierarchy from the default permissions provided by the **permissions** statement.

To explicitly provide access to an individual configuration mode hierarchy that would otherwise be denied, include the **allow-configuration** statement at the **[edit system login class *class-name*]** hierarchy level:

[edit system login class *class-name*]
allow-configuration "*regular-expression*";

To explicitly deny access to an individual configuration hierarchy that would otherwise be supported, include the **deny-configuration** statement at the **[edit system login class *class-name*]** hierarchy level:

[edit system login class *class-name*]
deny-configuration “*regular-expression*";

You can include one **deny-configuration** and one **allow-configuration** statement in each login class.

If you allow and deny the same set of configuration hierarchy levels, regular expressions, or commands, the **allow-configuration** statement permissions take precedence over the permissions specified by the **deny-configuration** statement. For example, if you include **allow-configuration "system services"** and **deny-configuration "system services"**, the login class user can continue to edit the configuration or issue commands at the **edit system services** hierarchy level.

Related Documentation

- Defining Access Privileges Using allow/deny-configuration Statements on page 1271
- Configuring Access Privilege Levels on page 1226

Specifying Access Privileges for Junos OS Operational Mode Commands

You can specify extended regular expressions by using the **allow-commands** and **deny-commands** statements to define a user's access privileges to individual operational mode commands. Doing so takes precedence over a login class permissions bit set for a user. You can include one **deny-commands** and one **allow-commands** statement in each login class.

To explicitly provide use of an individual operational mode command that would otherwise be denied, include the **allow-commands** statement at the **[edit system login class *class-name*]** hierarchy level:

```
[edit system login class class-name]
allow-commands "regular-expression";
```

To explicitly deny access to an individual operational mode command that would otherwise be supported, include the **deny-commands** statement at the **[edit system login class *class-name*]** hierarchy level:

```
[edit system login class class-name]
deny-commands "regular-expression";
```

If the regular expression contains any spaces, operators, or wildcard characters, enclose the expression in quotation marks. Regular expressions are not case-sensitive.

```
allow-commands "show interfaces";
```

NOTE: Modifiers are not supported within the regular expression string to be matched. If a modifier is used, then nothing is matched.

For example, the deny command **set protocols** does not match anything, whereas **protocols** matches *protocols*.

Explicitly providing access to operational mode commands using the **allow-commands** statement adds to the regular permissions set using the **permissions** statement. Likewise, explicitly denying access to operational mode commands using the **deny-commands** statement removes permissions for the specified commands from the default permissions provided by the **permissions** statement.

For example, if a login class has the permission **view** and the **allow-commands** statement includes the **request system software add** command, the specified login class user can install software, in addition to the permissions specified by the **view** permissions flag. Likewise, if a login class has the permission **all** and the **deny-commands** statement includes the **request system software add** command, the specified login class user can perform all operations allowed by the **all** permissions flag, except installing software using the **request system software add** command.

If you allow and deny the same commands, the **allow-commands** permissions take precedence over the permissions specified by **deny-commands**. For example, if you include **allow-commands "request system software add"** and **deny-commands "request system software add"**, the login class user is allowed to install software using the **request system software add** command.

If you specify a regular expression for **allow-commands** and **deny-commands** with two different variants of a command, the longest match is always executed.

For example, if you specify a regular expression for **allow-commands** with the **commit-synchronize** command and a regular expression for **deny-commands** with the **commit** command, users assigned to such a login class would be able to issue the **commit synchronize** command, but not the **commit** command. This is because **commit-synchronize** is the longest match between **commit** and **commit-synchronize**, and it is specified for **allow-commands**.

Likewise, if you specify a regular expression for **allow-commands** with the **commit** command and a regular expression for **deny-commands** with the **commit-synchronize** command, users assigned to such a login class would be able to issue the **commit** command, but not the **commit-synchronize** command. This is because **commit-synchronize** is the longest match between **commit** and **commit-synchronize**, and it is specified for **deny-commands**.

Anchors are required when specifying complex regular expressions with **allow-commands** or **deny-commands** statements. For example, when specifying multiple commands using the pipe (|) symbol for **allow-commands**, the following syntax is incorrect: **allow-commands = "(monitor.*)|(ping.*)|(show.*)|(exit)"** . Instead, you must specify the expression using the following syntax: **allow-commands** = **"(^monitor) | (^ping) | (^show) | (^exit)"** OR **allow-commands ="^(monitor | ping | show | exit)"**

Related Documentation

- Example: Configuring Access Privileges for Operational Mode Commands on page 1263
- Regular Expressions for Allowing and Denying Junos OS Operational Mode Commands on page 1220
- *allow-commands*
- *deny-commands*

Using Junos OS to Configure Logical System Administrators

Using Junos OS, you can partition a single router or switch into multiple logical devices that perform independent routing or switching tasks. When creating logical systems, you must configure logical system administrators and interfaces, assign logical interfaces to logical systems, and configure various other logical system statements.

The master administrator can assign one or more logical system administrators to each logical system. Once assigned to a logical system, administrators are restricted to viewing only configurations of the logical system to which they are assigned and accessing only the operational commands that apply to that particular logical system. This restriction means that these administrators cannot access global configuration statements, and all command output is restricted to the logical system to which the administrators are assigned.

To configure logical system administrators, include the **logical-system** ***logical-system-name*** statement at the **[edit system login class *class-name*]** hierarchy level and apply the class to the user. For example:

```
[edit]
system {
  login {
    class admin1 {
      permissions all;
      logical-system logical-system-LS1;
    }
    class admin2 {
      permissions view; # Gives users assigned to class admin2 the ability to view
        # but not to change the configuration.
      logical-system logical-system-LS2;
    }
    user user1 {
      class admin1;
    }
    user user2 {
      class admin2;
    }
  }
}
```

Fully implementing logical systems requires that you also configure any protocols, routing statements, switching statements, and policy statements for the logical system.

Related Documentation

- *Defining Junos OS Login Classes*
- Defining Junos OS Login Classes on page 1250

Using Regular Expressions on a RADIUS or TACACS+ Server to Allow or Deny Access to Commands

Use regular expressions to specify which operational or configuration mode commands are allowed or denied when you use a RADIUS or TACACS+ server for user authentication. You can specify the regular expressions using the appropriate Juniper Networks vendor-specific RADIUS or TACACS+ attributes in your authentication server configuration.

You can specify **allow-configuration**, **deny-configuration**, **allow-commands**, or **deny-commands** in a single extended regular expression, enclosing multiple commands in parentheses and separating them using the pipe symbol. For example, you can specify multiple **allow-commands** parameters using: **allow-commands= (cmd1 | cmd2 | cmd*n*)**. You can specify **user-permissions** as a list of comma-separated values, and not as a regular expression.

On a RADIUS or TACACS+ server, you can also use a simplified version for regular expressions where you specify each individual expression on a separate line. The simplified version is valid for **allow-commands**, **deny-commands**, **allow-configuration**, **deny-configuration**, and **permissions** vendor-specific attributes.

For a RADIUS server, specify the individual regular expressions using the following syntax:

Juniper-Allow-Commands+="cmd1"
Juniper-Allow-Commands+="cmd2"
Juniper-Allow-Commands+="cmd***n***"
Juniper-Deny-Commands+="cmd1"
Juniper-Deny-Commands+="cmd2"
Juniper-Deny-Commands+="cmd***n***"
Juniper-Allow-Configuration+="regex1"
Juniper-Allow-Configuration+="regex2"
Juniper-Allow-Configuration+="regex***n***"
Juniper-Deny-Configuration+="regex1"
Juniper-Deny-Configuration+="regex2"
Juniper-Deny-Configuration+="regex***n***"
Juniper-User-Permissions+="permission-flag1"
Juniper-User-Permissions+="permission-flag2"
Juniper-User-Permissions+="permission-flag***n***"

For a TACACS+ server, specify the individual regular expressions using the following syntax:

allow-commands1="cmd1"
allow-commands2="cmd2"
allow-commands***n***="cmd***n***"
deny-commands1="cmd1"
deny-commands2="cmd2"
deny-commands***n***="cmd***n***"
allow-configuration1="regex1"
allow-configuration2="regex2"
allow-configuration***n***="regex***n***"
deny-configuration1="regex1"
deny-configuration2="regex2"
deny-configuration***n***="regex***n***"
user-permissions1="permission-flag1"
user-permissions2="permission-flag2"
user-permissions***n***="permission-flag***n*** "

NOTE:

- Numeric values 1 to *n* in the syntax (for a TACACS+ server) must be unique but need not be sequential. For example, the following syntax is valid:

```
allow-commands1="cmd1"
allow-commands3="cmd3"
allow-commands2="cmd2"
deny-commands3="cmd3"
deny-commands2="cmd2"
deny-commands1="cmd1"
```

- The limit on the number of lines of individual regular expressions is imposed by the TACACS+ or RADIUS server.
- When you issue the **show cli authorization** command, the command output displays the regular expression in a single line, even if you specify each individual expression on a separate line.

For more information about Juniper Networks vendor-specific RADIUS and TACACS+ attributes, see "Juniper Networks Vendor-Specific RADIUS Attributes" on page 1203 and "Juniper Networks Vendor-Specific TACACS+ Attributes" on page 1205.

NOTE: When RADIUS or TACACS+ authentication is configured for a router, regular expressions configured on the RADIUS or TACACS+ server merge with any regular expressions configured on the local router at the **[edit system login class]** hierarchy level using the **allow-commands**, **deny-commands**, **allow-configuration**, **deny-configuration**, or **permissions** statements. If the final expression has a syntax error, the overall result is an invalid regular expression.

Related Documentation

- Junos OS Authentication Order for RADIUS, TACACS+, and Password Authentication on page 1211

VSA Match Conditions and Actions

EX Series switches and the QFX Series support the configuration of RADIUS server attributes specific to Juniper Networks. These attributes are known as vendor-specific attributes (VSAs). They are configured on RADIUS servers and work in combination with 802.1X authentication. Using VSAs, you can apply port firewall filter attributes as a subset of match conditions and actions sent from the RADIUS server to the switch as a result of successful 802.1X authentication.

Each term in a VSA configured through the RADIUS server consists of *match conditions* and an *action*. Match conditions are the values or fields that the packet must contain. You can define single, multiple, or no match conditions. If no match conditions are specified for the term, the packet is accepted by default. The action is the action that the switch takes if a packet matches the match conditions for the specific term. Allowed actions are to accept a packet or to discard a packet.

The following guidelines apply when you specify match conditions and actions for VSAs:

- Both **match** and **action** statements are mandatory.
- Any or all options (separated by commas) may be included in each **match** and **action** statement.
- Fields separated by commas will be ANDed if they are of a different type. The same types cannot be repeated.
- For OR cases (for example, match **10.1.1.0/24** OR **11.1.1.0/24**), apply multiple VSAs to the 802.1X supplicant.
- In order for the **forwarding-class** option to be applied, the forwarding class must be configured on the switch. If it is not configured on the switch, this option is ignored.

Table 109 on page 1259 describes the match conditions you can specify when configuring a VSA using the **match** command on the RADIUS server. The string that defines a match condition is called a *match statement*.

Table 109: Match Conditions

Option	Description
destination-mac *mac-address*	Destination media access control (MAC) address of the packet.
source-vlan *source-vlan*	Name of the source VLAN.
source-dot1q-tag *tag*	Tag value in the 802.1Q header, in the range **0** through **4095**.
destination-ip *ip-address*	Address of the final destination node.
ip-protocol *protocol-id*	IPv4 protocol value. In place of the numeric value, you can specify one of the following text synonyms: **ah**, **egp (8)**, **esp (50**, **gre (47)**, **icmp (1)**, **igmp (2)**, **ipip (4)**, **ipv6 (41)**, **ospf (89)**, **pim (103)**, **rsvp (46)**, **tcp (6)**, or **udp (17)**
source-port *port*	TCP or User Datagram Protocol (UDP) source port field. Normally, you specify this match statement in conjunction with the **ip-protocol** match statement to determine which protocol is being used on the port. In place of the numeric field, you can specify one of the text options listed under **destination-port**.

Table 109: Match Conditions *(continued)*

Option	Description
destination-port *port*	TCP or UDP destination port field. Normally, you specify this match in conjunction with the **ip-protocol** match statement to determine which protocol is being used on the port. In place of the numeric value, you can specify one of the following text synonyms (the port numbers are also listed): **afs** (1483), **bgp** (179), **biff** (512), **bootpc** (68), **bootps** (67), **cvspserver** (2401), **cmd** (514), **dhcp** (67), **domain** (53), **eklogin** (2105), **ekshell** (2106), **exec** (512), **finger** (79), **ftp** (21), **ftp-data** (20), **http** (80), **https** (443), **ident** (113), **imap** (143), **kerberos-sec** (88), **klogin** (543), **kpasswd** (761), **krb-prop** (754), **krbupdate** (760), **kshell** (544), **ldap** (389), **login** (513), **mobileip-agent** (434), **mobilip-mn** (435), **msdp** (639), **netbios-dgm** (138), **netbios-ns** (137), **netbios-ssn** (139), **nfsd** (2049), **nntp** (119), **ntalk** (518), **ntp** (123), **pop3** (110), **pptp** (1723), **printer** (515), **radacct** (1813), **radius** (1812), **rip** (520), **rkinit** (2108), **smtp** (25), **snmp** (161), **snmptrap** (162), **snpp** (444), **socks** (1080), **ssh** (22), **sunrpc** (111), **syslog** (514), **telnet** (23), **tacacs-ds** (65), **talk** (517), **tftp** (69), **timed** (525), **who** (513), **xdmcp** (177), **zephyr-clt** (2103), **zephyr-hm** (2104)

When you define one or more terms that specify the filtering criteria, you also define the action to take if the packet matches all criteria. Table 110 on page 1260 shows the actions that you can specify in a term.

Table 110: Actions for VSAs

Option	Description
(**allow** | **deny**)	Accept a packet or discard a packet silently without sending an Internet Control Message Protocol (ICMP) message.
forwarding-class *class-of-service*	(Optional) Classify the packet in one of the following forwarding classes: • **assured-forwarding** • **best-effort** • **expedited-forwarding** • **network-control**
loss-priority (**low** | **medium** | **high**)	(Optional) Set the packet loss priority (PLP) to **low**, **medium**, or **high**. Specify both the forwarding class and loss priority.

Related Documentation

- *Filtering 802.1X Supplicants Using RADIUS Server Attributes*
- *Understanding 802.1X and VSAs on EX Series Switches*
- Understanding VSAs on the QFX Series on page 1203

Configuration Examples

Example: Changing the Requirements for Junos OS Plain-Text Passwords

This example shows how to set various maximum and minimum requirements for plain-text passwords to increase password strength.

Requirements

This example requires a device running Junos 12.2 or greater. The **minimum-length** and **maximum-length** password requirements statements are available in earlier releases, however, you must have Junos OS Release 12.2 or greater to configure **minimum-lower-cases**, **minimum-numerics**, **minimum-punctuations**, or **minimum-upper-cases**.

Overview

You can use a variety of requirements to strengthen plain-text passwords for greater security. Junos OS provides a number of possible configurations at the **[edit system login password]** hierarchy level that allow you to require users to create plain-text passwords that conform to a particular set of requirements that may include such things as length, number of changes, type of characters, numbers, or letter case.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

set system login password minimum-length 12

set system login password maximum-length 22

set system login password minimum-numerics 1

set system login password minimum-upper-cases 1

set system login password minimum-lower-cases 1

set system login password minimum-punctuations 1

Configuring Requirements for Plain-Text Passwords

Step-by-Step Procedure

This example configures password requirements that require the user to creat a password that has a minimum length of 12 characters, a maximum length of 22 characters, and that includes at least one lower-case letter, at least one upper-case letter, at least one punctuation character, and at least one numeric character.

1. Navigate to configuration mode in the [system login password] hierarchy level.

   ```
   user@host> edit
   [edit]
   user@host# edit system login password
   ```

2. Set a minimum length requirement of 12 characters and a maximum length requirement of 22 characters for user passwords.

   ```
   [edit system login password]
   user@host# set minimum-length 12
   [edit system login password]
   user@host# set maximum-length 22
   ```

3. Require users to set a password that has at least one lower-case letter and at least one upper-case letter.

   ```
   [edit system login password]
   user@host# set minimum-lower-cases 1
   [edit system login password]
   user@host# set minimum-upper-cases 1
   ```

4. Require users to set a password that has at least one punctuation-class character and at least one number.

   ```
   [edit system login password]
   user@host# set minimum-punctuations 1
   [edit system login password]
   user@host# set minimum-numerics 1
   ```

Results

From configuration mode, confirm your configuration by entering the show command at the edit system login password hierarchy level. if the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit system login password]
user@host# show
minimum-length 12;
maximum-length 22;
```

```
minimum-numerics 1;
minimum-upper-cases 1;
minimum-lower-cases 1;
```

Related Documentation

- Special Requirements for Junos OS Plain-Text Passwords on page 1221
- *password (Login)*

Example: Configuring Access Privilege Levels

Create two access privilege classes on the router or switch, one for configuring and viewing user accounts only and the second for configuring and viewing SNMP parameters only:

```
[edit]
system {
  login {
    class user-accounts {
      permissions [ configure admin admin-control ];
    }
    class network-mgmt {
      permissions [ configure snmp snmp-control ];
    }
  }
}
```

Related Documentation

- Configuring Access Privilege Levels on page 1226

Example: Configuring Access Privileges for Operational Mode Commands

The following example shows how to configure access privileges for different login classes for individual operational mode commands:

```
[edit]
system {
  # This login class has operator privileges and the additional ability
    # to reboot the router.
    login {
    # This login class has operator privileges and the additional ability to reboot the
    # router or switch.
    class operator-and-boot {
      permissions [ clear network reset trace view ];
      allow-commands "request system reboot";
    }
    # This login class has operator privileges but can't use any commands beginning
    # with "set" .
    # This login class has operator privileges
      # but cannot use any commands beginning with "set"
      class operator-no-set {
      permissions [ clear network reset trace view ];
      deny-commands "^set";
    }
    # This login class has operator privileges and can install software but not view
      # BGP information, and can issue the show route command, without specifying
      # commands or arguments under it.
```

```
        class operator-and-install-but-no-bgp {
        permissions [ clear network reset trace view ];
        allow-commands "(request system software add)|(show route$)";
        deny-commands "show bgp";
      }
    }
  }
```

Related Documentation

- Specifying Access Privileges for Junos OS Operational Mode Commands on page 168

Example: Configuring a Plain-Text Password for Root Logins

The following example shows how to set a plain-text password for root logins:

```
[edit]
user@switch# set system root-authentication plain-text-password
New password: type root password
Retype new password: retype root password
[edit]
user@switch# show
system {
  root-authentication {
    encrypted-password "$1$14c5.$sBopasddsdfs0";
  }
}
```

Related Documentation

- Configuring the Root Password on page 146

Example: Configuring RADIUS Authentication

The Junos OS supports two protocols for central authentication of users on multiple routers: RADIUS and TACACS+. We recommend RADIUS because it is a multivendor IETF standard, and its features are more widely accepted than those of TACACS+ or other proprietary systems. In addition, we recommend using a one-time-password system for increased security, and all vendors of these systems support RADIUS.

The Junos OS uses one or more template accounts to perform user authentication. You create the template account or accounts, and then configure the user access to use that account. If the RADIUS server is unavailable, the fallback is for the login process to use the local account that set up on the router or switch.

The following example shows how to configure RADIUS authentication:

```
[edit]
system {
  authentication-order [ radius password ];
  root-authentication {
    encrypted-password "$9$aH1j8gqQ1gjyjgjhgjgiiiii"; # SECRET-DATA
  }
  name-server {
    10.1.1.1;
    10.1.1.2;
  }
```



```
}
```

The following example shows how to enable RADIUS authentication and define the shared secret between the client and the server. The secret enables the client and server to determine that they are talking to the trusted peer.

Define a timeout value for each server, so that if there is no response within the specified number of seconds, the router can try either the next server or the next authentication mechanism.

```
[edit]
system {
  radius-server {
    10.1.2.1 {
      secret "$9$aH1j8gqQ1sdjerrrhser"; # SECRET-DATA
      timeout 5;
    }
    10.1.2.2 {
      secret "$9$aH1j8gqQ1csdoiuardwefoiud"; # SECRET-DATA
      timeout 5;
    }
  }
}
```

Related Documentation

- *Configuring RADIUS Authentication*

Example: Configuring RADIUS System Accounting

The following example shows three servers (**10.5.5.5**, **10.6.6.6**, and **10.7.7.7**) configured for RADIUS accounting.

```
system {
  accounting {
    events [ login change-log interactive-commands ];
    destination {
      radius {
        server {
          10.5.5.5 {
            accounting-port 3333;
            secret $9$dkafeqwrew;
            source-address 10.1.1.1;
            retry 3;
            timeout 3;
          }
          10.6.6.6 secret $9$fe3erqwrez;
          10.7.7.7 secret $9$f34929ftby;
        }
      }
    }
  }
}
```

Related Documentation

- Configuring RADIUS System Accounting on page 1231

Example: Configuring the Root Password

The following example shows how to configure the root password:

```
[edit]
user@switch# set system root-authentication encrypted-password
  "$1$14c5.$sBopasddsdfs0"
[edit]
user@switch# show
system {
  root-authentication {
    encrypted-password "$1$14c5.$sBopasddsdfs0";
  }
}
```

Related Documentation

- Configuring the Root Password on page 146
- Example: Configuring a Plain-Text Password for Root Logins on page 1264
- Configuring the Root Password on page 1236

Example: Configuring SSH Authentication for Root Logins

The following example shows how to configure two public DSA keys for SSH authentication of root logins:

```
[edit system]
root-authentication {
  encrypted-password "$1$1wp5tqMX$uy/u5H7OdXTwfWTmeJWXe/";
  ## SECRET-DATA;
  ssh-dsa "2354 95 9304@boojum.per";
  ssh-dsa "0483 02 8362@ecbatana.per";
}
```

Related Documentation

- Configuring the Root Password on page 146
- Special Requirements for Junos OS Plain-Text Passwords on page 1221

Example: Configuring User Accounts

The following example shows how to create accounts for four router or switch users, and create an account for the template user **remote**. All users use one of the default system login classes. User **alexander** also has two digital signal algorithm (DSA) public keys configured for SSH authentication.

```
[edit]
system {
  login {
    user philip {
      full-name “Philip of Macedonia”;
      uid 1001;
      class super-user;
      authentication {
        encrypted-password “$1$poPPeY”;
      }
```



```
        }
        user alexander {
            full-name "Alexander the Great";
            uid 1002;
            class view;
            authentication {
                encrypted-password "$1$14c5.$sBopasdFFdssdfFFdsdfs0";
                ssh-dsa "8924 37 5678 5678@gaugamela.per";
                ssh-dsa "6273 94 9283@boojum.per";
            }
        }
        user darius {
            full-name "Darius King of Persia";
            uid 1003;
            class operator;
            authentication {
                ssh-rsa "1024 37 12341234@ecbatana.per";
            }
        }
        user anonymous {
            class unauthorized;
        }
        user remote {
            full-name "All remote users";
            uid 9999;
            class read-only;
        }
    }
}
```

Related Documentation

- *Junos OS User Accounts Overview*
- *Limiting the Number of User Login Attempts for SSH and Telnet Sessions*

Example: Configuring System Authentication for RADIUS, TACACS+, and Password Authentication

The following example shows how to configure system authentication for RADIUS, TACACS+, and password authentication.

In this example, only the user Philip and users authenticated by a remote RADIUS server can log in. If a user logs in and is not authenticated by the RADIUS server, the user is denied access to the router or switch. If the RADIUS server is not available, the user is authenticated using the **password** authentication method and allowed access to the router or switch. For more information about the password authentication method, see "Using Local Password Authentication" on page 1212.

When Philip tries to log in to the system, if the RADIUS server authenticates him, he is given access and privileges for the **super-user** class. Local accounts are not configured for other users. When they log in to the system and the RADIUS server authenticates them, they are given access using the same user ID (UID) 9999 and the privileges associated with the **operator** class.

```
[edit]
```

```
system {
   authentication-order radius;
   login {
      user philip {
         full-name "Philip";
         uid 1001;
         class super-user;
      }
      user remote {
         full-name "All remote users";
         uid 9999;
         class operator;
      }
   }
}
```

NOTE: For authorization purposes, you can use a template account to create a single account that can be shared by a set of users at the same time. For example, when you create a remote template account, a set of remote users can concurrently share a single UID. For more information about template accounts, see "Overview of Template Accounts for RADIUS and TACACS+ Authentication" on page 1200.

When a user logs in to a device, the user's login name is used by the RADIUS or TACACS+ server for authentication. If the user is authenticated successfully by the authentication server and the user is not configured at the **[edit system login user]** hierarchy level, the device uses the default remote template user account for the user, provided a remote template account is configured at the **edit system login user remote** hierarchy level. The remote template account serves as a default template user account for all users that are authenticated by the authentication server but not having a locally configured user account on the device. Such users share the same login class and UID.

To configure an alternate template user, specify the **user-name** parameter returned in the RADIUS authentication response packet. Not all RADIUS servers allow you to change this parameter. The following shows a sample Junos OS configuration:

```
[edit]
system {
   authentication-order radius;
   login {
      user philip {
         full-name "Philip";
         uid 1001;
         class super-user;
      }
      user operator {
         full-name "All operators";
         uid 9990;
         class operator;
      }
      user remote {
         full-name "All remote users";
```



```
            uid 9999;
            class read-only;
        }
    }
}
```

Assume your RADIUS server is configured with the following information:

- User Philip with password “olympia”
- User Alexander with password “bucephalus” and username “operator”
- User Darius with password “redhead” and username “operator”
- User Roxane with password “athena”

Philip would be given access as a superuser (**super-user**) because he has his own local user account. Alexander and Darius share UID 9990 and have access as operators. Roxane has no template-user override, so she shares access with all the other remote users, getting read-only access.

Related Documentation

- Configuring the Junos OS Authentication Order for RADIUS, TACACS+, and Local Password Authentication on page 1228

Example: Creating Login Classes with Specific Privileges

The following example shows how to create several user classes, each with specific privileges. In this example, you configure timeouts to disconnect the class members after a period of inactivity. Users’ privilege levels, and therefore the classes of which they are members, should be dependent on their responsibilities within the organization, and the permissions shown here are only examples.

The first class of users (called “observation”) can only view statistics and configuration. They are not allowed to modify any configuration. The second class of users (called “operation”) can view and modify the configuration. The third class of users (called “engineering”) has unlimited access and control.

```
[edit]
system {
    login {
        class observation {
            idle-timeout 5;
            permissions [ view ];
        }
        class operation {
            idle-timeout 5;
            permissions [ admin clear configure interface interface-control network
            reset routing routing-control snmp snmp-control trace-control
            firewall-control rollback ];
        }
        class engineering {
            idle-timeout 5;
            permissions all;
        }
    }
```

```
}
```

Related Documentation

- *Defining Junos OS Login Classes*

Example: Configuring User Login Accounts

The following example shows how to configure the local administrator account (**user admin**). If RADIUS fails or becomes unreachable, the login process reverts to password authentication on the local accounts on the router or switch.

```
[edit]
system {
  login {
    user admin {
      uid 1000;
      class engineering;
      authentication {
        encrypted-password "<PASSWORD>"; # SECRET-DATA
      }
    }
  }
}
```

Related Documentation

- *Configuring Junos OS User Accounts*

Example: Configuring RADIUS Template Accounts

The following example shows how to configure RADIUS template accounts for different users or groups of users:

```
[edit]
system {
  login {
    user observation {
      uid 1001;
      class observation;
    }
    user operation {
      uid 1002;
      class operation;
    }
    user engineering {
      uid 1003;
      class engineering;
    }
  }
}
```

Related Documentation

- Overview of Template Accounts for RADIUS and TACACS+ Authentication on page 1200

Defining Access Privileges Using allow/deny-configuration Statements

The following examples show how to configure access privileges for individual configuration mode hierarchy levels.

If the following statement is included in the configuration and the user's login class permission bit is set to **all**, the user cannot configure telnet parameters:

```
[edit system login class class-name]
user@switch# set deny-configuration "system services telnet"
```

If the following statement is included in the configuration and the user's login class permission bit is set to **all**, the user cannot issue login class commands within any login class whose name begins with “m”:

```
[edit system login class class-name]
user@switch# set deny-configuration "system login class m.*"
```

If the following statement is included in the configuration and the user's login class permission bit is set to **all**, the user cannot edit a configuration or issue commands (such as **commit**) at the login class or system services hierarchy levels:

```
[edit system login class class-name]
user@switch# set deny-configuration "(system login class) | (system services)"
```

The following example shows how to configure permissions for individual configuration mode hierarchies:

```
[edit]
system {
  login { # This login class has operator privileges and the additional ability to edit
    # configuration at the system services hierarchy level.
    class only-system-services {
      permissions [ configure ];
      allow-configuration "system services";
    }
    # services commands.
    class all-except-system-services { # This login class has operator privileges but
      # cannot edit any system services configuration.
      permissions [ all ];
      deny-configuration "system services";
    }
  }
}
```

Related Documentation

- *Specifying Access Privileges Using allow/deny-configuration Statements*
- Specifying Access Privileges for Junos OS Configuration Mode Hierarchies on page 1253

Example: Limiting the Number of Login Attempts for SSH and Telnet Sessions

The following example shows how to limit the user to four attempts when the user enters a password while logging in through SSH or Telnet. Set the **backoff-threshold** to 2, the **back-off-factor** to 5 seconds, and the **minimum-time** to 40 seconds. The user experiences a delay of 5 seconds after the second attempt to enter a correct password fails. After each subsequent failed attempt, the delay increases by 5 seconds. After the fourth and final failed attempt to enter a correct password, the user experiences an additional 10-second delay, and the connection closes after a total of 40 seconds.

The additional variables **maximum-time** and **lockout-period** are not set in this example.

```
[edit]
system {
  login {
    retry-options {
      backoff-threshold 2;
      backoff-factor 5;
      minimum-time 40;
      tries-before-disconnect 4;
    }
    password {
    }
  }
}
```

NOTE: This sample only shows the portion off the [edit system login] hierarchy level being modified.

Related Documentation

- *Limiting the Number of User Login Attempts for SSH and Telnet Sessions*
- *login*
- **login on page 254**

Configuration Statements

access

Syntax

```
access {
  address-assignment
  pool pool-name
  address-poolpool-name
  profile profile-name {
    accounting {
      accounting-stop-on-access-deny;
      accounting-stop-on-failure;
      (authentication-order (ldap radius | none);
      order (radius | none);
    }
    radius {
      accounting-server [server-addresses];
      authentication-server [server-addresses];
    }
  }
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure authentication, authorization, and accounting (AAA) services.

The statements are explained separately.

NOTE: **The [edit access] hierarchy is not available on QFabric systems.**

Default Not enabled

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring 802.1X RADIUS Accounting (CLI Procedure)*

accounting

Syntax

```
accounting {
  accounting-stop-on-access-deny;
  accounting-stop-on-failure;
  order (radius | none);
}
```

Hierarchy Level [edit access profile *profile-name*]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the authentication order for authentication, authorization, and accounting (AAA) services.

Default Not enabled

Options **none**—Use no authentication for specified subscribers.

radius—Use RADIUS authentication for specified subscribers.

The remaining statements are explained separately.

NOTE: The **[edit access]** hierarchy is not available on QFabric systems.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Example: Connecting a RADIUS Server for 802.1X to an EX Series Switch*
- *Configuring 802.1X RADIUS Accounting (CLI Procedure)*
- *Understanding 802.1X and RADIUS Accounting on EX Series Switches*
- *Configuring RADIUS Accounting*
- Understanding RADIUS Accounting on page 1202

accounting-options

Syntax

```
accounting-options {
  class-usage-profile profile-name {
    destination-classes {
      destination-class-name;
    }
    file filename;
    interval minutes;
    source-classes {
      source-class-name;
    }
  }
  file filename {
    archive-sites {
      site-name;
    }
    files number;
    nonpersistent;
    size bytes;
    start-time time;
    transfer-interval minutes;
  }
  filter-profile profile-name {
    counters {
      counter-name;
    }
    file filename;
    interval minutes;
  }
  interface-profile profile-name {
    fields {
      input-bytes;
      input-errors;
      input-multicast;
      input-packets;
      input-unicast;
      output-bytes;
      output-errors;
      output-multicast;
      output-packets;
      output-unicast;
      rpf-check-bytes;
      rpf-check-packets;
      rpf-check6-bytes;
      rpf-check6-packets;
      unsupported-protocol;
    }
    file filename;
    interval minutes;
  }
  mib-profile profile-name {
    file filename;
    interval minutes;
```



```
      object-names {
        mib-object-name;
      }
      operation (get | get-next | walk);
    }
    policy-decision-statistics-profile profile-name {
      application-aware-access-list-fields {
        address;
        application;
        application-group;
        input-bytes;
        input-interface;
        input-packets;
        mask;
        output-bytes;
        output-packets;
        subscriber-name;
        timestamp;
        vrf-name;
      }
      file filename;
    }
    routing-engine-profile profile-name {
      fields {
        field-name;
      }
      file filename;
      interval minutes;
    }
  }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure options for accounting statistics collection.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Understanding RADIUS Accounting on page 1202
- Understanding VSAs on the QFX Series on page 1203
- Configuring RADIUS System Accounting on page 1231
- Configuring Remote Template Accounts for User Authentication on page 1235
- Configuring Local User Template Accounts for User Authentication on page 1229

accounting-server

Syntax accounting-server[*server-addresses*];

Hierarchy Level [edit access profile *profile-name* radius]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the Remote Authentication Dial-In User Service (RADIUS) server for authentication. To configure multiple RADIUS servers, include multiple server addresses. The servers are tried in order and in a round-robin fashion until a valid response is received from one of the servers or until all the configured retry limits are reached.

Default Not enabled

Options ***server-addresses***—One or more addresses of RADIUS authentication servers.

NOTE: **The [edit access] hierarchy is not available on QFabric systems.**

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *show network-access aaa statistics authentication*
- *Example: Connecting a RADIUS Server for 802.1X to an EX Series Switch*
- *Understanding 802.1X and RADIUS Accounting on EX Series Switches*
- Understanding RADIUS Accounting on page 1202

accounting-stop-on-access-deny

Syntax accounting-stop-on-access-deny;

Hierarchy Level [edit access profile *profile-name* accounting]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the authentication order for authentication, authorization, and accounting (AAA) services to send an Acct-Stop message if the AAA server denies access to a supplicant.

NOTE: The **[edit access]** hierarchy is not available on QFabric systems.

Default Not enabled

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Example: Connecting a RADIUS Server for 802.1X to an EX Series Switch*
- *Configuring 802.1X RADIUS Accounting (CLI Procedure)*
- *show network-access aaa statistics authentication*
- *Configuring RADIUS Accounting*

accounting-stop-on-failure

Syntax accounting-stop-on-failure;

Hierarchy Level [edit access profile *profile-name* accounting]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure authentication order for authentication, authorization, and accounting (AAA) services to send an Acct-Stop message if a supplicant fails AAA authorization, but the RADIUS server grants access. For example, a supplicant might fail AAA authentication because of an internal error such as a timeout.

NOTE: The **[edit access]** hierarchy is not available on QFabric systems.

Default Not enabled

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Example: Connecting a RADIUS Server for 802.1X to an EX Series Switch*
- *Configuring 802.1X RADIUS Accounting (CLI Procedure)*
- *Understanding 802.1X and RADIUS Accounting on EX Series Switches*
- *Configuring RADIUS Accounting*
- Understanding RADIUS Accounting on page 1202

advertisement-interval

Syntax advertisement-interval *seconds*;

Hierarchy Level [edit protocols lldp],
[edit routing-instances *routing-instance-name* protocols lldp]

Release Information Statement introduced in Junos OS Release 9.6 for MX Series and T Series routers.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For MX Series and T Series routers and EX Series switches, configure an interval for LLDP advertisement.

For switches configured for Link Layer Discovery Protocol, configure the frequency at which LLDP advertisements are sent.

The **advertisement-interval** value must be greater than or equal to four times the **transmit-delay** value, or an error will be returned when you attempt to commit the configuration.

NOTE: The default value of **transmit-delay** is 2 seconds. If you configure the **advertisement-interval** as less than 8 seconds and you do not configure a value for **transmit-delay**, the default value of **transmit-delay** is automatically changed to 1 second in order to satisfy the requirement that the **advertisement-interval** value must be greater than or equal to four times the **transmit-delay** value.

Default Disabled.

Options *seconds*—Interval between LLDP advertisement.
Default: 30
Range: 5 through 32768

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Configuring LLDP*
- show lldp on page 1362
- *Configuring LLDP (CLI Procedure)*
- *Understanding 802.1X and LLDP and LLDP-MED on EX Series Switches*
- *transmit-delay*
- Understanding LLDP on page 1201

agent-address

Syntax agent-address outgoing-interface;

Hierarchy Level [edit snmp trap-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the agent address of all SNMPv1 traps generated by this router or switch. Currently, the only option is **outgoing-interface**, which sets the agent address of each SNMPv1 trap to the address of the outgoing interface of that trap.

Options **outgoing-interface**—Value of the agent address of all SNMPv1 traps generated by this router or switch. The **outgoing-interface** option sets the agent address of each SNMPv1 trap to the address of the outgoing interface of that trap.

Default: Disabled (the agent address is not specified in SNMPv1 traps).

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Agent Address for SNMP Traps*

archival

Syntax

```
archival {
  configuration {
    archive-sites {
      file://<path>/<filename>;
      ftp://username@host:<port>url-path password password;
      http://username@host:<port>url-path password password;
      pasvftp://username@host:<port>url-path password password;
      scp://username@host:<port>url-path password password;
    }
    transfer-interval interval;
    transfer-on-commit;
  }
}
```

Hierarchy Level [edit system]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure copying of the currently active configuration to an archive site. An archive site can be a file, or an FTP or SCP location.

NOTE: **The edit system archival hierarchy is not available on QFabric systems.**

Options The remaining statements are explained separately.

NOTE: **The [edit system archival] hierarchy is not available on QFabric systems.**

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Using Junos OS to Configure a Router or Switch to Transfer Its Configuration to an Archive Site on page 1147

archive-sites (Configuration File)

Syntax

```
archive-sites {
  file://<path>/<filename>;
  ftp://username@host:<port>url-path password password;
  http://username@host:<port>url-path password password;
  pasvftp://username@host:<port>url-path password password;
  scp://username@host:<port>url-path password password;
}
```

Hierarchy Level [edit system archival configuration]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify where to transfer the current configuration files. When specifying a URL in a Junos OS statement using an IPv6 host address, you must enclose the entire URL in quotation marks (" ") and enclose the IPv6 host address in brackets ([ ]). For example, **"scp://*username*<:*password*>@[*ipv6-host-address*]<:*port*>/*url-path*"**

If you specify more than one archive site, the router or switch attempts to transfer the configuration files to the first archive site in the list, moving to the next only if the transfer fails.

The destination filename is saved in the following format, where *n* corresponds to the number of the compressed configuration rollback file that has been archived:

router-name*_juniper.conf.*n*.gz_*YYYYMMDD_HHMMSS.

NOTE: The time included in the destination filename is always in Coordinated Universal Time (UTC) regardless of whether the time on the router or switch is configured as UTC or the local time zone. The default time zone on the router or switch is UTC.

NOTE: The **[edit system archival]** hierarchy is not available on QFabric systems.

Options The prefix used in the configuration statement determines the form of transfer:

file:// —transfer on a path to a named file

ftp:// —transfer using active FTP server

pasvftp:// —transfer to a device that only accepts passive FTP services

scp:// —transfer to a known host using background SCP file transfers

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring Archive Sites for Transfer of Active Configuration Files on page 1148
- Junos OS Commit Model for Router or Switch Configuration on page 29
- **configuration on page 1153**
- **transfer-on-commit on page 1155**

authentication-order

Syntax authentication-order [**none** | **password** | **radius**];

Hierarchy Level [edit access profile *profile-name*]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the order of authentication, authorization, and accounting (AAA) servers to use while sending authentication messages.

Default Not enabled

Options **none**—No authentication for specified subscribers.

password—Password authentication.

radius—RADIUS authentication.

NOTE: The **[edit access]** hierarchy is not available on QFabric systems.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

authentication-server

Syntax authentication-server [*server-addresses*];

Hierarchy Level [edit access profile *profile-name* radius]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the RADIUS server for authentication. To configure multiple RADIUS servers, include multiple server addresses. The servers are tried in order and in a round-robin fashion until a valid response is received from one of the servers or until all the configured retry limits are reached.

Options ***server-addresses***—Configure one or more RADIUS server addresses.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Example: Connecting a RADIUS Server for 802.1X to an EX Series Switch*
- *show network-access aaa statistics authentication*

authorization

Syntax authorization *authorization*;

Hierarchy Level [edit snmp community *community-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the access authorization for SNMP **Get**, **GetBulk**, **GetNext**, and **Set** requests.

Options *authorization*—Access authorization level:

- **read-only**—Enable **Get**, **GetNext**, and **GetBulk** requests.
- **read-write**—Enable all requests, including **Set** requests. You must configure a view to enable **Set** requests.

NOTE: **The read-write option is not supported on the QFX3000 QFabric system.**

Default: read-only

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring the SNMP Community String on page 6113

categories

Syntax

```
categories {
  category;
}
```

Hierarchy Level [edit snmp trap-group *group-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define the types of traps that are sent to the targets of the named trap group.

Default If you omit the **categories** statement, all trap types are included in trap notifications.

Options *category*—Name of a trap type: **authentication**, **chassis**, **configuration**, **link**, **remote-operations**, **rmon-alarm**, or **startup**.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring SNMP Trap Groups on page 6114

client-list

Syntax

```
client-list client-list-name {
  ip-addresses;
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define a list of SNMP clients.

Options *client-list-name*—Name of the client list.

ip-addresses—IP addresses of the SNMP clients to be added to the client list,

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Adding a Group of Clients to an SNMP Community on page 6115

client-list-name

Syntax client-list-name *client-list-name*;

Hierarchy Level [edit snmp community *community-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Add a client list or prefix list to an SNMP community.

Options ***client-list-name***—Name of the client list or prefix list.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Adding a Group of Clients to an SNMP Community on page 6115

clients

Syntax

```
clients {
  address <restrict>;
}
```

Hierarchy Level [edit snmp community *community-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the IPv4 or IPv6 addresses of the SNMP client hosts that are authorized to use this community.

Default If you omit the **clients** statement, all SNMP clients using this community string are authorized to access the switch.

Options ***address***—Address of an SNMP client that is authorized to access this switch. You must specify an address, not a hostname. To specify more than one client, include multiple ***address*** options.

restrict—(Optional) Do not allow the specified SNMP client to access the switch.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the SNMP Community String*

commit-delay

Syntax commit-delay *seconds*;

Hierarchy Level [edit snmp nonvolatile]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the timer for the SNMP **Set** reply and start of the commit.

Options ***seconds***—Delay between an affirmative SNMP **Set** reply and start of the commit operation.

Default: 5 seconds

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Commit Delay Timer*

community (SNMP)

Syntax

```
community community-name {
  authorization authorization;
  client-list-name client-list-name;
  clients {
    address restrict;
  }
  view view-name;
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define an SNMP community. An SNMP community authorizes SNMP clients based on the source IP address of incoming SNMP request packets. A community also defines which MIB objects are available and the operations (read-only or read-write) allowed on those objects.

NOTE: **The authorization read-write option is not supported on the QFX3000 QFabric system.**

The SNMP client application specifies an SNMP community name in **Get**, **GetBulk**, **GetNext**, and **Set** SNMP requests.

Default If you omit the **community** statement, all SNMP requests are denied.

Options *community-name*—Community string. If the name includes spaces, enclose it in quotation marks (" ").

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring the SNMP Community String on page 6113

configuration

Syntax

```
configuration {
  transfer-interval interval;
  transfer-on-commit;
  archive-sites {
    file://<path>/<filename>;
    ftp://username@host:<port>url-path password password;
    http://username@host:<port>url-path password password;
    pasvftp://username@host:<port>url-path password password;
    scp://username@host:<port>url-path password password;
  }
}
```

Hierarchy Level [edit system archival]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the router or switch to periodically transfer its currently active configuration (or after each commit).

NOTE: **The [edit system archival] hierarchy is not available on QFabric systems.**

Options The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Using Junos OS to Configure a Router or Switch to Transfer Its Configuration to an Archive Site on page 1147
- **archive on page 6299**
- **archive-sites on page 1151**
- **transfer-interval on page 1154**
- **transfer-on-commit on page 1155**

connection-limit

Syntax connection-limit *limit*;

Hierarchy Level [edit system services finger],
[edit system services ftp],
[edit system services netconf ssh],
[edit system services ssh],
[edit system services telnet],
[edit system services xnm-clear-text],
[edit system services xnm-ssl]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the maximum number of connections sessions for each type of system services (finger, ftp, ssh, telnet, xnm-clear-text, or xnm-ssl) per protocol (either IPv6 or IPv4).

Options *limit*—(Optional) Maximum number of established connections per protocol (either IPv6 or IPv4).

Range: 1 through 250

Default: 75

NOTE: The actual number of maximum connections depends on the availability of system resources, and might be fewer than the configured connection-limit value if the system resources are limited.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring clear-text or SSL Service for Junos XML Protocol Client Applications*
- *Configuring DTCP-over-SSH Service for the Flow-Tap Application*
- *Configuring Finger Service for Remote Access to the Router*
- *Configuring FTP Service for Remote Access to the Router or Switch*
- Configuring SSH Service for Remote Access to the Router or Switch on page 1243
- *Configuring Telnet Service for Remote Access to a Router or Switch*

contact

Syntax contact *contact*;

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define the value of the MIB II **sysContact** object, which is the contact person for the managed system.

Options ***contact***—Name of the contact person. If the name includes spaces, enclose it in quotation marks (" ").

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the System Contact on a Device Running Junos OS*

disable (LLDP)

Syntax disable;

Hierarchy Level [edit protocols lldp],
[edit protocols interface lldp]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Disable the LLDP configuration on the switch or on one or more interfaces.

Default If you do not configure LLDP, it is disabled on the switch and on specific switch interfaces.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- **show lldp on page 1362**
- *Configuring LLDP (CLI Procedure)*
- *Understanding 802.1X and LLDP and LLDP-MED on EX Series Switches*
- Configuring LLDP on page 1227
- Understanding LLDP on page 1201

falling-threshold (Health Monitor)

Syntax falling-threshold *percentage*;

Hierarchy Level [edit snmp health-monitor]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the lower threshold for the monitored object when you configure a health monitor alarm. By setting a rising and a falling threshold for a monitored variable, you can be alerted whenever the value of the variable falls outside the allowable operational range.

Options *percentage*—Lower threshold for the alarm entry.

Range: 1 through 100

Default: 70 percent of the maximum possible value

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- **rising-threshold on page 1331**
- Configuring Health Monitoring on page 6119

filter-duplicates

Syntax filter-duplicates;

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Filter duplicate **Get**, **GetNext**, or **GetBulk** SNMP requests.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Understanding the Implementation of SNMP on the QFabric System on page 6023
- Example: Configuring SNMP on page 6083

full-name

Syntax full-name *complete-name*;

Hierarchy Level [edit system login user]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the complete name of a user.

Options ***complete-name***—Full name of the user. If the name contains spaces, enclose it in quotation marks.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring Junos OS User Accounts*
- *user*
- user on page 306

health-monitor

Syntax

```
health-monitor {
  falling-threshold percentage;
  interval seconds;
  rising-threshold percentage;
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure health monitoring.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring Health Monitoring on page 6119
- Understanding Health Monitoring on page 6037

hold-multiplier

Syntax hold-multiplier *number*;

Hierarchy Level [edit protocols lldp]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for QFX Series.

Description Specify the multiplier used in combination with the **advertisement-interval** value to determine the length of time LLDP information is held before it is discarded. The default value is 4 (or 120 seconds).

Default Disabled.

Options *number*—A number used as a multiplier.

Range: 2 through 10

Default: 4 (or 120 seconds)

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show lldp on page 1362**
- *Configuring LLDP (CLI Procedure)*
- *Understanding 802.1X and LLDP and LLDP-MED on EX Series Switches*
- Configuring LLDP on page 1227
- Understanding LLDP on page 1201

idle-timeout (Access)

Syntax idle-timeout *seconds*;

Hierarchy Level [edit access group-profile *profile-name* ppp],
[edit access profile *profile-name* client *client-name* ppp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the idle timeout for a user. The router might consider a PPP session to be idle because of the following reasons:

- There is no ingress traffic on the PPP session.
- There is no egress traffic.
- There is neither ingress or egress traffic on the PPP session.
- There is no ingress or egress PPP control traffic. This is applicable only if keepalives are enabled.

Options *seconds*—Number of seconds a user can remain idle before the session is terminated.

Range: 0 through 4,294,967,295 seconds

Default: 0

NOTE: **The [edit access] hierarchy is not available on QFabric systems.**

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Group Profile for Defining L2TP Attributes*
- *Configuring PPP Properties for a Client-Specific Profile*
- *Applying PPP Attributes to L2TP LNS Subscribers with a User Group Profile*

interface (LLDP)

Syntax

```
interface (all | interface-name) {
  disable;
  power-negotiation {
    disable;
  }
}
```

Hierarchy Level [edit protocols lldp]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Link Layer Discovery Protocol (LLDP) on all interfaces or on a specific interface.

NOTE: On EX4300 switches, LLDP cannot be configured on the me0 or vme interface. Issuing the command **set protocols lldp interface me0** generates the following error message:

```
error: name: 'me0': Invalid interface
error: statement creation failed: interface
```

Issuing the command **set protocols lldp interface vme** generates the following error message:

```
error: name: 'vme': Invalid interface
error: statement creation failed: interface
```

Default None

Options **all**—All interfaces on the switch.

interface-name—Name of a specific interface.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring LLDP (CLI Procedure)*
- *Understanding 802.1X and LLDP and LLDP-MED on EX Series Switches*
- Configuring LLDP on page 1227
- Understanding LLDP on page 1201

interval (Health Monitor)

Syntax interval *seconds*;

Hierarchy Level [edit snmp health-monitor]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the interval between sampling of the object being monitored by the health monitor.

Options *seconds*—Time between samples, in seconds.

Range: **1** through **2147483647** seconds

Default: **300** seconds

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring Health Monitoring on page 6119

lldp

Syntax

```
lldp {
  advertisement-interval seconds;
  disable;
  hold-multiplier number;
  interface (all | [interface-name]) {
    disable;
    power-negotiation {
      disable;
    }
  }
  lldp-configuration-notification-interval seconds;
  management-address ip-management-address;
  netbios-snooping;
  ptopo-configuration-maximum-hold-time seconds;
  ptopo-configuration-trap-interval seconds;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>
      <no-stamp> <replace>;
    flag flag <disable>;
  }
  transmit-delay seconds;
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for QFX Series.

Description Configure Link Layer Discovery Protocol (LLDP). The switch uses LLDP to advertise its identity and capabilities on a LAN, as well as to receive information about other network devices. LLDP is defined in the IEEE standard 802.1AB-2005.

The remaining statements are explained separately.

NOTE: The **transmit-delay** and **netbios-snooping** options are not available on QFabric systems.

NOTE: On EX4300 switches, LLDP cannot be configured on the me0 or vme interface. Issuing the command **set protocols lldp interface me0** generates the following error message:

```
error: name: 'me0': Invalid interface
error: statement creation failed: interface
```

Issuing the command **set protocols lldp interface vme** generates the following error message:

```
error: name: 'vme': Invalid interface
error: statement creation failed: interface
```

Default LLDP is enabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show lldp on page 1362
- *Configuring LLDP (CLI Procedure)*
- *Understanding 802.1X and LLDP and LLDP-MED on EX Series Switches*
- Configuring LLDP on page 1227
- Understanding LLDP on page 1201

lldp-configuration-notification-interval

Syntax lldp-configuration-notification-interval *seconds*;

Hierarchy Level [edit protocols lldp]

Release Information Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify how often SNMP trap notifications are generated as a result of LLDP database changes. If the interval value is 0, trap notifications of database changes are disabled.

Default SNMP trap notifications of LLDP database changes are disabled.

Options *seconds*—Interval between trap notifications about LLDP database changes.

Range: 0 through 3600

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show lldp on page 1362

location

Syntax location *location*;

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define the value of the MIB II **sysLocation** object, which is the physical location of the managed system.

Options *location*—Location of the local system. You must enclose the name within quotation marks (" ").

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the System Location for a Device Running Junos OS*

management-address

Syntax management-address *ip-management-address*;

Hierarchy Level [edit protocols lldp]

Release Information Statement introduced in Junos OS Release 9.5 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the management address of the switch to be used in the LLDP Management type, length, and value (TLV) .

Default LLDP Management TLV uses the IP address of the switch's management Ethernet interface (**me0**) or the IP address of the virtual management Ethernet (VME) interface if the switch is a Virtual Chassis.

Options *ip-management-address*—You can specify either an IPv4 or IPv6 management address for the switch.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show lldp on page 1362
- *Understanding 802.1X and LLDP and LLDP-MED on EX Series Switches*
- *EX Series Switches Interfaces Overview*
- Understanding LLDP on page 1201

name

Syntax name *name*;

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the system name from the command-line interface.

Options ***name***—System name override.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the System Name*

nas-ip-address

Syntax nas-ip-address *ip-address*;

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the NAS-IP address for outgoing RADIUS packets.

Options **ip-address**—IP address of the network access server (NAS) that requests user authentication.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation
- *Configuring RADIUS Authentication*
- Configuring RADIUS Authentication on page 1233

nonvolatile

Syntax

```
nonvolatile {
  commit-delay seconds;
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure options for SNMP **Set** requests.

The statement is explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Commit Delay Timer*
- *commit-delay*

oid

Syntax oid *object-identifier* (exclude| include);

Hierarchy Level [edit snmp view *view-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify an object identifier (OID) used to represent a subtree of MIB objects.

Options **exclude**—Exclude the subtree of MIB objects represented by the specified OID.

include—Include the subtree of MIB objects represented by the specified OID.

object-identifier—OID used to represent a subtree of MIB objects. All MIB objects represented by this statement have the specified OID as a prefix. You can specify the OID using either a sequence of dotted integers or a subtree name.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring MIB Views on page 6116

order

Syntax order (**radius** | [***accounting-order-data-list***]);

Hierarchy Level [edit access profile *profile-name* accounting]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the order of authentication, authorization, and accounting (AAA) servers to use while sending accounting messages and updates.

Default No order specified

Options **radius**—RADIUS accounting for specified subscribers.

[*accounting-order-data-list*]— Set of data listing the authentication order to be used, enclosed by brackets. This can be any combination of the authentication methods, up to and including a full list of the entire authentication order.

NOTE: The **[edit access]** hierarchy is not available on QFabric systems.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Example: Connecting a RADIUS Server for 802.1X to an EX Series Switch*
- *Configuring 802.1X RADIUS Accounting (CLI Procedure)*
- *Configuring RADIUS Accounting*

port (RADIUS Server)

Syntax port *port-number*;

Hierarchy Level [edit system radius-server *address*],
[edit system accounting destination radius server *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the port number on which to contact the RADIUS server.

Options *number*—Port number on which to contact the RADIUS server.

Default: 1812 (as specified in RFC 2865)

NOTE: The **[edit system accounting]** hierarchy is not available on QFabric systems.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring RADIUS Authentication*
- Configuring RADIUS Authentication on page 1233

profile

Syntax

```
profile profile-name {
  accounting {
    accounting-stop-on-access-deny;
    accounting-stop-on-failure;
    order ( radius | [ accounting-order-data-list ] )];
  }
  authentication-order [authentication-method];
  radius {
    accounting-server [server-addresses];
    authentication-server [server-addresses];
  }
}
```

Hierarchy Level [edit access]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure an access profile. The access profile contains the entire authentication, authorization, and accounting (AAA) configuration that aids in handling AAA requests, including the authentication method and order, AAA server addresses, and AAA accounting.

Default Not enabled

Options ***profile-name***—Profile name of up to 32 characters.

The remaining statements are explained separately.

NOTE: **The [edit access] hierarchy is not available on QFabric systems.**

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Example: Connecting a RADIUS Server for 802.1X to an EX Series Switch*
- *Configuring 802.1X RADIUS Accounting (CLI Procedure)*
- *Configuring RADIUS Accounting*

protocols

Syntax

```
protocols {
  bgp {
    disable;
    accept-remote-nexthop;
    advertise-external <conditional>;
    advertise-inactive;
    (advertise-peer-as | no-advertise-peer-as);
    authentication-algorithm (aes-128-cmac-96 | hmac-sha-1-96 | md5);
    authentication-key key;
    authentication-key-chain key-chain;
    bfd-liveness-detection {
      authentication {
        algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
          meticulous-keyed-sha-1 | simple-password);
        key-chain key-chain-name;
        loose-check;
      }
      detection-time {
        threshold milliseconds;
      }
      hold-down-interval milliseconds;
      minimum-interval milliseconds;
      minimum-receive-interval milliseconds;
      multiplier number;
      no-adaptation;
      session-mode (automatic | multihop | single-hop);
      transmit-interval {
        minimum-interval milliseconds;
        threshold milliseconds;
      }
      version (1 | automatic);
    }
    cluster cluster-identifier;
    damping;
    description text-description;
    export [ policy-names ];
    family family-name {
      ... the family subhierarchies appear after the main [edit protocols bgp] hierarchy ...
    }
    graceful-restart {
      disable;
      restart-time seconds;
      stale-routes-time seconds;
    }
    group group-name {
      ... the group subhierarchy appears after the main [edit protocols bgp] hierarchy ...
    }
    hold-time seconds;
    import [ policy-names ];
    include-mp-next-hop;
    keep (all | none);
    local-address address;
```



```
    local-as autonomous-system <loops number> < alias> <private>;
    local-preference local-preference;
    log-updown;
    metric-out (metric | igp (delay-med-update | offset) | minimum-igp offset);
    mtu-discovery;
    multihop {
      no-nexthop-change;
      ttl ttl-value;
    }
    no-aggregator-id;
    no-client-reflect;
    out-delay seconds;
    outbound-route-filter {
      bgp-orf-cisco-mode;
      prefix-based {
        accept {
          inet;
          inet6;
        }
      }
    }
    passive;
    path-selection {
      always-compare-med;
      as-path-ignore;
      cisco-non-deterministic;
      external-router-id;
      med-plus-igp {
        igp-multiplier number;
        med-multiplier number;
      }
    }
    peer-as autonomous-system;
    preference preference;
    remove-private;
    tcp-mss segment-size;
    traceoptions {
      file filename <files number> <size maximum-file-size> <world-readable |
        no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
  }
  dcbx {
    disable;
    interface (interface-name | all) {
      disable;
      application-map application-map-name;
      applications {
        no-auto-negotiation;
      }
      enhanced-transmission-selection {
        no-auto-negotiation;
        no-recommendation-tlv;
        recommendation-tlv {
          no-auto-negotiation;
        }
```

```
        }
        dcbx-version (auto-negotiate | ieee-dcbx | dcbx-version-1.01);
        priority-flow-control {
            no-auto-negotiation;
        }
    }
}
iccp {
    authentication-key string;
    local-ip-addr local-ip-addr;
    peer ip-address{
        authentication-key string;
        backup-liveness-detection {
            backup-peer-ip ip-address;
        }
        liveness-detection {
            detection-time {
                threshold milliseconds;
            }
            minimum-intervalmilliseconds;
            minimum-receive-interval milliseconds;
            multiplier number;
            no-adaptation;
            transmit-interval {
                minimum-interval milliseconds;
                threshold milliseconds;
            }
            version (Liveness Detection) (1 | automatic);
        }
        local-ip-addr ipv4-address;
        session-establishment-hold-time seconds;
    }
    session-establishment-hold-time seconds;
    traceoptions {
        file <filename> <files number> <match regular-expression> <microsecond-stamp>
            <size size> <world-readable | no-world-readable>;
        flag flag;
        no-remote-trace;
    }
}
igmp-snooping {
    traceoptions {
        file filename <files number> <size size> <world-readable | no-world-readable> <match
            regex>;
        flag flag (detail | disable | receive | send);
    }
    vlan vlan-name {
        disable;
        }
        interface interface-name {
            group-limit limit;
            multicast-router-interface;
            static {
                group ip-address;
            }
        }
```

```
        robust-count number;
      }
    }
    isis {
      disable;
      export [ policy-names ];
      ignore-attached-bit;
      interface interface-name {
        bfd-liveness-detection {
          authentication {
            algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
              meticulous-keyed-sha-1 | simple-password);
            key-chain key-chain-name;
            loose-check;
          }
          detection-time {
            threshold milliseconds;
          }
          minimum-interval milliseconds;
          minimum-receive-interval milliseconds;
          multiplier number;
          no-adaptation;
          transmit-interval {
            minimum-interval milliseconds;
            threshold milliseconds;
          }
          version (1 | automatic);
        }
        checksum;
        csnp-interval (seconds | disable);
        disable;
        hello-padding (adaptive | loose | strict);
        level (1 | 2) {
          disable;
          hello-authentication-key key;
          hello-authentication-type authentication;
          hello-interval seconds;
          hold-time seconds;
          ipv4-multicast-metric number;
          metric metric;
          passive;
          priority number;
        }
        lsp-interval milliseconds;
        mesh-group (value | blocked);
        no-ipv4-multicast;
        no-unicast-topology;
        passive;
        point-to-point;
      }
      level (1 | 2) {
        disable;
        authentication-key key;
        authentication-type authentication;
        external-preference preference;
        no-csnp-authentication;
```

```
      no-hello-authentication;
      no-psnp-authentication;
      preference preference;
      prefix-export-limit number;
      wide-metrics-only;
    }
    loose-authentication-check;
    lsp-lifetime seconds;
    max-areas number;
    no-adjacency-holddown;
    no-authentication-check;
    no-ipv4-routing;
    overload {
      advertise-high-metrics;
      timeout seconds;
    }
    reference-bandwidth reference-bandwidth;
    rib-group {
      inet group-name;
    }
    topologies {
      ipv4-multicast;
    }
    traceoptions {
      file filename <files number> <size maximum-file-size> <world-readable |
        no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
    traffic-engineering {
      disable;
      family inet {
        shortcuts {
          multicast-rpf-routes:
        }
      }
    }
  }
  lldp {
    disable;
    advertisement-interval seconds;
    hold-multiplier number;
    interface (LLDP) (all | interface-name) {
      disable;
    }
    traceoptions {
      file filename <files number> <size size> <world-readable | no-world-readable> <match
        regex>;
      flag flag (detail | disable | receive | send);
    }
  }
  mstp {
    disable;
    bpdu-timeout-action;
    bridge-priority priority;
    configuration-name (MSTP) name;
    forward-delay seconds;
```



```
    hello-time seconds;
    interface (all | interface-name) {
      disable;
      bpdu-timeout-action {
        block;
        alarm;
      }
      cost  cost;
      edge;
      mode mode;
      no-root-port;
      priority priority;
    }
    max-age seconds;
    max-hops hops;
    msti msti-id {
      vlan (vlan-id | vlan-name);
      interface interface-name {
        disable;
        cost  cost;
        edge;
        mode mode;
        priority priority;
      }
    }
    revision-level revision-level;
    traceoptions {
      file filename <files number > <size size> <no-stamp | world-readable |
        no-world-readable>;
      flag flag;
    }
  }
  ospf {
    disable;
    area area-id {
      area-range ip-prefix</prefix-length> <exact> <override-metric metric> <restrict>;
      context-identifier identifier
      interface interface-name {
        disable;
        authentication {
          md5 key-id key key-string <start-time YYYY-MM-DD.hh:mm>;
          simple-password key-string;
        }
        bandwidth-based-metrics {
          bandwidth value metric number;
        }
        bfd-liveness-detection {
          authentication {
            algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
              meticulous-keyed-sha-1 | simple-password);
            key-chain key-chain-name;
            loose-check;
          }
          detection-time {
            threshold milliseconds;
          }
```

```
        full-neighbors-only;
        minimum-interval milliseconds;
        minimum-receive-interval milliseconds;
        multiplier number;
        no-adaptation;
        transmit-interval {
          minimum-interval milliseconds;
          threshold milliseconds;
        }
        version (1 | automatic);
      }
      dead-interval seconds;
      dynamic-neighbors;
      flood-reduction;
      hello-interval seconds;
      interface-type (nbma | p2mp | p2p);
      metric metric;
      neighbor address <eligible>;
      no-eligible-backup;
      no-interface-state-traps;
      no-neighbor-down-notification;
      passive {
        traffic-engineering {
          remote-node-id address;
        }
      }
      poll-interval seconds;
      priority number;
      retransmit-interval seconds;
      secondary;
      te-metric metric;
      topology (name | default | ipv4-multicast) {
        disable;
        bandwidth-based-metrics {
          bandwidth value;
          metric number;
        }
        metric metric;
      }
      transit-delay seconds;
    }
    network-summary-export [ policy-names ];
    network-summary-import [ policy-names ];
    nssa {
      area-range ip-prefix</prefix-length> <exact> <override-metric metric> <restrict>;
      default-lsa {
        default-metric metric;
        metric-type type;
        type-7;
      }
      (summaries | no-summaries);
    }
    stub <default-metric metric> <summaries | no-summaries>;
    virtual-link neighbor-id router-id transit-area area-id {
      disable;
      authentication {
```

```
            md5 key-id key key-string <start-time YYYY-MM-DD.hh:mm>;
            simple-password key-string;
        }
        dead-interval seconds;
        demand-circuit;
        flood-reduction;
        hello-interval seconds;
        ipsec-sa sa-name;
        no-neighbor-down-notification;
        retransmit-interval seconds;
        topology (name | default | ipv4-multicast) {
            disable;
            metric metric;
        }
        transit-delay seconds;
    }
}
database-protection {
    ignore-count number;
    ignore-time seconds;
    maximum-lsa number;
    reset-time seconds;
    warning-only;
    warning-threshold percent;
}
export [ policy-names ];
external-preference preference;
graceful-restart {
    disable;
    helper-disable <both | restart-signaling | standard>;
    no-strict-lsa-checking;
    notify-duration seconds;
    restart-duration seconds;
}
import [ policy-names ];
no-nssa-abr;
no-rfc-1583;
overload <timeout seconds>;
preference preference;
prefix-export-limit number;
reference-bandwidth reference-bandwidth;
rib-group group-name;
topology (default | ipv4-multicast | name) {
    overload;
    prefix-export-limit number;
    topology-id number;
}
traceoptions {
    file filename <files number> <size maximum-file-size> <world-readable |
        no-world-readable>;
    flag flag <flag-modifier> <disable>;
}
traffic-engineering {
    advertise-unnumbered-interfaces;
    credibiliity-protocol-preference;
    ignore-lsp-metrics;
```

```
        multicast-rpf-routes;
        no-topology;
        shortcuts <lsp-metric-into-summary>;
      }
    }
    pim {
      disable;
      assert-timeout seconds;
      dense-groups {
        addresses;
      }
      dr-election-on-p2p;
      export;
      family (inet | inet6) {
        disable;
      }
      graceful-restart {
        disable;
        restart-duration seconds;
      }
      import [ policy-names ];
      interface interface-name {
        accept-remote-source;
        disable;
        family (inet | inet6) {
          disable;
        }
        hello-interval seconds;
        mode (dense | sparse | sparse-dense);
        neighbor-policy [ policy-names ];
        override-interval milliseconds;
        priority number;
        propagation-delay milliseconds;
        reset-tracking-bit;
        version version;
      }
      join-load-balance;
      join-prune-timeout;
      nonstop-routing;
      override-interval milliseconds;
      propagation-delay milliseconds;
      reset-tracking-bit;
      rib-group group-name;
      rp {
        auto-rp {
          (announce | discovery | mapping);
          (mapping-agent-election | no-mapping-agent-election);
        }
        bootstrap {
          family (inet | inet6) {
            export [ policy-names ];
            import [ policy-names ];
            priority number;
          }
        }
        bootstrap-import [ policy-names ];
```



```
    bootstrap-export [ policy-names ];
    bootstrap-priority number;
    dr-register-policy [ policy-names ];
    embedded-rp {
      group-ranges {
        destination-ip-prefix</prefix-length>;
      }
      maximum-rps limit;
    }
    local {
      family (inet | inet6) {
        address address;
        anycast-pim {
          disable;
            rp-set {
            address address <forward-msdp-sa>;
          }
          local-address address;
        }
        group-ranges {
          destination-ip-prefix</prefix-length>;
        }
        hold-time seconds;
        priority number;
      }
    }
    rp-register-policy [ policy-names ];
    spt-threshold {
      infinity [ policy-names ];
    }
    static {
      address address {
        group-ranges {
        version version;
        destination-ip-prefix</prefix-length>;
        }
      }
    }
  }
  rpf-selection {
    group group-address{
      source source-address{
        next-hop next-hop-address;
      }
      wildcard-source {
        next-hop next-hop-address;
      }
    }
    prefix-list prefix-list-addresses {
      source source-address {
        next-hop next-hop-address;
      }
      wildcard-source {
        next-hop next-hop-address;
      }
    }
```

```
    traceoptions {
      file filename <files number> <size size> <world-readable | no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
    tunnel-devices [ mt-fpc/pic/port ];
  }
  rip {
    authentication-key password;
    authentication-type type;
    (check-zero | no-check-zero);
    group group-name {
      bfd-liveness-detection {
        authentication {
          algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
            meticulous-keyed-sha-1 | simple-password);
          key-chain key-chain-name;
          loose-check;
        }
        detection-time {
          threshold milliseconds;
        }
        minimum-interval milliseconds;
        minimum-receive-interval milliseconds;
        multiplier number;
        no-adaptation;
        transmit-interval {
          minimum-interval milliseconds;
          threshold milliseconds;
        }
        version (1 | automatic);
      }
      export [ policy-names ];
      import [ policy-names ];
      metric-out metric;
        neighbor neighbor-name {
          any-sender;
          authentication-key password;
          authentication-type type;
          bfd-liveness-detection {
            ... same statements as at the [edit protocols rip group group-name
              bfd-liveness-detection] hierarchy level ...
          }
          (check-zero | no-check-zero);
          import [ policy-names ];
          message-size number;
          metric-in metric;
          receive (both | none | version-1 | version-2);
          route-timeout seconds;
          send (broadcast | multicast | none | version-1);
          update-interval seconds;
        }
      preference preference;
      route-timeout seconds;
      update-interval seconds;
    }
    holddown seconds;
```

```
    import [ policy-names ];
    message-size number;
    metric-in metric;
    receive (both | none | version-1 | version-2);
    rib-group group-name;
    route-timeout seconds;
    send (broadcast | multicast | none | version-1);
    traceoptions {
      file filename <files number> <size maximum-file-size> <world-readable |
        no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
    update-interval seconds;
  }
  rstp {
    disable;
    bpdu-block-on-edge;
    bridge-priority priority;
    forward-delay seconds;
    hello-time seconds;
    interface (all | interface-name) {
      disable;
      bpdu-timeout-action {
        alarm;
        block;
      }
      cost  cost;
      edge;
      mode mode;
      no-root-port;
      priority priority;
    }
    max-age seconds;
    }
    traceoptions {
      file filename <files number > <size size> <no-stamp> <world-readable |
        no-world-readable>;
      flag flag;
    }
  }
  stp {
    disable;
    bridge-priority priority;
    forward-delay seconds;
    hello-time seconds;
    interface (all | interface-name) {
      disable;
      bpdu-timeout-action {
        alarm;
        block;
      }
      cost  cost;
      edge;
      mode mode;
      no-root-port;
      priority priority;
```



```
        }
        max-age seconds;
      }
        traceoptions {
          file filename <files number > <size size> <no-stamp | world-readable |
            no-world-readable>;
          flag flag;
        }
      uplink-failure-detection {
        group group-name {
          link-to-monitor interface-name;
          link-to-disable interface-name;
        }
      }
      vstp {
        bpdu-block-on-edge;
        disable (Spanning Trees);
        force-version (Spanning Trees) stp;
        vlan (Spanning Trees) vlan-id {
          bridge-priority (Spanning Trees) priority;
          forward-delay (Spanning Trees) seconds;
          hello-time (Spanning Trees) seconds;
          interface (Spanning Trees) (all | interface-name) {
            bpdu-timeout-action (Spanning Trees) {
              block (Spanning Trees);
              log (Spanning Trees);
            }
            cost (Spanning Trees)  cost;
            disable (Spanning Trees);
            edge (Spanning Trees);
            mode (Spanning Trees) mode;
            no-root-port (Spanning Trees);
            priority (Spanning Trees) priority;
          }
          max-age (Spanning Trees) seconds;
          traceoptions (Spanning Trees) {
            file filename <files number > <size size> <no-stamp | world-readable |
              no-world-readable>;
            flag flag;
          }
        }
      }
    }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure protocols.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Junos OS Routing Protocols Configuration Guide*

protocol-version

Syntax protocol-version *version*;

Hierarchy Level [edit system services ssh]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the secure shell (SSH) protocol version.

Default **v2**—SSH protocol version 2 is the default, introduced in Junos OS Release 11.4.

Options ***version***—SSH protocol version: **v1**, **v2**, or both.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring the SSH Protocol Version on page 1244

ptopo-configuration-maximum-hold-time

Syntax ptopo-configuration-maximum-hold-time *seconds*;

Hierarchy Level [edit protocols lldp]

Release Information Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure how long to maintain the physical topology database entries. The physical topology identifies the devices on the network and their physical interconnections.

Options ***seconds***—Time to maintain physical topology database entries.

Default: 300

Range: 1 through 2147483647

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show lldp on page 1362**
- *Understanding 802.1X and LLDP and LLDP-MED on EX Series Switches*
- Understanding LLDP on page 1201

ptopo-configuration-trap-interval

Syntax ptopo-configuration-trap-interval *seconds*;

Hierarchy Level [edit protocols lldp]

Release Information Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify how often SNMP trap notifications are sent regarding changes in physical topology global statistics.

Default SNMP trap notifications of changes in physical topology global statistics are disabled.

Options ***seconds***—Interval between SNMP trap notifications about physical topology global statistics.

Range: 0 through 3600

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

radius

Syntax

```
radius {
  accounting-server [server-addresses];
  authentication-server [server-addresses];
}
```

Hierarchy Level [edit access profile *profile-name*]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the RADIUS servers for authentication and for accounting. To configure multiple RADIUS servers, include multiple **radius** statements. The servers are tried in order and in a round-robin fashion until a valid response is received from one of the servers or until all the configured retry limits are reached.

The statements are explained separately.

NOTE: The **[edit access]** hierarchy is not available on QFabric systems.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Example: Connecting a RADIUS Server for 802.1X to an EX Series Switch*
- *Configuring 802.1X RADIUS Accounting (CLI Procedure)*
- *Filtering 802.1X Supplicants Using RADIUS Server Attributes*
- *Configuring RADIUS Accounting*

radius-options (edit system)

Syntax

```
radius-options {
  attributes {
    nas-ip-address ip-address;
  }
  password-protocol mschap-v2;
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
MS-CHAPv2 password protocol configuration option introduced in Junos OS Release 9.2.
MS-CHAPv2 password protocol configuration option introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

NOTE: **The radius-options statement is not available on QFabric systems.**

Description Configure RADIUS options for the NAS-IP address for outgoing RADIUS packets and password protocol used in RADIUS packets.

Options **nas-ip-address *ip-address***—IP address of the network access server (NAS) that requests user authentication.

password-protocol *mschap-v2*—Protocol MS-CHAPv2, used for password authentication and password changing.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring RADIUS Authentication*
- Configuring RADIUS Authentication on page 1233

radius-server

Syntax

```
radius-server server-address {
  accounting-port port-number;
  port number;
  retry number;
  secret password;
  source-address source-address;
  timeout seconds;
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a RADIUS server for Point-to-Point Protocol (PPP).

To configure multiple RADIUS servers, include multiple **radius-server** statements. The servers are tried in order and in a round-robin fashion until a valid response is received from one of the servers or until all the configured retry limits are reached.

Options *server-address*—Address of the RADIUS authentication server.

The remaining statements are explained separately.

NOTE: The accounting-port and source-address options are not available on QFabric systems.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring RADIUS Authentication on page 1233
- accounting-port on page 223
- port on page 1308
- retry on page 275
- secret on page 279
- source-address on page 282
- timeout on page 296

rate-limit

Syntax rate-limit *limit*;

Hierarchy Level [edit system services finger],
[edit system services ftp],
[edit system services netconf ssh],
[edit system services ssh],
[edit system services telnet],
[edit system services xnm-clear-text],
[edit system services xnm-ssl]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the maximum number of connections attempts per protocol (either IPv6 or IPv4) on an access service.

Default 150 connections

Options rate-limit *limit*—(Optional) Maximum number of connection attempts allowed per minute, per IP protocol (either IPv4 or IPv6).

Range: 1 through 250

Default: 150

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring clear-text or SSL Service for Junos XML Protocol Client Applications*

remote-debug-permission

Syntax remote-debug-permission (qfabric-admin | qfabric-operator | qfabric-user);

Hierarchy Level [edit system login user *username* authentication]
[edit system root-authentication]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description (QFabric systems only) Configure authentication classes that permit or deny user access to individual components of the QFabric system.

Default qfabric-user

Options **qfabric-admin**—Permits a user to log in to individual QFabric system components, view operations, and change component configurations.

qfabric-operator—Permits a user to log in to individual QFabric system components and view component operations.

qfabric-user—Prevents a user from logging in to individual QFabric system components.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring QFabric System Login Classes*
- request component login on page 1356
- *Understanding QFabric System Login Classes*

retry

Syntax retry *number*;

Hierarchy Level [edit system radius server *server-address*],
[edit system accounting destination radius server *server-address*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Number of times the router or switch is allowed to try to contact a RADIUS authentication or accounting server.

Options *number*—Number of retries allowed for contacting a RADIUS server.

Range: **1** through **10**

Default: **3**

NOTE: The **[edit system accounting]** hierarchy is not available on QFabric systems.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring RADIUS Authentication on page 1233
- *Configuring RADIUS Accounting*
- timeout on page 296

rising-threshold (Health Monitor)

Syntax rising-threshold *percentage*;

Hierarchy Level [edit snmp health-monitor]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the upper threshold for the monitored object when you configure a health monitor alarm. By setting a rising and a falling threshold for a monitored object, you can be alerted whenever the value of the variable falls outside the allowable operational range.

Options ***percentage***—Upper threshold for the alarm entry.

Range: **1** through **100**

Default: **80** percent of the maximum possible value

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring Health Monitoring on page 6119
- **falling-threshold on page 1296**

root-login

Syntax root-login (allow | deny | deny-password);

Hierarchy Level [edit system services ssh]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Control user access through SSH.

Default Allow user access through SSH.

Options **allow**—Allow users to log in to the router or switch as root through SSH.

deny—Disable users from logging in to the router or switch as root through SSH.

deny-password—Allow users to log in to the router or switch as root through SSH when the authentication method (for example, RSA authentication) does not require a password.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring the Root Login Through SSH on page 1244

services (Switches)

Syntax

```
services {
  service-deployment {
    servers address {
      port-number port-number;
    }
    source-address address;
  }
  ssh {
    connection-limit limit;
    protocol-version [v1 v2];
    rate-limit limit;
    root-login (allow | deny | deny-password);
  }
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the switch so that users on remote systems can access the local switch through SSH.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

snmp

Syntax

```
snmp {
  client-list client-list-name {
    ip-addresses;
  }
  community community-name {
    authorization authorization;
    client-list-name client-list-name;
    clients {
      address restrict;
    }
    logical-system logical-system-name {
      routing-instance routing-instance-name {
        clients {
        addresses;
        }
      }
    }
    routing-instance routing-instance-name {
      clients {
      addresses;
      }
    }
    view view-name;
  }
  contact contact;
  description description;
  filter-duplicates;
  filter-interfaces;
  health-monitor {
    falling-threshold integer;
    interval seconds;
    rising-threshold integer;
  }
  interface [ interface-names ];
  location location;
  name name;
  nonvolatile {
    commit-delay seconds;
  }
  rmon {
    alarm index {
      description description;
      falling-event-index index;
      falling-threshold integer;
      falling-threshold-interval seconds;
      interval seconds;
      request-type;
      rising-event-index index;
      rising-threshold integer;
      sample-type (absolute-value | delta-value);
      startup-alarm (falling-alarm | rising-alarm | rising-or-falling alarm);
      syslog-subtag syslog-subtag;
```

```
      variable oid-variable;
    }
    event index {
      community community-name;
      description description;
      type type;
    }
    history history-index {
      bucket-size number;
      interface interface-name;
      interval seconds;
      owner owner-name;
    }
  }
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable> <match
      regular-expression>;
    flag flag;
  }
  trap-group group-name {
    categories {
      category;
    }
    destination-port port-number;
    routing-instance routing-instance-name;
    targets {
      address;
    }
    version (all | v1 | v2);
  }
  trap-options {
    agent-address outgoing-interface;
    source-address address;
  }
  v3 {
    notify name {
      tag tag-name;
      type trap;
    }
    notify-filter profile-name {
      oid object-identifier (include | exclude);
    }
    snmp-community community-index {
      community-name community-name;
      security-name security-name;
      tag tag-name;
    }
    target-address target-address-name {
      address address;
      address-mask address-mask;
      logical-system logical-system;
      port port-number;
      retry-count number;
      routing-instance routing-instance-name;
      tag-list tag-list;
      target-parameters target-parameters-name;
```

```
      timeout seconds;
    }
    target-parameters target-parameters-name {
      notify-filter profile-name;
      parameters {
        message-processing-model (v1 | v2c | V3);
        security-level (authentication | none | privacy);
        security-model (usm | v1 | v2c);
        security-name security-name;
      }
    }
    usm {
      local-engine {
        user username {
          authentication-sha {
            authentication-password authentication-password;
          }
          authentication-md5 {
            authentication-password authentication-password;
          }
          authentication-none;
          privacy-aes128 {
            privacy-password privacy-password;
          }
          privacy-des {
            privacy-password privacy-password;
          }
          privacy-3des {
            privacy-password privacy-password;
          }
          privacy-none;
        }
      }
      remote-engine engine-id {
        user username {
          authentication-sha {
            authentication-password authentication-password;
          }
          authentication-md5 {
            authentication-password authentication-password;
          }
          authentication-none;
          privacy-aes128 {
            privacy-password privacy-password;
          }
          privacy-des {
            privacy-password privacy-password;
          }
          privacy-3des {
            privacy-password privacy-password;
          }
          privacy-none {
            privacy-password privacy-password;
          }
        }
      }
```

```
        }
        vacm {
          access {
            group group-name {
              (default-context-prefix | context-prefix context-prefix) {
                security-model (any | usm | v1 | v2c) {
                  security-level (authentication | none | privacy) {
                    notify-view view-name;
                    read-view view-name;
                    write-view view-name;
                  }
                }
              }
            }
          }
          security-to-group {
            security-model (usm | v1 | v2c) {
              security-name security-name {
                group group-name;
              }
            }
          }
        }
      }
      view view-name {
        oid object-identifier (include | exclude);
      }
    }
    }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure SNMP.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp–control—To add this statement to the configuration.

Related Documentation

- Understanding the Implementation of SNMP on page 6021
- Configuring SNMP on page 1237

source-address (SNMP)

Syntax source-address *address*;

Hierarchy Level [edit snmp trap-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the source address of every SNMP trap packet sent by this switch to a single address regardless of the outgoing interface. If the source address is not specified, the default is to use the address of the outgoing interface as the source address.

Options ***address***—Source address of SNMP traps. You can configure the source address of trap packets two ways: **lo0** or a valid IPv4 address configured on one of the interfaces. The value **lo0** indicates that the source address of all SNMP trap packets is set to the lowest loopback address configured at interface **lo0**.

Default: Disabled. (The source address is the address of the outgoing interface.)

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the Source Address for SNMP Traps*

ssh

Syntax

```
ssh {
  ciphers [ cipher-1 cipher-2 cipher-3 ...];
  client-alive-count-max seconds;
  client-alive-interval seconds;
  connection-limit limit;
  hostkey-algorithm <algorithm|no-algorithm>;
  key-exchange <algorithm>;
  macs <algorithm>;
  max-sessions-per-connection <number>;
  no-tcp-forwarding;
  protocol-version [v1 v2];
  rate-limit limit;
  root-login (allow | deny | deny-password);
}
```

Hierarchy Level [edit system services]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
client-alive-interval and **client-alive-max-count** statements introduced in Junos OS Release 12.2.

Description Allow SSH requests from remote systems to the local router or switch.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring SSH Service for Remote Access to the Router or Switch on page 1243

tacplus-options

Syntax

```
tacplus-options {
  (exclude-cmd-attribute | no-cmd-attribute-value);
  service-name service-name;
  timestamp-and-timezone;
}
```

Hierarchy Level [edit system]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Options for **no-cmd-attribute-value** and **exclude-cmd-attribute** introduced in Junos OS Release 9.3.
Statement introduced in Junos OS Release 11.1 for QFX Series.
Option for **timestamp-and-timezone** introduced in Junos OS Release 12.2.

Description Configure TACACS+ options for authentication and accounting.

Options

exclude-cmd-attribute—Exclude the **cmd** attribute value completely from start and stop accounting records to enable logging of accounting records in the correct log file on a TACACS+ server.

no-cmd-attribute-value—Set the **cmd** attribute value to an empty string in the TACACS+ accounting start and stop requests to enable logging of accounting records in the correct log file on a TACACS+ server.

service-name *service-name*—Name of the authentication service used when you configure multiple TACACS+ servers to use the same authentication service.

Default: junos-exec

timestamp-and-timezone—Include this statement if you want start time, stop time, and timezone attributes included in start/stop accounting records.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring TACACS+ Authentication*
- *Configuring TACACS+ System Accounting*
- Junos OS Authentication Order for RADIUS, TACACS+, and Password Authentication on page 1211
- Configuring TACACS+ Authentication on page 1245
- Configuring TACACS+ System Accounting on page 1248

targets

Syntax

```
targets {
  address;
}
```

Hierarchy Level [edit snmp trap-group *group-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure one or more systems to receive SNMP traps.

Options ***address***—IPv4 or IPv6 address of the system to receive traps. You must specify an address, not a hostname.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring SNMP Trap Groups on page 6114

traceoptions (LLDP)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable> <no-stamp>
    <replace>;
  flag flag <disable>;
}
```

Hierarchy Level [edit protocols lldp]

Release Information Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define tracing operations for the Link Layer Discovery Protocol (LLDP). You can trace messages under LLDP for LLDP and PTOPO MIBs.

NOTE: **The traceoptions statement is not supported on the QFX3000 QFabric system.**

Default Tracing operations are disabled.

Options

file *filename*—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**.

files *number*—(Optional) Maximum number of trace files. When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**, then **trace-file.1**, and so on, until the maximum ***xk*** to specify KB, ***xm*** to specify MB, or ***xg*** to specify GB number of trace files is reached. Then the oldest trace file is overwritten. If you specify a maximum number of files, you also must specify a maximum file size with the **size** option.

Range: 2 through 1000

Default: 3 files

flag *flag*—Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. You can include the following flags:

- **all**—All tracing operations.
- **configuration**—Trace configuration operations.
- **interface**—Trace interface update events.
- **netbios**—Trace NetBIOS events.
- **packet**—Trace packet events.
- **rtsock**—Trace routing socket operations.
- **snmp**—Trace SNMP configuration operations.

- **vlan**—Trace VLAN update events.

no-stamp—(Optional) Do not timestamp the trace file.

Default: If you omit this option, timestamp information is placed at the beginning of each line of the tracing output.

no-world-readable—(Optional) Restrict file access to the user who created the file.

replace—(Optional) Replace an existing trace file if there is one rather than appending output to it.

size ***size***—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**, then **trace-file.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten. If you specify a maximum number of files, you also must specify a maximum file size with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through 1 GB

Default: 128 KB

Default: If you do not include this option, tracing output is appended to an existing trace file.

world-readable—(Optional) Enable unrestricted file access.

NOTE: **The traceoptions statement is not supported on the QFX3000 QFabric system.**

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring LLDP-MED (CLI Procedure)*
- *Understanding 802.1X and LLDP and LLDP-MED on EX Series Switches*
- Configuring LLDP on page 1227
- Understanding LLDP on page 1201

transfer-interval (Configuration)

Syntax transfer-interval *interval*;

Hierarchy Level [edit system archival configuration]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the router or switch to periodically transfer its currently active configuration to an archive site.

NOTE: **The edit system archival hierarchy is not available on QFabric systems.**

Options ***interval***—Interval at which to transfer the current configuration to an archive site.

Range: 15 through 2880 minutes

NOTE: The **[edit system archival]** hierarchy is not available on QFabric systems.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring the Transfer Interval for Periodic Transfer of the Active Configuration to an Archive Site on page 1147
- **archive on page 6299**
- **configuration on page 1153**
- **transfer-on-commit on page 1155**

transfer-on-commit

Syntax transfer-on-commit;

Hierarchy Level [edit system archival configuration]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the router or switch to transfer its currently active configuration to an archive site each time you commit a candidate configuration.

NOTE: When specifying a URL in a Junos OS statement using an IPv6 host address, you must enclose the entire URL in quotation marks (" ") and enclose the IPv6 host address in brackets ([ ]). For example, "ftp://*username*<:*password*>@[*ipv6-host-address*]<:*port*>/*url-path*" .

NOTE: The [edit system archival] hierarchy is not available on QFabric systems.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring Transfer of the Current Active Configuration When a Configuration Is Committed on page 1148
- archive on page 6299
- configuration on page 1153
- transfer-interval on page 1154

trap-group

Syntax

```
trap-group group-name {
  categories {
    category;
  }
  destination-port port-number;
  routing-instance instance;
  targets {
    address;
  }
  version (all | v1 | v2);
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Create a named group of hosts to receive the specified trap notifications. The name of the trap group is embedded in SNMP trap notification packets as one variable binding (varbind) known as the community name. At least one trap group must be configured for SNMP traps to be sent.

Options *group-name*—Name of the trap group. If the name includes spaces, enclose it in quotation marks (" ").

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring SNMP Trap Groups*

trap-options

Syntax

```
trap-options {
  agent-address outgoing-interface;
  source-address address;
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Using SNMP trap options, you can set the source address of every SNMP trap packet sent by the router or switch to a single address, regardless of the outgoing interface. In addition, you can set the agent address of each SNMPv1 trap. For more information about the contents of SNMPv1 traps, see RFC 1157.

The remaining statements are explained separately.

Default Disabled

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring SNMP Trap Options*

user (Access)

Syntax

```
user username {
  authentication {
    (encrypted-password "password" | plain-text-password);
    load-key-file URL;
    remote-debug-permission (qfabric-admin | qfabric-operator |qfabric-user);
    ssh-dsa "public-key" <from hostname>;
    ssh-rsa "public-key" <from hostname>;
  }
  class class-name;
  full-name "complete-name";
  uid uid-value;
}
```

Hierarchy Level [edit system login]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure access permission for individual users.

Options The remaining statements are explained separately.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring Junos OS User Accounts on page 1226
- class on page 236

version

Syntax version (all | v1 | v2);

Hierarchy Level [edit snmp trap-group *group-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the version number of SNMP traps.

Default **all**—Send an SNMPv1 and SNMPv2 trap for every trap condition.

Options **all**—Send an SNMPv1 and SNMPv2 trap for every trap condition.

v1—Send SNMPv1 traps only.

v2—Send SNMPv2 traps only.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring SNMP Trap Groups on page 6114

CHAPTER 14

Administration

Routine Monitoring

Monitoring SNMP

There are several commands that you can access in Junos OS operational mode to monitor SNMP information. Some of the commands are:

- **show snmp health-monitor**, which displays the health monitor log and alarm information.
- **show snmp mib**, which displays information from the MIBs, such as device and system information.
- **show snmp statistics**, which displays SNMP statistics such as the number of packets, silent drops, and invalid output values.
- **show snmp rmon**, which displays the RMON alarm, event, history, and log information

The following example provides sample output from the **show snmp health-monitor** command:

user@switch> show snmp health-monitor

```
Alarm
Index  Variable description                           Value State

 32768 Health Monitor: root file system utilization
       jnxHrStoragePercentUsed.1                         58 active

 32769 Health Monitor: /config file system utilization
       jnxHrStoragePercentUsed.2                          0 active

 32770 Health Monitor: RE 0 CPU utilization
       jnxOperatingCPU.9.1.0.0                            0 active

 32773 Health Monitor: RE 0 Memory utilization
       jnxOperatingBuffer.9.1.0.0                        35 active

 32775 Health Monitor: jkernel daemon CPU utilization
       Init daemon                                        0 active
```

```
Chassis daemon                                    50 active
Firewall daemon                                    0 active
Interface daemon                                   5 active
SNMP daemon                                       11 active
MIB2 daemon                                       42 active
...
```

The following example provides sample output from the **show snmp mib** command:

user@switch> show snmp mib walk system

```
sysDescr.0    = Juniper Networks, Inc. qfx3500s internet router, kernel
JUNOS 11.1-20100926.0 #0: 2010-09-26 06:17:38 UTC builder@abc.juniper.net:
/volume/build/junos/11.1/production/20100926.0/obj-xlr/bsd/sys/compile/JUNIPER-xxxxx

Build date: 2010-09-26 06:00:10 U
sysObjectID.0 = jnxProductQFX3500
sysUpTime.0   = 24444184
sysContact.0  = J Smith
sysName.0     = Lab QFX3500
sysLocation.0 = Lab
sysServices.0 = 4
```

The following example provides sample output from the **show snmp statistics** command:

user@switch> show snmp statistics

```
SNMP statistics:
  Input:
    Packets: 0, Bad versions: 0, Bad community names: 0,
    Bad community uses: 0, ASN parse errors: 0,
    Too bigs: 0, No such names: 0, Bad values: 0,
    Read onlys: 0, General errors: 0,
    Total request varbinds: 0, Total set varbinds: 0,
    Get requests: 0, Get nexts: 0, Set requests: 0,
    Get responses: 0, Traps: 0,
    Silent drops: 0, Proxy drops: 0, Commit pending drops: 0,
    Throttle drops: 0, Duplicate request drops: 0
    Output:
    Packets: 0, Too bigs: 0, No such names: 0,
    Bad values: 0, General errors: 0,
    Get requests: 0, Get nexts: 0, Set requests: 0,
    Get responses: 0, Traps: 0
```

Related Documentation

- health-monitor on page 1297
- show snmp mib on page 6392
- show snmp statistics on page 1379

Monitoring Commands

- clear lldp neighbors
- clear lldp statistics
- request component login
- show ethernet-switching interfaces

- show lldp
- show lldp local-information
- show lldp neighbors
- show lldp statistics
- show route instance
- show snmp statistics
- ssh

clear lldp neighbors

Syntax clear lldp neighbors <interface *interface*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear the learned remote neighbor information on all or selected interfaces.

Options **none**—Clear the remote neighbor information on all interfaces.

interface *interface*—(Optional) Clear the remote neighbor information from the selected interface.

Required Privilege Level view

Related Documentation

- *show lldp*
- Configuring LLDP on page 1227
- Understanding LLDP on page 1201

List of Sample Output clear lldp neighbors on page 1354
clear lldp neighbors interface on page 1354

Sample Output

clear lldp neighbors

```
user@switch> clear lldp neighbors
```

clear lldp neighbors interface

```
user@switch> clear lldp neighbors interface ge-0/1/1.0
```


clear lldp statistics

Syntax

clear lldp statistics
<interface *interface*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Clear LLDP statistics on one or more interfaces.

Options

none—Clears LLDP statistics on all interfaces.

interface *interface-names*—(Optional) Clear LLDP statistics on an interface.

Required Privilege Level

view

Related Documentation

- Configuring LLDP on page 1227
- Understanding LLDP on page 1201

List of Sample Output

clear lldp statistics on page 1355
clear lldp statistics interface on page 1355

Sample Output

clear lldp statistics

```
user@switch> clear lldp statistics
```

clear lldp statistics interface

```
user@switch> clear lldp statistics interface ge-0/1/1.0
```


request component login

Syntax

request component login *component-name*

Release Information

Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

(QFabric systems only) Log in to a QFabric system component. To gain access to individual components by way of the **request component login** command, you must first provide the **qfabric-admin** or **qfabric-operator** class privilege to your user (for more information, see: remote-debug-permission).

Options

component-name—Specify the QFabric system component to which you wish to log in.

Required Privilege Level

admin

Related Documentation

- *Example: Configuring QFabric System Login Classes*
- remote-debug-permission on page 1329
- *Understanding QFabric System Login Classes*

List of Sample Output

Sample Output

The three sample output displays show the results of attempts to log in to Node device EE3093. The results differ depending on the privilege level assigned to the user.

request component login (with qfabric-admin Privileges)

```
admin@qfabric> request component login EE3093
Warning: Permanently added 'qfabric-node-ee3093,169.254.128.41' (RSA) to the list
 of known hosts.
--- JUNOS 11.3I built 2011-11-04 12:46:16 UTC
{master}
qfabric-admin@node-ee3093> ?
Possible completions:
  clear                Clear information in the system
  file                 Perform file operations
  help                 Provide help information
  load                 Load information from file
  monitor              Show real-time debugging information
  mtrace               Trace multicast path from source to receiver
  op                   Invoke an operation script
  ping                 Ping remote target
  quit                 Exit the management session
  request              Make system-level requests
  restart              Restart software process
  save                 Save information to file
  set                  Set CLI properties, date/time, craft interface message
  show                 Show system information
  ssh                  Start secure shell on another host
  start                Start shell
```

```
  telnet               Telnet to another host
  test                 Perform diagnostic debugging
  traceroute           Trace route to remote host{master}
qfabric-admin@node-ee3093>
```

request component login (with qfabric-operator Privileges)

```
operator@qfabric> request component login EE3093
Warning: Permanently added 'qfabric-node-ee3093,169.254.128.41' (RSA) to the list
 of known hosts.
--- JUNOS 11.3I built 2011-11-04 12:46:16 UTC
{master}
qfabric-operator@node-ee3093> ?
Possible completions:
  file                 Perform file operations
  help                 Provide help information
  load                 Load information from file
  op                   Invoke an operation script
  quit                 Exit the management session
  request              Make system-level requests
  save                 Save information to file
  set                  Set CLI properties, date/time, craft interface message
  show                 Show system information
  start                Start shell
  test                 Perform diagnostic debugging
{master}
qfabric-operator@node-ee3093>
```

request component login (with qfabric-user Privileges)

```
user0@qfabric> request component login EE3093
error: User user0 does not have sufficient permissions to login to device ee3093
```

show ethernet-switching interfaces

Syntax

show ethernet-switching interfaces
<brief | detail | summary>
<interface *interface-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display information about switched Ethernet interfaces.

Options

none—(Optional) Display brief information for Ethernet-switching interfaces.

brief | detail | summary—(Optional) Display the specified level of output.

interface *interface-name*—(Optional) Display Ethernet-switching information for a specific interface.

Required Privilege Level view

Related Documentation

- Troubleshooting Ethernet Switching on page 1731Understanding Bridging and VLANs on page 1402
- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Example: Setting Up Bridging with Multiple VLANs on page 1451
- Understanding FCoE on page 4799
- Interfaces Overview on page 1839

List of Sample Output

show ethernet-switching interfaces on page 1359
show ethernet-switching interfaces summary on page 1360
show ethernet-switching interfaces brief on page 1360
show ethernet-switching interfaces detail on page 1360
show ethernet-switching interfaces interface-name on page 1361

Output Fields Table 111 on page 1358 lists the output fields for the **show ethernet-switching interfaces** command. Output fields are listed in the approximate order in which they appear.

Table 111: show ethernet-switching interfaces Output Fields

Field Name	Field Description	Level of Output
Interface	Name of a switching interface.	All levels
State	Interface state. Values are **up** or **down**.	none, **brief**, **detail**, **summary**
VLAN members	Name of a VLAN.	none, **brief**, **detail**, **summary**

Table 111: show ethernet-switching interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Blocking	Forwarding state of the interface: • **blocked**—Traffic is not being forwarded on the interface. • **unblocked**—Traffic is forwarded on the interface. • **MAC limit exceeded**—The interface is temporarily disabled because of a MAC limiting error. The disabled interface is automatically restored to service when the disable timeout expires. • **MAC move limit exceeded**—The interface is temporarily disabled because of a MAC move limiting error. The disabled interface is automatically restored to service when the disable timeout expires. • **Storm control in effect** —The interface is temporarily disabled because of a storm control error. The disabled interface is automatically restored to service when the disable timeout expires. • **Storm control shutdown in effect** —The interface is temporarily disabled because of a storm control shutdown error. The disabled interface is automatically restored to service when the disable timeout expires.	none, **brief**, **detail**, **summary**
Index	VLAN index internal to Junos OS software.	**detail**
untagged | tagged	Specifies whether the interface forwards IEEE802.1Q-tagged or untagged traffic.	**detail**

Sample Output

show ethernet-switching interfaces

```
user@switch> show ethernet-switching interfaces

Interface    State     VLAN members          Blocking
xe-0/0/0.0   up        T1122                 unblocked
xe-0/0/1.0   down      default               - MAC limit exceeded
xe-0/0/2.0   down      default               - MAC move limit exceeded
xe-0/0/3.0   down      default               - Storm control in effect
xe-0/0/4.0   down      default               unblocked
xe-0/0/5.0   down      default               unblocked
xe-0/0/6.0   down      default               unblocked
xe-0/0/7.0   down      default               unblocked
xe-0/0/8.0   down      default               unblocked
xe-0/0/9.0   up        T111                  unblocked
xe-0/0/10.0  down      default               unblocked
xe-0/0/11.0  down      default               unblocked
xe-0/0/12.0  down      default               unblocked
xe-0/0/13.0  down      default               unblocked
xe-0/0/14.0  down      default               unblocked
xe-0/0/15.0  down      default               unblocked
xe-0/0/16.0  down      default               unblocked
xe-0/0/17.0  down      default               unblocked
xe-0/0/18.0  down      default               unblocked
xe-0/0/19.0  up        T111                  unblocked
xe-0/1/0.0   down      default               unblocked
xe-0/1/1.0   down      default               unblocked
xe-0/1/2.0   down      default               unblocked
xe-0/1/3.0   down      default               unblocked
```


show ethernet-switching interfaces summary

```
user@switch> show ethernet-switching interfaces summary
xe-0/0/0.0
xe-0/0/1.0
xe-0/0/2.0
xe-0/0/3.0
xe-0/0/8.0
xe-0/0/10.0
xe-0/0/11.0
```

show ethernet-switching interfaces brief

```
user@switch> show ethernet-switching interfaces brief
Interface    State    VLAN members          Blocking
xe-0/0/0.0   down     default               unblocked
xe-0/0/1.0   down     employee-vlan         unblocked
xe-0/0/2.0   down     employee-vlan         unblocked
xe-0/0/3.0   down     employee-vlan         unblocked
xe-0/0/8.0   down     employee-vlan         unblocked
xe-0/0/10.0  down     default               unblocked
xe-0/0/11.0  down     employee-vlan         unblocked
```

show ethernet-switching interfaces detail

```
user@switch> show ethernet-switching interfaces detail
Interface: xe-0/0/0.0 Index: 65
  State: down
  VLANs:
    default                untagged     unblocked

Interface: xe-0/0/1.0 Index: 66
  State: down
  VLANs:
    employee-vlan          untagged     unblocked

Interface: xe-0/0/2.0 Index: 67
  State: down
  VLANs:
    employee-vlan          untagged     unblocked

Interface: xe-0/0/3.0 Index: 68
  State: down
  VLANs:
    employee-vlan          untagged     unblocked

Interface: xe-0/0/8.0 Index: 69
  State: down
  VLANs:
    employee-vlan          untagged     unblocked

Interface: xe-0/0/10.0 Index: 70
  State: down
  VLANs:
    default                untagged     unblocked

Interface: xe-0/0/11.0 Index: 71
  State: down
  VLANs:
    employee-vlan          tagged       unblocked
```

show ethernet-switching interfaces interface-name

```
user@switch> show ethernet-switching interfaces xe-0/0/0.0
 Interface   State    VLAN members           Blocking
xe-0/0/0.0  down     default                unblocked
```

show lldp

Syntax

show lldp
<detail>

Release Information

Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display information about Link Layer Discovery Protocol (LLDP) and Link Level Discovery Protocol–Media Endpoint Discovery (LLDP-MED) configuration and capabilities on the switch. LLDP and LLDP-MED are used to learn about and to distribute device information on network links.

NOTE: LLDP-MED is not available on the QFX Series.

Options

none—Display LLDP information for all interfaces.

detail—(Optional) Display detailed LLDP information for all interfaces.

NOTE: **fast-start** is not available on the QFX Series.

Required Privilege Level

view

Related Documentation

- *Configuring LLDP (CLI Procedure)*
- *Configuring LLDP-MED (CLI Procedure)*
- *Understanding 802.1X and LLDP and LLDP-MED on EX Series Switches*
- Configuring LLDP on page 1227
- Understanding LLDP on page 1201

List of Sample Output

show lldp on page 1365
show lldp detail on page 1365

Output Fields

Table 112 on page 1363 lists the output fields for the **show lldp** command. Output fields are listed in the approximate order in which they appear.

Table 112: show lldp Output Fields

Field Name	Field Description	Level of Output
LLDP	LLDP operating state. The state can be **enabled** or **disabled**. NOTE: If a VLAN that has been configured for untagged packets on an interface also has Layer 2 protocol tunneling (L2PT) enabled for LLDP, the LLDP operating state for that interface is displayed as **disabled**.	All levels
Advertisement interval	Frequency, in seconds, at which LLDP advertisements are sent. This value is set by the advertisement-interval configuration statement.	All levels
Transmit delay	Seconds of delay before advertisements are sent to neighbors following a change to a TLV (type, length, or value) element in the LLDP protocol or to the state of the local system, such as a change in hostname or management address. You can set this value to reduce the delay in notifying neighbors of a change in the local system. This value is set by the *transmit-delay* configuration statement.	All levels
Hold timer	Multiplier used in combination with the **advertisement-interval** value to determine the length of time LLDP information is held before it is discarded. This value is set by the hold-multiplier configuration statement.	All levels
Notification interval	How often LLDP trap notifications are generated as a result of LLDP database changes. If the interval value is 0, LLDP trap notifications of database changes are disabled. This value is set by the ***lldp-configuration-notification-interval*** configuration statement.	All levels
Config Trap Interval	How often LLDP trap notifications are generated as a result of changes in topology—for example, when an endpoint connects or disconnects. If the interval value is 0, LLDP trap notifications of topology changes are disabled. This value is set by the ptopo-configuration-trap-interval configuration statement.	All levels
Connection Hold timer	Amount of time the system maintains dynamic topology entries. This value is set by the ptopo-configuration-maximum-hold-time configuration statement.	All levels
LLDP-MED	LLDP-MED operating state. The state can be **enabled** or **disabled**.	All levels
MED fast start count	Number of advertisements sent from a switch to a device, such as a VoIP telephone, when the device is first detected by the switch. These increased advertisements are temporary. After a device and a switch exchange information and can communicate, advertisements are reduced to one per second. This value is set by the ***fast-start*** configuration statement.	All levels
Interface	Name of the interface for which LLDP configuration information is being reported.	All levels
Parent Interface	Name of the aggregated Ethernet interface, if any, to which the interface belongs.	All levels

Table 112: show lldp Output Fields *(continued)*

Field Name	Field Description	Level of Output
LLDP	LLDP operating state. The state can be **enabled** or **disabled**.	All levels
Power Negotiation	LLDP power negotiation operating state. The state can be **Enabled** or **Disabled**.	All levels
Neighbor count	Total number of new LLDP neighbors detected since the last switch reboot.	**detail**
Interface	Name of the interface that is advertising VLAN information.	All levels
Vlan-id	VLAN tag associated with the interface sending LLDP frames. If the interface is not a member of a VLAN, the VLAN ID is advertised as 0.	**detail**
Vlan-name	VLAN name associated with the VLAN ID.	**detail**
LLDP basic TLVs supported	Basic TLVs supported on the switch: • **Chassis identifier**—TLV that advertises the MAC address associated with the local system. • **Port identifier**—TLV that advertises the port identification for the specified port in the local system. • **Port description**—Interface name for the port. • **System name**—TLV that advertises the user-configured name of the local system. • **System description**—TLV that advertises the system description containing information about the software and current image running on the system. This information is taken from the software and is not configurable. • **System capabilities**—TLV that advertises the primary functions performed by the system—for example, bridge or router. • **Management address**—TLV that advertises the IP management address of the local system.	**detail**
Supported LLDP 802 TLVs	802.3 TLVs supported on the switch: • **MAC/PHY configuration status**—TLV that advertises information about the physical interface, such as autonegotiation status and support and MAU type. The information is based on the physical interface structure and is not configurable. • **Power via MDI**—TLV that advertises MDI power support, PSE power pair, and power class information. • **Link aggregation**—TLV that advertises if the interface is aggregated and its aggregated interface ID. • **Maximum frame size**—TLV that advertises the maximum transmission unit (MTU) of the interface sending LLDP frames. • **Port VLAN tag**—TLV that advertises the VLAN tag configured on the interface. • **Port VLAN name**—TLV that advertises the VLAN name configured on the interface.	**detail**

Table 112: show lldp Output Fields *(continued)*

Field Name	Field Description	Level of Output

Supported LLDP MED TLVs	LLDP-MED TLVs supported on the switch:
	• **LLDP MED capabilities**—TLV that advertises the primary function of the port. The capabilities values range from 0 through 15:
	  • **0**—Capabilities
	  • **1**—Network Policy
	  • **2**—Location Identification
	  • **3**—Extended Power via MDI-PSE
	  • **4**—Inventory
	  • **5–15**—Reserved
	• **Network policy**—TLV that advertises the port VLAN configuration and associated Layer 2 and Layer 3 attributes. Attributes include the policy identifier, application types—such as voice or streaming video—802.1Q VLAN tagging, and 802.1p priority bits and DiffServ code points.
	• **Endpoint location**—TLV that advertises the physical location of the endpoint.
	• **Extended power Via MDI**—TLV that advertises the power type, power source, power priority, and power value of the port. It is the responsibility of the PSE device (network connectivity device) to advertise the power priority on a port.
		detail

Sample Output

show lldp

```
user@switch> show lldp
LLDP                    : Enabled
Advertisement interval : 30 seconds
Transmit delay          : 2 seconds
Hold timer              : 4 seconds
Notification interval   : 0 Second(s)
Config Trap Interval    : 0 seconds
Connection Hold timer   : 300 seconds

LLDP MED                : Disabled
MED fast start count    : 3 Packets


Interface      Parent Interface    LLDP       LLDP-MED     Power Negotiation
all            -                   Enabled    Enabled      Enabled
```

show lldp detail

```
user@switch> show lldp detail
LLDP                    : Enabled
Advertisement interval : 30 seconds
Transmit delay          : 2 seconds
Hold timer              : 4 seconds
Notification interval   : 0 Second(s)
Config Trap Interval    : 0 seconds
Connection Hold timer   : 300 seconds

LLDP MED                : Disabled
MED fast start count    : 3 Packets
```

```
Interface      Parent Interface    LLDP        LLDP-MED     Power Negotiation
  Neighbor count
all            -                   Enabled     Enabled      Enabled
  8

Interface      Parent Interface    Vlan-id     Vlan-name
xe-3/0/0.0     ae31.0              100         v100
xe-3/0/0.0     ae31.0              101         v101
xe-3/0/0.0     ae31.0              4000        v4000
xe-3/0/1.0     ae31.0              100         v100
xe-3/0/1.0     ae31.0              101         v101
xe-3/0/1.0     ae31.0              4000        v4000
xe-3/0/2.0     ae31.0              100         v100
xe-3/0/2.0     ae31.0              101         v101
xe-3/0/2.0     ae31.0              4000        v4000

LLDP basic TLVs supported:
Chassis identifier, Port identifier, Port description, System name, System
description, System capabilities, Management address.

Supported LLDP 802 TLVs:
MAC/PHY configuration/status, Power via MDI, Link aggregation, Maximum frame
size, Port VLAN tag, Port VLAN name.

Supported LLDP MED TLVs:
LLDP MED capabilities, Network policy, Endpoint location, Extended power
Via MDI.
```


show lldp local-information

Syntax show lldp local-information

Release Information Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the information that the switch provides in Link Layer Discovery Protocol (LLDP) advertisements to its neighbors.

Required Privilege Level view

Related Documentation

- *Configuring LLDP (CLI Procedure)*
- *Understanding 802.1X and LLDP and LLDP-MED on EX Series Switches*
- **management-address on page 1304**
- Configuring LLDP on page 1227
- Understanding LLDP on page 1201

List of Sample Output show lldp local-information (EX Series Switch) on page 1368

Output Fields Table 113 on page 1367 lists the output fields for the **show lldp local-information** command. Output fields are listed in the approximate order in which they appear.

Table 113: show lldp local-information Output Fields

Field Name	Field Description
LLDP Local Information details	Information about the local system (the switch): • **Chassis ID**—MAC address associated with the switch. • **System name**—User-configured name of the switch. • **System descr**—System description containing information about the switch model and the current software image running on the switch. This information is taken from the software and is not configurable.
System Capabilities	Capabilities (such as **bridge** or **router**) that are supported or enabled on the system.
Management Information	Details of the management information: **Port Name**, **Port Address** (such as **10.204.34.35**), **Address Type** (such as **ipv4** or **ipv6**), **Port ID** (SNMP interface index), **Port ID Subtype**, and **Port Subtype**. The **Port Subtype** displays: • **ifIndex(2)**— IP address of the switch's management Ethernet interface (**me0**) or virtual management Ethernet (**VME**) interface address (for a virtual chassis) is used to manage the switch. • **unknown(1)**—IP management address has been configured with set **protocols lldp management-address**.

Table 113: show lldp local-information Output Fields *(continued)*

Field Name	Field Description
Interface name	Name of the local interface which is configured for either LLDP or LLDP-MED.
Parent Interface	Name of the aggregated Ethernet interface, if any, to which the local interface belongs.
SNMP Index	SNMP interface index.
Interface description	User-configured port description.
Status	Administrative status of the interface: either **up** or **down**.
Tunneling	Status of tunneling on the interface: either **enabled** or **disabled**.

Sample Output

show lldp local-information (EX Series Switch)

```
user@switch> show lldp local-information

LLDP Local Information details

Chassis ID   : 00:1d:b5:aa:b9:f0
System name  : switch
System descr : Juniper Networks, Inc. ex8208 , version 10.4I0 [builder] Build
               date: 2010-11-17 12:38:30 UTC

System Capabilities
    Supported       : Bridge Router
    Enabled         : Bridge Router

Management Information
    Port Name       : -
    Port Address    : 10.93.54.6
    Address Type    : IPv4
    Port ID         : 34
    Port ID Subtype : local(7)
    Port Subtype    : ifIndex(2)

Interface name Parent Interface SNMP Index Interface description Status Tunneling
me0.0          -                34         -                     Down   Disabled
xe-3/0/0.0     ae31.0           769        xe-3/0/0.0            Up     Disabled
xe-3/0/1.0     ae31.0           770        xe-3/0/1.0            Up     Disabled
xe-3/0/2.0     ae31.0           771        xe-3/0/2.0            Up     Disabled
xe-3/0/3.0     ae31.0           772        xe-3/0/3.0            Up     Disabled
xe-3/0/4.0     ae31.0           577        xe-3/0/4.0            Up     Disabled
xe-3/0/5.0     ae31.0           578        xe-3/0/5.0            Up     Disabled
xe-3/0/6.0     ae31.0           579        xe-3/0/6.0            Up     Disabled
xe-3/0/7.0     ae31.0           581        xe-3/0/7.0            Up     Disabled
```

show lldp neighbors

Syntax

<show lldp *neighbors*>
<interface *interface-ids*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display learned information about Link Layer Discovery Protocol (LLDP) on all neighboring interfaces or on selected interfaces.

Options

none—Display learned LLDP information on all neighboring interfaces and devices.

interface ***interface-ids***—(Optional) Display learned LLDP information on the selected interfaces or devices.

NOTE: When a port with DCBX enabled begins to exchange type, length, and value (TLV) entries, optional LLDP TLVs on that port are not advertised to neighbors in order to interoperate with a wider variety of converged network adapters (CNAs). As a result, information for those ports will not be listed in the output for this command.

Required Privilege Level view

Related Documentation

- Configuring LLDP on page 1227
- Understanding LLDP on page 1201

List of Sample Output

show lldp neighbors on page 1371
show lldp neighbors interface on page 1372

Output Fields Table 114 on page 1369 lists the output fields for the **show lldp neighbors** command. Output fields are listed in the approximate order in which they appear.

Table 114: show lldp neighbors Output Fields

Field Name	Field Description
Local Interface	List of local interfaces for which neighbor information is available.
Parent Interface	List of aggregated Ethernet interfaces, if any, to which the local interfaces belong.
Chassis ID	List of chassis identifiers for neighbors.
Port info	List of port information gathered from neighbors. This could be the port identifier or port description.
System name	List of system names gathered from neighbors.

Table 114: show lldp neighbors Output Fields *(continued)*

Field Name	Field Description
LLDP Neighbor Information	Information about both the local system (the switch) and a neighbor system on the interface (appears when the **interface** option is used).
Local Information	Information about the local system (appears when the **interface** option is used).
Index	Local interface index (appears when the **interface** option is used).
Time to live	Number of seconds for which this information is valid (appears when the **interface** option is used).
Time mark	Date and timestamp of information (appears when the **interface** option is used).
Local Interface	Name of the local physical interface (appears when the **interface** option is used).
Parent Interface	Name of the aggregated Ethernet interface, if any, to which the interface belongs (appears when the **interface** option is used).
Local Port ID	Local interface SNMP index (appears when the interface option is used).
Ageout Count	Number of times the complete set of information advertised by the neighbor has been deleted from LLDP neighbor information maintained by the local system because the information timeliness interval has expired (appears when the **interface** option is used).
Neighbor Information	Information about a neighbor system on the interface (appears when the **interface** option is used).
Chassis type	Type of chassis identifier supplied, such as **MAC address** (appears when the **interface** option is used).
Chassis ID	Chassis identifier of the chassis type listed (appears when the **interface** option is used).
Port type	Type of port identifier supplied, such as **locally assigned** (appears when the **interface** option is used).
Port ID	Port identifier of the port type listed (appears when the **interface** option is used).
Port description	Port description (appears when the **interface** option is used).
System name	Name supplied by the system on the interface (appears when the **interface** option is used).
System Description	Description supplied by the system on the interface (appears when the **interface** option is used).

Table 114: show lldp neighbors Output Fields *(continued)*

Field Name	Field Description
System capabilities	Capabilities (such as **Bridge**, **Router**, and **Telephone**) that are supported or enabled by the system on the interface (appears when the **interface** option is used).
Management Info	Details of management information: **Type** (such as **ipv4** or **ipv6**), **Address** (such as **10.204.34.35**), **Port ID**, **Subtype**, **Interface Subtype**, and organization identifier (**OID**) (appears when the **interface** option is used). The **Interface Subtype** displays: • **ifIndex(2)**— IP address of the neighbor's management Ethernet interface (**me0**) or virtual management Ethernet (**VME**) interface address (for a virtual chassis) is used to manage the switch. • **unknown(1)**—Neighbor's IP management address has been configured with set **protocols lldp management-address**.
Media Info	Additional details about the endpoint device appear when a device that supports LLDP-MED is attached to the interface. The specific details depend upon the capabilities of the device. Details might include **Media endpoint class** (such as Class 3 for communication devices such as IP phones), **MED Hardware revision**, **MED Firmware revision**, **MED Software revision**, **MED Serial number**, **MED Manufacturer name**, or **MED Model name**.
Organization Info	One or more entries listing remote information by organizationally unique identifier (**OUI**), **Subtype**, **Index**, and **Info** (appears when the **interface** option is used).
Age	How long the neighbor has been identified (appears when the **interface** option is used and NetBIOS snooping is enabled on the switch).
Local Interface	Name of the local physical interface (appears when the **interface** option is used and NetBIOS snooping is enabled on the switch).
Parent Interface	Name of the aggregated Ethernet interface, if any, to which the interface belongs (appears when the **interface** option is used and NetBIOS snooping is enabled on the switch).
Chassis ID	Chassis identifier of the chassis type listed (appears when the **interface** option is used and NetBIOS snooping is enabled on the switch).
Port description	Port description (appears when the **interface** option is used and NetBIOS snooping is enabled on the switch).
System name	NetBIOS name of the host (appears when the **interface** option is used and NetBIOS snooping is enabled on the switch).

Sample Output

show lldp neighbors

`user@switch>` **show lldp neighbors**

```
Local Interface   Parent Interface   Chassis Id          Port info    System Name
xe-3/0/4.0        ae31.0              b0:c6:9a:63:80:40   xe-0/0/0.0   newyork31
xe-3/0/5.0        ae31.0              b0:c6:9a:63:80:40   xe-0/0/1.0   newyork31
xe-3/0/6.0        ae31.0              b0:c6:9a:63:80:40   xe-0/0/2.0   newyork31
xe-3/0/7.0        ae31.0              b0:c6:9a:63:80:40   xe-0/0/3.0   newyork31
xe-3/0/0.0        ae31.0              b0:c6:9a:63:80:40   xe-0/1/0.0   newyork31
xe-3/0/1.0        ae31.0              b0:c6:9a:63:80:40   xe-0/1/1.0   newyork31
xe-3/0/2.0        ae31.0              b0:c6:9a:63:80:40   xe-0/1/2.0   newyork31
xe-3/0/3.0        ae31.0              b0:c6:9a:63:80:40   xe-0/1/3.0   newyork31
```

show lldp neighbors interface

```
user@switch> show lldp neighbors interface ge-0/0/2

LLLDP Neighbor Information:
Local Information:
Index: 1 Time to live: 240 Time mark: Wed Dec  1 10:23:24 2010 Age: 29 secs
Local Interface    : ge-0/0/2.0
Parent Interface   : -
Local Port ID      : 507
Ageout Count       : 0

Neighbour Information:
Chassis type       : Mac address
Chassis ID         : 00:1f:12:38:7f:c0
Port type          : Locally assigned
Port ID            : 507
Port description   : ge-0/0/2.0
System name        : bng-148p5-dev


System Description : Juniper Networks, Inc. ex4200-48p , version 10.4I0 Build
date: 2010-11-30 09:32:17 UTC

System capabilities
        Supported  : Bridge Router
        Enabled    : Bridge Router

Management Info
        Type              : IPv4
        Address           : 10.204.96.235
        Port ID           : 34
        Subtype           : 1
        Interface Subtype : ifIndex(2)
        OID               : 1.3.6.1.2.1.31.1.1.1.1.34
Media endpoint class: Network Connectivity

Organization Info
       OUI      : 0.12.f
       Subtype  : 1
       Index    : 1
       Info     : 22A8360000

Organization Info
       OUI      : 0.12.f
       Subtype  : 2
       Index    : 2
       Info     : 030100
```

show lldp statistics

Syntax

show lldp statistics
<interface *interface-ids*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display LLDP statistics on all or selected interfaces.

Options

none—Display LLDP statistics on all interfaces and devices.

interface *interface-ids*—(Optional) Display LLDP statistics on the selected devices.

Required Privilege Level view

Related Documentation

- Configuring LLDP on page 1227
- Understanding LLDP on page 1201

List of Sample Output show lldp statistics on page 1373

Output Fields Table 115 on page 1373 lists the output fields for the **show lldp statistics** command. Output fields are listed in the approximate order in which they appear.

Table 115: show lldp statistics Output Fields

Field Name	Field Description	Level of Output
Interface	Name of an interface.	All levels
Received	Total number of LLDP frames received on an interface.	All levels
Unknown-TLVs	Number of unrecognized LLDP TLVs received on an interface.	All levels
With Errors	Number of LLDP frames received that contain errors.	All levels
Discarded TLVs	Number of LLDP TLVs received and then discarded on an interface.	All levels
Transmitted	Total number of LLDP frames transmitted on an interface.	All levels
Untransmitted	Total number of LLDP frames not transmitted on an interface.	All levels

Sample Output

show lldp statistics

```
user@switch> show lldp statistics

Interface  Received  Unknown TLVs  With Errors  Discarded TLVs  Transmitted
Untransmitted
me0.0      0         0             0            0               8003          0
```

```
ge-0/0/0.0 8002       0           0           0           8003        0
ge-0/0/1.0 8002       0           0           0           8003        0
```

show route instance

Syntax

show route instance
<brief | detail | summary>
<*instance-name*>
<operational>

Release Information Command introduced in Junos OS Release 11.3 for the QFX Series.

Description (QFabric systems only) Display routing instance information.

Options

none—(Same as **brief**) Display standard information about all routing instances.

brief | detail | summary—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**. (These options are not available with the **operational** keyword.)

instance-name—(Optional) Display information for a specified routing instance.

operational—(Optional) Display operational routing instances.

Required Privilege Level view

List of Sample Output

show route instance on page 1376
show route instance detail on page 1376
show route instance operational on page 1377
show route instance summary on page 1377

Output Fields Table 116 on page 1375 lists the output fields for the **show route instance** command. Output fields are listed in the approximate order in which they appear.

Table 116: show route instance Output Fields

Field Name	Field Description	Level of Output
Instance or ***instance-name***	Name of the routing instance.	All levels
Operational Routing Instances	(**operational** keyword only) Names of all operational routing instances.	—
Type	Type of routing instance: **forwarding** or **virtual-router**.	All levels
State	State of the routing instance: **active** or **inactive**.	**detail**
Interfaces	Name of interfaces belonging to this routing instance.	**detail**
Tables	Tables (and number of routes) associated with this routing instance.	**detail**
Router ID	Identifier for the router.	**detail**

Table 116: show route instance Output Fields *(continued)*

Field Name	Field Description	Level of Output
Primary RIB	Primary table for this routing instance.	**brief** none **summary**
Active/holddown/hidden	Number of active, hold-down, and hidden routes.	All levels

Sample Output

show route instance

```
user@switch> show route instance
Instance             Type
         Primary RIB                                    Active/holddown/hidden
master               forwarding
         inet.0                                         4/0/1

__juniper_private1__ forwarding
         __juniper_private1__.inet.0                    1/0/3

__juniper_private2__ forwarding
         __juniper_private2__.inet.0                    0/0/1

__juniper_private3__ forwarding
         __juniper_private3__.inet.0                    1/0/2

__juniper_private4__ forwarding
         __juniper_private4__.inet.0                    4/0/2

__master.anon__      forwarding

r1                 virtual-router

r2                 virtual-router
```

show route instance detail

```
user@switch> show route instance detail
master:
  Router ID: 3.3.3.7
  Type: forwarding        State: Active
  Tables:
    inet.0                 : 5 routes (4 active, 0 holddown, 1 hidden)

__juniper_private1__:
  Router ID: 0.0.0.0
  Type: forwarding        State: Active
  Interfaces:
    lo0.16385
    bme0.0
  Tables:
    __juniper_private1__.inet.0: 6 routes (1 active, 0 holddown, 3 hidden)

__juniper_private2__:
  Router ID: 0.0.0.0
  Type: forwarding        State: Active
  Interfaces:
    lo0.16384
```



```
  Tables:
    __juniper_private2__.inet.0: 1 routes (0 active, 0 holddown, 1 hidden)

__juniper_private3__:
  Router ID: 0.0.0.0
  Type: forwarding        State: Active
  Interfaces:
    bme0.1
  Tables:
    __juniper_private3__.inet.0: 4 routes (1 active, 0 holddown, 2 hidden)

__juniper_private4__:
  Router ID: 0.0.0.0
  Type: forwarding        State: Active
  Interfaces:
    bme0.2
  Tables:
    __juniper_private4__.inet.0: 8 routes (4 active, 0 holddown, 2 hidden)

__master.anon__:
  Router ID: 0.0.0.0
  Type: forwarding        State: Active

r1:
  Router ID: 0.0.0.0
  Type: virtual-router    State: Active
  Interfaces:
    xe-0/0/0.0

r2:
  Router ID: 0.0.0.0
  Type: virtual-router    State: Active
  Interfaces:
    xe-0/0/3.0
```

show route instance operational

```
user@switch> show route instance operational
Operational Routing Instances:

__juniper_private1__
__juniper_private2__
__juniper_private3__
__juniper_private4__
r1---qfabric
r2---qfabric
master
```

show route instance summary

```
user@switch> show route instance summary
Instance             Type
         Primary RIB                                     Active/holddown/hidden
master               forwarding
         inet.0                                          4/0/1

__juniper_private1__ forwarding
         __juniper_private1__.inet.0                     1/0/3

__juniper_private2__ forwarding
         __juniper_private2__.inet.0                     0/0/1
```

```
__juniper_private3__ forwarding
         __juniper_private3__.inet.0                      1/0/2

__juniper_private4__ forwarding
         __juniper_private4__.inet.0                      4/0/2

__master.anon__      forwarding

r1                 virtual-router
r2                 virtual-router
```


show snmp statistics

Syntax show snmp statistics

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display statistics about Simple Network Management Protocol (SNMP) packets sent and received by the router or switch.

Options This command has no options.

Required Privilege Level view

Related Documentation

- clear snmp statistics on page 6375

List of Sample Output show snmp statistics on page 1382

Output Fields Table 117 on page 1379 describes the output fields for the **show snmp statistics** command. Output fields are listed in the approximate order in which they appear.

Table 117: show snmp statistics Output Fields

Field Name	Field Description
Input	Information about received packets: • **Packets(snmpInPkts)**—Total number of messages delivered to the SNMP entity from the transport service. • **Bad versions—(snmpInBadVersions**) Total number of messages delivered to the SNMP entity that were for an unsupported SNMP version. • **Bad community names—(snmpInBadCommunityNames)** Total number of messages delivered to the SNMP entity that used an SNMP community name not known to the entity. • **Bad community uses—(snmpInBadCommunityUses)** Total number of messages delivered to the SNMP entity that represented an SNMP operation that was not allowed by the SNMP community named in the message. • **ASN parse errors—(snmpInASNParseErrs)** Total number of ASN.1 or BER errors encountered by the SNMP entity when decoding received SNMP messages. • **Too bigs—(snmpInTooBigs)** Total number of SNMP PDUs delivered to the SNMP entity with an error status field of **tooBig**. • **No such names—(snmpInNoSuchNames)** Total number of SNMP PDUs delivered to the SNMP entity with an error status field of **noSuchName**. • **Bad values—(snmpInBadValues)** Total number of SNMP PDUs delivered to the SNMP entity with an error status field of **badValue**. • **Read onlys—(snmpInReadOnlys)** Total number of valid SNMP PDUs delivered to the SNMP entity with an error status field of **readOnly**. Only incorrect implementations of SNMP generate this error.

Table 117: show snmp statistics Output Fields *(continued)*

Field Name	Field Description
Input (continued)	• **General errors—(snmpInGenErrs)** Total number of SNMP PDUs delivered to the SNMP entity with an error status field of **genErr**. • **Total requests varbinds—(snmpInTotalReqVars)** Total number of MIB objects retrieved successfully by the SNMP entity as a result of receiving valid SNMP **GetRequest** and **GetNext** PDUs. • **Total set varbinds—(snmpInSetVars)** Total number of MIB objects modified successfully by the SNMP entity as a result of receiving valid SNMP **SetRequest** PDUs. • **Get requests—(snmpInGetRequests)** Total number of SNMP **GetRequest** PDUs that have been accepted and processed by the SNMP entity. • **Get nexts—(snmpInGetNexts)** Total number of SNMP **GetNext** PDUs that have been accepted and processed by the SNMP entity. • **Set requests—(snmpInSetRequests)** Total number of SNMP **SetRequest** PDUs that have been accepted and processed by the SNMP entity. • **Get responses—(snmpInGetResponses)** Total number of SNMP **GetResponse** PDUs that have been accepted and processed by the SNMP entity. • **Traps—(snmpInTraps)** Total number of SNMP traps generated by the SNMP entity. • **Silent drops—(snmpSilentDrops)** Total number of **GetRequest**, **GetNextRequest**, **GetBulkRequest**, **SetRequests**, and **InformRequest** PDUs delivered to the SNMP entity that were silently dropped because the size of a reply containing an alternate response PDU with an empty variable-bindings field was greater than either a local constraint or the maximum message size associated with the originator of the requests. • **Proxy drops—(snmpProxyDrops)** Total number of **GetRequest**, **GetNextRequest**, **GetBulkRequest**, **SetRequests**, and **InformRequest** PDUs delivered to the SNMP entity that were silently dropped because the transmission of the message to a proxy target failed in such a way (other than a timeout) that no response PDU could be returned. • **Commit pending drops**—Number of SNMP packets for **Set** requests dropped because of a previous pending SNMP **Set** request on the committed configuration. • **Throttle drops**—Number of SNMP packets for any requests dropped reaching the throttle limit.

Table 117: show snmp statistics Output Fields *(continued)*

Field Name	Field Description
V3 Input	Information about SNMP version 3 packets: • **Unknown security models—(snmpUnknownSecurityModels)** Total number of packets received by the SNMP engine that were dropped because they referenced a security model that was not known to or supported by the SNMP engine. • **Invalid messages—(snmpInvalidMsgs)** Number of packets received by the SNMP engine that were dropped because there were invalid or inconsistent components in the SNMP message. • **Unknown pdu handlers—(snmpUnknownPDUHandlers)** Number of packets received by the SNMP engine that were dropped because the PDU contained in the packet could not be passed to an application responsible for handling the PDU type. • **Unavailable contexts—(snmpUnavailableContexts)** Number of requests received for a context that is known to the SNMP engine, but is currently unavailable. • **Unknown contexts—(snmpUnknownContexts)** Total number of requests received for a context that is unknown to the SNMP engine. • **Unsupported security levels—(usmStatsUnsupportedSecLevels)** Total number of packets received by the SNMP engine that were dropped because they requested a security level unknown to the SNMP engine (or otherwise unavailable). • **Not in time windows—(usmStatsNotInTimeWindows)** Total number of packets received by the SNMP engine that were dropped because they appeared outside the authoritative SNMP engine's window. • **Unknown user names—(usmStatsUnknownUserNames)** Total number of packets received by the SNMP engine that were dropped because they referenced a user that was not known to the SNMP engine. • **Unknown engine ids—(usmStatsUnknownEngineIDs)** Total number of packets received by the SNMP engine that were dropped because they referenced an SNMP engine ID that was not known to the SNMP engine. • **Wrong digests—(usmStatsWrongDigests)** Total number of packets received by the SNMP engine that were dropped because they did not contain the expected digest value. • **Decryption errors—(usmStatsDecryptionErrors)** Total number of packets received by the SNMP engine that were dropped because they could not be decrypted.

Table 117: show snmp statistics Output Fields *(continued)*

Field Name	Field Description
Output	Information about transmitted packets: • **Packets—(snmpOutPkts)** Total number of messages passed from the SNMP entity to the transport service. • **Too bigs—(snmpOutTooBigs)** Total number of SNMP PDUs generated by the SNMP entity with an error status field of **tooBig**. • **No such names—(snmpOutNoSuchNames)** Total number of SNMP PDUs delivered to the SNMP entity with an error status field of **noSuchName**. • **Bad values—(snmpOutBadValues)** Total number of SNMP PDUs generated by the SNMP entity with an error status field of **badValue**. • **General errors—(snmpOutGenErrs)** Total number of SNMP PDUs generated by the SNMP entity with an error status field of **genErr**. • **Get requests—(snmpOutGetRequests)** Total number of SNMP **GetRequest** PDUs generated by the SNMP entity. • **Get nexts—(snmpOutGetNexts)** Total number of SNMP **GetNext** PDUs generated by the SNMP entity. • **Set requests—(snmpOutSetRequests)** Total number of SNMP **SetRequest** PDUs generated by the SNMP entity. • **Get responses—(snmpOutGetResponses)** Total number of SNMP **GetResponse** PDUs generated by the SNMP entity. • **Traps—(snmpOutTraps)** Total number of SNMP traps generated by the SNMP entity.

Sample Output

show snmp statistics

```
user@host> show snmp statistics
SNMP statistics:
  Input:
    Packets: 246213, Bad versions: 12, Bad community names: 12,
    Bad community uses: 0, ASN parse errors: 96,
    Too bigs: 0, No such names: 0, Bad values: 0,
    Read onlys: 0, General errors: 0,
    Total request varbinds: 227084, Total set varbinds: 67,
    Get requests: 44942, Get nexts: 190371, Set requests: 10712,
    Get responses: 0, Traps: 0,
    Silent drops: 0, Proxy drops: 0, Commit pending drops: 0,
    Throttle drops: 0,
  V3 Input:
    Unknown security models: 0, Invalid messages: 0
    Unknown pdu handlers: 0, Unavailable contexts: 0
    Unknown contexts: 0, Unsupported security levels: 1
    Not in time windows: 0, Unknown user names: 0
    Unknown engine ids: 44, Wrong digests: 23, Decryption errors: 0
  Output:
    Packets: 246093, Too bigs: 0, No such names: 31561,
    Bad values: 0, General errors: 2,
    Get requests: 0, Get nexts: 0, Set requests: 0,
    Get responses: 246025, Traps: 0
```

ssh

Syntax

ssh *host*
<bypass-routing>
<inet | inet6>
<interface *interface-name*>
<logical-system *logical-system-name*>
<routing-instance *routing-instance-name*>
<source *address*>
<v1 | v2>

Syntax (EX Series Switch and the QFX Series)

ssh *host*
<bypass-routing>
<inet | inet6>
<interface *interface-name*>
<routing-instance *routing-instance-name*>
<source *address*>
<v1 | v2>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Use the SSH program to open a connection between a local router or switch and a remote system and execute commands on the remote system. You can issue the **ssh** command from the Junos OS CLI to log in to a remote system or from a remote system to log in to the local router or switch. When executing this command, you include one or more CLI commands by enclosing them in quotation marks and separating the commands with semicolons:

ssh *address* '*cli-command1* ; *cli-command2* '

Options

host—Name or address of the remote system.

bypass-routing—(Optional) Bypass the normal routing tables and send ping requests directly to a system on an attached network. If the system is not on a directly attached network, an error is returned. Use this option to ping a local system through an interface that has no route through it.

inet | inet6—(Optional) Create an IPv4 or IPv6 connection, respectively.

interface *interface-name*—(Optional) Interface name for the SSH session. (This option does not work when **default-address-selection** is configured at the **[edit system]** hierarchy level, because this configuration uses the loopback interface as the source address for all locally generated IP packets.)

logical-system *logical-system-name*—(Optional) Name of a particular logical system for the SSH attempt.

routing-instance *routing-instance-name*—(Optional) Name of the routing instance for the SSH attempt.

source *address*—(Optional) Source address of the SSH connection.

v1 | v2—(Optional) Use SSH version 1 or 2, respectively, when connecting to a remote host.

Additional Information To configure an SSH (version 1) key for your user account, include the **authentication ssh-rsa** statement at the **[edit system login user *user-name*]** hierarchy level. To configure an SSH (version 2) key for your user account, include the **authentication dsa-rsa** statement at the **[edit system login user *user-name*]** hierarchy level.

You can limit the number of times a user can attempt to enter a password while logging in through SSH. To specify the number of times a user can attempt to enter a password to log in through SSH, include the **retry-options** statement at the **[edit system login]** hierarchy level. For details, see the .

Required Privilege Level network

Related Documentation

- Configuring SSH Host Keys for Secure Copying of Data on page 1241

List of Sample Output ssh on page 1384

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

ssh

```
user@switch> ssh cree
Host key not found from the list of known hosts.
Are you sure you want to continue connecting (yes/no)? yes

Host ?cree' added to the list of known hosts.
boojun@cree's password:
Last login: Sun Jun 21 10:43:42 1998 from junos-router
% ...
```


PART 6

Ethernet Features

CHAPTER 15

Overview

Enhanced Layer 2 Software (ELS) CLI

Getting Started with Enhanced Layer 2 Software

Understanding Enhanced Layer 2 Software Support

Enhanced Layer 2 software (ELS) is automatically supported if your device is running a Junos OS release that supports it. You do not need to take any action to enable ELS, and you cannot disable ELS.

ELS is available on the following EX Series switches and QFX Series devices.

Table 118: ELS Support

Device	Initial ELS Release
EX4300 switches	13.2X50-D10
EX9200 switches	12.3R2
QFX3500 switches	13.2X50-D15
QFX3600 switches	13.2X50-D15
QFX5100 switches	13.2X51-D10

ELS is supported on the EX4300 and EX9200 switches for all Junos OS releases, starting with the initial releases shown in Table 36 on page 59.

ELS support was introduced on QFX3500 and QFX3600 switches in Junos OS Release 13.2X50-D15. ELS is only supported on the software package that supports Virtual Chassis (the **jinstall-qfx-3-*** software package) for QFX3500 and QFX3600 switches.

For QFX5100 switches, ELS support was introduced in Junos OS Release 13.2X51-D10 and is supported on the **jinstall-qfx-5-*** software package.

NOTE: ELS is not supported on software packages that can be installed in a QFabric system.

Using the ELS Translator Tool

The ELS Translator is a web-based tool that converts Junos OS Layer 2 configurations to Enhanced Layer 2 Software (ELS) configurations. This conversion tool supports all Juniper Networks EX Series, MX Series, and QFX Series platforms with ELS installed. The ELS Translator is hosted on Juniper Networks Customer Support website for EX Series switches, MX Series Universal Edge routers, and QFX Series switches and is available to registered users, internal users, partners, and premium service contract customers. You need to login using your Juniper Networks user name and password to access the ELS Translator tool.

Click to access the ELS translator tool.

If you are upgrading from a version of Junos OS that does not support ELS to a version of Junos OS that supports ELS, we recommend updating your configuration with the ELS Translator Tool using the following procedure:

1. Log onto your device using the console port.

   NOTE: **Only perform this procedure from the console port. You will lose connectivity to your device if you perform this procedure from a management port or any other interface.**

2. Copy your entire existing configuration into another file. Save the file to a remote location. See "Saving a Configuration to a File" on page 1141.
3. Retain the portion of your existing configuration related to management network connectivity (such as **[edit system]**). Delete all other top-level configuration hierarchy levels (such as **[edit interfaces]**, **[edit protocols]**, and **[edit vlans]**). Issue a **commit** operation to remove the deleted configuration hierarchy levels.
4. Perform the software upgrade. Reboot your device to complete the upgrade. See "Software Installation Overview" on page 109

   NOTE: **Maintain your console port connection during the reboot.**

5. Click to access the ELS translator tool in a web browser. Follow the instructions on the page to update your configuration.
6. Return to your console port connection. When the switch has rebooted to complete the software upgrade, copy the configuration from the ELS Translator Tool onto your switch. See "Uploading a Configuration File" on page 1145.
7. Commit the new configuration.

NOTE: **It is possible a script might not translate correctly, so review translated scripts carefully before loading the converted configuration on your switch or other device.**

Configuring a VLAN

You can configure one or more VLANs to perform Layer 2 bridging. The Layer 2 bridging functions include integrated routing and bridging (IRB) for support for Layer 2 bridging and Layer 3 IP routing on the same interface. EX Series and QFX Series switches can function as Layer 2 switches, each with multiple bridging, or broadcast, domains that participate in the same Layer 2 network. You can also configure Layer 3 routing support for a VLAN.

To configure a VLAN:

1. Create the VLAN by setting the unique VLAN name and configuring the VLAN ID:

[edit]
user@host# **set vlans *vlan-name* vlan-id *vlan-id-number***

2. Assign at least one interface to the VLAN:

[edit]
user@host# **set interface *interface-name* family ethernet-switching vlan members *vlan-name***

Configuring the Native VLAN Identifier

EX Series and QFX Series switches support receiving and forwarding routed or bridged Ethernet frames with 802.1Q VLAN tags. Typically, trunk ports, which connect switches to each other, accept untagged control packets but do not accept untagged data packets. You can enable a trunk port to accept untagged data packets by configuring a native VLAN ID on the interface on which you want the untagged data packets to be received.

To configure the native VLAN ID:

1. On the interface on which you want untagged data packets to be received, set the interface mode to trunk, which specifies that the interface is in multiple VLANs and can multiplex traffic between different VLANs.

[edit interfaces]
user@host# **set *interface-name* unit *logical-unit-number* family ethernet-switching interface-mode trunk**

2. Configure the native VLAN ID:

[edit interfaces]
user@host# **set *interface-name* native-vlan-id *number***

3. Assign the interface to the native VLAN ID:

[edit interfaces]
user@host# **set *interface-name* unit *logical-unit-number* family ethernet-switching vlan members *native-vlan-id-number***

Configuring Layer 2 Interfaces

To ensure that your high-traffic network is tuned for optimal performance, explicitly configure some settings on the switch's network interfaces.

To configure a Gigabit Ethernet interface or 10-Gigabit Ethernet interface for trunk interface mode:

[edit]
user@host# **set interfaces *interface-name* unit *logical-unit-number* family ethernet-switching interface-mode trunk**

To configure a Gigabit Ethernet interface or 10-Gigabit Ethernet interface for access interface mode:

[edit]
user@host# **set interfaces *interface-name* unit *logical-unit-number* family ethernet-switching interface-mode access**

Configuring Layer 3 Interfaces

To configure a Layer 3 interface, you must assign an IP address to the interface. You assign an address to an interface by specifying the address when configuring the protocol family. For the inet or inet6 family, configure the interface IP address.

You can configure interfaces with a 32-bit IP version 4 (IPv4) address and optionally with a destination prefix, sometimes called a subnet mask. An IPv4 address utilizes a 4-octet dotted decimal address syntax (for example, 192.16.1.1). An IPv4 address with destination prefix utilizes a 4-octet dotted decimal address syntax with a destination prefix appended (for example, 192.16.1.1/30).

To specify an IP address for the logical unit using IPv4:

`[edit]`
`user@host#` **set interfaces *interface-name* unit *logical-unit-number* family inet address *ip-address***

You represent IP version 6 (IPv6) addresses in hexadecimal notation using a colon-separated list of 16-bit values. You assign a 128-bit IPv6 address to an interface.

To specify an IP address for the logical unit using IPv6:

`[edit]`
`user@host#` **set interfaces *interface-name* unit *logical-unit-number* family inet6 address *ip-address***

Configuring an IRB Interface

Integrated routing and bridging (IRB) provides support for Layer 2 bridging and Layer 3 IP routing on the same interface. IRB enables you to route packets to another routed interface or to another VLAN that has a Layer 3 protocol configured. IRBs allow the device to recognize packets that are being sent to local addresses so that they are bridged (switched) whenever possible and are routed only when necessary. Whenever packets can be switched instead of routed, several layers of processing are eliminated. An interface named irb functions as a logical router on which you can configure a Layer 3 logical interface for VLAN. For redundancy, you can combine an IRB interface with implementations of the Virtual Router Redundancy Protocol (VRRP) in both bridging and virtual private LAN service (VPLS) environments.

To configure an IRB interface:

1. Create a Layer 2 VLAN by assigning it a name and a VLAN ID:

   `[edit]`
   `user@host#` **set vlans *vlan-name* vlan-id *vlan-id***
2. Create an IRB logical interface:

   `[edit]`
   `user@host#` **set interface irb unit *logical-unit-number* family inet address *ip-address***
3. Associate the IRB interface with the VLAN:

   `[edit]`
   `user@host#` **set vlans *vlan-name* l3-interface irb.*logical-unit-number***

Configuring an Aggregated Ethernet Interface and Configuring LACP on That Interface

Use the link aggregation feature to aggregate one or more links to form a virtual link or link aggregation group (LAG). The MAC client can treat this virtual link as if it were a single link to increase bandwidth, provide graceful degradation as failure occurs, and increase availability.

To configure an aggregated Ethernet interface:

1. Specify the number of aggregated Ethernet interfaces to be created:

   ```
   [edit chassis]
   user@host# set aggregated-devices ethernet device-count number
   ```
2. Specify the name of the link aggregation group interface:

   ```
   [edit interfaces]
   user@host# set interfaces aex
   ```
3. Specify the minimum number of links for the aggregated Ethernet interface (aex), that is, the defined bundle, to be labeled “up”:

   ```
   [edit interfaces]
   user@host# set aex aggregated-ether-options minimum-links number
   ```
4. Specify the link speed for the aggregated Ethernet bundle:

   ```
   [edit interfaces]
   user@host# set aex aggregated-ether-options link-speed link-speed
   ```
5. Specify the members to be included within the aggregated Ethernet bundle:

   ```
   [edit interfaces]
   user@host# set interface-name ether-options 802.3ad aex
   user@host# set interface-name ether-options 802.3ad aex
   ```
6. Specify an interface family for the aggregated Ethernet bundle:

   ```
   [edit interfaces]
   user@host# set aex unit 0 family inet address ip-address
   ```

For aggregated Ethernet interfaces on the device, you can configure the Link Aggregation Control Protocol (LACP). LACP bundles several physical interfaces to form one logical interface. You can configure aggregated Ethernet with or without LACP enabled.

When LACP is enabled, the local and remote sides of the aggregated Ethernet links exchange protocol data units (PDUs), containing information about the state of the link. You can configure Ethernet links to actively transmit PDUs, or you can configure the links to passively transmit them, sending out LACP PDUs only when they receive them from another link. One side of the link must be configured as active for the link to be up.

To configure LACP:

1. Enable one side of the aggregated Ethernet link as active:

   ```
   [edit interfaces]
   user@host# set aex aggregated-ether-options lacp active
   ```
2. Specify the interval at which the interfaces send LACP packets:

   ```
   [edit interfaces]
   user@host# set aex aggregated-ether-options lacp periodic interval
   ```

Enhanced Layer 2 CLI Configuration Statement and Command Changes

The enhanced Layer 2 Command Line Interface (CLI) feature is introduced in Junos OS Release 12.3R2. The enhanced Layer 2 CLI feature changes the CLI for some Layer 2 features on EX Series switches. This enhanced CLI will be used to configure Layer 2 features on future EX Series hardware platforms, and also to configure Layer 2 features on other Juniper Networks products.

The following tables provide a list of existing commands that were moved to new hierarchies or changed on EX Series switches as part of this CLI enhancement effort. The table is provided as a high-level reference only. For detailed information about these commands, use the links to the configuration statements provided in the table or see the technical documentation.

Table 119: Enhanced Layer 2 CLI Changes

Original Hierarchy	Changed Hierarchy	Change Description

ethernet-switching-options {
analyzer {
name {
...
}
}
}
	forwarding-options {
	analyzer {
	name {
	...
	}
	}
	}
		Statements moved to different hierarchy.

ethernet-switching-options {
authentication-whitelist {
...
}
}
	switch-options {
	...
	authentication-whitelist {
	...
	}
	}
		Hierarchy renamed.

ethernet-switching-options {
bpdu-block {
...
}
}
	protocols {
	layer2-control {
	bpdu-block {
	...
	}
	}
	}
		Statement moved to different hierarchy.

ethernet-switching-options {
dot1q-tunneling {
ether-type (0x8100 | 0x88a8 | 0x9100);
...
}
}
	interfaces *interface-name* {
	ether-options {
	ethernet-switch-profile {
	tag-protocol-id [*tpids*];
	}
	}
	}
	
	interfaces *interface-name* {
	aggregated-ether-options {
	ethernet-switch-profile {
	tag-protocol-id [*tpids*];
	}
	}
	}
		Statement replaced with new statement and moved to different hierarchy.

ethernet-switching-options {
interfaces *interface-name* {
no-mac-learning;
...
}
}
	switch-options {
	interfaces *interface-name* {
	no-mac-learning;
	...
	}
	}
		Hierarchy renamed.

Table 119: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

ethernet-switching-options {
mac-notification {
notification-interval *seconds*;
...
}
}
	—	Statements deleted.

ethernet-switching-options {
mac-table-aging-time *seconds*;
...
}
	protocols {
	l2-learning {
	global-mac-table-aging-time *seconds*;
	...
	}
	}
		Statement replaced with new statement and moved to different hierarchy.

ethernet-switching-options {
nonstop-bridging;
}
	protocols {
	layer2-control {
	nonstop-bridging {
	}
	}
	}
		Statement moved to different hierarchy.

ethernet-switching-options {
port-error-disable {
disable-timeout *timeout*;
...
}
}
	interfaces *interface-name* family
	ethernet-switching {
	recovery-timeout *seconds*;
	}
		Statement replaced with a new statement.

ethernet-switching-options {
redundant-trunk-group {
group *name* {
description;
interface *interface-name* {
primary;
}
preempt-cutover-timer *seconds*;
...
}
}
}
	switch-options {
	redundant-trunk-group {
	group *name* {
	description;
	interface *interface-name* {
	primary;
	}
	preempt-cutover-timer *seconds*;
	...
	}
	}
	}
		Hierarchy renamed.

Table 119: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

ethernet-switching-options {
secure-access-port {
interface (all | *interface-name*) {
(**dhcp-trusted** | no-dhcp-trusted);
static-ip *ip-address* {
mac *mac-address*;
vlan *vlan-name*;
}
}
vlan (all | *vlan-name*) {
(arp-inspection | no-arp-inspection);
dhcp-option82 {
disable;
circuit-id {
prefix *hostname*;
use-interface-description;
use-vlan-id;
}
remote-id {
prefix (*hostname* | mac | none);
use-interface-description;
use-string *string*;
}
vendor-id [*string*];
}
(**examine-dhcp** | no-examine-dhcp);
}
(**ip-source-guard** | no-ip-source-guard);
}
}
	vlans *vlan-name* forwarding-options{
	dhcp-security {
	arp-inspection;
	group ***group-name*** {
	interface*interface-name* {
	static-ip *ip-address* {
	mac *mac-address*;
	}
	}
	overrides {
	no-option-82;
	trusted;
	}
	}
	ip-source-guard;
	no-dhcp-snooping;
	option-82 {
	circuit-id {
	prefix {
	host-name;
	routing-instance-name;
	}
	use-interface-description (device |
	logical);
	use-vlan-id;
	}
	remote-id {
	host-name;
	use-interface-description (device |
	logical);
	use-string *string*;
	}
	vendor-id {
	use-string *string*;
	}
	}
	}
		Statements moved to different hierarchy.
		
		NOTE: The statement **examine-dhcp** does not exist in the changed hierarchy. Instead, DHCP snooping is enabled automatically when other DHCP security features are enabled on a VLAN. See *Configuring Port Security (CLI Procedure)* for additional information.

ethernet-switching-options {
secure-access-port {
dhcp-snooping-file {
location *local_pathname* | *remote_URL*;
timeout *seconds*;
write-interval *seconds*;
}
}
	system [
	processes [
	dhcp-service
	dhcp-snooping-file *local_pathname* |
	remote_URL;
	write-interval *interval*;
	}
	}
		Statement moved to different hierarchy.

ethernet-switching-options {
secure-access-port vlan (all | *vlan-name*{
mac-move-limit
}
	vlans *vlan-name* switch-options {
	mac-move-limit
	}
		Statement moved to different hierarchy.

Table 119: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

ethernet-switching-options {
static {
vlan *vlan-id* {
mac *mac-address* next-hop
interface-name;
...
}
}
}
	vlans {
	vlan-name {
	switch-options {
	interface *interface-name* {
	static-mac *mac-address*;
	...
	}
	}
	}
	}
		Statement replaced with new statement and moved to different hierarchy.

ethernet-switching-options {
storm-control {
(...)
}
}
	forwarding-options {
	storm-control-profiles *profile-name* {
	(...)
	}
	}
	
	interfaces *interface-name* unit *number* family
	ethernet-switching {
	storm-control *storm-control-profile*;
	}
		Storm control configuration is done in two steps. The first step is to create a storm control profile at the [edit forwarding-options] hierarchy, and the second step is to bind the profile to a logical interface at the [edit interfaces] hierarchy. See *Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches* for additional information.

ethernet-switching-options {
traceoptions {
file *filename* <files *number*> <no-stamp>
<replace> <size *size*> <world-readable
| no-world-readable>;
flag *flag* <disable>;
...
}
}
	—	Statements removed.

ethernet-switching-options {
unknown-unicast-forwarding {
(...)
}
}
	switch-options {
	unknown-unicast-forwarding {
	(...)
	}
	}
		Hierarchy renamed.

ethernet-switching-options {
voip {
interface (all | [*interface-name* |
access-ports]) {
forwarding-class (assured-forwarding
| best-effort | expedited-forwarding
| network-control);
vlan *vlan-name*;
...
}
}
}
	switch-options {
	voip {
	interface (all | [*interface-name* |
	access-ports]) {
	forwarding-class (assured-forwarding
	| best-effort | expedited-forwarding
	| network-control);
	vlan *vlan-name*;
	...
	}
	}
	}
		Hierarchy renamed.

Table 119: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

interfaces *interface-name* {
ether-options {
link-mode *mode*;
speed (auto-negotiation | *speed*)
}
}
	interfaces *interface-name* {
	link-mode *mode*;
	speed *speed*)
	}
		Statements moved to different hierarchy.

interfaces *interface-name* {
unit *logical-unit-number* {
family ethernet-switching {
native-vlan-id *vlan-id*
}
}
}
	interfaces *interface-name* {
	native-vlan-id *vlan-id*
	}
		Statement moved to different hierarchy.

interfaces *interface-name* {
unit *logical-unit-number* {
family ethernet-switching {
port-mode *mode*
}
}
}
	interfaces *interface-name* {
	unit *logical-unit-number* {
	family ethernet-switching {
	interface-mode *mode*
	}
	}
	}
		Statement replaced with a new statement.

interfaces vlan	**interfaces irb**	Statement replaced with a new statement.

Table 119: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

protocols {
igmp-snooping {
traceoptions {
file *filename* <files *number*>
<no-stamp> <replace>
<size *maximum-file-size*>
<world-readable |
no-world-readable>;
flag *flag* <*flag-modifier*> <disable>;
}
vlan (all | *vlan-identifier*) {
disable;
data-forwarding {
receiver {
install;
source-vlans *vlan-name*;
}
source {
groups *ip-address*;
}
}
immediate-leave;
interface (all | *interface-name*) {
multicast-router-interface;
static {
group *multicast-ip-address*;
}
}
proxy {
source-address *ip-address*;
}
robust-count *number*;
}
}
}
	protocols {
	igmp-snooping {
	vlan *vlan-name* {
	immediate-leave;
	interface *interface-name* {
	group-limit <1..65535>
	host-only-interface
	multicast-router-interface;
	immediate-leave;
	static {
	group *multicast-ip-address* {
	source < >
	}
	}
	}
	}
	l2-querier {
	source-address *ip-address*;
	}
	proxy {
	source-address *ip-address*;
	}
	query-interval *number*;
	query-last-member-interval *number*;
	query-response-interval *number*;
	robust-count *number*;
	traceoptions {
	file *filename* <files *number*>
	<no-stamp> <replace>
	<size *maximum-file-size*>
	<world-readable |
	no-world-readable>;
	flag *flag* <*flag-modifier*>;
	}
	}
	}
	}
		IGMP snooping is configured on a VLAN.

vlans {
vlan-name {
dot1q-tunneling {
customer-vlans (*id* | native | *range*);
layer2-protocol-tunneling all |
protocol-name {
drop-threshold *number*;
shutdown-threshold *number*;
...
}
}
}
}
	interface *interface-name* {
	encapsulation extended-vlan-bridge;
	flexible-vlan-tagging;
	native-vlan-id *number*;
	unit *logical-unit-number* {
	input-vlan-map *action*;
	output-vlan-map *action*;
	vlan-id *number*;
	vlan-id-list [*vlan-id vlan-id–vlan-id*];
	}
	}
		Statements replaced with new statements and moved to different hierarchy

Table 119: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

vlans {
  vlan-name {
    filter{
      input *filter-name*
      output *filter-name*;
      ...
    }
  }
}
	vlans {
	  vlan-name {
	    forwarding-options {
	      filter{
	        input *filter-name*
	        output *filter-name*;
	        ...
	      }
	    }
	  }
	}
		Statements moved to different hierarchy.

vlans {
  vlan-name {
    interface *interface-name* {
      egress;
      ingress;
      mapping (native (push | swap) | policy
        | *tag* (push | swap));
      pvlan-trunk;
      ...
    }
  }
}
	—	Statements removed. You can assign interfaces to a VLAN using the [edit interfaces *interface-name* unit *logical-unit-number* family ethernet-switching vlan members *vlan-name*] hierarchy.

vlans {
  vlan-name {
    isolation-id *id-number*;
    ...
  }
}
	—	Statement removed.

vlans {
  vlan-name {
    l3-interface **vlan**.*logical-interface-number*;
    ...
  }
}
	vlans {
	  vlan-name {
	    l3-interface **irb**.*logical-interface-number*;
	    ...
	  }
	}
		Syntax changed.

vlans {
  vlan-name {
    l3-interface-ingress-counting
      layer-3-interface-name;
    ...
  }
}
	—	Statement removed. Ingress traffic is automatically tracked.

Table 119: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

vlans {
vlan-name {
mac-limit *limit* **action** *action*;
...
}
}
	vlans {
	vlan-name {
	switch-options {
	interface-mac-limit *limit* {
	packet-action *action*;
	...
	}
	}
	}
	}
	
	vlans {
	vlan-name {
	switch-options {
	interface *interface-name* {
	interface-mac-limit *limit* {
	packet-action *action*;
	...
	}
	}
	}
	}
	}
		Statements moved to different hierarchies and renamed.

vlans {
vlan-name {
mac-table-aging-time *seconds*;
...
}
}
	protocols {
	l2-learning {
	global-mac-table-aging-time *seconds*;
	...
	}
	}
		Statement moved to different hierarchy and renamed.

vlans {
vlan-name {
no-local-switching;
...
}
}
	—	Statement removed.

vlans {
vlan-name {
no-mac-learning;
...
}
}
	vlans {
	vlan-name {
	switch-options {
	no-mac-learning *limit*
	...
	}
	}
	}
		Statement moved to different hierarchy.

vlans {
vlan-name {
primary-vlan *vlan-name*;
...
}
}
	—	Statement removed.

Table 119: Enhanced Layer 2 CLI Changes *(continued)*

Original Hierarchy	Changed Hierarchy	Change Description

vlans {
  vlan-name {
    vlan-prune;
    ...
  }
}
	—	Statement removed.

vlans {
  vlan-name {
    vlan-range *vlan-id-low-vlan-id-high*;
    ...
  }
}
	vlans {
	  vlan-name {
	    vlan-id-list [*vlan-id-numbers*];
	    ...
	  }
	}
		Statement replaced with new statement.

Bridging and VLANs

Layer 2 Learning and Forwarding for VLANs Overview

When you configure a VLAN, Layer 2 address learning is enabled by default. The VLAN learns unicast media access control (MAC) addresses to avoid flooding the packets to all the ports in the VLAN. Each VLAN creates a source MAC entry in its source and destination MAC tables for each source MAC address learned from packets received on the ports that belong to the VLAN.

NOTE: **Traffic is not flooded back onto the interface on which it was received. However, because this "split horizon" occurs at a late stage, the packet statistics displayed by commands such as show interfaces queue will include flood traffic.**

You can optionally disable MAC learning either for the entire device or for a specific VLAN or logical interface. You can also configure the following Layer 2 learning and forwarding properties:

- Static MAC entries for logical interfaces only
- Limit to the number of MAC addresses learned from a specific logical interface or from all the logical interfaces in a VLAN
- Size of the MAC address table for the VLAN
- MAC accounting for a VLAN

Related Documentation

- *Layer 2 Learning and Forwarding Overview*

Understanding Bridging and VLANs

Network switches use Layer 2 bridging protocols to discover the topology of their LAN and to forward traffic toward destinations on the LAN. This topic explains the following concepts regarding bridging and VLANs:

History of VLANs

Ethernet LANs were originally designed for small, simple networks that primarily carried text. However, over time, the type of data carried by LANs grew to include voice, graphics, and video. This more complex data, when combined with the ever-increasing speed of transmission, eventually became too much of a load for the original Ethernet LAN design. Multiple packet collisions were significantly slowing down the larger LANs.

The IEEE 802.1D-2004 standard helped evolve Ethernet LANs to cope with the higher data and transmission requirements by defining the concept of *transparent bridging* (generally called simply *bridging*). Bridging divides a single physical LAN (now called a single *broadcast domain*) into two or more virtual LANs, or VLANs. Each *VLAN* is a collection of some of the LAN nodes grouped together to form individual broadcast domains.

When VLANs are grouped logically by function or organization, a significant percentage of data traffic stays within the VLAN. This relieves the load on the LAN because all traffic no longer has to be forwarded to all nodes on the LAN. A VLAN first transmits packets within the VLAN, thereby reducing the number of packets transmitted on the entire LAN. Because packets whose origin and destination are in the same VLAN are forwarded only within the local VLAN, packets that are not destined for the local VLAN are the only ones forwarded to other broadcast domains. This way, bridging and VLANs limit the amount of traffic flowing across the entire LAN by reducing the possible number of collisions and packet retransmissions within VLANs and on the LAN as a whole.

How Bridging of VLAN Traffic Works

Because the objective of the IEEE 802.1D-2004 standard was to reduce traffic and therefore reduce potential transmission collisions for Ethernet, a system was implemented to reuse information. Instead of having a switch go through a location process every time a frame is sent to a node, the transparent bridging protocol allows a switch to record the location of known nodes. When packets are sent to nodes, those destination node locations are stored in address-lookup tables called *Ethernet switching tables*. Before sending a packet, a switch using bridging first consults the switching tables to see if that node has already been located. If the location of a node is known, the frame is sent directly to that node.

Transparent bridging uses five mechanisms to create and maintain Ethernet switching tables on the switch:

- Learning
- Forwarding
- Flooding
- Filtering
- Aging

The key bridging mechanism used by LANs and VLANs is *learning*. When a switch is first connected to an Ethernet LAN or VLAN, it has no information about other nodes on the network. As packets are sent, the switch learns the embedded MAC addresses of the sending nodes and stores them in the Ethernet switching table, along with two other pieces of information—the interface (or port) on which the traffic was received on the destination node and the time the address was learned.

Learning allows switches to then do *forwarding*. By consulting the Ethernet switching table to see whether the table already contains the frame's destination MAC address, switches save time and resources when forwarding packets to the known MAC addresses. If the Ethernet switching table does not contain an entry for an address, the switch uses flooding to learn that address.

Flooding finds a particular destination MAC address without using the Ethernet switching table. When traffic originates on the switch and the Ethernet switching table does not yet contain the destination MAC address, the switch first floods the traffic to all other interfaces within the VLAN. When the destination node receives the flooded traffic, it can send an acknowledgment packet back to the switch, allowing it to learn the MAC address of the node and add the address to its Ethernet switching table.

Filtering, the fourth bridging mechanism, is how broadcast traffic is limited to the local VLAN whenever possible. As the number of entries in the Ethernet switching table grows, the switch pieces together an increasingly complete picture of the VLAN and the larger LAN—it learns which nodes are in the local VLAN and which are on other network segments. The switch uses this information to filter traffic. Specifically, for traffic whose source and destination MAC addresses are in the local VLAN, filtering prevents the switch from forwarding this traffic to other network segments.

To keep entries in the Ethernet switching table current, the switch uses a fifth bridging mechanism, *aging*. Aging is the reason that the Ethernet switching table entries include timestamps. Each time the switch detects traffic from a MAC address, it updates the timestamp. A timer on the switch periodically checks the timestamp, and if it is older than a user-configured value, the switch removes the node's MAC address from the Ethernet switching table. This aging process eventually flushes unavailable network nodes out of the Ethernet switching table.

Packets Are Either Tagged or Untagged

When an Ethernet LAN is divided into VLANs, each VLAN is identified by a unique 802.1Q ID. The VLAN IDs 1 through 4094 can be assigned to VLANs, while VLAN IDs 0 and 4095 are reserved by Junos OS and cannot be assigned.

Ethernet packets include a tag protocol identifier (TPID) EtherType field, which identifies the protocol being transported. When a device within a VLAN generates a packet, this field includes a value of 0x8100, which indicates that the packet is a VLAN-tagged packet. The packet also has a VLAN ID field that includes the unique 802.1Q ID, which identifies the VLAN to which the packet belongs.

In addition to the TPID EtherType value of 0x8100, switches that run Junos OS that does not support the Enhanced Layer 2 Software (ELS) configuration style also support values of 0x88a8 (Provider Bridging and Shortest Path Bridging) and 0x9100 (Q-inQ).

For a simple network that has only a single VLAN, all packets include a default 802.1Q tag, which is the only VLAN membership that does not mark the packet as tagged. These packets are untagged packets.

Switch Interface Modes—Access, Trunk, or Tagged Access

Ports, or interfaces, on a switch operate in one of three modes:

- Access mode
- Trunk mode
- Tagged-access mode

Access Mode

An interface in access mode connects a switch to a single network device, such as a desktop computer, an IP telephone, a printer, a file server, or a security camera. Access interfaces accept only untagged packets.

By default, when you boot a switch that runs Junos OS that does not support ELS and use the factory default configuration, or when you boot such a switch and do not explicitly configure a port mode, all interfaces on the switch are in access mode and accept only untagged packets from the VLAN named **default**. You can optionally configure another VLAN and use that VLAN instead of **default**.

On a switch that runs Junos OS that supports ELS, the VLAN named **default** is not supported. Therefore, on such switches, you must explicitly configure at least one VLAN, even if your network is simple and you want only one broadcast domain to exist. After you assign an interface to a VLAN, the interface functions in access mode.

For switches that run either type of software, you can also configure a trunk port or interface to accept untagged packets from a user-configured VLAN. For details about this concept (native VLAN), see "Trunk Mode and Native VLAN" on page 1405.

Trunk Mode

Trunk mode interfaces are generally used to connect switches to one another. Traffic sent between switches can then consist of packets from multiple VLANs, with those packets multiplexed so that they can be sent over the same physical connection. Trunk interfaces usually accept only tagged packets and use the VLAN ID tag to determine both the packets' VLAN origin and VLAN destination.

On a switch that runs software that does not support ELS, an untagged packet is not recognized on a trunk port unless you configure additional settings on that port.

On a switch that runs Junos OS that supports ELS, a trunk port recognizes untagged control packets for protocols such as the Link Aggregation Control Protocol (LACP) and the Link Layer Discovery Protocol (LLDP). However, the trunk port does not recognize untagged data packets unless you configure additional settings on that port.

In the rare case where you want untagged packets to be recognized by a trunk port on switches that run either type of software, you must configure the single VLAN on a trunk port as a *native VLAN*. For more information about native VLANs, see "Trunk Mode and Native VLAN" on page 1405.

Trunk Mode and Native VLAN

On a switch that runs Junos OS that does not support ELS, a trunk port does not recognize packets that do not include VLAN tags, which are also known an untagged packets. On a switch that runs Junos OS that supports ELS, a trunk port recognizes untagged control packets, but it does not recognize untagged data packets. With native VLAN configured, untagged packets that a trunk port normally does not recognize are sent over the trunk interface. In a situation where packets pass from a device, such as an IP phone or printer, to a switch in access mode, and you want those packets sent from the switch over a trunk port, use native VLAN mode. Create a native VLAN by configuring a VLAN ID for it, and specify that the trunk port is a member of the native VLAN.

The switch's trunk port will then treat those packets differently than the other tagged packets. For example, if a trunk port has three VLANs, 10, 20, and 30, assigned to it with VLAN 10 being the native VLAN, packets on VLAN 10 that leave the trunk port on the other end have no 802.1Q header (tag).

There is another native VLAN option for switches that do not support ELS. You can have the switch add and remove tags for untagged packets. To do this, you first configure the single VLAN as a native VLAN on a port attached to a device on the edge. Then, assign a VLAN ID tag to the single native VLAN on the port connected to a device. Last, add the VLAN ID to the trunk port. Now, when the switch receives the untagged packet, it adds the ID you specified and sends and receives the tagged packets on the trunk port configured to accept that VLAN.

Tagged-Access Mode

Only switches that run Junos OS that does not use the ELS configuration style support tagged-access mode. Tagged-access mode accommodates cloud computing, specifically scenarios including virtual machines or virtual computers. Because several virtual computers can be included on one physical server, the packets generated by one server can contain an aggregation of VLAN packets from different virtual machines on that server. To accommodate this situation, tagged-access mode reflects packets back to the physical server on the same downstream port when the destination address of the packet was learned on that downstream port. Packets are also reflected back to the physical server on the downstream port when the destination has not yet been learned. Therefore, the third interface mode, tagged access, has some characteristics of access mode and some characteristics of trunk mode:

- Like access mode, tagged-access mode connects the switch to an access layer device. Unlike access mode, tagged-access mode is capable of accepting VLAN tagged packets.
- Like trunk mode, tagged-access mode accepts VLAN tagged packets from multiple VLANs. Unlike trunk port interfaces, which are connected at the core/distribution layer, tagged-access port interfaces connect devices at the access layer.

  Like trunk mode, tagged-access mode also supports native VLAN.

NOTE: Control packets are never reflected back on the downstream port.

Additional Advantages of Using VLANs

In addition to reducing traffic and thereby speeding up the network, VLANs have the following advantages:

- VLANs provide segmentation services traditionally provided by routers in LAN configurations, thereby reducing hardware equipment costs.
- Packets coupled to a VLAN can be reliably identified and sorted into different domains. You can contain broadcasts within parts of the network, thereby freeing up network resources. For example, when a DHCP server is plugged into a switch and starts broadcasting its presence, you can prevent some hosts from accessing it by using VLANs to split up the network.
- For security issues, VLANs provide granular control of the network because each VLAN is identified by a single IP subnetwork. All packets passing in and out of a VLAN are consistently tagged with the VLAN ID of that VLAN, thereby providing easy identification, because a VLAN ID on a packet cannot be altered. (For a switch that runs Junos OS that does not support ELS, we recommend that you avoid using 1 as a VLAN ID, because that ID is a default value.)
- VLANs react quickly to host relocation—this is also due to the persistent VLAN tag on packets.
- On an Ethernet LAN, all network nodes must be physically connected to the same network. In VLANs, the physical location of nodes is not important—you can group

network devices in any way that makes sense for your organization, such as by department or business function, types of network nodes, or physical location.

Maximum VLANs and VLAN Members Per Switch

The number of VLANs supported per switch varies for each switch. Use the configuration-mode command **set vlans *vlan-name* vlan-id ?** to determine the maximum number of VLANs allowed on a switch. You cannot exceed this VLAN limit because you have to assign a specific ID number when you create a VLAN—you could overwrite one of the numbers, but you cannot exceed the limit.

You can, however, exceed the recommended VLAN member maximum for a switch.

On a switch that runs Junos OS that does not support the ELS configuration style, the maximum number of VLAN members allowed on the switch is eight times the maximum number of VLANs that the switch supports (vmember limit = vlan max * 8). If the configuration of the switch exceeds the recommended VLAN member maximum, a warning message appears when you commit the configuration. If you commit the configuration despite the warning, the commit succeeds, but there is a risk of the Ethernet switching process (eswd) failing as a result of memory allocation failure.

On a switch that runs Junos OS that supports ELS, the maximum number of VLAN members allowed on the switch is 24 times the maximum number of VLANs that the switch supports (vmember limit = vlan max * 24). If the configuration of the switch exceeds the recommended VLAN member maximum, a warning message appears in the system log (syslog).

A Default VLAN Is Configured on Most Switches

Some switches that run Junos OS that do not support the ELS configuration style are preconfigured with a VLAN named **default** that does not tag packets and operates only with untagged packets. On these switches, each interface already belongs to the VLAN named **default** and all traffic uses this VLAN until you configure more VLANs and assign traffic to those VLANs.

NOTE: When a Juniper Networks QFX3500 or QFX3600 switch is interconnected with other switches in a Virtual Chassis configuration, each individual switch that is included as a member of the configuration is identified with a member ID. The member ID functions as an FPC slot number. When you are configuring interfaces for a Virtual Chassis configuration, you specify the appropriate member ID (0 through 9) as the slot element of the interface name. The default factory settings for a Virtual Chassis configuration include FPC 0 as a member of the default VLAN because FPC 0 is configured as part of the ethernet-switching family. In order to include FPC 1 through FPC 9 in the default VLAN, add the ethernet-switching family to the configurations for those interfaces.

Assigning Traffic to VLANs

You can assign traffic on any switch to a particular VLAN by referencing either the interface port of the traffic or the MAC addresses of devices sending traffic.

Assign VLAN Traffic According to the Interface Port Source

This method is most commonly used to assign traffic to VLANs. In this case, you specify that all traffic received on a particular switch interface is assigned to a specific VLAN. You configure this VLAN assignment when you configure the switch, by using either the VLAN number (called a VLAN ID) or by using the VLAN name, which the switch then translates into a numeric VLAN ID. This method is referred to simply as creating a VLAN because it is the most commonly used method.

Assign VLAN Traffic According to the Source MAC Address

In this case, all traffic received from a specific MAC address is forwarded to a specific egress interface (next hop) on the switch. MAC-based VLANs are either static (named MAC addresses configured one at a time) or dynamic (configured using a RADIUS server).

To configure a static MAC-based VLAN on a switch that supports ELS, see "Adding a Static MAC Address Entry to the Ethernet Switching Table (CLI Procedure)" on page 1527.To configure a static MAC-based VLAN on a switch that does not support ELS, see "Adding a Static MAC Address Entry to the Ethernet Switching Table (CLI Procedure)" on page 1527.

Forwarding VLAN Traffic

To pass traffic within a VLAN, the switch uses Layer 2 forwarding protocols, including IEEE 802.1Q spanning-tree protocols.

To pass traffic between two VLANs, the switch uses standard Layer 3 routing protocols, such as static routing, OSPF, and RIP. The same interfaces that support Layer 2 bridging protocols also support Layer 3 routing protocols, providing multilayer switching.

To pass traffic from a single device on an access port to a switch and then pass those packets on a trunk port, use the native mode configuration previously discussed under "Trunk Mode" on page 1405.

VLANs Communicate with Integrated Routing and Bridging Interfaces or Routed VLAN Interfaces

Traditionally, switches sent traffic to hosts that were part of the same broadcast domain (VLAN) but routers were needed to route traffic from one broadcast domain to another. Also, only routers performed other Layer 3 functions such as traffic engineering.

Switches that run Junos OS that supports the ELS configuration style perform inter-VLAN routing functions using an integrated routing and bridging (IRB) interface named irb, while switches that run Junos OS that does not support ELS perform these functions using a routed VLAN interface (RVI) named vlan. These interfaces detect both MAC addresses and IP addresses and route data to Layer 3 interfaces, thereby frequently eliminating the need to have both a switch and a router.

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Example: Setting Up Bridging with Multiple VLANs on page 1451
- Understanding FCoE on page 4799
- Interfaces Overview on page 1839

Understanding Routed VLAN Interfaces

To segment traffic on a LAN into separate broadcast domains, you create separate virtual LANs (VLANs). VLANs limit the amount of traffic flowing across the entire LAN, reducing the possible number of collisions and packet retransmissions within the LAN. For example, you might want to create a VLAN that includes the employees in a department and the resources that they use often, such as printers, servers, and so on.

Of course, you also want to allow these employees to communicate with people and resources in other VLANs. To forward packets between VLANs, you normally you need a router that connects the VLANs. However, you can accomplish this forwarding on a switch without using a router by configuring a routed VLAN interface (RVI). Using this approach reduces complexity and avoids the costs associated with purchasing, installing, managing, powering, and cooling another device.

An RVI is a special type of Layer 3 virtual interface named **vlan**. Like normal Layer 3 interfaces, the **vlan** interface needs a logical unit number with an IP address. In fact, to be useful an RVI needs at least two logical units and two IP addresses—you must create units with addresses in each of the subnets associated with the VLANs between which you want traffic to be routed. That is, if you have two VLANs (for example, VLAN **red** and VLAN **blue**) with corresponding subnets, your RVI must have a logical unit with an address in the subnet for **red** and a logical unit with an address in the subnet for **blue**. The switch automatically creates direct routes to these subnets and uses these routes to forward traffic between VLANs.

NOTE: If you are using a version of Junos OS that supports Enhanced Layer 2 Software (ELS), you can also create a Layer 3 virtual interface named irb instead of vlan—that is, both statements are supported by ELS

Table 120 on page 1409 shows values you might use when configuring an RVI:

Table 120: Sample RVI Values

Property	Settings
VLAN names and tags (IDs)	**blue**, ID **100** **red**, ID **200**
Subnets associated with VLANs	**blue**: **192.0.2.0/25** (addresses **192.0.2.1** through **192.0.2.126**) **red**: **192.0.2.128/25** (addresses **192.0.2.129** through **192.0.2.254**)
RVI name	interface **vlan**

Table 120: Sample RVI Values *(continued)*

Property	Settings
RVI units and addresses	logical unit 100: **192.0.2.1/25** logical unit 200: **192.0.2.129/25**

For the sake of consistency and to avoid confusion, Table 120 on page 1409 shows RVI logical unit numbers that match the IDs of the corresponding VLANs. However, you do not have to assign logical unit numbers that match the VLAN IDs—you can use any values for the units. To bind the logical units of the RVI to the appropriate VLANs, you use the **l3-interface** statement.

Because RVIs operate at Layer 3, you can use Layer 3 services such as firewall filters or CoS rewriting with them. RVIs are similar to integrated routing and bridging (IRB) interfaces supported on Juniper routers and switch virtual interfaces (SVIs) and bridge-group virtual interfaces (BVIs) supported on other vendors' devices.

Table 121 on page 1410 shows the number of RVIs that each QFX platform supports.

Table 121: Number of Supported RVIs by Platform

Platform	Number of Supported RVIs
QFX3500	1200
QFX3000-G	2000
QFX3000-M	2000

Related Documentation

- Example: Configuring Routing Between VLANs on One Switch on page 1428
- **irb (Interfaces) on page 2067**

Understanding MAC Learning

MAC learning is the process of obtaining the MAC addresses of all the nodes on a network.

When a node is first connected to an Ethernet LAN or VLAN, it has no information about the other nodes on the network. As data is sent through the network, data packets include a data frame listing their source and destination MAC addresses. The data frame is forwarded to a target port, which is connected to the second device. The MAC address is learned locally at the target port, which facilitates communications for frames that later enter the target port and contain addresses previously learned from a received frame.

MAC learning can also be enabled on a per-VLAN basis. See*Example: Disabling MAC Learning in a VLAN* for further information.

By default, MAC learning is enabled on the QFX Series.

Related Documentation

- Introduction to the Media Access Control (MAC) Layer 2 Sublayer on page 1411
- Overview of Layer 2 Networking on page 1412

Layer 2 Networking

Introduction to the Media Access Control (MAC) Layer 2 Sublayer

This topic provides an introduction to the MAC sublayer of the data link layer (Layer 2).

In Layer 2 of a network, the Media Access Control (MAC) sublayer provides addressing and channel access control mechanisms that enable several terminals or network nodes to communicate in a network.

The MAC sublayer acts as an interface between the logical link control (LLC) Ethernet sublayer and Layer 1 (the physical layer). The MAC sublayer emulates a full-duplex logical communication channel in a multipoint network. This channel may provide unicast, multicast, or broadcast communication service. The MAC sublayer uses MAC protocols to prevent collisions.

In Layer 2, multiple devices on the same physical link can uniquely identify one another at the data link layer, by using the MAC addresses that are assigned to all ports on a switch. A MAC algorithm accepts as input a secret key and an arbitrary-length message to be authenticated, and outputs a MAC address.

A MAC address is a 12-digit hexadecimal number (48 bits in long). MAC addresses are usually written in one of these formats:

- MM:MM:MM:SS:SS:SS
- MM-MM-MM-SS-SS-SS

The first half of a MAC address contains the ID number of the adapter manufacturer. These IDs are regulated by an Internet standards body. The second half of a MAC address represents the serial number assigned to the adapter by the manufacturer.

Contrast MAC addressing, which works at Layer 2, with IP addressing, which runs at Layer 3 (networking and routing). One way to remember the difference is that the MAC addresses apply to a physical or virtual node, whereas IP addresses apply to the software implementation of that node. MAC addresses are typically fixed on a per-node basis, whereas IP addresses change when the node moves from one part of the network to another.

IP networks maintain a mapping between the IP and MAC addresses of a node using the Address Resolution Protocol (ARP) table. DHCP also typically uses MAC addresses when assigning IP addresses to nodes.

Related Documentation

- Overview of Layer 2 Networking on page 1412
- Understanding MAC Learning on page 1410

Overview of Layer 2 Networking

Layer 2, also known as the Data Link Layer, is the second level in the seven-layer OSI reference model for network protocol design. Layer 2 is equivalent to the link layer (the lowest layer) in the TCP/IP network model. Layer2 is the network layer used to transfer data between adjacent network nodes in a wide area network or between nodes on the same local area network.

A *frame* is a protocol data unit, the smallest unit of bits on a Layer 2 network. Frames are transmitted to and received from devices on the same local area network (LAN). Unilke bits, frames have a defined structure and can be used for error detection, control plane activities and so forth. Not all frames carry user data. The network uses some frames to control the data link itself..

At Layer 2, *unicast* refers to sending frames from one node to a single other node, whereas *multicast* denotes sending traffic from one node to multiple nodes, and *broadcasting* refers to the transmission of frames to all nodes in a network. A *broadcast domain* is a logical division of a network in which all nodes of that network can be reached at Layer 2 by a broadcast.

Segments of a LAN can be linked at the frame level using *bridges*. Bridging creates separate broadcast domains on the LAN, creating VLANs, which are independent logical networks that group together related devices into separate network segments. The grouping of devices on a VLAN is independent of where the devices are physically located in the LAN. Without bridging and VLANs, all devices on the Ethernet LAN are in a single broadcast domain, and all the devices detect all the packets on the LAN.

Forwarding is the relaying of packets from one network segment to another by nodes in the network. On a VLAN, a frame whose origin and destination are in the same VLAN are forwarded only within the local VLAN. A network segment is a portion of a computer network wherein every device communicates using the same physical layer.

Layer 2 contains two sublayers:

- Logical link control (LLC) sublayer, which is responsible for managing communications links and handling frame traffic.
- Media access control (MAC) sublayer, which governs protocol access to the physical network medium. By using the MAC addresses that are assigned to all ports on a switch, multiple devices on the same physical link can uniquely identify one another.

The ports, or interfaces, on a switch operate in either access mode, tagged-access, or trunk mode:

- *Access mode* ports connect to a network device such as a desktop computer, an IP telephone, a printer, a file server, or a security camera. The port itself belongs to a single VLAN. The frames transmitted over an access interface are normal Ethernet frames. By default, all ports on a switch are in access mode.
- *Tagged-Access mode* ports connect to a network device such as a desktop computer, an IP telephone, a printer, a file server, or a security camera. The port itself belongs to a single VLAN. The frames transmitted over an access interface are normal Ethernet frames. By default, all ports on a switch are in access mode. Tagged-access mode accommodates cloud computing, specifically scenarios including virtual machines or virtual computers. Because several virtual computers can be included on one physical server, the packets generated by one server can contain an aggregation of VLAN packets from different virtual machines on that server. To accommodate this situation, tagged-access mode reflects packets back to the physical server on the same downstream port when the destination address of the packet was learned on that downstream port. Packets are also reflected back to the physical server on the downstream port when the destination has not yet been learned. Therefore, the third interface mode, tagged access, has some characteristics of access mode and some characteristics of trunk mode:
- *Trunk mode* ports handle traffic for multiple VLANs, multiplexing the traffic for all those VLANs over the same physical connection. Trunk interfaces are generally used to interconnect switches to other devices or switches.

  With native VLAN configured, frames that do not carry VLAN tags are sent over the trunk interface. If you have a situation where packets pass from a device to a switch in access mode, and you want to then send those packets from the switch over a trunk port, use native VLAN mode. Configure the single VLAN on the switch's port (which is in access mode) as a native VLAN. The switch's trunk port will then treat those frames differently than the other tagged packets. For example, if a trunk port has three VLANs, 10, 20, and 30, assigned to it with VLAN 10 being the native VLAN, frames on VLAN 10 that leave the trunk port on the other end have no 802.1Q header (tag). There is another native VLAN option. You can have the switch add and remove tags for untagged packets. To do this, you first configure the single VLAN as a native VLAN on a port attached to a device on the edge. Then, assign a VLAN ID tag to the single native VLAN on the port connected to a device. Last, add the VLAN ID to the trunk port. Now, when the switch receives the untagged packet, it adds the ID you specified and sends and receives the tagged packets on the trunk port configured to accept that VLAN.

Including the sublayers, Layer 2 on the QFX Series supports the following functionality:

- Unicast, multicast, and broadcast traffic.
- Bridging.
- VLAN 802.1Q—Also known as *VLAN tagging*, this protocol allows multiple bridged networks to transparently share the same physical network link by adding VLAN tags to an Ethernet frame.

- Extension of Layer 2 VLANs across multiple switches using Spanning Tree Protocol (STP) prevents looping across the network.
- *MAC learning*, including per-VLAN MAC learning and Layer 2 learning suppression—This process obtains the MAC addresses of all the nodes on a network
- Link aggregation—This process groups of Ethernet interfaces at the physical layer to form a single link layer interface, also known as a *link aggregation group (LAG)* or LAG bundle
- Storm control on the physical port for unicast, multicast, and broadcast
- STP support, including 802.1d, RSTP, MSTP, and Root Guard

Related Documentation

- Understanding Bridging and VLANs on page 1402
- *Understanding Bridging*

Understanding Layer 2 Broadcasting

In a Layer 2 network, *broadcasting* refers to sending traffic to all nodes on a network.

Layer 2 broadcast traffic stays within a local area network (LAN) boundary; known as the *broadcast domain*. Layer 2 broadcast traffic is sent to the broadcast domain using a MAC address of FF:FF:FF:FF:FF:FF. Every device in the broadcast domain recognizes this MAC address and passes the broadcast traffic on to other devices in the broadcast domain, if applicable. Broadcasting can be compared to unicasting (sending traffic to a single node) or multicasting (delivering traffic to a group of nodes simultaneously).

Layer 3 broadcast traffic, however, is sent to all devices in a network using a broadcast network address. For example, if your network address is 192.0.0.0, the broadcast network address is 192.255.255.255. In this case, only devices that belong to the 192.0.0.0 network receive the Layer 3 broadcast traffic. Devices that do not belong to this network drop the traffic.

Broadcasting is used in the following situations:

- Address Resolution Protocol (ARP) uses broadcasting to map MAC addresses to IP addresses. ARP dynamically binds the IP address (the logical address) to the correct MAC address. Before IP unicast packets can be sent, ARP discovers the MAC address used by the Ethernet interface where the IP address is configured.
- Dynamic Host Configuration Protocol (DHCP) uses broadcasting to dynamically assign IP addresses to hosts on a network segment or subnet.
- Routing protocols use broadcasting to advertise routes.

Excessive broadcast traffic can sometimes create a broadcast storm. A broadcast storm occurs when messages are broadcast on a network and each message prompts a receiving node to respond by broadcasting its own messages on the network. This, in turn, prompts further responses that create a snowball effect. The LAN is suddenly flooded with packets, creating unnecessary traffic that leads to poor network performance or even a complete loss of network service.

Related Documentation

- Overview of Layer 2 Networking on page 1412
- Understanding Storm Control on page 4471
- *Understanding Bridging*
- Understanding Bridging and VLANs on page 1402

Understanding Unicast

Unicasting is the act of sending data from one node of the network to another. In contrast, multicast transmissions send traffic from one data node to multiple other data nodes.

Unknown unicast traffic consists of unicast frames with unknown destination MAC addresses. By default, the switch floods these unicast frames that are traveling in a VLAN to all interfaces that are members of the VLAN. Forwarding this type of traffic to interfaces on the switch can trigger a security issue. The LAN is suddenly flooded with packets, creating unnecessary traffic that leads to poor network performance or even a complete loss of network service. This is known as a traffic storm.

To prevent a storm, you can disable the flooding of unknown unicast packets to all interfaces by configuring one VLAN or all VLANs to forward any unknown unicast traffic to a specific trunk interface. (This channels the unknown unicast traffic to a single interface.)

Related Documentation

- Overview of Layer 2 Networking on page 1412
- Understanding Bridging and VLANs on page 1402

Understanding the Unified Forwarding Table

On the QFX5100 switch, you can control the allocation of forwarding table memory available to store the following:

- MAC addresses
- Layer 3 host entries
- Longest prefix match (LPM) table entries

This feature gives you the flexibility to configure your QFX5100 to match the needs of your particular network environment.

You configure the mix that best meets your needs by choosing the appropriate profile. Table 122 on page 1416 lists the profiles you can choose and the associated maximum values for each type of table entry.

Table 122: Unified Forwarding Table Profiles

Profile Name	MAC Table	Host Table (unicast and multicast addresses)						LPM Table	
	MAC Addresses	IPv4 unicast	IPv6 unicast	IPv4 (*, G)	IPv4 (S, G)	IPv6 (*, G)	IPv6 (S, G)	IPv4 Entries	IPv6 Entries (prefix <= 64)
l2-profile-one	288K	16K	8K	8K	8K	4K	4K	16K	8K
l2-profile-two	224K	80K	40K	40K	40K	20K	20K	16K	8K
l2-profile-three (default)	160K	144K	72K	72K	72K	36K	36K	16K	8K
l3-profile	96K	208K	104K	104K	104K	52K	52K	16K	8K
lpm-profile (Do not use for IPv6)	32K	16K	8K	8K	8K	4K	4K	128K	64K

Note that if the host or LPM table stores the maximum number of entries for any given type, the entire shared table is full and is unable to accommodate *any* entries of any other type. As you can see, different entry types occupy different amounts of memory. For example, an IPv6 unicast address occupies twice as much memory as an IPv4 unicast address, and an IPv6 multicast address occupies four times as much memory as an IPv4 unicast address. Table 123 on page 1416 lists various valid combinations that the host table can store if you use the **l2-profile-one** profile. Each row in the table represents a case in which the host table is full and cannot accommodate any more entries.

Table 123: Example Host Table Combinations Using l2-profile-one

IPv4 unicast	IPv6 unicast	IPv4 multicast (*, G)	IPv4 multicast (S, G)	IPv6 multicast (*, G)	IPv6 multicast (S, G)
16K	0	0	0	0	0
12K	2K	0	0	0	0
12K	0	2	2	0	0
8K	4K	0	0	0	0
4K	2K	2	2	0	0
0	4K	0	0	1K	1K

The LPM table is also shared and the same principles apply. Table 124 on page 1417 provides examples of valid combinations that the LPM table can store, also using the **l2-profile-one** profile. Once again, each row in the table represents a case in which the table is full and cannot accommodate any more entries.

Table 124: Example LPM Table Combinations Using l2-profile-one

IPv4 entries	IPv6 Entries (prefix <= 64)
16K	0
0	8K
8K	4K
4K	6K

NOTE: If you want to use more than 16 IPv6 addresses with prefix lengths greater than 64, you must follow the instructions at "Configuring the Unified Forwarding Table" on page 1548. As that topic explains, if you increase the number of addresses with prefix lengths greater than 64, you reduce the amount of LPM-table memory available to store IPv6 addresses with prefixes less than or equal to 64.

Related Documentation

- Configuring the Unified Forwarding Table on page 1548

Proxy ARP

Understanding Proxy ARP

You can configure proxy Address Resolution Protocol (ARP) to enable the switch to respond to ARP queries for network addresses by offering its own Ethernet media access control (MAC) address. With proxy ARP enabled, the switch captures and routes traffic to the intended destination.

Proxy ARP is useful in situations where hosts are on different physical networks and you do not want to use subnet masking. Because ARP broadcasts are not propagated between hosts on different physical networks, hosts will not receive a response to their ARP request if the destination is on a different subnet. Enabling the switch to act as an ARP proxy allows the hosts to transparently communicate with each other through the switch. Proxy ARP can help hosts on a subnet reach remote subnets without your having to configure routing or a default gateway.

What Is ARP?

Ethernet LANs use ARP to map Ethernet MAC addresses to IP addresses. Each device maintains a cache containing a mapping of MAC addresses to IP addresses. The switch maintains this mapping in a cache that it consults when forwarding packets to network devices. If the ARP cache does not contain an entry for the destination device, the host (the DHCP client) broadcasts an ARP request for that device's address and stores the response in the cache.

Proxy ARP Overview

When proxy ARP is enabled, if the switch receives an ARP request for which it has a route to the target (destination) IP address, the switch responds by sending a proxy ARP reply packet containing its own MAC address. The host that sent the ARP request then sends its packets to the switch, which forwards them to the intended host.

NOTE: **For security reasons, the source address in an ARP request must be on the same subnet as the interface on which the ARP request is received.**

You can configure proxy ARP for each interface. You can also configure proxy ARP for a VLAN by using a routed VLAN interface (RVI).

QFX Series devices support two modes of proxy ARP, restricted and unrestricted. Both modes require that the switch have an active route to the destination address of the ARP request.

- Restricted—The switch responds to ARP requests in which the physical networks of the source and target are different and does not respond if the source and target IP addresses are on the same subnet. In this mode, hosts on the same subnet communicate without proxy ARP. We recommend that you use this mode on the switch.
- Unrestricted—The switch responds to all ARP requests for which it has a route to the destination. This is the default mode (because it is the default mode in Juniper Networks Junos operating system (Junos OS) configurations other than those on the switch). We recommend using restricted mode on the switch.

Best Practices for Proxy ARP

We recommend these best practices for configuring proxy ARP on the switches:

- Set proxy ARP to restricted mode.
- Use restricted mode when configuring proxy ARP on RVIs.
- If you set proxy ARP to unrestricted, disable gratuitous ARP requests on each interface enabled for proxy ARP.

Related Documentation

- Configuring Proxy ARP on page 1551
- **proxy-arp on page 1577**

Spanning Trees

Overview of Spanning-Tree Protocols

QFX Series switches provide Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), Multiple Spanning Tree Protocol (MSTP), and VLAN Spanning Tree Protocol (VSTP). The default spanning-tree protocol on the QFX Series is RSTP. RSTP provides faster convergence times than STP. However, some legacy networks require the slower convergence times of basic STP.

The STP support provided for the QFX Series includes:

- IEEE 802.1d
- 802.1w RSTP
- 802.1s MSTP

If your network includes IEEE 802.1D 1998 bridges, you can remove RSTP and explicitly configure STP. See "Configuring STP" on page 1553. When you explicitly configure STP, the QFX Series products use the IEEE 802.1D 2004 specification, force version 0. This configuration runs a version of RSTP that is compatible with the classic, basic STP. If you use virtual LANs (VLANs), you should enable VSTP and use it on your network. See "Understanding VSTP" on page 1422.

You can use the same operational commands (**show spanning-tree bridge** and **show spanning-tree interface**) to check the status of your spanning-tree configuration, regardless of which spanning-tree protocol has been configured.

STP uses bridge protocol data unit (BPDU) packets to exchange information with other switches. BPDUs send hello packets out at regular intervals to exchange information across bridges and detect loops in a network topology. There are two types of BPDUs:

- Configuration BPDUs—These BPDUs contain configuration information about the transmitting switch and its ports, including switch and port MAC addresses, switch priority, port priority, and port cost.
- Topology change notification (TCN) BPDUs—When a bridge needs to signal a topology change, it starts to send TCNs on its root port. The designated bridge receives the TCN, acknowledges it, and generates another one for its own root port. The process continues until the TCN reaches the root bridge.

STP uses the information provided by the BPDUs to elect a root bridge, identify root ports for each switch, identify designated ports for each physical LAN segment, and prune specific redundant links to create a loop-free tree topology. All leaf devices calculate the best path to the root device and place their ports in blocking or forwarding states based on the best path to the root. The resulting tree topology provides a single active Layer 2 data path between any two end stations.

Understanding Spanning Tree Protocols on a QFabric System

Although there is no need to run STP in a QFabric system, you can connect a QFabric system to another Layer 2 device and use STP. STP traffic can only be processed on network Node groups. Other Node groups, such redundant server Node groups and server Node groups, discard the STP bridge protocol data units (BPDUs) traffic and disable the interface automatically. Server Node groups only process host-facing protocols, whereas Network Node groups process all supported protocols.

Related Documentation

- Understanding BPDU Protection for STP, RSTP, and MSTP on page 1423
- Understanding MSTP on page 1420
- Understanding RSTP on page 1421
- Understanding VSTP on page 1422

Understanding MSTP

Although RSTP provides faster convergence time than STP does, it still does not solve a problem inherent in STP: all VLANs within a LAN must share the same spanning tree. To solve this problem, the QFX Series products use Multiple Spanning Tree Protocol (MSTP) to create a loop-free topology in networks with multiple spanning-tree regions.

An MSTP region allows a group of bridges to be modeled as a single bridge. An MSTP region contains multiple spanning-tree instances (MSTIs). MSTIs provide different paths for different VLANs. This functionality facilitates more efficient load sharing across redundant links.

An MSTP region can support up to 64 MSTIs, and each instance can support from 1 through 4094 VLANs.

Related Documentation

- Overview of Spanning-Tree Protocols on page 1419
- Understanding RSTP on page 1421
- Example: Configuring Network Regions for VLANs with MSTP on page 1480

Understanding RSTP

Juniper Networks QFX Series products use Rapid Spanning Tree Protocol (RSTP) on the network side of the QFX Series to provide quicker convergence time than the base Spanning Tree Protocol (STP) does. RSTP identifies certain links as point to point. When a point-to-point link fails, the alternate link can transition to the forwarding state, which speeds up convergence.

Although STP provides basic loop prevention functionality, it does not provide fast network convergence when there are topology changes. The STP process to determine network state transitions is slower than the RSTP process because it is timer-based. A device must reinitialize every time a topology change occurs. The device must start in the listening state and transition to the learning state and eventually to a forwarding or blocking state. When default values are used for the maximum age (20 seconds) and forward delay (15 seconds), it takes 50 seconds for the device to converge. RSTP converges faster because it uses a handshake mechanism based on point-to-point links instead of the timer-based process used by STP.

For networks with virtual LANs (VLANs), you can use VLAN Spanning Tree Protocol (VSTP), which takes the paths of each VLAN into account when calculating routes. VSTP uses RSTP by default.

An RSTP domain running from the edge outward on a QFX Series product has the following components:

- A *root port*, which is the “best path” to the root device.
- A *designated port*, which indicates that the switch is the designated bridge for the other switch connecting to this port.
- An *alternate port*, which provides an alternate root port.
- A *backup port*, which provides an alternate designated port.

Port assignments change through messages exchanged throughout the domain. An RSTP device generates configuration messages once per hello time interval. If an RSTP device does not receive a configuration message from its neighbor after an interval of three hello times, it determines that the connection with the neighbor is lost. When a *root port* or a *designated port* fails on a device, the device generates a configuration message with the proposal bit set. Once its neighbor device receives this message, it verifies that this configuration message is valid for that port and starts a *synchronizing* operation to ensure that all of its ports are in sync with the new information.

Similar sets of messages propagate through the network, restoring the connectivity very quickly after a topology change (in a well-designed network that uses RSTP, network convergence can take as little as 0.5 seconds). If a device does not receive an agreement to a proposal message it has sent, it returns to the original IEEE 802.D convention.

RSTP was originally defined in the IEEE 802.1w draft specification and later incorporated into the IEEE 802.1D-2004 specification.

VSTP and RSTP can be configured at the same time. If you configure VSTP and RSTP at the same time and the switch has more than 253 VLANs, VSTP is configured only for the first 253 VLANs. For the remaining VLANs, only RSTP is configured. RSTP and VSTP are the only spanning-tree protocols that can be configured at the same time on the QFX Series.

Related Documentation

- Overview of Spanning-Tree Protocols on page 1419
- Understanding MSTP on page 1420
- Understanding VSTP on page 1422
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466

Understanding VSTP

VLAN Spanning Tree Protocol (VSTP) enables Juniper Networks switches to run one or more Spanning Tree Protocol (STP) or Rapid Spanning Tree Protocol (RSTP) instances for each VLAN on which VSTP is enabled. For networks with multiple VLANs, VSTP improves intelligent tree spanning by defining best paths within the VLANs instead of within the entire network.

You can configure VSTP for a maximum of 253 VLANs.

VSTP and RSTP can be configured at the same time. If you configure VSTP and RSTP at the same time and the switch has more than 253 VLANs, VSTP is configured only for the first 253 VLANs. For the remaining VLANs, only RSTP is configured. RSTP and VSTP are the only spanning-tree protocols that can be configured at the same time on a switch.

NOTE: **We recommend that you enable VSTP on all VLANs that could receive VSTP bridge protocol data units (BPDUs).**

Related Documentation

- Overview of Spanning-Tree Protocols on page 1419
- Understanding RSTP on page 1421
- Configuring VLAN Spanning Tree Protocol on page 1554
- Configuring VLAN Spanning-Tree Protocol on page 1556
- **vstp on page 1611**

Understanding BPDU Protection for STP, RSTP, and MSTP

NOTE: Using the original CLI, you can disable BPDU protection on interfaces by issuing the **set ethernet-switching-options bpdu-block** ***interface-name*** **disable** command.

A Juniper Networks QFX Series product provides Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), and Multiple Spanning Tree Protocol (MSTP). Bridge protocol data unit (BPDU) protection can help prevent STP misconfigurations that can lead to network outages.

A loop-free network is supported through the exchange of a special type of frame called a BPDU. Receipt of BPDUs on certain interfaces in an STP, RSTP, VSTP, or MSTP topology, however, can lead to network outages. Enable BPDU protection on those interfaces to prevent these outages.

Peer STP applications running on the switch interfaces use BPDUs to communicate. Ultimately, the exchange of BPDUs determines which interfaces block traffic and which interfaces become root ports and forward traffic.

However, a user bridge application running on a device connected to the switch can also generate BPDUs. If these BPDUs are picked up by STP applications running on the switch, they can trigger STP miscalculations, and those miscalculations can lead to network outages.

Enable BPDU protection on switch interfaces connected to user devices or on interfaces on which no BPDUs are expected, such as edge ports. If BPDUs are received on a protected interface, the interface is disabled and stops forwarding frames.

Not only can you configure BPDU protection on a switch with a spanning tree, but also on a switch without a spanning tree. This type of topology typically consists of a non-STP switch connected to an STP switch through a trunk interface.

To configure BPDU protection on a switch with a spanning tree, include the **bpdu-block-on-edge** statement at the [**edit protocols** (**stp** | **mstp** | **rstp**)] hierarchy level. To configure BPDU protection on a switch without a spanning tree, include the **bpdu-block** statement at the [**edit ethernet-switching-options interface** ***interface-name***] hierarchy level.

If BPDUs are sent to an interface (indicating that the misconfiguration has been corrected), the interface can be unblocked in one of two ways:

- If the **disable-timeout** statement has been included in the BPDU configuration, the interface automatically returns to service after the timer expires.
- Use the operational mode command **clear ethernet-switching bpdu-error**.

Disabling the BPDU protection configuration does not unblock the interface.

Related Documentation

- Example: Configuring BPDU Protection on STP Interfaces to Prevent STP Miscalculations on page 1513
- Understanding Loop Protection for STP, RSTP, VSTP, and MSTP on page 1424
- Understanding Root Protection for STP, RSTP, VSTP, and MSTP on page 1425
- Understanding MSTP on page 1420
- Understanding RSTP on page 1421
- Understanding VSTP on page 1422

Understanding Loop Protection for STP, RSTP, VSTP, and MSTP

A Juniper Networks QFX Series product provides Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), and Multiple Spanning Tree Protocol (MSTP). Loop protection increases the efficiency of STP, RSTP, and MSTP by preventing ports from entering a forwarding state that would cause a loop to open in the network.

A loop-free network in spanning-tree topologies is supported through the exchange of a special type of frame called a bridge protocol data unit (BPDU). Peer STP applications running on the switch interfaces use BPDUs to communicate. Ultimately, the exchange of BPDUs determines which interfaces block traffic (preventing loops) and which interfaces become root ports and forward traffic.

However, a blocking interface can mistakenly transition to the forwarding state if the interface stops receiving BPDUs from its designated port on the segment. Such a transition error can occur when there is a hardware error on the switch or software configuration error between the switch and its neighbor.

When loop protection is enabled, the spanning-tree topology detects root ports and blocked ports and ensures that both keep receiving BPDUs. If a loop-protection-enabled interface stops receiving BPDUs from its designated port, it reacts as it would react to a problem with the physical connection on this interface. It does not transition the interface to a forwarding state, but instead transitions it to a loop-inconsistent state. The interface recovers and it transitions back to the spanning-tree blocking state as soon as it receives a BPDU.

We recommend that you enable loop protection on all switch interfaces that have a chance of becoming root or designated ports. Loop protection is most effective when enabled in the entire switched network. When you enable loop protection, you must configure at least one action (**alarm**, **block**, or both).

An interface can be configured for either loop protection or root protection, but not for both.

Related Documentation

- Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree on page 1517
- Understanding Root Protection for STP, RSTP, VSTP, and MSTP on page 1425
- Understanding BPDU Protection for STP, RSTP, and MSTP on page 1423

- Understanding MSTP on page 1420
- Understanding RSTP on page 1421
- Overview of Spanning-Tree Protocols on page 1419
- Understanding VSTP on page 1422

Understanding Root Protection for STP, RSTP, VSTP, and MSTP

A Juniper Networks QFX Series product provides Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), and Multiple Spanning Tree Protocol (MSTP). A loop-free network is supported through the exchange of a special type of frame called a bridge protocol data unit (BPDU). Peer STP applications running on the switch interfaces use BPDUs to communicate. Ultimately, the exchange of BPDUs determines which interfaces block traffic and which interfaces become root ports and forward traffic.

You can also see BPDUs generated when you run a bridge application on a device attached to the switch. This can interfere with root port election, which may sometimes lead to the wrong root port being elected through the above process. Root protection allows you to manually enforce the root bridge placement in the network.

Enable root protection on interfaces that should not receive higher-priority BPDUs from the root bridge and should not be elected as the root port. These interfaces become designated ports and are typically located on an administrative boundary. If the bridge receives more STP BPDUs on a port that has root protection enabled, that port transitions to a root-prevented STP state (inconsistency state), and the interface is blocked. This blocking prevents a bridge that should not be the root bridge from being elected the root bridge. After the bridge stops receiving more STP BPDUs on the interface with root protection, the interface returns to a listening state, followed by a learning state, and ultimately back to a forwarding state. Recovery back to the forwarding state is automatic.

When root protection is enabled on an interface, it is enabled for all the STP instances on that interface. The interface is blocked only for instances for which it receives more BPDUs. Otherwise, it participates in the spanning-tree topology.

An interface can be configured for either root protection or loop protection, but not for both.

Related Documentation

- Example: Configuring Root Protection to Enforce Root Bridge Placement in Spanning Trees on page 1521
- Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree on page 1517
- Example: Configuring BPDU Protection on STP Interfaces to Prevent STP Miscalculations on page 1513
- Understanding MSTP on page 1420
- Understanding RSTP on page 1421
- Overview of Spanning-Tree Protocols on page 1419

- Understanding VSTP on page 1422

CHAPTER 16

Configuration

Bridging and VLAN Configuration Examples

Example: Configuring Routing Between VLANs on One Switch

To segment traffic on a LAN into separate broadcast domains, you create separate virtual LANs (VLANs). For example, you might want to create a VLAN that includes the employees in a department and the resources that they use often, such as printers, servers, and so on.

Of course, you also want to allow these employees to communicate with people and resources in other VLANs. To forward packets between VLANs you normally you need a router that connects the VLANs. However, you can accomplish this on a Juniper Networks switch without using a router by configuring a routed VLAN interface (RVI). Using this approach reduces complexity and avoids the costs associated with purchasing, installing, managing, powering, and cooling another device.

Requirements

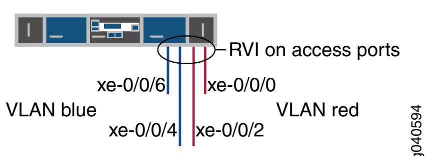
This example uses the following hardware and software components:

- One switch
- Junos OS Release 11.1 or later

Overview and Topology

This example uses an RVI to route traffic between two VLANs on the same switch. The topology is shown in Figure 16 on page 1428.

Figure 16: RVI with One Switch



This example shows a simple configuration to illustrate the basic steps for creating two VLANs on a single switch and configuring an RVI to enable routing between the VLANs. One VLAN, called **blue**, is for the sales and marketing group, and a second, called **red**, is for the customer support team. The sales and support groups each have their own file servers and wireless access points. Each VLAN must have a unique name, tag (VLAN ID), and distinct IP subnet. Table 125 on page 1428 lists the components of the sample topology.

Table 125: Components of the Multiple VLAN Topology

Property	Settings
VLAN names and tag IDs	**blue**, ID **100** **red**, ID **200**

Table 125: Components of the Multiple VLAN Topology *(continued)*

Property	Settings
Subnets associated with VLANs	**blue**: **192.0.2.0/25** (addresses **192.0.2.1** through **192.0.2.126**) **red**: **192.0.2.128/25** (addresses **192.0.2.129** through **192.0.2.254**)
Interfaces in VLAN **blue**	Sales server port: **xe-0/0/4** Sales wireless access points: **xe-0/0/6**
Interfaces in VLAN **red**	Support server port: **xe-0/0/0** Support wireless access points: **xe-0/0/2**
RVI name	interface **vlan**
RVI units and addresses	logical unit 100: **192.0.2.1/25** logical unit 200: **192.0.2.129/25**

This configuration example creates two IP subnets, one for the blue VLAN and the second for the red VLAN. The switch bridges traffic within the VLANs. For traffic passing between two VLANs, the switch routes the traffic using an RVI on which you have configured addresses in each IP subnet.

To keep the example simple, the configuration steps show only a few interfaces and VLANs. Use the same configuration procedure to add more interfaces and VLANs. By default, all interfaces are in access mode, so you do not have to configure the port mode.

Configure Layer 2 switching for two VLANs

CLI Quick Configuration

To quickly configure Layer 2 switching for the two VLANs (**blue** and **red**) and to quickly configure Layer 3 routing of traffic between the two VLANs, copy the following commands and paste them into the switch terminal window:

```
[edit]
set interfaces xe-0/0/4 unit 0 description “Sales server port”
set interfaces xe-0/0/4 unit 0 family ethernet-switching vlan members blue
set interfaces xe-0/0/6 unit 0 description “Sales wireless access point port”
set interfaces xe-0/0/6 unit 0 family ethernet-switching vlan members blue
set interfaces xe-0/0/0 unit 0 description “Support servers”
set interfaces xe-0/0/0 unit 0 family ethernet-switching vlan members red
set interfaces xe-0/0/2 unit 0 description “Support wireless access point port”
set interfaces xe-0/0/2 unit 0 family ethernet-switching vlan members red
set interfaces vlan unit 100 family inet address 192.0.2.1/25
set interfaces vlan unit 200 family inet address 192.0.2.129/25
set vlans blue l3-interface vlan.100
set vlans blue vlan-id 100
set vlans red vlan-id 200
set vlans red l3-interface vlan.200
```

Step-by-Step Procedure

To configure the switch interfaces and the VLANs to which they belong:

1. Configure the interface for the sales server in the blue VLAN:

   ```
   [edit interfaces xe-0/0/4 unit 0]
   user@switch# set description "Sales server port"
   user@switch# set family ethernet-switching vlan members blue
   ```

2. Configure the interface for the wireless access point in the blue VLAN:

   ```
   [edit interfaces xe-0/0/6 unit 0]
   user@switch# set description "Sales wireless access point port"
   user@switch# set family ethernet-switching vlan members blue
   ```

3. Configure the interface for the support server in the red VLAN:

   ```
   [edit interfaces xe-0/0/0 unit 0]
   user@switch# set description "Support server port"
   user@switch# set family ethernet-switching vlan members red
   ```

4. Configure the interface for the wireless access point in the red VLAN:

   ```
   [edit interfaces xe-0/0/2 unit 0]
   user@switch# set description "Support wireless access point port"
   user@switch# set family ethernet-switching vlan members red
   ```

Step-by-Step Procedure

Now create the VLANs and the RVI. The RVI will have logical units in the broadcast domains of both VLANs.

1. Create the red and blue VLANs by configuring the VLAN IDs for them:

   ```
   [edit vlans]
   user@switch# set blue vlan-id 100
   user@switch# set red vlan-id 200
   ```

2. Create the interface named **vlan** with a logical unit in the sales broadcast domain (blue VLAN):

   ```
   [edit interfaces]
   user@switch# set vlan unit 100 family inet address 192.0.2.1/25
   ```

   The unit number is arbitrary and does not have to match the VLAN tag ID. However, configuring the unit number to match the VLAN ID can help avoid confusion.

   NOTE: **If you are using a version of Junos OS that supports Enhanced Layer 2 Software (ELS), you can also create a Layer 3 virtual interface named irb instead of vlan.**

3. Add a logical unit in the support broadcast domain (red VLAN) to the **vlan** interface:

   ```
   [edit interfaces]
   user@switch# set vlan unit 200 family inet address 192.0.2.129/25
   ```

4. Complete the RVI configuration by binding the red and blue VLANs (Layer 2) with the appropriate logical units of the **vlan** interface (Layer 3):

   ```
   [edit vlans]
   user@switch# set blue l3-interface vlan.100
   user@switch# set red l3-interface vlan.200
   ```

Display the results of the configuration:

```
user@switch> show configuration
interfaces {
   xe-0/0/4 {
      unit 0 {
         description "Sales server port";
         family ethernet-switching {
            vlan members blue;
         }
      }
   }
   xe-0/0/6 {
      unit 0 {
         description "Sales wireless access point port";
         family ethernet-switching {
            vlan members blue;
         }
      }
   }
   xe-0/0/0 {
      unit 0 {
         description "Support server port";
         family ethernet-switching {
            vlan members red;
         }
      }
   }
   xe-0/0/2 {
      unit 0 {
         description "Support wireless access point port";
         family ethernet-switching {
            vlan members red;
         }
      }
   }
   vlan {
      unit 100 {
         family inet address 192.0.2.1/25;
      }
      unit 200 {
         family inet address 192.0.2.129/25;
         }
      }
   }
}
vlans {
   blue {
      vlan-id 100;
      interface xe-0/0/4.0:
      interface xe-0/0/6.0;
      l3-interface vlan 100;
   }
   red {
      vlan-id 200;
      interface xe-0/0/0.0:
      interface xe-0/0/2.0;
      l3-interface vlan 200;
```

```
    }
  }
```

TIP: To quickly configure the blue and red VLAN interfaces, issue the **load merge terminal** command, copy the hierarchy, and paste it into the switch terminal window.

Verification

To verify that the **blue** and **red**VLANs have been created and are operating properly, perform these tasks:

- Verifying That the VLANs Have Been Created and Associated with the Correct Interfaces on page 1432
- Verifying That Traffic Can Be Routed Between the Two VLANs on page 1432

Verifying That the VLANs Have Been Created and Associated with the Correct Interfaces

Purpose Verify that the VLANs **blue** and **red** have been created on the switch and that all connected interfaces on the switch are members of the correct VLAN.

Action List all VLANs configured on the switch:

```
user@switch> show vlans
Name           Tag      Interfaces
default                xe-0/0/0.0, xe-0/0/2.0, xe-0/0/4.0, xe-0/0/6.0,
blue           100      xe-0/0/4.0, xe-0/0/6,
red            200      xe-0/0/0.0, xe-0/0/2.0, *
mgmt                    me0.0*
```

Meaning The **show vlans** command lists all VLANs configured on the switch and which interfaces are members of each VLAN. This command output shows that the **blue** and **red** VLANs have been created. The **blue** VLAN has a tag ID of 100 and is associated with interfaces **xe-0/0/4.0** and **xe-0/0/6.0**. VLAN **red** has a tag ID of 200 and is associated with interfaces **xe-0/0/0.0** and **xe-0/0/2.0**.

Verifying That Traffic Can Be Routed Between the Two VLANs

Purpose Verify routing between the two VLANs.

Action Verify that the RVI logical units are up:

```
user@switch> show interfaces terse
vlan.100                 up    up   inet     192.0.2.1/25

vlan.200                 up    up   inet     192.0.2.129/25
```

NOTE: At least one port (access or trunk) with an appropriate VLAN assigned to it must be up for the vlan interface to be up.

Verify that switch has created routes that use the RVI logical units:

```
user@switch> show route
192.0.2.0/25        *[Direct/0] 1d 03:26:45
                     > via vlan.100
192.0.2.1/32        *[Local/0] 1d 03:26:45
                       Local via vlan.100
192.0.2.128/25      *[Direct/0] 1d 03:26:45
                     > via vlan.200
192.0.2.129/32      *[Local/0] 1d 03:26:45
                       Local via vlan.200
```

List the Layer 3 routes in the switch's Address Resolution Protocol (ARP) table:

```
user@switch> show arp
MAC Address                Address          Name                       Flags

00:00:0c:06:2c:0d          192.0.2.7        vlan.100                   None
00:13:e2:50:62:e0          192.0.2.132      vlan.200                   None
```

Meaning The output of the **show interfaces** and **show route** commands show that the Layer 3 RVI logical units are working and the switch has used them to create direct routes that it will use to forward traffic between the VLAN subnets. The **show arp** command displays the mappings between the IP addresses and MAC addresses for devices on both **vlan.100** (associated with VLAN **blue**) and **vlan.200** (associated with VLAN **red**).These two devices can communicate.

Related Documentation

- Understanding Routed VLAN Interfaces on page 1409
- **irb (Interfaces) on page 2067**
- **l3-interface on page 1618**

Example: Setting Up Basic Bridging and a VLAN on the QFX Series

The QFX Series products use bridging and virtual LANs (VLANs) to connect network devices—storage devices, file servers, and other LAN components—in a LAN and to segment the LAN into smaller bridging domains.

To segment traffic on a LAN into separate broadcast domains, you create separate virtual LANs (VLANs) on a switch. Each VLAN is a collection of network nodes. When you use VLANs, frames whose origin and destination are in the same VLAN are forwarded only within the local VLAN, and only frames not destined for the local VLAN are forwarded to other broadcast domains. VLANs thus limit the amount of traffic flowing across the entire LAN, reducing the possible number of collisions and packet retransmissions within the LAN.

This example describes how to configure basic bridging and VLANs for the QFX Series:

- Requirements on page 1434
- Overview and Topology on page 1434

- Configuration on page 1434
- Verification on page 1443

Requirements

This example uses the following software and hardware components:

- Junos OS Release 11.1 or later for the QFX Series
- A configured and provisioned QFX Series product

Overview and Topology

To use a switch to connect network devices on a LAN, you must at a minimum configure bridging and VLANs. By default, bridging is enabled on all switch interfaces, all interfaces are in access mode, and all interfaces belong to a VLAN called **employee-vlan**, which is automatically configured. When you plug in access devices—such as desktop computers, file servers, and printers—they are joined immediately into the **employee-vlan** VLAN, and the LAN is up and running.

The topology used in this example consists of a single QFX3500 switch, with a total of 48 10-Gbps Ethernet ports. (For the purposes of this example, the QSFP+ ports Q0-Q3, which are ports xe-0/1/0 through xe-0/1/15, are excluded.) You use the ports to connect devices that have their own power sources. Table 1 details the topology used in this configuration example.

Table 126: Components of the Basic Bridging Configuration Topology

Property	Settings
Switch hardware	QFX3500 switch, with 48 10-Gbps Ethernet ports
VLAN name	**employee-vlan**
VLAN ID	10
Connections to file servers	**xe-0/0/17** and **xe-0/0/18**
Direct connections to desktop PCs and laptops	**xe-0/0/0** through **xe-0/0/16**
Connections to integrated printer/fax/copier machines	**xe-0/0/19** through **xe-0/0/40**
Unused ports	**xe-0/0/41** through **xe-0/0/47**

Configuration

CLI Quick Configuration

To quickly configure a VLAN, copy the following commands and paste them into the switch terminal window:

```
[edit]
set vlans employee-vlan vlan-id 10
set interfaces xe-0/0/0 unit 0 family ethernet-switching vlan members employee-vlan
```



```
set interfaces xe-0/0/1 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/2 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/3 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/4 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/5 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/6 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/7 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/8 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/9 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/10 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/11 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/12 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/13 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/14 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/15 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/16 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/17 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/18 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/19 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/22 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/23 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/24 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/25 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/26 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/27 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/28 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/29 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/30 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/31 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/32 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/33 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/34 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/35 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/36 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/37 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/38 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/39 unit 0 family ethernet-switching vlan members employee-vlan
set interfaces xe-0/0/40 unit 0 family ethernet-switching vlan members employee-vlan
```

Step-by-Step Procedure

To set up basic bridging and a VLAN:

1. Create a VLAN named employee-vlan and specify the VLAN ID of 10 for it:

   ```
   [edit vlans]
   user@switch# set employee-vlan vlan-id 10
   ```

2. Assign interfaces xe-0/0/0 through xe-0/0/40 to the employee-vlan VLAN:

   ```
   [edit interface]
   user@switch# set xe-0/0/0 unit 0 family ethernet-switching vlan members employee-vlan
   user@switch# set xe-0/0/1 unit 0 family ethernet-switching vlan members employee-vlan
   user@switch# set xe-0/0/2 unit 0 family ethernet-switching vlan members employee-vlan
   user@switch# set xe-0/0/3 unit 0 family ethernet-switching vlan members employee-vlan
   user@switch# set xe-0/0/4 unit 0 family ethernet-switching vlan members employee-vlan
   user@switch# set xe-0/0/5 unit 0 family ethernet-switching vlan members employee-vlan
   user@switch# set xe-0/0/6 unit 0 family ethernet-switching vlan members employee-vlan
   user@switch# set xe-0/0/7 unit 0 family ethernet-switching vlan members employee-vlan
   user@switch# set xe-0/0/8 unit 0 family ethernet-switching vlan members employee-vlan
   user@switch# set xe-0/0/9 unit 0 family ethernet-switching vlan members employee-vlan
   ```

```
user@switch# set xe-0/0/10 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/11 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/12 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/13 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/14 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/15 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/16 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/17 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/18 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/19 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/20 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/21 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/22 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/23 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/24 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/25 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/26 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/27 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/28 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/29 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/30 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/31 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/32 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/33 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/34 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/35 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/36 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/37 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/38 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/39 unit 0 family ethernet-switching vlan members employee-vlan
user@switch# set xe-0/0/40 unit 0 family ethernet-switching vlan members employee-vlan
```

3. Connect the two file servers to ports xe-0/0/17 and xe-0/0/18.
4. Connect the desktop PCs and laptops to ports xe-0/0/0 through xe-0/0/16.
5. Connect the integrated printer/fax/copier machines to ports xe-0/0/19 through xe-0/0/40.

Results Check the results of the configuration:

```
user@switch> show configuration
    xe-0/0/0 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/1 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/2 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/3 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/4 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/5 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/6 {
        unit 0 {
            family ethernet-switching {
```

```
            vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/7 {
    unit 0 {
        family ethernet-switching {
             vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/8 {
    unit 0 {
        family ethernet-switching {
            vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/9 {
    unit 0 {
        family ethernet-switching {
            vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/10 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/11 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/12 {
    unit 0 {
        family ethernet-switching {
            vlan {
                members employee-vlan;
            }
        }
    }
}
```



```
xe-0/0/13 {
    unit 0 {
        family ethernet-switching {
            vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/14 {
    unit 0 {
        family ethernet-switching {
            vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/15 {
    unit 0 {
        family ethernet-switching {
            vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/16 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/17 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/18 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/19 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
```

```
    }
}
xe-0/0/20 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/21 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/22 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/23 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/24 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/25 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
            }
        }
    }
}
xe-0/0/26 {
    unit 0 {
        family ethernet-switching {
                   vlan {
                members employee-vlan;
```



```
                }
            }
        }
    }
    xe-0/0/27 {
        unit 0 {
            family ethernet-switching {
                    vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/28 {
        unit 0 {
            family ethernet-switching {
                    vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/29 {
        unit 0 {
            family ethernet-switching {
                    vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/30 {
        unit 0 {
            family ethernet-switching {
                    vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/31 {
        unit 0 {
            family ethernet-switching {
                    vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/32 {
        unit 0 {
            family ethernet-switching {
                    vlan {
                    members employee-vlan;
                }
            }
        }
    }
    xe-0/0/33 {
        unit 0 {
            family ethernet-switching {
```

```
                vlan {
            members employee-vlan;
        }
    }
}
}
xe-0/0/34 {
    unit 0 {
        family ethernet-switching {
                vlan {
            members employee-vlan;
        }
    }
}
}
xe-0/0/35 {
    unit 0 {
        family ethernet-switching {
                vlan {
            members employee-vlan;
        }
    }
}
}
xe-0/0/36 {
    unit 0 {
        family ethernet-switching {
                vlan {
            members employee-vlan;
        }
    }
}
}
xe-0/0/37 {
    unit 0 {
        family ethernet-switching {
                vlan {
            members employee-vlan;
        }
    }
}
}
xe-0/0/38 {
    unit 0 {
        family ethernet-switching {
                vlan {
            members employee-vlan;
        }
    }
}
}
xe-0/0/39 {
    unit 0 {
        family ethernet-switching {
                vlan {
            members employee-vlan;
        }
    }
}
}
xe-0/0/40 {
```



```
        unit 0 {
            family ethernet-switching {
                        vlan {
                     members employee-vlan;
                }
            }
        }
    }
```

Verification

To verify that switching is operational and that **employee-vlan** has been created, perform these tasks:

- Verifying That the VLAN Has Been Created on page 1443
- Verifying That Interfaces Are Associated with the Proper VLANs on page 1444

Verifying That the VLAN Has Been Created

Purpose Verify that the VLAN named **employee-vlan** has been created on the switch.

Action List all VLANs configured on the switch:

```
user@switch>  show vlans
Routing instance        VLAN name             Tag          Interfaces
default-switch          employee-vlan            10
                                                                xe-0/0/0.0
                                                                xe-0/0/1.0
                                                                xe-0/0/2.0
                                                                xe-0/0/3.0
                                                                xe-0/0/4.0
                                                                xe-0/0/5.0
                                                                xe-0/0/6.0
                                                                xe-0/0/7.0
                                                                xe-0/0/8.0
                                                                xe-0/0/9.0
                                                                xe-0/0/10.0
                                                                xe-0/0/11.0
                                                                xe-0/0/12.0
                                                                xe-0/0/13.0
                                                                xe-0/0/14.0
                                                                xe-0/0/15.0
                                                                xe-0/0/16.0
                                                                xe-0/0/17.0
                                                                xe-0/0/18.0
                                                                xe-0/0/19.0
                                                                xe-0/0/20.0
                                                                xe-0/0/21.0
                                                                xe-0/0/22.0
                                                                xe-0/0/23.0
                                                                xe-0/0/24.0
                                                                xe-0/0/25.0
                                                                xe-0/0/26.0
                                                                xe-0/0/27.0
                                                                xe-0/0/28.0
                                                                xe-0/0/29.0
                                                                xe-0/0/30.0
                                                                xe-0/0/31.0
                                                                xe-0/0/32.0
                                                                xe-0/0/33.0
                                                                xe-0/0/34.0
                                                                xe-0/0/35.0
                                                                xe-0/0/36.0
                                                                xe-0/0/37.0
                                                                xe-0/0/38.0
                                                                xe-0/0/39.0
                                                                xe-0/0/40.0
...
```

Meaning The **show vlans** command lists the VLANs configured on the switch. This output shows that the VLAN **employee-vlan** has been created.

Verifying That Interfaces Are Associated with the Proper VLANs

Purpose Verify that Ethernet switching is enabled on switch interfaces and that all interfaces are included in the VLAN.

Action List all interfaces on which switching is enabled:

```
user@switch>  show ethernet-switching interfaces
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/0.0                    65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/1.0                    65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/2.0                    65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/3.0                    65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/4.0                    65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/5.0                    65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/6.0                    65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
```



```
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/7.0                    65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/8.0                    65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/9.0                    65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/10.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/11.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/12.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/13.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/14.0                   65535                                 untagged
```



```
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/15.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/16.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/17.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/18.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/19.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/20.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/21.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
```

```
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/22.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/23.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/24.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/25.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/26.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/27.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/28.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/29.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
```



```
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/30.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/31.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/32.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/33.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/34.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/35.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
xe-0/0/36.0                   65535                                 untagged
             employee-vlan 10
                              65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG   MAC      STP          Logical         Tagging
interface    members          limit    state        interface flags
```

```
xe-0/0/37.0                    65535                                untagged
             employee-vlan 10
                               65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG    MAC      STP          Logical         Tagging
interface    members           limit    state        interface flags
xe-0/0/38.0                    65535                                untagged
             employee-vlan 10
                               65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG    MAC      STP          Logical         Tagging
interface    members           limit    state        interface flags
xe-0/0/39.0                    65535                                untagged
             employee-vlan 10
                               65535    Discarding
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down )
Logical      Vlan       TAG    MAC      STP          Logical         Tagging
interface    members           limit    state        interface flags
xe-0/0/40.0                    65535                                untagged
             employee-vlan 10
                               65535    Discarding
...
```

Meaning The **show ethernet-switching interfaces** command lists all interfaces on which switching is enabled (in the **Logical interface** column), along with the VLANs that are active on the interfaces (in the **VLAN members** column). The output in this example shows all the connected interfaces, xe-0/0/0 through xe-0/0/40, are all part of VLAN **employee-vlan**. Notice that the interfaces listed are the logical interfaces, not the physical interfaces. For example, the output shows xe-0/0/0.0 instead of xe-0/0/0. This is because Junos OS creates VLANs on logical interfaces, not directly on physical interfaces.

Related Documentation

- Example: Setting Up Bridging with Multiple VLANs on page 1451
- Understanding Bridging and VLANs on page 1402

Bridging and VLAN Configuration Examples (Original CLI Only)

Example: Disabling MAC Learning

By default, MAC learning is enabled on the QFX Series. This topic provides examples for disabling, enabling, and verifying the operation of MAC learning on the QFX Series. These examples require that you be logged in as the root user to the switch on which you wish to modify MAC learning.

NOTE: This task uses Junos OS for QFX3500 and QFX3600 switches does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see “Example: Disabling MAC Learning” on page 1457.

- To disable MAC learning in a VLAN:

```
[edit]
user@switch# edit ethernet-switching-options interfaces xe-0/0/0.0
[edit ethernet-switching-options interfaces xe-0/0/0.0]
user@switch# set no-mac-learning
```

- To reenable MAC learning:

```
[edit]
user@switch# edit ethernet-switching-options interfaces xe-0/0/0.0
[edit ethernet-switching-options interfaces xe-0/0/0.0]
user@switch# delete no-mac-learning
```

- To verify the status of MAC learning on the QFX Series:

```
user@switch> show ethernet-switching table
Learning stats: 10 learn msg rcvd, 2 error, 0 forced update
Interface               Local pkts          Transit pkts       Error
xe-0/0/0.0         0                  6                  1
xe-0/0/22.0        0                  0                  0
xe-0/0/1.0         0                  4                  1
xe-0/0/2.0         0                  0                  0
xe-0/0/3.0         0                  0                  0
xe-0/0/4.0         0                  0                  0
xe-0/0/19.0        0                  0                  0
xe-0/0/18.0        0                  0                  0
xe-0/0/9.0         0                  0                  0
```

Related Documentation

- Understanding MAC Learning on page 1410
- Disabling MAC Learning on page 1537
- *no-mac-learning (Per VLAN)*

Example: Setting Up Bridging with Multiple VLANs

The QFX Series products use bridging and virtual LANs (VLANs) to connect network devices in a LAN—storage devices, file servers, and other network components—and to segment the LAN into smaller bridging domains.

To segment traffic on a LAN into separate broadcast domains, you create separate virtual LANs (VLANs) on a switch. Each VLAN is a collection of network nodes. When you use VLANs, frames whose origin and destination are in the same VLAN are forwarded only within the local VLAN, and only frames not destined for the local VLAN are forwarded to other broadcast domains. VLANs thus limit the amount of traffic flowing across the entire LAN, reducing the possible number of collisions and packet retransmissions within the LAN.

NOTE: This task uses Junos OS for QFX3500 and QFX3600 switches does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see "Example: Setting Up Bridging with Multiple VLANs" on page 1458.

This example describes how to configure bridging for the QFX Series and how to create two VLANs to segment the LAN:

Requirements

This example uses the following hardware and software components:

- A configured and provisioned QFX3500 switch
- Junos OS Release 11.1 or later for the QFX Series

Overview and Topology

Switches connect all devices in an office or data center into a single LAN to provide sharing of common resources such as file servers. The default configuration creates a single VLAN, and all traffic on the switch is part of that broadcast domain. Creating separate network segments reduces the span of the broadcast domain and enables you to group related users and network resources without being limited by physical cabling or by the location of a network device in the building or on the LAN.

This example shows a simple configuration to illustrate the basic steps for creating two VLANs on a single switch. One VLAN, called **sales**, is for the sales and marketing group, and a second, called **support**, is for the customer support team. The sales and support groups each have their own dedicated file servers and other resources. For the switch ports to be segmented across the two VLANs, each VLAN must have its own broadcast domain, identified by a unique name and tag (VLAN ID). In addition, each VLAN must be on its own distinct IP subnet.

The topology used in this example consists of a single QFX3500 switch, with a total of 48 10-Gbps Ethernet ports. (For the purposes of this example, the QSFP+ ports Q0-Q3, which are ports xe-0/1/0 through xe-0/1/15, are excluded.)

Table 127: Components of the Multiple VLAN Topology

Property	Settings
Switch hardware	QFX3500 switch configured with 48 10-Gbps Ethernet ports (**xe-0/0/0** through **xe-0/0/47**)

Table 127: Components of the Multiple VLAN Topology *(continued)*

Property	Settings
VLAN names and tag IDs	**sales**, tag **100** **support**, tag **200**
VLAN subnets	**sales**: **192.0.2.0/25** (addresses **192.0.2.1** through **192.0.2.126**) **support**: **192.0.2.128/25** (addresses **192.0.2.129** through **192.0.2.254**)
Interfaces in VLAN **sales**	File servers: **xe-0/0/20** and **xe-0/0/21**
Interfaces in VLAN **support**	File servers: **xe-0/0/46** and **xe-0/0/47**
Unused interfaces	**xe-0/0/2** and **xe-0/0/25**

This configuration example creates two IP subnets, one for the sales VLAN and the second for the support VLAN. The switch bridges traffic within a VLAN. For traffic passing between two VLANs, the switch routes the traffic using a Layer 3 routing interface on which you have configured the address of the IP subnet.

To keep the example simple, the configuration steps show only a few devices in each of the VLANs. Use the same configuration procedure to add more LAN devices.

Configuration

CLI Quick Configuration

To quickly configure Layer 2 switching for the two VLANs (**sales** and **support**) and to quickly configure Layer 3 routing of traffic between the two VLANs, copy the following commands and paste them into the switch terminal window:

```
[edit]
set interfaces xe-0/0/0 unit 0 family ethernet-switching vlan members sales
set interfaces xe-0/0/3 unit 0 family ethernet-switching vlan members sales
set interfaces xe-0/0/22 unit 0 family ethernet-switching vlan members sales
set interfaces xe-0/0/20 unit 0 description “Sales file server port”
set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members sales
set interfaces xe-0/0/24 unit 0 family ethernet-switching vlan members support
set interfaces xe-0/0/26 unit 0 family ethernet-switching vlan members support
set interfaces xe-0/0/44 unit 0 family ethernet-switching vlan members support
set interfaces xe-0/0/46 unit 0 description “Support file server port”
set interfaces xe-0/0/46 unit 0 family ethernet-switching vlan members support
set interfaces vlan unit 0 family inet address 192.0.2.0/25
set interfaces vlan unit 1 family inet address 192.0.2.128/25
set vlans sales l3–interface vlan.0
set vlans sales vlan-id 100
set vlans support vlan-id 200
set vlans support l3-interface vlan.1
```

Step-by-Step Procedure

Configure the switch interfaces and the VLANs to which they belong. By default, all interfaces are in access mode, so you do not have to configure the port mode.

1. Configure the interface for the file server in the **sales** VLAN:

   ```
   [edit interfaces xe-0/0/20 unit 0]
   user@switch# set description "Sales file server port"
   user@switch# set family ethernet-switching vlan members sales
   ```

2. Configure the interface for the file server in the **support** VLAN:

   ```
   [edit interfaces xe-0/0/46 unit 0]
   user@switch# set description "Support file server port"
   user@switch# set family ethernet-switching vlan members support
   ```

3. Create the subnet for the **sales** broadcast domain:

   ```
   [edit interfaces]
   user@switch# set vlan unit 0 family inet address 192.0.2.1/25
   ```

4. Create the subnet for the **support** broadcast domain:

   ```
   [edit interfaces]
   user@switch# set vlan unit 1 family inet address 192.0.2.129/25
   ```

5. Configure the VLAN tag IDs for the **sales** and **support** VLANs:

   ```
   [edit vlans]
   user@switch# set sales vlan-id 100
   user@switch# set support vlan-id 200
   ```

6. To route traffic between the **sales** and **support** VLANs, define the interfaces that are members of each VLAN and associate a Layer 3 interface:

   ```
   [edit vlans]
   user@switch# set sales l3-interface vlan.0
   user@switch# set support l3-interface vlan.1
   ```

Display the results of the configuration:

```
user@switch> show configuration
interfaces {
  xe-0/0/20 {
    unit 0 {
      description "Sales file server port";
      family ethernet-switching {
        vlan members sales;
      }
    }
  }
  xe-0/0/46 {
    unit 0 {
      description "Support file server port";
      family ethernet-switching {
        vlan members support;
      }
    }
    vlans {
      unit 0 {
        family inet address 192.0.2.1/25;
      }
      unit 1 {
        family inet address 192.0.2.129/25;
      }
```



```
      }
    }
  }
  vlans {
    sales {
      vlan-id 100;
      interface xe-0/0/0.0:
      interface xe-0/0/3/0;
      interface xe-0/0/20.0;
      interface xe-0/0/22.0;
      l3-interface vlan 0;
    }
    support {
      vlan-id 200;
      interface xe-0/0/24.0:
      interface xe-0/0/26.0;
      interface xe-0/0/44.0;
      interface xe-0/0/46.0;
      l3-interface vlan 1;
    }
  }
```

TIP: To quickly configure the sales and support VLAN interfaces, issue the **load merge terminal** command. Then copy the hierarchy and paste it into the switch terminal window.

Verification

Verify that the **sales** and **support** VLANs have been created and are operating properly, perform these tasks:

- Verifying That the VLANs Have Been Created and Associated with the Correct Interfaces on page 1455
- Verifying That Traffic Is Being Routed Between the Two VLANs on page 1456
- Verifying That Traffic Is Being Switched Between the Two VLANs on page 1456

Verifying That the VLANs Have Been Created and Associated with the Correct Interfaces

Purpose Verify that the **sales** and **support** VLANs have been created on the switch and that all connected interfaces on the switch are members of the correct VLAN.

Action To list all VLANs configured on the switch, use the **show vlans** command:

```
user@switch> show vlans
Name           Tag     Interfaces
default
                       xe-0/0/1.0, xe-0/0/2.0, xe-0/0/4.0, xe-0/0/5.0,
                       xe-0/0/6.0,  xe-0/0/7.0, xe-0/0/8.0, xe-0/0/9.0,
                       xe-0/0/10.0*, xe-0/0/11.0, xe-0/0/12.0, xe-0/0/13.0*,
                       xe-0/0/14.0, xe-0/0/15.0, xe-0/0/16.0, xe-0/0/17.0,
                       xe-0/0/18.0, xe-0/0/19.0, xe-0/0/21.0, xe-0/0/23.0*,
                       xe-0/0/25.0, xe-0/0/27.0, xe-0/0/28.0, xe-0/0/29.0,
```



```
                       xe-0/0/30.0, xe-0/0/31.0, xe-0/0/32.0, xe-0/0/33.0,
                       xe-0/0/34.0, xe-0/0/35.0, xe-0/0/36.0, xe-0/0/37.0,
                       xe-0/0/38.0, xe-0/0/39.0, xe-0/0/40.0, xe-0/0/41.0,
                       xe-0/0/42.0, xe-0/0/43.0, xe-0/0/45.0, xe-0/0/47.0,
                       xe-0/1/0.0*, xe-0/1/1.0*, xe-0/1/2.0*, xe-0/1/3.0*

sales        100
                       xe-0/0/0.0*, xe-0/0/3.0, xe-0/0/20.0, xe-0/0/22.0

support      200
                       xe-0/0/0.24, xe-0/0/26.0, xe-0/0/44.0, xe-0/0/46.0*
mgmt
                       me0.0*
```

Meaning The **show vlans** command lists all VLANs configured on the switch and which interfaces are members of each VLAN. This command output shows that the **sales** and **support** VLANs have been created. The **sales** VLAN has a tag ID of 100 and is associated with interfaces **xe-0/0/0.0**, **xe-0/0/3.0**, **xe-0/0/20.0**, and **xe-0/0/22.0**. VLAN **support** has a tag ID of 200 and is associated with interfaces **xe-0/0/24.0**, **xe-0/0/26.0**, **xe-0/0/44.0**, and **xe-0/0/46.0**.

Verifying That Traffic Is Being Routed Between the Two VLANs

Purpose Verify routing between the two VLANs.

Action List the Layer 3 routes in the switch Address Resolution Protocol (ARP) table:

```
user@switch> show arp
MAC Address       Address         Name                    Flags

00:00:0c:06:2c:0d        192.0.2.3       vlan.0                 None
00:13:e2:50:62:e0        192.0.2.11      vlan.1                 None
```

Meaning Sending IP packets on a multiaccess network requires mapping from an IP address to a MAC address (the physical or hardware address). The ARP table displays the mapping between the IP address and MAC address for both **vlan.0** (associated with **sales**) and **vlan.1** (associated with **support**). These VLANs can route traffic to each other.

Verifying That Traffic Is Being Switched Between the Two VLANs

Purpose Verify that learned entries are being added to the Ethernet switching table.

Action List the contents of the Ethernet switching table:

```
user@switch> show ethernet-switching table

Ethernet-switching table: 8 entries, 5 learned
  VLAN              MAC address       Type         Age Interfaces
  default           *                 Flood          - All-members
  default           00:00:05:00:00:01 Learn          - xe-0/0/10.0
  default           00:00:5e:00:01:09 Learn          - xe-0/0/13.0
  default           00:19:e2:50:63:e0 Learn          - xe-0/0/23.0
  sales             *                 Flood          - All-members
  sales             00:00:5e:00:07:09 Learn          - xe-0/0/0.0
```



```
support           *                 Flood          - All-members
support           00:00:5e:00:01:01 Learn          - xe-0/0/46.0
```

Meaning The output shows that learned entries for the **sales** and **support** VLANs have been added to the Ethernet switching table, and are associated with interfaces **xe-0/0/0.0** and **xe-0/0/46.0**. Even though the VLANs were associated with more than one interface in the configuration, these interfaces are the only ones that are currently operating.

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433

- *Understanding Bridging*

Bridging and VLAN Configuration Examples (ELS CLI Only)

Example: Disabling MAC Learning

By default, MAC learning is enabled on the QFX Series. This topic provides examples for disabling, enabling, and verifying the operation of MAC learning on the QFX Series. These examples require that you be logged in as the root user to the switch on which you wish to modify MAC learning.

NOTE: This task uses Junos OS for QFX3500 and QFX3600 switches with support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see "Example: Disabling MAC Learning" on page 1450. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

- To disable MAC learning in a VLAN:

```
[edit]
user@switch# set vlans vlan10 switch-options interface xe-0/0/0.0 no-mac-learning
```

- To reenable MAC learning:

```
[edit] vlans vlan10 switch-options interface xe-0/0/0.0
user@switch# delete no-mac-learning
```

- To verify the status of MAC learning on the QFX Series:

```
user@switch> show ethernet-switching table
Learning stats: 10 learn msg rcvd, 2 error, 0 forced update
Interface             Local pkts          Transit pkts       Error
xe-0/0/0.0        0                 6                 1
xe-0/0/22.0       0                 0                 0
xe-0/0/1.0        0                 4                 1
xe-0/0/2.0        0                 0                 0
xe-0/0/3.0        0                 0                 0
xe-0/0/4.0        0                 0                 0
xe-0/0/19.0       0                 0                 0
xe-0/0/18.0       0                 0                 0
```

```
xe-0/0/9.0          0                0                0
```

Related Documentation

- Understanding MAC Learning on page 1410
- Disabling MAC Learning on page 1547
- **no-mac-learning on page 1625**

Example: Setting Up Bridging with Multiple VLANs

The QFX Series products use bridging and virtual LANs (VLANs) to connect network devices in a LAN—storage devices, file servers, and other network components—and to segment the LAN into smaller bridging domains.

To segment traffic on a LAN into separate broadcast domains, you create separate virtual LANs (VLANs) on a switch. Each VLAN is a collection of network nodes. When you use VLANs, frames whose origin and destination are in the same VLAN are forwarded only within the local VLAN, and only frames not destined for the local VLAN are forwarded to other broadcast domains. VLANs thus limit the amount of traffic flowing across the entire LAN, reducing the possible number of collisions and packet retransmissions within the LAN.

This example describes how to configure bridging for the QFX Series and how to create two VLANs to segment the LAN:

NOTE: This task supports the Enhanced Layer 2 Software (ELS) configuration style. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58. If your switch runs software that does not supports ELS, see "Example: Setting Up Bridging with Multiple VLANs" on page 1451.

Requirements

This example uses the following hardware and software components:

- A configured and provisioned QFX3500 switch
- Junos OS Release 13.2X50-D15 or later for the QFX Series

Overview and Topology

Switches connect all devices in an office or data center into a single LAN to provide sharing of common resources such as file servers. The default configuration creates a single VLAN, and all traffic on the switch is part of that broadcast domain. Creating separate network segments reduces the span of the broadcast domain and enables you to group related users and network resources without being limited by physical cabling or by the location of a network device in the building or on the LAN.

This example shows a simple configuration to illustrate the basic steps for creating two VLANs on a single switch. One VLAN, called **sales**, is for the sales and marketing group, and a second, called **support**, is for the customer support team. The sales and support groups each have their own dedicated file servers and other resources. For the switch ports to be segmented across the two VLANs, each VLAN must have its own broadcast domain, identified by a unique name and tag (VLAN ID). In addition, each VLAN must be on its own distinct IP subnet.

The topology used in this example consists of a single QFX3500 switch, with a total of 48 10-Gbps Ethernet ports. (For the purposes of this example, the QSFP+ ports Q0-Q3, which are ports xe-0/1/0 through xe-0/1/15, are excluded.)

Table 128: Components of the Multiple VLAN Topology

Property	Settings
Switch hardware	QFX3500 switch configured with 48 10-Gbps Ethernet ports (**xe-0/0/0** through **xe-0/0/47**)
VLAN names and tag IDs	**sales**, tag **100** **support**, tag **200**
VLAN subnets	**sales**: **192.0.2.0/25** (addresses **192.0.2.1** through **192.0.2.126**) **support**: **192.0.2.128/25** (addresses **192.0.2.129** through **192.0.2.254**)
Interfaces in VLAN **sales**	File servers: **xe-0/0/20** and **xe-0/0/21**
Interfaces in VLAN **support**	File servers: **xe-0/0/46** and **xe-0/0/47**
Unused interfaces	**xe-0/0/2** and **xe-0/0/25**

This configuration example creates two IP subnets, one for the sales VLAN and the second for the support VLAN. The switch bridges traffic within a VLAN. For traffic passing between two VLANs, the switch routes the traffic using a Layer 3 routing interface on which you have configured the address of the IP subnet.

To keep the example simple, the configuration steps show only a few devices in each of the VLANs. Use the same configuration procedure to add more LAN devices.

Configuration

CLI Quick Configuration

To quickly configure Layer 2 switching for the two VLANs (**sales** and **support**) and to quickly configure Layer 3 routing of traffic between the two VLANs, copy the following commands and paste them into the switch terminal window:

```
[edit]
set interfaces xe-0/0/0 unit 0 family ethernet-switching vlan members sales
set interfaces xe-0/0/3 unit 0 family ethernet-switching vlan members sales
set interfaces xe-0/0/22 unit 0 family ethernet-switching vlan members sales
```

```
set interfaces xe-0/0/20 unit 0 description "Sales file server port"
set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members sales
set interfaces xe-0/0/24 unit 0 family ethernet-switching vlan members support
set interfaces xe-0/0/26 unit 0 family ethernet-switching vlan members support
set interfaces xe-0/0/44 unit 0 family ethernet-switching vlan members support
set interfaces xe-0/0/46 unit 0 description "Support file server port"
set interfaces xe-0/0/46 unit 0 family ethernet-switching vlan members support
set interfaces vlan unit 0 family inet address 192.0.2.0/25
set interfaces vlan unit 1 family inet address 192.0.2.128/25
set vlans sales l3–interface irb.0
set vlans sales vlan-id 100
set vlans support vlan-id 200
set vlans support l3-interface irb.1
```

Step-by-Step Procedure

Configure the switch interfaces and the VLANs to which they belong. By default, all interfaces are in access mode, so you do not have to configure the port mode.

1. Configure the interface for the file server in the **sales** VLAN:

   ```
   [edit interfaces xe-0/0/20 unit 0]
   user@switch# set description "Sales file server port"
   user@switch# set family ethernet-switching vlan members sales
   ```
2. Configure the interface for the file server in the **support** VLAN:

   ```
   [edit interfaces xe-0/0/46 unit 0]
   user@switch# set description "Support file server port"
   user@switch# set family ethernet-switching vlan members support
   ```
3. Create the subnet for the **sales** broadcast domain:

   ```
   [edit interfaces]
   user@switch# set vlan unit 0 family inet address 192.0.2.1/25
   ```
4. Create the subnet for the **support** broadcast domain:

   ```
   [edit interfaces]
   user@switch# set vlan unit 1 family inet address 192.0.2.129/25
   ```
5. Configure the VLAN tag IDs for the **sales** and **support** VLANs:

   ```
   [edit vlans]
   user@switch# set sales vlan-id 100
   user@switch# set support vlan-id 200
   ```
6. To route traffic between the **sales** and **support** VLANs, define the interfaces that are members of each VLAN and associate a Layer 3 interface:

   ```
   [edit vlans]
   user@switch# set sales l3-interface irb.0
   user@switch# set support l3-interface irb.1
   ```

Display the results of the configuration:

```
user@switch> show configuration
interfaces {
  xe-0/0/20 {
    unit 0 {
      description "Sales file server port";
      family ethernet-switching {
        vlan members sales;
      }
    }
  }
  xe-0/0/46 {
```



```
          unit 0 {
            description "Support file server port";
            family ethernet-switching {
              vlan members support;
            }
          }
          vlans {
            unit 0 {
              family inet address 192.0.2.1/25;
            }
            unit 1 {
              family inet address 192.0.2.129/25;
            }
          }
        }
      }
      vlans {
        sales {
          vlan-id 100;
          interface xe-0/0/0.0:
          interface xe-0/0/3/0;
          interface xe-0/0/20.0;
          interface xe-0/0/22.0;
          l3-interface irb0;
        }
        support {
          vlan-id 200;
          interface xe-0/0/24.0:
          interface xe-0/0/26.0;
          interface xe-0/0/44.0;
          interface xe-0/0/46.0;
          l3-interface irb1;
        }
      }
```

TIP: To quickly configure the sales and support VLAN interfaces, issue the **load merge terminal** command. Then copy the hierarchy and paste it into the switch terminal window.

Verification

Verify that the **sales** and **support** VLANs have been created and are operating properly, perform these tasks:

- Verifying That the VLANs Have Been Created and Associated with the Correct Interfaces on page 1462
- Verifying That Traffic Is Being Routed Between the Two VLANs on page 1462
- Verifying That Traffic Is Being Switched Between the Two VLANs on page 1463

Verifying That the VLANs Have Been Created and Associated with the Correct Interfaces

Purpose Verify that the **sales** and **support** VLANs have been created on the switch and that all connected interfaces on the switch are members of the correct VLAN.

Action To list all VLANs configured on the switch, use the **show vlans** command:

```
user@switch> show vlans
Name          Tag     Interfaces
default
                      xe-0/0/1.0, xe-0/0/2.0, xe-0/0/4.0, xe-0/0/5.0,
                      xe-0/0/6.0,  xe-0/0/7.0, xe-0/0/8.0, xe-0/0/9.0,
                      xe-0/0/10.0*, xe-0/0/11.0, xe-0/0/12.0, xe-0/0/13.0*,
                      xe-0/0/14.0, xe-0/0/15.0, xe-0/0/16.0, xe-0/0/17.0,
                      xe-0/0/18.0, xe-0/0/19.0, xe-0/0/21.0, xe-0/0/23.0*,
                      xe-0/0/25.0, xe-0/0/27.0, xe-0/0/28.0, xe-0/0/29.0,
                      xe-0/0/30.0, xe-0/0/31.0, xe-0/0/32.0, xe-0/0/33.0,
                      xe-0/0/34.0, xe-0/0/35.0, xe-0/0/36.0, xe-0/0/37.0,
                      xe-0/0/38.0, xe-0/0/39.0, xe-0/0/40.0, xe-0/0/41.0,
                      xe-0/0/42.0, xe-0/0/43.0, xe-0/0/45.0, xe-0/0/47.0,
                      xe-0/1/0.0*, xe-0/1/1.0*, xe-0/1/2.0*, xe-0/1/3.0*

sales       100
                      xe-0/0/0.0*, xe-0/0/3.0, xe-0/0/20.0, xe-0/0/22.0

support     200
                      xe-0/0/0.24, xe-0/0/26.0, xe-0/0/44.0, xe-0/0/46.0*
mgmt
                      me0.0*
```

Meaning The **show vlans** command lists all VLANs configured on the switch and which interfaces are members of each VLAN. This command output shows that the **sales** and **support** VLANs have been created. The **sales** VLAN has a tag ID of 100 and is associated with interfaces **xe-0/0/0.0**, **xe-0/0/3.0**, **xe-0/0/20.0**, and **xe-0/0/22.0**. VLAN **support** has a tag ID of 200 and is associated with interfaces **xe-0/0/24.0**, **xe-0/0/26.0**, **xe-0/0/44.0**, and **xe-0/0/46.0**.

Verifying That Traffic Is Being Routed Between the Two VLANs

Purpose Verify routing between the two VLANs.

Action List the Layer 3 routes in the switch Address Resolution Protocol (ARP) table:

```
user@switch> show arp
MAC Address       Address         Name                    Flags

00:00:0c:06:2c:0d       192.0.2.3      vlan.0                  None
00:13:e2:50:62:e0       192.0.2.11     vlan.1                  None
```

Meaning Sending IP packets on a multiaccess network requires mapping from an IP address to a MAC address (the physical or hardware address). The ARP table displays the mapping between the IP address and MAC address for both **vlan.0** (associated with **sales**) and **vlan.1** (associated with **support**). These VLANs can route traffic to each other.

Verifying That Traffic Is Being Switched Between the Two VLANs

Purpose Verify that learned entries are being added to the Ethernet switching table.

Action List the contents of the Ethernet switching table:

```
user@switch> show ethernet-switching table

Ethernet-switching table: 8 entries, 5 learned
  VLAN              MAC address       Type         Age Interfaces
  default           *                 Flood          - All-members
  default           00:00:05:00:00:01 Learn          - xe-0/0/10.0
  default           00:00:5e:00:01:09 Learn          - xe-0/0/13.0
  default           00:19:e2:50:63:e0 Learn          - xe-0/0/23.0
  sales             *                 Flood          - All-members
  sales             00:00:5e:00:07:09 Learn          - xe-0/0/0.0
  support           *                 Flood          - All-members
  support           00:00:5e:00:01:01 Learn          - xe-0/0/46.0
```

Meaning The output shows that learned entries for the **sales** and **support** VLANs have been added to the Ethernet switching table, and are associated with interfaces **xe-0/0/0.0** and **xe-0/0/46.0**. Even though the VLANs were associated with more than one interface in the configuration, these interfaces are the only ones that are currently operating.

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Understanding Bridging and VLANs on page 1402

Proxy ARP Example (Original CLI Only)

Example: Configuring Proxy ARP

You can configure proxy Address Resolution Protocol (ARP) on switch to enable the switch to respond to ARP queries for network addresses by offering its own MAC address. With proxy ARP enabled, the switch captures and routes traffic to the intended destination.

This example shows how to configure proxy ARP on an access switch:

Requirements

This example uses the following hardware and software components:

- One QFX3500 switch
- Junos OS Release 11.1 or later for the QFX Series

Overview and Topology

This example shows the configuration of proxy ARP on an interface using restricted mode. In restricted mode, the switch does not act as a proxy for hosts on the same subnet.

The topology for this example consists of one switch. When a host wants to communicate with a host that is not already in its ARP table, it broadcasts an ARP request for the MAC address of the destination host:

- When proxy ARP is not enabled, a host that shares the same IP address replies directly to the ARP request, providing its MAC address, and future transmissions are sent directly to the destination host MAC address.
- When proxy ARP is enabled, the switch responds to ARP requests, providing the switch's MAC address—even when the destination IP address is the same as the source IP address. Thus, communications must be sent through the switch and then routed through the switch to the appropriate destination.

Configuration

To configure proxy ARP, perform the following tasks:

CLI Quick Configuration

To quickly configure proxy ARP on an interface, copy the following command and paste it into the switch terminal window:

```
[edit]
set interfaces ge-0/0/3 unit 0 proxy-arp restricted
```

Step-by-Step Procedure

You configure proxy ARP on individual interfaces.

1. To configure proxy ARP on an interface:

```
[edit interfaces]
user@switch# set xe-0/0/3 unit 0 proxy-arp restricted
```

BEST PRACTICE: We recommend that you configure proxy ARP in restricted mode. In restricted mode, the switch does not act as a proxy if the source and target IP addresses are on the same subnet. If you use unrestricted mode, disable gratuitous ARP requests on the interface to avoid a situation wherein the switch's response to a gratuitous ARP request appears to the host to be an indication of an IP conflict.

```
[edit interfaces]
user@switch# set xe-0/0/3 no-gratuitous-arp-request
```

Results

Display the results of the configuration:

```
user@switch> show configuration
  interfaces {
    xe-0/0/3 {
      unit 0 {
        proxy-arp restricted;
        family ethernet-switching;
```

```
    }
  }
```

Verification

To verify that the switch is sending proxy ARP messages, perform these tasks:

- Verifying That the Switch Is Sending Proxy ARP Messages on page 1465

Verifying That the Switch Is Sending Proxy ARP Messages

Purpose Verify that the switch is sending proxy ARP messages.

Action List the system statistics for ARP messages:

```
user@switch> show system statistics arp
arp:
         90060 datagrams received
         34 ARP requests received
         610 ARP replies received
         2 resolution request  received
         0 unrestricted proxy requests
         0 restricted proxy requests
         0 received proxy requests
         0 unrestricted proxy requests not proxied
         0 restricted proxy requests not proxied
         0 datagrams with bogus interface
         0 datagrams with incorrect length
         0 datagrams for non-IP protocol
         0 datagrams with unsupported op code
         0 datagrams with bad protocol address length
         0 datagrams with bad hardware address length
         0 datagrams with multicast source address
         0 datagrams with multicast target address
         0 datagrams with my own hardware address
         0 datagrams for an address not on the interface
         0 datagrams with a broadcast source address
         294 datagrams with source address duplicate to mine
         89113 datagrams which were not for me
         0 packets discarded waiting for resolution
         0 packets sent after waiting for resolution
         309 ARP requests sent
         35 ARP replies sent
         0 requests for memory denied
         0 requests dropped on entry
         0 requests dropped during retry
         0 requests dropped due to interface deletion
         0 requests on unnumbered interfaces
         0 new requests on unnumbered interfaces
         0 replies for from unnumbered interfaces
         0 requests on unnumbered interface with non-subnetted donor
         0 replies from unnumbered interface with non-subnetted donor
```

Meaning The statistics show that two proxy ARP requests were received. The **unrestricted proxy requests not proxied** and **restricted proxy requests not proxied** fields indicate that all the unproxied ARP requests received have been proxied by the switch.

Related Documentation

- Configuring Proxy ARP (CLI Procedure) on page 1552
- Configuring Proxy ARP on page 1551
- Understanding Proxy ARP on page 1417

STP Configuration Examples

Example: Configuring Faster Convergence and Improving Network Stability with RSTP

The QFX Series products use Rapid Spanning Tree Protocol (RSTP) to provide a loop-free topology. RSTP identifies certain links as point to point. When a point-to-point link fails, the alternate link can transition to the forwarding state. RSTP provides quicker reconvergence time than original STP because it uses protocol handshake messages rather than fixed timeouts. Eliminating the need to wait for timers to expire makes RSTP more efficient than STP.

This example describes how to configure RSTP on four QFX3500 switches:

Requirements

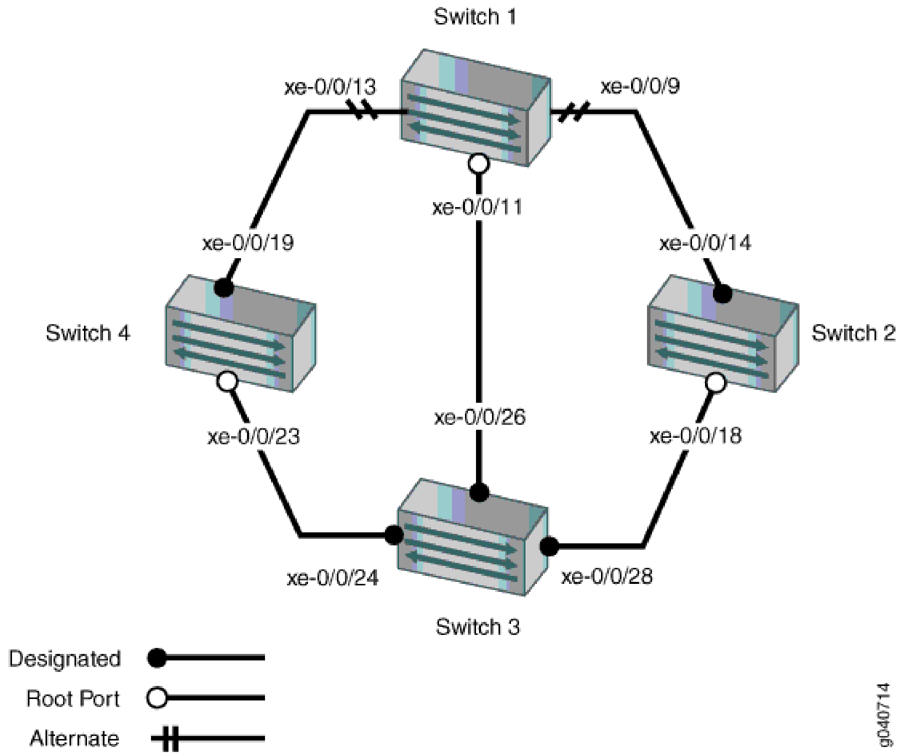
This example uses the following hardware and software components:

- Junos OS Release 11.1 for the QFX3500 switches
- Four QFX3500 switches

Overview and Topology

In this example, QFX3500 switches are connected in the topology displayed in Figure 17 on page 1467 to create a loop-free topology.

Figure 17: Network Topology for RSTP



The interfaces shown in Table 129 on page 1467 will be configured for RSTP.

NOTE: You can configure RSTP on logical or physical interfaces. This example shows RSTP configured on logical interfaces.

Table 129: Topology for Configuring RSTP on the QFX Series

Components	Settings
Switch 1	The following ports on Switch 1 are connected in this way: • **xe-0/0/9** is connected to Switch 2 • **xe-0/0/13** is connected to Switch 4 • **xe-0/0/11** is connected to Switch 3
Switch 2	The following ports on Switch 2 are connected in this way: • **xe-0/0/14** is connected to Switch 1 • **xe-0/0/18** is connected to Switch 3

Table 129: Topology for Configuring RSTP on the QFX Series *(continued)*

Components	Settings
Switch 3	The following ports on Switch 3 are connected in this way: • **xe-0/0/26** is connected to Switch 1 • **xe-0/0/28** is connected to Switch 2 • **xe-0/0/24** is connected to Switch 4
Switch 4	The following ports on Switch 4 are connected in this way: • **xe-0/0/19** is connected to Switch 1 • **xe-0/0/23** is connected to Switch 3
VLAN names and tag IDs	**sales-vlan**, tag **10** **engineering-vlan**, tag **20** **publications-vlan**, tag **30** **support-vlan**, tag **40**

This configuration example creates a loop-free topology between four switches using RSTP.

An RSTP topology contains ports that have specific roles:

- The *root port* is responsible for forwarding data to the root bridge.
- The *alternate port* is a standby port for the root port. When a root port goes down, the alternate port becomes the active root port.
- The *designated port* forwards data to the downstream network segment or device.
- The *backup port* is a backup port for the designated port. When a designated port goes down, the backup port becomes the active designated port and starts forwarding data.

Configuring RSTP on Switch 1

CLI Quick Configuration

To quickly configure interfaces and RSTP on Switch 1, copy the following commands and paste them into the switch terminal window:

NOTE: If you are configuring RSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit]
set vlans sales-vlan description "Sales VLAN"
set vlans sales-vlan vlan-id 10
set vlans engineering-vlan description "Engineering VLAN"
set vlans engineering-vlan vlan-id 20
set vlans publications-vlan description "Publications VLAN"
set vlans publications-vlan vlan-id 30
```

```
set vlans support-vlan description “Support VLAN”
set vlans support-vlan vlan-id 40
set interfaces xe-0/0/13 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/9 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/11 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/13 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/9 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/11 unit 0 family ethernet-switching port-mode trunk
set protocols rstp bridge-priority 16k
set protocols rstp interface xe-0/0/13.0 cost 1000
set protocols rstp interface xe-0/0/13.0 mode point-to-point
set protocols rstp interface xe-0/0/9.0 cost 1000
set protocols rstp interface xe-0/0/9.0 mode point-to-point
set protocols rstp interface xe-0/0/11.0 cost 1000
set protocols rstp interface xe-0/0/11.0 mode point-to-point
```

Step-by-Step Procedure

To configure interfaces and RSTP on Switch 1:

1. Configure the VLANs **sales-vlan**, **engineering-vlan** and **publications-vlan**, and **support-vlan**:

```
[edit vlans]
user@switch1# set sales-vlan description “Sales VLAN”
user@switch1# set sales-vlan vlan-id 10
user@switch1# set engineering-vlan description “Engineering VLAN”
user@switch1# set engineering-vlan vlan-id 20
user@switch1# set publications-vlan description “Publications VLAN”
user@switch1# set publications-vlan vlan-id 30
```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```
[edit interfaces]
user@switch1# set xe-0/0/13 unit 0 family ethernet-switching vlan members [10 20 30
40]
user@switch1# set xe-0/0/9 unit 0 family ethernet-switching vlan members [10 20 30
40]
user@switch1# set xe-0/0/11 unit 0 family ethernet-switching vlan members [10 20 30
40]
```

3. Configure the port mode for the interfaces:

NOTE: If you are configuring RSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit interfaces]
user@switch1# set xe-0/0/13 unit 0 family ethernet-switching port-mode trunk
user@switch1# set xe-0/0/9 unit 0 family ethernet-switching port-mode trunk
user@switch1# set xe-0/0/11 unit 0 family ethernet-switching port-mode trunk
```

4. Configure RSTP on the switch:

```
[edit protocols]
user@switch1# rstp bridge-priority 16k
user@switch1# rstp interface xe-0/0/13.0 cost 1000
user@switch1# rstp interface xe-0/0/13.0 mode point-to-point
user@switch1# rstp interface xe-0/0/9.0 cost 1000
```

```
user@switch1# rstp interface xe-0/0/9.0 mode point-to-point
user@switch1# rstp interface xe-0/0/11.0 cost 1000
user@switch1# rstp interface xe-0/0/11.0 mode point-to-point
```

Results Check the results of the configuration:

```
user@switch1> show configuration
interfaces {
   xe-0/0/13 {
      unit 0 {
         family ethernet-switching {
            port-mode trunk;
            vlan {
               members [10 20 30 40];
            }
         }
      }
   }
   xe-0/0/9 {
      unit 0 {
         family ethernet-switching {
            port-mode trunk;
            vlan {
               members [10 20 30 40];
            }
         }
      }
   }
   xe-0/0/11 {
      unit 0 {
         family ethernet-switching {
            port-mode trunk;
            vlan {
               members [10 20 30 40];
            }
         }
      }
   }
}
protocols {
   rstp {
      bridge-priority 16k;
         interface xe-0/0/13.0 {
            cost 1000;
            mode point-to-point;
         }
         interface xe-0/0/9.0 {
            cost 1000;
            mode point-to-point;
         }
         interface xe-0/0/11.0 {
            cost 1000;
            mode point-to-point;
         }
      }
   }
```



```
}
vlans {
  sales-vlan {
    vlan-id 10;
  }
  engineering-vlan {
    vlan-id 20;
  }
  publications-vlan {
    vlan-id 30;
  }
  support-vlan {
    vlan-id 40;
  }
}
```

Configuring RSTP on Switch 2

CLI Quick Configuration

To quickly configure interfaces and RSTP on Switch 2, copy the following commands and paste them into the switch terminal window:

NOTE: If you are configuring RSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit]
set vlans sales-vlan description "Sales VLAN"
set vlans sales-vlan vlan-id 10
set vlans engineering-vlan description "Engineering VLAN"
set vlans engineering-vlan vlan-id 20
set vlans publications-vlan description "Publications VLAN"
set vlans publications-vlan vlan-id 30
set vlans support-vlan description "Support VLAN"
set vlans support-vlan vlan-id 40
set interfaces xe-0/0/14 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/18 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/14 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/18 unit 0 family ethernet-switching port-mode trunk
set protocols rstp bridge-priority 32k
set protocols rstp interface xe-0/0/14.0 cost 1000
set protocols rstp interface xe-0/0/14.0 mode point-to-point
set protocols rstp interface xe-0/0/18.0 cost 1000
set protocols rstp interface xe-0/0/18.0 mode point-to-point
```

Step-by-Step Procedure

To configure interfaces and RSTP on Switch 2:

1. Configure the VLANs **sales-vlan**, **engineering-vlan** and **publications-vlan**, and **support-vlan**:

```
[edit vlans]
user@switch2# set sales-vlan description “Sales VLAN”
user@switch2# set sales-vlan vlan-id 10
user@switch2# set engineering-vlan description “Engineering VLAN”
user@switch2# set engineering-vlan vlan-id 20
user@switch2# set publications-vlan description “Publications VLAN”
user@switch2# set publications-vlan vlan-id 30
user@switch2# set support-vlan vlan-description “Support VLAN”
user@switch2# set publications-vlan vlan-id 40
```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```
[edit interfaces]
user@switch2# set xe-0/0/14 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch2# set xe-0/0/18 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

NOTE: If you are configuring RSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit interfaces]
user@switch2# set xe-0/0/14 unit 0 family ethernet-switching port-mode trunk
user@switch2# set xe-0/0/18 unit 0 family ethernet-switching port-mode trunk
```

4. Configure RSTP on the switch:

```
[edit protocols]
user@switch2# rstp bridge-priority 32k
user@switch2# rstp interface xe-0/0/14.0 cost 1000
user@switch2# rstp interface xe-0/0/14.0 mode point-to-point
user@switch2# rstp interface xe-0/0/18.0 cost 1000
user@switch2# rstp interface xe-0/0/18.0 mode point-to-point
```

Results

Check the results of the configuration:

```
user@switch2> show configuration
interfaces {
  xe-0/0/14 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members [10 20 30 40];
        }
      }
    }
  }
```

```
      xe-0/0/18 {
        unit 0 {
          family ethernet-switching {
            port-mode trunk;
            vlan {
              members [10 20 30 40];
            }
          }
        }
      }
    }
    protocols {
      rstp {
        bridge-priority 32k;
          interface xe-0/0/14.0 {
            cost 1000;
            mode point-to-point;
          }
          interface xe-0/0/18.0 {
            cost 1000;
            mode point-to-point;
          }
        }
      }
    }
    vlans {
      sales-vlan {
        vlan-id 10;
      }
      engineering-vlan {
        vlan-id 20;
      }
      publications-vlan {
        vlan-id 30;
      }
      support-vlan {
        vlan-id 40;
      }
    }
```

Configuring RSTP on Switch 3

CLI Quick Configuration

To quickly configure interfaces and RSTP on Switch 3, copy the following commands and paste them into the switch terminal window:

NOTE: If you are configuring RSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit]
set vlans sales-vlan description “Sales VLAN”
```

```
set vlans sales-vlan vlan-id 10
set vlans engineering-vlan description "Engineering VLAN"
set vlans engineering-vlan vlan-id 20
set vlans publications-vlan description "Publications VLAN"
set vlans publications-vlan vlan-id 30
set vlans support-vlan description "Support VLAN"
set vlans support-vlan vlan-id 40
set interfaces xe-0/0/26 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/28 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/24 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/26 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/28 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/24 unit 0 family ethernet-switching port-mode trunk
set protocols rstp bridge-priority 8k
set protocols rstp interface xe-0/0/26.0 cost 1000
set protocols rstp interface xe-0/0/26.0 mode point-to-point
set protocols rstp interface xe-0/0/28.0 cost 1000
set protocols rstp interface xe-0/0/28.0 mode point-to-point
set protocols rstp interface xe-0/0/24.0 cost 1000
set protocols rstp interface xe-0/0/24.0 mode point-to-point
```

Step-by-Step Procedure

To configure interfaces and RSTP on Switch 3:

1. Configure the VLANs **sales-vlan**, **engineering-vlan**, **publications-vlan**, and **support-vlan**:

```
[edit vlans]
user@switch3# set sales-vlan description "Sales VLAN"
user@switch3# set sales-vlan vlan-id 10
user@switch3# set engineering-vlan description "Engineering VLAN"
user@switch3# set engineering-vlan vlan-id 20
user@switch3# set publications-vlan description "Publications VLAN"
user@switch3# set publications-vlan vlan-id 30
user@switch3# set support-vlan description "Support VLAN"
user@switch3# set publications-vlan vlan-id 40
```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```
[edit interfaces]
user@switch3# set xe-0/0/26 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch3# set xe-0/0/28 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch3# set xe-0/0/24 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

> NOTE: If you are configuring RSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit interfaces]
user@switch3# set xe-0/0/26 unit 0 family ethernet-switching port-mode trunk
user@switch3# set xe-0/0/28 unit 0 family ethernet-switching port-mode trunk
user@switch3# set xe-0/0/24 unit 0 family ethernet-switching port-mode trunk
```

4. Configure RSTP on the switch:


```
[edit protocols]
user@switch3# rstp bridge-priority 8k
user@switch3# rstp interface xe-0/0/26.0 cost 1000
user@switch3# rstp interface xe-0/0/26.0 mode point-to-point
user@switch3# rstp interface xe-0/0/28.0 cost 1000
user@switch3# rstp interface xe-0/0/28.0 mode point-to-point
user@switch3# rstp interface xe-0/0/24.0 cost 1000
user@switch3# rstp interface xe-0/0/24.0 mode point-to-point
```

Results Check the results of the configuration:

```
user@switch3> show configuration
  interfaces {
    xe-0/0/26 {
      unit 0 {
        family ethernet-switching {
          port-mode trunk;
          vlan {
            members [10 20 30 40];
          }
        }
      }
    }
    xe-0/0/28 {
      unit 0 {
        family ethernet-switching {
          port-mode trunk;
          vlan {
            members [10 20 30 40];
          }
        }
      }
    }
    xe-0/0/24 {
      unit 0 {
        family ethernet-switching {
          port-mode trunk;
          vlan {
            members [10 20 30 40];
          }
        }
      }
    }
  }
}
protocols {
  rstp {
    bridge-priority 8k;
      interface xe-0/0/26.0 {
        cost 1000;
        mode point-to-point;
      }
      interface xe-0/0/28.0 {
        cost 1000;
        mode point-to-point;
      }
```

```
          interface xe-0/0/24.0 {
            cost 1000;
            mode point-to-point;
          }
        }
        bridge-priority 8k;
          }
        }
      }
    }
    vlans {
      sales-vlan {
        vlan-id 10;
      }
      engineering-vlan {
        vlan-id 20;
      }
      publications-vlan {
        vlan-id 30;
      }
      support-vlan {
        vlan-id 40;
      }
    }
```

Configuring RSTP on Switch 4

CLI Quick Configuration

To quickly configure interfaces and RSTP on Switch 4, copy the following commands and paste them into the switch terminal window:

NOTE: If you are configuring RSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit]
set vlans sales-vlan description “Sales VLAN”
set vlans sales-vlan vlan–id 10
set vlans engineering-vlan description “Engineering VLAN”
set vlans engineering-vlan vlan-id 20
set vlans publications-vlan description “Publications VLAN”
set vlans publications-vlan vlan-id 30
set vlans support-vlan description “Support VLAN”
set vlans support-vlan vlan-id 40
set interfaces xe-0/0/23 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/19 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/23 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/19 unit 0 family ethernet-switching port-mode trunk
set protocols rstp bridge-priority 16k
set protocols rstp interface xe-0/0/23.0 cost 1000
set protocols rstp interface xe-0/0/23.0 mode point-to-point
set protocols rstp interface xe-0/0/19.0 cost 1000
set protocols rstp interface xe-0/0/19.0 mode point-to-point
```

Step-by-Step Procedure

To configure interfaces and RSTP on Switch 4:

1. Configure the VLANs **sales-vlan**, **engineering-vlan**, **publications-vlan**, and **support-vlan**:

```
[edit vlans]
user@switch4# set sales-vlan description "Sales VLAN"
user@switch4# set sales-vlan vlan-id 10
user@switch4# set engineering-vlan description "Engineering VLAN"
user@switch4# set engineering-vlan vlan-id 20
user@switch4# set publications-vlan description "Publications VLAN"
user@switch4# set publications-vlan vlan-id 30
user@switch4# set support-vlan description "Support VLAN"
user@switch4# set publications-vlan vlan-id 40
```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```
[edit interfaces]
user@switch4# set xe-0/0/23 unit 0 family ethernet-switching vlan members [10 20 30
40]
user@switch4# set xe-0/0/19 unit 0 family ethernet-switching vlan members [10 20 30
40]
```

3. Configure the port mode for the interfaces:

> NOTE: If you are configuring RSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit interfaces]
user@switch4# set xe-0/0/23 unit 0 family ethernet-switching port-mode trunk
user@switch4# set xe-0/0/19 unit 0 family ethernet-switching port-mode trunk
```

4. Configure RSTP on the switch:

```
[edit protocols]
user@switch4# rstp bridge-priority 16k
user@switch4# rstp interface all cost 1000
user@switch4# rstp interface xe-0/0/23.0 cost 1000
user@switch4# rstp interface xe-0/0/23.0 mode point-to-point
user@switch4# rstp interface xe-0/0/19.0 cost 1000
user@switch4# rstp interface xe-0/0/19.0 mode point-to-point
```

Results

Check the results of the configuration:

```
user@switch4> show configuration
interfaces {
  xe-0/0/23 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members [10 20 30 40];
        }
      }
    }
  }
```



```
    xe-0/0/19 {
      unit 0 {
        family ethernet-switching {
          port-mode trunk;
          vlan {
            members [10 20 30 40];
          }
        }
      }
    }
  }
  protocols {
    rstp {
      bridge-priority 16k;
        interface xe-0/0/23.0 {
          cost 1000;
          mode point-to-point;
        }
        interface xe-0/0/19.0 {
          cost 1000;
          mode point-to-point;
        }
      }
    }
  }
  vlans {
    sales-vlan {
      vlan-id 10;
    }
    engineering-vlan {
      vlan-id 20;
    }
    publications-vlan {
      vlan-id 30;
    }
    support-vlan {
      vlan-id 40;
    }
  }
```

Verification

To confirm that the configuration is working properly, perform these tasks:

- Verifying RSTP Configuration on Switch 1 on page 1478
- Verifying RSTP Configuration on Switch 2 on page 1479
- Verifying RSTP Configuration on Switch 3 on page 1479
- Verifying RSTP Configuration on Switch 4 on page 1480

Verifying RSTP Configuration on Switch 1

Purpose Verify that the RSTP configuration on Switch 1 is correct.

Action In operational mode, issue the **show spanning-tree interface** command:

```
user@switch1> show spanning-tree interface

Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/13.0     128:527      128:525   16384.0019e25040e0     1000   BLK    ALT
xe-0/0/9.0      128:529      128:513   32768.0019e2503d20     1000   BLK    ALT
xe-0/0/11.0     128:531      128:513    8192.0019e25051e0     1000   FWD    ROOT
```

Meaning See the topology in Figure 17 on page 1467. The operational mode command **show spanning-tree interface** shows that **xe-0/0/13.0** is in a forwarding state. The other interfaces on Switch 1 are blocked.

Verifying RSTP Configuration on Switch 2

Purpose Verify that the RSTP configuration on Switch 2 is correct.

Action In operational mode issue the **show spanning-tree interface** command:

```
user@switch2> show spanning-tree interface


Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/14.0     128:513      128:513   32768.0019e2503d20     1000   BLK    DESG
xe-0/0/18.0     128:519      128:515    8192.0019e25051e0     1000   FWD    ROOT
```

Meaning See the topology in Figure 17 on page 1467. The operational mode command **show spanning-tree interface** shows that interface **xe-0/0/18.0** is in a forwarding state and the root port. The other interface on Switch 2 is blocked.

Verifying RSTP Configuration on Switch 3

Purpose Verify that the RSTP configuration on Switch 3 is correct.

Action In operational mode, issue the **show spanning-tree interface** command:

```
user@switch3> show spanning-tree interface

Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/26.0     128:513       128:513   8192.0019e25051e0      1000   FWD     DESG
xe-0/0/28.0     128:515       128:515   8192.0019e25051e0      1000   FWD     DESG
xe-0/0/24.0     128:517       128:517   8192.0019e25051e0      1000   FWD     DESG
```

Meaning See the topology in Figure 17 on page 1467. The operational mode command **show spanning-tree interface** shows that no interface is the root interface.

Verifying RSTP Configuration on Switch 4

Purpose Verify the RSTP configuration on Switch 4.

Action In operational mode, issue the **show spanning-tree interface** command:

```
user@switch4> show spanning-tree interface
Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost

xe-0/0/23.0    128:523       128:517   8192.0019e25051e0      1000   FWD     ROOT
xe-0/0/19.0    128:525       128:525  16384.0019e25040e0      1000   FWD     DESG
```

Meaning See the topology in Figure 17 on page 1467. The operational mode command **show spanning-tree interface** shows that interface **xe-0/0/23.0** is the root interface and is in the forwarding state.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Understanding RSTP on page 1421

Example: Configuring Network Regions for VLANs with MSTP

Multiple Spanning Tree Protocol (MSTP) is used to create a loop-free topology in networks using multiple spanning-tree regions, each region containing multiple spanning-tree instances (MSTIs). MSTIs provide different paths for different VLANs. This functionality facilitates more efficient load sharing across redundant links.

You can create up to 64 MSTI instances for QFX Series products, and each MSTI supports up to 4094 VLANs.

This example describes how to configure MSTP on four QFX3500 switches:

Requirements

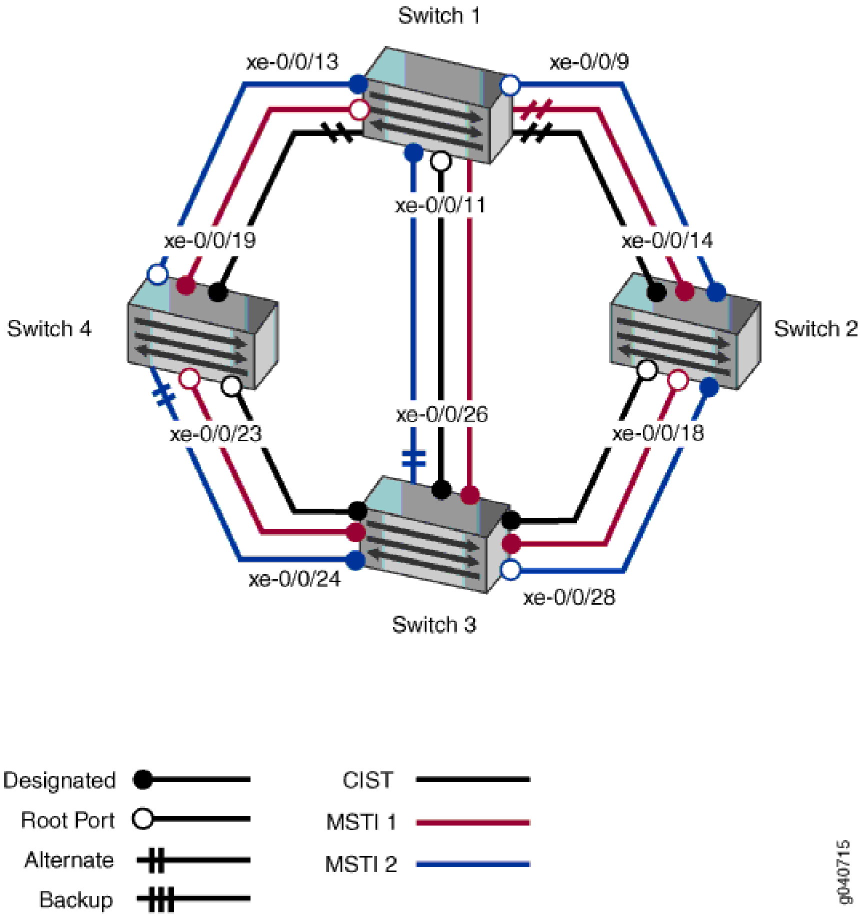
This example uses the following hardware and software components:

- Junos OS Release 11.1 for the QFX3500 switches
- Four QFX3500 switches

Overview and Topology

When the number of VLANs grows in a network, MSTP provides a more faster way of creating a loop-free topology using MSTIs. Each MSTI in the spanning-tree domain maintains its own tree. Each tree can be mapped to different links, utilizing bandwidth that would be unavailable to a single tree. MSTIs reduce demand on system resources.

Figure 18: Network Topology for MSTP



The interfaces shown in Table 130 on page 1482 will be configured for MSTP.

NOTE: You can configure MSTP on logical or physical interfaces. This example shows MSTP configured on logical interfaces.

Table 130: Topology for Configuring MSTP on the QFX Series

Components	Settings
Switch 1	The following ports on Switch 1 are connected in this way: • **xe-0/0/9** is connected to Switch 2 • **xe-0/0/13** is connected to Switch 4 • **xe-0/0/11** is connected to Switch 3
Switch 2	The following ports on Switch 2 are connected in this way: • **xe-0/0/14** is connected to Switch 1 • **xe-0/0/18** is connected to Switch 3

Table 130: Topology for Configuring MSTP on the QFX Series *(continued)*

Components	Settings
Switch 3	The following ports on Switch 3 are connected in this way: • **xe-0/0/26** is connected to Switch 1 • **xe-0/0/28** is connected to Switch 2 • **xe-0/0/24** is connected to Switch 4
Switch 4	The following ports on Switch 4 are connected in this way: • **xe-0/0/19** is connected to Switch 1 • **xe-0/0/23** is connected to Switch 3
VLAN names and tag IDs	**sales-vlan**, tag **10** **engineering-vlan**, tag **20** **publications-vlan**, tag **30** **support-vlan**, tag **40**
MSTIs	**1** **2**

The topology in Figure 18 on page 1482 shows a Common Internal Spanning Tree (CIST). The CIST is a single spanning tree connecting all devices in the network. The switch with the highest priority is elected as the root bridge of the CIST.

Also in an MSTP topology are ports that have specific roles:

- The *root port* is responsible for forwarding data to the root bridge.
- The *alternate port* is a standby port for the root port. When a root port goes down, the alternate port becomes the active root port.
- The *designated port* forwards data to the downstream network segment or device.
- The *backup port* is a backup port for the designated port. When a designated port goes down, the backup port becomes the active designated port and starts forwarding data.

In this example, one MSTP region, **region1**, contains Switch 1, Switch 2, Switch 3, and Switch 4. Within the region, four VLANs are created:

- The **sales-vlan** supports sales traffic and has a VLAN tag identifier of 10.
- The **engineering-vlan** supports data traffic and has a VLAN tag identifier of 20.
- The **publications-vlan** supports publications VLAN traffic (for supplicants that fail 802.1X authentication) and has a VLAN tag identifier of 30.
- The **support-vlan** supports video traffic and has a VLAN tag identifier of 40.

The VLANs are associated with specific interfaces on each of the four switches. Two MSTIs, **1** and **2**, are then associated with the VLAN tag identifiers, and some MSTP parameters, such as cost, are configured on each switch.

Configuring MSTP on Switch 1

CLI Quick Configuration

To quickly configure interfaces and MSTP on Switch 1, copy the following commands and paste them into the switch terminal window:

NOTE: If you are configuring MSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit]
set vlans sales-vlan description “Sales VLAN”
set vlans sales-vlan vlan-id 10
set vlans engineering-vlan description “Engineering VLAN”
set vlans engineering-vlan vlan-id 20
set vlans publications-vlan description “Publications VLAN”
set vlans publications-vlan vlan-id 30
set vlans support-vlan description “Support VLAN”
set vlans support-vlan vlan-id 40
set interfaces xe-0/0/13 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/9 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/11 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/13 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/9 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/11 unit 0 family ethernet-switching port-mode trunk
set protocols mstp configuration-name region1
set protocols mstp bridge-priority 16k
set protocols mstp interface xe-0/0/13.0 cost 1000
set protocols mstp interface xe-0/0/13.0 mode point-to-point
set protocols mstp interface xe-0/0/9.0 cost 1000
set protocols mstp interface xe-0/0/9.0 mode point-to-point
set protocols mstp interface xe-0/0/11.0 cost 1000
set protocols mstp interface xe-0/0/11.0 mode point-to-point
set protocols mstp msti 1 bridge-priority 16k
set protocols mstp msti 1 vlan [10 20]
set protocols mstp msti 1 interface xe-0/0/11.0 cost 4000
set protocols mstp msti 2 bridge-priority 8k
set protocols mstp msti 2 vlan [30 40]
```

Step-by-Step Procedure

To configure interfaces and MSTP on Switch 1:

1. Configure the VLANs **sales-vlan**, **engineering-vlan**, **publications-vlan**, and **support-vlan**:

   ```
   [edit vlans]
   user@switch1# set sales-vlan description “Sales VLAN”
   user@switch1# set sales-vlan vlan-id 10
   user@switch1# set engineering-vlan description “Engineering VLAN”
   user@switch1# set engineering-vlan vlan-id 20
   user@switch1# set publications-vlan description “Publications VLAN”
   user@switch1# set publications-vlan vlan-id 30
   user@switch1# set support-vlan description “Support VLAN”
   user@switch1# set publications-vlan vlan-id 40
   ```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```
[edit interfaces]
user@switch1# set xe-0/0/13 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch1# set xe-0/0/9 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch1# set xe-0/0/11 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

> NOTE: If you are configuring MSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit interfaces]
user@switch1# set xe-0/0/13 unit 0 family ethernet-switching port-mode trunk
user@switch1# set xe-0/0/9 unit 0 family ethernet-switching port-mode trunk
user@switch1# set xe-0/0/11 unit 0 family ethernet-switching port-mode trunk
```

4. Configure MSTP on the switch, including the two MSTIs:

```
[edit protocols]
user@switch1# mstp configuration-name region1
user@switch1# mstp bridge-priority 16k
user@switch1# mstp interface xe-0/0/13.0 cost 1000
user@switch1# mstp interface xe-0/0/13.0 mode point-to-point
user@switch1# mstp interface xe-0/0/9.0 cost 1000
user@switch1# mstp interface xe-0/0/9.0 mode point-to-point
user@switch1# mstp interface xe-0/0/11.0 cost 4000
user@switch1# mstp interface xe-0/0/11.0 mode point-to-point
user@switch1# mstp msti 1 bridge-priority 16k
user@switch1# mstp msti 1 vlan [10 20]
user@switch1# mstp msti 1 interface xe-0/0/11.0 cost 4000
user@switch1# mstp msti 2 bridge-priority 8k
user@switch1# mstp msti 2 vlan [30 40]
```

Results Check the results of the configuration:

```
user@switch1> show configuration
interfaces {
  xe-0/0/13 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members 10;
          members 20;
          members 30;
          members 40;
        }
      }
    }
  }
  xe-0/0/9 {
    unit 0 {
      family ethernet-switching {
```

```
                port-mode trunk;
                vlan {
                    members 10;
                    members 20;
                    members 30;
                    members 40;
                }
            }
        }
    }
    xe-0/0/11 {
        unit 0 {
            family ethernet-switching {
                port-mode trunk;
                vlan {
                    members 10;
                    members 20;
                    members 30;
                    members 40;
                }
            }
        }
    }
}
protocols {
    mstp {
        configuration-name region1;
    bridge-priority 16k;
        interface xe-0/0/13.0 {
            cost 1000;
            mode point-to-point;
        }
        interface xe-0/0/9.0 {
            cost 1000;
            mode point-to-point;
        }
        interface xe-0/0/11.0 {
            cost 4000;
            mode point-to-point;
        }
    msti 1 {
        bridge-priority 16k;
        vlan [ 10 20 ];
        interface xe-0/0/11.0 {
            cost 4000;
        }
    }
    msti 2 {
        bridge-priority 8k;
        vlan [ 30 40 ];
    }
}
vlans {
    sales-vlan {
        vlan-id 10;
    }
```

```
    engineering-vlan {
      vlan-id 20;
    }
    publications-vlan {
      vlan-id 30;
    }
    support-vlan {
      vlan-id 40;
    }
  }
```

Configuring MSTP on Switch 2

CLI Quick Configuration

To quickly configure interfaces and MSTP on Switch 2, copy the following commands and paste them into the switch terminal window:

NOTE: If you are configuring MSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit]
set vlans sales-vlan description “Sales VLAN”
set vlans sales-vlan vlan-id 10
set vlans engineering-vlan description “Engineering VLAN”
set vlans engineering-vlan vlan-id 20
set vlans publications-vlan description “Publications VLAN”
set vlans publications-vlan vlan-id 30
set vlans support-vlan description “Support VLAN”
set vlans support-vlan vlan-id 40
set interfaces xe-0/0/14 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/18 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/14 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/18 unit 0 family ethernet-switching port-mode trunk
set protocols mstp configuration-name region1
set protocols mstp bridge-priority 32k
set protocols mstp interface xe-0/0/14.0 cost 1000
set protocols mstp interface xe-0/0/14.0 mode point-to-point
set protocols mstp interface xe-0/0/18.0 cost 1000
set protocols mstp interface xe-0/0/18.0 mode point-to-point
set protocols mstp msti 1 bridge-priority 32k
set protocols mstp msti 1 vlan [10 20]
set protocols mstp msti 2 bridge-priority 4k
set protocols mstp msti 2 vlan [30 40]
```


Step-by-Step Procedure

To configure interfaces and MSTP on Switch 2:

1. Configure the VLANs **sales-vlan**, **engineering-vlan**, **publications-vlan**, and **support-vlan**:

```
[edit vlans]
user@switch2# set sales-vlan description “Sales VLAN”
user@switch2# set sales-vlan vlan-id 10
user@switch2# set engineering-vlan description “Engineering VLAN”
user@switch2# set engineering-vlan vlan-id 20
user@switch2# set publications-vlan description “Publications VLAN”
user@switch2# set publications-vlan vlan-id 30
user@switch2# set support-vlan vlan-description “Support VLAN”
user@switch2# set publications-vlan vlan-id 40
```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```
[edit interfaces]
user@switch2# set xe-0/0/14 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch2# set xe-0/0/18 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

NOTE: If you are configuring MSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit interfaces]
user@switch2# set xe-0/0/14 unit 0 family ethernet-switching port-mode trunk
user@switch2# set xe-0/0/18 unit 0 family ethernet-switching port-mode trunk
```

4. Configure MSTP on the switch, including the two MSTIs:

```
[edit protocols]
user@switch2# mstp configuration-name region1
user@switch2# mstp bridge-priority 32k
user@switch2# mstp interface xe-0/0/14.0 cost 1000
user@switch2# mstp interface xe-0/0/14.0 mode point-to-point
user@switch2# mstp interface xe-0/0/18.0 cost 1000
user@switch2# mstp interface xe-0/0/18.0 mode point-to-point
user@switch2# mstp interface all cost 1000
user@switch2# mstp msti 1 bridge-priority 32k
user@switch2# mstp msti 1 vlan [10 20]
user@switch2# mstp msti 2 bridge-priority 4k
user@switch2# mstp msti 2 vlan [30 40]
```

Results

Check the results of the configuration:

```
user@switch2> show configuration
interfaces {
  xe-0/0/14 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
```

```
                members 10;
                members 20;
                members 30;
                members 40;
              }
            }
          }
        }
        xe-0/0/18 {
          unit 0 {
            family ethernet-switching {
              port-mode trunk;
              vlan {
                members 10;
                members 20;
                members 30;
                members 40;
              }
            }
          }
        }
      }
      protocols {
        mstp {
          configuration-name region1;
          bridge-priority 32k;
          interface xe-0/0/14.0 {
            cost 1000;
            mode point-to-point;
          }
          interface xe-0/0/18.0 {
            cost 1000;
            mode point-to-point;
          }
          msti 1 {
            bridge-priority 32k;
            vlan [ 10 20 ];
          }
          msti 2 {
            bridge-priority 4k;
            vlan [ 30 40 ];
          }
        }
      }
      vlans {
        sales-vlan {
          vlan-id 10;
        }
        engineering-vlan {
          vlan-id 20;
        }
        publications-vlan {
          vlan-id 30;
        }
        support-vlan {
          vlan-id 40;
```

```
  }
}
```

Configuring MSTP on Switch 3

CLI Quick Configuration

To quickly configure interfaces and MSTP on Switch 3, copy the following commands and paste them into the switch terminal window:

NOTE: If you are configuring MSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit]
set vlans sales-vlan description “Sales VLAN”
set vlans sales-vlan vlan-id 10
set vlans engineering-vlan description “Engineering VLAN”
set vlans engineering-vlan vlan-id 20
set vlans publications-vlan description “Publications VLAN”
set vlans publications-vlan vlan-id 30
set vlans support-vlan description “Support VLAN”
set vlans support-vlan vlan-id 40
set interfaces xe-0/0/26 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/28 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/24 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/26 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/28 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/24 unit 0 family ethernet-switching port-mode trunk
set protocols mstp configuration-name region1
set protocols mstp bridge-priority 8k
set protocols mstp interface xe-0/0/26.0 cost 1000
set protocols mstp interface xe-0/0/26.0 mode point-to-point
set protocols mstp interface xe-0/0/28.0 cost 1000
set protocols mstp interface xe-0/0/28.0 mode point-to-point
set protocols mstp interface xe-0/0/24.0 cost 1000
set protocols mstp interface xe-0/0/24.0 mode point-to-point
set protocols mstp msti 1 bridge-priority 4k
set protocols mstp msti 1 vlan [10 20]
set protocols mstp msti 2 bridge-priority 16k
set protocols mstp msti 2 vlan [30 40]
```

Step-by-Step Procedure

To configure interfaces and MSTP on Switch 3:

1. Configure the VLANs **sales-vlan**, **engineering-vlan**, **publications-vlan**, and **support-vlan**:

```
[edit vlans]
user@switch3# set sales-vlan description “Sales VLAN”
user@switch3# set sales-vlan vlan-id 10
user@switch3# set engineering-vlan description “Engineering VLAN”
user@switch3# set engineering-vlan vlan-id 20
user@switch3# set publications-vlan description “Publications VLAN”
user@switch3# set publications-vlan vlan-id 30
user@switch3# set support-vlan description “Support VLAN”
user@switch3# set publications-vlan vlan-id 40
```


2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```
[edit interfaces]
user@switch3# set xe-0/0/26 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch3# set xe-0/0/28 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch3# set xe-0/0/24 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

NOTE: If you are configuring MSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit interfaces]
user@switch3# set xe-0/0/26 unit 0 family ethernet-switching port-mode trunk
user@switch3# set xe-0/0/28 unit 0 family ethernet-switching port-mode trunk
user@switch3# set xe-0/0/24 unit 0 family ethernet-switching port-mode trunk
```

4. Configure MSTP on the switch, including the two MSTIs:

```
[edit protocols]
user@switch3# mstp configuration-name region1
user@switch3# mstp bridge-priority 8k
user@switch3# mstp interface xe-0/0/26.0 cost 1000
user@switch3# mstp interface xe-0/0/26.0 mode point-to-point
user@switch3# mstp interface xe-0/0/28.0 cost 1000
user@switch3# mstp interface xe-0/0/28.0 mode point-to-point
user@switch3# mstp interface xe-0/0/24.0 cost 1000
user@switch3# mstp interface xe-0/0/24.0 mode point-to-point
user@switch3# mstp interface all cost 1000
user@switch3# mstp msti 1 bridge-priority 4k
user@switch3# mstp msti 1 vlan [10 20]
user@switch3# mstp msti 2 bridge-priority 16k
user@switch3# mstp msti 2 vlan [30 40]
```

Results Check the results of the configuration:

```
user@switch3> show configuration
  interfaces {
    xe-0/0/26 {
      unit 0 {
        family ethernet-switching {
          port-mode trunk;
          vlan {
            members 10;
            members 20;
            members 30;
            members 40;
          }
        }
      }
    }
```

```
        xe-0/0/28 {
            unit 0 {
                family ethernet-switching {
                    port-mode trunk;
                    vlan {
                        members 10;
                        members 20;
                        members 30;
                        members 40;
                    }
                }
            }
        }
        xe-0/0/24 {
            unit 0 {
                family ethernet-switching {
                    port-mode trunk;
                    vlan {
                        members 10;
                        members 20;
                        members 30;
                        members 40;
                    }
                }
            }
        }
    }
}
protocols {
    mstp {
        configuration-name region1;
        bridge-priority 8k;
        interface xe-0/0/26.0 {
            cost 1000;
            mode point-to-point;
        }
        interface xe-0/0/28.0 {
            cost 1000;
            mode point-to-point;
        }
        interface xe-0/0/24.0 {
            cost 1000;
            mode point-to-point;
        }
        msti 1 {
            bridge-priority 4k;
            vlan [ 10 20 ];
        }
        msti 2 {
            bridge-priority 16k;
            vlan [ 30 40 ];
        }
    }
}
vlans {
    sales-vlan {
```

```
        vlan-id 10;
    }
    engineering-vlan {
        vlan-id 20;
    }
    publications-vlan {
        vlan-id 30;
    }
    support-vlan {
        vlan-id 40;
    }
}
```

Configuring MSTP on Switch 4

CLI Quick Configuration

To quickly configure interfaces and MSTP on Switch 4, copy the following commands and paste them into the switch terminal window:

NOTE: If you are configuring MSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit]
set vlans sales-vlan description “Sales VLAN”
set vlans sales-vlan vlan-id 10
set vlans engineering-vlan description “Engineering VLAN”
set vlans engineering-vlan vlan-id 20
set vlans publications-vlan description “Publications VLAN”
set vlans publications-vlan vlan-id 30
set vlans support-vlan description “Support VLAN”
set vlans support-vlan vlan-id 40
set interfaces xe-0/0/23 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/19 unit 0 family ethernet-switching vlan members [10 20 30 40]
set interfaces xe-0/0/23 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/19 unit 0 family ethernet-switching port-mode trunk
set protocols mstp configuration-name region1
set protocols mstp bridge-priority 16k
set protocols mstp interface xe-0/0/23.0 cost 1000
set protocols mstp interface xe-0/0/23.0 mode point-to-point
set protocols mstp interface xe-0/0/19.0 cost 1000
set protocols mstp interface xe-0/0/19.0 mode point-to-point
set protocols mstp msti 1 bridge-priority 16k
set protocols mstp msti 1 vlan [10 20]
set protocols mstp msti 2 bridge-priority 32k
set protocols mstp msti 2 vlan [30 40]
```

Step-by-Step Procedure

To configure interfaces and MSTP on Switch 4:

1. Configure the VLANs **sales-vlan**, **engineering-vlan**, **publications-vlan**, and **support-vlan**:

```
[edit vlans]
user@switch4# set sales-vlan description “Sales VLAN”
user@switch4# set sales-vlan vlan-id 10
user@switch4# set engineering-vlan description “Engineering VLAN”
user@switch4# set engineering-vlan vlan-id 20
user@switch4# set publications-vlan description “Publications VLAN”
user@switch4# set publications-vlan vlan-id 30
user@switch4# set support-vlan description “Support VLAN”
user@switch4# set publications-vlan vlan-id 40
```

2. Configure the VLANs on the interfaces, including support for the Ethernet switching protocol:

```
[edit interfaces]
user@switch4# set xe-0/0/23 unit 0 family ethernet-switching vlan members [10 20 30 40]
user@switch4# set xe-0/0/19 unit 0 family ethernet-switching vlan members [10 20 30 40]
```

3. Configure the port mode for the interfaces:

NOTE: If you are configuring MSTP on devices that support the Enhanced Layer 2 Switching (ELS) CLI, use the **interface-mode** statement instead of the **port-mode** statement. The **port-mode** statement has been replaced with the **interface-mode** statement.

```
[edit interfaces]
user@switch4# set ge-0/0/23 unit 0 family ethernet-switching port-mode trunk
user@switch4# set ge-0/0/19 unit 0 family ethernet-switching port-mode trunk
```

4. Configure MSTP on the switch, including the two MSTIs:

```
[edit protocols]
user@switch4# mstp configuration-name region1
user@switch4# mstp bridge-priority 16k
user@switch4# mstp interface all cost 1000
user@switch4# mstp interface xe-0/0/23.0 cost 1000
user@switch4# mstp interface xe-0/0/23.0 mode point-to-point
user@switch4# mstp interface xe-0/0/19.0 cost 1000
user@switch4# mstp interface xe-0/0/19.0 mode point-to-point
user@switch4# mstp msti 1 bridge-priority 16k
user@switch4# mstp msti 1 vlan [10 20]
user@switch4# mstp msti 2 bridge-priority 32k
user@switch4# mstp msti 2 vlan [30 40]
```

Results

Check the results of the configuration:

```
user@switch4> show configuration
interfaces {
  xe-0/0/23 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
```

```
                members 10;
                members 20;
                members 30;
                members 40;
              }
            }
          }
        }
        xe-0/0/19 {
          unit 0 {
            family ethernet-switching {
              port-mode trunk;
              vlan {
                members 10;
                members 20;
                members 30;
                members 40;
              }
            }
          }
        }
      }
      protocols {
        mstp {
          configuration-name region1;
          bridge-priority 16k;
          interface xe-0/0/23.0 {
            cost 1000;
            mode point-to-point;
          }
          interface xe-0/0/19.0 {
            cost 1000;
            mode point-to-point;
          }
          msti 1 {
            bridge-priority 16k;
            vlan [ 10 20 ];
          }
          msti 2 {
            bridge-priority 32k;
            vlan [ 30 40 ];
          }
        }
      }
      vlans {
        sales-vlan {
          vlan-id 10;
        }
        engineering-vlan {
          vlan-id 20;
        }
        publications-vlan {
          vlan-id 30;
        }
        support-vlan {
          vlan-id 40;
```

```
    }
  }
```

Verification

To confirm that the configuration is working properly, perform these tasks:

Verifying MSTP Configuration on Switch 1

Purpose Verify the MSTP configuration on Switch 1.

Action Use the operational mode commands:

```
user@switch1> show spanning-tree interface
Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID         bridge ID          Cost
xe-0/0/13.0     128:527      128:525   16384.0019e25040e0     1000   FWD    ROOT
xe-0/0/9.0      128:529      128:513   32768.0019e2503d20     1000   BLK    ALT
xe-0/0/11.0     128:531      128:513    8192.0019e25051e0     4000   BLK    ALT

Spanning tree interface parameters for instance 1

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID         bridge ID          Cost
xe-0/0/13.0     128:527      128:525   16385.0019e25040e0     1000   FWD    ROOT
xe-0/0/9.0      128:529      128:513   32769.0019e2503d20     1000   BLK    ALT
xe-0/0/11.0     128:531      128:513    4097.0019e25051e0     4000   BLK    ALT

Spanning tree interface parameters for instance 2

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID         bridge ID          Cost
xe-0/0/13.0     128:527      128:527    8194.0019e25044e0     1000   FWD    DESG
xe-0/0/9.0      128:529      128:513    4098.0019e2503d20     1000   FWD    ROOT
xe-0/0/11.0     128:531      128:531    8194.0019e25044e0     1000   FWD    DESG
```

```
user@switch1> show spanning-tree bridge
STP bridge parameters
Context ID                          : 0
Enabled protocol                    : MSTP

STP bridge parameters for CIST
  Root ID                           : 8192.00:19:e2:50:51:e0
  Root cost                         : 0
  Root port                         : xe-0/0/13.0
  CIST regional root                : 8192.00:19:e2:50:51:e0
  CIST internal root cost           : 2000
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Hop count                         : 18
  Message age                       : 0
  Number of topology changes        : 3
  Time since last topology change   : 921 seconds
  Local parameters
    Bridge ID                       : 16384.00:19:e2:50:44:e0
    Extended system ID              : 0
    Internal instance ID            : 0

STP bridge parameters for MSTI 1
  MSTI regional root                : 4097.00:19:e2:50:51:e0
  Root cost                         : 2000
  Root port                         : xe-0/0/13.0
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Hop count                         : 18
  Local parameters
    Bridge ID                       : 16385.00:19:e2:50:44:e0
```

```
    Extended system ID            : 0
    Internal instance ID          : 1

STP bridge parameters for MSTI 2
  MSTI regional root              : 4098.00:19:e2:50:3d:20
  Root cost                       : 1000
  Root port                       : xe-0/0/9.0
  Hello time                      : 2 seconds
  Maximum age                     : 20 seconds
  Forward delay                   : 15 seconds
  Hop count                       : 19
  Local parameters
    Bridge ID                     : 8194.00:19:e2:50:44:e0
    Extended system ID            : 0
    Internal instance ID          : 2
```

Meaning The operational mode command **show spanning-tree interface** displays spanning-tree domain information such as the designated port and the port roles.

The operational mode command **show spanning-tree bridge** displays the spanning-tree domain information at either the bridge level or the interface level. If the optional interface name is omitted, all interfaces in the spanning-tree domain are displayed.

Verifying MSTP Configuration on Switch 2

Purpose Verify the MSTP configuration on Switch 2.

Action Use the operational mode commands:

```
user@switch2> show spanning-tree interface


Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/14.0     128:513      128:513   32768.0019e2503d20      1000   FWD    DESG
xe-0/0/18.0     128:519      128:515    8192.0019e25051e0      1000   FWD    ROOT

Spanning tree interface parameters for instance 1

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/14.0     128:513      128:513   32769.0019e2503d20      1000   FWD    DESG
xe-0/0/18.0     128:519      128:515    4097.0019e25051e0      1000   FWD    ROOT

Spanning tree interface parameters for instance 2

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/14.0     128:513      128:513    4098.0019e2503d20      1000   FWD    DESG

xe-0/0/18.0     128:519      128:519    4098.0019e2503d20      1000   FWD    DESG


user@switch2> show spanning-tree bridge
STP bridge parameters
Context ID                           : 0
Enabled protocol                     : MSTP

STP bridge parameters for CIST
  Root ID                            : 8192.00:19:e2:50:51:e0
  Root cost                          : 0
  Root port                          : xe-0/0/18.0
  CIST regional root                 : 8192.00:19:e2:50:51:e0
  CIST internal root cost            : 1000
  Hello time                         : 2 seconds
  Maximum age                        : 20 seconds
  Forward delay                      : 15 seconds
  Hop count                          : 19
  Message age                        : 0
  Number of topology changes         : 1
  Time since last topology change    : 782 seconds
  Local parameters
    Bridge ID                        : 32768.00:19:e2:50:3d:20
    Extended system ID               : 0
    Internal instance ID             : 0

STP bridge parameters for MSTI 1
  MSTI regional root                 : 4097.00:19:e2:50:51:e0
  Root cost                          : 1000
  Root port                          : xe-0/0/18.0
  Hello time                         : 2 seconds
  Maximum age                        : 20 seconds
  Forward delay                      : 15 seconds
  Hop count                          : 19
  Local parameters
    Bridge ID                        : 32769.00:19:e2:50:3d:20
```



```
    Extended system ID            : 0
    Internal instance ID          : 1

STP bridge parameters for MSTI 2
  MSTI regional root              : 4098.00:19:e2:50:3d:20
  Hello time                      : 2 seconds
  Maximum age                     : 20 seconds
  Forward delay                   : 15 seconds
  Local parameters
    Bridge ID                     : 4098.00:19:e2:50:3d:20
    Extended system ID            : 0
    Internal instance ID          : 2
```

Meaning The operational mode command **show spanning-tree interface** displays spanning-tree domain information such as the designated port and the port roles.

The operational mode command **show spanning-tree bridge** displays the spanning-tree domain information at either the bridge level or the interface level. If the optional interface name is omitted, all interfaces in the spanning-tree domain are displayed.

Verifying MSTP Configuration on Switch 3

Purpose Verify the MSTP configuration on Switch 3.

Action Use the operational mode commands:

```
user@switch3> show spanning-tree interface

Spanning tree interface parameters for instance 0

Interface      Port ID    Designated       Designated          Port     State   Role
                           port ID          bridge ID          Cost
xe-0/0/26.0     128:513       128:513    8192.0019e25051e0      1000   FWD     DESG
xe-0/0/28.0     128:515       128:515    8192.0019e25051e0      1000   FWD     DESG
xe-0/0/24.0     128:517       128:517    8192.0019e25051e0      1000   FWD     DESG

Spanning tree interface parameters for instance 1

Interface      Port ID    Designated       Designated          Port     State   Role
                           port ID          bridge ID          Cost
xe-0/0/26.0     128:513       128:513    4097.0019e25051e0      1000   FWD     DESG
xe-0/0/28.0     128:515       128:515    4097.0019e25051e0      1000   FWD     DESG
xe-0/0/24.0     128:517       128:517    4097.0019e25051e0      1000   FWD     DESG


Spanning tree interface parameters for instance 2

Interface      Port ID    Designated       Designated          Port     State   Role
                           port ID          bridge ID          Cost
xe-0/0/26.0     128:513       128:531    8194.0019e25044e0      1000   BLK     ALT
xe-0/0/28.0     128:515       128:519    4098.0019e2503d20      1000   FWD     ROOT
xe-0/0/24.0     128:517       128:517   16386.0019e25051e0      1000   FWD     DESG

user@switch3> show spanning-tree bridge
STP bridge parameters
Context ID                          : 0
Enabled protocol                    : MSTP

STP bridge parameters for CIST
  Root ID                           : 8192.00:19:e2:50:51:e0
  CIST regional root                : 8192.00:19:e2:50:51:e0
  CIST internal root cost           : 0
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Number of topology changes        : 3
  Time since last topology change   : 843 seconds
  Local parameters
    Bridge ID                       : 8192.00:19:e2:50:51:e0
    Extended system ID              : 0
    Internal instance ID            : 0

STP bridge parameters for MSTI 1
  MSTI regional root                : 4097.00:19:e2:50:51:e0
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Local parameters
    Bridge ID                       : 4097.00:19:e2:50:51:e0
    Extended system ID              : 0
    Internal instance ID            : 1

STP bridge parameters for MSTI 2
  MSTI regional root                : 4098.00:19:e2:50:3d:20
```

```
Root cost                          : 1000
Root port                          : xe-0/0/28.0
Hello time                         : 2 seconds
Maximum age                        : 20 seconds
Forward delay                      : 15 seconds
Hop count                          : 19
Local parameters
  Bridge ID                        : 16386.00:19:e2:50:51:e0
  Extended system ID               : 0
  Internal instance ID             : 2
```

Meaning The operational mode command **show spanning-tree interface** displays spanning-tree domain information such as the designated port and the port roles.

The operational mode command **show spanning-tree bridge** displays the spanning-tree domain information at either the bridge level or the interface level. If the optional interface name is omitted, all interfaces in the spanning-tree domain are displayed.

Verifying MSTP Configuration on Switch 4

Purpose Verify the MSTP configuration on Switch 4.

Action Use the operational mode commands:

```
user@switch4> show spanning-tree interface
Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost

xe-0/0/23.0     128:523      128:517   8192.0019e25051e0      1000  FWD    ROOT
xe-0/0/19.0     128:525      128:525  16384.0019e25040e0      1000  FWD    DESG

Spanning tree interface parameters for instance 1

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/23.0     128:523      128:517   4097.0019e25051e0      1000  FWD    ROOT
xe-0/0/19.0     128:525      128:525  16385.0019e25040e0      1000  FWD    DESG


Spanning tree interface parameters for instance 2

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/23.0     128:523      128:517  16386.0019e25051e0      1000  BLK    ALT
xe-0/0/19.0     128:525      128:527   8194.0019e25044e0      1000  FWD    ROOT

user@switch4> show spanning-tree bridge
STP bridge parameters
Context ID                          : 0
Enabled protocol                    : MSTP

STP bridge parameters for CIST
  Root ID                           : 8192.00:19:e2:50:51:e0
  Root cost                         : 0
  Root port                         : xe-0/0/23.0
  CIST regional root                : 8192.00:19:e2:50:51:e0
  CIST internal root cost           : 1000
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Hop count                         : 19
  Message age                       : 0
  Number of topology changes        : 4
  Time since last topology change   : 887 seconds
  Local parameters
    Bridge ID                       : 16384.00:19:e2:50:40:e0
    Extended system ID              : 0
    Internal instance ID            : 0

STP bridge parameters for MSTI 1
  MSTI regional root                : 4097.00:19:e2:50:51:e0
  Root cost                         : 1000
  Root port                         : xe-0/0/23.0
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Hop count                         : 19
  Local parameters
    Bridge ID                       : 16385.00:19:e2:50:40:e0
    Extended system ID              : 0
```



```
    Internal instance ID          : 1

STP bridge parameters for MSTI 2
  MSTI regional root              : 4098.00:19:e2:50:3d:20
  Root cost                       : 2000
  Root port                       : xe-0/0/19.0
  Hello time                      : 2 seconds
  Maximum age                     : 20 seconds
  Forward delay                   : 15 seconds
  Hop count                       : 18
  Local parameters
    Bridge ID                     : 32770.00:19:e2:50:40:e0
    Extended system ID            : 0
    Internal instance ID          : 2
```

Meaning The operational mode command **show spanning-tree interface** displays spanning-tree domain information such as the designated port and the port roles.

The operational mode command **show spanning-tree bridge** displays the spanning-tree domain information at either the bridge level or the interface level. If the optional interface name is omitted, all interfaces in the spanning-tree domain are displayed.

Related Documentation

- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding MSTP on page 1420

Example: Connecting an Access Switch to a Distribution Switch

In large local area networks (LANs), you commonly need to aggregate traffic from a number of access switches into a distribution switch.

This example describes how to connect an access switch to a distribution switch:

- Requirements on page 1504
- Overview and Topology on page 1505
- Configuring the Access Switch on page 1505
- Configuring the Distribution Switch on page 1509
- Verification on page 1511

Requirements

This example uses the following hardware and software components:

- For the distribution switch, one EX 4200-24F switch. This model is designed to be used as a distribution switch for aggregation or collapsed core network topologies and in space-constrained data centers. It has twenty-four 1-Gigabit Ethernet fiber SFP ports and an EX-UM-2XFP uplink module with two 10-Gigabit Ethernet XFP ports.
- For the access switch, one EX 3200-24P, which has twenty-four 1-Gigabit Ethernet ports, all of which support Power over Ethernet (PoE), and an uplink module with four 1-Gigabit Ethernet ports.

- Junos OS Release 11.1 or later for the QFX Series

Overview and Topology

In a large office that is spread across several floors or buildings, or in a data center, you commonly aggregate traffic from a number of access switches into a distribution switch. This configuration example shows a simple topology to illustrate how to connect a single access switch to a distribution switch.

In the topology, the LAN is segmented into two VLANs, one for the sales department and the second for the support team. One 1-Gigabit Ethernet port on the access switch's uplink module connects to the distribution switch, to one 1-Gigabit Ethernet port on the distribution switch.

Table 131 on page 1505 explains the components of the example topology. The example shows how to configure one of the three access switches. The other access switches could be configured in the same manner.

Table 131: Components of the Topology for Connecting an Access Switch to a Distribution Switch

Property	Settings
Access switch hardware	EX 3200-24P, 24 1-Gigabit Ethernet ports, all PoE-enabled (**ge-0/0/0** through **ge-0/0/23**); one 4-port 1–Gigabit Ethernet uplink module (EX-UM-4SFP)
Distribution switch hardware	EX 4200-24F, 24 1-Gigabit Ethernet fiber SPF ports (**ge-0/0/0** through **ge-0/0/23**); one 2–port 10–Gigabit Ethernet XFP uplink module (EX-UM-4SFP)
VLAN names and tag IDs	**sales**, tag **100support**, tag **200**
VLAN subnets	**sales**: **192.0.2.0/25** (addresses **192.0.2.1** through **192.0.2.126**)**support**: **192.0.2.128/25** (addresses **192.0.2.129** through **192.0.2.254**)
Trunk port interfaces	On the access switch: **ge-0/1/0**On the distribution switch: **ge-0/0/0**
Access port interfaces in VLAN **sales** (on access switch)	Avaya IP telephones: **ge-0/0/3** through **ge-0/0/19**Wireless access points: **ge-0/0/0** and **ge-0/0/1**Printers: **ge-0/0/22** and **ge-0/0/23**File servers: **ge-0/0/20** and **ge-0/0/21**
Access port interfaces in VLAN **support** (on access switch)	Avaya IP telephones: **ge-0/0/25** through **ge-0/0/43**Wireless access points: **ge-0/0/24**Printers: **ge-0/0/44** and **ge-0/0/45**File servers: **ge-0/0/46** and **ge-0/0/47**
Unused interfaces on access switch	**ge-0/0/2** and **ge-0/0/25**

Configuring the Access Switch

To configure the access switch:

CLI Quick Configuration

To quickly configure the access switch, copy the following commands and paste them into the switch terminal window:

```
[edit]
```

```
set interfaces ge-0/0/0 unit 0 description “Sales Wireless access point port”
set interfaces ge-0/0/0 unit 0 family ethernet-switching vlan members sales
set interfaces ge-0/0/3 unit 0 description “Sales phone port”
set interfaces ge-0/0/3 unit 0 family ethernet-switching vlan members sales
set interfaces ge-0/0/22 unit 0 description “Sales printer port”
set interfaces ge-0/0/22 unit 0 family ethernet-switching vlan members sales
set interfaces ge-0/0/20 unit 0 description “Sales file server port”
set interfaces ge-0/0/20 unit 0 family ethernet-switching vlan members sales
set interfaces ge-0/0/24 unit 0 description “Support wireless access point port”
set interfaces ge-0/0/24 unit 0 family ethernet-switching vlan members support
set interfaces ge-0/0/26 unit 0 description “Support phone port”
set interfaces ge-0/0/26 unit 0 family ethernet-switching vlan members support
set interfaces ge-0/0/44 unit 0 description “Support printer port”
set interfaces ge-0/0/44 unit 0 family ethernet-switching vlan members support
set interfaces ge-0/0/46 unit 0 description “Support file server port”
set interfaces ge-0/0/46 unit 0 family ethernet-switching vlan members support
set interfaces ge-0/1/0 unit 0 description “Uplink module port connection to distribution switch”
set interfaces ge-0/1/0 unit 0 family ethernet-switching port-mode trunk
set interfaces ge-0/1/0 unit 0 family ethernet-switching native-vlan-id 1
set interfaces ge-0/1/0 unit 0 family ethernet switching vlan members [sales support]
set interfaces vlan unit 0 family inet address 192.0.2.1/25
set interfaces vlan unit 1 family inet address 192.0.2.129/25
set vlans sales interface ge-0/0/0.0
set vlans sales interface ge-0/0/3.0
set vlans sales interface ge-0/0/22.0
set vlans sales interface ge-0/0/20.0
set vlans sales l3-interface vlan.0
set vlans sales vlan-id 100
set vlans sales vlan-description “Sales VLAN”
set vlans support interface ge-0/0/24.0
set vlans support interface ge-0/0/26.0
set vlans support interface ge-0/0/44.0
set vlans support interface ge-0/0/46.0
set vlans support vlan-id 200
set vlans support l3–interface vlan.1
set vlans support vlan-description “Support VLAN”
```

Step-by-Step Procedure

To configure the access switch:

1. Configure the 1-Gigabit Ethernet interface on the uplink module to be the trunk port that connects to the distribution switch:

   `[edit interfaces ge-0/1/0 unit 0]user@access-switch#` **setdescription “Uplink module port connection to distribution switch”**`user@access-switch#` **set ethernet-switching port-mode trunk**
2. Specify the VLANs to be aggregated on the trunk port:

   `[edit interfaces ge-0/1/0 unit 0]user@access-switch#` **set ethernet-switching vlanmembers [sales support]**
3. Configure the VLAN ID to use for packets that are received with no dot1q tag (untagged packets):

   `[edit interfaces ge-0/1/0 unit 0]user@access-switch#` **set ethernet-switching native-vlan-id 1**
4. Configure the sales VLAN:

   `[edit vlans sales]user@access-switch#` **set vlan-description “Sales VLAN”**`user@access-switch#` **set vlan-id (VLANs) 100**`user@access-switch#` **set l3-interface (VLAN) vlan.0**
5. Configure the support VLAN:

[edit vlans support]user@access-switch# **set vlan-description "Support VLAN"**user@access-switch# **set** vlan-id (VLANs) **200**user@access-switch# **set** l3-interface (VLAN) **vlan.1**

6. Create the subnet for the sales broadcast domain:

   [edit interfaces]user@access-switch# **set vlan unit 0 family inet address 192.0.2.1/25**

7. Create the subnet for the support broadcast domain:

   [edit interfaces]user@access-switch# **set vlan unit 1 family inet address 192.0.2.129/25**

8. Configure the interfaces in the sales VLAN:

   [edit interfaces]user@access-switch# **set ge-0/0/0 unit 0 description "Sales wireless access point port"**user@access-switch# **set ge-0/0/0 unit 0 family ethernet-switching vlan members sales**user@access-switch# **set ge-0/0/3 unit 0 description "Sales phone port"**user@access-switch# **set ge-0/0/3 unit 0 family ethernet-switching vlan members sales**user@access-switch# **set ge-0/0/20 unit 0 description "Sales file server port"**user@access–switch# **set ge-0/0/20 unit 0 family ethernet-switching vlan members sales**user@access-switch# **set ge-0/0/22 unit 0 description "Sales printer port"**user@access-switch# **set ge-0/0/22 unit 0 family ethernet-switching vlan members sales**

9. Configure the interfaces in the support VLAN:

   [edit interfaces]user@access-switch# **set ge-0/0/24 unit 0 description "Support wireless access point port"**user@access-switch# **set ge-0/0/24 unit 0 family ethernet-switching vlan members support**user@access-switch# **set ge-0/0/26 unit 0 description "Support phone port"**user@access-switch# **set ge-0/0/26 unit 0 family ethernet-switching vlan members support**user@access-switch# **set ge-0/0/44 unit 0 description "Support printer port"**user@access-switch# **set ge-0/0/44 unit 0 family ethernet-switching vlan members support**user@access-switch# **set ge-0/0/46 unit 0 description "Support file server port"**user@access-switch# **set ge-0/0/46 unit 0 family ethernet-switching vlan members support**

10. Configure descriptions and VLAN tag IDs for the sales and support VLANs:

    [edit vlans]user@access-switch# **set sales vlan-description "Sales VLAN"**user@access-switch# **set sales vlan-id 100**user@access-switch# **set support vlan-description "Support VLAN"**user@access-switch# **set support vlan-id 200**

11. To route traffic between the sales and support VLANs and associate a Layer 3 interface with each VLAN:

    [edit vlans]user@access-switch# **set sales l3-interface vlan.0**user@access-switch# **set support l3-interface vlan.1**

Results Display the results of the configuration:

```
user@access-switch> show
interfaces {
  ge-0/0/0 {
    unit 0 {
      description "Sales wireless access point port";
      family ethernet-switching {
        vlan members sales;
      }
    }
  }
  ge-0/0/3 {
    unit 0 {
      description "Sales phone port";
        family ethernet-switching {
        vlan members sales;
```

```
            }
        }
    }
    ge-0/0/20 {
        unit 0 {
            description "Sales file server port";
                family ethernet-switching {
                vlan members sales;
            }
        }
    }
    ge-0/0/22 {
        unit 0 {
            description "Sales printer port";
                family ethernet-switching {
                vlan members sales;
            }
        }
    }
    ge-0/0/24 {
        unit 0 {
            description "Support wireless access point port";
                family ethernet-switching {
                vlan members support;
            }
        }
    }
    ge-0/0/26 {
        unit 0 {
            description "Support phone port";
                family ethernet-switching {
                vlan members support;
            }
        }
    }
    ge-0/0/44 {
        unit 0 {
            description "Support printer port";
                family ethernet-switching {
                vlan members sales;
            }
        }
    }
    ge-0/0/46 {
        unit 0 {
            description "Support file server port";
                family ethernet-switching {
                vlan members support;
            }
        }
    }
    ge-0/1/0 {
        unit 0 {
            description "Uplink module port connection to distribution switch";
                family ethernet-switching {
                port-mode trunk;
```



```
            vlan members [ sales support ];
          native-vlan-id 1;
        }
      }
    }
    vlan {
      unit 0 {
        family inet address 192.0.2.1/25;
      }
      unit 1 {
        family inet address 192.0.2.129/25;
      }
    }
  }
  vlans {
    sales {
      vlan-id 100;
      vlan-description “Sales VLAN”;
      l3-interface vlan.0;
    }
    support {
      vlan-id 200;
      vlan-description “Support VLAN”;
      l3-interface vlan.1;
    }
  }
```

TIP: To quickly configure the distribution switch, issue the **load merge terminal** command, then copy the hierarchy and paste it into the switch terminal window.

Configuring the Distribution Switch

To configure the distribution switch:

CLI Quick Configuration

To quickly configure the distribution switch, copy the following commands and paste them into the switch terminal window:

```
set interfaces ge-0/0/0 description “Connection to access switch”
set interfaces ge-0/0/0 ethernet-switching port-mode trunk
set interfaces ge-0/0/0 ethernet-switching vlan members [ sales support ]
set interfaces ge-0/0/0 ethernet-switching native-vlan-id 1
set interfaces vlan unit 0 family inet address 192.0.2.2/25
set interfaces vlan unit 1 family inet address 192.0.2.130/25
set vlans sales vlan-description “Sales VLAN”
set vlans sales vlan-id 100
set vlans sales l3-interface vlan.0
set vlans support vlan-description “Support VLAN”
set vlans support vlan-id 200
set vlans support l3-interface vlan.1
```

Step-by-Step Procedure

To configure the distribution switch:

1. Configure the interface on the switch to be the trunk port that connects to the access switch:

   `[edit interfaces ge-0/0/0 unit 0]user@distribution-switch#` **set description "Connection to access switch"**`user@distribution-switch#` **set ethernet-switching port-mode trunk**
2. Specify the VLANs to be aggregated on the trunk port:

   `[edit interfaces ge-0/0/0 unit 0]user@distribution-switch#` **set ethernet-switching vlanmembers [sales support]**
3. Configure the VLAN ID to use for packets that are received with no dot1q tag (untagged packets):

   `[edit interfaces]user@distribution-switch#` **set ge-0/0/0 ethernet-switching native-vlan-id** 1
4. Configure the sales VLAN:

   `[edit vlans sales]user@distribution-switch#` **set vlan-description "Sales VLAN"**`user@distribution-switch#` **set vlan-id (VLANs) 100**`user@distribution-switch#` **set l3-interface (VLAN) vlan.0**
5. Configure the support VLAN:

   `[edit vlans support]user@distribution-switch#` **set vlan-description "Support VLAN"**`user@distribution-switch#` **set vlan-id (VLANs) 200**`user@distribution-switch#` **set l3-interface (VLAN) vlan.1**
6. Create the subnet for the sales broadcast domain:

   `[edit interfaces]user@distribution-switch#` **set vlan unit 0 family inet address 192.0.2.2/25**
7. Create the subnet for the support broadcast domain:

   `[edit interfaces] user@distribution-switch#` **set vlan unit 1 family inet address 192.0.2.130/25**

Results

Display the results of the configuration:

```
user@distribution-switch> show
interfaces {
  ge-0/0/0 {
    description "Connection to access switch";
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan members [ sales support ];
        native-vlan-id 1;
      }
    }
  }
  vlan {
    unit 0 {
      family inet address 192.0.2.2/25;
    }
    unit 1 {
      family inet address 192.0.2.130/25;
    }
  }
}
```

```
vlans {
  sales {
    vlan-id 100;
    vlan-description "Sales VLAN";
    l3-interface vlan.0;
  }
  support {
    vlan-id 200;
    vlan-description "Support VLAN";
    l3-interface vlan.1;
  }
}
```

TIP: To quickly configure the distribution switch, issue the **load merge terminal** command, then copy the hierarchy and paste it into the switch terminal window.

Verification

To confirm that the configuration is working properly, perform these tasks:

- Verifying the VLAN Members and Interfaces on the Access Switch on page 1511
- Verifying the VLAN Members and Interfaces on the Distribution Switch on page 1512

Verifying the VLAN Members and Interfaces on the Access Switch

Purpose Verify that the **sales** and **support** have been created on the switch.

Action List all VLANs configured on the switch:

```
user@switch> show vlans

Name           Tag     Interfaces
default
                       ge-0/0/1.0, ge-0/0/2.0, ge-0/0/4.0, ge-0/0/5.0,
                       ge-0/0/6.0, ge-0/0/7.0, ge-0/0/8.0*, ge-0/0/9.0,

                       ge-0/0/10.0, ge-0/0/11.0*, ge-0/0/12.0, ge-0/0/13.0,
                       ge-0/0/14.0, ge-0/0/15.0, ge-0/0/16.0, ge-0/0/17.0,
                       ge-0/0/18.0, ge-0/0/19.0*,ge-0/0/21.0, ge-0/0/23.0,
                       ge-0/0/25.0, ge-0/0/27.0*,ge-0/0/28.0, ge-0/0/29.0,
                       ge-0/0/30.0, ge-0/0/31.0*,ge-0/0/32.0, ge-0/0/33.0,
                       ge-0/0/34.0, ge-0/0/35.0*,ge-0/0/36.0, ge-0/0/37.0,
                       ge-0/0/38.0, ge-0/0/39.0*,ge-0/0/40.0, ge-0/0/41.0,
                       ge-0/0/42.0, ge-0/0/43.0*,ge-0/0/45.0, ge-0/0/47.0,
                       ge-0/1/1.0*, ge-0/1/2.0*, ge-0/1/3.0*

sales         100
                       ge-0/0/0.0*, ge-0/0/3.0, ge-0/0/20.0, ge-0/0/22.0,
                       ge-0/1/0.0*,

support       200
                       ge-0/0/24.0*, ge-0/0/26.0, ge-0/0/44.0, ge-0/0/46.0,

mgmt
                       me0.0*
```

Meaning The output shows the **sales** and **support** VLANs and the interfaces associated with them.

Verifying the VLAN Members and Interfaces on the Distribution Switch

Purpose Verify that the **sales** and **support** have been created on the switch.

Action List all VLANs configured on the switch:

```
user@switch> show vlans

Name           Tag     Interfaces
default
                       ge-0/0/1.0, ge-0/0/2.0, ge-0/0/3.0, ge-0/0/4.0,
                       ge-0/0/5.0, ge-0/0/6.0, ge-0/0/7.0*, ge-0/0/8.0,

                       ge-0/0/9.0, ge-0/0/10.0*, ge-0/0/11.0, ge-0/0/12.0,
                       ge-0/0/13.0, ge-0/0/14.0, ge-0/0/15.0, ge-0/0/16.0,
                       ge-0/0/17.0, ge-0/0/18.0*, ge-0/0/19.0, ge-0/0/20.0,
                       ge-0/0/21.0, ge-0/0/22.0*, ge-0/0/23.0, ge-0/1/1.0*,
                       ge-0/1/2.0*, ge-0/1/3.0*

sales          100
                       ge-0/0/0.0*

support        200
                       ge-0/0/0.0*

mgmt
                       me0.0*
```

Meaning The output shows the **sales** and **support** VLANs associated to interface **ge-0/0/0.0**. Interface **ge-0/0/0.0** is the trunk interface connected to the access switch.

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Example: Setting Up Bridging with Multiple VLANs on page 1451

- *Understanding Bridging*

Example: Configuring BPDU Protection on STP Interfaces to Prevent STP Miscalculations

The QFX Series products provide Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP). Configure BPDU protection on interfaces to prevent them from receiving BPDUs that could result in STP misconfigurations, which could lead to network outages.

This example describes how to configure BPDU protection on access interfaces in QFX Series products in an RSTP topology:

Requirements

This example uses the following hardware and software components:

- Junos OS Release 11.1 or later for the QFX Series

- Two edged-linked switches in an RSTP topology

NOTE: By default, RSTP is enabled on the QFX Series.

Overview and Topology

A loop-free network is supported through the exchange of a special type of frame called a bridge protocol data unit (BPDU). However, receipt of BPDUs on certain interfaces in an STP, RSTP, or MSTP topology. It can lead to network outages by triggering an STP misconfiguration. To prevent such outages, enable BPDU protection on those interfaces that should not receive BPDUs.

Enable BPDU protection on switch interfaces connected to user devices or on interfaces on which no BPDUs are expected, such as edge ports. If a BPDU is received on a BPDU-protected interface, the interface is disabled and stops forwarding frames.

Two switches are displayed in Figure 19 on page 1514. In this example, Switch 1 and Switch 2 are configured for RSTP and create a loop-free topology. The interfaces on Switch 2 are access ports.

This example shows you how to configure interface **xe-0/0/5** and interface **xe-0/0/6** as edge ports and how to configure BPDU protection. When BPDU protection is enabled, the interfaces transition to a blocking state when they receive BPDUs.

Figure 19: BPDU Protection Topology

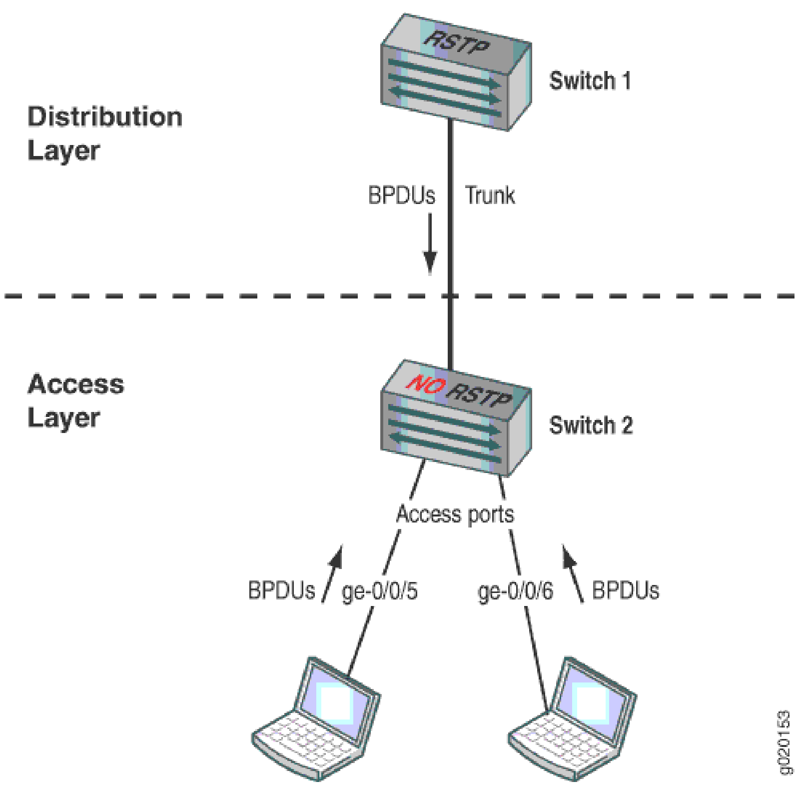


Table 132 on page 1515 shows the components that will be configured for BPDU protection.

Table 132: Components of the Topology for Configuring BPDU Protection on the QFX Series

Component	Settings
Switch 1 (Distribution Layer)	Switch 1 is connected to Switch 2 on a trunk interface.
Switch 2 (Access Layer)	Switch 2 has these access ports that require BPDU protection: • xe-0/0/5 • xe-0/0/6

This configuration example uses an RSTP topology. You also can configure BPDU protection for STP or MSTP topologies at the [**edit protocols** (**mstp** \| **stp**)] hierarchy level.

Configuration

CLI Quick Configuration

To quickly configure BPDU protection on Switch 2, copy the following commands and paste them into the switch terminal window:

```
[edit]
set protocols rstp interface xe-0/0/5 edge
set protocols rstp interface xe-0/0/6 edge
set protocols rstp bpdu-block-on-edge
```

Step-by-Step Procedure

To configure BPDU protection:

1. Configure interface **xe-0/0/5** and interface **xe-0/0/6** on Switch 2 as edge ports:

   ```
   [edit protocols rstp]
   user@switch# set interface xe-0/0/5 edge
   user@switch#set interface xe-0/0/6 edge
   ```
2. Configure BPDU protection on all edge ports:

   ```
   [edit protocols rstp]
   user@switch# setbpdu-block-on-edge
   ```

Results

Check the results of the configuration:

```
user@switch> show configuration protocols rstp
interface xe-0/0/5.0 {
  edge;
}
interface xe-0/0/6.0 {
  edge;
}
bpdu-block-on-edge;
```

Verification

To confirm that the configuration is working properly, perform these tasks:

- Displaying the Interface State Before BPDU Protection Is Triggered on page 1516
- Verifying That BPDU Protection Is Working Correctly on page 1516

Displaying the Interface State Before BPDU Protection Is Triggered

Purpose Before BPDUs are being received from the devices connected to interface **xe-0/0/5** and interface **xe-0/0/6**, confirm the interface state.

Action You can verify the interface state using the **show spanning-tree interface** command:

```
user@switch> show spanning-tree interface

Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/0.0      128:513      128:513  32768.0019e2503f00     20000  BLK    DIS
xe-0/0/1.0      128:514      128:514  32768.0019e2503f00     20000  BLK    DIS
xe-0/0/2.0      128:515      128:515  32768.0019e2503f00     20000  BLK    DIS
xe-0/0/3.0      128:516      128:516  32768.0019e2503f00     20000  FWD    DESG
xe-0/0/4.0      128:517      128:517  32768.0019e2503f00     20000  FWD    DESG
xe-0/0/5.0      128:518      128:518  32768.0019e2503f00     20000  FWD    DESG
xe-0/0/6.0      128:519      128:519  32768.0019e2503f00     20000  FWD    DESG
[output truncated]
```

Meaning The output shows that interface **xe-0/0/5.0** and interface **xe-0/0/6.0** are designated ports in a forwarding state.

Verifying That BPDU Protection Is Working Correctly

Purpose In this example, the devices connected to Switch 2 start sending BPDUs to interface **xe-0/0/5.0** and interface **xe-0/0/6.0** . Verify that BPDU protection is configured on the interfaces.

Action You can verify that BPDU protection is configured on the interfaces by using the **show spanning-tree interface** command:

```
user@switch> show spanning-tree interface

Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/0.0      128:513     128:513  32768.0019e2503f00     20000   BLK    DIS
xe-0/0/1.0      128:514     128:514  32768.0019e2503f00     20000   BLK    DIS
xe-0/0/2.0      128:515     128:515  32768.0019e2503f00     20000   BLK    DIS
xe-0/0/3.0      128:516     128:516  32768.0019e2503f00     20000   FWD    DESG
xe-0/0/4.0      128:517     128:517  32768.0019e2503f00     20000   FWD    DESG
xe-0/0/5.0      128:518     128:518  32768.0019e2503f00     20000   BLK    DIS
(Bpdu-Incon)
xe-0/0/6.0      128:519     128:519  32768.0019e2503f00     20000   BLK    DIS
(Bpdu-Incon)
xe-0/0/7.0      128:520       128:1  16384.00aabbcc0348     20000   FWD    ROOT
xe-0/0/8.0      128:521     128:521  32768.0019e2503f00     20000   FWD    DESG
[output truncated]
```

Meaning When BPDUs are sent from the devices to interface **xe-0/0/5.0** and interface **xe-0/0/6.0** on Switch 2, the output from the operational mode command **show spanning-tree interface** shows that the interfaces have transitioned to a BPDU inconsistent state. The BPDU inconsistent state blocks the interfaces and prevents them from forwarding traffic.

Disabling the BPDU protection configuration on an interface does not unblock the interface. If the disable-timeout statement has been included in the BPDU configuration, the interface automatically returns to service after the timer expires. Otherwise, use the operational mode command clear ethernet-switching bpdu-error to unblock the interface.

If the devices connected to Switch 2 send BPDUs to the interfaces again, BPDU protection is triggered once more and the interfaces transition back to the BPDU inconsistent state. In such cases, you need to find and repair the misconfiguration on the devices that is triggering the sending of BPDUs to Switch 2.

Related Documentation

- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree on page 1517
- Example: Configuring Root Protection to Enforce Root Bridge Placement in Spanning Trees on page 1521
- Understanding BPDU Protection for STP, RSTP, and MSTP on page 1423

Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree

The QFX Series products provide Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), and Multiple Spanning Tree Protocol

(MSTP). Loop protection increases the efficiency of STP, RSTP, and MSTP by preventing interfaces from moving into a forwarding state that would create a loop in the network.

This example describes how to configure loop protection for an interface for the QFX Series in an RSTP topology:

Requirements

This example uses the following hardware and software components:

- Junos OS Release 11.1 or later for the QFX Series
- Three switches in an RSTP topology

NOTE: **By default, RSTP is enabled for the QFX Series.**

Overview and Topology

A loop-free network in spanning-tree topologies is supported through the exchange of a special type of frame called a bridge protocol data unit (BPDU). Peer STP applications running on the switch interfaces use BPDUs to communicate. Ultimately, the exchange of BPDUs determines which interfaces block traffic (preventing loops) and which interfaces become root ports and forward traffic.

A blocking interface can transition to the forwarding state in error if the interface stops receiving BPDUs from its designated port on the segment. Such a transition error can occur when there is a hardware error on the switch or software configuration error between the switch and its neighbor. When this happens, a loop appears in the spanning tree. Loops in a Layer 2 topology cause broadcast, unicast, and multicast frames to continuously circle the looped network. As a switch processes a flood of frames in a looped network, its resources become depleted, and the ultimate result is a network outage.

NOTE: **An interface can be configured for either loop protection or root protection, but not for both.**

Three switches are displayed in Figure 20 on page 1519. In this example, they are configured for RSTP and create a loop-free topology. Interface **xe-0/0/6** is blocking traffic between Switch 3 and Switch 1; thus, traffic is forwarded through interface **xe-0/0/7** on Switch 2. BPDUs are being sent from the root bridge on Switch 1 to both of these interfaces.

This example shows how to configure loop protection on interface **xe-0/0/6** to prevent it from transitioning from a blocking state to a forwarding state and creating a loop in the spanning-tree topology.

Figure 20: Network Topology for Loop Protection

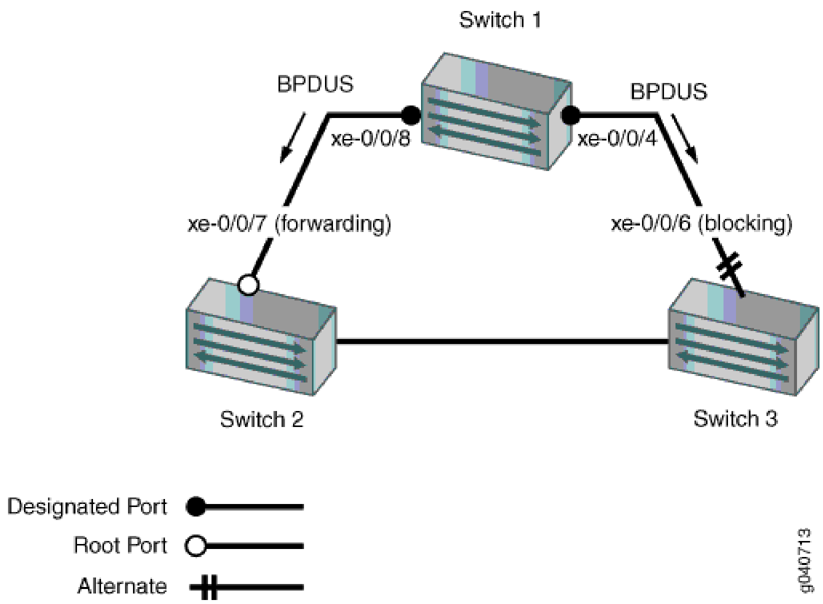


Table 133 on page 1519 shows the components that will be configured for loop protection.

Table 133: Topology for Configuring Loop Protection on the QFX Series

Components	Settings
Switch 1	Switch 1 is the root bridge.
Switch 2	Switch 2 has the root port **xe-0/0/7**.
Switch 3	Switch 3 is connected to Switch 1 through interface **xe-0/0/6**.

A spanning-tree topology contains ports that have specific roles:

- The *root port* is responsible for forwarding data to the root bridge.
- The *alternate port* is a standby port for the root port. When a root port goes down, the alternate port becomes the active root port.
- The *designated port* forwards data to the downstream network segment or device.

This configuration example uses an RSTP topology. However, you can also configure loop protection for STP or MSTP topologies at the [**edit protocols** (**mstp** | **stp**)] hierarchy level.

Configuration

CLI Quick Configuration

To quickly configure loop protection on interface **xe-0/0/6**:

```
[edit]
set protocols rstp interface xe-0/0/6 bpdu-timeout-action block
```

Step-by-Step Procedure

To configure loop protection:

1. Configure interface **xe-0/0/6** on Switch 3:

   ```
   [edit protocols rstp]
   user@switch# set interface xe-0/0/6bpdu-timeout-action block
   ```

Results

Check the results of the configuration:

```
user@switch> show configuration protocols rstp
interface xe-0/0/6.0 {
  bpdu-timeout-action {
    block;
  }
}
```

Verification

To confirm that the configuration is working properly, perform these tasks:

- Displaying the Interface State Before Loop Protection Is Triggered on page 1520
- Verifying That Loop Protection Is Working on an Interface on page 1521

Displaying the Interface State Before Loop Protection Is Triggered

Purpose

Before loop protection is triggered on interface **xe-0/0/6**, confirm that the interface is blocked.

Action

Display the interface state and role before applying root protection:

```
user@switch>  show spanning-tree interface

Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/0.0     128:513      128:513   32768.0019e2503f00     20000  BLK    DIS
xe-0/0/1.0     128:514      128:514   32768.0019e2503f00     20000  BLK    DIS
xe-0/0/2.0     128:515      128:515   32768.0019e2503f00     20000  BLK    DIS
xe-0/0/3.0     128:516      128:516   32768.0019e2503f00     20000  FWD    DESG
xe-0/0/4.0     128:517      128:517   32768.0019e2503f00     20000  FWD    DESG
xe-0/0/5.0     128:518      128:518   32768.0019e2503f00     20000  FWD    DESG
xe-0/0/6.0     128:519        128:2   16384.00aabbcc0348     20000  BLK    ALT
[output truncated]
```

Meaning

The output from the operational mode command **show spanning-tree interface** shows that **xe-0/0/6.0** is the alternate port and is blocked.

Verifying That Loop Protection Is Working on an Interface

Purpose Verify that the loop protection configuration on interface **xe-0/0/6**. RSTP has been disabled on interface **xe-0/0/4** on Switch 1. This stops BPDUs from being sent to interface **xe-0/0/6** and triggering loop protection on that interface.

Action Display the interface state and role after applying root protection:

```
user@switch> show spanning-tree interface

Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/0.0      128:513     128:513  32768.0019e2503f00     20000  BLK    DIS
xe-0/0/1.0      128:514     128:514  32768.0019e2503f00     20000  BLK    DIS
xe-0/0/2.0      128:515     128:515  32768.0019e2503f00     20000  BLK    DIS
xe-0/0/3.0      128:516     128:516  32768.0019e2503f00     20000  FWD    DESG
xe-0/0/4.0      128:517     128:517  32768.0019e2503f00     20000  FWD    DESG
xe-0/0/5.0      128:518     128:518  32768.0019e2503f00     20000  FWD    DESG
xe-0/0/6.0      128:519     128:519  32768.0019e2503f00     20000  BLK    DIS
(Loop-Incon)
[output truncated]
```

Meaning The operational mode command **show spanning-tree interface** shows that interface **xe-0/0/6.0** has detected that BPDUs are no longer being forwarded to it and has moved into a loop-inconsistent state. The loop-inconsistent state prevents the interface from transitioning to a forwarding state. The interface recovers and transitions back to its original state as soon as it receives BPDUs.

Related Documentation

- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Example: Configuring Root Protection to Enforce Root Bridge Placement in Spanning Trees on page 1521
- Example: Configuring BPDU Protection on STP Interfaces to Prevent STP Miscalculations on page 1513
- Understanding Loop Protection for STP, RSTP, VSTP, and MSTP on page 1424

Example: Configuring Root Protection to Enforce Root Bridge Placement in Spanning Trees

QFX Series products provide Layer 2 loop prevention through Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP). Root protection increases the efficiency of STP, RSTP, and MSTP by allowing network administrators to enforce the root bridge placement in the network manually.

This example describes how to configure root protection on an interface for the QFX Series.

Requirements

This example uses the following hardware and software components:

- Junos OS Release 11.1 or later for the QFX Series
- Four switches in an RSTP topology

Before you configure the interface for root protection, be sure you have:

- RSTP operating on the switches.

NOTE: By default, RSTP is enabled on the QFX Series.

Overview and Topology

Peer STP applications running on switch interfaces exchange a special type of frame called a bridge protocol data unit (BPDU). Switches communicate interface information using BPDUs to create a loop-free topology that ultimately determines the root bridge and which interfaces block or forward traffic in the spanning tree.

You can also see BPDUs generated when you run a bridge application on a device attached to the switch. This can interfere with root port election, which may sometimes lead to the wrong root port being elected through the above process. Root protection allows you to manually enforce the root bridge placement in the network.

To prevent this from happening, enable root protection on interfaces that should not receive more BPDUs from the root bridge and should not be elected as the root port. These interfaces are typically located on an administrative boundary and are designated ports.

When root protection is enabled on an interface:

- The interface is blocked from becoming the root port.
- Root protection is enabled for all STP instances on that interface.
- The interface is blocked only for instances for which it receives more BPDUs. Otherwise, it participates in the spanning-tree topology.

NOTE: An interface can be configured for either root protection or loop protection, but not for both.

Four switches are displayed in Figure 21 on page 1523. In this example, they are configured for RSTP and create a loop-free topology. Interface **xe-0/0/7** on Switch 1 is a designated port on an administrative boundary. It connects to Switch 4. Switch 3 is the root bridge. Interface **xe-0/0/6** on Switch 1 is the root port.

This example shows how to configure root protection on interface **xe-0/0/7** to prevent it from transitioning to become the root port.

Figure 21: Network Topology for Root Protection

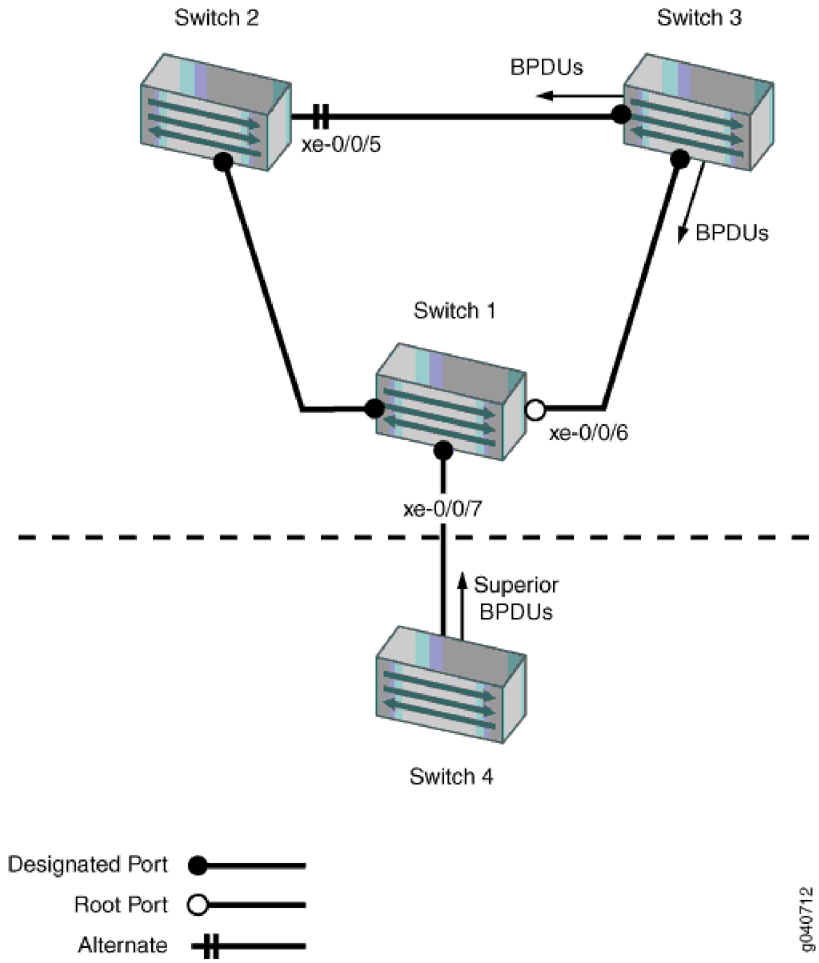


Table 134 on page 1523 shows the components that will be configured for root protection.

Table 134: Topology for Configuring Root Protection on the QFX Series

Component	Settings
Switch 1	Switch 1 is connected to Switch 4 through interface **xe-0/0/7**.
Switch 2	Switch 2 is connected to Switch 1 and Switch 3. Interface **xe-0/0/4** is the alternate port in the RSTP topology.
Switch 3	Switch 3 is the root bridge and is connected to Switch 1 and Switch 2.

Table 134: Topology for Configuring Root Protection on the QFX Series *(continued)*

Component	Settings
Switch 4	Switch 4 is connected to Switch 1. After loop protection is configured on interface **xe-0/0/7**, Switch 4 sends more BPDUs that trigger loop protection on interface **xe-0/0/7**.

A spanning-tree topology contains ports that have specific roles:

- The *root port* is responsible for forwarding data to the root bridge.
- The *alternate port* is a standby port for the root port. When a root port goes down, the alternate port becomes the active root port.
- The *designated port* forwards data to the downstream network segment or device.

This configuration example uses an RSTP topology. However, you can also configure root protection for STP or MSTP topologies at the [**edit protocols** (**mstp** | **stp**)] hierarchy level.

Configuration

CLI Quick Configuration

To quickly configure root protection on interface **xe-0/0/7**, copy the following command and paste it into the switch terminal window:

```
[edit]
set protocols rstp interface xe-0/0/7 no-root-port
```

Step-by-Step Procedure

To configure root protection:

1. Configure interface **xe-0/0/7**:

   ```
   [edit protocols rstp]
   user@switch#
   set interface xe-0/0/7 no-root-port
   ```

Results

Check the results of the configuration:

```
user@switch> show configuration protocols rstp
interface xe-0/0/7.0 {
  no-root-port;
}
```

Verification

To confirm that the configuration is working properly, perform these tasks:

- Displaying the Interface State Before Root Protection Is Triggered on page 1524
- Verifying That Root Protection Is Working on the Interface on page 1525

Displaying the Interface State Before Root Protection Is Triggered

Purpose

Before root protection is triggered on interface **xe-0/0/7**, confirm the interface state.

Action Confirm the state of the interfaces before root protection is configured:

```
user@switch> show spanning-tree interface

Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/0.0      128:513      128:513  32768.0019e2503f00     20000   BLK    DIS
xe-0/0/1.0      128:514      128:514  32768.0019e2503f00     20000   BLK    DIS
xe-0/0/2.0      128:515      128:515  32768.0019e2503f00     20000   BLK    DIS
xe-0/0/3.0      128:516      128:516  32768.0019e2503f00     20000   FWD    DESG
xe-0/0/4.0      128:517      128:517  32768.0019e2503f00     20000   FWD    DESG
xe-0/0/5.0      128:518        128:2  16384.00aabbcc0348     20000   BLK    ALT
xe-0/0/6.0      128:519        128:1  16384.00aabbcc0348     20000   FWD    ROOT
xe-0/0/7.0      128:520      128:520  32768.0019e2503f00     20000   FWD    DESG
[output truncated]
```

Meaning The output from the operational mode command **show spanning-tree interface** shows that **xe-0/0/7.0** is a designated port in a forwarding state.

Verifying That Root Protection Is Working on the Interface

Purpose A configuration change takes place on Switch 4. A lower bridge priority on Switch 4 causes it to send more BPDUs to interface **xe-0/0/7**. Receipt of more BPDUs on interface **xe-0/0/7** triggers root protection. Verify that root protection is operating on interface **xe-0/0/7**.

Action Verify that root protection has been configured and is operating correctly:

```
user@switch> show spanning-tree interface

Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-0/0/0.0      128:513      128:513  32768.0019e2503f00     20000   BLK    DIS
xe-0/0/1.0      128:514      128:514  32768.0019e2503f00     20000   BLK    DIS
xe-0/0/2.0      128:515      128:515  32768.0019e2503f00     20000   BLK    DIS
xe-0/0/3.0      128:516      128:516  32768.0019e2503f00     20000   FWD    DESG
xe-0/0/4.0      128:517      128:517  32768.0019e2503f00     20000   FWD    DESG
xe-0/0/5.0      128:518        128:2  16384.00aabbcc0348     20000   BLK    ALT
xe-0/0/6.0      128:519        128:1  16384.00aabbcc0348     20000   FWD    ROOT
xe-0/0/7.0      128:520      128:520  32768.0019e2503f00     20000   BLK    DIS
(Root-Incon)
[output truncated]
```

Meaning The operational mode command show spanning-tree interface shows that interface **xe-0/0/7.0** has transitioned to a loop inconsistent state. The loop inconsistent state blocks the interface and prevents it from becoming a candidate for the root port. When the root bridge no longer receives more STP BPDUs from the interface, the interface recovers and transitions back to a forwarding state. Recovery is automatic.

Related Documentation

- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree on page 1517
- Example: Configuring BPDU Protection on STP Interfaces to Prevent STP Miscalculations on page 1513
- Understanding Root Protection for STP, RSTP, VSTP, and MSTP on page 1425

Bridging and VLAN Configuration Tasks

Configuring Static ARP Entries

You can create static ARP table entries, which are explicit mappings between IP addresses and MAC addresses.

- To configure a static ARP entry:

```
[edit interfaces interface-name unit logical-unit-number family inet address address]
user@switch# set arp ip-address (mac | multicast-mac) mac-address
```

The IP address that you specify must be part of the subnet defined in the enclosing **address** statement.

To associate a multicast MAC address with a unicast IP address, use the **multicast-mac** statement.

Specify the MAC address as 6 hexadecimal bytes in one of the following formats: ***nnnn.nnnn.nnnn*** or ***nn:nn:nn:nn:nn:nn***; for example, **0011.2233.4455** or **00:11:22:33:44:55**.

Related Documentation

- Understanding Static ARP Entries on page 4470
- *arp*

Bridging and VLAN Configuration Tasks (Original CLI Only)

- Creating a Series of Tagged VLANs on page 1536
- Disabling MAC Learning on page 1537

Adding a Static MAC Address Entry to the Ethernet Switching Table (CLI Procedure)

NOTE: This task uses Junos OS for EX Series switches and Junos OS for QFX3500 and QFX3600 switches that does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see "Adding a Static MAC Address Entry to the Ethernet Switching Table (CLI Procedure)" on page 1539. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

The Ethernet switching table, also known as the forwarding table, specifies the known locations of VLAN nodes. There are two ways to populate the Ethernet switching table on a switch. The easiest method is to let the switch update the table with MAC addresses.

The second way to populate the Ethernet switching table is to manually insert a VLAN node location into the table. You can do this to reduce flooding and speed up the switch's automatic learning process. To further optimize the switching process, indicate the next hop (next interface) packets will use after leaving the node.

Before configuring a static MAC address, be sure that you have:

- Set up the VLAN. See *Configuring VLANs for EX Series Switches (CLI Procedure)* or"Configuring VLANs" on page 1534.

To add a MAC address to the Ethernet switching table:

1. Specify the MAC address to add to the table:

   ```
   [edit ethernet-switching-options]
   set static vlan vlan-name mac mac-address
   ```
2. Indicate the next hop MAC address for packets sent to the indicated MAC address:

   ```
   [edit ethernet-switching-options]
   set static vlan vlan-name mac mac-address next-hop interface
   ```

Related Documentation

- *Understanding Bridging and VLANs on EX Series Switches*
- Understanding Bridging and VLANs on page 1402

Configuring MAC Limiting (CLI Procedure)

This task uses Junos OS for EX Series switches and QFX3500 and QFX3600 switches that does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see "Configuring MAC Limiting (CLI Procedure)" on page 1539. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

This topic describes various ways of configuring a limitation on MAC addresses in packets that are received and forwarded by the switch.

Before you can change a MAC limit that was previously set for an interface or a VLAN, you must first clear existing entries in the MAC address forwarding table that correspond to the change you want to make. Thus, to change the limit on an interface, first clear the MAC address forwarding table entries for that interface. To change the limit on all interfaces and VLANs, clear all MAC address forwarding table entries. To change the limit on a VLAN, clear the MAC address forwarding table entries for that VLAN.

To clear MAC addresses from the forwarding table:

- Clear MAC address entries from a specific interface (here, the interface is **ge-0/0/1**) in the forwarding table:

  `user@switch>` **clear ethernet-switching-table interface ge-0/0/1**
- Clear all MAC address entries in the forwarding table:

  `user@switch>`**clear ethernet-switching-table**
- Clear MAC address entries from a specific VLAN (here, the VLAN is vlan-abc):

  `user@switch>` **clear ethernet-switching-table vlan vlan-abc**

The different ways of setting a MAC limit are described in the following sections:

Configuring MAC Limiting for Port Security by Limiting the Number of MAC Addresses That Can be Learned on Interfaces

To configure MAC limiting for port security by setting a maximum number of MAC addresses that can be learned on interfaces.

- Apply the MAC limit on a single interface (here, the interface is ge-0/0/1):

  `[edit ethernet-switching-options secure-access-port]`
  `user@switch#` **set interface ge-0/0/1 mac-limit 10**

  When no action is specified for configuring the MAC limit on an interface, the switch performs the default action **drop** if the limit is exceeded.

- Apply the MAC limit on a single access interface, on the basis of its membership within a specific VLAN (here, the interface is ge-0/0/1 and the VLAN is v1.

  `[edit ethernet-switching-options secure-access-port]`
  `user@switch#` **set interface ge–0/0/1 vlan v1 mac-limit 5**

  With this type of configuration, the switch drops any additional packets if the limit is exceeded, and also logs a message.

- Apply the limit to all access interfaces:

  `[edit ethernet-switching-options secure-access-port]`
  `user@switch#` **set interface all mac-limit 10**

  When no action is specified for configuring the MAC limit on all interfaces, the switch performs the default action **drop** if the limit is exceeded:

Configuring MAC Limiting for Port Security by Specifying MAC Addresses That Are Allowed

You must clear existing entries in the MAC address forwarding table prior to changing the MAC address limit.

To configure MAC limiting for port security by specifying allowed MAC addresses:

- On a single interface (here, the interface is ge-0/0/2):

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface ge–0/0/2 allowed-mac 00:05:85:3A:82:80
user@switch# set interface ge–0/0/2 allowed-mac 00:05:85:3A:82:81
user@switch# set interface ge–0/0/2 allowed-mac 00:05:85:3A:82:83
```

- On all interfaces:

```
[edit ethernet-switching-options secure-access-port]
user@switch#set interface all allowed-mac 00:05:85:3A:82:80
user@switch#set interface all allowed-mac 00:05:85:3A:82:81
user@switch#set interface all allowed-mac 00:05:85:3A:82:83
```

Configuring MAC Limiting for VLANs

You must clear existing entries in the MAC address forwarding table before you can change the MAC address limit.

MAC limiting for a VLAN restricts the MAC addresses that can be learned for that VLAN, but does *not* drop the packet. Therefore, setting the MAC limit on a VLAN is not considered a port-security feature.

NOTE: The configuration of specific allowed MAC addresses does not apply to VLANs.

To configure MAC limiting for a VLAN using the CLI:

- Limit the number of dynamic MAC addresses on a VLAN:

  If the MAC limit on a specific VLAN is exceeded, the switch logs the MAC addresses of packets that cause the limit to be exceeded. No other action is possible.

  ```
  [edit vlans]
  user@switch# set vlan-abc mac-limit 20
  ```

  NOTE: When you are applying a MAC limit on a VLAN, do not set **mac-limit** to 1 for a VLAN composed of Routed VLAN Interfaces (RVIs) or a VLAN composed of aggregated Ethernet bundles using LACP. In these cases, setting the **mac-limit** to 1 prevents the switch from learning MAC addresses other than the automatic addresses:

  - For RVIs, the first MAC address inserted into the forwarding database is the MAC address of the RVI.
  - For aggregated Ethernet bundles using LACP, the first MAC address inserted into the forwarding database in the forwarding table is the source address of the protocol packet.

  If the VLAN is composed of regular access or trunk interfaces, you can set the **mac-limit** to 1 if you choose to do so.

Related Documentation

- *Configuring MAC Limiting (J-Web Procedure)*
- Example: Configuring MAC Limiting, Including Dynamic and Allowed MAC Addresses, to Protect the Switch from Ethernet Switching Table Overflow Attacks on page 4499
- *Verifying That MAC Limiting Is Working Correctly*
- *Setting the none Action on an Interface to Override a MAC Limit Applied to All Interfaces (CLI Procedure)*
- *Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)*
- *Understanding MAC Limiting and MAC Move Limiting for Port Security on EX Series Switches*
- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- *Understanding Bridging and VLANs on EX Series Switches*
- *no-allowed-mac-log*
- *show vlans*

Configuring MAC Notification

When a MAC address is learned or unlearned, SNMP notifications can be sent to the network management system at regular intervals to record the addition or removal of the MAC address. This process is known as *MAC notification*.

The MAC notification interval defines how often Simple Network Management Protocol (SNMP) notifications logging the addition or removal of MAC addresses on the switch are sent to the network management system.

MAC notification is disabled by default. When MAC notification is enabled, the default MAC notification interval is 30 seconds.

To enable or disable MAC notification, or to set the MAC notification interval, perform these tasks:

- Enabling MAC Notification on page 1531
- Disabling MAC Notification on page 1531
- Setting the MAC Notification Interval on page 1531

Enabling MAC Notification

MAC notification is disabled by default. You need to perform this procedure to enable MAC notification.

To enable MAC notification on the switch with the default MAC notification interval of 30 seconds:

```
[edit ethernet-switching-options]
user@switch# set mac-notification
```

To enable MAC notification on the switch with any other MAC notification interval (here, 60 seconds):

```
[edit ethernet-switching-options]
user@switch# set mac-notification notification-interval 60
```

Disabling MAC Notification

MAC notification is disabled by default. Perform this procedure only if MAC notification was previously enabled on your switch.

To disable MAC notification on the switch:

```
[edit ethernet-switching-options]
user@switch# delete mac-notification
```

Setting the MAC Notification Interval

The default MAC notification interval is 30 seconds. The procedure to change the MAC notification interval to a different interval is identical to the procedure to enable MAC notification on the switch with a nondefault value for the MAC notification interval.

To set the MAC notification interval on the switch (here, the MAC notification interval is set to 5 seconds):

```
[edit ethernet-switching-options]
user@switch# set mac-notification notification-interval 5
```

Related Documentation

- Verifying That MAC Notification Is Working Properly on page 1669

Configuring MAC Table Aging

MAC table aging ensures that a switch tracks only active nodes on the network and that it is able to flush out network nodes that are no longer available.

To manage MAC entries more efficiently, you can configure an entry's aging time, which is the maximum time that an entry can remain in the MAC address table before it is deleted because it has reached its maximum age.

NOTE: This task uses Junos OS for Junos OS for QFX3500 and QFX3600 switches that does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see "Configuring MAC Table Aging" on page 1541.

You can use the **set-mac-table-aging-time** command to configure how long entries remain in the Ethernet switching table before expiring. Here the VLAN is **employee-vlan**:

```
[edit vlans employee-vlan]
user@switch# set mac-table-aging-time 200
```

Related Documentation

- Understanding Bridging and VLANs on page 1402
- Example: Setting Up Bridging with Multiple VLANs on page 1451
- Example: Connecting an Access Switch to a Distribution Switch on page 1504

Configuring Routed VLAN Interfaces

Routed VLAN interfaces (RVIs) enable a switch to recognize which packets are being sent to local addresses so that they are bridged whenever possible and are routed only when needed. Whenever packets can be switched instead of routed, several layers of processing are eliminated. Switching also reduces the number of address look-ups.

To configure the routed VLAN interface:

1. Create the VLAN by assigning it a name and a VLAN ID:

   ```
   [edit]
   user@switch# set vlans support vlan-id 111
   ```
2. Assign an interface to the VLAN by specifying the logical interface (with the **unit** statement) and specifying the VLAN name as the member:

   ```
   [edit]
   user@switch# set interfaces ge-0/0/18 unit 0 family ethernet-switching vlan members support
   ```


3. Create the subnet for the VLAN's broadcast domain:

```
[edit]
user@switch# set interfaces vlan unit 111 family inet address 111.111.111.1/24
```

4. Bind a Layer 3 interface with the VLAN:

```
[edit]
user@switch# set vlans support l3-interface vlan.111
```

NOTE: Layer 3 interfaces on trunk ports allow the interface to transfer traffic between multiple VLANs. Within a VLAN, traffic is bridged, while across VLANs, traffic is routed.

You can display the configuration settings:

```
user@switch> show interfaces vlan terse
Interface               Admin Link Proto    Local                 Remote
vlan                    up    up
vlan.111                up    up   inet     111.111.111.1/24

user@switch> show vlans
Name           Tag     Interfaces
default
                       None
employee-vlan  20
                       ge-1/0/0.0, ge-1/0/1.0, ge-1/0/2.0
marketing      40
                       ge-1/0/10.0, ge-1/0/20.0, ge-1/0/30.0
support        111
                       ge-0/0/18.0
mgmt
                       bme0.32769, bme0.32771*

user@switch> show ethernet-switching table
Ethernet-switching table: 1 entries, 0 learned
  VLAN            MAC address       Type         Age Interfaces
  support         00:19:e2:50:95:a0 Static         - Router
```

Related Documentation

Configuring the Native VLAN Identifier

Switches support receiving and forwarding routed or bridged Ethernet frames with 802.1Q VLAN tags. The logical interface on which untagged packets are received must have the same native VLAN ID as that on the physical interface.

NOTE: This task uses Junos OS for QFX3500 and QFX3600 switches that does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see "Configuring the Native VLAN Identifier (CLI Procedure)" on page 1543.

To configure the native VLAN ID using the CLI:

1. Configure the port mode as **trunk** so that the interface is on multiple VLANs and can multiplex traffic between different VLANs. Trunk interfaces typically connect to other switches and to routers on the LAN.

```
[edit interfaces xe-0/0/3 unit 0 family ethernet-switching]
user@switch# set port-mode trunk
```

2. Configure the native VLAN ID:

```
[edit interfaces xe-0/0/3 unit 0 family ethernet-switching]
user@switch# set native-vlan-id 3
```

Related Documentation

- Understanding Bridging and VLANs on page 1402
- Example: Setting Up Bridging with Multiple VLANs on page 1451
- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433

Configuring VLANs

Switches use VLANs to make logical groupings of network nodes with their own broadcast domains. You can use VLANs to limit the traffic flowing across the entire LAN and reduce collisions and packet retransmissions.

NOTE: This task uses Junos OS for the QFX Series that does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see "Configuring VLANs" on page 1544.

For each endpoint on the VLAN, configure the following VLAN parameters on the corresponding interface:

1. Specify the description of the VLAN:

```
[edit interfaces interface-name unit 0]
user@switch# set description vlan-description
```

2. Specify the unique name of the VLAN:

NOTE: In a QFabric system, do not configure "default" as the name of a VLAN. Though the QFabric system will allow you to configure and commit a VLAN with the name "default" in the current software with no commit errors, it will not work. Junos OS 12.2 and onwards will not allow you to commit a VLAN with the name "default."

```
[edit interfaces interface-name unit 0]
user@switch# set family ethernet-switching vlan members vlan-name
```

3. Create the subnet for the VLAN:

```
[edit interfaces]
user@switch# set vlan unit 0 family inet address ip-address
```

4. Configure the VLAN tag ID or VLAN ID range for the VLAN:

```
[edit vlans]
user@switch# set vlan-name vlan-id vlan-id-number
```

or

```
[edit vlans]
user@switch# set vlan-name vlan-range vlan-id-low-vlan-id-high
```

5. Specify the maximum time that an entry can remain in the forwarding table before it ages out:

```
[edit vlans]
user@switch# set vlan-name mac-table-aging-time time
```

6. Specify a VLAN firewall filter to be applied to incoming or outgoing packets:

```
[edit vlans]
user@switch# set vlan-name filter (input | output) filter-name
```

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Configuring Routed VLAN Interfaces on page 1532
- Creating a Series of Tagged VLANs on page 1536
- Understanding Bridging and VLANs on page 1402

Creating a Series of Tagged VLANs

When you divide an Ethernet LAN into multiple VLANs, each VLAN is assigned a unique IEEE 802.1Q tag. This tag is associated with each frame in the VLAN, and the network nodes receiving the traffic can use the tag to identify which VLAN a frame is associated with.

Instead of configuring VLANs and 802.1Q tags one at a time for a trunk interface, you can configure a VLAN range to create a series of tagged VLANs.

When an Ethernet LAN is divided into VLANs, each VLAN is identified by a unique 802.1Q tag. The tag is applied to all frames so that the network nodes receiving the frames can detect which VLAN the frames belong to. Trunk ports, which multiplex traffic among a number of VLANs, use the tag to determine the origin of frames and where to forward them.

For example, you could configure the VLAN **employee** and specify a tag range of **10 through 12**. This creates the following VLANs and tags:

- VLAN **employee-10**, tag **10**
- VLAN **employee-11**, tag **11**
- VLAN **employee-12**, tag **12**

Creating tagged VLANs in a series has the following limitations:

- Layer 3 interfaces do not support this feature.
- Because an access interface can only support one VLAN member, access interfaces also do not support this feature.

NOTE: This task uses Junos OS for QFX3500 and QFX3600 switches that does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does support ELS, see "Creating a Series of Tagged VLANs" on page 1546..

To configure a series of tagged VLANs using the CLI (here, the VLAN is **employee**):

1. Configure the series (here, a VLAN series from 120 through 130):

```
[edit]
user@switch# set vlans employee vlan-range 120-130
```

2. Associate a series of tagged VLANs when you configure an interface in one of two ways:

- Include the name of the series:

```
[edit interfaces]
user@switch# set interfaces xe-0/0/22.0 family ethernet-switching vlanmembers employee
```

- Include the VLAN range:

```
[edit interfaces]
user@switch# set interfaces xe-0/0/22.0 family ethernet-switching vlan members 120–130
```

Associating a series of tagged VLANS to an interface by name or by VLAN range has the same result: VLANs **__employee_120__** through **__employee_130__** are created.

NOTE: When a series of VLANs is created using the vlan-range command, the VLAN names are preceded and followed by a double underscore.

Related Documentation

- Verifying That a Series of Tagged VLANs Has Been Created on page 1669
- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Example: Setting Up Bridging with Multiple VLANs on page 1451
- *Understanding Bridging*

Disabling MAC Learning

By default, MAC learning is globally enabled on all nodes in a QFX Series product. This topic describes how to disable MAC learning, as well as how to reenable and verify that MAC learning has been enabled or disabled.

Disabling dynamic MAC learning on the QFX Series prevents a node from learning source and destination MAC addresses.

NOTE: This task uses Junos OS for QFX3500 and QFX3600 switches does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see “Disabling MAC Learning” on page 1547.

- To disable MAC learning on the QFX Series:

```
[edit ethernet-switching-options interfaces interface]
user@switch# set no-mac-learning
```

- To enable MAC learning on the QFX Series:

```
[edit ethernet-switching-options interfaces interface]
user@switch# delete no-mac-learning
user@switch# deactivate no-mac-learning
```

- To verify the status of MAC learning on the QFX Series, view the Ethernet MAC learning statistics in operational mode.

```
user@switch> show ethernet-switching table
Ethernet-switching table: 2 entries, 1 learned
  VLAN              MAC address       Type         Age Interfaces
  default           *                 Flood          - All-members
  default           00:1f:12:39:90:80 Learn         29 xe-/0/0.0
```

Related Documentation

- Understanding MAC Learning on page 1410
- Example: Disabling MAC Learning on page 1450
- no-mac-learning on page 1625

Bridging and VLAN Configuration Tasks (ELS CLI Only)

Adding a Static MAC Address Entry to the Ethernet Switching Table (CLI Procedure)

NOTE: This task uses Junos OS for EX Series switches and Junos OS for QFX3500 and QFX3600 switches with support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see "Adding a Static MAC Address Entry to the Ethernet Switching Table (CLI Procedure)" on page 1527. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

The Ethernet switching table, also known as the forwarding table, specifies the known locations of VLAN nodes and the addresses of devices within those nodes. There are two ways to populate the Ethernet switching table on a switch. The easiest method is to let the switch update the table with MAC addresses.

The second way to populate the Ethernet switching table is to manually insert addresses into the table. You can do this to reduce flooding and speed up the switch's automatic learning process.

Before configuring a static MAC address, be sure that you have:

- Set up the VLAN. See *Configuring VLANs for EX Series Switches (CLI Procedure)* or "Configuring VLANs" on page 1534.

To configure an interface to have a static MAC address:

```
[edit vlans vlan-name switch-options interface interface-name]
user@switch# set static-mac mac-address
```

Related Documentation

- *Understanding Bridging and VLANs on EX Series Switches*

Configuring MAC Limiting (CLI Procedure)

NOTE: This task uses Junos OS for EX Series switches and QFX3500 and QFX3600 switches with support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see "Configuring MAC Limiting (CLI Procedure)" on page 1527. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

This topic describes various ways of configuring a limitation on MAC addresses in packets that are received and forwarded by the switch.

NOTE: On a QFX Series Virtual Chassis, if you include the **shutdown** option at the **[edit vlans *vlan-name* switch-options interface *interface-name* interface-mac-limit packet-action]** hierarchy level and issue the **commit** operation, the system generates a commit error. The system does not generate an error if you include the **shutdown** option at the **[edit switch-options interface *interface-name* interface-mac-limit packet-action]** hierarchy level.

The different ways of setting a MAC limit are described in the following sections:

Limiting the Number of MAC Addresses Learned by an Interface

To secure a port, you can set the maximum number of MAC addresses that can be learned by an interface:

- Set the MAC limit on an interface, and specify an action that the switch takes after the specified limit is exceeded:

  ```
  [edit switch-options]
  user@switch# set interface interface-name interface-mac-limit limit packet-action action
  ```

  After you set a new MAC limit for the interface, the system clears existing entries in the MAC address forwarding table associated with the interface.

Limiting the Number of MAC Addresses Learned by a VLAN

To limit the number of MAC addresses learned by a VLAN:

1. Set the maximum number of MAC addresses that can be learned by a VLAN, and specify an action that the switch takes after the specified limit is exceeded:

   ```
   [edit vlans]
   user@switch# set vlan-name switch-options mac-table-size limit packet-action action
   ```

2. Set the maximum number of MAC addresses that can be learned by one *or* all interfaces in the VLAN, and specify an action that the switch takes after the specified limit is exceeded:

   ```
   [edit vlans]
   user@switch# set vlan-name switch-options interface interface-name interface-mac-limit limit packet-action action
   [edit vlans]
   user@switch# set vlan-name switch-options interface-mac-limit limit packet-action action
   ```

NOTE: If you specify a MAC limit and packet action for all interfaces in the VLAN *and* a specific interface in the VLAN, the MAC limit and packet action specified at the specific interface level takes precedence. Also, at the VLAN interface level, only the **drop** and **drop-and-log** options are supported.

After you set new MAC limits for a VLAN by using the **mac-table-size** statement or for interfaces associated with a VLAN by using the **interface-mac-limit** statement, the system clears the corresponding existing entries in the MAC address forwarding table.

Related Documentation

- *Understanding Bridging and VLANs on EX Series Switches*
- *Configuring Persistent MAC Learning (CLI Procedure)*

Configuring MAC Table Aging

MAC table aging ensures that a switch tracks only active nodes on the network and that it is able to flush out network nodes that are no longer available.

To manage MAC entries more efficiently, you can configure an entry's aging time, which is the maximum time that an entry can remain in the MAC address table before it is deleted because it has reached its maximum age.

NOTE: This task uses Junos OS for QFX3500 and QFX3600 switches with support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see "Configuring MAC Table Aging" on page 1532. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

You can use the **set-mac-table-aging-time** command to configure how long entries remain in the Ethernet switching table before expiring. Here the VLAN is **employee-vlan**:

```
[edit vlans employee-vlan switch-options]
user@switch# set mac-table-aging-time 200
```

Related Documentation

- Understanding Bridging and VLANs on page 1402
- Example: Setting Up Bridging with Multiple VLANs on page 1458
- Example: Connecting an Access Switch to a Distribution Switch on page 1504

Configuring Routed VLAN Interfaces

Routed VLAN interfaces (RVIs) enable a switch to recognize which packets are being sent to local addresses so that they are bridged whenever possible and are routed only when needed. Whenever packets can be switched instead of routed, several layers of processing are eliminated. Switching also reduces the number of address look-ups.

To configure the routed VLAN interface:

1. Create the VLAN by assigning it a name and a VLAN ID:

```
[edit]
user@switch# set vlans support vlan-id 111
```

2. Assign an interface to the VLAN by specifying the logical interface (with the **unit** statement) and specifying the VLAN name as the member:

```
[edit]
user@switch# set interfaces ge-0/0/18 unit 0 family ethernet-switching vlan members
support
```

3. Create the subnet for the VLAN's broadcast domain:

```
[edit]
user@switch# set interfaces vlan unit 111 family inet address 111.111.111.1/24
```

4. Bind a Layer 3 interface with the VLAN:

```
[edit]
user@switch# set vlans support l3-interface vlan.111
```

NOTE: Layer 3 interfaces on trunk ports allow the interface to transfer traffic between multiple VLANs. Within a VLAN, traffic is bridged, while across VLANs, traffic is routed.

You can display the configuration settings:

```
user@switch> show interfaces vlan terse
Interface                Admin Link Proto    Local                 Remote
vlan                     up    up
vlan.111                 up    up   inet     111.111.111.1/24

user@switch> show vlans
Name           Tag     Interfaces
default
                       None
employee-vlan  20
                       ge-1/0/0.0, ge-1/0/1.0, ge-1/0/2.0
marketing      40
                       ge-1/0/10.0, ge-1/0/20.0, ge-1/0/30.0
support        111
                       ge-0/0/18.0
mgmt
                       bme0.32769, bme0.32771*

user@switch> show ethernet-switching table
Ethernet-switching table: 1 entries, 0 learned
  VLAN              MAC address       Type         Age Interfaces
  support           00:19:e2:50:95:a0 Static         - Router
```

Related Documentation

Configuring the Native VLAN Identifier (CLI Procedure)

NOTE: This task uses Junos OS for EX Series switches and Junos OS for QFX3500 and QFX3600 switches with support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see *Configuring the Native VLAN Identifier (CLI Procedure)*. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

Switches can receive and forward routed or bridged Ethernet frames with 802.1Q VLAN tags. Typically, trunk ports, which connect switches to each other, accept untagged control packets but do not accept untagged data packets. You can enable a trunk port to accept untagged data packets by configuring a native VLAN ID on the interface on which you want the untagged data packets to be received. The logical interface on which untagged packets are to be received must be configured with the same VLAN ID as the native VLAN ID configured on the physical interface.

To configure the native VLAN ID by using the command-line interface (CLI):

1. On the interface on which you want untagged data packets to be received, set the interface mode to **trunk**, which specifies that the interface is in multiple VLANs and can multiplex traffic between different VLANs.:

```
[edit interfaces]
user@switch# set interface-name unit logical-unit-number family
ethernet-switching interface-mode trunk
```

2. Configure the native VLAN ID:

```
[edit interfaces]
user@switch# set interface-name native-vlan-id vlan-id
```

3. Specify that the logical interface that will receive the untagged data packets is a member of the native VLAN:

```
[edit interfaces]
user@switch# set interface-name unit logical-unit-number family
ethernet-switching vlan members vlan-id
```

Related Documentation

- *Understanding Bridging and VLANs on EX Series Switches*
- *Example: Connecting Access Switches to a Distribution Switch*
- *Example: Setting Up Basic Bridging and a VLAN for an EX Series Switch*
- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433

Configuring VLANs

Switches use VLANs to make logical groupings of network nodes with their own broadcast domains. You can use VLANs to limit the traffic flowing across the entire LAN and reduce collisions and packet retransmissions.

NOTE: This task supports the Enhanced Layer 2 Software (ELS) configuration style. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58. If your switch runs software that does not support ELS, see "Configuring VLANs" on page 1534.

For each endpoint on the VLAN, configure the following VLAN parameters on the corresponding interface:

1. Specify the description of the VLAN:

   ```
   [edit interfaces interface-name unit 0]
   user@switch# set description vlan-description
   ```
2. Specify the unique name of the VLAN:

   NOTE: Switches that run Junos OS with the ELS configuration style do not support a default VLAN. Therefore, on such switches, you must explicitly configure at least one VLAN, even if your network is simple and you want only one broadcast domain to exist.

   ```
   [edit interfaces interface-name unit 0]
   user@switch# set family ethernet-switching vlan members vlan-name
   ```
3. Create the subnet for the VLAN:

   ```
   [edit interfaces]
   user@switch# set vlan unit 0 family inet address ip-address
   ```
4. Configure the VLAN tag ID or VLAN ID list for the VLAN:

   ```
   [edit vlans]
   user@switch# set vlan-name vlan-id vlan-id-number
   ```

   or

   ```
   [edit vlans]
   user@switch# set vlan-name vlan-id-list [vlan-ids | vlan-id--vlan-id-]
   ```
5. Specify the maximum time that an entry can remain in the forwarding table before it ages out:

   ```
   [edit vlans]
   user@switch# set vlan-name switch-options mac-table-aging-time time
   ```
6. Specify a VLAN firewall filter to be applied to incoming or outgoing packets:

   ```
   [edit vlans]
   user@switch# set vlan-name filter (input | output) filter-name
   ```

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Configuring Routed VLAN Interfaces on page 1532

- Creating a Series of Tagged VLANs on page 1536
- Understanding Bridging and VLANs on page 1402

Creating a Series of Tagged VLANs

When you divide an Ethernet LAN into multiple VLANs, each VLAN is assigned a unique IEEE 802.1Q tag. This tag is associated with each frame in the VLAN, and the network nodes receiving the traffic can use the tag to identify which VLAN a frame is associated with.

Instead of configuring VLANs and 802.1Q tags one at a time for a trunk interface, you can configure a VLAN range to create a series of tagged VLANs.

When an Ethernet LAN is divided into VLANs, each VLAN is identified by a unique 802.1Q tag. The tag is applied to all frames so that the network nodes receiving the frames can detect which VLAN the frames belong to. Trunk ports, which multiplex traffic among a number of VLANs, use the tag to determine the origin of frames and where to forward them.

For example, you could configure the VLAN **employee** and specify a tag range of **10 through 12**. This creates the following VLANs and tags:

- VLAN **employee-10**, tag **10**
- VLAN **employee-11**, tag **11**
- VLAN **employee-12**, tag **12**

Creating tagged VLANs in a series has the following limitations:

- Layer 3 interfaces do not support this feature.
- Because an access interface can only support one VLAN member, access interfaces also do not support this feature.

NOTE: This task uses Junos OS for Junos OS for QFX3500 and QFX3600 switches with support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see "Creating a Series of Tagged VLANs" on page 1536. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

To configure a series of tagged VLANs using the CLI (here, the VLAN is **employee**):

1. Configure the series (here, a VLAN series from 120 through 130):

```
[edit]
user@switch# set vlans employee vlan-id-list [ 120-130 ]
```

2. Associate a series of tagged VLANs when you configure an interface in one of two ways:

- Include the name of the series:

```
[edit interfaces]
user@switch# set interfaces xe-0/0/22.0 family ethernet-switching vlanmembers employee
```

- Include the VLAN range:

```
[edit interfaces]
user@switch# set interfaces xe-0/0/22.0 family ethernet-switching vlan members 120–130
```

Associating a series of tagged VLANS to an interface by name or by VLAN range the same result: VLANs **__employee_120__** through **__employee_130__** are created.

NOTE: When a series of VLANs is created using the vlan-id-list command, the VLAN names are preceded and followed by a double underscore.

Related Documentation

- Verifying That a Series of Tagged VLANs Has Been Created on page 1669
- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Example: Setting Up Bridging with Multiple VLANs on page 1458
- Understanding Bridging and VLANs on page 1402

Disabling MAC Learning

By default, MAC learning is globally enabled on all nodes in a QFX Series product. This topic describes how to disable MAC learning, as well as how to reenable and verify that MAC learning has been enabled or disabled.

NOTE: This task uses Junos OS for QFX3500 and QFX3600 switches with support for the Enhanced Layer 2 Software (ELS) configuration style. This task supports the Enhanced Layer 2 Software (ELS) configuration style. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58 If your switch runs software that does not support ELS, see "Disabling MAC Learning" on page 1537.

Disabling dynamic MAC learning on the QFX Series prevents a node from learning source and destination MAC addresses.

- To disable MAC learning on the QFX Series:

```
[edit vlans vlan-name switch-options interface interface-name]
user@switch# set no-mac-learning
```

- To enable MAC learning on the QFX Series:

```
[edit vlans vlan-name switch-options interface interface-name]
user@switch# delete no-mac-learning
user@switch# deactivate no-mac-learning
```

- To verify the status of MAC learning on the QFX Series, view the Ethernet MAC learning statistics in operational mode.

```
user@switch> show ethernet-switching table
Ethernet-switching table: 2 entries, 1 learned
  VLAN              MAC address       Type         Age Interfaces
  default           *                 Flood          - All-members
  default           00:1f:12:39:90:80 Learn         29 xe-/0/0.0
```

Related Documentation

- Understanding MAC Learning on page 1410
- Example: Disabling MAC Learning on page 1457
- no-mac-learning on page 1625

Unified Forwarding Table Configuration Task

Configuring the Unified Forwarding Table

Configuring an Address-Storage Profile

On the QFX5100 switch, you can control the allocation of memory available to store the following:

- MAC addresses
- Layer 3 host entries
- Longest prefix match table entries

You configure the mix that best meets your needs by choosing the appropriate profile. Table 135 on page 1548 lists the profiles you can choose and the associated values for each type of entry.

Table 135: Unified Forwarding Table Profiles

Profile Name	MAC Table	Host Table (unicast and multicast addresses)						LPM Table	
	MAC Addresses	IPv4 unicast	IPv6 unicast	IPv4 (*, G)	IPv4 (S, G)	IPv6 (*, G)	IPv6 (S, G)	IPv4 Entries	IPv6 Entries (prefix <= 64)
l2-profile-one	288K	16K	8K	8K	8K	4K	4K	16K	8K
l2-profile-two	224K	80K	40K	40K	40K	20K	20K	16K	8K

Table 135: Unified Forwarding Table Profiles *(continued)*

Profile Name	MAC Table	Host Table (unicast and multicast addresses)						LPM Table	
l2-profile-three (default)	160K	144K	72K	72K	72K	36K	36K	16K	8K
l3-profile	96K	208K	104K	104K	104K	52K	52K	16K	8K
lpm-profile (Do not use for IPv6)	32K	16K	8K	8K	8K	4K	4K	128K	64K

Note that if the host or LPM table stores the maximum number of entries for any given type, the entire table is full and is unable to accommodate *any* entries of any other type. For information about valid combinations of table entries see "Understanding the Unified Forwarding Table" on page 1415.

To configure the profile that you want, enter and commit the following statement:

```
[edit]
user@switch# set chassis forwarding-options profile-name
```

NOTE: When you configure a profile, all the data interfaces on the switch restart. The management interfaces are unaffected.

The settings for **l2-profile-three** are configured by default. That is, if you do not enter a **set forwarding–options chassis** ***profile-name*** statement, these settings are configured.

WARNING: The **lpm-profile** does not work for IPv6 traffic. Do not use this profile for IPv6.

Configuring IPv6 Addresses with /65 to /127 Prefix Lengths

If you want to use more than 16 IPv6 addresses with prefixes in the range /65 through /127 you must enter and commit the following statement:

```
[edit]
user@switch# set chassis forwarding-options profile-name num-65-127-prefix value
```

in which *value* can be a value in the range 1 through 128. Each increment adds support for 16 IPv6 addresses with prefixes between /65 and /127, for a maximum of 2048 such addresses (16 x 128 = 2048). The system supports 16 of these addresses by default, so to increase the number of supported addresses, you must enter a value of 2 or greater. For example, if you enter **2**, the system will support 32 IPv6 addresses with prefixes in the range /65 through /127.

Each increment that you add for IPv6 addresses with prefixes in the range /65 through /127 reduces the number of forwarding table entries that are available for IPv4 addresses and IPv6 addresses with prefixes outside this range. If you enter **128** to configure support for the maximum number of IPv6 addresses with prefixes in the range /65 through /127, the portion of the longest prefix match section of the forwarding table available to IPv4 addresses and IPv6 addresses with prefixes outside the /65 through /127 range is reduced by 8K.

NOTE: When you configure the num-65-127-prefix value, all the data interfaces on the switch restart. The management interfaces are unaffected.

Related Documentation

- Understanding the Unified Forwarding Table on page 1415

Forwarding Mode Configuration Task

Configuring the Forwarding Mode

By default, QFX Series products forward packets using store-and-forward mode. You can configure all the interfaces on a QFX series switch or QFabric to use cut-through mode instead.

To enable cut-through switching mode, enter the following statement:

```
[edit forwarding-options]
user@switch# set cut-through
```

Related Documentation

- cut-through on page 1562

Proxy ARP Configuration Task (Original CLI Only)

Configuring Proxy ARP

You can configure proxy Address Resolution Protocol (ARP) to enable the switch to respond to ARP queries for network addresses by offering its own media access control (MAC) address. With proxy ARP enabled, the switch captures and routes traffic to the intended destination.

To configure proxy ARP on a single interface:

```
[edit interfaces]
user@switch# set xe-0/0/3 unit 0 proxy-arp restricted
```

BEST PRACTICE: We recommend that you configure proxy ARP in restricted mode. In restricted mode, the switch is not a proxy if the source and target IP addresses are on the same subnet. If you use unrestricted mode, disable gratuitous ARP requests on the interface to avoid the situation of the switch's response to a gratuitous ARP request appearing to the host to be an indication of an IP conflict:

To configure proxy ARP on a routed VLAN interface (RVI):

```
[edit interfaces]
user@switch# set vlan unit 100 proxy-arp restricted
```

Related Documentation

- Understanding Proxy ARP on page 1417
- Verifying That Proxy ARP Is Working Correctly on page 1671
- Understanding Routed VLAN Interfaces on page 1409

Proxy ARP Configuration Task (ELS CLI Only)

- Configuring Proxy ARP (CLI Procedure) on page 1552

Configuring Proxy ARP (CLI Procedure)

NOTE: This task uses Junos OS for EX Series switches and QFX3500 and QFX3600 switches with support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see *Configuring Proxy ARP (CLI Procedure)* or "Configuring Proxy ARP" on page 1551. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

You can configure proxy Address Resolution Protocol (ARP) on your switch to enable the switch to respond to ARP queries for network addresses by offering its own media access control (MAC) address. With proxy ARP enabled, the switch captures and routes traffic to the intended destination.

To configure proxy ARP on a single interface:

```
[edit interfaces]
user@switch# set interface-name unit logical-unit-number proxy-arp (restricted |
unrestricted)
```

BEST PRACTICE: We recommend that you configure proxy ARP in restricted mode. In restricted mode, the switch does not act as a proxy if the source and target IP addresses are on the same subnet. If you decide to use unrestricted mode, disable gratuitous ARP requests on the interface to avoid a situation wherein the switch's response to a gratuitous ARP request appears to the host to be an indication of an IP conflict.

To configure proxy ARP on an integrated routing and bridging (IRB) interface:

```
[edit interfaces]
user@switch# set irb.logical-unit-number proxy-arp restricted
```

Related Documentation

- *Example: Configuring Proxy ARP on an EX Series Switch*
- Verifying That Proxy ARP Is Working Correctly on page 1671
- *Configuring Integrated Routing and Bridging Interfaces (CLI Procedure)*

STP Configuration Tasks

Configuring STP

The default spanning-tree protocol on the QFX Series is Rapid Spanning Tree Protocol (RSTP). RSTP provides faster convergence times than Spanning Tree Protocol (STP) does. However, some legacy networks require the slower convergence times of basic STP.

If your network includes 802.1D 1998 bridges, you can remove RSTP and explicitly configure STP. When you explicitly configure STP, the QFX Series products use the IEEE 802.1D 2004 specification, force version 0. This configuration runs a version of RSTP that is compatible with the classic, basic STP.

To configure STP using the CLI:

1. Delete the RSTP configuration on the interface (here, the interface is **xe-0/0/5**):

   ```
   [edit]
   user@switch# delete protocols rstp interface xe-0/0/5
   ```
2. Configure STP on the interface:

   ```
   [edit]
   user@switch# set protocols stp interface xe-0/0/5
   ```
3. Commit the configuration:

   ```
   [edit]
   user@switch# commit
   ```

Related Documentation

- show spanning-tree bridge on page 1706
- show spanning-tree interface on page 1711
- Overview of Spanning-Tree Protocols on page 1419

Unblocking an Interface That Receives BPDUs in Error

NOTE: BPDU block protection is disabled on Node devices.

QFX Series switches use bridge protocol data unit (BPDU) protection on interfaces to prevent them from receiving BPDUs that could trigger a spanning-tree misconfiguration. If BPDUs are received on a BPDU-protected interface, the interface transitions to a blocking state and stops forwarding frames.

After you fix the misconfiguration that triggered the sending of BPDUs to an interface, you can unblock the interface and return it to service.

NOTE: This task describes how to use both the original CLI and the Enhanced Layer 2 Software (ELS) CLI. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

To unblock an interface after fixing the misconfiguration that triggered the BPDUs and return it to service:

- (Original CLI) Automatically unblock an interface by configuring a timer that expires (here, the interface is **xe-0/0/6**):

```
[edit ethernet-switching-options]
user@switch# set bpdu-blockdisable-timeout 30 interface xe-0/0/6
```

- (ELS CLI) Automatically unblock an interface by configuring a timer that expires (here, the interface is **xe-0/0/6**):

```
[edit protocols layer2-control]
user@switch# set bpdu-blockdisable-timeout 30 interface xe-0/0/6
```

- Manually unblock an interface using the operational mode command:

```
user@switch> clear ethernet-switching bpdu-error interface xe-0/0/6
```

Related Documentation

- Example: Configuring BPDU Protection on STP Interfaces to Prevent STP Miscalculations on page 1513
- Understanding BPDU Protection for STP, RSTP, and MSTP on page 1423

STP Configuration Tasks (Original CLI Only)

Configuring VLAN Spanning Tree Protocol

VLAN Spanning Tree Protocol (VSTP) enables the QFX Series to run one or more Spanning Tree Protocol (STP) or Rapid Spanning Tree Protocol (RSTP) instances for each VLAN on which VSTP is enabled. For networks with multiple VLANs, VSTP improves intelligent tree spanning by defining the best paths within the VLANs instead of within the entire network.

NOTE: This task uses Junos OS for the QFX Series that does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see "Configuring VLAN Spanning-Tree Protocol" on page 1556.

To configure VSTP:

1. (Optional) Enable Rapid Spanning Tree Protocol (RSTP):

   ```
   [edit protocols]
   user@switch# set rstp
   ```

   VSTP can run on a maximum of 253 VLANs; RSTP runs on the remaining VLANs if configured. Enabling RSTP ensures that a spanning-tree protocol runs on all VLANs.

2. Enable VSTP.

   - To enable VSTP on multiple VLANs using a VLAN group:

     ```
     [edit protocols]
     ```


user@switch# **set** vstp **vlan-group group** ***group-name*** **vlan** ***vlan-id-range***

- To enable VSTP on all VLANs:

```
[edit protocols]
user@switch# set vstp vlan all
```

NOTE: You must enable RSTP if you used the **set vstp vlan all** statement to enable VSTP and if the switch has more than 253 VLANs. If you use the **set vstp vlan all** statement to enable VSTP on a switch with more than 253 VLANs, the configuration cannot be committed.

- To enable VSTP on a VLAN using a single VLAN ID:

```
[edit protocols]
user@switch# set vstp vlan vlan-id
```

- To enable VSTP on a VLAN using a single VLAN name:

```
[edit protocols]
user@switch# set vstp vlan vlan-name
```

Related Documentation

- Understanding VSTP on page 1422

STP Configuration Tasks (ELS CLI Only)

Configuring VLAN Spanning-Tree Protocol

You can configure the VLAN Spanning-Tree Protocol (VSTP) under the following hierarchy levels:

NOTE: This task supports the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not supports ELS, see "Configuring VLAN Spanning Tree Protocol" on page 1554.

- [edit *logical-systems logical-system-name protocols*]
- [edit *logical-systems logical-system-name routing-instances routing-instance-name protocols*]
- [edit *protocols*]
- [edit *routing-instances routing-instance-name protocols*]

The routing instance type can be either **virtual-switch** or **layer2-control**.

To configure the VLAN Spanning-Tree Protocol:

1. Enable VSTP as the version of spanning-tree protocol to be configured:

   ```
   [edit]
   user@host@ edit ... protocols (STP Type) vstp
   ```
2. (Optional) For compatibility with older bridges that do not support VSTP, you can run force VSTP to run as the original IEEE 802.1D Spanning-Tree Protocol (STP) version:

   ```
   [edit ... protocols vstp]
   user@host# set force-version stp
   ```

   NOTE: If VSTP has been forced to run as the original STP version, you can revert back to VSTP by first removing the **force-version** statement from the configuration and then entering the *clear spanning-tree protocol-migration* configuration mode command.

3. Configure the interfaces that participate in the VSTP instance.

   a. Enable configuration of the interface:

      `[edit ... protocols vstp]`
      `user@host#` **edit interface *interface-name***

   b. Configure the interface priority:

      `[edit ... protocols vstp interface` *`interface-name`*`]`
      `user@host#` **set priority *interface-priority***

   c. (Optional) By default, the interface link cost is determined by the link speed. You can configure the interface link cost to control which bridge is the designated bridge and which port is the designated port:

      `[edit ... protocols vstp interface` *`interface-name`*`]`
      `user@host#` **set cost *interface-link-cost***

   d. Configure the interface link mode to identify point-to-point links:

      `[edit ... protocols vstp interface` *`interface-name`*`]`
      `user@host#` **set mode (p2p | shared)**

      Specify **p2p** if the link is point to point. Specify **shared** is the link is a shared media.

   e. (Optional) Configure the interface as an edge port:

      `[edit ... protocols vstp interface` *`interface-name`*`]`
      `user@host#` **set edge**

      Edge ports do not expect to receive bridge protocol data unit (BPDU) packets. If a BPDU packet is received for an edge port, the port becomes a nonedge port

   You can also enable BPDU root protection for all spanning-tree protocol instances on the interface. BPDU root protect ensures the port is the spanning-tree designated port. If the port receives superior BPDU packets, root protect moves this port to a root-prevented spanning-tree state. For configuration details, see *Checking the Status of Spanning-Tree Instance Interfaces*.

4. Enable configuration of a VLAN instance:

   `[edit ... protocols vstp]`
   `user@host#` **edit vlan *vlan-id***

5. Configure the bridge priority

   `[edit ... protocols vstp vlan` *`vlan-id`*`]`
   `user@host#` **set bridge-priority *bridge-priority***

   For more information, see *Bridge Priority for Election of Root Bridge and Designated Bridge*.

6. Configure hello BPDU timers.

   a. Configure the maximum expected arrival time of hello BPDUs:

   ```
   [edit ... protocols vstp vlan vlan-id]
   user@host# set max-age seconds
   ```

   b. Configure the time interval at which the root bridge transmits configuration BPDUs:

   ```
   [edit ... protocols vstp vlan vlan-id]
   user@host# set hello-time seconds
   ```

7. (Optional) By default, the bridge port remains in the listening and learning states for 15 seconds before transitioning to the forwarding state. You can specify a delay from **4** through **20** seconds instead:

   ```
   [edit ... protocols vstp vlan vlan-id]
   user@host# set forward-delay seconds
   ```

8. Configure the interfaces that participate in the VSTP instance.

   a. Enable configuration of the interface:

   ```
   [edit ... protocols vstp vlan vlan-id]
   user@host# edit interface interface-name
   ```

   b. Configure the interface priority:

   ```
   [edit ... protocols vstp vlan vlan-id interface interface-name]
   user@host# set priority interface-priority
   ```

   c. (Optional) By default, the interface link cost is determined by the link speed. You can configure the interface link cost to control which bridge is the designated bridge and which port is the designated port:

   ```
   [edit ... protocols vstp vlan vlan-id interface interface-name]
   user@host# set cost interface-link-cost
   ```

   d. Configure the interface link mode to identify point-to-point links:

   ```
   [edit ... protocols vstp vlan vlan-id interface interface-name]
   user@host# set mode (p2p | shared)
   ```

   Specify **p2p** if the link is point to point. Specify **shared** is the link is a shared media.

   e. (Optional) Configure the interface as an edge port:

   ```
   [edit ... protocols vstp vlan vlan-id interface interface-name]
   user@host# set edge
   ```

   Edge ports do not expect to receive bridge protocol data unit (BPDU) packets. If a BPDU packet is received for an edge port, the port becomes a nonedge port

   You can also enable BPDU root protection for all spanning-tree protocol instances on the interface. BPDU root protect ensures the port is the spanning-tree designated port. If the port receives superior BPDU packets, root protect moves this port to a root-prevented spanning-tree state. For configuration details, see *Checking the Status of Spanning-Tree Instance Interfaces*.

9. Verify the VSTP configuration:

   ```
   [edit]
   ... { # Optional logical system and/or routing instance
     protocols (STP Type) {
       vstp {
   ```



```
        force-version stp; # Optional.
        interface interface-name {
          priority interface-priority;
          cost interface-link-cost; # Optional.
          mode (p2p | shared);
          edge; # Optional.
        }
        vlan vlan-id {
          bridge-priority bridge-priority;
          max-age seconds;
          hello-time seconds;
          forward-delay seconds; # Optional.
          interface interface-name {
            priority interface-priority;
            cost interface-link-cost; # Optional.
            mode (p2p | shared);
            edge; # Optional.
          }
        }
      }
    }
  }
```

Related Documentation

- *Spanning-Tree Protocols Supported*
- *RSTP or VSTP Forced to Run as IEEE 802.1D STP*
- *Reverting to RSTP or VSTP from Forced IEEE 802.1D STP*
- *VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview*
- *VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Topology*

Unified Forwarding Table Configuration Statements

forwarding-options (chassis)

Syntax

```
forwarding optionsprofile-name {
  num-65-127-prefix value
}
```

Hierarchy Level [edit chassis]

Release Information Statement introduced in Junos 13.2 for the QFX Series.

Description Configure a unified forwarding table profile to allocate the amount a memory available for the following:

- MAC addresses
- Layer 3 host entries
- Longest prefix match table entries

Options **profile-name**—name of the profile to use for memory allocation in the unified forwarding table. Table 136 on page 1560 lists the profiles you can choose and the associated values for each type of entry.

Table 136: Unified Forwarding Table Profiles

Profile Name	MAC Table	Host Table (unicast and multicast addresses)						LPM Table	
	MAC Addresses	IPv4 unicast	IPv6 unicast	IPv4 (*, G)	IPv4 (S, G)	IPv6 (*, G)	IPv6 (S, G)	IPv4 Entries	IPv6 Entries (prefix <= 64)
l2-profile-one	288K	16K	8K	8K	8K	4K	4K	16K	8K
l2-profile-two	224K	80K	40K	40K	40K	20K	20K	16K	8K
l2-profile-three (default)	160K	144K	72K	72K	72K	36K	36K	16K	8K
l3-profile	96K	208K	104K	104K	104K	52K	52K	16K	8K
lpm-profile (Do not use for IPv6)	32K	16K	8K	8K	8K	4K	4K	128K	64K

Note that if the host or LPM table stores the maximum number of entries for any given type, the entire table is full and is unable to accommodate *any* entries of any other type. For information about valid combinations of table entries see “Understanding the Unified Forwarding Table” on page 1415.

WARNING: The lpm-profile does not work for IPv6 traffic. Do not use this profile for IPv6.

Required Privilege Level

Related Documentation

- Understanding the Unified Forwarding Table on page 1415
- Configuring the Unified Forwarding Table on page 1548

num-65-127-prefix

Syntax num-65-127-prefix *value*

Hierarchy Level [edit chassis forwarding-options *profile-name*]

Release Information Statement introduced in Junos 13.2 for the QFX Series.

Description Configure the number of supported IPv6 addresses with prefixes in the range /65 through /127.

Options **value**—Value in the range 1 through 128. Each increment adds support for 16 IPv6 addresses with prefixes between /65 and /127, for a maximum of 2048 such addresses (16 x 128 = 2048).

Required Privilege Level

Related Documentation

- Configuring the Unified Forwarding Table on page 1548

Forwarding Mode Configuration Statement (Original CLI Only)

- cut-through on page 1562

cut-through

Syntax cut-through;

Hierarchy Level [edit forwarding-options]

Description Configures all the interfaces in the QFX series switch or QFabric to use cut-through forwarding mode instead of store-and-forward mode.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring the Forwarding Mode on page 1550

Protocols Configuration Statement

protocols

Syntax

```
protocols {
  bgp {
    disable;
    accept-remote-nexthop;
    advertise-external <conditional>;
    advertise-inactive;
    (advertise-peer-as | no-advertise-peer-as);
    authentication-algorithm (aes-128-cmac-96 | hmac-sha-1-96 | md5);
    authentication-key key;
    authentication-key-chain key-chain;
    bfd-liveness-detection {
      authentication {
        algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
          meticulous-keyed-sha-1 | simple-password);
        key-chain key-chain-name;
        loose-check;
      }
      detection-time {
        threshold milliseconds;
      }
      hold-down-interval milliseconds;
      minimum-interval milliseconds;
      minimum-receive-interval milliseconds;
      multiplier number;
      no-adaptation;
      session-mode (automatic | multihop | single-hop);
      transmit-interval {
        minimum-interval milliseconds;
        threshold milliseconds;
      }
      version (1 | automatic);
    }
    cluster cluster-identifier;
    damping;
    description text-description;
    export [ policy-names ];
    family family-name {
      ... the family subhierarchies appear after the main [edit protocols bgp] hierarchy ...
    }
    graceful-restart {
      disable;
      restart-time seconds;
      stale-routes-time seconds;
    }
    group group-name {
      ... the group subhierarchy appears after the main [edit protocols bgp] hierarchy ...
    }
    hold-time seconds;
    import [ policy-names ];
    include-mp-next-hop;
    keep (all | none);
    local-address address;
```

```
    local-as autonomous-system <loops number> < alias> <private>;
    local-preference local-preference;
    log-updown;
    metric-out (metric | igp (delay-med-update | offset) | minimum-igp offset);
    mtu-discovery;
    multihop {
      no-nexthop-change;
      ttl ttl-value;
    }
    no-aggregator-id;
    no-client-reflect;
    out-delay seconds;
    outbound-route-filter {
      bgp-orf-cisco-mode;
      prefix-based {
        accept {
          inet;
          inet6;
        }
      }
    }
    passive;
    path-selection {
      always-compare-med;
      as-path-ignore;
      cisco-non-deterministic;
      external-router-id;
      med-plus-igp {
        igp-multiplier number;
        med-multiplier number;
      }
    }
    peer-as autonomous-system;
    preference preference;
    remove-private;
    tcp-mss segment-size;
    traceoptions {
      file filename <files number> <size maximum-file-size> <world-readable |
        no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
  }
  dcbx {
    disable;
    interface (interface-name | all) {
      disable;
      application-map application-map-name;
      applications {
        no-auto-negotiation;
      }
      enhanced-transmission-selection {
        no-auto-negotiation;
        no-recommendation-tlv;
        recommendation-tlv {
          no-auto-negotiation;
        }
```



```
    }
    dcbx-version (auto-negotiate | ieee-dcbx | dcbx-version-1.01);
    priority-flow-control {
      no-auto-negotiation;
    }
  }
}
iccp {
  authentication-key string;
  local-ip-addr local-ip-addr;
  peer ip-address{
    authentication-key string;
    backup-liveness-detection {
      backup-peer-ip ip-address;
    }
    liveness-detection {
      detection-time {
        threshold milliseconds;
      }
      minimum-intervalmilliseconds;
      minimum-receive-interval milliseconds;
      multiplier number;
      no-adaptation;
      transmit-interval {
        minimum-interval milliseconds;
        threshold milliseconds;
      }
      version (Liveness Detection) (1 | automatic);
    }
    local-ip-addr ipv4-address;
    session-establishment-hold-time seconds;
  }
  session-establishment-hold-time seconds;
  traceoptions {
    file <filename> <files number> <match regular-expression> <microsecond-stamp>
      <size size> <world-readable | no-world-readable>;
    flag flag;
    no-remote-trace;
  }
}
igmp-snooping {
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable> <match
      regex>;
    flag flag (detail | disable | receive | send);
  }
  vlan vlan-name {
    disable;
    }
    interface interface-name {
      group-limit limit;
      multicast-router-interface;
      static {
        group ip-address;
      }
    }
```

```
        robust-count number;
      }
    }
    isis {
      disable;
      export [ policy-names ];
      ignore-attached-bit;
      interface interface-name {
        bfd-liveness-detection {
          authentication {
            algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
              meticulous-keyed-sha-1 | simple-password);
            key-chain key-chain-name;
            loose-check;
          }
          detection-time {
            threshold milliseconds;
          }
          minimum-interval milliseconds;
          minimum-receive-interval milliseconds;
          multiplier number;
          no-adaptation;
          transmit-interval {
            minimum-interval milliseconds;
            threshold milliseconds;
          }
          version (1 | automatic);
        }
        checksum;
        csnp-interval (seconds | disable);
        disable;
        hello-padding (adaptive | loose | strict);
        level (1 | 2) {
          disable;
          hello-authentication-key key;
          hello-authentication-type authentication;
          hello-interval seconds;
          hold-time seconds;
          ipv4-multicast-metric number;
          metric metric;
          passive;
          priority number;
        }
        lsp-interval milliseconds;
        mesh-group (value | blocked);
        no-ipv4-multicast;
        no-unicast-topology;
        passive;
        point-to-point;
      }
      level (1 | 2) {
        disable;
        authentication-key key;
        authentication-type authentication;
        external-preference preference;
        no-csnp-authentication;
```



```
        no-hello-authentication;
        no-psnp-authentication;
        preference preference;
        prefix-export-limit number;
        wide-metrics-only;
      }
      loose-authentication-check;
      lsp-lifetime seconds;
      max-areas number;
      no-adjacency-holddown;
      no-authentication-check;
      no-ipv4-routing;
      overload {
        advertise-high-metrics;
        timeout seconds;
      }
      reference-bandwidth reference-bandwidth;
      rib-group {
        inet group-name;
      }
      topologies {
        ipv4-multicast;
      }
      traceoptions {
        file filename <files number> <size maximum-file-size> <world-readable |
          no-world-readable>;
        flag flag <flag-modifier> <disable>;
      }
      traffic-engineering {
        disable;
        family inet {
          shortcuts {
            multicast-rpf-routes:
          }
        }
      }
    }
    lldp {
      disable;
      advertisement-interval seconds;
      hold-multiplier number;
      interface (LLDP) (all | interface-name) {
        disable;
      }
      traceoptions {
        file filename <files number> <size size> <world-readable | no-world-readable> <match
          regex>;
        flag flag (detail | disable | receive | send);
      }
    }
    mstp {
      disable;
      bpdu-timeout-action;
      bridge-priority priority;
      configuration-name (MSTP) name;
      forward-delay seconds;
```



```
    hello-time seconds;
    interface (all | interface-name) {
      disable;
      bpdu-timeout-action {
        block;
        alarm;
      }
      cost  cost;
      edge;
      mode mode;
      no-root-port;
      priority priority;
    }
    max-age seconds;
    max-hops hops;
    msti msti-id {
      vlan (vlan-id | vlan-name);
      interface interface-name {
        disable;
        cost  cost;
        edge;
        mode mode;
        priority priority;
      }
    }
    revision-level revision-level;
    traceoptions {
      file filename <files number > <size size> <no-stamp | world-readable |
        no-world-readable>;
      flag flag;
    }
  }
  ospf {
    disable;
    area area-id {
      area-range ip-prefix</prefix-length> <exact> <override-metric metric> <restrict>;
      context-identifier identifier
      interface interface-name {
        disable;
        authentication {
          md5 key-id key key-string <start-time YYYY-MM-DD.hh:mm>;
          simple-password key-string;
        }
        bandwidth-based-metrics {
          bandwidth value metric number;
        }
        bfd-liveness-detection {
          authentication {
            algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
              meticulous-keyed-sha-1 | simple-password);
            key-chain key-chain-name;
            loose-check;
          }
          detection-time {
            threshold milliseconds;
          }
```



```
      full-neighbors-only;
      minimum-interval milliseconds;
      minimum-receive-interval milliseconds;
      multiplier number;
      no-adaptation;
      transmit-interval {
        minimum-interval milliseconds;
        threshold milliseconds;
      }
      version (1 | automatic);
    }
    dead-interval seconds;
    dynamic-neighbors;
    flood-reduction;
    hello-interval seconds;
    interface-type (nbma | p2mp | p2p);
    metric metric;
    neighbor address <eligible>;
    no-eligible-backup;
    no-interface-state-traps;
    no-neighbor-down-notification;
    passive {
      traffic-engineering {
        remote-node-id address;
      }
    }
    poll-interval seconds;
    priority number;
    retransmit-interval seconds;
    secondary;
    te-metric metric;
    topology (name | default | ipv4-multicast) {
      disable;
      bandwidth-based-metrics {
        bandwidth value;
        metric number;
      }
      metric metric;
    }
    transit-delay seconds;
  }
  network-summary-export [ policy-names ];
  network-summary-import [ policy-names ];
  nssa {
    area-range ip-prefix</prefix-length> <exact> <override-metric metric> <restrict>;
    default-lsa {
      default-metric metric;
      metric-type type;
      type-7;
    }
    (summaries | no-summaries);
  }
  stub <default-metric metric> <summaries | no-summaries>;
  virtual-link neighbor-id router-id transit-area area-id {
    disable;
    authentication {
```

```
            md5 key-id key key-string <start-time YYYY-MM-DD.hh:mm>;
            simple-password key-string;
          }
          dead-interval seconds;
          demand-circuit;
          flood-reduction;
          hello-interval seconds;
          ipsec-sa sa-name;
          no-neighbor-down-notification;
          retransmit-interval seconds;
          topology (name | default | ipv4-multicast) {
            disable;
            metric metric;
          }
          transit-delay seconds;
        }
      }
      database-protection {
        ignore-count number;
        ignore-time seconds;
        maximum-lsa number;
        reset-time seconds;
        warning-only;
        warning-threshold percent;
      }
      export [ policy-names ];
      external-preference preference;
      graceful-restart {
        disable;
        helper-disable <both | restart-signaling | standard>;
        no-strict-lsa-checking;
        notify-duration seconds;
        restart-duration seconds;
      }
      import [ policy-names ];
      no-nssa-abr;
      no-rfc-1583;
      overload <timeout seconds>;
      preference preference;
      prefix-export-limit number;
      reference-bandwidth reference-bandwidth;
      rib-group group-name;
      topology (default | ipv4-multicast | name) {
        overload;
        prefix-export-limit number;
        topology-id number;
      }
      traceoptions {
        file filename <files number> <size maximum-file-size> <world-readable |
          no-world-readable>;
        flag flag <flag-modifier> <disable>;
      }
      traffic-engineering {
        advertise-unnumbered-interfaces;
        credibiliity-protocol-preference;
        ignore-lsp-metrics;
```

```
        multicast-rpf-routes;
        no-topology;
        shortcuts <lsp-metric-into-summary>;
      }
    }
    pim {
      disable;
      assert-timeout seconds;
      dense-groups {
        addresses;
      }
      dr-election-on-p2p;
      export;
      family (inet | inet6) {
        disable;
      }
      graceful-restart {
        disable;
        restart-duration seconds;
      }
      import [ policy-names ];
      interface interface-name {
        accept-remote-source;
        disable;
        family (inet | inet6) {
          disable;
        }
        hello-interval seconds;
        mode (dense | sparse | sparse-dense);
        neighbor-policy [ policy-names ];
        override-interval milliseconds;
        priority number;
        propagation-delay milliseconds;
        reset-tracking-bit;
        version version;
      }
      join-load-balance;
      join-prune-timeout;
      nonstop-routing;
      override-interval milliseconds;
      propagation-delay milliseconds;
      reset-tracking-bit;
      rib-group group-name;
      rp {
        auto-rp {
          (announce | discovery | mapping);
          (mapping-agent-election | no-mapping-agent-election);
        }
        bootstrap {
          family (inet | inet6) {
            export [ policy-names ];
            import [ policy-names ];
            priority number;
          }
        }
        bootstrap-import [ policy-names ];
```

```
    bootstrap-export [ policy-names ];
    bootstrap-priority number;
    dr-register-policy [ policy-names ];
    embedded-rp {
      group-ranges {
        destination-ip-prefix</prefix-length>;
      }
      maximum-rps limit;
    }
    local {
      family (inet | inet6) {
        address address;
        anycast-pim {
          disable;
            rp-set {
            address address <forward-msdp-sa>;
          }
          local-address address;
        }
        group-ranges {
          destination-ip-prefix</prefix-length>;
        }
        hold-time seconds;
        priority number;
      }
    }
    rp-register-policy [ policy-names ];
    spt-threshold {
      infinity [ policy-names ];
    }
    static {
      address address {
        group-ranges {
        version version;
        destination-ip-prefix</prefix-length>;
        }
      }
    }
  }
  rpf-selection {
    group group-address{
      source source-address{
        next-hop next-hop-address;
      }
      wildcard-source {
        next-hop next-hop-address;
      }
    }
    prefix-list prefix-list-addresses {
      source source-address {
        next-hop next-hop-address;
      }
      wildcard-source {
        next-hop next-hop-address;
      }
    }
```



```
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
  tunnel-devices [ mt-fpc/pic/port ];
}
rip {
  authentication-key password;
  authentication-type type;
  (check-zero | no-check-zero);
  group group-name {
    bfd-liveness-detection {
      authentication {
        algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 |
          meticulous-keyed-sha-1 | simple-password);
        key-chain key-chain-name;
        loose-check;
      }
      detection-time {
        threshold milliseconds;
      }
      minimum-interval milliseconds;
      minimum-receive-interval milliseconds;
      multiplier number;
      no-adaptation;
      transmit-interval {
        minimum-interval milliseconds;
        threshold milliseconds;
      }
      version (1 | automatic);
    }
    export [ policy-names ];
    import [ policy-names ];
    metric-out metric;
      neighbor neighbor-name {
        any-sender;
        authentication-key password;
        authentication-type type;
        bfd-liveness-detection {
          ... same statements as at the [edit protocols rip group group-name
            bfd-liveness-detection] hierarchy level ...
        }
        (check-zero | no-check-zero);
        import [ policy-names ];
        message-size number;
        metric-in metric;
        receive (both | none | version-1 | version-2);
        route-timeout seconds;
        send (broadcast | multicast | none | version-1);
        update-interval seconds;
      }
    preference preference;
    route-timeout seconds;
    update-interval seconds;
  }
  holddown seconds;
```

```
    import [ policy-names ];
    message-size number;
    metric-in metric;
    receive (both | none | version-1 | version-2);
    rib-group group-name;
    route-timeout seconds;
    send (broadcast | multicast | none | version-1);
    traceoptions {
      file filename <files number> <size maximum-file-size> <world-readable |
        no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
    update-interval seconds;
  }
  rstp {
    disable;
    bpdu-block-on-edge;
    bridge-priority priority;
    forward-delay seconds;
    hello-time seconds;
    interface (all | interface-name) {
      disable;
      bpdu-timeout-action {
        alarm;
        block;
      }
      cost  cost;
      edge;
      mode mode;
      no-root-port;
      priority priority;
    }
    max-age seconds;
    }
    traceoptions {
      file filename <files number > <size size> <no-stamp> <world-readable |
        no-world-readable>;
      flag flag;
    }
  }
  stp {
    disable;
    bridge-priority priority;
    forward-delay seconds;
    hello-time seconds;
    interface (all | interface-name) {
      disable;
      bpdu-timeout-action {
        alarm;
        block;
      }
      cost  cost;
      edge;
      mode mode;
      no-root-port;
      priority priority;
```



```
      }
      max-age seconds;
    }
      traceoptions {
        file filename <files number > <size size> <no-stamp | world-readable |
          no-world-readable>;
        flag flag;
      }
    uplink-failure-detection {
      group group-name {
        link-to-monitor interface-name;
        link-to-disable interface-name;
      }
    }
    vstp {
      bpdu-block-on-edge;
      disable (Spanning Trees);
      force-version (Spanning Trees) stp;
      vlan (Spanning Trees) vlan-id {
        bridge-priority (Spanning Trees) priority;
        forward-delay (Spanning Trees) seconds;
        hello-time (Spanning Trees) seconds;
        interface (Spanning Trees) (all | interface-name) {
          bpdu-timeout-action (Spanning Trees) {
            block (Spanning Trees);
            log (Spanning Trees);
          }
          cost (Spanning Trees)  cost;
          disable (Spanning Trees);
          edge (Spanning Trees);
          mode (Spanning Trees) mode;
          no-root-port (Spanning Trees);
          priority (Spanning Trees) priority;
        }
        max-age (Spanning Trees) seconds;
        traceoptions (Spanning Trees) {
          file filename <files number > <size size> <no-stamp | world-readable |
            no-world-readable>;
          flag flag;
        }
      }
    }
  }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure protocols.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Junos OS Routing Protocols Configuration Guide*

Proxy ARP Configuration Statement (Original CLI Only)

proxy-arp

Syntax proxy-arp (restricted | unrestricted);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.6 for EX Series switches.
restricted added in Junos OS Release 10.0 for EX Series switches.
Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description For Ethernet interfaces only, configure the router or switch to respond to any ARP request, as long as the router or switch has an active route to the ARP request's target address.

NOTE: You must configure the IP address and the inet family for the interface when you enable proxy ARP.

Default Proxy ARP is not enabled. The router or switch responds to an ARP request only if the destination IP address is its own.

Options

- **none**—The router or switch responds to any ARP request for a local or remote address if the router or switch has a route to the target IP address.
- **restricted**—(Optional) The router or switch responds to ARP requests in which the physical networks of the source and target are different and does not respond if the source and target IP addresses are in the same subnet. The router or switch must also have a route to the target IP address.
- **unrestricted**—(Optional) The router or switch responds to any ARP request for a local or remote address if the router or switch has a route to the target IP address.

Default: unrestricted

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Restricted and Unrestricted Proxy ARP*
- *Configuring Proxy ARP (CLI Procedure)*
- Configuring Proxy ARP (CLI Procedure) on page 1552
- *Example: Configuring Proxy ARP on an EX Series Switch*
- *Configuring Gratuitous ARP*

STP Configuration Statements

alarm (STP)

Syntax alarm;

Hierarchy Level [edit protocols mstp interface (all | *interface-name*) bpdu-timeout-action],
[edit protocols rstp interface (all | *interface-name*) bpdu-timeout-action],
[edit protocols stp interface (all | *interface-name*) bpdu-timeout-action],
[edit protocols vstp vlan *vlan-id* interface (all | *interface-name*) bpdu-timeout-action]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For interfaces configured for loop protection, configure the software to generate a message to be sent to the system log file to record the loop-protection event.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree on page 1517
- Understanding Loop Protection for STP, RSTP, VSTP, and MSTP on page 1424
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

block

Syntax block;

Hierarchy Level [edit protocols mstp (Spanning Trees) interface (all | *interface-name*) bpdu-timeout-action],
[edit protocols rstp interface (all | *interface-name*) bpdu-timeout-action],
[edit protocols stp interface (all | *interface-name*) bpdu-timeout-action],
[edit protocols vstp vlan *vlan-id* interface (all | *interface-name*) bpdu-timeout-action]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure loop protection on a specific interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree on page 1517
- Understanding Loop Protection for STP, RSTP, VSTP, and MSTP on page 1424
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

bpdu-block

Syntax

```
bpdu-block {
  interface (all | [interface-name]);
  disable-timeout timeout;
}
```

Hierarchy Level

- For platforms with ELS CLI:

  [edit protocols layer2-control]

- For platforms with Original CLI:

  [edit ethernet-switching-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure BPDU protection on an interface. If the interface receives BPDUs, it is disabled.

NOTE: **BPDU block protection is disabled on Node devices.**

The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Unblocking an Interface That Receives BPDUs in Error on page 1553
- **clear ethernet-switching bpdu-error on page 1674**
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

bpdu-block-on-edge

Syntax bpdu-block-on-edge;

Hierarchy Level [edit protocols mstp],
[edit protocols rstp],
[edit protocols vstp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure bridge protocol data unit (BPDU) protection on all edge ports of a switch.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding VSTP on page 1422
- Example: Configuring BPDU Protection on STP Interfaces to Prevent STP Miscalculations on page 1513
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- **clear ethernet-switching bpdu-error on page 1674**
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

bpdu-timeout-action

Syntax

```
bpdu-timeout-action {
  alarm;
  block;
}
```

Hierarchy Level

[edit protocols mstp interface (all | *interface-name*)],
[edit protocols rstp interface (all | *interface-name*)],
[edit protocols stp interface (all | *interface-name*)],
[edit protocols vstp vlan *vlan-id* interface (all | *interface-name*)]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure the BPDU timeout action on a specific interface. You must configure at least one action (**alarm**, **block**, or both).

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Example: Configuring Loop Protection to Prevent Interfaces from Transitioning from Blocking to Forwarding in a Spanning Tree on page 1517
- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Understanding Loop Protection for STP, RSTP, VSTP, and MSTP on page 1424
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

bridge-priority

Syntax bridge-priority *priority*;

Hierarchy Level [edit protocols mstp],
[edit protocols mstp *msti-id*],
[edit protocols rstp],
[edit protocols stp],
[edit protocols vstp vlan *vlan-id*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the bridge priority. The bridge priority determines which bridge is elected as the root bridge. If two bridges have the same path cost to the root bridge, the bridge priority determines which bridge becomes the designated bridge for a LAN segment.

Options *priority*—Bridge priority. It can be set only in increments of 4096.

Range: 0 through 61,440

Default: 32,768

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Understanding MSTP on page 1420
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

configuration-name (MSTP)

Syntax configuration-name *configuration-name*;

Hierarchy Level [edit protocols mstp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the configuration name. The configuration name is the MSTP region name carried in the MSTP BPDUs.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Understanding MSTP on page 1420
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

cost (STP)

Syntax cost *cost*;

Hierarchy Level [edit protocols mstp interface (all | *interface-name*)],
[edit protocols mstp msti *msti-id* interface *interface-name*],
[edit protocols rstp (Spanning Trees) interface (all | *interface-name*)],
[edit protocols stp interface (all | *interface-name*)],
[edit protocols vstp vlan *vlan-id* interface (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), configure the link cost to control which bridge is the designated bridge and which interface is the designated interface.

Default Link cost is determined by the link speed.

Options *cost*—Link cost associated with the port.

Range: 1 through 200,000,000

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding MSTP on page 1420
- Overview of Spanning-Tree Protocols on page 1419
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**

- *show spanning-tree interface*

disable (STP)

Syntax

disable;

Hierarchy Level

[edit protocols mstp],
[edit protocols mstpinterface *interface-name*],
[edit protocols mstp msti *msti-id* vlan (*vlan-id* | *vlan-name*) interface *interface-name*],
[edit protocols rstp],
[edit protocols rstp interface *interface-name*],
[edit protocols stp],
[edit protocols stp interface *interface-name*],
[edit protocols vstp],
[edit protocols vstp vlan *vlan-id* interface (all | *interface-name*)]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Disable STP, MSTP, RSTP, or VSTP on the switch or on a specific interface.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding MSTP on page 1420
- Overview of Spanning-Tree Protocols on page 1419
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

disable-timeout (BPDU)

Syntax disable-timeout *timeout*;

Hierarchy Level [edit ethernet-switching-options bpdu-block]
[edit protocols layer2-control bpdu-block]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For interfaces configured for BPDU protection, specify the amount of time an interface receiving BPDUs is disabled.

Default The disable timeout is not enabled.

Options *timeout*: Length of time, in seconds, that the interface receiving BPDUs is disabled. Once the timeout expires, the interface is brought back into service.

Range: 10 through 3600 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Example: Configuring BPDU Protection on STP Interfaces to Prevent STP Miscalculations on page 1513
- Understanding BPDU Protection for STP, RSTP, and MSTP on page 1423
- **show spanning-tree bridge on page 1706**
- **show spanning-tree interface on page 1711**

edge (STP)

Syntax edge;

Hierarchy Level [edit protocols mstp interface (all | *interface-name*)],
[edit protocols mstp msti *msti-id* interface *interface-name*],
[edit protocols rstp interface (all | *interface-name*)],
[edit protocols stp interface (all | *interface-name*)],
[edit protocols vstp vlan *vlan-id* interface (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), configure interfaces as edge interfaces. Edge interfaces immediately transition to a forwarding state.

Default Edge interfaces are not enabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding MSTP on page 1420
- Overview of Spanning-Tree Protocols on page 1419
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

forward-delay

Syntax forward-delay *seconds*;

Hierarchy Level [edit protocols mstp],
[edit protocols rstp],
[edit protocols stp],
[edit protocols vstp vlan *vlan-id*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), specify how long a bridge interface remains in the listening and learning states before transitioning to the forwarding state.

Options *seconds*—Number of seconds the bridge interface remains in the listening and learning states.

Range: 4 through 30 seconds

Default: 15 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding MSTP on page 1420
- Overview of Spanning-Tree Protocols on page 1419
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

force-version

Syntax force-version stp;

Hierarchy Level [edit protocols vstp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Force VLAN Spanning Tree Protocol (VSTP) to use the STP protocol instead of the default protocol, RSTP.

Options **stp**—Spanning Tree Protocol

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*
- Understanding VSTP on page 1422

hello-time

Syntax hello-time *seconds*;

Hierarchy Level [edit protocols mstp],
[edit protocols rstp],
[edit protocols rstp],
[edit protocols vstp vlan *vlan-id*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), specify the time interval at which the root bridge transmits configuration BPDUs.

Options *seconds*—Number of seconds between transmissions of configuration BPDUs.

Range: 1 through 10 seconds

Default: 2 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding MSTP on page 1420
- Overview of Spanning-Tree Protocols on page 1419
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

interface (Spanning Trees)

Syntax

```
interface interface-name {
  arp-on-stp;
  bpdu-timeout-action
    block;
    log;
  cost cost;
  disable;
  edge;
  mode mode;
  no-root-port;
  priority priority;
}
```

Hierarchy Level

[edit protocols mstp],
[edit protocols mstp msti *msti-id*],
[edit protocols rstp],
[edit protocols stp],
[edit protocols vstp vlan (all | *vlan-id* | *vlan-name*)]

Release Information

Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement updated in Junos OS Release 9.4 for EX Series switches to add VSTP support.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), configure an interface.

The **edge**, **mode**, and **no-root-port** options are not available at the [**edit protocols mstp msti *msti-id***] hierarchy level.

Options

interface-name—Name of an interface.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *show spanning-tree bridge*
- *show spanning-tree interface*
- *Example: Configuring Network Regions for VLANs with MSTP on EX Series Switches*
- *Example: Faster Convergence and Improved Network Stability with RSTP on EX Series Switches*
- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- *Configuring VSTP (CLI Procedure)*

- show spanning-tree bridge on page 1706

interface (BPDU)

Syntax interface (all | *interface-name*);

Hierarchy Level [edit ethernet-switching-options bpdu-block]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Apply BPDU protection to all interfaces or one or more interfaces.

Options **all**—All interfaces.

interface-name—Name of the interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding BPDU Protection for STP, RSTP, and MSTP on page 1423
- show spanning-tree bridge on page 1706
- show spanning-tree interface on page 1711

interface (STP)

Syntax

```
interface interface-name {
  disable;
  cost cost;
  edge;
  mode mode;
  no-root-port;
  priority priority;
}
```

Hierarchy Level

[edit protocols mstp],
[edit protocols mstp msti],
[edit protocols rstp],
[edit protocols stp],
[edit protocols vstp vlan *vlan-id*]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), configure an interface.

Options

interface-name—Name of a Gigabit Ethernet interface.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding RSTP on page 1421
- Understanding MSTP on page 1420
- Overview of Spanning-Tree Protocols on page 1419
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- *show spanning-tree interface*

max-age

Syntax max-age *seconds*;

Hierarchy Level [edit protocols mstp],
[edit protocols rstp],
[edit protocols stp],
[edit protocols vstp vlan *vlan-id*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), specify the maximum age of received protocol BPDUs.

Options ***seconds***—Maximum age of received protocol BPDUs.

Range: 6 through 40 seconds

Default: 20 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding MSTP on page 1420
- Overview of Spanning-Tree Protocols on page 1419
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- **show spanning-tree interface on page 1711**

max-hops

Syntax max-hops *hops*;

Hierarchy Level [edit protocols mstp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Multiple Spanning Tree Protocol (MSTP), configure the maximum number of hops that a BPDU can be forwarded in the MSTP region.

Options *hops* — Number of hops the BPDU can be forwarded.

Range: 1 through 255 hops

Default: 20 hops

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Understanding MSTP on page 1420
- **show spanning-tree bridge on page 1706**
- **show spanning-tree interface on page 1711**

mode (STP)

Syntax mode *mode*;

Hierarchy Level [edit protocols mstp interface (all | *interface-name*)],
[edit protocols mstp msti *msti-id* interface *interface-name*],
[edit protocols rstp interface (all | *interface-name*)],
[edit protocols stp interface (all | *interface-name*)],
[edit protocols vstp vlan *vlan-id* interface (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), configure the link mode to identify point-to-point links.

Default For a full-duplex link, the default link mode is **point-to-point**. For a half-duplex link, the default link mode is **shared**.

Options *mode*—Link mode:

- **point-to-point**—Link is point to point.
- **shared**—Link is shared media.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding MSTP on page 1420
- Overview of Spanning-Tree Protocols on page 1419
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- **show spanning-tree interface on page 1711**

msti

Syntax

```
msti msti-id {
  vlan (vlan-id | vlan-name);
  interface interface-name {
    disable;
    cost cost;
    edge;
    mode mode;
    priority priority;
  }
}
```

Hierarchy Level [edit protocols mstp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the Multiple Spanning Tree Instance (MSTI) identifier for Multiple Spanning Tree Protocol (MSTP). MSTI IDs are local to each region, so you can reuse the same MSTI ID in different regions.

Default MSTI is disabled.

Options *msti-id* —MSTI identifer.

Range: 1 through 4094. The Common Instance Spanning Tree (CIST) is always MSTI 0.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show spanning-tree bridge on page 1706
- show spanning-tree interface on page 1711
- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Understanding MSTP on page 1420

mstp

Syntax

```
mstp {
  disable;
  bpdu-timeout-action;
  bridge-priority priority;
  configuration-name (MSTP) name;
  forward-delay seconds;
  hello-time seconds;
  interface (all | interface-name) {
    bpdu-timeout-action {
      block;
      alarm;
    }
    disable;
    cost cost;
    edge;
    mode mode;
    no-root-port;
    priority priority;
  }
  max-age seconds;
  max-hops hops;
  msti msti-id {
    vlan (vlan-id | vlan-name);
    interface interface-name {
      disable;
      cost cost;
      edge;
      mode mode;
      priority priority;
    }
  }
  traceoptions {
    file name <replace> <size size> <files number> <no-stamp>
      <(world-readable | no-world-readable)>;
    flag flag <flag-modifier> <disable>;
  }
  revision-level revision-level;
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Multiple Spanning Tree Protocol (MSTP). MSTP is defined in the IEEE 802.1Q-2003 specification and is used to create a loop-free topology in networks with multiple spanning-tree regions.

The statements are explained separately.

Default MSTP is disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Understanding MSTP on page 1420
- **show spanning-tree bridge on page 1706**
- **show spanning-tree interface on page 1711**

no-root-port

Syntax no-root-port;

Hierarchy Level [edit protocols mstp interface (all | *interface-name*)],
[edit protocols rstp interface (all | *interface-name*)],
[edit protocols stp interface (all | *interface-name*)],
[edit protocols vstp vlan *vlan-id* interface (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure an interface to be a spanning tree designated port. If the bridge receives more STP bridge protocol data units (BPDUs) on a root-protected interface, that interface transitions to a root-prevented STP state (inconsistency state) and the interface is blocked. This blocking prevents a bridge that should not be the root bridge from being elected the root bridge. When the bridge stops receiving more STP BPDUs on the root-protected interface, interface traffic is no longer blocked.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Root Protection to Enforce Root Bridge Placement in Spanning Trees on page 1521
- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- **show spanning-tree interface on page 1711**

priority (STP)

Syntax

priority *priority*;

Hierarchy Level

[edit protocols mstp interface (all | *interface-name*)],
[edit protocols mstp msti *msti-id* interface *interface-name*],
[edit protocols rstp interface (all | *interface-name*)],
[edit protocols stp interface (all | *interface-name*)],
[edit protocols vstp vlan *vlan-id* interface (all | *interface-name*)]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

For Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), VLAN Spanning Tree Protocol (VSTP), or Multiple Spanning Tree Protocol (MSTP), specify the interface priority to control which interface is elected as the root port.

Options

priority—Interface priority. The interface priority must be set in increments of 16.

Range: 0 through 240

Default: 128

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding MSTP on page 1420
- Overview of Spanning-Tree Protocols on page 1419
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- **show spanning-tree interface on page 1711**

revision-level

Syntax revision-level *revision-level*;

Hierarchy Level [edit protocols mstp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Multiple Spanning Tree Protocol (MSTP), set the revision number of the MSTP configuration.

Default The revision number is disabled.

Options *revision-level*—Revision number of the MSTP region configuration.

Range: 0 through 65535

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Understanding MSTP on page 1420
- show spanning-tree bridge on page 1706
- show spanning-tree interface on page 1711

rstp

Syntax

```
rstp {
  disable;
  bpdu-block-on-edge;
  bridge-priority priority;
  forward-delay seconds;
  hello-time seconds;
  interface (all | interface-name) {
    bpdu-timeout-action {
      block;
      alarm;
    }
    disable;
    cost cost;
    edge;
    mode mode;
    no-root-port;
    priority priority;
  }
  max-age seconds;
  traceoptions {
    file name <replace> <size size> <files number> <no-stamp>
      <(world-readable | no-world-readable)>;
    flag flag <flag-modifier> <disable>;
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Rapid Spanning Tree Protocol (RSTP). RSTP is defined in the IEEE 802.1D-2004 specification and is used to prevent loops in Layer 2 networks, providing shorter convergence times than those provided with basic STP.

The statements are explained separately.

Default RSTP is enabled on all Ethernet switching interfaces.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding RSTP on page 1421
- show spanning-tree bridge on page 1706
- show spanning-tree interface on page 1711

stp

Syntax

```
stp {
  disable;
  bridge-priority priority;
  forward-delay seconds;
  hello-time seconds;
  interface (all | interface-name) {
    disable;
    bpdu-timeout-action {
      block;
      alarm;
    }
    cost  cost;
    edge;
    mode mode;
    no-root-port;
    priority priority;
  }
  max-age seconds;
  traceoptions {
    file name <replace> <size size> <files number> <no-stamp>
      <(world-readable | no-world-readable)>;
    flag flag <flag-modifier> <disable>;
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description When you explicitly configure STP, a switch uses the IEEE 802.1D 2004 specification, force version 0. This configuration runs a version of RSTP that is compatible with the classic, basic STP (defined in the IEEE 802.1D 1998 specification).

The remaining statements are explained separately.

Default STP is disabled; by default, RSTP is enabled on all Ethernet switching ports.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BPDU Protection on STP Interfaces to Prevent STP Miscalculations on page 1513
- Configuring STP on page 1553
- Overview of Spanning-Tree Protocols on page 1419
- **show spanning-tree bridge on page 1706**
- **show spanning-tree interface on page 1711**

traceoptions (STP)

Syntax

```
traceoptions {
  file name <replace> <size size> <files number> <no-stamp>
    <(world-readable | no-world-readable)>;
  flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit protocols mstp],
[edit protocols rstp],
[edit protocols stp],
[edit protocols vstp vlan *vlan-id*]
[edit protocols layer2-control]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

NOTE: traceoptions is not supported on QFabric systems.

Description

Set STP protocol-level tracing options.

Default

Traceoptions is disabled.

Options

disable—(Optional) Disable the tracing operation. One use of this option is to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file ***name*** —Name of the file to receive the output of the tracing operation. Enclose the name in quotation marks. We recommend that you place STP tracing output in the file **/var/log/stp-log**.

files ***number*** —(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten.

If you specify a maximum number of files, you must also specify a maximum file size with the size option.

Range: 2 through 1000 files

Default: 1 trace file only

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements. These are the STP-specific tracing options:

- **all**—Trace all operations.
- **all-failures**—Trace all failure conditions.
- **bpdu**—Trace BPDU reception and transmission.

- **bridge-detection-state-machine**—Trace the bridge detection state machine.
- **events**—Trace events of the protocol state machine.
- **port-information-state-machine**—Trace the port information state machine.
- **port-migration-state-machine**—Trace the port migration state machine.
- **port-receive-state-machine**—Trace the port receive state machine.
- **port-role-select-state-machine**—Trace the port role selection state machine.
- **port-role-transit-state-machine**—Trace the port role transit state machine.
- **port-transmit-state-machine**—Trace the port transmit state machine.
- **port-state-transit-state-machine**—Trace the port state transit state machine.
- **ppmd**—Trace the state and events for the ppmd process.
- **state-machine-variables**—Trace when the state machine variables change.
- **timers**—Trace protocol timers.
- **topology-change-state-machine**—Trace the topology change state machine.

The following are the global tracing options:

- **all**—All tracing operations.
- **config-internal**—Trace configuration internals.
- **general**—Trace general events.
- **normal**—All normal events.

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **parse**—Trace configuration parsing.
- **policy**—Trace policy operations and actions.
- **regex-parse**—Trace regular-expression parsing.
- **route**—Trace routing table changes.
- **state**—Trace state transitions.
- **task**—Trace protocol task processing.
- **timer**—Trace protocol task timer processing.

no-stamp—(Optional) Do not place timestamp information at the beginning of each line in the trace file.

Default: If you omit this option, timestamp information is placed at the beginning of each line of the tracing output.

no-world-readable—(Optional) Prevent any user from reading the log file.

replace—(Optional) Replace an existing trace file if there is one.

Default: If you do not include this option, tracing output is appended to an existing trace file.

size ***size***—(Optional) Maximum size of each trace file, in kilobytes (KB) or megabytes (MB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0.** When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Example: Configuring Faster Convergence and Improving Network Stability with RSTP on page 1466
- Understanding RSTP on page 1421
- Understanding MSTP on page 1420
- Overview of Spanning-Tree Protocols on page 1419
- Understanding VSTP on page 1422
- **show spanning-tree bridge on page 1706**
- **show spanning-tree interface on page 1711**

vlan (STP)

Syntax

```
vlan (vlan-id | vlan-name) {
  bridge-priority priority;
  forward-delay seconds;
  hello-time seconds;
  interface (all | interface-name) {
    bpdu-timeout-action {
      block;
      alarm;
    }
    cost  cost;
    disable;
    edge;
    mode mode;
    no-root-port;
    priority priority;
  }
  max-age seconds;
  traceoptions {
    file filename <files number > <size size> <no-stamp | world-readable |
      no-world-readable>;
    flag flag;
  }
}
```

Hierarchy Level [edit protocolsmstpmsti *msti-id*],
[edit protocols vstp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the VLANs for a Multiple Spanning Tree Instance (MSTI).

The remaining statements are explained separately.

TIP: To display a list of all configured VLANs on the system, including VLANs that are configured but not committed, type ? after vlan or vlans in your configuration mode command line. Note that only one VLAN is displayed for a VLAN range.

Default Not enabled.

Options *vlan-id*—Numeric VLAN identifier.

vlan-name—Name of the VLAN.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Network Regions for VLANs with MSTP on page 1480
- Understanding MSTP on page 1420
- Understanding VSTP on page 1422

vstp

Syntax

```
vstp {
  disable;
  bpdu-block-on-edge;
  force-version stp;
  vlan (vlan-id | vlan-name) {
    bridge-priority priority;
    forward-delay seconds;
    hello-time seconds;
    interface (all | interface-name) {
      disable;
        bpdu-timeout-action {
          alarm;
          block;
      }
      cost  cost;
      edge;
      mode mode;
      no-root-port;
      priority priority;
    }
    max-age seconds;
    traceoptions {
      file name <replace> <size size> <files number> <no-stamp>
        <world-readable | no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure VLAN Spanning Tree Protocol (VSTP). VSTP is used to prevent loops in Layer 2 networks on a per-VLAN basis.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding VSTP on page 1422
- show spanning-tree bridge on page 1706
- show spanning-tree interface on page 1711

VLAN Configuration Statements

description (VLAN)

Syntax description *text-description*;

Hierarchy Level [edit vlans *vlan-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Provide a textual description for the VLAN. The text has no effect on the operation of the VLAN or switch.

Options ***text-description***—Text to describe the interface. It can contain letters, numbers, and hyphens (-) and can be up to 255 characters long. If the text includes spaces, enclose the entire text in quotation marks.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Understanding Bridging and VLANs on page 1402
- **show vlans on page 1722**

ethernet-switching-options

Syntax

```
ethernet-switching-options {
  analyzer {
    name {
      input {
        egress {
          interface (all | interface-name);
        }
        ingress {
          interface (all | interface-name);
          vlan (vlan-id | vlan-name);
        }
      output {
        interface interface-name;
        ip-address ip-address;
        vlan (vlan-id | vlan-name);
      }
    }
  }
  bpdu-block {
    interface (all | [interface-name]);
    disable-timeout timeout;
  }
  dot1q-tunneling {
    ether-type (0x8100 | 0x88a8 | 0x9100)
  }
  interfaces interface-name {
    no-mac-learning;
  }
  mac-table-aging-time seconds {
  }
  port-error-disable {
    disable-timeout timeout;
  }
  secure-access-port {
    dhcp-snooping-file {
      location local_pathname | remote_URL;
      timeout seconds;
      write-interval seconds;
    }
    interface (all | interface-name) {
      allowed-mac {
        mac-address-list;
      }
      (dhcp-trusted | no-dhcp-trusted);
      fcoe-trusted;
      mac-limit limit action action;
      no-allowed-mac-log;
    }
    vlan (all | vlan-name) {
      (arp-inspection | no-arp-inspection) [
        forwarding-class (for DHCP Snooping or DAI Packets) class-name;
      }
```

```
        dhcp-option82 {
          circuit-id {
            prefix (Circuit ID for Option 82) hostname;
            use-interface-description;
            use-vlan-id;
          }
          remote-id {
            prefix (Remote ID for Option 82) hostname | mac | none;
            use-interface-description;
            use-string string;
          }
          vendor-id <string>;
        }
        (examine-dhcp | no-examine-dhcp) {
          forwarding-class (for DHCP Snooping or DAI Packets) class-name;
        }
        examine-fip {
          examine-vn2vn {
            beacon-period milliseconds;
          }
          fc-map fc-map-value;
        }
        mac-move-limit limit <fabric-limit limit action action;
      }
    }
    static {
      vlan vlan-id {
        mac mac-address next-hop interface-name;
      }
    }
    storm-control {
      interface (all | interface-name) {
        bandwidth bandwidth;
        no-broadcast;
        no-multicast;
        no-unknown-unicast;
      }
    }
    traceoptions {
      file filename <files number> <no-stamp> <replace> <size size> <world-readable |
        no-world-readable>;
      flag flag <disable>;
    }
    unknown-unicast-forwarding {
      vlan (all | vlan-name) {
        interface interface-name;
      }
    }
  }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Ethernet switching options.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Overview of Access Port Protection on page 4451
- Understanding Storm Control on page 4471

filter (VLANs)

Syntax filter (input | output) *filter-name*;

Hierarchy Level [edit vlans *vlan-name*]
[edit vlans *vlan-name* forwarding-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Apply a firewall filter to traffic ingressing or egressing a VLAN.

Default All incoming traffic is accepted unmodified to a VLAN, and all outgoing traffic is sent unmodified from a VLAN.

Options *filter-name*—Name of a firewall filter defined at the **[edit firewall family *family-name* filter]** hierarchy level.

input—Apply a firewall filter to VLAN ingress traffic.

output—Apply a firewall filter to VLAN egress traffic.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Firewall Filters on page 4531
- Overview of Firewall Filters on page 4409

forwarding-options

Syntax

```
forwarding-options {
  dhcp-security {
    arp-inspection;
    group group-name {
      interface interface-name {
        static-ip ip-address {
          mac mac-address;
        }
      }
      overrides {
        no-option82;
        trusted;
        untrusted;
      }
    }
    ip-source-guard;
    no-dhcp-snooping;
    option-82 {
      circuit-id {
        prefix {
          host-name;
          logical-system-name;
          routing-instance-name;
        }
        use-interface-description (device | logical);
        use-vlan-id;
      }
      remote-id {
        host-name hostname;
        use-interface-description (device | logical);
        use-string string;
      }
      vendor-id {
        use-string string;
      }
    }
  }
```

Hierarchy Level [edit]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.3 for QFX Series switches.

Description Configure traffic forwarding.

The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Traffic Forwarding and Monitoring*
- *[edit forwarding-options] Hierarchy Level*

interface (VLANs)

Syntax

```
interface interface-name {
  mapping (native (push | swap) | tag (push | swap));
}
```

Hierarchy Level [edit vlans *vlan-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For a specific VLAN, configure an interface.

Options ***interface-name***—Name of the interface.

The remaining statement is explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Configuring VLANs on page 1534
- *Understanding Bridging*

l3-interface (VLAN)

Syntax l3-interface (vlan.*logical-interface-number* | irb.*logical-interface-number*);

Hierarchy Level [edit vlans *vlan-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
irb option introduced in Junos OS Release 13.2 for the QFX Series.

Description Associate a Layer 3 interface with the VLAN. Configure Layer 3 interfaces on trunk ports to allow the interface to transfer traffic between VLANs. Traffic between VLANs must be routed, which requires a common Layer 3 interface.

Default No Layer 3 (routing) interface is associated with the VLAN.

Options vlan.*logical-interface-number*—Number of the logical interface. Use the **unit** number that you used when you created the **vlan** interface with a **set** interfaces **vlan** unit statement.

NOTE: You can use this statement with versions of Junos OS that do not and do not support Enhanced Layer 2 Software (ELS).

irb.*logical-interface-number*—Logical interface defined with a **set** interfaces irb statement.

NOTE: Use this statement with versions of Junos OS that support Enhanced Layer 2 Software (ELS).

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show ethernet-switching interfaces on page 1358
- show vlans on page 1722

mac (Static MAC-Based VLANs)

Syntax

```
mac mac-address {
    next-hop interface-name;
}
```

Hierarchy Level [edit ethernet-switching-options static vlan *vlan-name*]

Description Specify the MAC address to add to the Ethernet switching table.

The remaining statement is explained separately.

Options *mac-address*—MAC address

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Adding a Static MAC Address Entry to the Ethernet Switching Table (CLI Procedure) on page 1527

mac-limit

Syntax mac-limit *number*;

Hierarchy Level [edit vlans *vlan-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the number of MAC addresses allowed on a VLAN.

Default MAC limit is disabled.

Options *number*—Maximum number of MAC addresses.

Range: 1 through 32768

NOTE: **This statement is not supported on QFabric systems.**

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show vlans on page 1722**
- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Configuring MAC Table Aging on page 1532
- *Understanding Bridging*

mac-statistics

Syntax mac-statistics;

Hierarchy Level [edit bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options],
[edit logical-systems *logical-system-name* switch-options],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit routing-instances *routing-instance-name* switch-options],
[edit routing-instances *routing-instance-name* protocols evpn],
[edit switch-options],
[edit switch-options],
[edit vlans *vlan-name* switch-options]

Release Information Statement introduced in Junos OS Release 8.4.
Support for the **switch-options** statement added in Junos OS Release 9.2.
Support for top-level configuration for the **virtual-switch** type of routing instance added in Junos OS Release 9.2. In Junos OS Release 9.1 and earlier, the routing instances hierarchy supported this statement only for a VPLS instance or a bridge domain configured within a virtual switch.
Support for logical systems added in Junos OS Release 9.6.
[edit switch-options] and [edit vlans *vlan-name* switch-options] hierarchy levels introduced in Junos OS Release 12.3R2 for EX Series switches.
Support for EVPNs added in Junos OS Release 13.2 for MX 3D Series routers.
[edit switch-options] and [edit vlans *vlan-name* switch-options] hierarchy levels introduced in Junos OS Release 13.2 for the QFX Series.

Description (MX Series routers, EX Series switches, and QFX Series only) For bridge domains or VLANs, enable MAC accounting either for a specific bridge domain or VLAN, or for a set of bridge domains or VLANs associated with a Layer 2 trunk port.

Default disabled

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Layer 2 Learning and Forwarding for Bridge Domains Overview*
- Layer 2 Learning and Forwarding for VLANs Overview on page 1401
- *Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports*
- *Layer 2 Learning and Forwarding for VLANs Acting as a Switch for a Layer 2 Trunk Port*
- *Configuring EVPN Routing Instances*

mac-table-aging-time

Syntax mac-table-aging-time *seconds*;

Hierarchy Level For platforms without ELS:

[edit ethernet-switching-options],
[edit vlans *vlan-name*]

For platforms with ELS:

[edit vlans *vlan-name* switch-options]

Release Information Statement introduced for specific VLANs in Junos OS Release 11.1 for the QFX Series.

Description Define how long entries remain in the Ethernet switching table before expiring:

- If you specify this statement at the **[ethernet-switching-options]** hierarchy level, it applies to all VLANs on the switch.
- If you specify this statement at the **[vlans]** hierarchy level, it applies to the specified VLAN.

Default 300 seconds

Options *seconds*—Time that entries remain in the Ethernet switching table before being removed.

- **Range**—60 to 1,000,000 seconds.
- **Default**—300 seconds.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Configuring MAC Table Aging on page 1532
- Configuring MAC Table Aging on page 1541
- Understanding Bridging and VLANs on page 1402
- **show ethernet-switching statistics aging on page 1694**

mac-table-size

Syntax

```
mac-table-size limit {
  packet-action drop;
}
```

Hierarchy Level

[edit bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options],
[edit logical-systems *logical-system-name* switch-options],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit routing-instances *routing-instance-name* switch-options],
[edit switch-options]
[edit vlans *vlan-name* switch-options]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for the **switch-options** statement added in Junos OS Release 9.2.
Support for top-level configuration for the **virtual-switch** type of routing instance added in Junos OS Release 9.2. In Junos OS Release 9.1 and earlier, the routing instances hierarchy supported this statement only for a VPLS instance or a bridge domain configured within a virtual switch.
Support for logical systems added in Junos OS Release 9.6.
Support at the **[edit vlans *vlan-name* switch-options]** hierarchy level introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Support at the **[edit vlans *vlan-name* switch-options]** hierarchy level introduced in Junos OS Release 13.2 for the QFX Series.

Description

Modify the size of the MAC address table for the bridge domain or VLAN, a set of bridge domains or VLANs associated with a trunk port, or a virtual switch.

Options

limit—Specify the maximum number of addresses in the MAC address table.

Range: (EX Series switches only) 16 through 65,535 MAC addresses; (other devices) 16 through 1,048,575 MAC addresses

Default: (EX Series switches only) 65,536 MAC addresses; (other devices) 5120 MAC addressesThere is no default MAC address limit for the **mac-table-size** statement at the **[edit switch-options]** hierarchy level. The number of MAC addresses that can be learned is only limited by the platform, 65,535 MAC addresses for EX Series switches and 1,048,575 MAC addresses for other devices.

The remaining statement is explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Layer 2 Learning and Forwarding for Bridge Domains Overview*
- Layer 2 Learning and Forwarding for VLANs Overview on page 1401
- *Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports*
- *Layer 2 Learning and Forwarding for VLANs Acting as a Switch for a Layer 2 Trunk Port*
- Configuring MAC Limiting (CLI Procedure) on page 1539

members

Syntax members [(all | *names* | *vlan-ids*)];

Hierarchy Level [edit interfaces *interface-name* unit 0 family ethernet-switching vlan]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For trunk interfaces, configure the VLANs for which the interface can carry traffic.

TIP: To display a list of all configured VLANs on the system, including VLANs that are configured but not committed, type ? after vlan or vlans in your configuration mode command line. Note that only one VLAN is displayed for a VLAN range.

Options all—Specify that this trunk interface be a member of all the VLANs that are configured on this switch. When a new VLAN is configured on the switch, this trunk interface automatically becomes a member of the VLAN.

NOTE: Each VLAN that is configured must have a specified VLAN ID when you attempt to commit the configuration; otherwise, the configuration commit fails. Also, all cannot be the name of a VLAN on the switch.

names—Names of one or more VLANs.

vlan-ids—Numeric identifiers of one or more VLANs.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Understanding Bridging and VLANs on page 1402
- show ethernet-switching interfaces on page 1358
- show vlans on page 1722

native-vlan-id

Syntax native-vlan-id *vlan-id*;

Hierarchy Level For platforms without ELS:

[edit interfaces *interface-name* unit 0 family ethernet-switching],

For platforms with ELS:

[edit interfaces *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the VLAN identifier to associate with untagged packets received on the interface. The logical interface on which untagged packets are received must be configured with the same VLAN ID as the native VLAN ID configured on the physical interface. To configure the logical interface, include the **vlan-id** statement (matching the **native-vlan-id** statement on the physical interface) at the **[edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level**.

When the **native-vlan-id** statement is combined with the interface-mode statement, untagged packets are accepted and forwarded within the bridge domain or VLAN that is configured with the matching VLAN ID.

When the **native-vlan-id** statement is combined with the *flexible-vlan-tagging* statement, untagged packets are accepted on the interfaces that are configured for Q-in-Q tunneling.

.

Options *vlan-id*—Numeric identifier of the VLAN.

Range: 1 through 4094

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Junos OS Network Interfaces Configuration Guide*
-
- show ethernet-switching interfaces on page 1358
- show vlans on page 1722

no-mac-learning

Syntax no-mac-learning *limit*;

Hierarchy Level For platforms without ELS:

[edit ethernet-switching-options interfaces *interface-name*]

For platforms with ELS:

[edit vlans *vlan-name* switch-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Disable MAC address learning for the specified interface. Disabling MAC address learning on an interface disables learning for all the VLANs of which that interface is a member.

Default MAC learning is enabled.

Required Privilege Level routing—To view this statement in the configuration.
routing–control—To add this statement to the configuration.

Related Documentation

-

static (Static MAC-Based VLANs)

Syntax

```
static {
  vlan vlan-name {
    mac mac-address {
      next-hop interface-name;
    }
  }
}
```

Hierarchy Level [edit ethernet-switching-options]

Release Information Statement introduced in Junos OS Release 11.1 for EX Series switches.

Description Specify VLAN and MAC addresses to add to the Ethernet switching table.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Adding a Static MAC Address Entry to the Ethernet Switching Table (CLI Procedure) on page 1527

vlan-id (VLANs)

Syntax vlan-id *number*;

Hierarchy Level For platforms without ELS:

[edit vlans *vlan-name* vlan-range]

For platforms without ELS and with ELS:

[edit vlans *vlan-name*]

For ELS platforms only:

[edit interfaces *interface-name* unit *number*]
[edit vlans *vlan-name* vlan-id-list]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure an 802.1Q tag to apply to all traffic that originates on the VLAN.

Default On a QFX3500 and QFX3500 switch, if you use the default factory configuration, all traffic originating on the VLAN is untagged and has a VLAN identifier of **1**. The number zero is reserved for priority tagging and the number 4093 is also reserved.

On a QFX5100 switch, if you use the default factory configuration, all traffic originating on the VLAN is untagged and has a VLAN identifier of **1**. The number zero is reserved for priority tagging and the number 4093 is also reserved.

NOTE: You can only create up 4090 VLANs on a QFX5100 switch. If you create more than 4090 VLANs, the interfaces associated with the extra VLANs are not displayed in the **show vlans** command output. For example, if you create 4094 VLANs, the extra VLANs will not have interfaces associated with the VLANs. The order in which you configure the extra VLANs determines which interfaces are missing from the **show vlans** command output.

Options *number* —VLAN tag identifier.

Range: 0 through 4093.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up Bridging with Multiple VLANs on page 1451
- *Understanding Bridging*

vlan-tagging

Syntax vlan-tagging;

Hierarchy Level [edit interfaces *interface-name*]
[edit interfaces interface-range *interface-range-name*]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Enable VLAN tagging. The platform receives and forwards single-tag frames with 802.1Q VLAN tags.

Default VLAN tagging is disabled by default.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- vlan-id on page 2117
- Configuring a Layer 3 Logical Interface on page 2019

VLAN Configuration Statements (Original CLI Only)

drop-threshold

Syntax drop-threshold *number*;

Hierarchy Level [edit vlans *vlan-name* dot1q-tunneling layer2-protocol-tunneling (all | *protocol-name*)]

Release Information Statement introduced in Junos OS Release 10.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the maximum number of Layer 2 PDUs of the specified protocol that can be received per second on the interfaces in a specified VLAN before the switch begins dropping the Layer 2 PDUs. The drop threshold value must be less than or equal to the shutdown threshold value.

L2PT processing is done by the CPU, and L2PT traffic to the CPU is rate-limited to a maximum of 1000 pps. If traffic is received at a rate faster than this limit, the rate limit causes the traffic to be dropped before it hits the threshold and the dropped packets are not reported in L2PT statistics. This can also occur if you configure a drop threshold that is less than 1000 pps but traffic is received at a faster rate. For example, if you configure a drop threshold of 900 pps and the VLAN receives traffic at rate of 1100 pps, L2PT statistics will show that 100 packets were dropped. The 100 packets dropped because of the rate limit will not be reported. Similarly, if you do not configure a drop threshold and the VLAN receives traffic at rate of 1100 pps, the 100 packets dropped because of the rate limit are not reported.

NOTE: If the drop threshold value is greater than the shutdown threshold value and you try to commit the configuration, the commit operation fails.

You can specify a drop threshold value without specifying a shutdown threshold value.

Default No drop threshold is specified.

Options *number*—Maximum number of Layer 2 PDUs of the specified protocol that can be received per second on the interfaces in a specified VLAN before the switch begins dropping the Layer 2 PDUs.

Range: 1 through 1000

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Layer 2 Protocol Tunneling on EX Series Switches*
- *Configuring Layer 2 Protocol Tunneling on EX Series Switches (CLI Procedure)*
- *Configuring Layer 2 Protocol Tunneling*
- *shutdown-threshold*

ethernet-switching-options

Syntax

```
ethernet-switching-options {
  analyzer {
    name {
      input {
        egress {
          interface (all | interface-name);
        }
        ingress {
          interface (all | interface-name);
          vlan (vlan-id | vlan-name);
        }
      output {
        interface interface-name;
        ip-address ip-address;
        vlan (vlan-id | vlan-name);
      }
    }
  }
  bpdu-block {
    interface (all | [interface-name]);
    disable-timeout timeout;
  }
  dot1q-tunneling {
    ether-type (0x8100 | 0x88a8 | 0x9100)
  }
  interfaces interface-name {
    no-mac-learning;
  }
  mac-table-aging-time seconds {
  }
  port-error-disable {
    disable-timeout timeout;
  }
  secure-access-port {
    dhcp-snooping-file {
      location local_pathname | remote_URL;
      timeout seconds;
      write-interval seconds;
    }
    interface (all | interface-name) {
      allowed-mac {
        mac-address-list;
      }
      (dhcp-trusted | no-dhcp-trusted);
      fcoe-trusted;
      mac-limit limit action action;
      no-allowed-mac-log;
    }
    vlan (all | vlan-name) {
      (arp-inspection | no-arp-inspection) [
        forwarding-class (for DHCP Snooping or DAI Packets) class-name;
      }
```

```
            dhcp-option82 {
              circuit-id {
                prefix (Circuit ID for Option 82) hostname;
                use-interface-description;
                use-vlan-id;
              }
              remote-id {
                prefix (Remote ID for Option 82) hostname | mac | none;
                use-interface-description;
                use-string string;
              }
              vendor-id <string>;
            }
            (examine-dhcp | no-examine-dhcp) {
              forwarding-class (for DHCP Snooping or DAI Packets) class-name;
            }
            examine-fip {
              examine-vn2vn {
                beacon-period milliseconds;
              }
              fc-map fc-map-value;
            }
            mac-move-limit limit <fabric-limit limit action action;
          }
        }
        static {
          vlan vlan-id {
            mac mac-address next-hop interface-name;
          }
        }
        storm-control {
          interface (all | interface-name) {
            bandwidth bandwidth;
            no-broadcast;
            no-multicast;
            no-unknown-unicast;
          }
        }
        traceoptions {
          file filename <files number> <no-stamp> <replace> <size size> <world-readable |
            no-world-readable>;
          flag flag <disable>;
        }
        unknown-unicast-forwarding {
          vlan (all | vlan-name) {
            interface interface-name;
          }
        }
      }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Ethernet switching options.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Overview of Access Port Protection on page 4451
- Understanding Storm Control on page 4471

mac-notification

Syntax

```
mac-notification {
  notification-interval seconds;
}
```

Hierarchy Level [edit ethernet-switching-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Enable MAC notification for a switch. If you configure this statement without setting a notification interval, MAC notification is enabled with the default MAC notification interval of 30 seconds.

The remaining statement is explained separately.

Default MAC notification is disabled by default.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring MAC Notification on page 1531

next-hop (Static MAC-Based VLANs)

Syntax next-hop *interface-name;*

Hierarchy Level [edit ethernet-switching-options static vlan *vlan-name* mac *mac-address*]

Release Information Statement introduced in Junos OS Release 11.1 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the next hop for the indicated Ethernet node.

Options *interface-name*—Name of the next-hop interface.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Adding a Static MAC Address Entry to the Ethernet Switching Table (CLI Procedure) on page 1527

port-mode

Syntax port-mode (access | tagged-access | trunk);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family ethernet-switching]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

NOTE: This statement does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see interface-mode. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

Configure whether an interface on the switch operates in access, tagged access, or trunk mode.

Default All switch interfaces are in access mode.

Options

access—Have the interface operate in access mode. In this mode, the interface can be in a single VLAN only. Access interfaces typically connect to network devices such as PCs, printers, IP telephones, and IP cameras.

tagged-access—Have the interface operate in access mode. In this mode, the interface can be in multiple VLANs. Access interfaces typically connect to network devices such as PCs, printers, IP telephones, and IP cameras.

trunk—Have the interface operate in trunk mode. In this mode, the interface can be in multiple VLANs and can multiplex traffic between different VLANs. Trunk interfaces typically connect to other switches and to routers on the LAN.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Reflective Relay*
- *Example: Configuring Reflective Relay for Use with VEPA Technology*

traceoptions (Ethernet Switching Options)

Syntax

```
traceoptions {
  file filename <files number> <no-stamp> <replace> <size size> <world-readable |
    no-world-readable>;
  flag flag <disable>;
}
```

Hierarchy Level [edit ethernet-switching-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

NOTE: **The traceoptions statement is not supported on the QFX3000 QFabric system.**

Description Define global tracing operations for access security features on Ethernet switches.

Default The **traceoptions** feature is disabled by default.

Options

disable—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file ***filename*** —Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**.

files ***number*** —(Optional) Maximum number of trace files. When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**, then **trace-file.1**, and so on, until the maximum number of trace files is reached (***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify gigabytes), at which point the oldest trace file is overwritten. If you specify a maximum number of files, you also must specify a maximum file size with the **size** option.

Range: 2 through 1000

Default: 3 files

flag ***flag*** —Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. You can include the following flags:

- **access-security**—Trace access security events.
- **all**—All tracing operations.
- **analyzer**—Trace analyzer events.
- **config-internal**—Trace internal configuration operations.
- **filter**—Trace filter transaction events.
- **forwarding-database**—Trace forwarding database events.

- **general**—Trace general events.
- **interface**—Trace interface events.
- **krt**—Trace communications over routing sockets.
- **lib**—Trace library calls.
- **nexthop**—Trace next-hop events.
- **normal**—Trace normal events.
- **parse**—Trace reading of the configuration.
- **regex-parse**—Trace regular-expression parsing operations.
- **rtg**—Trace redundant trunk group events.
- **state**—Trace state transitions.
- **stp**—Trace spanning-tree events.
- **task**—Trace Ethernet-switching task processing.
- **timer**—Trace Ethernet-switching timer processing.
- **unknown-unicast-forwarding**—Trace unknown unicast forwarding events.
- **vlan**—Trace VLAN events.

no-stamp—(Optional) Do not timestamp the trace file.

Default: If you omit this option, timestamp information is placed at the beginning of each line of the tracing output.

no-world-readable—(Optional) Restrict file access to the user who created the file.

replace—(Optional) Replace an existing trace file if there is one rather than appending to it.

Default: If you do not include this option, tracing output is appended to an existing trace file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes. When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**, then **trace-file.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten. If you specify a maximum number of files, you also must specify a maximum file size with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify gigabytes

Range: 10 KB through 1 gigabyte

Default: 128 KB

world-readable—(Optional) Enable unrestricted file access.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Overview of Spanning-Tree Protocols on page 1419
- *Understanding Bridging*

vlan (Ethernet)

Syntax

```
vlan {
  members [ (all | names | vlan-ids) ];
}
```

Hierarchy Level

[edit interfaces ge-*chassis/slot/port* unit *logical-unit-number* ethernet-switching],
[edit interfaces xe-*chassis/slot/port* unit *logical-unit-number* ethernet-switching]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

For Gigabit Ethernet and aggregated Ethernet interfaces, assign an 802.1Q VLAN tag ID to a logical interface.

The statements are explained separately.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up Bridging with Multiple VLANs on page 1451
- *Junos OS Network Interfaces Configuration Guide*

vlan (Static MAC-based VLANs)

Syntax

```
vlan vlan-name {
  mac mac-address {
      next-hop interface-name;
  }
}
```

Hierarchy Level

[edit ethernet-switching-options static]

Release Information

Statement introduced in Junos OS Release 11.1 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Specify the name of a VLAN to add to the Ethernet switching table.

Options

vlan-name—Name of the VLAN to add to the Ethernet switching table.

The remaining statements are explained separately.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Adding a Static MAC Address Entry to the Ethernet Switching Table (CLI Procedure) on page 1527

vlan (Unknown Unicast)

Syntax
```
vlan (all | vlan-name) {
  interface interface-name;
}
```

Hierarchy Level [edit ethernet-switching-options unknown-unicast-forwarding]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify a VLAN from which unknown unicast packets will be forwarded, or specify that the packets should be forwarded from *all* VLANS. Unknown unicast packets are forwarded from a VLAN to a specific trunk interface.

The remaining statement is explained separately.

TIP: To display a list of all configured VLANs on the system, including VLANs that are configured but not committed, type ? after vlan or vlans in your configuration mode command line. Note that only one VLAN is displayed for a VLAN range.

Options all—All VLANs.

vlan-name—Name of a VLAN.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Unknown Unicast Forwarding*
- *Verifying That Unknown Unicast Packets Are Forwarded to a Trunk Interface*
- *Understanding Unknown Unicast Forwarding*
- show ethernet-switching table on page 1700
- show vlans on page 1722

vlan-range

Syntax vlan-range *vlan-id-low-vlan-id-high*;

Hierarchy Level [edit vlans *vlan-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure multiple VLANs. Each VLAN is assigned a VLAN ID number from the range.

Default None.

Options ***vlan-id-low-vlan-id-high***—Specify the first and last VLAN ID number for the group of VLANs.

Required Privilege Level routing—To view this statement in the configuration.
routing–control—To add this statement to the configuration.

Related Documentation

- Configuring VLANs on page 1534
- Configuring Routed VLAN Interfaces on page 1532
- *Understanding Bridging*

vlans

Syntax

```
vlans {
  vlan-name {
    description text-description;
    dot1q-tunneling {
      customer-vlans (id | range);
    }
    filter input filter-name;
    filter output filter-name;
    interface interface-name {
      isolated;
      mapping (policy | tag push | native push);
      promiscuous;
    }
    isolation-vlan-id;
    l3-interface vlan.logical-interface-number;
    mac-limit number;
    mac-table-aging-time seconds;
    no-local-switching;
    no-mac-learning;
    primary-vlan vlan-name;
    pvlan extend-secondary-vlan-id vlan-id;
    vlan-id number;
    vlan-range vlan-id-low-vlan-id-high;
  }
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statements for private VLANs and Q-in-Q tunneling introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure VLAN properties on the QFX Series.

Default If you use the default factory configuration, all switch interfaces become part of the VLAN **default**.

Options *vlan-name*—Name of the VLAN. The name can contain letters, numbers, hyphens (-), and periods (.) and can be up to 255 characters long.

The remaining statements are described separately.

Required Privilege Level routing—To view this statement in the configuration.
routing–control—To add this statement to the configuration.

Related Documentation

- Configuring VLANs on page 1534
- *Configuring Q-in-Q Tunneling*
- Creating a Series of Tagged VLANs on page 1536

- Configuring Routed VLAN Interfaces on page 1532
- *Creating a Private VLAN on a Single Switch*
- *Understanding Bridging*

VLAN Configuration Statements (ELS CLI Only)

[edit vlans] Configuration Statement Hierarchy on the QFX Series

This topic lists supported and unsupported configuration statements in the **[edit vlans]** hierarchy level on EX Series switches.

- *Supported* statements are those that you can use to configure some aspect of a software feature on the switch.
- *Unsupported* statements are those that appear in the command-line interface (CLI) on the switch, but that have no effect on switch operation if you configure them.
- Not all features are supported on all switch platforms. For detailed information about feature support on specific EX Series switch platforms, see *QFX Series Virtual Chassis Software Features Overview*.

This topic lists:

Supported Statements in the [edit vlans] Hierarchy Level

The following hierarchy shows the **[edit vlans]** configuration statements supported on one or more of the EX Series switches:

```
vlans {
  vlan-name {
    description text-description;
```



```
domain-type bridge;
forwarding-options {
  dhcp-security {
    arp-inspection;
    group group-name {
      interface interface-name {
        static-ip ip-address {
          mac mac-address;
        }
      }
      overrides {
        no-option82;
        trusted;
      }
    }
    ip-source-guard;
    no-dhcp-snooping;
    option-82 {
      circuit-id {
        prefix {
          host-name;
          logical-system-name;
          routing-instance-name;
        }
        use-interface-description (device | logical);
        use-vlan-id;
      }
      remote-id {
        host-name;
        use-interface-description (device | logical);
        use-string string;
      }
      vendor-id {
        use-string string;
      }
    }
  }
  filter {
    input filter-name;
    output filter-name;
  }
  flood {
    input filter-name;
  }
}
l3-interface irb.logical-unit-number;
multicast-snooping-options {
  flood-groups [group-names];
  forwarding-cache {
    threshold {
      reuse threshold;
      suppress threshold;
    }
  }
  graceful-restart {
    disable;
```

```
          restart-duration duration;
        }
        host-outbound-traffic {
          dot1p bits;
          forwarding-class forwarding-class;
        }
        multichassis-lag-replicate-state;
        nexthop-hold-time time;
        options {
          syslog {
            level level;
            mark interval;
            upto level;
          }
        }
        traceoptions {
          file filename {
            files number;
            no-world-readable;
            size file-size;
            world-readable;
          }
          flag flag {
            disable;
          }
        }
      }
      switch-options {
        interface interface-name {
          interface-mac-limit limit {
            packet-action action;
          }
          static-mac mac-address;
        }
        interface-mac-limit limit {
          packet-action action;
        }
        mac-move-limit limit {
          packet-action action;
        }
        mac-table-size limit {
          packet-action drop;
        }
        no-mac-learning;
      }
      vlan-id number;
      vlan-id-list [vlan-id | vlan-id–vlan-id];
    }
  }
```

Unsupported Statements in the [edit vlans] Hierarchy Level

All statements in the **[edit vlans]** hierarchy level that are displayed in the command-line interface (CLI) on the switch are supported on the switch and operate as documented with the following exceptions:

Table 137: Unsupported [edit vlans] Configuration Statements on EX Series Switches

Statement	Hierarchy Level
NOTE: Variables, such as *filename*, are not shown in the statements or hierarchies.	
mcae-mac-synchronize	**[edit vlans]**
no-irb-layer-2-copy	**[edit vlans]**

Related Documentation

- Understanding Bridging and VLANs on page 1402

dhcp-relay

Syntax

```
dhcp-relay {
  active-server-group server-group-name;
  authentication {
    password password-string;
    username-include {
      circuit-type;
      delimiter delimiter-character;
      domain-name domain-name-string;
      interface-name;
      logical-system-name;
      mac-address;
      option-60;
      option-82 <circuit-id> <remote-id>;
      routing-instance-name;
      user-prefix user-prefix-string;
    }
  }
  dhcpv6 {
    active-server-group server-group-name;
    authentication {
      password password-string;
      username-include {
        circuit-type;
        client-id;
        delimiter delimiter-character;
        domain-name domain-name-string;
        interface-name;
        logical-system-name;
        relay-agent-interface-id;
        relay-agent-remote-id;
        relay-agent-subscriber-id;
        routing-instance-name;
        user-prefix user-prefix-string;
      }
    }
    dynamic-profile profile-name {
      aggregate-clients (merge | replace);
      use-primary primary-profile-name;
    }
    group group-name {
      active-server-group server-group-name;
      authentication {
        ...
      }
      dynamic-profile profile-name {
        ...
      }
      interface interface-name {
        exclude;
        liveness-detection {
          failure-action (clear-binding | clear-binding-if-interface-up | log-only);
          method {
```



```
                  bfd {
                    version (0 | 1 | automatic);
                    minimum-interval milliseconds;
                    minimum-receive-interval milliseconds;
                    multiplier number;
                    no-adaptation;
                    transmit-interval {
                      minimum-interval milliseconds;
                      threshold milliseconds;
                    }
                    detection-time {
                      threshold milliseconds;
                    }
                    session-mode(automatic | multihop | singlehop);
                    holddown-interval milliseconds;
                  }
                }
              }
              overrides {
                ...
              }
              service-profile dynamic-profile-name;
              trace;
              upto upto-interface-name;
            }
            service-profile dynamic-profile-name;
          }
          overrides {
            ...
          }
          relay-agent-interface-id {
            ...
          }
        service-profile dynamic-profile-name;
        liveness-detection {
          failure-action (clear-binding | clear-binding-if-interface-up | log-only);
          method {
            bfd {
              version (0 | 1 | automatic);
              minimum-interval milliseconds;
              minimum-receive-interval milliseconds;
              multiplier number;
              no-adaptation;
              transmit-interval {
                minimum-interval milliseconds;
                threshold milliseconds;
              }
              detection-time {
                threshold milliseconds;
              }
              session-mode(automatic | multihop | singlehop);
              holddown-interval milliseconds;
            }
          }
        }
        overrides {
```

```
      allow-snooped-clients;
      interface-client-limit number;
      no-allow-snooped-clients;
      no-bind-on-request;
      send-release-on-delete;
    }
    relay-agent-interface-id {
      prefix prefix;
      use-interface-description (logical | device):
    }
    server-group {
      server-group-name {
        server-ip-address;
      }
    }
  duplicate-clients-on-interface;
  dynamic-profile profile-name {
    aggregate-clients (merge | replace);
    use-primary primary-profile-name;
  }
  forward-snooped-clients (all-interfaces | configured-interfaces |
    non-configured-interfaces);
  group group-name {
    active-server-group server-group-name;
    authentication {
      ...
    }
    dynamic-profile profile-name {
      ...
    }
    interface interface-name {
      exclude;
      liveness-detection {
        failure-action (clear-binding | clear-binding-if-interface-up | log-only);
        method {
          bfd {
            version (0 | 1 | automatic);
            minimum-interval milliseconds;
            minimum-receive-interval milliseconds;
            multiplier number;
            no-adaptation;
            transmit-interval {
              minimum-interval milliseconds;
              threshold milliseconds;
            }
            detection-time {
              threshold milliseconds;
            }
            session-mode(automatic | multihop | singlehop);
            holddown-interval milliseconds;
          }
        }
      }
      overrides {
        ...
      }
```

```
        service-profile dynamic-profile-name;
        trace;
        upto upto-interface-name;
    }
    overrides {
        ...
    }
    relay-option-82 {
        ...
    }
    service-profile dynamic-profile-name;
}
liveness-detection {
    failure-action (clear-binding | clear-binding-if-interface-up | log-only);
    method {
        bfd {
            version (0 | 1 | automatic);
            minimum-interval milliseconds;
            minimum-receive-interval milliseconds;
            multiplier number;
            no-adaptation;
            transmit-interval {
                minimum-interval milliseconds;
                threshold milliseconds;
            }
            detection-time {
                threshold milliseconds;
            }
            session-mode(automatic | multihop | singlehop);
            holddown-interval milliseconds;
        }
    }
}
overrides {
    allow-snooped-clients;
    always-write-giaddr;
    always-write-option-82;
    client-discover-match <option60-and-option82>;
    disable-relay;
    interface-client-limit number;
    layer2-unicast-replies;
    no-allow-snooped-clients;
    OBSOLETE - no-arp;
    no-bind-on-request;
    proxy-mode;
    replace-ip-source-with;
    send-release-on-delete;
    trust-option-82;
}
relay-option-82 {
    circuit-id {
        prefix prefix;
        use-interface-description (logical | device);
    }
}
server-group {
```

```
      server-group-name {
         server-ip-address;
      }
   }
   service-profile dynamic-profile-name;
}
```

Hierarchy Level [edit forwarding-options],
[edit vlans forwarding-options]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure extended Dynamic Host Configuration Protocol (DHCP) relay and DHCPv6 relay options on the switch and enable the switch to function as a DHCP relay agent. A DHCP relay agent forwards DHCP request and reply packets between a DHCP client and a DHCP server.

DHCP relay supports the attachment of dynamic profiles and also interacts with the local AAA Service Framework to use back-end authentication servers, such as RADIUS, to provide subscriber authentication. You can attach dynamic profiles and configure authentication support on a global basis or for a specific group of interfaces.

The extended DHCP and DHCPv6 relay agent options configured with the **dhcp-relay** and **dhcpv6** statements are incompatible with the DHCP/BOOTP relay agent options configured with the **bootp** statement. As a result, the extended DHCP or DHCPv6 relay agent and the DHCP/BOOTP relay agent cannot both be enabled on the router at the same time.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

forwarding-options

Syntax

```
forwarding-options {
  dhcp-relay {
    active-server-group server-group-name;
    authentication {
      password password-string;
      username-include {
        circuit-type;
        delimiter delimiter-character;
        domain-name domain-name-string;
        interface-name;
        logical-system-name;
        mac-address;
        option-60;
        option-82 <circuit-id> <remote-id>;
        routing-instance-name;
        user-prefix user-prefix-string;
      }
    }
    dhcpv6 {
      active-server-group server-group-name;
      authentication {
        password password-string;
        username-include {
          circuit-type;
          client-id;
          delimiter delimiter-character;
          domain-name domain-name-string;
          interface-name;
          logical-system-name;
          relay-agent-interface-id;
          relay-agent-remote-id;
          relay-agent-subscriber-id;
          routing-instance-name;
          user-prefix user-prefix-string;
        }
      }
      dynamic-profile profile-name {
        aggregate-clients (merge | replace);
        use-primary primary-profile-name;
      }
      group group-name {
        active-server-group server-group-name;
        authentication {
          ...
        }
        dynamic-profile profile-name {
          ...
        }
        interface interface-name {
          exclude;
          liveness-detection {
            failure-action (clear-binding | clear-binding-if-interface-up | log-only);
```



```
            method {
              bfd {
                version (0 | 1 | automatic);
                minimum-interval milliseconds;
                minimum-receive-interval milliseconds;
                multiplier number;
                no-adaptation;
                transmit-interval {
                  minimum-interval milliseconds;
                  threshold milliseconds;
                }
                detection-time {
                  threshold milliseconds;
                }
                session-mode(automatic | multihop | singlehop);
                holddown-interval milliseconds;
              }
            }
          }
          overrides {
            ...
          }
          service-profile dynamic-profile-name;
          trace;
          upto upto-interface-name;
        }
        service-profile dynamic-profile-name;
        }
        overrides {
          ...
        }
        relay-agent-interface-id {
          ...
        }
      service-profile dynamic-profile-name;
      liveness-detection {
        failure-action (clear-binding | clear-binding-if-interface-up | log-only);
        method {
          bfd {
            version (0 | 1 | automatic);
            minimum-interval milliseconds;
            minimum-receive-interval milliseconds;
            multiplier number;
            no-adaptation;
            transmit-interval {
              minimum-interval milliseconds;
              threshold milliseconds;
            }
            detection-time {
              threshold milliseconds;
            }
            session-mode(automatic | multihop | singlehop);
            holddown-interval milliseconds;
          }
        }
      }
```



```
    overrides {
      allow-snooped-clients;
      interface-client-limit number;
      no-allow-snooped-clients;
      no-bind-on-request;
      send-release-on-delete;
    }
    relay-agent-interface-id {
      prefix prefix;
      use-interface-description (logical | device):
    }
    server-group {
      server-group-name {
        server-ip-address;
      }
    }
  duplicate-clients-on-interface;
  dynamic-profile profile-name {
    aggregate-clients (merge | replace);
    use-primary primary-profile-name;
  }
  forward-snooped-clients (all-interfaces | configured-interfaces |
    non-configured-interfaces);
  group group-name {
    active-server-group server-group-name;
    authentication {
      ...
    }
    dynamic-profile profile-name {
      ...
    }
    interface interface-name {
      exclude;
      liveness-detection {
        failure-action (clear-binding | clear-binding-if-interface-up | log-only);
        method {
          bfd {
            version (0 | 1 | automatic);
            minimum-interval milliseconds;
            minimum-receive-interval milliseconds;
            multiplier number;
            no-adaptation;
            transmit-interval {
              minimum-interval milliseconds;
              threshold milliseconds;
            }
            detection-time {
              threshold milliseconds;
            }
            session-mode(automatic | multihop | singlehop);
            holddown-interval milliseconds;
          }
        }
      }
      overrides {
        ...
```

```
        }
        service-profile dynamic-profile-name;
        trace;
        upto upto-interface-name;
      }
      overrides {
        ...
      }
      OBSOLETE - relay-option-60 {
        ...
      }
      relay-option-82 {
        ...
      }
      service-profile dynamic-profile-name;
    }
    liveness-detection {
      failure-action (clear-binding | clear-binding-if-interface-up | log-only);
      method {
        bfd {
          version (0 | 1 | automatic);
          minimum-interval milliseconds;
          minimum-receive-interval milliseconds;
          multiplier number;
          no-adaptation;
          transmit-interval {
            minimum-interval milliseconds;
            threshold milliseconds;
          }
          detection-time {
            threshold milliseconds;
          }
          session-mode(automatic | multihop | singlehop);
          holddown-interval milliseconds;
        }
      }
    }
    overrides {
      allow-snooped-clients;
      always-write-giaddr;
      always-write-option-82;
      client-discover-match <option60-and-option82>;
      disable-relay;
      interface-client-limit number;
      layer2-unicast-replies;
      no-allow-snooped-clients;
      no-bind-on-request;
      proxy-mode;
      replace-ip-source-with;
      send-release-on-delete;
      trust-option-82;
    }
    relay-option-82 {
      circuit-id {
        prefix prefix;
        use-interface-description (logical | device);
```



```
            }
        }
        server-group {
            server-group-name {
                server-ip-address;
            }
        }
        service-profile dynamic-profile-name;
    }
    dhcp-security {
        arp-inspection;
        group group-name {
            interface interface-name {
                static-ip ip-address {
                    mac mac-address;
                }
            }
            overrides {
                no-option82;
                trusted;
                untrusted;
            }
        }
        ip-source-guard;
        no-dhcp-snooping;
        option-82 {
            circuit-id {
                prefix {
                    host-name;
                    logical-system-name;
                    routing-instance-name;
                }
                use-interface-description (device | logical);
                use-vlan-id;
            }
            remote-id {
                host-name hostname;
                use-interface-description (device | logical);
                use-string string;
            }
            vendor-id {
                use-string string;
            }
        }
    }
    fip-security {
        examine-vn2vf;
        examine-vn2vn {
            beacon-period milliseconds;
        }
        fc-map fc-map-value;
        interface interface-name {
            (fcoe-trusted | no-fcoe-trusted;)
        }
    }
}
```

Hierarchy Level [edit]
[edit vlans]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.3 for QFX Series switches.

Description Configure traffic forwarding.

The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interface-mac-limit

Syntax

interface-mac-limit *limit* {
  packet-action *action*;
}

Hierarchy Level

[edit bridge-domains *bridge-domain-name* bridge-options],
[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options interface *interface-name*],
[edit logical-systems *logical-system-name* switch-options],
[edit logical-systems *logical-system-name* switch-options interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit routing-instances *routing-instance-name* switch-options],
[edit routing-instances *routing-instance-name* switch-options interface *interface-name*],
[edit switch-options],
[edit switch-options],
[edit switch-options interface *interface-name*],
[edit switch-options interface *interface-name*],
[edit vlans *vlan-name* switch-options],
[edit vlans *vlan-name* switch-options interface *interface-name*]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for the **switch-options** statement added in Junos OS Release 9.2.
Support for top-level configuration for the **virtual-switch** type of routing instance added in Junos OS Release 9.2. In Junos OS Release 9.1 and earlier, the routing instances hierarchy supported this statement only for a VPLS instance or a bridge domain configured within a virtual switch.
Support for logical systems added in Junos OS Release 9.6.
Support at [edit switch-options], [edit switch-options interface *interface-name*], [edit vlans *vlan-name* switch-options], and [edit vlans *vlan-name* switch-options interface *interface-name*] hierarchy levels introduced in Junos OS Release 12.3R2 for EX Series switches.
Support at hierarchy levels under **[edit vlans *vlan-name*]** introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description (MX Series routers, EX Series switches, and the QFX Series) Configure a limit to the number of MAC addresses that can be learned from a bridge domain or VLAN, virtual switch, or set of bridge domains or VLANs.

Default All devices except the EX Series switches: 1024 MAC addresses for each logical interface; EX Series switches: 65,536 MAC addresses for each interface and VLAN.

Options ***limit***—Maximum number of MAC addresses learned from an interface.

Range: 1 through 131,071 MAC addresses per interface, or 1 through 65,535 MAC addresses per interface

The remaining statement is explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Layer 2 Learning and Forwarding for Bridge Domains Overview*
- Layer 2 Learning and Forwarding for VLANs Overview on page 1401
- *Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports*
- Configuring MAC Limiting (CLI Procedure) on page 1539

interface-mode

Syntax interface-mode (access | trunk);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family bridge],
[edit interfaces *interface-name* unit *logical-unit-number* family ethernet-switching],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family bridge]

Release Information Statement introduced in Junos OS Release 9.2.
Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description

NOTE: This statement supports the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see port-mode. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

(QFX Series 3500 and 3600 standalone switches)—Determine whether the logical interface accepts or discards packets based on VLAN tags. Specify the **trunk** option to accept packets with a VLAN ID that matches the list of VLAN IDs specified in the **vlan-id** or **vlan-id-list** statement, then forward the packet within the bridge domain or VLAN configured with the matching VLAN ID. Specify the **access** option to accept packets with no VLAN ID, then forward the packet within the bridge domain or VLAN configured with the VLAN ID that matches the VLAN ID specified in the **vlan-id** statement.

NOTE: On MX Series routers, if you want IGMP snooping to be functional for a bridge domain, then you should not configure interface-mode and irb for that bridge. Such a configuration commit succeeds, but IGMP snooping is not functional, and a message informing the same is displayed. For more information, see *Configuring a Trunk Interface on a Bridge Network*.

Options

access—Configure a logical interface to accept untagged packets. Specify the VLAN to which this interface belongs using the **vlan-id** statement.

trunk—Configure a single logical interface to accept packets tagged with any VLAN ID specified with the **vlan-id** or **vlan-id-list** statement.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring a Logical Interface for Access Mode*
- *Configuring a Logical Interface for Trunk Mode*

- *Example: Connecting Access Switches to a Distribution Switch*

packet-action

Syntax packet-action *action*;

Hierarchy Level
[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name* interface-mac-limit *limit*],
[edit bridge-domains *bridge-domain-name* bridge-options interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name* interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name* interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options interface *interface-name* interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options interface-mac-limit *limit*],
[edit logical-systems *logical-system-name* switch-options interface-mac-limit *limit*],
[edit protocols l2-learning global-mac-limit *limit*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name* interface-mac-limit *limit*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface-mac-limit *limit*],
[edit routing-instances *routing-instance-name* protocols evpn interface-mac-limit],
[edit routing-instances *routing-instance-name* protocols evpn interface *interface-name* interface-mac-limit],
[edit routing-instances *routing-instance-name* protocols evpn mac-table-size *limit*],
[edit routing-instances *routing-instance-name* switch-options interface *interface-name* interface-mac-limit *limit*],
[edit routing-instances *routing-instance-name* switch-options interface-mac-limit *limit*],
[edit switch-options interface-mac-limit *limit*],
[edit switch-options interface *interface-name* interface-mac-limit *limit*],
[edit switch-options interface-mac-limit *limit*],
[edit switch-options interface *interface-name* interface-mac-limit *limit*],
[edit switch-options interface-mac-limit *limit*],
[edit switch-options mac-table-size *limit*],
[edit switch-options interface *interface-name* interface-mac-limit *limit*],
[edit vlans *vlan-name* switch-options interface *interface-name* interface-mac-limit *limit*],
[edit vlans *vlan-name* switch-options interface-mac-limit *limit*],
[edit vlans *vlan-name* switch-options mac-table-size *limit*]
[edit vlans *vlan-name* switch-options interface-mac-limit *limit*],
[edit vlans *vlan-name* switch-options interface *interface-name* interface-mac-limit *limit*],
[edit vlans *vlan-name* switch-options mac-table-size *limit*]

Release Information
Statement introduced in Junos OS Release 8.4.
Support for the **switch-options** statement added in Junos OS Release 9.2.
Support for top-level configuration for the **virtual-switch** type of routing instance added in Junos OS Release 9.2. In Junos OS Release 9.1 and earlier, the routing instances hierarchy supported this statement only for a VPLS instance or a bridge domain configured within a virtual switch.

Support for logical systems added in Junos OS Release 9.6.
[edit switch-options interface *interface-name* interface-mac-limit *limit*], [edit switch-options interface-mac-limit *limit*], [edit switch-options mac-table-size *limit*], [edit vlans *vlan-name* switch-options interface *interface-name* interface-mac-limit *limit*], [edit vlans *vlan-name* switch-options interface-mac-limit *limit*], and [edit vlans *vlan-name* switch-options mac-table-size *limit*] hierarchy levels introduced in Junos OS Release 12.3R2 for EX Series switches.
Support for EVPNs introduced in Junos OS Release 13.2 on MX Series 3D Universal Edge Routers.
Support at the **[edit switch-options interface *interface-name* interface-mac-limit *limit*]** hierarchy level and hierarchy levels under **[edit vlans *vlan-name*]** introduced in Junos OS Release 13.2X50-D10 for EX Series switches and Junos OS Release 13.2 for the QFX Series.

Description Specify the action taken when packets with new source MAC addresses are received after the MAC address limit is reached. If this statement is not configured, packets with new source MAC addresses are forwarded by default.

NOTE: On a QFX Series Virtual Chassis, if you include the **shutdown** option at the **[edit vlans *vlan-name* switch-options interface *interface-name* interface-mac-limit packet-action]** hierarchy level and issue the **commit** operation, the system generates a commit error. The system does not generate an error if you include the **shutdown** option at the **[edit switch-options interface *interface-name* interface-mac-limit packet-action]** hierarchy level.

Default Disabled. The default is for packets for new source MAC addresses to be forwarded after the MAC address limit is reached.

Options **drop**—Drop packets with new source MAC addresses, and do not learn the new source MAC addresses.

drop-and-log—(EX Series switches and QFX Series only) Drop packets with new source MAC addresses, and generate an alarm, an SNMP trap, or a system log entry.

log—(EX Series switches and QFX Series only) Hold packets with new source MAC addresses, and generate an alarm, an SNMP trap, or a system log entry.

none—(EX Series switches and QFX Series only) Forward packets with new source MAC addresses, and learn the new source MAC address.

shutdown—(EX Series switches and QFX Series only) Disable the specified interface, and generate an alarm, an SNMP trap, or a system log entry.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring EVPN Routing Instances*
- Configuring MAC Limiting (CLI Procedure) on page 1539
- *Configuring Persistent MAC Learning (CLI Procedure)*
- *Layer 2 Learning and Forwarding for Bridge Domains Overview*
- Layer 2 Learning and Forwarding for VLANs Overview on page 1401
- *Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports*
- Layer 2 Learning and Forwarding for VLANs Overview on page 1401
- *Layer 2 Learning and Forwarding for VLANs Acting as a Switch for a Layer 2 Trunk Port*

service-id

Syntax service-id *number*;

Hierarchy Level [edit switch-options]
[edit vlans *vlan-name*]

Release Information Statement introduced in Junos OS Release 12.3R2 for EX Series switches and MX Series routers.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Specify a service identifier for each multichassis aggregated Ethernet interface that belongs to a link aggregation group (LAG).

Options **number**—A number that identifies a particular service.

Range: 1 through 65535

Required Privilege Level system—To view this statement in the configuration.
system control—To add this statement to the configuration.

switch-options

Syntax

```
switch-options {
  interface interface-name {
    interface-mac-limit limit {
      packet-action drop;
    }
    no-mac-learning;
    static-mac static-mac-address {
      vlan-id number;
    }
  }
  interface-mac-limit limit {
    packet-action drop;
  }
  mac-statistics;
  mac-table-size limit {
    packet-action drop;
  }
  no-mac-learning;
  service-id number;
}
```

Hierarchy Level

[edit *number*],
[edit vlans *vlan--name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* vlans *vlan-name*],
[edit routing-instances *routing-instance-name* vlans *vlan-name*]

Release Information

Statement introduced in Junos OS Release 12.3R2 for EX Series switches and MX Series routers.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description

Configure Layer 2 learning and forwarding properties for a VLAN or a virtual switch.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

static-mac

Syntax

static-mac *mac-address* {
  vlan-id *number*;
}

Hierarchy Level

[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols evpn interface *interface-name*]
[edit vlans *vlan-name* switch-options interface *interface-name*]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.
[edit vlans *vlan-name* switch-options interface *interface name*] hierarchy level introduced in Junos OS Release 12.3R2 for EX Series switches.
Support for EVPNs added in Junos OS Release 13.2 for MX 3D Series routers. The **vlan-id** option is not available for EVPNs.
[edit vlans *vlan-name* switch-options interface *interface name*] hierarchy level introduced in Junos OS Release 13.2 for the QFX Series.

Description

Configure a static MAC address for a logical interface in a bridge domain or VLAN.

The **vlan-id** option can be specified for **static-macs** only if **vlan-id all** is configured for the bridging domain or VLAN.

Options

mac-address—MAC address

vlan-id ***number***—(Optional) VLAN identifier to associate with static MAC address.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring EVPN Routing Instances*
- *Layer 2 Learning and Forwarding for Bridge Domains Overview*
- Layer 2 Learning and Forwarding for VLANs Overview on page 1401

vlan-id-list

Syntax vlan-id-list [*vlan-id-numbers*];

Hierarchy Level
[edit bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*]
[edit interfaces *interface-name* unit 0],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit vlans *vlan-name*]

Release Information
Statement introduced in Junos OS Release 9.4.
Support for logical systems added in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Specify a VLAN identifier list to use for a bridge domain or VLAN in trunk mode.

Specify the **trunk** option in the **interface-mode** statement to accept packets with a VLAN ID that matches the list of VLAN IDs specified in the **vlan-id-list** statement to forward the packet within the bridge domain or VLAN configured with the matching VLAN ID. Specify the **access** option to accept packets with no VLAN ID to forward the packet within the bridge domain or VLAN configured with the VLAN ID that matches the VLAN ID specified in the **vlan-id** statement.

This statement also enables you to bind a logical interface to a list of VLAN IDs, thereby configuring the logical interface to receive and forward a frame with a tag that matches the specified VLAN ID list.

Options ***vlan-id-numbers***—Valid VLAN identifiers. You can combine individual numbers with range lists including a hyphen.

Range: 0 through 4095

NOTE: On EX Series switches and the QFX Series, the range is 0 through 4094.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Configuring a Bridge Domain*
- *Configuring a VLAN*
- *Configuring VLANs for EX Series Switches (CLI Procedure)*
- Configuring VLANs on page 1544

- *Configuring VLAN Identifiers for Bridge Domains and VPLS Routing Instances*
- *Configuring VLAN Identifiers for VLANs and VPLS Routing Instances*
- *Configuring Q-in-Q Tunneling (CLI Procedure)*

vlan-rewrite

Syntax vlan-rewrite translate (200 500 | 201 501)

Hierarchy Level [edit interfaces *interface-name* unit *number* family bridge interface-mode trunk]
[edit interfaces *interface-name* unit *number* family ethernet-switching interface-mode trunk]

Release Information Statement introduced in Junos OS Release 9.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Translates an incoming VLAN to a bridge-domain VLAN, corresponding counter translation at egress. Supports translation of VLAN 200 to VLAN 500 and VLAN 201 to VLAN 501. Other valid VLANs pass through without translation.

Options **translate 200 500**—Translates incoming packets with VLAN 200 to 500.

translate 201 501—Translates incoming packets with VLAN 201 to 501.

translate 202 502—Translates incoming packets with VLAN 202 to 502.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Rewriting a VLAN Tag and Adding a New Tag*

vlans

Syntax

```
vlans {
  vlan-name {
    description text-description;
    domain-type bridge;
    forwarding-options {
      dhcp-security {
        arp-inspection;
        group group-name {
          interface interface-name {
            static-ip ip-address {
              mac mac-address;
            }
          }
          overrides {
            no-option82;
            trusted;
            untrusted;
          }
        }
        ip-source-guard;
        no-dhcp-snooping;
        option-82 {
          circuit-id {
            prefix {
              host-name;
              logical-system-name;
              routing-instance-name;
            }
            use-interface-description (device | logical);
            use-vlan-id;
          }
          remote-id {
            host-name hostname;
            use-interface-description (device | logical);
            use-string string;
          }
          vendor-id {
            use-string string;
          }
        }
      }
      fip-security {
        examine-vn2vf;
        examine-vn2vn {
          beacon-period milliseconds;
        }
        fc-map fc-map-value;
        interface interface-name {
          (fcoe-trusted | no-fcoe-trusted;)
        }
      }
    }
```



```
l3-interface irb.logical-unit-number;
multicast-snooping-options {
  flood-groups [group-names];
  forwarding-cache {
    threshold {
      reuse threshold;
      suppress threshold;
    }
  }
  graceful-restart {
    disable;
    restart-duration duration;
  }
  host-outbound-traffic {
    dot1p bits;
    forwarding-class forwarding-class;
  }
  multichassis-lag-replicate-state;
  nexthop-hold-time time;
  options {
    syslog {
      level level;
      mark interval;
      upto level;
    }
  }
  traceoptions {
    file filename {
      files number;
      no-world-readable;
      size file-size;
      world-readable;
    }
    flag flag {
      disable;
    }
  }
}
switch-options {
  interface interface-name {
    interface-mac-limit limit {
      packet-action action;
    }
    static-mac mac-address;
  }
  interface-mac-limit limit {
    packet-action action;
  }
  mac-move-limit limit {
    packet-action action;
  }
  mac-table-size limit {
    packet-action drop;
  }
  no-mac-learning;
}
```

```
      vlan-id number;
      vlan-id-list [vlan-id | vlan-id–vlan-id];
   }
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.
Statements for private VLANs and Q-in-Q tunneling introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure VLAN properties on the QFX Series.

Default If you use the default factory configuration, all switch interfaces become part of the VLAN **default**.

Options ***vlan-name***—Name of the VLAN. The name can contain letters, numbers, hyphens (-), and periods (.) and can be up to 255 characters long.

The remaining statements are described separately.

Required Privilege Level routing—To view this statement in the configuration.
routing–control—To add this statement to the configuration.

Related Documentation

- Understanding Bridging and VLANs on page 1402
- Configuring VLANs on page 1544

CHAPTER 17

Administration

Routine Monitoring

Verifying That MAC Notification Is Working Properly

Purpose Verify that MAC notification is enabled or disabled, and that the MAC notification interval is set to the specified value.

Action To verify that MAC notification is enabled or disabled and also to verify the MAC notification interval setting.

```
user@switch> show ethernet-switching mac-notification
Notification Status: Enabled
Notification Interval: 30
```

Meaning The output in the **Notification Status** field shows that MAC notification is enabled. The output in the **Notification Status** field would display **Disabled** if MAC notification was disabled.

The **Notification Interval** field output shows that the MAC notification interval is set to 30 seconds.

Related Documentation

- Configuring MAC Notification on page 1531

Verifying That a Series of Tagged VLANs Has Been Created

Purpose Verify that a series of tagged VLANs has been created on the switch.

Action

1. Display the VLANs in the ascending order of their VLAN ID:

```
user@switch> show vlans sort-by tag
```

```
Name               Tag         Interfaces
__employee_120__    120
                              xe-0/0/22.0*
__employee_121__    121
                              xe-0/0/22.0*
__employee_122__    122
                              xe-0/0/22.0*
__employee_123__    123
                              xe-0/0/22.0*
__employee_124__    124
                              xe-0/0/22.0*
__employee_125__    125
                              xe-0/0/22.0*
__employee_126__    126
                              xe-0/0/22.0*
__employee_127__    127
                              xe-0/0/22.0*
__employee_128__    128
                              xe-0/0/22.0*
__employee_129__    129
                              xe-0/0/22.0*
__employee_130__    130
                              xe-0/0/22.0*
```

2. Display the VLANs by the alphabetical order of the VLAN name:

   `user@switch>` show vlans **sort-by name**

```
Name               Tag   Interfaces

__employee_120__   120
                         xe-0/0/22.0*
__employee_121__   121
                         xe-0/0/22.0*
__employee_122__   122
                         xe-0/0/22.0*
__employee_123__   123
                         xe-0/0/22.0*
__employee_124__   124
                         xe-0/0/22.0*
__employee_125__   125
                         xe-0/0/22.0*
__employee_126__   126
                         xe-0/0/22.0*
__employee_127__   127
                         xe-0/0/22.0*
__employee_128__   128
                         xe-0/0/22.0*
__employee_129__   129
                         xe-0/0/22.0*
__employee_130__   130
                         xe-0/0/22.0*
```

3. Display the VLANs by specifying the VLAN range name (here, the VLAN range name is **employee**):

   `user@switch>` show vlans **employee**

```
Name               Tag   Interfaces

__employee_120__   120
```



```
                        xe-0/0/22.0*
__employee_121__ 121
                        xe-0/0/22.0*
__employee_122__ 122
                        xe-0/0/22.0*
__employee_123__ 123
                        xe-0/0/22.0*
__employee_124__ 124
                        xe-0/0/22.0*
__employee_125__ 125
                        xe-0/0/22.0*
__employee_126__ 126
                        xe-0/0/22.0*
__employee_127__ 127
                        xe-0/0/22.0*
__employee_128__ 128
                        xe-0/0/22.0*
__employee_129__ 129
                        xe-0/0/22.0*
__employee_130__ 130
                        xe-0/0/22.0*
```

Meaning The sample output shows the VLANs configured on the switch. The series of tagged VLANs is displayed: **__employee__120__** through **__employee_130__**. Each of the tagged VLANs is configured on the trunk interface **xe-0/0/22.0**. The asterisk (*****) next to the interface name indicates that the interface is **UP**.

When a series of VLANs is created using the **vlan-range** statement, the VLAN names are preceded and followed by a double underscore.

Related Documentation

- Creating a Series of Tagged VLANs on page 1536
- Creating a Series of Tagged VLANs on page 1546

Verifying That Proxy ARP Is Working Correctly

Purpose Verify that the switch is sending proxy ARP messages.

Action List the system statistics for ARP:

```
user@switch> show system statistics arp
arp:
         90060 datagrams received
         34 ARP requests received
         610 ARP replies received
         2 resolution request  received
         0 unrestricted proxy requests
         0 restricted proxy requests
         0 received proxy requests
         0 unrestricted proxy requests not proxied
         0 restricted proxy requests not proxied
         0 datagrams with bogus interface
         0 datagrams with incorrect length
         0 datagrams for non-IP protocol
         0 datagrams with unsupported op code
         0 datagrams with bad protocol address length
         0 datagrams with bad hardware address length
```

```
0 datagrams with multicast source address
0 datagrams with multicast target address
0 datagrams with my own hardware address
0 datagrams for an address not on the interface
0 datagrams with a broadcast source address
294 datagrams with source address duplicate to mine
89113 datagrams which were not for me
0 packets discarded waiting for resolution
0 packets sent after waiting for resolution
309 ARP requests sent
35 ARP replies sent
0 requests for memory denied
0 requests dropped on entry
0 requests dropped during retry
0 requests dropped due to interface deletion
0 requests on unnumbered interfaces
0 new requests on unnumbered interfaces
0 replies for from unnumbered interfaces
0 requests on unnumbered interface with non-subnetted donor
0 replies from unnumbered interface with non-subnetted donor
```

Meaning

The statistics show that two proxy ARP requests were received. The **unrestricted proxy requests not proxied** and **restricted proxy requests not proxied** fields indicate that all the unproxied ARP requests received have been proxied by the switch.

Related Documentation

- Configuring Proxy ARP on page 1551
- Configuring Proxy ARP (CLI Procedure) on page 1552

Monitoring Commands

- clear ethernet-switching bpdu-error
- clear ethernet-switching layer2-protocol-tunneling error
- clear ethernet-switching layer2-protocol-tunneling statistics
- clear ethernet-switching table
- clear spanning-tree statistics
- show ethernet-switching interfaces
- show ethernet-switching layer2-protocol-tunneling interface
- show ethernet-switching layer2-protocol-tunneling statistics
- show ethernet-switching layer2-protocol-tunneling vlan
- show ethernet-switching mac-learning-log
- show ethernet-switching mac-notification
- show ethernet-switching statistics aging
- show ethernet-switching statistics mac-learning
- show ethernet-switching table
- show spanning-tree bridge
- show spanning-tree interface

- show spanning-tree mstp configuration
- show spanning-tree statistics
- show system statistics arp
- show vlans

clear ethernet-switching bpdu-error

Syntax clear ethernet-switching bpdu-error interface *interface-name*

Release Information Command introduced in Junos OS Release 9.1 for EX Series switches. Command updated in Junos OS Release 11.1 for EX Series switches—a BPDU error shuts down the interface and this command brings the interface back up.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear bridge protocol data unit (BPDU) errors from an interface and bring up the interface.

Options *interface-name*—Clear BPDU errors on the specified interface.

Required Privilege Level clear

Related Documentation

- show spanning-tree interface on page 1711
- *Understanding BPDU Protection for STP, RSTP, and MSTP on EX Series Switches*
- Understanding BPDU Protection for STP, RSTP, and MSTP on page 1423

List of Sample Output clear ethernet-switching bpdu-error interface on page 1674

Sample Output

clear ethernet-switching bpdu-error interface

```
user@switch> clear ethernet-switching bpdu-error interface xe-0/0/1.0
```

clear ethernet-switching layer2-protocol-tunneling error

Syntax

clear ethernet-switching layer2-protocol-tunneling error
<interface *interface-name*>

Release Information

Command introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Clear Layer 2 protocol tunneling (L2PT) errors on one or more interfaces. If an interface has been disabled because the amount of Layer 2 protocol traffic exceeded the shutdown threshold or because the switch has detected an error in the network topology or configuration, use this command to reenable the interface.

Options

none—Clears L2PT errors on all interfaces.

interface *interface-name*—(Optional) Clear L2PT errors on the specified interface.

Required Privilege Level

view

Related Documentation

- *Example: Configuring Layer 2 Protocol Tunneling on EX Series Switches*
- *Configuring Layer 2 Protocol Tunneling on EX Series Switches (CLI Procedure)*
- *Configuring Layer 2 Protocol Tunneling*

List of Sample Output

clear ethernet-switching layer2-protocol-tunneling error on page 1675
clear ethernet-switching layer2-protocol-tunneling error interface xe-0/0/1.0 on page 1675

Sample Output

clear ethernet-switching layer2-protocol-tunneling error

`user@switch>` **clear ethernet-switching layer2-protocol-tunneling error**

clear ethernet-switching layer2-protocol-tunneling error interface xe-0/0/1.0

`user@switch>` **clear ethernet-switching layer2-protocol-tunneling error interface xe-0/0/1.0**

clear ethernet-switching layer2-protocol-tunneling statistics

Syntax

clear ethernet-switching layer2-protocol-tunneling statistics
<interface *interface-name*>
<vlan *vlan-name*>

Release Information

Command introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Clear Layer 2 protocol tunneling (L2PT) statistics on one or more interfaces or VLANs.

Options

none—Clear L2PT statistics on all interfaces and VLANs.

interface *interface-name*—(Optional) Clear L2PT statistics on the specified interface.

vlan *vlan-name*—(Optional) Clear L2PT statistics on the specified VLAN.

Required Privilege Level

view

Related Documentation

- show ethernet-switching layer2-protocol-tunneling statistics on page 1686
- *Example: Configuring Layer 2 Protocol Tunneling on EX Series Switches*
- *Configuring Layer 2 Protocol Tunneling on EX Series Switches (CLI Procedure)*
- *Configuring Layer 2 Protocol Tunneling*

List of Sample Output

clear ethernet-switching layer2-protocol-tunneling statistics on page 1676
clear ethernet-switching layer2-protocol-tunneling error interface ge-0/1/1.0 on page 1676
clear ethernet-switching layer2-protocol-tunneling error vlan v2 on page 1676

Sample Output

clear ethernet-switching layer2-protocol-tunneling statistics

```
user@switch> clear ethernet-switching layer2-protocol-tunneling statistics
```

clear ethernet-switching layer2-protocol-tunneling error interface ge-0/1/1.0

```
user@switch> clear ethernet-switching layer2-protocol-tunneling statistics interface xe-0/1/1.0
```

clear ethernet-switching layer2-protocol-tunneling error vlan v2

```
user@switch> clear ethernet-switching layer2-protocol-tunneling statistics vlan v2
```

clear ethernet-switching table

Syntax

clear ethernet-switching table
<interface *interface-name*>
<mac *mac-address*>
<management-vlan>
<persistent-mac <*interface* | *mac-address*>>
<vlan *vlan-name*>

Syntax (QFX Series)

clear ethernet-switching table
<interface *interface-name*>
<mac *mac-address*>
<persistent-mac <*interface* | *mac-address*>>
<vlan *vlan-name*>

Release Information

Command introduced in Junos OS Release 9.3 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

NOTE: On a QFabric system, using this command on an FCoE-enabled VLAN when FCoE sessions are active can cause traffic flooding and FCoE traffic drop. The FCoE sessions are not terminated and the traffic reconverges after a short period of time.

Clear learned entries, which are media access control (MAC) addresses, in the Ethernet switching table (also called the forwarding database table).

Options

none—Clear learned entries in the Ethernet switching table, except for persistent MAC addresses.

interface *interface-name*—(Optional) Clear all learned MAC addresses for the specified interface from the Ethernet switching table.

mac *mac-address*—(Optional) Clear the specified learned MAC address from the Ethernet switching table.

management-vlan—(Optional) Clear all MAC addresses learned for the management VLAN from the Ethernet switching table. Note that you do not specify a VLAN name because only one management VLAN exists.

persistent-mac <*interface* | *mac-address*>—(Optional) Clear all MAC addresses, including persistent MAC addresses. Use the **interface** option to clear all MAC addresses on an interface, or use the **mac-address** option to clear all entries for a specific MAC address.

Use this command whenever you move a device in your network that has a persistent MAC address on the switch. If you move the device to another port on the switch and do not clear the persistent MAC address from the original port it was learned on, then the new port will not learn the MAC address and the device will not be able to connect. If the original port is down when you move the device, then the new port will learn the MAC address and the device can connect—however, unless you cleared the MAC address on the original port, when the port comes back up, the system reinstalls the persistent MAC address in the forwarding table for that port. If this occurs, the address is removed from the new port and the device loses connectivity.

vlan ***vlan-name***—(Optional) Clear all MAC addresses learned for the specified VLAN from the Ethernet switching table.

Required Privilege Level view

Related Documentation

- *show ethernet-switching table*
- show ethernet-switching table on page 1700
- *Verifying That Persistent MAC Learning Is Working Correctly*

List of Sample Output clear ethernet-switching table on page 1678

Output Fields This command produces no output.

Sample Output

clear ethernet-switching table

```
user@switch> clear ethernet-switching table
```


clear spanning-tree statistics

Syntax

clear spanning-tree statistics
<interface *interface-name*>
<logical-system *logical-system-name*>

Syntax (EX Series Switches and the QFX Series)

clear spanning-tree statistics
<interface *interface-name*>

Release Information

Command introduced in Junos OS Release 8.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Clear Spanning Tree Protocol statistics.

Options

none—Reset STP counters for all interfaces for all routing instances.

interface *interface-name*—(Optional) Clear STP statistics for the specified interface only.

logical-system *logical-system-name*—(Optional) Clear STP statistics on a particular logical system.

NOTE: **The logical-system option is not available on QFabric systems.**

Required Privilege Level

clear

Related Documentation

- show spanning-tree statistics on page 1719

List of Sample Output

clear stp statistics on page 1679

Sample Output

clear stp statistics

```
user@host> clear stp statistics
```


show ethernet-switching interfaces

Syntax

show ethernet-switching interfaces
<brief | detail | summary>
<interface *interface-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display information about switched Ethernet interfaces.

Options

none—(Optional) Display brief information for Ethernet-switching interfaces.

brief | detail | summary—(Optional) Display the specified level of output.

interface ***interface-name***—(Optional) Display Ethernet-switching information for a specific interface.

Required Privilege Level view

Related Documentation

- Troubleshooting Ethernet Switching on page 1731Understanding Bridging and VLANs on page 1402
- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Example: Setting Up Bridging with Multiple VLANs on page 1451
- Understanding FCoE on page 4799
- Interfaces Overview on page 1839

List of Sample Output

show ethernet-switching interfaces on page 1681
show ethernet-switching interfaces summary on page 1682
show ethernet-switching interfaces brief on page 1682
show ethernet-switching interfaces detail on page 1682
show ethernet-switching interfaces interface-name on page 1683

Output Fields Table 111 on page 1358 lists the output fields for the **show ethernet-switching interfaces** command. Output fields are listed in the approximate order in which they appear.

Table 138: show ethernet-switching interfaces Output Fields

Field Name	Field Description	Level of Output
Interface	Name of a switching interface.	All levels
State	Interface state. Values are **up** or **down**.	none, **brief**, **detail**, **summary**
VLAN members	Name of a VLAN.	none, **brief**, **detail**, **summary**

Table 138: show ethernet-switching interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Blocking	Forwarding state of the interface: • **blocked**—Traffic is not being forwarded on the interface. • **unblocked**—Traffic is forwarded on the interface. • **MAC limit exceeded**—The interface is temporarily disabled because of a MAC limiting error. The disabled interface is automatically restored to service when the disable timeout expires. • **MAC move limit exceeded**—The interface is temporarily disabled because of a MAC move limiting error. The disabled interface is automatically restored to service when the disable timeout expires. • **Storm control in effect** —The interface is temporarily disabled because of a storm control error. The disabled interface is automatically restored to service when the disable timeout expires. • **Storm control shutdown in effect** —The interface is temporarily disabled because of a storm control shutdown error. The disabled interface is automatically restored to service when the disable timeout expires.	none, **brief**, **detail**, **summary**
Index	VLAN index internal to Junos OS software.	**detail**
untagged | tagged	Specifies whether the interface forwards IEEE802.1Q-tagged or untagged traffic.	**detail**

Sample Output

show ethernet-switching interfaces

```
user@switch> show ethernet-switching interfaces

Interface    State     VLAN members           Blocking
xe-0/0/0.0   up        T1122                  unblocked
xe-0/0/1.0   down      default                – MAC limit exceeded
xe-0/0/2.0   down      default                – MAC move limit exceeded
xe-0/0/3.0   down      default                – Storm control in effect
xe-0/0/4.0   down      default                unblocked
xe-0/0/5.0   down      default                unblocked
xe-0/0/6.0   down      default                unblocked
xe-0/0/7.0   down      default                unblocked
xe-0/0/8.0   down      default                unblocked
xe-0/0/9.0   up        T111                   unblocked
xe-0/0/10.0  down      default                unblocked
xe-0/0/11.0  down      default                unblocked
xe-0/0/12.0  down      default                unblocked
xe-0/0/13.0  down      default                unblocked
xe-0/0/14.0  down      default                unblocked
xe-0/0/15.0  down      default                unblocked
xe-0/0/16.0  down      default                unblocked
xe-0/0/17.0  down      default                unblocked
xe-0/0/18.0  down      default                unblocked
xe-0/0/19.0  up        T111                   unblocked
xe-0/1/0.0   down      default                unblocked
xe-0/1/1.0   down      default                unblocked
xe-0/1/2.0   down      default                unblocked
xe-0/1/3.0   down      default                unblocked
```


show ethernet-switching interfaces summary

```
user@switch> show ethernet-switching interfaces summary
xe-0/0/0.0
xe-0/0/1.0
xe-0/0/2.0
xe-0/0/3.0
xe-0/0/8.0
xe-0/0/10.0
xe-0/0/11.0
```

show ethernet-switching interfaces brief

```
user@switch> show ethernet-switching interfaces brief
Interface   State    VLAN members           Blocking
xe-0/0/0.0  down     default                unblocked
xe-0/0/1.0  down     employee-vlan          unblocked
xe-0/0/2.0  down     employee-vlan          unblocked
xe-0/0/3.0  down     employee-vlan          unblocked
xe-0/0/8.0  down     employee-vlan          unblocked
xe-0/0/10.0 down     default                unblocked
xe-0/0/11.0 down     employee-vlan          unblocked
```

show ethernet-switching interfaces detail

```
user@switch> show ethernet-switching interfaces detail
Interface: xe-0/0/0.0 Index: 65
  State: down
  VLANs:
    default                untagged     unblocked

Interface: xe-0/0/1.0 Index: 66
  State: down
  VLANs:
    employee-vlan          untagged     unblocked

Interface: xe-0/0/2.0 Index: 67
  State: down
  VLANs:
    employee-vlan          untagged     unblocked

Interface: xe-0/0/3.0 Index: 68
  State: down
  VLANs:
    employee-vlan          untagged     unblocked

Interface: xe-0/0/8.0 Index: 69
  State: down
  VLANs:
    employee-vlan          untagged     unblocked

Interface: xe-0/0/10.0 Index: 70
  State: down
  VLANs:
    default                untagged     unblocked

Interface: xe-0/0/11.0 Index: 71
  State: down
  VLANs:
    employee-vlan          tagged       unblocked
```

show ethernet-switching interfaces interface-name

```
user@switch> show ethernet-switching interfaces xe-0/0/0.0
 Interface   State    VLAN members           Blocking
xe-0/0/0.0  down     default                unblocked
```

show ethernet-switching layer2-protocol-tunneling interface

Syntax

show ethernet-switching-layer2-protocol-tunneling interface
<*interface-name*>

Release Information

Command introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display information about Layer 2 protocol tunneling (L2PT) on interfaces that have been configured for L2PT.

Options

none—Display L2PT information about all interfaces on which L2PT is enabled.

interface-name—(Optional) Display L2PT information for the specified interface.

Required Privilege Level

view

Related Documentation

- show ethernet-switching layer2-protocol-tunneling statistics on page 1686
- show ethernet-switching layer2-protocol-tunneling vlan on page 1689
- *Configuring Layer 2 Protocol Tunneling on EX Series Switches (CLI Procedure)*
- show ethernet-switching layer2-protocol-tunneling statistics on page 1686
- show ethernet-switching layer2-protocol-tunneling vlan on page 1689
- *Configuring Layer 2 Protocol Tunneling*

List of Sample Output

show ethernet-switching layer2-protocol-tunneling interface on page 1685
show ethernet-switching layer2-protocol-tunneling interface xe-0/0/0.0 on page 1685

Output Fields

Table 139 on page 1684 lists the output fields for the **show ethernet-switching layer2-protocol-tunneling interface** command. Output fields are listed in the approximate order in which they appear.

Table 139: show ethernet-switching layer2-protocol-tunneling interface Output Fields

Field Name	Field Description
Interface	Name of an interface on the switch.
Operation	Type of operation being performed on the interface. Values are **Encapsulation** and **Decapsulation**.
State	State of the interface. Values are **active** and **shutdown**.
Description	If the interface state is **shutdown**, displays why the interface is shut down. If the description says **Loop detected**, it means that the interface is an access interface that has received L2PT-enabled PDUs. Access interfaces should not receive L2PT-enabled PDUs. This scenario might mean that there is a loop in the network.

Sample Output

show ethernet-switching layer2-protocol-tunneling interface

user@switch> **show ethernet-switching layer2-protocol-tunneling interface**

```
Layer2 Protocol Tunneling information:
Interface     Operation      State     Description
xe-0/0/0.0    Encapsulation  Shutdown  Shutdown threshold exceeded
xe-0/0/1.0    Decapsulation  Shutdown  Loop detected
xe-0/0/2.0    Decapsulation  Active
```

show ethernet-switching layer2-protocol-tunneling interface xe-0/0/0.0

user@switch> **show ethernet-switching layer2-protocol-tunneling interface xe-0/0/0.0**

```
Layer2 Protocol Tunneling information:
Interface     Operation      State     Description
xe-0/0/0.0    Encapsulation  Shutdown  Shutdown threshold exceeded
```

show ethernet-switching layer2-protocol-tunneling statistics

Syntax

show ethernet-switching-layer2-protocol-tunneling statistics
<interface *interface-name*>
<vlan *vlan-name*>

Release Information

Command introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display Layer 2 protocol tunneling (L2PT) statistics for Layer 2 PDU packets received by the switch.

NOTE: The **show ethernet-switching-layer2-protocol-tunneling statistics** command does not display L2PT statistics for Layer 2 PDU packets transmitted from the switch.

Options

none—Display L2PT statistics for all interfaces on which you enabled L2PT.

interface *interface-name*—(Optional) Display L2PT statistics for the specified interface.

vlan *vlan-name*—(Optional) Display L2PT statistics for the specified VLAN.

Required Privilege Level

view

Related Documentation

- clear ethernet-switching layer2-protocol-tunneling statistics on page 1676
- show ethernet-switching layer2-protocol-tunneling interface on page 1684
- show ethernet-switching layer2-protocol-tunneling vlan on page 1689

- *show vlans*
- *Example: Configuring Layer 2 Protocol Tunneling on EX Series Switches*
- *Configuring Layer 2 Protocol Tunneling on EX Series Switches (CLI Procedure)*

- show vlans on page 1722

- *Configuring Layer 2 Protocol Tunneling*

List of Sample Output

show ethernet-switching layer2-protocol-tunneling statistics on page 1687
show ethernet-switching layer2-protocol-tunneling statistics interface xe-0/0/0.0 on page 1687
show ethernet-switching layer2-protocol-tunneling statistics vlan v2 on page 1687

Output Fields

Table 140 on page 1687 lists the output fields for the **show ethernet-switching layer2-protocol-tunneling statistics** command. Output fields are listed in the approximate order in which they appear.

Table 140: show ethernet-switching layer2-protocol-tunneling statistics Output Fields

VLAN	Field Description
VLAN	Name of a VLAN on which L2PT has been configured.
Interface	Name of an interface on which L2PT has been configured.
Protocol	Name of a protocol for which L2PT has been enabled. Values are **all**, **802.1x**, **802.3ah**, **cdp**, **e-lmi**, **gvrp**, **lacp**, **lldp**, **mmrp**, **mvrp**, **stp**, **udld**, **vstp**, and **vtp**.
Operation	Type of operation being performed on the interface. Values are **Encapsulation** and **Decapsulation**.
Packets	Number of packets that have been encapsulated or de-encapsulated.
Drops	Number of packets that have exceeded the drop threshold and have been dropped.
Shutdowns	Number of times that packets have exceeded the shutdown threshold and the interface has been shut down.

Sample Output

show ethernet-switching layer2-protocol-tunneling statistics

```
user@switch> show ethernet-switching layer2-protocol-tunneling statistics

Layer2 Protocol Tunneling Statistics:
VLAN   Interface  Protocol  Operation     Packets Drops      Shutdowns
v1     xe-0/0/0.0 mvrp      Encapsulation 0       0          0
v1     xe-0/0/1.0 mvrp      Decapsulation 0       0          0
v1     xe-0/0/2.0 mvrp      Decapsulation 60634   0          0
v2     xe-0/0/0.0 cdp       Encapsulation 0       0          0
v2     xe-0/0/0.0 gvrp      Encapsulation 0       0          0
v2     xe-0/0/0.0 lldp      Encapsulation 0       0          0
```

show ethernet-switching layer2-protocol-tunneling statistics interface xe-0/0/0.0

```
user@switch> show ethernet-switching layer2-protocol-tunneling statistics interface xe-0/0/0.0

Layer2 Protocol Tunneling Statistics:
VLAN    Interface  Protocol Operation      Packets  Drops     Shutdowns
v1      xe-0/0/0.0 mvrp     Encapsulation  0        0          0
v2      xe-0/0/0.0 cdp      Encapsulation  0        0          0
v2      xe-0/0/0.0 gvrp     Encapsulation  0        0          0
v2      xe-0/0/0.0 lldp     Encapsulation  0        0          0
v2      xe-0/0/0.0 mvrp     Encapsulation  0        0          0
v2      xe-0/0/0.0 stp      Encapsulation  0        0          0
v2      xe-0/0/0.0 vtp      Encapsulation  0        0          0
v2      xe-0/0/0.0 vstp     Encapsulation  0        0          0
```

show ethernet-switching layer2-protocol-tunneling statistics vlan v2

```
user@switch> show ethernet-switching layer2-protocol-tunneling statistics vlan v2

Layer2 Protocol Tunneling Statistics:
VLAN    Interface   Protocol Operation       Packets  Drops   Shutdowns
v2      xe-0/0/0.0  cdp      Encapsulation   0        0       0
v2      xe-0/0/0.0  gvrp     Encapsulation   0        0       0
```

```
v2      xe-0/0/0.0  lldp     Encapsulation   0        0       0
v2      xe-0/0/0.0  mvrp     Encapsulation   0        0       0
v2      xe-0/0/0.0  stp      Encapsulation   0        0       0
v2      xe-0/0/0.0  vtp      Encapsulation   0        0       0
v2      xe-0/0/0.0  vstp     Encapsulation   0        0       0
v2      xe-0/0/1.0  cdp      Decapsulation   0        0       0
v2      xe-0/0/1.0  gvrp     Decapsulation   0        0       0
v2      xe-0/0/1.0  lldp     Decapsulation   0        0       0
v2      xe-0/0/1.0  mvrp     Decapsulation   0        0       0
v2      xe-0/0/1.0  stp      Decapsulation   0        0       0
v2      xe-0/0/1.0  vtp      Decapsulation   0        0       0
```


show ethernet-switching layer2-protocol-tunneling vlan

Syntax show ethernet-switching-layer2-protocol-tunneling vlan <*vlan-name*>

Release Information Command introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description Display information about Layer 2 protocol tunneling (L2PT) on VLANs that have been configured for L2PT.

Options **none**—Display information about L2PT for the VLANs on which you have configured L2PT.

vlan-name—(Optional) Display information about L2PT for the specified VLAN.

Required Privilege Level view

Related Documentation

- show ethernet-switching layer2-protocol-tunneling interface on page 1684
- show ethernet-switching layer2-protocol-tunneling statistics on page 1686
- *show vlans*
- *Example: Configuring Layer 2 Protocol Tunneling on EX Series Switches*
- *Configuring Layer 2 Protocol Tunneling on EX Series Switches (CLI Procedure)*
- show vlans on page 1722
- *Configuring Layer 2 Protocol Tunneling*

List of Sample Output show ethernet-switching layer2-protocol-tunneling vlan on page 1690
show ethernet-switching layer2-protocol-tunneling vlan v2 on page 1690

Output Fields Table 141 on page 1689 lists the output fields for the **show ethernet-switching layer2-protocol-tunneling vlan** command. Output fields are listed in the approximate order in which they appear.

Table 141: show ethernet-switching layer2-protocol-tunneling vlan Output Fields

Field Name	Field Description
VLAN	Name of the VLAN on which L2PT has been configured.
Protocol	Name of a protocol for which L2PT has been enabled. Values are **all**, **802.1x**, **802.3ah**, **cdp**, **e-lmi**, **gvrp**, **lacp**, **lldp**, **mmrp**, **mvrp**, **stp**, **vstp**, and **vtp**.
Drop Threshold	Maximum number of Layer 2 PDUs of the specified protocol that can be received per second on the VLAN before the switch begins dropping the Layer 2 PDUs.
Shutdown Threshold	Maximum number of Layer 2 PDUs of the specified protocol that can be received per second on the VLAN before the interface is disabled.

Sample Output

show ethernet-switching layer2-protocol-tunneling vlan

```
user@switch> show ethernet-switching layer2-protocol-tunneling vlan

Layer2 Protocol Tunneling VLAN information:
VLAN          Protocol      Drop       Shutdown
                            Threshold  Threshold
v1            mvrp          100        200
v2            cdp           0          0
v2            cdp           0          0
v2            gvrp          0          0
```

show ethernet-switching layer2-protocol-tunneling vlan v2

```
user@switch> show ethernet-switching layer2-protocol-tunneling vlan v2

Layer2 Protocol Tunneling VLAN information:
VLAN          Protocol      Drop       Shutdown
                            Threshold  Threshold
v2            cdp           0          0
v2            cdp           0          0
v2            gvrp          0          0
```

show ethernet-switching mac-learning-log

Syntax show ethernet-switching mac-learning-log

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Displays the event log of learned MAC addresses.

Required Privilege Level view

Related Documentation

- show ethernet-switching table on page 1700
- show ethernet-switching interfaces on page 1358

List of Sample Output show ethernet-switching mac-learning-log on page 1691

Output Fields Table 142 on page 1691 lists the output fields for the **show ethernet-switching mac-learning-log** command. Output fields are listed in the approximate order in which they appear.

Table 142: show ethernet-switching mac-learning-log Output Fields

Field Name	Field Description
Date and Time	Timestamp when the MAC address was added or deleted from the log.
vlan_name	VLAN name. A value defined by the user for all user-configured VLANs.
MAC	Learned MAC address.
Deleted | Added	MAC address deleted from or added to the MAC learning log.
Blocking	Forwarding state of the interface: • **blocked**—Traffic is not being forwarded on the interface. • **unblocked**—Traffic is forwarded on the interface.

Sample Output

show ethernet-switching mac-learning-log

```
user@switch> show ethernet-switching mac-learning-log
Mon Feb 25 08:07:05 2008
 vlan_name v1 mac 00:00:00:00:00:00 was deleted
Mon Feb 25 08:07:05 2008
 vlan_name v9 mac 00:00:00:00:00:00 was deleted
Mon Feb 25 08:07:05 2008
 vlan_name HR_vlan mac 00:00:00:00:00:00 was deleted
Mon Feb 25 08:07:05 2008
 vlan_name v3 mac 00:00:00:00:00:00 was deleted
Mon Feb 25 08:07:05 2008
 vlan_name v12 mac 00:00:00:00:00:00 was deleted
```

```
Mon Feb 25 08:07:05 2008
 vlan_name v13 mac 00:00:00:00:00:00 was deleted
Mon Feb 25 08:07:05 2008
 vlan_name sales_vlan mac 00:00:00:00:00:00 was deleted
Mon Feb 25 08:07:05 2008
 vlan_name employee1 mac 00:00:00:00:00:00 was deleted
Mon Feb 25 08:07:05 2008
 vlan_name employee2 mac 00:00:00:00:00:00 was deleted
Mon Feb 25 08:07:05 2008
 vlan_name v3 mac 00:00:00:00:00:00 was added
Mon Feb 25 08:07:05 2008
 vlan_name HR_vlan mac 00:00:00:00:00:00 was added
Mon Feb 25 08:07:05 2008
 vlan_name employee2 mac 00:00:00:00:00:00 was added
Mon Feb 25 08:07:05 2008
 vlan_name employee1 mac 00:00:00:00:00:00 was added
Mon Feb 25 08:07:05 2008
 vlan_name employee2 mac 00:00:05:00:00:05 was learned
Mon Feb 25 08:07:05 2008
 vlan_name employee1 mac 00:30:48:90:54:89 was learned
Mon Feb 25 08:07:05 2008
 vlan_name HR_vlan mac 00:00:5e:00:01:00 was learned
Mon Feb 25 08:07:05 2008
 vlan_name sales_vlan mac 00:00:5e:00:01:08 was learned
[output truncated]
```


show ethernet-switching mac-notification

Syntax show ethernet-switching mac-notification

Release Information Command introduced in Junos OS Release 9.6 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display information about MAC notification.

Required Privilege Level view

Related Documentation
- *Verifying That MAC Notification Is Working Properly*

List of Sample Output
show ethernet-switching mac-notification (MAC Notification Enabled) on page 1693
show ethernet-switching mac-notification (MAC Notification Disabled) on page 1693

Output Fields Table 143 on page 1693 lists the output fields for the **show ethernet-switching mac-notification** command. Output fields are listed in the order in which they appear.

Table 143: show ethernet-switching mac-notification Output Fields

Field Name	Field Description
Notification Status	MAC notification status: • **Enabled**—MAC notification is enabled. • **Disabled**—MAC notification is disabled.
Notification Interval	MAC notification interval in seconds.

Sample Output

show ethernet-switching mac-notification (MAC Notification Enabled)

```
user@switch> show ethernet-switching mac-notification
Notification Status                : Enabled
Notification Interval              : 30
```

Sample Output

show ethernet-switching mac-notification (MAC Notification Disabled)

```
user@switch> show ethernet-switching mac-notification
Notification Status                : Disabled
Notification Interval              : 0
```

show ethernet-switching statistics aging

Syntax

show ethernet-switching statistics aging
<brief | detail>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display media access control (MAC) aging statistics.

Options

none—(Optional) Display MAC aging statistics.

brief | detail—(Optional) Display the specified level of output.

Required Privilege Level

view

Related Documentation

- show ethernet-switching statistics mac-learning on page 1696
- mac-table-aging-time on page 1621
- Configuring MAC Table Aging on page 1532

List of Sample Output

show ethernet-switching statistics aging on page 1695

Output Fields

Table 144 on page 1694 lists the output fields for the **show ethernet-switching statistics aging** command. Output fields are listed in the approximate order in which they appear.

Table 144: show ethernet-switching statistics aging Output Fields

Field Name	Field Description	Level of Output
Total age messages received	Total number of aging messages received from the hardware.	All levels
Immediate aging	Aging message indicating that the entry should be removed immediately.	All levels
MAC address seen	Aging message indicating that the MAC address has been detected by hardware and that the aging timer should be stopped.	All levels
MAC address not seen	Aging message indicating that the MAC address has not been detected by the hardware and that the aging timer should be started.	All levels
Error age messages	The received aging message contains the following errors: • **Invalid VLAN**—The VLAN of the packet does not exist. • **No such entry**—The MAC address and VLAN pair provided by the aging message does not exist. • **Static entry**—An unsuccessful attempt was made to age out a static MAC entry.	All levels

Sample Output

show ethernet-switching statistics aging

```
user@switch> show ethernet-switching statistics aging

Total age messages received: 0
  Immediate aging: 0, MAC address seen: 0, MAC address not seen: 0
Error age messages: 0
  Invalid VLAN: 0, No such entry: 0, Static entry: 0
```

show ethernet-switching statistics mac-learning

Syntax

show ethernet-switching statistics mac-learning
<brief | detail>
<interface *interface-name*>

Release Information

Command introduced in Junos OS Release 9.4 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display media access control (MAC) learning statistics.

Options

none—(Optional) Display MAC learning statistics for all interfaces.

brief | detail—(Optional) Display the specified level of output. The default is **brief**.

interface *interface-name*—(Optional) Display MAC learning statistics for the specified interface.

Required Privilege Level

view

Related Documentation

- *show ethernet-switching statistics aging*
- *show ethernet-switching mac-learning-log*
- *show ethernet-switching table*
- *show ethernet-switching interfaces*
- *Example: Setting Up Basic Bridging and a VLAN for an EX Series Switch*
- *Example: Setting Up Bridging with Multiple VLANs for EX Series Switches*
- **show ethernet-switching statistics aging on page 1694**
- **show ethernet-switching mac-learning-log on page 1691**
- **show ethernet-switching table on page 1700**
- **show ethernet-switching interfaces on page 1358**
- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Example: Setting Up Bridging with Multiple VLANs on page 1451

List of Sample Output

show ethernet-switching statistics mac-learning on page 1697
show ethernet-switching statistics mac-learning detail on page 1698
show ethernet-switching statistics mac-learning interface ge-0/0/28 detail on page 1698
show ethernet-switching statistics mac-learning interface on page 1698
show ethernet-switching statistics mac-learning detail (QFX Series) on page 1698

Output Fields

Table 145 on page 1697 lists the output fields for the **show ethernet-switching statistics mac-learning** command. Output fields are listed in the approximate order in which they appear.

Table 145: show ethernet-switching statistics mac-learning Output Fields

Field Name	Field Description	Level of Output
Interface	Name of the interface for which statistics are being reported. (Displayed in the output under the heading **Interface**.)	All levels
Learning message from local packets	MAC learning message generated due to packets coming in on the management interface. (Displayed in the output under the heading **Local pkts**.)	All levels
Learning message from transit packets	MAC learning message generated due to packets coming in on network interfaces. (Displayed in the output under the heading **Transit pkts**.)	All levels
Learning message with error	MAC learning messages received with errors (Displayed under the heading **Error**): • **Invalid VLAN**—The VLAN of the packet does not exist. • **Invalid MAC**—The MAC address is either NULL or a multicast MAC address. • **Security violation**—The MAC address is not an allowed MAC address. • **Interface down**—The MAC address is learned on an interface that is down. • **Incorrect membership**—The MAC address is learned on an interface that is not a member of the VLAN. • **Interface limit**—The number of MAC addresses learned on the interface has exceeded the limit. • **MAC move limit**—This MAC address has moved among multiple interfaces too many times in a given interval. • **VLAN limit**—The number of MAC addresses learned on the VLAN has exceeded the limit. • **VLAN membership limit**—The number of MAC addresses learned on the interface as a member of the specified VLAN (VLAN membership MAC limit) has exceeded the limit. • **Invalid VLAN index**—The VLAN of the packet, although configured, does not yet exist in the kernel. • **Interface not learning**—The MAC address is learned on an interface that does not yet allow learning—for example, the interface is blocked. • **No nexthop**—The MAC address is learned on an interface that does not have a unicast next hop. • **MAC learning disabled**—The MAC address is learned on an interface on which MAC learning has been disabled. • **Others**—The message contains some other error.	All levels

Sample Output

show ethernet-switching statistics mac-learning

```
user@switch> show ethernet-switching statistics mac-learning

Learning stats: 0 learn msg rcvd, 0 error
  Interface        Local pkts        Transit pkts      Error
  ge-0/0/0.0       0                 0                 0
  ge-0/0/1.0       0                 0                 0
  ge-0/0/2.0       0                 0                 0
  ge-0/0/3.0       0                 0                 0
```

show ethernet-switching statistics mac-learning detail

```
user@switch> show ethernet-switching statistics mac-learning detail
Learning stats: 0 learn msg rcvd, 0 error

    Interface: ge-0/0/0.0
    Learning message from local packets:   0
    Learning message from transit packets: 1
    Learning message with error:           0
      Invalid VLAN:              0       Invalid MAC:              0
      Security violation:        0       Interface down:           0
      Incorrect membership:      0       Interface limit:          0
      MAC move limit:            0       VLAN limit:               0
      Invalid VLAN index:        0       Interface not learning:   0
      No nexthop:                0       MAC learning disabled:    0
      Others:                    0

    Interface: ge-0/0/1.0
    Learning message from local packets:   0
    Learning message from transit packets: 2
    Learning message with error:           0
      Invalid VLAN:              0       Invalid MAC:              0
      Security violation:        0       Interface down:           0
      Incorrect membership:      0       Interface limit:          0
      MAC move limit:            0       VLAN limit:               0
      Invalid VLAN index:        0       Interface not learning:   0
      No nexthop:                0       MAC learning disabled:    0
      Others:                    0
```

show ethernet-switching statistics mac-learning interface ge-0/0/28 detail

```
user@switch> show ethernet-switching statistics mac-learning interface ge-0/0/28 detail

    Interface: ge-0/0/28.0
    Learning message from local packets:   0
    Learning message from transit packets: 5
    Learning message with error:           0
      Invalid VLAN:              0       Invalid MAC:              0
      Security violation:        0       Interface down:           0
      Incorrect membership:      0       Interface limit:          0
      MAC move limit:            0       VLAN limit:               0
                                         VLAN membership limit:    20
      Invalid VLAN index:        0       Interface not learning:   0
      No nexthop:                0       MAC learning disabled:    0
      Others:                    0
```

show ethernet-switching statistics mac-learning interface

```
user@switch> show ethernet-switching statistics mac-learning interface ge-0/0/1
Interface         Local pkts        Transit pkts      Error
ge-0/0/1.0        0                 1                 1
```

show ethernet-switching statistics mac-learning detail (QFX Series)

```
user@switch> show ethernet-switching statistics mac-learning detail
Learning stats: 0 learn msg rcvd, 0 error

    Interface: xe-0/0/0.0
    Learning message from local packets:   0
    Learning message from transit packets: 1
    Learning message with error:           0
```



```
  Invalid VLAN:              0      Invalid MAC:                 0
  Security violation:        0      Interface down:              0
  Incorrect membership:      0      Interface limit:             0
  MAC move limit:            0      VLAN limit:                  0
  Invalid VLAN index:        0      Interface not learning:      0
  No nexthop:                0      MAC learning disabled:       0
  Others:                    0

Interface: xe-0/0/1.0
Learning message from local packets:   0
Learning message from transit packets: 2
Learning message with error:           0
  Invalid VLAN:              0      Invalid MAC:                 0
  Security violation:        0      Interface down:              0
  Incorrect membership:      0      Interface limit:             0
  MAC move limit:            0      VLAN limit:                  0
  Invalid VLAN index:        0      Interface not learning:      0
  No nexthop:                0      MAC learning disabled:       0
  Others:                    0
```

show ethernet-switching table

Syntax

show ethernet-switching table
<brief | detail | extensive | summary>
<interface *interface-name*>
<management-vlan>
<sort-by (*name* | *tag*)>
<vlan *vlan-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.
Output for private VLANs introduced in Junos OS Release 12.1 for the QFX Series.

Description

Displays the Ethernet switching table.

Options

none—(Optional) Display brief information about the Ethernet switching table.

brief | detail | extensive | summary—(Optional) Display the specified level of output.

interface *interface-name*—(Optional) Display the Ethernet switching table for a specific interface.

management-vlan—(Optional) Display the Ethernet switching table for a management VLAN.

sort-by (*name* | *tag*)—(Optional) Display VLANs in ascending order of VLAN IDs or VLAN names.

vlan *vlan-name*—(Optional) Display the Ethernet switching table for a specific VLAN.

Required Privilege Level

view

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Example: Setting Up Bridging with Multiple VLANs on page 1451

List of Sample Output

Output Fields

Table 146 on page 1700 lists the output fields for the **show ethernet-switching table** command. Output fields are listed in the approximate order in which they appear.

Table 146: show ethernet-switching table Output Fields

Field Name	Field Description	Level of Output
VLAN	Name of a VLAN.	All levels

Table 146: show ethernet-switching table Output Fields *(continued)*

Field Name	Field Description	Level of Output
MAC address	MAC address associated with the VLAN.	All levels
Type	Type of MAC address: • **static**—The MAC address is manually created. • **learn**—The MAC address is learned dynamically from a packet's source MAC address. • **flood**—The MAC address is unknown and flooded to all members.	All levels
Age	Time remaining before the entry ages out and is removed from the Ethernet switching table.	All levels
Interfaces	Interface associated with learned MAC addresses or with the **All-members** option (flood entry).	All levels
Learned	For learned entries, the time at which the entry was added to the Ethernet switching table.	**detail**, **extensive**

Sample Output

show ethernet-switching table

```
user@switch> show ethernet-switching table
Ethernet-switching table: 57 entries, 17 learned
  VLAN              MAC address       Type         Age Interfaces
  F2                *                 Flood          - All-members
  F2                00:00:05:00:00:03 Learn          0 xe-0/0/44.0
  F2                00:19:e2:50:7d:e0 Static         - Router
  Linux             *                 Flood          - All-members
  Linux             00:19:e2:50:7d:e0 Static         - Router
  Linux             00:30:48:90:54:89 Learn          0 xe-0/0/47.0
  T1                *                 Flood          - All-members
  T1                00:00:05:00:00:01 Learn          0 xe-0/0/46.0
  T1                00:00:5e:00:01:00 Static         - Router
  T1                00:19:e2:50:63:e0 Learn          0 xe-0/0/46.0
  T1                00:19:e2:50:7d:e0 Static         - Router
  T10               *                 Flood          - All-members
  T10               00:00:5e:00:01:09 Static         - Router
  T10               00:19:e2:50:63:e0 Learn          0 xe-0/0/46.0
  T10               00:19:e2:50:7d:e0 Static         - Router
  T111              *                 Flood          - All-members
  T111              00:19:e2:50:63:e0 Learn          0 xe-0/0/15.0
  T111              00:19:e2:50:7d:e0 Static         - Router
  T111              00:19:e2:50:ac:00 Learn          0 xe-0/0/15.0
  T2                *                 Flood          - All-members
  T2                00:00:5e:00:01:01 Static         - Router
  T2                00:19:e2:50:63:e0 Learn          0 xe-0/0/46.0
  T2                00:19:e2:50:7d:e0 Static         - Router
  T3                *                 Flood          - All-members
  T3                00:00:5e:00:01:02 Static         - Router
  T3                00:19:e2:50:63:e0 Learn          0 xe-0/0/46.0
  T3                00:19:e2:50:7d:e0 Static         - Router
  T4                *                 Flood          - All-members
```



```
  T4                00:00:5e:00:01:03 Static         - Router
  T4                00:19:e2:50:63:e0 Learn          0 xe-0/0/46.0
[output truncated]
```

show ethernet-switching table (Private VLANs)

```
user@switch> show ethernet-switching table
Ethernet-switching table: 10 entries, 3 learned
  VLAN              MAC address       Type         Age Interfaces
  pvlan             *                 Flood          - All-members
  pvlan             00:10:94:00:00:02 Replicated        - xe-0/0/28.0
  pvlan             00:10:94:00:00:35 Replicated        - xe-0/0/46.0
  pvlan             00:10:94:00:00:46 Replicated        - xe-0/0/4.0
  c2                *                 Flood          - All-members
  c2                00:10:94:00:00:02 Learn          0 xe-0/0/28.0
  c1                *                 Flood          - All-members
  c1                00:10:94:00:00:46 Learn          0 xe-0/0/4.0
  __pvlan_pvlan_xe-0/0/46.0__ *       Flood          - All-members
  __pvlan_pvlan_xe-0/0/46.0__ 00:10:94:00:00:35 Learn        0 xe-0/0/46.0
```

show ethernet-switching table brief

```
user@switch> show ethernet-switching table brief
Ethernet-switching table: 57 entries, 17 learned
  VLAN              MAC address       Type         Age Interfaces
  F2                *                 Flood          - All-members
  F2                00:00:05:00:00:03 Learn          0 xe-0/0/44.0
  F2                00:19:e2:50:7d:e0 Static         - Router
  Linux             *                 Flood          - All-members
  Linux             00:19:e2:50:7d:e0 Static         - Router
  Linux             00:30:48:90:54:89 Learn          0 xe-0/0/47.0
  T1                *                 Flood          - All-members
  T1                00:00:05:00:00:01 Learn          0 xe-0/0/46.0
  T1                00:00:5e:00:01:00 Static         - Router
  T1                00:19:e2:50:63:e0 Learn          0 xe-0/0/46.0
  T1                00:19:e2:50:7d:e0 Static         - Router
  T10               *                 Flood          - All-members
  T10               00:00:5e:00:01:09 Static         - Router
  T10               00:19:e2:50:63:e0 Learn          0 xe-0/0/46.0
  T10               00:19:e2:50:7d:e0 Static         - Router
  T111              *                 Flood          - All-members
  T111              00:19:e2:50:63:e0 Learn          0 xe-0/0/15.0
  T111              00:19:e2:50:7d:e0 Static         - Router
  T111              00:19:e2:50:ac:00 Learn          0 xe-0/0/15.0
  T2                *                 Flood          - All-members
  T2                00:00:5e:00:01:01 Static         - Router
  T2                00:19:e2:50:63:e0 Learn          0 xe-0/0/46.0
  T2                00:19:e2:50:7d:e0 Static         - Router
  T3                *                 Flood          - All-members
  T3                00:00:5e:00:01:02 Static         - Router
  T3                00:19:e2:50:63:e0 Learn          0 xe-0/0/46.0
  T3                00:19:e2:50:7d:e0 Static         - Router
  T4                *                 Flood          - All-members
  T4                00:00:5e:00:01:03 Static         - Router
  T4                00:19:e2:50:63:e0 Learn          0 xe-0/0/46.0
[output truncated]
```

show ethernet-switching table detail

```
user@switch> show ethernet-switching table detail
Ethernet-switching table: 57 entries, 17 learned
  F2, *
```



```
  Interface(s): xe-0/0/44.0
  Type: Flood
  Nexthop index: 0

F2, 00:00:05:00:00:03
  Interface(s): xe-0/0/44.0
  Type: Learn, Age: 0, Learned: 2:03:09
  Nexthop index: 0

F2, 00:19:e2:50:7d:e0
  Interface(s): Router
  Type: Static
  Nexthop index: 0

Linux, *
  Interface(s): xe-0/0/47.0
  Type: Flood
  Nexthop index: 0

Linux, 00:19:e2:50:7d:e0
  Interface(s): Router
  Type: Static
  Nexthop index: 0

Linux, 00:30:48:90:54:89
  Interface(s): xe-0/0/47.0
  Type: Learn, Age: 0, Learned: 2:03:08
  Nexthop index: 0

T1, *
  Interface(s): xe-0/0/46.0
  Type: Flood
  Nexthop index: 0

T1, 00:00:05:00:00:01
  Interface(s): xe-0/0/46.0
  Type: Learn, Age: 0, Learned: 2:03:07
  Nexthop index: 0

T1, 00:00:5e:00:01:00
  Interface(s): Router
  Type: Static
  Nexthop index: 0

T1, 00:19:e2:50:63:e0
  Interface(s): xe-0/0/46.0
  Type: Learn, Age: 0, Learned: 2:03:07
  Nexthop index: 0

T1, 00:19:e2:50:7d:e0
  Interface(s): Router
  Type: Static
  Nexthop index: 0

T10, *
  Interface(s): xe-0/0/46.0
  Type: Flood
  Nexthop index: 0

T10, 00:00:5e:00:01:09
  Interface(s): Router
```

```
    Type: Static
    Nexthop index: 0

  T10, 00:19:e2:50:63:e0
    Interface(s): xe-0/0/46.0
    Type: Learn, Age: 0, Learned: 2:03:08
    Nexthop index: 0

  T10, 00:19:e2:50:7d:e0
    Interface(s): Router
    Type: Static
    Nexthop index: 0

  T111, *
    Interface(s): xe-0/0/15.0
    Type: Flood
    Nexthop index: 0
[output truncated]
```

show ethernet-switching table extensive

```
user@switch> show ethernet-switching table extensive
Ethernet-switching table: 57 entries, 17 learned
  F2, *
    Interface(s): xe-0/0/44.0
    Type: Flood
    Nexthop index: 0

  F2, 00:00:05:00:00:03
    Interface(s): xe-0/0/44.0
    Type: Learn, Age: 0, Learned: 2:03:09
    Nexthop index: 0

  F2, 00:19:e2:50:7d:e0
    Interface(s): Router
    Type: Static
    Nexthop index: 0

  Linux, *
    Interface(s): xe-0/0/47.0
    Type: Flood
    Nexthop index: 0

  Linux, 00:19:e2:50:7d:e0
    Interface(s): Router
    Type: Static
    Nexthop index: 0

  Linux, 00:30:48:90:54:89
    Interface(s): xe-0/0/47.0
    Type: Learn, Age: 0, Learned: 2:03:08
    Nexthop index: 0

  T1, *
    Interface(s): xe-0/0/46.0
    Type: Flood
    Nexthop index: 0

  T1, 00:00:05:00:00:01
    Interface(s): xe-0/0/46.0
    Type: Learn, Age: 0, Learned: 2:03:07
```



```
    Nexthop index: 0

  T1, 00:00:5e:00:01:00
    Interface(s): Router
    Type: Static
    Nexthop index: 0

  T1, 00:19:e2:50:63:e0
    Interface(s): xe-0/0/46.0
    Type: Learn, Age: 0, Learned: 2:03:07
    Nexthop index: 0

  T1, 00:19:e2:50:7d:e0
    Interface(s): Router
    Type: Static
    Nexthop index: 0

  T10, *
    Interface(s): xe-0/0/46.0
    Type: Flood
    Nexthop index: 0

  T10, 00:00:5e:00:01:09
    Interface(s): Router
    Type: Static
    Nexthop index: 0

  T10, 00:19:e2:50:63:e0
    Interface(s): xe-0/0/46.0
    Type: Learn, Age: 0, Learned: 2:03:08
    Nexthop index: 0

  T10, 00:19:e2:50:7d:e0
    Interface(s): Router
    Type: Static
    Nexthop index: 0

  T111, *
    Interface(s): xe-0/0/15.0
    Type: Flood
    Nexthop index: 0
[output truncated]
```

show ethernet-switching table interface

```
user@switch> show ethernet-switching table interface xe-0/0/1
Ethernet-switching table: 1 unicast entries
  VLAN              MAC address       Type         Age Interfaces
  V1                *                 Flood          - All-members
  V1                00:00:05:00:00:05 Learn          0 xe-0/0/1.0
```

show spanning-tree bridge

Syntax

show spanning-tree bridge
<brief | detail>
<msti *msti-id*>
<routing-instance *routing-instance-name*>
<vlan-id *vlan-id*>

Syntax (QFX Series)

show spanning-tree bridge
<brief | detail>
<msti *msti-id*>
<vlan-id *vlan-id*>

Release Information

Command introduced in Junos OS Release 8.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the configured or calculated Spanning Tree Protocol (STP) parameters.

Options

none—(Optional) Display brief STP bridge information for all multiple spanning-tree instances (MSTIs).

brief | detail—(Optional) Display the specified level of output.

msti ***msti-id***—(Optional) Display STP bridge information for the specified MSTI.

routing-instance ***routing-instance-name***—(Optional) Display STP bridge information for the specified routing instance.

vlan-id ***vlan-id***—(Optional) Display STP bridge information for the specified VLAN.

Required Privilege Level

view

List of Sample Output

show spanning-tree bridge routing-instance on page 1707
show spanning-tree bridge msti on page 1708
show spanning-tree bridge vlan-id (MSTP) on page 1709
show spanning-tree bridge (RSTP) on page 1709
show spanning-tree bridge vlan-id (RSTP) on page 1710

Output Fields

Table 147 on page 1706 lists the output fields for the **show spanning-tree bridge** command. Output fields are listed in the approximate order in which they appear.

Table 147: show spanning-tree bridge Output Fields

Field Name	Field Description
Routing instance name	Name of the routing instance under which the bridge is configured.
Enabled protocol	Spanning Tree Protocol type enabled.
Root ID	Bridge ID of the elected spanning-tree root bridge. The bridge ID consists of a configurable bridge priority and the MAC address of the bridge.

Table 147: show spanning-tree bridge Output Fields *(continued)*

Field Name	Field Description
Root cost	Calculated cost to reach the root bridge from the bridge where the command is entered.
Root port	Interface that is the current elected root port for this bridge.
CIST regional root	Bridge ID of the elected MSTP regional root bridge.
CIST internal root cost	Calculated cost to reach the regional root bridge from the bridge where the command is entered.
Hello time	Configured number of seconds between transmissions of configuration bridge protocol data units (BPDUs).
Maximum age	Configured maximum expected arrival time of hello bridge protocol data units (BPDUs).
Forward delay	How long an STP bridge port remains in the listening and learning states before transitioning to the forwarding state.
Hop count	Configured maximum number of hops a BPDU can be forwarded in the MSTP region.
Message age	Number of elapsed seconds since the most recent BPDU was received.
Number of topology changes	Total number of STP topology changes detected since the routing device last booted.
Time since last topology change	Number of elapsed seconds since the most recent topology change.
Bridge ID (Local)	Locally configured bridge ID. The bridge ID consists of a configurable bridge priority and the MAC address of the bridge.
Extended system ID	System identifier.
MSTI regional root	Bridge ID of the elected MSTP regional root bridge.

Sample Output

show spanning-tree bridge routing-instance

```
user@host> show spanning-tree bridge routing-instance vs1 detail
STP bridge parameters
Routing instance name               : vs1
Enabled protocol                    : MSTP

STP bridge parameters for CIST
  Root ID                           : 32768.00:13:c3:9e:c8:80
  Root cost                         : 0
```

```
  Root port                         : ge-10/2/0
  CIST regional root                : 32768.00:13:c3:9e:c8:80
  CIST internal root cost           : 22000
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Hop count                         : 18
  Message age                       : 0
  Number of topology changes        : 1
  Time since last topology change   : 1191 seconds
  Local parameters
    Bridge ID                       : 32768.00:90:69:0b:7f:d1
    Extended system ID              : 1

STP bridge parameters for MSTI 1
  MSTI regional root                : 32769.00:13:c3:9e:c8:80
  Root cost                         : 22000
  Root port                         : ge-10/2/0
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Hop count                         : 18
  Number of topology changes        : 1
  Time since last topology change   : 1191 seconds
  Local parameters
    Bridge ID                       : 32769.00:90:69:0b:7f:d1
    Extended system ID              : 1

STP bridge parameters for MSTI 2
  MSTI regional root                : 32770.00:13:c3:9e:c8:80
  Root cost                         : 22000
  Root port                         : ge-10/2/0
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Hop count                         : 18
  Number of topology changes        : 1
  Time since last topology change   : 1191 seconds
  Local parameters
    Bridge ID                       : 32770.00:90:69:0b:7f:d1
    Extended system ID              : 1
```

show spanning-tree bridge msti

```
user@host> show spanning-tree bridge msti 1 routing-instance vs1 detail
STP bridge parameters
Routing instance name               : vs1
Enabled protocol                    : MSTP

STP bridge parameters for MSTI 1
  MSTI regional root                : 32769.00:13:c3:9e:c8:80
  Root cost                         : 22000
  Root port                         : xe-10/2/0
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Hop count                         : 18
  Number of topology changes        : 1
  Time since last topology change   : 1191 seconds
  Local parameters
```

```
    Bridge ID                       : 32769.00:90:69:0b:7f:d1
    Extended system ID              : 1
```

show spanning-tree bridge vlan-id (MSTP)

```
user@host> show spanning-tree bridge vlan-id 1101 routing-instance vs1 detail
STP bridge parameters
Routing instance name               : vs1
Enabled protocol                    : MSTP

STP bridge parameters for CIST
  Root ID                           : 32768.00:13:c3:9e:c8:80
  Root cost                         : 0
  Root port                         : xe-10/2/0
  CIST regional root                : 32768.00:13:c3:9e:c8:80
  CIST internal root cost           : 22000
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Hop count                         : 18
  Message age                       : 0
  Number of topology changes        : 0
  Local parameters
    Bridge ID                       : 32768.00:90:69:0b:7f:d1
    Extended system ID              : 1
    Hello time                      : 2 seconds
    Maximum age                     : 20 seconds
    Forward delay                   : 15 seconds
    Path cost method                : 32 bit
    Maximum hop count               : 20
```

show spanning-tree bridge (RSTP)

```
user@host> show spanning-tree bridge
STP bridge parameters
Routing instance name               : GLOBAL
Enabled protocol                    : RSTP
  Root ID                           : 28672.00:90:69:0b:3f:d0
  Hello time                        : 2 seconds
  Maximum age                       : 20 seconds
  Forward delay                     : 15 seconds
  Message age                       : 0
  Number of topology changes        : 58
  Time since last topology change   : 14127 seconds
  Local parameters
    Bridge ID                       : 28672.00:90:69:0b:3f:d0
    Extended system ID              : 0

 STP bridge parameters for bridge VLAN 10
   Root ID                          : 28672.00:90:69:0b:3f:d0
   Hello time                       : 2 seconds
   Maximum age                      : 20 seconds
   Forward delay                    : 15 seconds
   Message age                      : 0
   Number of topology changes       : 58
   Time since last topology change : 14127 seconds
   Local parameters
     Bridge ID                      : 28672.00:90:69:0b:3f:d0
     Extended system ID             : 0

 STP bridge parameters for bridge VLAN 20
```



```
   Root ID                        : 28672.00:90:69:0b:3f:d0
   Hello time                     : 2 seconds
   Maximum age                    : 20 seconds
   Forward delay                  : 15 seconds
   Message age                    : 0
   Number of topology changes     : 58
   Time since last topology change : 14127 seconds
   Local parameters
     Bridge ID                    : 28672.00:90:69:0b:3f:d0
     Extended system ID           : 0
```

show spanning-tree bridge vlan-id (RSTP)

```
user@host> show spanning-tree bridge vlan-id 10
STP bridge parameters
Routing instance name               : GLOBAL
Enabled protocol                    : RSTP

 STP bridge parameters for VLAN 10
   Root ID                        : 28672.00:90:69:0b:3f:d0
   Hello time                     : 2 seconds
   Maximum age                    : 20 seconds
   Forward delay                  : 15 seconds
   Message age                    : 0
   Number of topology changes     : 58
   Time since last topology change : 14127 seconds
   Local parameters
     Bridge ID                    : 28672.00:90:69:0b:3f:d0
     Extended system ID           : 0
```

show spanning-tree interface

Syntax

show spanning-tree interface
<brief | detail>
<msti *msti-id*>
<routing-instance *routing-instance-name*>
<vlan-id *vlan-id*>

Syntax (EX Series Switches and the QFX Series)

show spanning-tree interface
<brief | detail>
<msti *msti-id*>
<vlan-id *vlan-id*>

Release Information

Command introduced in Junos OS Release 8.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the configured or calculated interface-level STP parameters.

Options

none—Display brief STP interface information.

brief | detail—(Optional) Display the specified level of output.

msti *msti-id*—(Optional) Display STP interface information for the specified MST instance.

routing-instance *routing-instance-name*—(Optional) Display STP interface information for the specified routing instance.

vlan-id *vlan-id*—(Optional) Display STP interface information for the specified VLAN.

Required Privilege Level

view

List of Sample Output

show spanning-tree interface on page 1712
show spanning-tree interface (QFX Series) on page 1713
show spanning-tree interface detail on page 1713
show spanning-tree interface msti on page 1715
show spanning-tree interface vlan-id on page 1715
show spanning-tree interface (VSTP) on page 1716
show spanning-tree interface vlan-id (VSTP) on page 1716

Output Fields

Table 148 on page 1711 lists the output fields for the **show spanning-tree Interface** command. Output fields are listed in the approximate order in which they appear.

Table 148: show spanning-tree Interface Output Fields

Field Name	Field Description
Interface name	Interface configured to participate in the STP, RSTP, VSTP, or MSTP instance.

Table 148: show spanning-tree Interface Output Fields *(continued)*

Field Name	Field Description
Port ID	Logical interface identifier configured to participate in the MSTP or VSTP instance.
Designated port ID	Port ID of the designated port for the LAN segment to which this interface is attached.
Designated bridge ID	Bridge ID of the designated bridge for the LAN segment to which this interface is attached.
Port Cost	Configured cost for the interface.
Port State	STP port state: forwarding (**FWD**), blocking (**BLK**), listening, learning, or disabled.
Port Role	MSTP, VSTP, or RSTP port role: designated (**DESG**), backup (**BKUP**), alternate (**ALT**), (**ROOT**), or Root Prevented (**Root-Prev**).
Link type	MSTP, VSTP, or RSTP link type. Shared or point-to-point (pt-pt) and edge or nonedge.
Alternate	Identifies the interface as an MSTP, VSTP, or RSTP alternate root port (**Yes**) or nonalternate root port (**No**).
Boundary Port	Identifies the interface as an MSTP regional boundary port (**Yes**) or nonboundary port (**No**).

Sample Output

show spanning-tree interface

```
user@host> show spanning-tree interface routing-instance vs1 detail
Spanning tree interface parameters for instance 0

Interface     Port ID   Designated      Designated         Port    State  Role
                         port ID        bridge ID          Cost
ae1             128:1         128:1  32768.0090690b47d1      1000  FWD    DESG
ge-2/1/2        128:2         128:2  32768.0090690b47d1     20000  FWD    DESG
ge-2/1/5        128:3         128:3  32768.0090690b47d1     29999  FWD    DESG
ge-2/2/1        128:4        128:26  32768.0013c39ec880     20000  FWD    ROOT
xe-9/2/0        128:5         128:5  32768.0090690b47d1      2000  FWD    DESG
xe-9/3/0        128:6         128:6  32768.0090690b47d1      2000  FWD    DESG

Spanning tree interface parameters for instance 1

Interface     Port ID   Designated      Designated         Port    State  Role
                         port ID        bridge ID          Cost
ae1             128:1         128:1  32769.0090690b47d1      1000  FWD    DESG
ge-2/1/2        128:2         128:2  32769.0090690b47d1     20000  FWD    DESG
ge-2/1/5        128:3         128:3  32769.0090690b47d1     29999  FWD    DESG
ge-2/2/1        128:4        128:26  32769.0013c39ec880     20000  FWD    ROOT
xe-9/2/0        128:5         128:5  32769.0090690b47d1      2000  FWD    DESG
xe-9/3/0        128:6         128:6  32769.0090690b47d1      2000  FWD    DESG
```



```
Spanning tree interface parameters for instance 2

Interface     Port ID    Designated       Designated         Port    State  Role
                          port ID       bridge ID          Cost
ae1               128:1        128:1  32770.0090690b47d1      1000  FWD    DESG
ge-2/1/2          128:2        128:2  32770.0090690b47d1     20000  FWD    DESG
ge-2/1/5          128:3        128:3  32770.0090690b47d1     29999  FWD    DESG
ge-2/2/1          128:4       128:26  32770.0013c39ec880     20000  FWD    ROOT
xe-9/2/0          128:5        128:5  32770.0090690b47d1      2000  FWD    DESG
xe-9/3/0          128:6        128:6  32770.0090690b47d1      2000  FWD    DESG
```

show spanning-tree interface (QFX Series)

```
user@lf0> show spanning-tree interface routing-instance vs1 detail
Spanning tree interface parameters for instance 0

Interface     Port ID    Designated       Designated         Port    State  Role
                          port ID       bridge ID          Cost
ae1               128:1        128:1  32768.0090690b47d1      1000  FWD    DESG
ge-2/1/2          128:2        128:2  32768.0090690b47d1     20000  FWD    DESG
ge-2/1/5          128:3        128:3  32768.0090690b47d1     29999  FWD    DESG
ge-2/2/1          128:4       128:26  32768.0013c39ec880     20000  FWD    ROOT
xe-9/2/0          128:5        128:5  32768.0090690b47d1      2000  FWD    DESG
xe-9/3/0          128:6        128:6  32768.0090690b47d1      2000  FWD    DESG

Spanning tree interface parameters for instance 1

Interface     Port ID    Designated       Designated         Port    State  Role
                          port ID       bridge ID          Cost
ae1               128:1        128:1  32769.0090690b47d1      1000  FWD    DESG
ge-2/1/2          128:2        128:2  32769.0090690b47d1     20000  FWD    DESG
ge-2/1/5          128:3        128:3  32769.0090690b47d1     29999  FWD    DESG
ge-2/2/1          128:4       128:26  32769.0013c39ec880     20000  FWD    ROOT
xe-9/2/0     128:5        128:5   32769.0090690b47d1      2000  FWD    DESG
xe-9/3/0     128:6        128:6   32769.0090690b47d1      2000  FWD    DESG

Spanning tree interface parameters for instance 2

Interface     Port ID    Designated       Designated         Port    State  Role
                          port ID       bridge ID          Cost
ae1               128:1        128:1  32770.0090690b47d1      1000  FWD    DESG
ge-2/1/2          128:2        128:2  32770.0090690b47d1     20000  FWD    DESG
ge-2/1/5          128:3        128:3  32770.0090690b47d1     29999  FWD    DESG
ge-2/2/1          128:4       128:26  32770.0013c39ec880     20000  FWD    ROOT
xe-9/2/0     128:5        128:5   32770.0090690b47d1      2000  FWD    DESG
xe-9/3/0     128:6        128:6   32770.0090690b47d1      2000  FWD    DESG
```

show spanning-tree interface detail

```
user@host> show spanning-tree interface routing-instance vs1 detail
Spanning tree interface parameters for instance 0

Interface name               : ae1
Port identifier              : 128.1
Designated port ID           : 128.1
Port cost                    : 1000
Port state                   : Forwarding
Designated bridge ID         : 32768.00:90:69:0b:47:d1
Port role                    : Designated
Link type                    : Pt-Pt/NONEDGE
```

```
Boundary port                 : No

Interface name               : ge-2/1/2
Port identifier              : 128.2
Designated port ID           : 128.2
Port cost                    : 20000
Port state                   : Forwarding
Designated bridge ID         : 32768.00:90:69:0b:47:d1
Port role                    : Designated
Link type                    : Pt-Pt/NONEDGE
Boundary port                 : No

Interface name               : ge-2/1/5
Port identifier              : 128.3
Designated port ID           : 128.3
Port cost                    : 29999
Port state                   : Forwarding
Designated bridge ID         : 32768.00:90:69:0b:47:d1
Port role                    : Designated
Link type                    : Pt-Pt/NONEDGE
Boundary port                 : No

Interface name               : ge-2/2/1
Port identifier              : 128.4
Designated port ID           : 128.26
Port cost                    : 20000
Port state                   : Forwarding
Designated bridge ID         : 32768.00:13:c3:9e:c8:80
Port role                    : Root
Link type                    : Pt-Pt/NONEDGE
Boundary port                 : No

Interface name               : xe-9/2/0
Port identifier              : 128.5
Designated port ID           : 128.5
Port cost                    : 2000
Port state                   : Forwarding
Designated bridge ID         : 32768.00:90:69:0b:47:d1
Port role                    : Designated
Link type                    : Pt-Pt/NONEDGE
Boundary port                 : No

Interface name               : xe-9/3/0
Port identifier              : 128.6
Designated port ID           : 128.6
Port cost                    : 2000
Port state                   : Forwarding
Designated bridge ID         : 32768.00:90:69:0b:47:d1
Port role                    : Designated
Link type                    : Pt-Pt/NONEDGE
Boundary port                 : No


Spanning tree interface parameters for instance 1

Interface name               : ae1
Port identifier              : 128.1
Designated port ID           : 128.1
Port cost                    : 1000
Port state                   : Forwarding
Designated bridge ID         : 32768.00:90:69:0b:47:d1
```



```
Port role                      : Designated
Link type                      : Pt-Pt/NONEDGE
Boundary port                   : No

Interface name                 : ge-2/1/2
Port identifier                : 128.2
Designated port ID             : 128.2
Port cost                      : 20000
Port state                     : Forwarding
Designated bridge ID           : 32768.00:90:69:0b:47:d1
Port role                      : Designated
Link type                      : Pt-Pt/NONEDGE
Boundary port                   : No

Interface name                 : ge-2/1/5
Port identifier                : 128.3
Designated port ID             : 128.3
Port cost                      : 29999
Port state                     : Forwarding
Designated bridge ID           : 32768.00:90:69:0b:47:d1
Port role                      : Designated
Link type                      : Pt-Pt/NONEDGE
Boundary port                   : No

Interface name                 : ge-2/2/1
Port identifier                : 128.4
Designated port ID             : 128.26
Port cost                      : 20000
Port state                     : Forwarding
Designated bridge ID           : 32768.00:13:c3:9e:c8:80
Port role                      : Root
Link type                      : Pt-Pt/NONEDGE
Boundary port                   : No

...
```

show spanning-tree interface msti

```
user@host> show spanning-tree interface msti 1 routing-instance vs1 detail
 Spanning tree interface parameters for instance 1

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
xe-7/0/0        128:1        128:1   32769.0090690b4fd1      2000   FWD    DESG
ge-5/1/0        128:2        128:2   32769.0090690b4fd1     20000   FWD    DESG
ge-5/1/1        128:3        128:3   32769.0090690b4fd1     20000   FWD    DESG
ae1             128:4        128:1   32769.0090690b47d1     10000   BLK    ALT
ge-5/1/4        128:5        128:3   32769.0090690b47d1     20000   BLK    ALT
xe-7/2/0        128:6        128:6   32769.0090690b47d1      2000   FWD    ROOT
```

show spanning-tree interface vlan-id

```
user@host> show spanning-tree interface vlan-id 101 routing-instance vs1 detail
Spanning tree interface parameters for instance 0

Interface     Port ID    Designated      Designated         Port    State  Role
                          port ID        bridge ID          Cost
ge-11/0/5       128:1        128:1   32768.0090690b7fd1     20000   FWD    DESG
ge-11/0/6       128:2        128:1   32768.0090690b7fd1     20000   BLK    BKUP
ge-11/1/0       128:3        128:2   32768.0090690b4fd1     20000   BLK    ALT
ge-11/1/1       128:4        128:3   32768.0090690b4fd1     20000   BLK    ALT
```

```
ge-11/1/4       128:5        128:1  32768.0090690b47d1     20000  BLK    ALT
xe-10/0/0       128:6        128:5  32768.0090690b4fd1      2000  BLK    ALT
xe-10/2/0       128:7        128:4  32768.0090690b47d1      2000  FWD    ROOT
```

show spanning-tree interface (VSTP)

```
user@host> show spanning-tree interface
Spanning tree interface parameters for instance 0

Interface    Port ID    Designated      Designated         Cost    State  Role
                         port ID        bridge ID
ge-1/0/1        128:1        128:1  28672.0090690b3fe0     20000  FWD    DESG
ge-1/0/2        128:2        128:2  28672.0090690b3fe0     20000  FWD    DESG

Spanning tree interface parameters for VLAN 10

Interface    Port ID    Designated      Designated         Cost    State  Role
                         port ID        bridge ID
ge-1/0/1        128:1        128:1  28672.0090690b3fe0     20000  FWD    DESG
ge-1/0/2        128:2        128:2  28672.0090690b3fe0     20000  FWD    DESG

Spanning tree interface parameters for VLAN 20

Interface    Port ID    Designated      Designated         Cost    State  Role
                         port ID        bridge ID
ge-1/0/1        128:1        128:1  28672.0090690b3fe0     20000  FWD    DESG
ge-1/0/2        128:2        128:2  28672.0090690b3fe0     20000  FWD    DESG
```

show spanning-tree interface vlan-id (VSTP)

```
user@host> show spanning-tree interface vlan-id 10
Spanning tree interface parameters for VLAN 10

Interface    Port ID    Designated      Designated         Cost    State  Role
                         port ID        bridge ID
ge-1/0/1        128:1        128:1  28672.0090690b3fe0     20000  FWD    DESG
ge-1/0/2        128:2        128:2  28672.0090690b3fe0     20000  FWD    DESG
```


show spanning-tree mstp configuration

Syntax

show spanning-tree mstp configuration
<brief | detail>
<routing-instance *routing-instance-name*>

Syntax (EX Series Switch and the QFX Series)

show spanning-tree mstp configuration
<brief | detail>

Release Information

Command introduced in Junos OS Release 8.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the MSTP configuration.

Options

none—Display MSTP configuration information.

brief | detail—(Optional) Display the specified level of output.

routing-instance *routing-instance-name*—(Optional) Display MSTP configuration information for the specified routing instance.

Required Privilege Level

view

List of Sample Output

show spanning-tree mstp configuration detail on page 1718
show spanning-tree mstp configuration detail (QFX Series) on page 1718

Output Fields

Table 149 on page 1717 lists the output fields for the **show spanning-tree mstp configuration** command. Output fields are listed in the approximate order in which they appear.

Table 149: show spanning-tree mstp configuration Output Fields

Field Name	Field Description
Context id	Internally generated identifier.
Region name	MSTP region name carried in the MSTP BPDUs.
Revision	Revision number of the MSTP configuration.
Configuration digest	Numerical value derived from the VLAN-to-instance mapping table.
MSTI	MST instance identifier.
Member VLANs	VLAN identifiers associated with the MSTI.

Sample Output

show spanning-tree mstp configuration detail

```
user@host> show spanning-tree mstp configuration routing-instance vs1 detail
MSTP configuration information
Context identifier     : 1
Region name            : henry
Revision               : 3
Configuration digest   : 0x6da4b5c4fd587757eef35675365e1


MSTI     Member VLANs
   0 0-99,101-199,201-4094
   1 100
   2 200
```

show spanning-tree mstp configuration detail (QFX Series)

```
user@lf0> show spanning-tree mstp configuration routing-instance vs1 detail
MSTP configuration information
Context identifier     : 1
Region name            : henry
Revision               : 3
Configuration digest   : 0x6da4b5c4fd587757eef35675365e1


MSTI     Member VLANs
   0 0-99,101-199,201-4094
   1 100
   2 200
```


show spanning-tree statistics

Syntax

show spanning-tree statistics
<brief | detail>
<interface *interface-name*>
<routing-instance *routing-instance-name*>

Syntax (EX Series Switch and the QFX Series)

show spanning-tree statistics
<brief | detail>
<interface *interface-name* | vlan *vlan-id*>

Release Information

Command introduced in Junos OS Release 8.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for QFX Series switches.

Description

Display STP statistics.

Options

none—Display brief STP statistics.

brief | detail—(Optional) Display the specified level of output.

interface ***interface-name***—(Optional) Display STP statistics for the specified interface.

routing-instance ***routing-instance-name***—(Optional) Display STP statistics for the specified routing instance.

Required Privilege Level

view

List of Sample Output

show spanning-tree statistics routing-instance on page 1720
show spanning-tree statistics interface routing-instance detail on page 1720

Output Fields

Table 150 on page 1719 lists the output fields for the **show spanning-tree statistics** command. Output fields are listed in the approximate order in which they appear.

Table 150: show spanning-tree statistics Output Fields

Field Name	Field Description
Message type	Type of message being counted.
BPDUs sent	Total number of BPDUs sent.
BPDUs received	Total number of BPDUs received.
BPDUs sent in last interval	Number of BPDUs sent within a specified interval.
BPDUs received in last interval	Number of BPDUs received within a specified interval.
Interface	Interface for which the statistics are being displayed.

Table 150: show spanning-tree statistics Output Fields *(continued)*

Field Name	Field Description
Next BPDU transmission	Number of seconds until the next BPDU is scheduled to be sent.

Sample Output

show spanning-tree statistics routing-instance

```
user@host> show spanning-tree statistics routing-instance vs1 detail
Routing instance level STP statistics
Message type                  : bpdus
BPDUs sent                    : 1396
BPDUs received                : 1027
BPDUs sent in last interval    : 5        (duration: 4 sec)
BPDUs received in last interval: 4        (duration: 4 sec)
```

show spanning-tree statistics interface routing-instance detail

```
user@host> show spanning-tree statistics interface ge-11/1/4 routing-instance vs1 detail
Interface    BPDUs sent   BPDUs received      Next BPDU
                                             transmission
ge-11/1/4            7           190                0
```


show system statistics arp

Syntax show system statistics arp

Release Information Command introduced in Junos OS Release 9.6 for EX Series switches.

Description Display system-wide Address Resolution Protocol (ARP) statistics.

Required Privilege Level view

Related Documentation

- *Example: Configuring Proxy ARP on an EX Series Switch*
- Verifying That Proxy ARP Is Working Correctly on page 1671

show system statistics arp

```
user@switch> show system statistics arp
arp:
         90060 datagrams received
         34 ARP requests received
         610 ARP replies received
         0 resolution request  received
         0 unrestricted proxy requests
         0 restricted proxy requests
         0 received proxy requests
         0 unrestricted proxy requests not proxied
         0 restricted proxy requests not proxied
         0 datagrams with bogus interface
         0 datagrams with incorrect length
         0 datagrams for non-IP protocol
         0 datagrams with unsupported op code
         0 datagrams with bad protocol address length
         0 datagrams with bad hardware address length
         0 datagrams with multicast source address
         0 datagrams with multicast target address
         0 datagrams with my own hardware address
         0 datagrams for an address not on the interface
         0 datagrams with a broadcast source address
         294 datagrams with source address duplicate to mine
         89113 datagrams which were not for me
         0 packets discarded waiting for resolution
         0 packets sent after waiting for resolution
         309 ARP requests sent
         35 ARP replies sent
         0 requests for memory denied
         0 requests dropped on entry
         0 requests dropped during retry
         0 requests dropped due to interface deletion
         0 requests on unnumbered interfaces
         0 new requests on unnumbered interfaces
         0 replies for from unnumbered interfaces
         0 requests on unnumbered interface with non-subnetted donor
         0 replies from unnumbered interface with non-subnetted donor
```

show vlans

Syntax

show vlans
<brief | detail | extensive>
<dot1q-tunneling>
<sort-by (tag | name)>
<vlan-range-name>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.
Option **dot1q-tunneling** added in Junos OS Release 12.1 for the QFX Series.

Description

Display information about VLANs configured on bridged Ethernet interfaces. For interfaces configured to support a VoIP VLAN and a data VLAN, the **show vlans** command displays both tagged and untagged membership for those VLANs.

NOTE: When a series of VLANs is created using the **vlan-range** statement, such VLAN names are preceded and followed by a double underscore. For example, a series of VLANs using the VLAN range 1 through 3 and the base VLAN name **marketing** would be displayed as **__marketing_1__**, **__marketing_2__**, and **__marketing_3__**.

NOTE: To display an 802.1X supplicant successfully authenticated in multiple-supplicant mode with dynamic VLAN movement, use the **show vlans** ***vlan-name*** **extensive** operational mode command, where ***vlan-name*** is the dynamic VLAN.

Options

none—Display information for all VLANs. VLAN information is displayed by VLAN name in ascending order.

brief | detail | extensive—(Optional) Display the specified level of output.

sort-by (tag | name)—(Optional) Display VLANs in ascending order of VLAN IDs or VLAN names.

vlan-range-name—(Optional) Display VLANs in ascending order of VLAN range names.

Required Privilege Level

view

Related Documentation

- Example: Setting Up Basic Bridging and a VLAN on the QFX Series on page 1433
- Example: Setting Up Bridging with Multiple VLANs on page 1451
- *Understanding Bridging*
- show ethernet-switching interfaces on page 1358

List of Sample Output

Output Fields Table 115 on page 1373 lists the output fields for the **show vlans** command. Output fields are listed in the approximate order in which they appear.

Table 151: show vlans Output Fields

Field Name	Field Description	Level of Output
Name	Name of a VLAN.	none, **brief**
Tag	802.1Q tag applied to this VLAN. If **none** is displayed, no tag is applied.	All levels
Interfaces	Interface associated with learned MAC addresses or **All-members** option (flood entry). An asterisk (*) beside the interface indicates that the interface is **UP**.	All levels
Address	IP address.	none, **brief**
Ports Active /Total	Number of interfaces associated with a VLAN: **Active** indicates interfaces that are **UP**, and **Total** indicates interfaces that are active and inactive.	**brief**
VLAN	Name of a VLAN.	**detail**, **extensive**
Admin state	State of the interface. Values are: **enabled**—The interface is turned on, and the physical link is operational and can pass packets.	**detail**,**extensive**
MAC learning Status	Indicates if MAC learning is disabled.	**detail**, **extensive**
Description	Description for the VLAN.	**detail**,**extensive**
Primary IP	Primary IP address associated with a VLAN.	**detail**
Number of interfaces	Number of interfaces associated with a VLAN. Both the total number of interfaces and the number of active interfaces associated with a VLAN are displayed.	**detail**, **extensive**
STP	Spanning tree associated with a VLAN.	**detail**,**extensive**
Tagged interfaces	Tagged interfaces with which a VLAN is associated.	**detail**,**extensive**

Table 151: show vlans Output Fields *(continued)*

Field Name	Field Description	Level of Output
Untagged interfaces	Untagged interfaces with which a VLAN is associated.	**detail**, **extensive**
Dot1q Tunneling Status	Indicates if Q-in-Q tunneling is enabled.	**extensive**
Customer VLAN ranges	List of customer VLAN (C-VLAN) ranges associated with this service VLAN (S-VLAN).	**extensive**
Private VLAN Mode	The private VLAN mode for this VLAN. Values include **Primary**, **Isolated**, and **Community**.	**extensive**
Primary VLAN	Primary VLAN tag for this secondary VLAN.	**extensive**
Internal Index	VLAN index internal to Junos OS software.	**extensive**
Origin	Manner in which the VLAN was created: **static** or **learn**.	**extensive**
Protocol	Port-based VLAN or MAC-based VLAN. MAC-based protocol is displayed when VLAN assignment is done either statically or dynamically through 802.1X,	**extensive**
IP addresses	IP address associated with a VLAN.	**extensive**
Number of MAC entries	For MAC-based VLANs created either statically or dynamically, the MAC addresses associated with an interface.	**extensive**
Number of mapping rules	Number of mapping rules for Q-in-Q tunneling (**Push**) and VLAN translation (**Swap**).	
Secondary VLANs	Secondary VLANs associated with a primary VLAN.	**extensive**
Isolated VLANs	Isolated VLANs associated with a primary VLAN.	**extensive**
Community VLANs	Community VLANs associated with a primary VLAN.	**extensive**
VLANs summary	VLAN counts: • **Total**—Total number of VLANs on the switch. • **Configured VLANs**—Number of VLANs that are based on user-configured settings. • **Internal VLANs**—Number of VLANs created by the system with no explicit configuration or protocol—for example, the **default** VLAN and the VLAN created when a trunk interface is not configured with native VLAN membership. • **Temporary VLANs**—Number of VLANs from the previous configuration that the system retains for a limited time after restart. Temporary VLANs are converted into one of the other types of VLAN, or are removed from the system if the current configuration does not require them.	All levels

Table 151: show vlans Output Fields *(continued)*

Field Name	Field Description	Level of Output

Dot1q VLANs summary	802.1Q VLAN counts:
	• **Total**—Total number of 802.1Q-tagged and untagged VLANs on the switch.
	• **Tagged VLANs**—Number of 802.1Q-tagged VLANs.
	• **Untagged VLANs**—Number of untagged 802.1Q VLANs.
	• **Private VLAN**—Counts of the following kinds of 802.1Q private VLANs (PVLANs):
	  ◦ **Primary VLANs**—Number of primary forwarding private VLANs.
	  ◦ **Community VLANs**—Number of community transporting and forwarding private VLANs.
	  ◦ **Isolated VLANs**—Number of isolated receiving and forwarding private VLANs.
	  ◦ **Inter–switch–isolated VLANs**—Number of inter-switch isolated receiving and forwarding private VLANs.
		All levels

Dot1q Tunneled VLANs summary	Q-in-Q-tunneled VLAN counts: • **Total**—Total number of Q-in-Q-tunneled VLANs on the switch. • **Private VLAN**—Counts of primary, community, and isolated Q-in-Q-tunneled private VLANs (PVLANs).	All levels

Sample Output

show vlans

```
user@switch> show vlans

Name            Tag     Interfaces
default         None
                        xe-0/0/34.0, xe-0/0/33.0, xe-0/0/32.0, xe-0/0/31.0,
                        xe-0/0/30.0, xe-0/0/29.0, xe-0/0/28.0, xe-0/0/27.0,
                        xe-0/0/26.0, xe-0/0/25.0, xe-0/0/19.0, xe-0/0/18.0,
                        xe-0/0/17.0, xe-0/0/16.0, xe-0/0/15.0, xe-0/0/14.0,
                        xe-0/0/13.0, xe-0/0/11.0, xe-0/0/9.0, xe-0/0/8.0,
                        xe-0/0/3.0, xe-0/0/2.0, xe-0/0/1.0
v0001           1
                        xe-0/0/24.0, xe-0/0/23.0, xe-0/0/22.0, xe-0/0/21.0
v0002           2
                        None
v0003           3
                        None
v0004           4
                        None
v0005           5
                        None
```

show vlans (Private VLANs)

```
user@switch> show vlans

Name            Tag     Interfaces
__pvlan_pvlan_xe-0/0/46.0__
```



```
                              xe-0/0/44.0*, xe-0/0/46.0*
c1
                              xe-0/0/4.0*, xe-0/0/44.0*
c2
                              xe-0/0/28.0*, xe-0/0/44.0*
default
                              None
pvlan          500
                              xe-0/0/4.0*, xe-0/0/28.0*, xe-0/0/44.0*, xe-0/0/46.0*
```

show vlans brief

```
user@switch> show vlans brief
                                                    Ports
Name           Tag     Address                      Active/Total
default        None                                 0/23
v0001          1                                    0/4
v0002          2                                    0/0
v0003          3                                    0/0
v0004          4                                    0/0
v0005          5                                    0/0
v0006          6                                    0/0
v0007          7                                    0/0
v0008          8                                    0/0
v0009          9                                    0/0
v0010          10                                   0/2
v0011          11                                   0/0
v0012          12                                   0/0
v0013          13                                   0/0
v0014          14                                   0/0
v0015          15                                   0/0
v0016          16                                   0/0
```

show vlans detail

```
user@switch> show vlans detail
VLAN: default, Tag: Untagged, Admin state: Enabled
  Description: None
  Primary IP: None, Number of interfaces: 23 (Active = 0)
  STP: None, RTG: None
  Untagged interfaces: xe-0/0/34.0, xe-0/0/33.0, xe-0/0/32.0, xe-0/0/31.0,
  xe-0/0/30.0, xe-0/0/29.0, xe-0/0/28.0, xe-0/0/27.0, xe-0/0/26.0,
  xe-0/0/25.0, xe-0/0/19.0, xe-0/0/18.0, xe-0/0/17.0, xe-0/0/16.0,
  xe-0/0/15.0, xe-0/0/14.0, xe-0/0/13.0, xe-0/0/11.0, xe-0/0/9.0, xe-0/0/8.0,
  xe-0/0/3.0, xe-0/0/2.0, xe-0/0/1.0,
  Tagged interfaces: None

VLAN: v0001, Tag: 802.1Q Tag 1, Admin state: Enabled
  Description: None
  Primary IP: None, Number of interfaces: 4 (Active = 0)
  Dot1q Tunneling Status: Enabled
  STP: None, RTG: None
  Untagged interfaces: None
  Tagged interfaces: xe-0/0/24.0, xe-0/0/23.0, xe-0/0/22.0, xe-0/0/21.0,

VLAN: v0002, Tag: 802.1Q Tag 2, Admin state: Enabled
  Description: None
  Primary IP: None, Number of interfaces: 0 (Active = 0)
  STP: None, RTG: None
  Untagged interfaces: None
  Tagged interfaces: None
```



```
VLAN: v0003, Tag: 802.1Q Tag 3, Admin state: Enabled
  Description: None
  Primary IP: None, Number of interfaces: 0 (Active = 0)
  STP: None, RTG: None
  Untagged interfaces: None
  Tagged interfaces: None

VLAN: vlan4000, 802.1Q Tag: Untagged, Admin State: Enabled
MAC learning Status: Disabled
Number of interfaces: 0 (Active = 0)
```

show vlans extensive (Port-Based)

```
user@switch> show vlans extensive
VLAN: default, created at Mon Feb  4 12:13:47 2008
  Tag: None, Internal index: 0, Admin state: Enabled, Origin: static
  Description: None
  Customer VLAN ranges:
                   1-4100
    Protocol: Port based
  IP addresses: None
  STP: None, RTG: None.
  Number of interfaces: Tagged 0 (Active = 0), Untagged 23 (Active = 0)
    xe-0/0/34.0 (untagged, access)
    xe-0/0/33.0 (untagged, access)
    xe-0/0/32.0 (untagged, access)
    xe-0/0/31.0 (untagged, access)
    xe-0/0/30.0 (untagged, access)
    xe-0/0/29.0 (untagged, access)
    xe-0/0/28.0 (untagged, access)
    xe-0/0/27.0 (untagged, access)
    xe-0/0/26.0 (untagged, access)
    xe-0/0/25.0 (untagged, access)
    xe-0/0/19.0 (untagged, access)
    xe-0/0/18.0 (untagged, access)
    xe-0/0/17.0 (untagged, access)
    xe-0/0/16.0 (untagged, access)
    xe-0/0/15.0 (untagged, access)
    xe-0/0/14.0 (untagged, access)
    xe-0/0/13.0 (untagged, access)
    xe-0/0/11.0 (untagged, access)
    xe-0/0/9.0 (untagged, access)
    xe-0/0/8.0 (untagged, access)
    xe-0/0/3.0 (untagged, access)
    xe-0/0/2.0 (untagged, access)
    xe-0/0/1.0 (untagged, access)

Secondary VLANs: Isolated 1, Community  1
  Isolated VLANs :
      __pvlan_pvlan_xe-0/0/3.0__
  Community VLANs :
      comm1

VLAN: v0001, created at Mon Feb  4 12:13:47 2008
  Tag: 1, Internal index: 1, Admin state: Enabled, Origin: static
  Description: None
  Protocol: Port based, Layer 3 interface: None
  IP addresses: None
  STP: None, RTG: None.
  Number of interfaces: Tagged 4 (Active = 0), Untagged 0 (Active = 0)
```

```
    xe-0/0/24.0 (tagged, trunk)
    xe-0/0/23.0 (tagged, trunk)
    xe-0/0/22.0 (tagged, trunk)
    xe-0/0/21.0 (tagged, trunk)

VLAN: v0002, created at Mon Feb  4 12:13:47 2008
  Tag: 2, Internal index: 2, Admin state: Enabled, Origin: static
  Description: None
  Protocol: Port based, Layer 3 interface: None
  IP addresses: None
  STP: None, RTG: None.
  Number of interfaces: Tagged 0 (Active = 0), Untagged 0 (Active = 0)
    None

VLAN: v0003, created at Mon Feb  4 12:13:47 2008
  Tag: 3, Internal index: 3, Admin state: Enabled, Origin: static
  Description: None
  Protocol: Port based, Layer 3 interface: None
  IP addresses: None
  STP: None, RTG: None.
  Number of interfaces: Tagged 0 (Active = 0), Untagged 0 (Active = 0)
    None
```

show vlans (Q-in-Q Tunneling)

```
user@switch> show vlans dot1q-tunneling
Name           Tag     Interfaces
sv100          100     xe-0/0/4.0*, xe-0/0/15.0*
```

show vlans extensive (Q-in-Q Tunneling)

```
user@switch> show vlans sv100 extensive
VLAN: sv100, Created at: Sat Sep 10 12:53:52 2011
802.1Q Tag: 100, Internal index: 2, Admin State: Enabled, Origin: Static
Dot1q Tunneling Status: Enabled
Customer VLAN ranges:
                     10-20
                     40-50
Protocol: Port Mode
Number of interfaces: Tagged 1 (Active = 1), Untagged  0 (Active = 0)
      ge-0/0/0.0, tagged, trunk

Number of mapping rules:
      Push 1 (Active = 0), Policy 0 (Active = 0), Swap 0 (Active = 0)

      xe-0/0/3.0*, 300, push
```

show vlans extensive (Q-in-Q Tunneling and L2TP)

```
user@switch> show vlans v1 extensive
VLAN: v1, Created at: Fri Mar 2 05:07:38 2012
802.1Q Tag: 100, Internal index: 4, Admin State: Enabled, Origin: Static
Dot1q Tunneling status: Enabled
Layer2 Protocol Tunneling status: Enabled
```

show vlans sort-by tag

```
user@switch> show vlans sort-by tag
Name           Tag     Interfaces
default                       None
__vlan-x_1__   1
```



```
                      None
__vlan-x_2__    2
                      None
__vlan-x_3__    3
                      None
__vlan-x_4__    4
                      None
__vlan-x_5__    5
                      None
__vlan-x_6__    6
                      None
__vlan-x_7__    7
                      None
__vlan-x_8__    8
                      None
__vlan-x_9__    9
                      None
__vlan-x_10__   10
                      None
__vlan-x_11__   11
                      None
__vlan-x_12__   12
                      None
__vlan-x_13__   13
                      None
__vlan-x_14__   14
                      None
__vlan-x_15__   15
                      None
__vlan-x_16__   16
                      None
__vlan-x_17__   17
                      None
__vlan-x_18__   18
                      None
__vlan-x_19__   19
                      None
__vlan-x_20__   20
                      None
```

show vlans sort-by name

```
user@switch> show vlans sort-by employee

Name                Tag   Interfaces

__employee_120__   120
                          xe-0/0/22.0*
__employee_121__   121
                          xe-0/0/22.0*
__employee_122__   122
                          xe-0/0/22.0*
__employee_123__   123
                          xe-0/0/22.0*
__employee_124__   124
                          xe-0/0/22.0*
__employee_125__   125
                          xe-0/0/22.0*
__employee_126__   126
                          xe-0/0/22.0*
__employee_127__   127
```



```
                    xe-0/0/22.0*
__employee_128__ 128
                    xe-0/0/22.0*
__employee_129__ 129
                    xe-0/0/22.0*
__employee_130__ 130
                    xe-0/0/22.0*
```

show vlans tag

```
user@switch> show vlans employee

Name             Tag   Interfaces

__employee_120__ 120
                       xe-0/0/22.0*
__employee_121__ 121
                       xe-0/0/22.0*
__employee_122__ 122
                       xe-0/0/22.0*
__employee_123__ 123
                       xe-0/0/22.0*
__employee_124__ 124
                       xe-0/0/22.0*
__employee_125__ 125
                       xe-0/0/22.0*
__employee_126__ 126
                       xe-0/0/22.0*
__employee_127__ 127
                       xe-0/0/22.0*
__employee_128__ 128
                       xe-0/0/22.0*
__employee_129__ 129
                       xe-0/0/22.0*
__employee_130__ 130
                       xe-0/0/22.0*
```

CHAPTER 18

Troubleshooting

Troubleshooting Procedures

Troubleshooting Ethernet Switching

Problem Sometimes a MAC address entry in the switch's Ethernet switching table is not updated after the device with that MAC address has been moved from one interface to another on the switch. Typically, the switch does not wait for a MAC address expiration when a MAC move operation occurs. As soon as the switch detects the MAC address on the new interface, it immediately updates the table. Many network devices send a gratuitous ARP packet when switching an IP address from one device to another. The switch updates its ARP cache table after receipt of such gratuitous ARP messages, and then it also updates its Ethernet switching table.

Sometimes silent devices, such as syslog servers or SNMP trap receivers that receive UDP traffic but do not return acknowledgment (ACK) messages to the traffic source, fail to send gratuitous ARP packets when a device moves. If such a move occurs when the system administrator is not available to explicitly clear the affected interfaces by issuing the **clear ethernet-switching table** command, the entry for the moved device in the Ethernet switching table is not updated.

Solution Set up the switch to handle unattended MAC address switchovers.

1. Reduce the system-wide ARP aging timer. (By default, the ARP aging timer is set at 20 minutes. The range of the ARP aging timer is from 1 through 240 minutes.)

   ```
   [edit system arp]
   user@switch# set aging-timer 3
   ```
2. Set the MAC aging timer to the same value as the ARP timer. (By default, the MAC aging timer is set to 300 seconds. The range is 15 to 1,000,000 seconds.)

   ```
   [edit vlans]
   user@switch# set vlans sales mac-table-aging-time 180
   ```

The ARP entry and the MAC address entry for the moved device expire within the times specified by the aging timer values. After the entries expire, the switch sends a new ARP message to the IP address of the device. The device responds to the ARP message, thereby refreshing the entries in the switch's ARP cache table and Ethernet switching table.

Related Documentation

- *arp*
- mac-table-aging-time on page 1621

PART 7

High Availability

CHAPTER 19

Overview

Software Features Overview

Graceful Restart Concepts

With routing protocols, any service interruption requires that an affected router recalculate adjacencies with neighboring routers, restore routing table entries, and update other protocol-specific information. An unprotected restart of a router can result in forwarding delays, route flapping, wait times stemming from protocol reconvergence, and even dropped packets. The main benefits of graceful restart are uninterrupted packet forwarding and temporary suppression of all routing protocol updates. Graceful restart enables a router to pass through intermediate convergence states that are hidden from the rest of the network.

Three main types of graceful restart are available on Juniper Networks routing platforms:

- Graceful restart for aggregate and static routes and for routing protocols—Provides protection for aggregate and static routes and for Border Gateway Protocol (BGP), End System-to-Intermediate System (ES-IS), Intermediate System-to-Intermediate System (IS-IS), Open Shortest Path First (OSPF), Routing Information Protocol (RIP), next-generation RIP (RIPng), and Protocol Independent Multicast (PIM) sparse mode routing protocols.
- Graceful restart for MPLS-related protocols—Provides protection for Label Distribution Protocol (LDP), Resource Reservation Protocol (RSVP), circuit cross-connect (CCC), and translational cross-connect (TCC).
- Graceful restart for virtual private networks (VPNs)—Provides protection for Layer 2 and Layer 3 VPNs.

Graceful restart works similarly for routing protocols and MPLS protocols and combines components of these protocol types to enable graceful restart in VPNs. The main benefits of graceful restart are uninterrupted packet forwarding and temporary suppression of all routing protocol updates. Graceful restart thus enables a router to pass through intermediate convergence states that are hidden from the rest of the network.

Most graceful restart implementations define two types of routers—the restarting router and the helper router. The restarting router requires rapid restoration of forwarding state information so it can resume the forwarding of network traffic. The helper router assists the restarting router in this process. Graceful restart configuration statements typically affect either the restarting router or the helper router.

Related Documentation

- *Understanding High Availability Features on Juniper Networks Routers*
- *Graceful Restart System Requirements*
- *Aggregate and Static Routes*
- *Graceful Restart and Routing Protocols*
- *Graceful Restart and MPLS-Related Protocols*
- *Graceful Restart and Layer 2 and Layer 3 VPNs*
- *Graceful Restart on Logical Systems*
- *Example: Configuring Graceful Restart*
- *Configuring Graceful Restart for QFabric Systems*

Understanding VRRP

The Juniper Networks QFX Series supports the Virtual Router Redundancy Protocol (VRRP). This topic covers:

- Overview of VRRP on page 1736
- Sample VRRP Topology on page 1737

Overview of VRRP

Configuring end hosts on your network with static default routes minimizes configuration effort and complexity and reduces processing overhead on the end hosts. When hosts are configured with static routes, the failure of the default gateway normally results in a catastrophic event, isolating all hosts that are unable to detect available alternate paths to their gateway. Using Virtual Router Redundancy Protocol (VRRP) enables you to dynamically provide alternative gateways for end hosts if the primary gateway fails.

VRRP (defined in RFC 3768) provides dynamic failover of IP addresses from one router to another in the event of failure. You can implement VRRP to provide a highly available default path to a gateway without needing to configure dynamic routing or router discovery protocols on end hosts.

Switches configured with VRRP share a virtual IP address, which is the address you configure as the default route on the hosts. At any time, one of the switches is the VRRP master, meaning that it owns the virtual IP address and is the active default gateway. The other devices are backups. The switches dynamically assign master and backup roles based on priorities that you configure (**1 through 255**). If the master fails, the backup switch with the highest priority becomes the master within a few seconds. This is done without any interaction with the hosts.

In VRRP operation, the master sends advertisements to the backup switches at regular intervals. The default interval is 1 second. If the backup switches do not receive an advertisement for a set period, the backup with the highest priority takes over as master within a few seconds and begins forwarding packets. This is done without any interaction with the hosts.

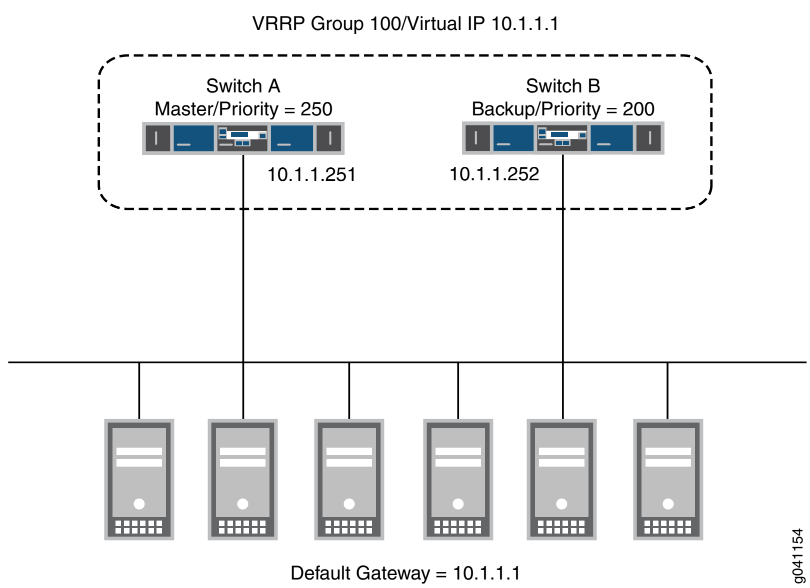
NOTE: Priority 255 cannot be set for routed VLAN interfaces (RVIs).

You can configure two QFabric systems to participate in a VRRP configuration as if they were two standalone switches. One benefit of this configuration is if you use VMware's vMotion, virtual machines can transition between hosts connected to the QFabric systems without updating their default gateway information. For example, a virtual machine running on a host connected to a QFabric system in data center A can transition to a host connected to a QFabric system in data center B without needing to resolve a new gateway IP address and MAC address.

Sample VRRP Topology

Figure 22 on page 1737 illustrates a basic VRRP topology. In this example, switches A and B are running VRRP and share the virtual IP address 10.1.1.1. The default gateway for each of the clients is 10.1.1.1.

Figure 22: Basic VRRP Topology



The following illustrates basic VRRP behavior using Figure 22 on page 1737 for reference:

1. When any of the servers wants to send traffic out of the LAN, it sends the traffic to the default gateway address of 10.1.1.1. This is a virtual IP address (VIP) owned by VRRP group 100. Because switch A is the master of the group, the VIP is associated with the "real" address 10.1.1.251 on switch A, and traffic from the servers is actually

sent to this address. (Switch A is the master because it has been configured with a higher priority value.)

2. If there is a failure on switch A that prevents it from forwarding traffic to or from the servers—for example, if the interface connected to the LAN fails—switch B becomes the master and assumes ownership of the VIP. The servers continue to send traffic to the VIP, but because the VIP is now associated with the “real” address 10.1.1.252 on switch B (because of change of master), the traffic is sent to switch B instead of switch A.
3. If the problem that caused the failure on switch A is corrected, switch A becomes the master again and reasserts ownership of the VIP. In this case, the servers resume sending traffic to switch A.

Notice that no configuration changes are required on the servers for them to switch between sending traffic to switch A and switch B. When the VIP moves between 10.1.1.251 and 10.1.1.252, the change is detected by normal TCP-IP behavior and no configuration or intervention is required on the servers.

Related Documentation

- Configuring Basic VRRP Support on page 1752
- Example: Configuring VRRP for Load Sharing on page 1746
- *Understanding VRRP Between QFabric Systems*

CHAPTER 20

Configuration

Configuration Tasks for Graceful Restart

Configuring Routing Protocols Graceful Restart

This topic includes the following sections:

Enabling Graceful Restart

By default, graceful restart is disabled. To enable graceful restart, include the **graceful-restart** statement at the **[edit routing-instance *instance-name* routing-options]** or **[edit routing-options]** hierarchy level.

For example:

```
routing-options {
  graceful-restart;
```

```
}
```

To configure the duration of the graceful restart period, include the **restart-duration** at the **[edit routing-options graceful-restart]** hierarchy level.

NOTE: Helper mode (the ability to assist a neighboring router attempting a graceful restart) is enabled by default when you start the routing platform, even if graceful restart is not enabled. You can disable helper mode on a per-protocol basis.

```
[edit]
routing-options {
  graceful-restart {
    disable;
    restart-duration seconds;
  }
}
```

To disable graceful restart globally, include the **disable** statement at the **[edit routing-options graceful-restart]** hierarchy level.

When graceful restart is enabled for all routing protocols at the **[edit routing-options graceful-restart]** hierarchy level, you can disable graceful restart on a per-protocol basis.

NOTE: If you configure graceful restart after a BGP or LDP session has been established, the BGP or LDP session restarts and the peers negotiate graceful restart capabilities. Also, the BGP peer routing statistics are reset to zero.

Configuring Graceful Restart Options for BGP

To configure the duration of the BGP graceful restart period, include the **restart-time** statement at the **[edit protocols bgp graceful-restart]** hierarchy level. To set the length of time the router waits to receive messages from restarting neighbors before declaring them down, include the **stale-routes-time** statement at the **[edit protocols bgp graceful-restart]** hierarchy level.

```
[edit]
protocols {
  bgp {
    graceful-restart {
      disable;
      restart-time seconds;
      stale-routes-time seconds;
    }
  }
}
routing-options {
  graceful-restart;
}
```

To disable BGP graceful restart capability for all BGP sessions, include the **disable** statement at the **[edit protocols bgp graceful-restart]** hierarchy level.

NOTE: To set BGP graceful restart properties or disable them for a group, include the desired statements at the **[edit protocols bgp group *group-name* graceful-restart]** hierarchy level.

To set BGP graceful restart properties or disable them for a specific neighbor in a group, include the desired statements at the **[edit protocols bgp group *group-name* neighbor *ip-address* graceful-restart]** hierarchy level.

NOTE: Configuring graceful restart for BGP resets the BGP peer routing statistics to zero. Also, existing BGP sessions restart, and the peers negotiate graceful restart capabilities.

Configuring Graceful Restart Options for ES-IS

On J Series Services Routers, to configure the duration of the ES-IS graceful restart period, include the **restart-duration** statement at the **[edit protocols esis graceful-restart]** hierarchy level.

```
[edit]
protocols {
  esis {
    graceful-restart {
      disable;
      restart-duration seconds;
    }
  }
}
routing-options {
  graceful-restart;
}
```

To disable ES-IS graceful restart capability, include the **disable** statement at the **[edit protocols esis graceful-restart]** hierarchy level.

Configuring Graceful Restart Options for IS-IS

To configure the duration of the IS-IS graceful restart period, include the **restart-duration** statement at the **[edit protocols isis graceful-restart]** hierarchy level.

```
[edit]
protocols {
  isis {
    graceful-restart {
      disable;
      helper-disable;
      restart-duration seconds;
    }
  }
}
routing-options {
  graceful-restart;
```

```
}
```

To disable IS-IS graceful restart helper capability, include the **helper-disable** statement at the **[edit protocols isis graceful-restart]** hierarchy level. To disable IS-IS graceful restart capability, include the **disable** statement at the **[edit protocols isis graceful-restart]** hierarchy level.

NOTE: If you configure Bidirectional Forwarding Detection (BFD) and graceful restart for IS-IS, graceful restart might not work as expected.

NOTE: You can also track graceful restart events with the **traceoptions** statement at the **[edit protocols isis]** hierarchy level. For more information, see "Tracking Graceful Restart Events" on page 1745.

Configuring Graceful Restart Options for OSPF and OSPFv3

To configure the duration of the OSPF/OSPFv3 graceful restart period, include the **restart-duration** statement at the **[edit protocols (ospf | ospf3) graceful-restart]** hierarchy level. To specify the length of time for which the router notifies helper routers that it has completed graceful restart, include the **notify-duration** at the **[edit protocols (ospf | ospf3) graceful-restart]** hierarchy level. Strict OSPF link-state advertisement (LSA) checking results in the termination of graceful restart by a helping router. To disable strict LSA checking, include the **no-strict-lsa-checking** statement at the **[edit protocols (ospf | ospf3) graceful-restart]** hierarchy level.

```
[edit]
protocols {
  ospf | ospfv3{
    graceful-restart {
      disable;
      helper-disable
      no-strict-lsa-checking;
      notify-duration seconds;
      restart-duration seconds;
    }
  }
}
routing-options {
  graceful-restart;
}
```

To disable OSPF/OSPFv3 graceful restart, include the **disable** statement at the **[edit protocols (ospf | ospf3) graceful-restart]** hierarchy level.

Starting with Release 11.3, the Junos OS supports both the standard (based on RFC 3623, *Graceful OSPF Restart*) and the restart signaling-based (as specified in RFC 4811, RFC 4812, and RFC 4813) helper modes for OSPF version 2 graceful restart configurations. Both the standard and restart signaling-based helper modes are enabled by default. To disable the helper mode for OSPF version 2 graceful restart configurations, include the **helper-disable <both | restart-signaling | standard>** statement at the **[edit protocols ospf**

graceful-restart] hierarchy level. Note that the last committed statement always takes precedence over the previous one.

```
[edit protocols ospf]
  graceful-restart {
    helper-disable <both | restart-signaling | standard>
  }
```

To reenable the helper mode, delete the **helper-disable** statement from the configuration by using the **delete protocols ospf graceful-restarthelper-disable <restart-signaling | standard | both>** command. In this case also, the last executed command takes precedence over the previous ones.

NOTE:

Restart signaling-based helper mode is not supported for OSPFv3 configurations. To disable helper mode for OSPFv3 configurations, include the *helper-disable* statement at the **[edit protocols ospfv3 graceful-restart]** hierarchy level.

TIP: You can also track graceful restart events with the **traceoptions** statement at the **[edit protocols (ospf | ospf3)]** hierarchy level. For more information, see "Tracking Graceful Restart Events" on page 1745.

NOTE: You cannot enable OSPFv3 graceful restart between a routing platform running Junos OS Release 7.5 and earlier and a routing platform running Junos OS Release 7.6 or later. As a workaround, make sure both routing platforms use the same Junos OS version.

NOTE: If you configure BFD and graceful restart for OSPF, graceful restart might not work as expected.

Configuring Graceful Restart Options for RIP and RIPng

To configure the duration of the RIP or RIPng graceful restart period, include the **restart-time** statement at the **[edit protocols (rip | ripng) graceful-restart]** hierarchy level.

```
[edit]
protocols {
  (rip | ripng) {
    graceful-restart {
      disable;
      restart-time seconds;
    }
  }
}
```



```
routing-options {
  graceful-restart;
}
```

To disable RIP or RIPng graceful restart capability, include the **disable** statement at the **[edit protocols (rip | ripng) graceful-restart]** hierarchy level.

Configuring Graceful Restart Options for PIM Sparse Mode

PIM sparse mode continues to forward existing multicast packet streams during a graceful restart, but does not forward new streams until after the restart is complete. After a restart, the routing platform updates the forwarding state with any updates that were received from neighbors and occurred during the restart period. For example, the routing platform relearns the join and prune states of neighbors during the restart, but does not apply the changes to the forwarding table until after the restart.

PIM sparse mode-enabled routing platforms generate a unique 32-bit random number called a generation identifier. Generation identifiers are included by default in PIM hello messages, as specified in the IETF Internet draft *Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised)*. When a routing platform receives PIM hellos containing generation identifiers on a point-to-point interface, Junos OS activates an algorithm that optimizes graceful restart.

Before PIM sparse mode graceful restart occurs, each routing platform creates a generation identifier and sends it to its multicast neighbors. If a PIM sparse mode-enabled routing platform restarts, it creates a new generation identifier and sends it to its neighbors. When a neighbor receives the new identifier, it resends multicast updates to the restarting router to allow it to exit graceful restart efficiently. The restart phase completes when either the PIM state becomes stable or when the restart interval timer expires.

If a routing platform does not support generation identifiers or if PIM is enabled on multipoint interfaces, the PIM sparse mode graceful restart algorithm does not activate, and a default restart timer is used as the restart mechanism.

To configure the duration of the PIM graceful restart period, include the **restart-duration** statement at the **[edit protocols pim graceful-restart]** hierarchy level:

```
[edit]
protocols {
  pim {
    graceful-restart {
      disable;
      restart-duration seconds;
    }
  }
}
routing-options {
  graceful-restart;
}
```

To disable PIM sparse mode graceful restart capability, include the **disable** statement at the **[edit protocols pim graceful-restart]** hierarchy level.

NOTE: Multicast forwarding can be interrupted in two ways. First, if the underlying routing protocol is unstable, multicast reverse-path-forwarding (RPF) checks can fail and cause an interruption. Second, because the forwarding table is not updated during the graceful restart period, new multicast streams are not forwarded until graceful restart is complete.

Tracking Graceful Restart Events

To track the progress of a graceful restart event, you can configure graceful restart trace options flags for IS-IS and OSPF/OSPFv3. To configure graceful restart trace options, include the **graceful-restart** statement at the **[edit protocols *protocol* traceoptions flag]** hierarchy level:

```
[edit protocols]
isis {
  traceoptions {
    flag graceful-restart;
  }
}
(ospf | ospf3) {
  traceoptions {
    flag graceful-restart;
  }
}
```

Related Documentation

- Graceful Restart Concepts on page 1735
- *Graceful Restart System Requirements*
- *Graceful Restart and Routing Protocols*
- Verifying Graceful Restart Operation on page 1799
- *Example: Configuring Graceful Restart*

Configuration Task for Graceful Switchover

- Configuring Graceful Routing Engine Switchover in a Virtual Chassis (CLI Procedure) on page 1746

Configuring Graceful Routing Engine Switchover in a Virtual Chassis (CLI Procedure)

In a Virtual Chassis, one member switch is assigned the master role and has the master Routing Engine. Another member switch is assigned the backup role and has the backup Routing Engine. Graceful Routing Engine switchover (GRES) enables the master and backup Routing Engines in a Virtual Chassis configuration to switch from the master to backup without interruption to packet forwarding. When you configure graceful Routing Engine switchover, the backup Routing Engine automatically synchronizes with the master Routing Engine to preserve kernel state information and the forwarding state.

To set up the Virtual Chassis configuration to use graceful Routing Engine switchover (GRES):

1. Set up a minimum of two switches in a Virtual Chassis configuration with mastership priority of 255:

```
[edit]
user@switch# set virtual-chassis member 0 mastership-priority 255
[edit]
user@switch# set virtual-chassis member 1 mastership-priority 255
```

2. Set up graceful Routing Engine switchover:

```
[edit]
user@switch# set chassis redundancy graceful-switchover
```

Commit the configuration.

NOTE: We recommend that you use the **commit synchronize** command to save any configuration changes that you make to a multimember Virtual Chassis.

Related Documentation

- *Example: Configuring an EX4200 Virtual Chassis with a Master and Backup in a Single Wiring Closet*
- *High Availability Features for EX Series Switches Overview*
- *Understanding EX Series Virtual Chassis Configuration*
- *Understanding QFX Series Virtual Chassis*

Configuration Example for VRRP

Example: Configuring VRRP for Load Sharing

If you do not want to dedicate a switch to be a VRRP backup (and therefore leave it idle unless the master fails), you can create a load-sharing configuration in which each participating switch simultaneously acts as a master and a backup.

One reason to use a load-sharing (active-active) configuration is that you are more likely to actively monitor and maintain both switches and notice if a problem occurs on either of them. If you use a configuration in which one switch is only a backup (an active-backup configuration), you might be less likely to pay attention to the backup switch while it is idle. In the worst case, this could lead to the backup switch developing an undetected problem and not being able to perform adequately when a failover occurs.

Requirements

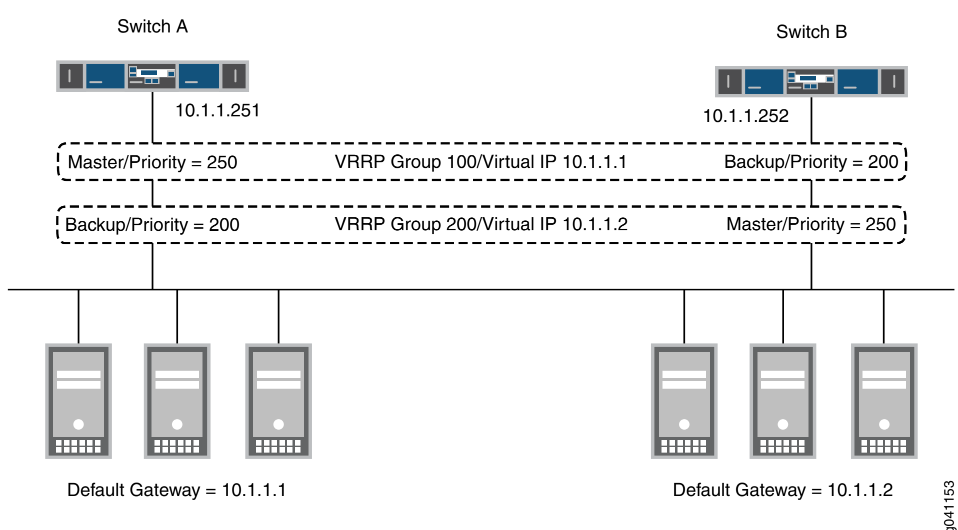
This example uses the following hardware and software components:

- Two QFX3500 switches
- Junos OS Release 11.3 or later
- Static routing or a dynamic routing protocol enabled on both switches.

Overview and Topology

This example uses two VRRP groups, each of which has its own virtual IP address. Devices on the LAN use one of these virtual IP addresses as their default gateway. If one of the switches fails, the other switch takes over for it. In the topology shown in Figure 23 on page 1747, for example, Switch A is the master for VRRP group 100. If Switch A fails, Switch B takes over and forwards traffic that the end devices send to the default gateway address 10.1.1.1.

Figure 23: VRRP Load-Sharing Configuration



This example shows a simple configuration to illustrate the basic steps for configuring two switches running VRRP to back each other up. Table 152 on page 1748 lists VRRP settings for each switch.

Table 152: Settings for VRRP Load-Sharing Example

Switch A	Switch B
VRRP Group 100: • Interface address: 10.1.1.251 • VIP: 10.1.1.1 • Priority: 250	VRRP Group 100: • Interface address: 10.1.1.252 • VIP: 10.1.1.1 • Priority: 200
VRRP Group 200: • Interface address: 10.1.1.251 • VIP: 10.1.1.2 • Priority: 200	VRRP Group 200: • Interface address: 10.1.1.252 • VIP: 10.1.1.2 • Priority: 250

In addition to configuring the two switches as shown, you must configure your end devices so that some of them use one of the virtual IP addresses as their default gateway and the remaining end devices use the other virtual IP address as their default gateway.

Note that if a failover occurs, the remaining switch might be unable to handle all of the traffic, depending on the demand.

Configuring VRRP on Both Switches

CLI Quick Configuration

Enter the following on Switch A:

```
[edit]
set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.251/24 vrrp-group 100 virtual-address 10.1.1.1
set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.251/24 vrrp-group 100 priority 250
set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.251/24 vrrp-group 200 virtual-address 10.1.1.2
set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.251/24 vrrp-group 200 priority 200
```

Enter the following on Switch B:

```
[edit]
set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.252/24 vrrp-group 100 virtual-address 10.1.1.1
set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.252/24 vrrp-group 100 priority 200
set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.252/24 vrrp-group 200 virtual-address 10.1.1.2
set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.252/24 vrrp-group 200 priority 250
```

Step-by-Step Procedure

Configure the VRRP groups and priorities on Switch A:

1. Create VRRP group 100 on Switch A and configure the virtual IP address for the group:

   ```
   [edit]
   user@switch# set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.252/24 vrrp-group 100 virtual-address 10.1.1.1
   ```
2. Assign the VRRP priority for this interface in this group:

   ```
   [edit]
   user@switch# set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.251/24 vrrp-group 100 priority 250
   ```


3. Create VRRP group 200 on Switch A and configure the virtual IP address for the group:

```
[edit]
user@switch# set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.251/24 vrrp-group 200 virtual-address 10.1.1.2
```

4. Assign the VRRP priority for this interface in this group:

```
[edit]
user@switch# set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.251/24 vrrp-group 100 priority 200
```

Step-by-Step Procedure

Configure the VRRP groups and priorities on Switch B:

1. Create VRRP group 100 on Switch B and configure the virtual IP address for the group:

```
[edit]
user@switch# set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.252/24 vrrp-group 100 virtual-address 10.1.1.1
```

2. Assign the VRRP priority for this interface in this group:

```
[edit]
user@switch# set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.252/24 vrrp-group 100 priority 200
```

   Switch A remains the master for group 100 because it has the highest priority for this group.

3. Create VRRP group 200 on Switch A and configure the virtual IP address for the group:

```
[edit]
user@switch# set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.252/24 vrrp-group 200 virtual-address 10.1.1.2
```

4. Assign the VRRP priority for this interface in this group:

```
[edit]
user@switch# set interfaces xe-0/0/0 unit 0 family inet address 10.1.1.251/24 vrrp-group 100 priority 250
```

   Switch B becomes the master for group 200 because it has the highest priority for this group.

Results

Display the results of the configuration on Switch A:

```
user@switch> show configuration
interfaces {
  xe-0/0/0 {
    unit 0 {
      family inet {
        address 10.1.1.251 {
          vrrp-group 100 {
            virtual address 10.1.1.1
            priority 250
          }
          vrrp-group 200 {
            virtual address 10.1.1.2
            priority 200
```

```
                }
              }
            }
          }
        }
      }
```

Display the results of the configuration on Switch B:

```
user@switch> show configuration
interfaces {
  xe-0/0/0 {
    unit 0 {
      family inet {
        address 10.1.1.252 {
          vrrp-group 100 {
            virtual address 10.1.1.1
            priority 200
          }
          vrrp-group 200 {
            virtual address 10.1.1.2
            priority 250
          }
        }
      }
    }
  }
}
```

Verification

- Verifying that VRRP is Working on Switch A on page 1750
- Verifying that VRRP is Working on Switch B on page 1751

Verifying that VRRP is Working on Switch A

Purpose Verify that VRRP is active on Switch A and that the master and backup roles are correct.

Action Use the following command to verify that VRRP is active on Switch A and that the switch is master for group 100 and backup for group 200.

```
user@switch> show vrrp
Interface         State          Group    VR state      Timer              Type
  Address
xe-0/0/0.0      up              100      master       A .0327  lcl    10.1.1.251
                                                             vip    10.1.1.1
xe-0/0/0.0      up              200      backup       A .0327  lcl    10.1.1.251
                                                             vip    10.1.1.2
```

Meaning The **show vrrp** command displays fundamental information about the VRRP configuration. This output shows that both VRRP groups are active and that this switch has assumed the correct master and backup roles. The **lcl** address is the physical address of the interface and the **vip** address is the virtual address shared by both switches. The **Timer** value (**A .0327**) indicates the remaining time (in seconds) in which this switch expects to receive a VRRP advertisement from the other switch. If an advertisement for group

200 does not arrive before the timer expires, Switch A asserts itself as the master for this group.

Verifying that VRRP is Working on Switch B

Purpose Verify that VRRP is active on Switch B and that the master and backup roles are correct.

Action Use the following command to verify that VRRP is active on Switch B and that the switch is backup for group 100 and master for group 200.

```
user@switch> show vrrp
Interface         State            Group    VR state      Timer              Type
  Address
xe-0/0/0.0      up               100     backup      A .0327  lcl    10.1.1.252
                                                           vip   10.1.1.1
xe-0/0/0.0      up               200     master      A .0327  lcl    10.1.1.252
                                                           vip   10.1.1.2
```

Meaning The **show vrrp** command displays fundamental information about the VRRP configuration. This output shows that both VRRP groups are active and that this switch has assumed the correct master and backup roles. The **lcl** address is the physical address of the interface and the **vip** address is the virtual address shared by both switches. The **Timer** value (**A .0327**) indicates the remaining time (in seconds) in which this switch expects to receive a VRRP advertisement from the other switch. If an advertisement for group 100 does not arrive before the timer expires, Switch B asserts itself as the master for this group.

Related Documentation

- Understanding VRRP on page 1736
- Configuring Basic VRRP Support on page 1752

Configuration Tasks for VRRP

Configuring Basic VRRP Support

To configure basic VRRP support, configure VRRP groups on interfaces by including the **vrrp-group** statement:

```
vrrp-group group-id {
  priority number;
  virtual-address [ addresses ];
}
```

An interface can be a member of multiple VRRP groups.

You can include this statement at the following hierarchy level:

- **[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*]**

For each interface, you must configure the following:

- Group identifier—Assign a value from 0 through 255. You must use the same identifier for each switch in the VRRP group.
- Priority—Assign a value from 1 through 255. The switch with the highest priority becomes the VRRP master. Assign different priorities to each switch in the VRRP group. If there are two or more switches with the same priority, the switch with the VRRP interface that has the highest IP address becomes the master.
- Virtual IP address—Normally, you configure only one address per group, but you can configure as many as eight addresses. Do not include a prefix length in a virtual IP address. The following considerations apply to configuring a virtual IP address:
  - You must configure the same address on all the switches in the VRRP group.
  - If you configure a virtual IP address to be the same as a physical interface address, the switch with that interface becomes the master for the group. You must configure the priority to be 255, and you must configure preemption by including the **preempt** statement.
  - If the virtual IP address is not the same as the physical interface address, you must ensure that the address does not appear anywhere else in the switch configuration. For example, verify that you do not use this address for another interface (including an aggregated Ethernet interface) or for a static ARP entry.

NOTE: If you enable MAC source address filtering on an interface, you must include the virtual MAC address in the list of source MAC addresses that you specify in the **source-address-filter** statement at the **[edit interfaces *interface-name*]** hierarchy. MAC addresses ranging from **00:00:5e:00:01:00** through **00:00:5e:00:01:ff** are reserved for VRRP, as defined in RFC 3768. The VRRP group number must be the decimal equivalent of the last hexadecimal byte of the virtual MAC address.

Related Documentation

- Understanding VRRP on page 1736
- Configuring the Startup Period for VRRP Operations on page 1754
- Configuring VRRP Authentication (IPv4 Only) on page 1753

Configuring VRRP Authentication (IPv4 Only)

VRRP (IPv4 only) protocol exchanges can be authenticated to guarantee that only trusted switches participate in a VRRP group. By default, VRRP authentication is disabled. You can configure one of the following authentication methods for a group, and each switch in the same group must use the same method:

- Simple authentication—Uses a text password included in the transmitted packet. The receiving switch uses an authentication key (password) to verify the packet.
- Message Digest 5 (MD5) algorithm—Adds an authentication header (AH) to the IP packet that encapsulates the VRRP packet. You create an authentication key that is used to create a hash of the packet, and the hash is stored in the AH. A receiving switch recalculates the hash on the incoming packet and compares the hashes. If they are identical, the packet is valid and is accepted. Otherwise the switch drops the incoming packet.

To enable authentication and specify an authentication method, include the **authentication-type** statement.

authentication-type *authentication*;

authentication can be **simple** or **md5**. The authentication type must be the same for all the switches in the VRRP group.

You can include this statement at the following hierarchy level:

- **[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*]**

If you include the **authentication-type** statement, you can configure a key (password) on each interface by including the **authentication-key** statement:

authentication-key *key*;

key (the password) is an ASCII string. For simple authentication, it can be from 1 through 8 characters long. For MD5 authentication, it can be from 1 through 16 characters long. If you include spaces, enclose all characters in quotation marks (" ").

NOTE: **The key must be the same for all switches in the VRRP group.**

You can include this statement at the following hierarchy level:

- **[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*]**

Related Documentation

- Understanding VRRP on page 1736
- Configuring Basic VRRP Support on page 1752

Configuring the Startup Period for VRRP Operations

Configure the startup-silent period interval to avoid alarms caused by the delay or interruption of the incoming VRRP advertisement packets while an interface is coming online. The period starts when the state of a VRRP interface is changed from down to up. During this period, Master Down Events are ignored.

To configure the startup period for VRRP operations, include the **startup-silent-period** statement at the **[edit protocols vrrp]** hierarchy level:

```
[edit protocols vrrp]
startup-silent-period seconds;
```

Related Documentation

- Understanding VRRP on page 1736
- Configuring Basic VRRP Support on page 1752
- Example: Configuring VRRP for Load Sharing on page 1746

Configuring the Advertisement Interval for the VRRP Master

By default, the master switch sends VRRP advertisement packets every second to all members of the VRRP group. These packets indicate that the master switch is still operational. If the master switch fails or becomes unreachable, the backup switch with the highest priority value becomes the new master switch.

You can modify the advertisement interval in seconds or in milliseconds; the interval must be the same for all routing platforms in the VRRP group.

This topic contains the following sections:

Modifying the Advertisement Interval in Seconds

To modify the time, in seconds, between the sending of VRRP advertisement packets, include the **advertise-interval** statement:

```
advertise-interval seconds;
```

The interval can be from 1 through 255 seconds.

You can include this statement at the following hierarchy level:

- [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*]

Modifying the Advertisement Interval in Milliseconds

To modify the time, in milliseconds, between the sending of VRRP advertisement packets, include the **fast-interval** statement:

```
fast-interval milliseconds;
```

The interval can be from 100 through 999 milliseconds.

You can include this statement at the following hierarchy level:

- [edit interfaces *interface-name* unit *logical-unit-number* family (inet | inet6) address *address* (vrrp-group | vrrp-inet6-group) *group-id*]

NOTE: Junos OS sets the advertisement interval to 0 in VRRP packets. When you configure VRRP with other vendors' equipment, the **fast-interval** statement works correctly only when the other equipment also has the advertisement interval set to 0 in the VRRP packet. Otherwise, Junos OS interprets other routers' settings as advertisement timer errors.

Related Documentation

- Understanding VRRP on page 1736
- Configuring Basic VRRP Support on page 1752
- Example: Configuring VRRP for Load Sharing on page 1746

Configuring VRRP Preemption and Hold Time

Configuring VRRP Preemption

By default, a higher-priority VRRP backup switch preempts a lower-priority master switch. To explicitly enable this behavior, include the following statement:

```
preempt;
```

To prohibit a higher-priority VRRP backup switch from preempting a lower-priority master switch, include the following statement on the lower-priority switch:

```
no-preempt;
```

You can include these statements at the following hierarchy level:

- **[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*]**

Configuring the Preemption Hold Time

You can also configure a preemption hold time, which is the number of seconds a higher-priority backup router that has just started up waits before preempting the master router. You might want to configure a hold time so that routing protocols or other Junos OS components converge before preemption occurs.

The hold time is applied only on startup. By default, the hold-time value is 0 seconds, meaning that preemption can occur immediately after the backup router starts up.

To modify the preemption hold-time value, configure the following statement:

```
hold-time seconds;
```

The hold time can be from 0 through 3600 seconds.

You can include this statement at the following hierarchy level:

- **[edit interfaces *interface-name* unit *logical-unit-number* family inet *address* vrrp-group *group-id*] preempt**

Overriding the Hold Time

You can use the asymmetric-hold-time statement to configure a VRRP master to fail over to the backup immediately—without waiting for the preemption hold time to expire—when a tracked route goes down. Otherwise, the master waits for the hold time to expire before it initiates a failover when a tracked route goes down.

When the tracked route comes up again, the new backup (original master) router waits for the preemption hold time to expire before it reasserts mastership.

You can include this statement at the following hierarchy level:

- **[edit protocols vrrp]**

Related Documentation

- Understanding VRRP on page 1736
- Configuring Basic VRRP Support on page 1752
- Example: Configuring VRRP for Load Sharing on page 1746

Configuring a Route to Be Tracked

A VRRP master can track a route and dynamically trigger a new master router election if the route becomes unreachable. To enable this behavior, you must configure a cost that will be subtracted from the priority of the master if the tracked route becomes unreachable. The new priority must be less than the priority of one of the backups so that the backup becomes the new master.

To configure a route to be tracked, include the following statements:

```
track {
  priority-hold-time seconds;
  route prefix/prefix-length routing-instance default priority-cost priority;
}
```

You can include these statements at the following hierarchy level:

- **[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*]**

The **prefix** and **prefix-length** values specify the route to be tracked. The **priority-hold-time** statement is the minimum length of time that must elapse between priority changes. If the priority of the master changes because of a tracking event, the priority hold timer begins. If another tracking event or manual configuration change occurs while the timer is running, the new priority update is postponed until the timer expires. You might configure the **priority-hold-time** statement to prevent problems that could occur if there were multiple VRRP transitions in a short period of time.

The **priority-cost** option is the value to be subtracted from the VRRP priority when the tracked route goes down. The value can be **1** through **254**. The sum of the costs for all tracked interfaces and routes must be less than or equal to the configured priority (so that subtracting all the costs results in a priority equal to or greater than 0).

Related Documentation

- Understanding VRRP on page 1736
- Configuring Basic VRRP Support on page 1752
- Example: Configuring VRRP for Load Sharing on page 1746
- Configuring a Logical Interface to Be Tracked on page 1757

Configuring a Logical Interface to Be Tracked

VRRP can track whether a logical interface is up, down, or not present, and can change the priority of the switch based on the state of the interface, which might trigger a new master election. VRRP can also track the operational speed of a logical interface and update the priority of the switch when the speed crosses a configured threshold. For each VRRP group, you can track as many as 10 logical interfaces.

When interface tracking is enabled on a switch, you cannot assign the switch a priority of 255 to make it the master for the group.

To configure a logical interface to be tracked, include the following statements:

```
track {
  interface interface-name {
    bandwidth-threshold bits-per-second priority-cost priority;
    priority-cost priority;
  }
  priority-hold-time seconds;
}
```


You can include these statements at the following hierarchy level:

- **[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*]**

The interface specified is the interface to be tracked for the VRRP group. The **priority-hold-time** statement is the minimum length of time that must elapse between priority changes. If the priority changes because of a tracking event, the priority hold timer begins. If another tracking event or manual configuration change occurs while the timer is running, the new priority update is postponed until the timer expires. You might configure the **priority-hold-time** statement to prevent problems that could occur if there were multiple VRRP transitions in a short period of time.

The **bandwidth-threshold** statement specifies a threshold for the tracked interface. If the bandwidth of the tracked interface drops below the threshold value, the system subtracts the bandwidth threshold **priority-cost** value from the VRRP priority for the switch. You can create as many as five **bandwidth-threshold** statements for each tracked interface.

The interface **priority-cost** statement is the value to be subtracted from the VRRP priority when the tracked route goes down. The value can be **1** through **254**. The sum of the costs for all tracked interfaces and routes must be less than or equal to the configured priority (so that subtracting all the costs results in a priority equal to or greater than 0).

WARNING: **On a QFabric system, do not apply interface tracking to a multichassis link aggregation group (MC-LAG) that includes an interface belonging to a network Node group device and an interface belonging to a server Node group device. If you do apply interface tracking to an MC-LAG configured in this way, a priority update will not occur if the state of the MC-LAG interface changes.**

If you configure tracking for more than one interface, Junos OS subtracts the sum of the priority costs for the tracked interfaces from the VRRP priority if all the tracked interfaces fail. However, if you configure the interface **priority-cost** statement and the bandwidth threshold **priority-cost** statement, they are not added together. The switch uses only one priority cost for a tracked interface, as indicated in Table 153 on page 1758:

Table 153: Interface State and Priority Cost Usage

Tracked Interface State	Priority Cost Usage
Down	**priority cost *priority***
Not down; media speed below one or more bandwidth thresholds	Priority-cost of the lowest applicable bandwidth threshold

You must configure an interface priority cost only if you do not configure any bandwidth thresholds. If you do not configure an interface **priority-cost** value and the interface fails, Junos OS subtracts the bandwidth threshold **priority-cost** value of the lowest bandwidth threshold from the priority of the switch.

Related Documentation

- Understanding VRRP on page 1736
- Configuring Basic VRRP Support on page 1752
- Example: Configuring VRRP for Load Sharing on page 1746
- Configuring a Route to Be Tracked on page 1756

Configuring a Backup to Accept Packets Destined for the Virtual IP Address

By default, a switch configured to be a VRRP backup but acting as the master does not process packets sent to the virtual IP address—that is, packets in which the destination address is the virtual IP address. To configure a backup switch to process packets sent to the virtual IP address while it is acting as the master, include the **accept-data** statement on the backup:

```
accept-data;
```

You can include this statement at the following hierarchy level:

- **[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group] *group-id***

To explicitly prohibit the backup from accepting packets destined for the virtual IP address while acting as master, include the **no-accept-data** statement:

```
no-accept-data;
```

If you include the **accept-data** statement, configure the connected hosts so that they:

- Process gratuitous ARP requests.
- Do not use packets other than ARP replies to update their ARP cache.

This statement is disabled by default. If you enable it, your configuration does not comply with RFC 3768.

To restrict incoming IP packets to ICMP only, you must configure firewall filters to accept only ICMP packets.

Related Documentation

- Understanding VRRP on page 1736
- Configuring Basic VRRP Support on page 1752
- Example: Configuring VRRP for Load Sharing on page 1746

Configuring Passive ARP Learning for VRRP Backups

By default, VRRP backup switches drop ARP requests for the MAC address of the VRRP IP. This means that backups do not learn the ARP mappings (IP address to MAC address mappings) for the hosts sending the requests. If it becomes the master, the configured backup must learn all the entries that were present in the ARP cache of the original master. In environments with many directly attached hosts, the number of ARP entries to learn can be very large. This can cause a significant delay while the backup transitions to the master state, during which traffic transmitted to some of the hosts might be dropped.

Passive ARP learning enables the ARP cache in the backup to learn approximately the same contents as the ARP cache in the master, thus preventing the problem of needing to learn many ARP entries quickly. To enable passive ARP learning, include the **passive-learning** statement at the **[edit system arp]** hierarchy level:

```
[edit system arp]
passive-learning;
```

We recommend setting passive learning on both the backup and master VRRP switches. Doing so prevents the need to manually configure a master that fails and becomes a backup. While a switch operates as the master, the passive learning configuration has no impact. The configuration takes effect only when a switch operates as a backup.

Related Documentation

- Understanding VRRP on page 1736
- Configuring Basic VRRP Support on page 1752
- Example: Configuring VRRP for Load Sharing on page 1746

Configuring the Silent Period

When the state of a VRRP interface changes from down to up, a silent period begins. During this period, any master down events are ignored. Configure the silent period interval to avoid problems that can be caused if incoming VRRP advertisement packets are delayed or interrupted while an interface starts up.

To configure the silent period, include the **startup-silent-period** statement at the **[edit protocols vrrp]** hierarchy level:

```
[edit protocols vrrp]
startup-silent-period seconds;
```

Related Documentation

- Understanding VRRP on page 1736
- Configuring Basic VRRP Support on page 1752
- Example: Configuring VRRP for Load Sharing on page 1746

Configuring Inheritance for a VRRP Group

Junos OS enables you to configure VRRP groups on the various subnets of a VLAN to inherit the state and configuration of one of the groups, which is known as the *active VRRP group*. By configuring inheritance, you can prevent VRRP groups other than the active group from sending out VRRP advertisements. When the **vrrp-inherit-from** configuration statement is included in the configuration, only the active VRRP group from which the other VRRP groups are inheriting the state sends out VRRP advertisements; the groups inheriting the state do not send any VRRP advertisements, because the state is maintained only on the group from which the state is inherited.

If the **vrrp-inherit-from** statement is not configured, each of the VRRP master groups in the various subnets on the VLAN sends out separate VRRP advertisements and adds to the traffic on the VLAN.

To configure inheritance for a VRRP group, include the **vrrp-inherit-from** statement at the **[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*]**:

[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*
  vrrp-group *group-id*]
vrrp-inherit-from *vrrp-group*;

When you configure a group to inherit a state from another group, note the following conditions:

- Both inheriting groups and active groups must be on the same physical interface and logical system. However, the groups need not necessarily be on the same VLAN or logical interface.
- Both inheriting groups and active groups must be on the same routing instances; however, this limitation does not apply for groups on the integrated routing and bridging (IRB) interfaces.

When you include the **vrrp-inherit-from** statement for a VRRP group, the VRRP group inherits the following parameters from the active group:

- **advertise-interval**
- **authentication-key**
- **authentication-type**
- **fast-interval**
- **preempt | no-preempt**
- **priority**
- **track interfaces**
- **track route**

However, you can configure the **accept-data | no-accept-data** statement for the group to specify whether the interface should accept packets destined for the virtual IP address.

Related Documentation

- Understanding VRRP on page 1736
- Configuring Basic VRRP Support on page 1752
- Example: Configuring VRRP for Load Sharing on page 1746

Configuration Statements for Graceful Restart

disable

Syntax disable;

Hierarchy Level [edit logical-systems *logical-system-name* protocols (bgp | isis | ldp | ospf | ospf3 | pim | rip | ripng | rsvp) graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (bgp | ldp | ospf | ospf3 | pim) graceful-restart],
[edit protocols (bgp | esis | isis | ospf | ospf3 | ldp | pim | rip | ripng | rsvp) graceful-restart],
[edit protocols bgp group *group-name* graceful-restart],
[edit protocols bgp group *group-name* neighbor *ip-address* graceful-restart],
[edit routing-instances *routing-instance-name* protocols (bgp | ldp | ospf | ospf3 | pim) graceful-restart],
[edit routing-instances *routing-instance-name* routing-options graceful-restart],
[edit routing-options graceful-restart]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Disable graceful restart.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Enabling Graceful Restart*
- Configuring Routing Protocols Graceful Restart on page 1739
- *Configuring Graceful Restart for MPLS-Related Protocols*
- *Configuring VPN Graceful Restart*
- *Configuring Logical System Graceful Restart*
- *Graceful Restart Configuration Statements*
- *Configuring Graceful Restart for QFabric Systems*

disable (BGP Graceful Restart)

Syntax disable;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* graceful-restart],
[edit protocols bgp graceful-restart],
[edit protocols bgp group *group-name* graceful-restart],
[edit protocols bgp group *group-name* neighbor *address* graceful-restart]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Disable graceful restart for BGP. Graceful restart allows a routing device undergoing a restart to inform its adjacent neighbors and peers of its condition.

NOTE: When you disable graceful restart at one level in the configuration statement hierarchy, it is also disabled at lower levels in the same hierarchy. For example, if you disable graceful restart at the **[edit protocols bgp group *group-name*]** hierarchy level, it is disabled for all the peers in the group. Therefore, if you want to enable graceful restart for some peers in a group and disable it for others, enable graceful restart at the **[edit protocols bgp group *group-name*]** hierarchy level and disable graceful restart for each peer at the **[edit protocols bgp group *group-name* neighbor *address*]** hierarchy level.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Graceful Restart Options for BGP on page 1740
- *Configuring Graceful Restart for QFabric Systems*
- graceful-restart on page 1765

graceful-restart (Enabling Globally)

Syntax

```
graceful-restart {
  disable;
  helper-disable;
  maximum-helper-recovery-time seconds;
  maximum-helper-restart-time seconds;
  notify-duration seconds;
  recovery-time seconds;
  restart-duration seconds;
  stale-routes-time seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit routing-options],
[edit routing-instances *routing-instance-name* routing-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure graceful restart globally to enable the feature. You cannot enable graceful restart for specific protocols unless graceful restart is also enabled globally. You can, optionally, modify the global settings at the individual protocol level.

For VPNs, the **graceful-restart** statement allows a router whose VPN control plane is undergoing a restart to continue to forward traffic while recovering its state from neighboring routers.

For BGP, if you configure graceful restart after a BGP session has been established, the BGP session restarts and the peers negotiate graceful restart capabilities.

Default

Graceful restart is disabled by default.

Options

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Enabling Graceful Restart*
- Configuring Routing Protocols Graceful Restart on page 1739
- *Configuring Graceful Restart for MPLS-Related Protocols*
- *Configuring VPN Graceful Restart*
- *Configuring Logical System Graceful Restart*
- *Graceful Restart Configuration Statements*
- *Configuring Graceful Restart for QFabric Systems*

graceful-restart (Protocols BGP)

Syntax

```
graceful-restart {
  disable;
  restart-time seconds;
  stale-routes-time seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*
neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure graceful restart for BGP. Graceful restart allows a routing device undergoing a restart to inform its adjacent neighbors and peers of its condition. Graceful restart is disabled by default.

To configure the duration of the BGP graceful restart period, include the **restart-time** statement at the **[edit protocols bgp graceful-restart]** hierarchy level. To set the length of time the router waits to receive messages from restarting neighbors before declaring them down, include the **stale-routes-time** statement at the **[edit protocols bgp graceful-restart]** hierarchy level.

NOTE: If you configure graceful restart after a BGP session has been established, the BGP session restarts and the peers negotiate graceful restart capabilities.

Configure graceful restart globally at the **[edit routing-options]** or **[edit routing-instances *instance-name* routing-options]** hierarchy level to enable the feature. You cannot enable graceful restart for specific protocols unless graceful restart is also enabled globally. You can, optionally, modify the global settings at the individual protocol level.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Graceful Restart Options for BGP on page 1740
- *Configuring Graceful Restart for QFabric Systems*
- *Junos OS High Availability Library for Routing Devices*

graceful-restart (Protocols OSPF)

Syntax

```
graceful-restart {
  disable;
  helper-disable (standard | restart-signaling | both);
  no-strict-lsa-checking;
  notify-duration seconds;
  restart-duration seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf]

Release Information

Statement introduced before Junos OS Release 7.4.
Support for the **no-strict-lsa-checking** statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the helper mode **standard**, **restart-signaling**, and **both** options introduced in Junos OS Release 11.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure graceful restart for OSPF.

Graceful restart allows a routing device to restart with minimal effects to the network, and is enabled for all routing protocols at the **[edit routing-options]** hierarchy level.

Options

disable—Disable graceful restart for OSPF.

helper-disable (standard | restart-signaling| both)—Disable helper mode for graceful restart. When helper mode is disabled, a device cannot help a neighboring device that is attempting to restart. Beginning with Junos OS Release 11.4, you can configure restart signaling-based helper mode for OSPFv2 graceful restart configurations. The **standard**, **restart-signaling**, and **both** options are only supported for OSPFv2. Specify **standard** to disable helper mode for standard graceful restart (based on RFC 3623). Specify **restart-signaling** to disable helper mode for restart signaling-based graceful restart (based on RFC 4811, RFC 4812, and RFC 4813). Specify **both** to disable helper mode for both standard and restart signaling-based graceful restart. The last committed statement takes precedence over the previously configured statement.

Default: Helper mode is enabled by default. For OSPFv2, both standard and restart-signaling based helper modes are enabled by default.

no-strict-lsa-checking—Disable strict OSPF link-state advertisement (LSA) checking to prevent the termination of graceful restart by a helping router. LSA checking is enabled by default.

NOTE: The **helper-disable** statement and the **no-strict-lsa-checking** statement cannot be configured at the same time. If you attempt to configure both statements at the same time, the routing device displays a warning message when you enter the **show protocols (ospf | ospf3)** command.

notify-duration *seconds*—Estimated time needed to send out purged grace LSAs over all the interfaces.

Range: 1 through 3600 seconds

Default: 30 seconds

restart-duration *seconds*—Estimated time needed to reacquire a full OSPF neighbor from each area.

Range: 1 through 3600 seconds

Default: 180 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Graceful Restart for OSPF on page 3464
- Example: Configuring the Helper Capability Mode for OSPFv2 Graceful Restart on page 3468
- Example: Configuring the Helper Capability Mode for OSPFv3 Graceful Restart on page 3472
- Example: Disabling Strict LSA Checking for OSPF Graceful Restart on page 3475
- *Configuring Graceful Restart for QFabric Systems*
- *Junos OS High Availability Library for Routing Devices*

helper-disable (OSPF)

Syntax helper-disable < both | restart-signaling | standard >;

Hierarchy Level [edit logical-systems *logical-system-name* protocols ospf graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf graceful-restart],
[edit protocols ospf graceful-restart],
[edit routing-instances *routing-instance-name* protocols ospf graceful-restart]

Release Information Statement introduced before Junos OS Release 7.4.
Options **both**, **restart-signaling**, and **standard** introduced in Junos OS Release 11.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Disable helper mode for graceful restart. When helper mode is disabled, a router cannot help a neighboring router that is attempting to restart. The last committed statement takes precedence over the previously configured statement.

Default Helper mode is enabled by default for OSPF.

Options **both**—(Optional) Disable helper mode for both standard and restart signaling-based graceful restart.

restart-signaling—(Optional) Disable helper mode for restart signaling-based graceful restart (based on RFC 4811, RFC 4812, and RFC 4813).

NOTE: Restart signaling-based helper mode is not supported for OSPFv3 configurations.

standard—(Optional) Disable helper mode for standard graceful restart (based on RFC 3623).

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Routing Protocols Graceful Restart on page 1739
- *Configuring Graceful Restart for MPLS-Related Protocols*
- *Configuring Graceful Restart for QFabric Systems*

no-strict-lsa-checking

Syntax no-strict-lsa-checking;

Hierarchy Level [edit protocols (ospf | ospf3) graceful-restart]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Disable strict OSPF link-state advertisement (LSA) checking to prevent the termination of graceful restart by a helping router or switch.

Default By default, LSA checking is enabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Graceful Restart Options for OSPF and OSPFv3 on page 1742
- *Configuring Graceful Restart for QFabric Systems*
- *maximum-neighbor-recovery-time*
- *recovery-time*

notify-duration

Syntax notify-duration *seconds*;

Hierarchy Level [edit protocols (ospf | ospf3) graceful-restart],
[edit logical-systems *logical-system-name* protocols (ospf | ospf3) graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols (ospf | ospf3) graceful-restart],
[edit routing-instances *instance-name* protocols (ospf | ospf3) graceful-restart]

Release Information Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the length of time the router or switch notifies helper OSPF routers that it has completed graceful restart.

Options *seconds*—Length of time in the router notifies helper OSPF routers that it has completed graceful restart.

Range: 1 through 3600

Default: 30

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Graceful Restart Options for OSPF and OSPFv3 on page 1742
- *Configuring Graceful Restart for QFabric Systems*
- restart-duration on page 1772

redundancy (Graceful Switchover)

Syntax

```
redundancy {
  failover {
    on-disk-failure;
    on-loss-of-keepalives;
  }
  graceful-switchover;
}
```

Hierarchy Level [edit chassis]

Release Information Statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Enable redundant Routing Engines on a Virtual Chassis with two or more member switches or on a standalone EX6200 or EX8200 switch with more than one Routing Engine.

The remaining statements are explained separately.

Default Redundancy is enabled for the Routing Engines.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- graceful-switchover on page 1775
- Configuring Graceful Routing Engine Switchover in a Virtual Chassis (CLI Procedure) on page 1746
- *Installing Software on an EX Series Switch with Redundant Routing Engines (CLI Procedure)*
- *High Availability Features for EX Series Switches Overview*

restart-duration

Syntax restart-duration *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols (isis | ospf | ospf3 | pim) graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3 | pim) graceful-restart],
[edit protocols (esis | isis | ospf | ospf3 | pim) graceful-restart],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3 | pim) graceful-restart],
[edit routing-options graceful-restart]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the grace period for graceful restart globally.

Additionally, you can individually configure the duration of the graceful restart period for the End System-to-Intermediate System (ES-IS), Intermediate System-to-Intermediate System (IS-IS), Open Shortest Path First (OSPF), and OSPFv3 protocols and for Protocol Independent Multicast (PIM) sparse mode.

Options *seconds*—Time for the graceful restart period.

Range:

The range of values varies according to whether the graceful restart period is being set globally or for a particular protocol:

- **[edit routing-options graceful-restart]** (global setting)—120 through 900
- ES-IS—30 through 300
- IS-IS—30 through 300
- OSPF/OSPFv3—1 through 3600
- PIM—30 through 300

Default:

The default value varies according to whether the graceful restart period is being set globally or for a particular protocol:

- **[edit routing-options graceful-restart]** (global setting)—300
- ES-IS—180
- IS-IS—210
- OSPF/OSPFv3—180
- PIM—60

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Enabling Graceful Restart*
- Configuring Routing Protocols Graceful Restart on page 1739
- *Configuring Graceful Restart for MPLS-Related Protocols*
- *Configuring VPN Graceful Restart*
- *Configuring Graceful Restart for VPNs*
- *Configuring Logical System Graceful Restart*
- *Graceful Restart Configuration Statements*
- *Configuring Graceful Restart for QFabric Systems*

restart-time (BGP Graceful Restart)

Syntax restart-time *seconds*;

Hierarchy Level [edit protocols (bgp | rip | ripng) graceful-restart],
[edit logical-systems *logical-system-name* protocols (bgp | rip | ripng) graceful-restart (Enabling Globally)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp graceful-restart],
[edit routing-instances *routing-instance-name* protocols bgp graceful-restart]

Release Information Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the duration of the BGP, RIP, or next-generation RIP (RIPng) graceful restart period.

Options *seconds*—Length of time for the graceful restart period.

Range: 1 through 600 seconds

Default: Varies by protocol:

- BGP—120 seconds
- RIP and RIPng—60 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Graceful Restart Options for BGP on page 1740
- Configuring Graceful Restart Options for RIP and RIPng on page 1743
- *Configuring Graceful Restart for QFabric Systems*
- stale-routes-time on page 1774

stale-routes-time

Syntax stale-routes-time *seconds*;

Hierarchy Level [edit logical-systems *logical-routing-name* protocols bgp graceful-restart],
[edit logical-systems *logical-routing-name* routing-instances *routing-instance-name* protocols bgp graceful-restart],
[edit protocols bgp graceful-restart],
[edit routing-instances *routing-instance-name* protocols bgp graceful-restart]

Release Information Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the maximum time that stale routes are kept during a restart. The **stale-routes-time** statement allows you to set the length of time the routing device waits to receive messages from restarting neighbors before declaring them down.

Options *seconds*—Time the router device waits to receive messages from restarting neighbors before declaring them down.

Range: 1 through 600 seconds

Default: 300 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Graceful Restart Options for BGP on page 1740
- *Configuring Graceful Restart for QFabric Systems*
- **restart-time (BGP Graceful Restart) on page 1773**

Configuration Statement for Graceful Switchover

- graceful-switchover on page 1775

graceful-switchover

Syntax graceful-switchover;

Hierarchy Level [edit chassis redundancy]

Release Information Statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description For switches with more than one Routing Engine, including those in a Virtual Chassis, configure the master Routing Engine to switch over gracefully to a backup Routing Engine without interruption to packet forwarding.

Default Graceful Routing Engine switchover (GRES) is disabled.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Nonstop Active Routing on EX Series Switches*
- Configuring Graceful Routing Engine Switchover in a Virtual Chassis (CLI Procedure) on page 1746
- *Configuring Nonstop Active Routing*
- *Installing Software on an EX Series Switch with Redundant Routing Engines (CLI Procedure)*

Configuration Statements for VRRP

- startup-silent-period on page 1792
- traceoptions on page 1793
- track (VRRP) on page 1795
- virtual-address on page 1796
- vrrp-group on page 1797

accept-data

Syntax (accept-data | no-accept-data);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description In a Virtual Router Redundancy Protocol (VRRP) configuration, determine whether or not a router that is acting as the master router accepts all packets destined for the virtual IP address.

- **accept-data**—Enable the master router to accept all packets destined for the virtual IP address.
- **no-accept-data**—Prevent the master router from accepting packets other than the ARP packets destined for the virtual IP address.

Default If the router acting as the master router is the IP address owner or has its priority set to 255, the master router, by default, responds to all packets sent to the virtual IP address. However, if the router acting as the master router does not own the IP address or has its priority set to a value less than 255, the master router responds only to ARP requests.

NOTE:

- If you want to restrict the incoming IP packets to ICMP packets only, you must configure firewall filters to accept only ICMP packets.
- If you include the **accept-data** statement, your routing platform configuration does not comply with RFC 3768 (see section 6.4.3 of RFC 3768, *Virtual Router Redundancy Protocol (VRRP)*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring an Interface to Accept Packets Destined for the Virtual IP Address*

advertise-interval

Syntax advertise-interval *seconds*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description Configure the interval between Virtual Router Redundancy Protocol (VRRP) IPv4 advertisement packets.

All routers in the VRRP group must use the same advertisement interval.

NOTE: When VRRPv3 is enabled, the **advertise-interval** statement cannot be used to configure advertisement intervals. Instead, use the **fast-interval** statement to configure advertisement intervals.

Options *seconds*—Interval between advertisement packets.

Range: 1 through 255 seconds

Default: 1 second

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Advertisement Interval for the VRRP Master Router*
- fast-interval on page 1784
- *inet6-advertise-interval*
- *version-3*

asymmetric-hold-time

Syntax asymmetric-hold-time;

Hierarchy Level [edit protocols vrrp]

Release Information Statement introduced in Junos OS 11.3 for the QFX Series.

Description Configure a VRRP master to fail over to a backup immediately—without waiting for the preemption hold time to expire—when a tracked route goes down. Otherwise, the master waits for the hold time to expire before it initiates a failover when a tracked route goes down.

When the tracked route comes up again, the new backup (original master) router waits for the preemption hold time to expire before it reasserts mastership.

Default **asymmetric-hold-time** is disabled.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring VRRP Preemption and Hold Time on page 1755

authentication-key

Syntax authentication-key *key*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description Configure a Virtual Router Redundancy Protocol (VRRP) IPv4 authentication key. You also must specify a VRRP authentication scheme by including the **authentication-type** statement.

All routers in the VRRP group must use the same authentication scheme and password.

NOTE: When VRRPv3 is enabled, the **authentication-type** and **authentication-key** statements cannot be configured for any VRRP groups.

Options *key*—Authentication password. For simple authentication, it can be 1 through 8 characters long. For Message Digest 5 (MD5) authentication, it can be 1 through 16 characters long. If you include spaces, enclose all characters in quotation marks (" ").

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring VRRP Authentication (IPv4 Only)*
- Configuring VRRP Authentication (IPv4 Only) on page 1753
- **authentication-type on page 1781**
- *version-3*

authentication-type

Syntax authentication-type *authentication*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description Enable Virtual Router Redundancy Protocol (VRRP) IPv4 authentication and specify the authentication scheme for the VRRP group. If you enable authentication, you must specify a password by including the **authentication-key** statement.

All routers in the VRRP group must use the same authentication scheme and password.

NOTE: When VRRPv3 is enabled, the **authentication-type** and **authentication-key** statements cannot be configured for any VRRP groups.

Options *authentication*—Authentication scheme:

- **simple**—Use a simple password. The password is included in the transmitted packet, so this method of authentication is relatively insecure.
- **md5**—Use the MD5 algorithm to create an encoded checksum of the packet. The encoded checksum is included in the transmitted packet. The receiving routing platform uses the authentication key to verify the packet, discarding it if the digest does not match. This algorithm provides a more secure authentication scheme.

Default: none (no authentication is performed).

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring VRRP Authentication (IPv4 Only)*
- Configuring VRRP Authentication (IPv4 Only) on page 1753
- **authentication-key on page 1780**
- *version-3*

bandwidth-threshold

Syntax bandwidth-threshold *bits-per-second* priority-cost *priority*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* track interface *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* track interface *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* track interface *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* track interface *interface-name*]

Release Information Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description Specify the bandwidth threshold for Virtual Router Redundancy Protocol (VRRP) logical interface tracking.

Options *bits-per-second*—Bandwidth threshold for the tracked interface. When the bandwidth of the tracked interface drops below the specified value, the VRRP group uses the bandwidth threshold priority cost value. You can include up to five bandwidth threshold statements for each interface you track.

Range: 1 through 10000000000000 bits per second

priority-cost ***priority***—The value subtracted from the configured VRRP priority when the tracked interface or route is down to force a new master router election. The sum of all the costs for all interfaces or routes that are tracked must be less than or equal to the configured priority of the VRRP group.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring a Logical Interface to Be Tracked*
- Configuring a Logical Interface to Be Tracked on page 1757

failover-delay

Syntax failover-delay *milliseconds*;

Hierarchy Level [edit protocols vrrp]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description If you configure multiple VRRP groups on an interface (using multiple VLANs), traffic for some of the groups might be briefly dropped if a failover occurs. This can happen because the new master must send gratuitous ARP replies for each VRRP group to update the ARP tables in the connected devices, and there is a short delay between each gratuitous ARP reply. Traffic sent by devices that have not yet received the gratuitous ARP reply is dropped (until the device receives the reply and learns the MAC address of the new master).

If you configure a failover delay, the new master delays sending gratuitous ARP replies for the period that you set. This allows the new master to send the ARP replies for all of the VRRP groups simultaneously.

Options ***milliseconds***—Specify the failover delay time, in milliseconds.

Range: 50 through 2000

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Troubleshooting VRRP on page 1835
- **show vrrp on page 1824**

fast-interval

Syntax fast-interval *milliseconds*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description Configure the interval, in milliseconds, between Virtual Router Redundancy Protocol (VRRP) advertisement packets.

All routers in the VRRP group must use the same advertisement interval.

Options ***milliseconds***—Interval between advertisement packets.

Range: 10 through 40,950 milliseconds (range extended from 100–999 to 10–40,950 in Junos OS Release 12.2).

NOTE: When configuring VRRP for IPv4, if you have chosen not to enable VRRPv3, you cannot set a value less than 100 for **fast-interval**. Commit check fails if a value less than 100 is configured.

Default: 1 second

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Advertisement Interval for the VRRP Master Router*
- Configuring the Advertisement Interval for the VRRP Master on page 1754
- **advertise-interval on page 1778**
- **advertise-interval on page 1778**
- *inet6-advertise-interval*
- *version-3*

hold-time (VRRP)

Syntax hold-time *seconds*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* preempt],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* preempt],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* preempt],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* preempt]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description In a Virtual Router Redundancy Protocol (VRRP) configuration, set the hold time before a higher-priority backup router preempts the master router.

Default VRRP preemption is not timed.

Options *seconds*—Hold-time period.

Range: 0 through 3600 seconds

Default: 0 seconds (VRRP preemption is not timed.)

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring a Backup Router to Preempt the Master Router*
- Configuring VRRP Preemption and Hold Time on page 1755

interface (VRRP Group)

Syntax

interface *interface-name* {
  bandwidth-threshold *bits-per-second* priority-cost *priority*;
  priority-cost *priority*;
}

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* track],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* track],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* track],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* track]

Release Information

Statement introduced before Junos OS Release 7.4.
bandwidth-threshold statement added in Junos OS Release 8.1.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description

Enable logical interface tracking for a Virtual Router Redundancy Protocol (VRRP) group.

WARNING: On a QFabric system, do not apply interface tracking to a multichassis link aggregation group (MC-LAG) that includes an interface belonging to a network Node group device and an interface belonging to a server Node group device. If you do apply interface tracking to an MC-LAG configured in this way, a priority update will not occur if the state of the MC-LAG interface changes.

Options

interface-name—Interface to be tracked for this VRRP group.

Range: 1 through 10 interfaces

The remaining statements are explained separately.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring a Logical Interface to Be Tracked*
- Configuring a Logical Interface to Be Tracked on page 1757
- *Junos OS Services Interfaces Library for Routing Devices*

preempt (VRRP)

Syntax

(preempt | no-preempt) {
  hold-time *seconds*;
}

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description

In a Virtual Router Redundancy Protocol (VRRP) configuration, determine whether or not a backup router can preempt a master router:

- **preempt**—Allow the master router to be preempted.

NOTE: By default, a higher-priority backup router can preempt a lower-priority master router.

- **no-preempt**—Prohibit the preemption of the master router. When **no-preempt** is configured, the backup router cannot preempt the master router even if the backup router has a higher priority.

The remaining statement is explained separately.

Default

By default the **preempt** statement is enabled, and a higher-priority backup router preempts a lower-priority master router even if the **preempt** statement is not explicitly configured.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring a Backup Router to Preempt the Master Router*
- Configuring VRRP Preemption and Hold Time on page 1755

priority (Protocols VRRP)

Syntax priority *priority*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description Configure a Virtual Router Redundancy Protocol (VRRP) router's priority for becoming the master default router. The router with the highest priority within the group becomes the master.

Options *priority*—Router's priority for being elected to be the master router in the VRRP group. A larger value indicates a higher priority for being elected.

Range: 1 through 255

Default: 100 (for backup routers)

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Basic VRRP Support*
- Configuring Basic VRRP Support on page 1752

priority-cost (VRRP)

Syntax priority-cost *priority*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* track interface *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* track interface *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* track interface *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* track interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.2 for ACX2000 Universal Access Routers.

Description Configure a Virtual Router Redundancy Protocol (VRRP) router's priority cost for becoming the master default router. The router with the highest priority within the group becomes the master.

Options *priority*—The value subtracted from the configured VRRP priority when the tracked interface or route is down to force a new master router election. The sum of all the costs for all interfaces or routes that are tracked must be less than or equal to the configured priority of the VRRP group.

Range: 1 through 254

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring a Logical Interface to Be Tracked*
- Configuring a Logical Interface to Be Tracked on page 1757

priority-hold-time

Syntax priority-hold-time *seconds*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* track],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* track],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* track],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* track]

Release Information Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description Configure a Virtual Router Redundancy Protocol (VRRP) router's priority hold time to define the minimum length of time that must elapse between dynamic priority changes. If the dynamic priority changes because of a tracking event, the priority hold timer begins running. If another tracking event or manual configuration change occurs while the timer is running, the new dynamic priority update is postponed until the timer expires.

NOTE: When the track feature is configured, and if VRRP should pre-empt due to the tracking interface or route transition, any configured pre-empt hold time will be ignored. VRRP master will pre-empt according to the configuration of the priority-hold time.

Options *seconds*—Minimum length of time that must elapse between dynamic priority changes.

Range: 0through 3600 seconds

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring a Logical Interface to Be Tracked*
- Configuring a Logical Interface to Be Tracked on page 1757

route (Interfaces)

Syntax route *prefix* routing-instance *instance-name* priority-cost *priority*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* track],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* track],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id* track],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id* track]

Release Information Statement introduced in Junos OS Release 9.0.
Statement introduced in Junos OS 11.3 for QFX Series.
Statement introduced in Junos OS 12.1 for EX Series switches.

Description Enable route tracking for a Virtual Router Redundancy Protocol (VRRP) group.

Options ***prefix***—Route to be tracked for this VRRP group.

priority-cost *priority*—The value subtracted from the configured VRRP priority when the tracked interface or route is down, forcing a new master router election. The sum of all the costs for all interfaces or routes that are tracked must be less than or equal to the configured priority of the VRRP group.

routing-instance *instance-name*—Routing instance in which the route is to be tracked. If the route is in the default, or global, routing instance, the value for ***instance-name*** must be **default**.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring a Route to Be Tracked*
- Configuring a Route to Be Tracked on page 1756

startup-silent-period

Syntax startup-silent-period *seconds*;

Hierarchy Level [edit protocols vrrp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description Instruct the system to ignore the Master Down Event when an interface transitions from the down state to the up state. This statement is used to avoid incorrect error alarms caused by the delay or interruption of incoming Virtual Router Redundancy Protocol (VRRP) advertisement packets during the interface startup phase.

Options *seconds*—Number of seconds for the startup period.

Default: 4 seconds

Range: 1 through 2000 seconds

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Startup Period for VRRP Operations*
- Configuring the Startup Period for VRRP Operations on page 1754

traceoptions

Syntax

```
traceoptions {
  file <filename> <files number> <match regular-expression> <microsecond-stamp>
    <size size> <world-readable | no-world-readable>;
  flag flag;
  no-remote-trace;
}
```

Hierarchy Level [edit protocols vrrp]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Define tracing operations for the Virtual Router Redundancy Protocol (VRRP) process.

To specify more than one tracing operation, include multiple **flag** statements.

By default, VRRP logs the error, dcd configuration, and routing socket events in a file in the directory **/var/log**.

NOTE: **The traceoptions statement is not supported on a QFabric system.**

Default If you do not include this statement, no VRRP-specific tracing operations are performed.

Options

filename *filename*—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. By default, VRRP tracing output is placed in the file **vrrpd**.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. When the maximum number is reached, the oldest trace file is overwritten.

Range: 0 through 4,294,967,296 files

Default: 3 files

If you specify a maximum number of files, you also must specify a maximum file size with the **size** option.

flag *flag*—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements. These are the VRRP-specific tracing options:

- **all**—All VRRP tracing operations
- **database**—Database changes
- **general**—General events
- **interfaces**—Interface changes

- **normal**—Normal events
- **packets**—Packets sent and received
- **state**—State transitions
- **timer**—Timer events

match ***regex***—(Optional) Refine the output to include only those lines that match the given regular expression.

microsecond-stamp—(Optional) Provide a timestamp with microsecond granularity.

no-world-readable—Restrict users from reading the log file.

size ***size***—(Optional) Maximum size of each trace file, in kilobytes, megabytes, or gigabytes. When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*****.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*****.0.** is renamed ***trace-file*****.1** and ***trace-file*** is renamed ***trace-file*****.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

Syntax: ***x*****k** to specify KB, ***x*****m** to specify MB, or ***x*****g** to specify GB

Range: 10 KB through the maximum file size supported on your routing platform

Default: 1 MB

If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

world-readable—Allow users to read the log file.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Tracing VRRP Operations*

track (VRRP)

Syntax

```
track {
  interface interface-name {
    bandwidth-threshold bits-per-second priority-cost priority;
    priority-cost priority;
  }
  priority-hold-time seconds;
  route prefix/prefix-length routing-instance instance-name priority-cost priority;
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet6 address *address* vrrp-inet6-group *group-id*]

Release Information

Statement introduced before Junos OS Release 7.4.
priority-hold-time statement added in Junos OS Release 8.1.
route statement added in Junos OS Release 9.0.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description

Enable logical interface tracking, route tracking, or both, for a Virtual Router Redundancy Protocol (VRRP) group.

Options

The remaining statements are described separately.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring a Logical Interface to Be Tracked*
- *Configuring a Route to Be Tracked*
- Configuring a Logical Interface to Be Tracked on page 1757
- Configuring a Route to Be Tracked on page 1756

virtual-address

Syntax virtual-address [*addresses*];

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* vrrp-group *group-id*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description Configure the addresses of the virtual routers in a Virtual Router Redundancy Protocol (VRRP) IPv4 or IPv6 group. You can configure up to eight addresses.

Options ***addresses***—Addresses of one or more virtual routers. Do not include a prefix length. If the address is the same as the interface's physical address, the interface becomes the master virtual router for the group.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Basic VRRP Support*
- Configuring Basic VRRP Support on page 1752

vrrp-group

Syntax

```
vrrp-group group-id {
  (accept-data | no-accept-data);
  advertise-interval seconds;
  advertisements-threshold number;
  authentication-key key;
  authentication-type authentication;
  fast-interval milliseconds;
  (preempt | no-preempt) {
    hold-time seconds;
  }
  priority number;
  track {
    interface interface-name {
      bandwidth-threshold bits-per-second priority-cost priority;
      priority-cost priority;
    }
    priority-hold-time seconds;
    route prefix/prefix-length routing-instance instance-name priority-cost priority;
  }
  virtual-address [ addresses ];
  vrrp-inherit-from vrrp-group;
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description

Configure a Virtual Router Redundancy Protocol (VRRP) IPv4 group.

Options

group-id—VRRP group identifier. If you enable MAC source address filtering on the interface, you must include the virtual MAC address in the list of source MAC addresses that you specify in the **source-address-filter** statement. MAC addresses ranging from **00:00:5e:00:01:00** through **00:00:5e:00:01:ff** are reserved for VRRP, as defined in RFC 2338. The VRRP group number must be the decimal equivalent of the last hexadecimal byte of the virtual MAC address.

Range: 0 through 255

The remaining statements are explained separately.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Basic VRRP Support*
- *Example: Configuring VRRP*
- Configuring Basic VRRP Support on page 1752

- Example: Configuring VRRP for Load Sharing on page 1746
- *vrrp-inet6-group*

CHAPTER 21

Administration

Operational Mode Commands for Graceful Restart

Verifying Graceful Restart Operation

This topic contains the following sections:

Graceful Restart Operational Mode Commands

To verify proper operation of graceful restart, use the following commands:

- **show bgp neighbor** (for BGP graceful restart)
- **show log** (for IS-IS and OSPF/OSPFv3 graceful restart)
- **show (ospf | ospfv3) overview** (for OSPF/OSPFv3 graceful restart)
- **show rsvp neighbor detail** (for RSVP graceful restart—helper router)
- **show rsvp version** (for RSVP graceful restart—restarting router)
- **show ldp session detail** (for LDP graceful restart)
- **show connections** (for CCC and TCC graceful restart)

- **show route instance detail** (for Layer 3 VPN graceful restart and for any protocols using graceful restart in a routing instance)
- **show route protocol l2vpn** (for Layer 2 VPN graceful restart)

For more information about these commands and a description of their output fields, see the CLI Explorer.

Verifying BGP Graceful Restart

To view graceful restart information for BGP sessions, use the **show bgp neighbor** command:

```
user@PE1> show bgp neighbor 192.255.10.1
Peer: 192.255.10.1+179 AS 64595 Local: 192.255.5.1+1106 AS 64595
  Type: Internal    State: Established    Flags: <>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ static ]
  Options:<Preference LocalAddress HoldTime GracefulRestart Damping PeerAS Refresh>

  Local Address: 192.255.5.1 Holdtime: 90 Preference: 170
  IPSec SA Name: hope
  Number of flaps: 0
  Peer ID: 192.255.10.1     Local ID: 192.255.5.1      Active Holdtime: 90
  Keepalive Interval: 30
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 180
 Stale routes from peer are kept for: 180
 Restart time requested by this peer: 300
  NLRI that peer supports restart for: inet-unicast
  NLRI that peer saved forwarding for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Table inet.0 Bit: 10000
    RIB State: restart is complete
    Send state: in sync
    Active prefixes: 0
    Received prefixes: 0
    Suppressed due to damping: 0
  Last traffic (seconds): Received 19   Sent 19   Checked 19
  Input messages:  Total 2      Updates 1       Refreshes 0     Octets 42
  Output messages: Total 3      Updates 0       Refreshes 0     Octets 116
  Output Queue[0]: 0
```

Verifying IS-IS and OSPF Graceful Restart

To view graceful restart information for IS-IS and OSPF, configure traceoptions (see "Tracking Graceful Restart Events" on page 1745).

Here is the output of a traceoptions log from an OSPF restarting router:

```
Oct  8 05:20:12 Restart mode - sending grace lsas
Oct  8 05:20:12 Restart mode - estimated restart duration timer triggered
Oct  8 05:20:13 Restart mode - Sending more grace lsas
```

Here is the output of a traceoptions log from an OSPF helper router:

```
Oct  8 05:20:14 Helper mode for neighbor 192.255.5.1
Oct  8 05:20:14  Received multiple grace lsa from 192.255.5.1
```

Verifying CCC and TCC Graceful Restart

To view graceful restart information for CCC and TCC connections, use the **show connections** command. The following example assumes four remote interface CCC connections between CE1 and CE2:

```
user@PE1> show connections
CCC and TCC connections [Link Monitoring On]
  Legend for status (St)               Legend for connection types
  UN -- uninitialized                  if-sw:  interface switching
  NP -- not present                    rmt-if: remote interface switching
  WE -- wrong encapsulation            lsp-sw: LSP switching
  DS -- disabled
  Dn -- down                           Legend for circuit types
  -> -- only outbound conn is up       intf -- interface
  <- -- only inbound  conn is up       tlsp -- transmit LSP
  Up -- operational                    rlsp -- receive LSP
  RmtDn -- remote CCC down
  Restart -- restarting
```

CCC Graceful restart : Restarting

```
Connection/Circuit                  Type    St      Time last up     # Up trans
CE1-CE2-0                           rmt-if  Restart -----                     0
  fe-1/1/0.0                          intf  Up
  PE1-PE2-0                           tlsp  Up
  PE2-PE1-0                           rlsp  Up
CE1-CE2-1                           rmt-if  Restart -----                     0
  fe-1/1/0.1                          intf  Up
  PE1-PE2-1                           tlsp  Up
  PE2-PE1-1                           rlsp  Up
CE1-CE2-2                           rmt-if  Restart -----                     0
  fe-1/1/0.2                          intf  Up
  PE1-PE2-2                           tlsp  Up
  PE2-PE1-2                           rlsp  Up
CE1-CE2-3                           rmt-if  Restart -----                     0
  fe-1/1/0.3                          intf  Up
  PE1-PE2-3                           tlsp  Up
  PE2-PE1-3                           rlsp  Up
```

Related Documentation

- Graceful Restart Concepts on page 1735
- *Configuring Graceful Restart for QFabric Systems*

show bgp neighbor

Syntax

show bgp neighbor
<exact-instance *instance-name*>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<*neighbor-address*>
<orf (detail | *neighbor-address*)

Syntax (EX Series Switch and QFX Series)

show bgp neighbor
<instance *instance-name*>
<exact-instance *instance-name*>
<*neighbor-address*>
<orf (*neighbor-address* | detail)

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
orf option introduced in Junos OS Release 9.2.
exact-instance option introduced in Junos OS Release 11.4.

Description

Display information about BGP peers.

Options

none—Display information about all BGP peers.

exact-instance *instance-name*—(Optional) Display information for the specified instance only.

instance *instance-name*—(Optional) Display information about BGP peers for all routing instances whose name begins with this string (for example, **cust1**, **cust11**, and **cust111** are all displayed when you run the **show bgp neighbor instance cust1** command).

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

neighbor-address—(Optional) Display information for only the BGP peer at the specified IP address.

orf (detail | *neighbor-address*)—(Optional) Display outbound route-filtering information for all BGP peers or only for the BGP peer at the specified IP address. The default is to display brief output. Use the **detail** option to display detailed output.

Additional Information

For information about the **local-address, nlri**, **hold-time,** and **preference** statements, see the *Junos OS Routing Protocols Library for Routing Devices*.

Required Privilege Level

view

Related Documentation

- clear bgp neighbor on page 3131

List of Sample Output

show bgp neighbor on page 1809
show bgp neighbor (CLNS) on page 1810
show bgp neighbor (Layer 2 VPN) on page 1810
show bgp neighbor (Layer 3 VPN) on page 1812
show bgp neighbor neighbor-address on page 1813
show bgp neighbor neighbor-address on page 1814
show bgp neighbor orf neighbor-address detail on page 1815

Output Fields Table 154 on page 1803 describes the output fields for the **show bgp neighbor** command. Output fields are listed in the approximate order in which they appear.

Table 154: show bgp neighbor Output Fields

Field Name	Field Description
Peer	Address of the BGP neighbor. The address is followed by the neighbor port number.
AS	AS number of the peer.
Local	Address of the local routing device. The address is followed by the peer port number.
Type	Type of peer: **Internal** or **External**.
State	Current state of the BGP session: • **Active**—BGP is initiating a transport protocol connection in an attempt to connect to a peer. If the connection is successful, BGP sends an Open message. • **Connect**—BGP is waiting for the transport protocol connection to be completed. • **Established**—The BGP session has been established, and the peers are exchanging update messages. • **Idle**—This is the first stage of a connection. BGP is waiting for a Start event. • **OpenConfirm**—BGP has acknowledged receipt of an open message from the peer and is waiting to receive a keepalive or notification message. • **OpenSent**—BGP has sent an open message and is waiting to receive an open message from the peer.
Flags	Internal BGP flags: • **Aggregate Label**—BGP has aggregated a set of incoming labels (labels received from the peer) into a single forwarding label. • **CleanUp**—The peer session is being shut down. • **Delete**—This peer has been deleted. • **Idled**—This peer has been permanently idled. • **ImportEval**—At the last commit operation, this peer was identified as needing to reevaluate all received routes. • **Initializing**—The peer session is initializing. • **SendRtn**—Messages are being sent to the peer. • **Sync**—This peer is synchronized with the rest of the peer group. • **TryConnect**—Another attempt is being made to connect to the peer. • **Unconfigured**—This peer is not configured. • **WriteFailed**—An attempt to write to this peer failed.

Table 154: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Last state	Previous state of the BGP session: • **Active**—BGP is initiating a transport protocol connection in an attempt to connect to a peer. If the connection is successful, BGP sends an Open message. • **Connect**—BGP is waiting for the transport protocol connection to be completed. • **Established**—The BGP session has been established, and the peers are exchanging update messages. • **Idle**—This is the first stage of a connection. BGP is waiting for a Start event. • **OpenConfirm**—BGP has acknowledged receipt of an open message from the peer and is waiting to receive a keepalive or notification message. • **OpenSent**—BGP has sent an open message and is waiting to receive an open message from the peer.
Last event	Last activity that occurred in the BGP session: • **Closed**—The BGP session closed. • **ConnectRetry**—The transport protocol connection failed, and BGP is trying again to connect. • **HoldTime**—The session ended because the hold timer expired. • **KeepAlive**—The local routing device sent a BGP keepalive message to the peer. • **Open**—The local routing device sent a BGP open message to the peer. • **OpenFail**—The local routing device did not receive an acknowledgment of a BGP open message from the peer. • **RecvKeepAlive**—The local routing device received a BGP keepalive message from the peer. • **RecvNotify**—The local routing device received a BGP notification message from the peer. • **RecvOpen**—The local routing device received a BGP open message from the peer. • **RecvUpdate**—The local routing device received a BGP update message from the peer. • **Start**—The peering session started. • **Stop**—The peering session stopped. • **TransportError**—A TCP error occurred.
Last error	Last error that occurred in the BGP session: • **Cease**—An error occurred, such as a version mismatch, that caused the session to close. • **Finite State Machine Error**—In setting up the session, BGP received a message that it did not understand. • **Hold Time Expired**—The session's hold time expired. • **Message Header Error**—The header of a BGP message was malformed. • **Open Message Error**—A BGP open message contained an error. • **None**—No errors occurred in the BGP session. • **Update Message Error**—A BGP update message contained an error.
Export	Name of the export policy that is configured on the peer.
Import	Name of the import policy that is configured on the peer.

Table 154: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Options	Configured BGP options: • **AddressFamily**—Configured address family: **inet** or **inet-vpn**. • **AutheKeyChain**—Authentication key change is enabled. • **DropPathAttributes**—Certain path attributes are configured to be dropped from neighbor updates during inbound processing. • **GracefulRestart**—Graceful restart is configured. • **HoldTime**—Hold time configured with the **hold-time** statement. The hold time is three times the interval at which keepalive messages are sent. • **IgnorePathAttributes**—Certain path attributes are configured to be ignored in neighbor updates during inbound processing. • **Local Address**—Address configured with the **local-address** statement. • **Multihop**—Allow BGP connections to external peers that are not on a directly connected network. • **NLRI**—Configured MBGP state for the BGP group: **multicast**, **unicast**, or both if you have configured **nlri any**. • **Peer AS**—Configured peer autonomous system (AS). • **Preference**—Preference value configured with the **preference** statement. • **Refresh**—Configured to refresh automatically when the policy changes. • **Rib-group**—Configured routing table group.
Path-attributes dropped	Path attribute codes that are dropped from neighbor updates.
Path-attributes ignored	Path attribute codes that are ignored during neighbor updates.
Authentication key change	(appears only if the **authentication-keychain** statement has been configured) Name of the authentication keychain enabled.
Authentication algorithm	(appears only if the **authentication-algorithm** statement has been configured) Type of authentication algorithm enabled: **hmac** or **md5**.
Address families configured	Names of configured address families for the VPN.
Local Address	Address of the local routing device.
Remove-private options	Options associated with the remove-private statement.
Holdtime	Hold time configured with the **hold-time** statement. The hold time is three times the interval at which keepalive messages are sent.
Flags for NLRI inet-label-unicast	Flags related to labeled-unicast: • **TrafficStatistics**—Collection of statistics for labeled-unicast traffic is enabled.

Table 154: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Traffic statistics	Information about labeled-unicast traffic statistics: • **Options**—Options configured for collecting statistics about labeled-unicast traffic. • **File**—Name and location of statistics log files. • **size**—Size of all the log files, in bytes. • **files**—Number of log files.
Traffic Statistics Interval	Time between sample periods for labeled-unicast traffic statistics, in seconds.
Preference	Preference value configured with the **preference** statement.
Outbound Timer	Time for which the route is available in Junos OS routing table before it is exported to BGP. This field is displayed in the output only if the **out-delay** parameter is configured to a non-zero value.
Number of flaps	Number of times the BGP session has gone down and then come back up.
Peer ID	Router identifier of the peer.
Group index	Index number for the BGP peer group. The index number differentiates between groups when a single BGP group is split because of different configuration options at the group and peer levels.
Peer index	Index that is unique within the BGP group to which the peer belongs.
Local ID	Router identifier of the local routing device.
Local Interface	Name of the interface on the local routing device.
Active holdtime	Hold time that the local routing device negotiated with the peer.
Keepalive Interval	Keepalive interval, in seconds.
BFD	Status of BFD failure detection.
Local Address	Name of directly connected interface over which direct EBGP peering is established.
NLRI for restart configured on peer	Names of address families configured for restart.
NLRI advertised by peer	Address families supported by the peer: **unicast** or **multicast**.
NLRI for this session	Address families being used for this session.
Peer supports Refresh capability	Remote peer's ability to send and request full route table readvertisement (route refresh capability). For more information, see RFC 2918, *Route Refresh Capability for BGP-4*.
Restart time configured on peer	Configured time allowed for restart on the neighbor.

Table 154: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Stale routes from peer are kept for	When graceful restart is negotiated, the maximum time allowed to hold routes from neighbors after the BGP session has gone down.
Peer does not support Restarter functionality	Graceful restart restarter-mode is disabled on the peer.
Peer does not support Receiver functionality	Graceful restart helper-mode is disabled on the peer.
Restart time requested by this peer	Restart time requested by this neighbor during capability negotiation.
Restart flag received from the peer	When this field appears, the BGP speaker has restarted (Restarting), and this peer should not wait for the **end-of-rib** marker from the speaker before advertising routing information to the speaker.
NLRI that peer supports restart for	Neighbor supports graceful restart for this address family.
NLRI peer can save forwarding state	Neighbor supporting this address family saves all forwarding states.
NLRI that peer saved forwarding for	Neighbor saves all forwarding states for this address family.
NLRI that restart is negotiated for	Router supports graceful restart for this address family.
NLRI of received end-of-rib markers	Address families for which end-of-routing-table markers are received from the neighbor.
NLRI of all end-of-rib markers sent	Address families for which end-of-routing-table markers are sent to the neighbor.
Peer supports 4 byte AS extension (peer-as 1)	Peer understands 4-byte AS numbers in BGP messages. The peer is running Junos OS Release 9.1 or later.
NLRIs for which peer can receive multiple paths	Appears in the command output of the local router if the downstream peer is configured to receive multiple BGP routes to a single destination, instead of only receiving the active route. Possible value is **inet-unicast**.
NLRIs for which peer can send multiple paths: inet-unicast	Appears in the command output of the local router if the upstream peer is configured to send multiple BGP routes to a single destination, instead of only sending the active route. Possible value is **inet-unicast**.

Table 154: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Table inet.*number*	Information about the routing table: • **RIB State**—BGP is in the graceful restart process for this routing table: **restart is complete** or **restart in progress**. • **Bit**—Number that represents the entry in the routing table for this peer. • **Send state**—State of the BGP group: **in sync**, **not in sync**, or **not advertising**. • **Active prefixes**—Number of prefixes received from the peer that are active in the routing table. • **Received prefixes**—Total number of prefixes from the peer, both active and inactive, that are in the routing table. • **Accepted prefixes**—Total number of prefixes from the peer that have been accepted by a routing policy. • **Suppressed due to damping**—Number of routes currently inactive because of damping or other reasons. These routes do not appear in the forwarding table and are not exported by routing protocols.
Last traffic (seconds)	Last time any traffic was received from the peer or sent to the peer, and the last time the local routing device checked.
Input messages	Messages that BGP has received from the receive socket buffer, showing the total number of messages, number of update messages, number of times a policy is changed and refreshed, and the buffer size in octets. The buffer size is 16 KB.
Output messages	Messages that BGP has written to the transmit socket buffer, showing the total number of messages, number of update messages, number of times a policy is changed and refreshed, and the buffer size in octets. The buffer size is 16 KB.
Input dropped path attributes	Information about dropped path attributes: • Code—Path attribute code. • Count—Path attribute count.
Input ignored path attributes	Information about ignored path attributes: • Code—Path attribute code. • Count—Path attribute count.
Output queue	Number of BGP packets that are queued to be transmitted to a particular neighbor for a particular routing table. Output queue **0** is for unicast NLRIs, and queue **1** is for multicast NLRIs.
Trace options	Configured tracing of BGP protocol packets and operations.
Trace file	Name of the file to receive the output of the tracing operation.
Filter Updates recv	(**orf** option only) Number of outbound-route filters received for each configured address family. NOTE: The counter is cumulative. For example, the counter is increased after the remote peer either resends or clears the outbound route filtering prefix list.

Table 154: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Immediate	(**orf** option only) Number of route updates received with the immediate flag set. The immediate flag indicates that the BGP peer should readvertise the updated routes. NOTE: The counter is cumulative. For example, the counter is increased after the remote peer either resends or clears the outbound route filtering prefix list.
Filter	(**orf** option only) Type of prefix filter received: **prefix-based** or **extended-community**.
Received filter entries	(**orf** option only) List of received filters displayed.
seq	(**orf** option only) Numerical order assigned to this prefix entry among all the received outbound route filter prefix entries.
prefix	(**orf** option only) Address for the prefix entry that matches the filter.
minlength	(**orf** option only) Minimum prefix length, in bits, required to match this prefix.
maxlength	(**orf** option only) Maximum prefix length, in bits, required to match this prefix.
match	(**orf** option only) For this prefix match, whether to **permit** or **deny** route updates.

Sample Output

show bgp neighbor

```
user@host > show bgp neighbor
Peer: 10.255.7.250+179 AS 10   Local: 10.255.7.248+63740 AS 10
  Type: Internal    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ redist_static ]
  Options: <Preference LocalAddress PeerAS Refresh>
  Local Address: 10.255.7.248 Holdtime: 90 Preference: 170 Outbound Timer: 50
  Number of flaps: 0
  Peer ID: 10.255.7.250    Local ID: 10.255.7.248      Active Holdtime: 90
  Keepalive Interval: 30         Group index: 0    Peer index: 0
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 10)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              1
    Received prefixes:            1
```



```
    Accepted prefixes:          1
    Suppressed due to damping:  0
    Advertised prefixes:        1
  Last traffic (seconds): Received 9    Sent 5    Checked 5
  Input messages:  Total 36     Updates 2       Refreshes 0     Octets 718
  Output messages: Total 37     Updates 1       Refreshes 0     Octets 796
  Output Queue[0]: 0

Peer: 10.255.162.214+52193 AS 100 Local: 10.255.167.205+179 AS 100
   Type: Internal    State: Established  (route reflector client)Flags: <Sync>
   Last State: OpenConfirm   Last Event: RecvKeepAlive
   Last Error: None
   Options: <Preference LocalAddress Cluster AddressFamily Rib-group Refresh>
   Address families configured: inet-unicast inet-vpn-unicast route-target
   Local Address: 10.255.167.205 Holdtime: 90 Preference: 170
   Number of flaps: 0
   Peer ID: 10.255.162.214  Local ID: 10.255.167.205    Active Holdtime: 90
   Keepalive Interval: 30         Group index: 0    Peer index: 1
```

show bgp neighbor (CLNS)

```
user@host> show bgp neighbor
Peer: 10.245.245.1+179 AS 200  Local: 10.245.245.3+3770 AS 100
  Type: External    State: Established    Flags: <ImportEval Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Multihop Preference LocalAddress HoldTime AddressFamily PeerAS
Rib-group Refresh>
  Address families configured: iso-vpn-unicast
  Local Address: 10.245.245.3 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.245.245.1     Local ID: 10.245.245.3     Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  NLRI advertised by peer: iso-vpn-unicast
  NLRI for this session: iso-vpn-unicast
  Peer supports Refresh capability (2)
  Table bgp.isovpn.0 Bit: 10000
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
    Send state: in sync
    Active prefixes:            3
    Received prefixes:          3
    Suppressed due to damping:  0
    Advertised prefixes:        3
  Table aaaa.iso.0
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
    Send state: not advertising
    Active prefixes:            3
    Received prefixes:          3
    Suppressed due to damping:  0
  Last traffic (seconds): Received 6    Sent 5    Checked 5
  Input messages:  Total 1736   Updates 4       Refreshes 0     Octets 33385
  Output messages: Total 1738   Updates 3       Refreshes 0     Octets 33305
  Output Queue[0]: 0
  Output Queue[1]: 0
```

show bgp neighbor (Layer 2 VPN)

```
user@host> show bgp neighbor
Peer: 10.69.103.2     AS 65100 Local: 10.69.103.1     AS 65103
  Type: External    State: Active         Flags: <ImportEval>
```



```
  Last State: Idle          Last Event: Start
  Last Error: None
  Export: [ BGP-INET-import ]
  Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily   PeerAS
 Refresh>
  Address families configured: inet-unicast
  Local Address: 10.69.103.1 Holdtime: 90 Preference: 170
  Number of flaps: 0
Peer: 10.69.104.2     AS 65100 Local: 10.69.104.1     AS 65104
  Type: External    State: Active         Flags: <ImportEval>
  Last State: Idle          Last Event: Start
  Last Error: None
  Export: [ BGP-L-import ]
  Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily PeerAS
 Refresh>
  Address families configured: inet-labeled-unicast
  Local Address: 10.69.104.1 Holdtime: 90 Preference: 170
  Number of flaps: 0
Peer: 10.255.14.182+179 AS 69    Local: 10.255.14.176+2131 AS 69
  Type: Internal    State: Established    Flags: <ImportEval>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily
  Rib-group Refresh>
  Address families configured: inet-vpn-unicast l2vpn
  Local Address: 10.255.14.176 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.255.14.182    Local ID: 10.255.14.176    Active Holdtime: 90
  Keepalive Interval: 30
  NLRI for restart configured on peer: inet-vpn-unicast l2vpn
  NLRI advertised by peer: inet-vpn-unicast l2vpn
  NLRI for this session: inet-vpn-unicast l2vpn
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-vpn-unicast l2vpn
  NLRI peer can save forwarding state: inet-vpn-unicast l2vpn
  NLRI that peer saved forwarding for: inet-vpn-unicast l2vpn
  NLRI that restart is negotiated for: inet-vpn-unicast l2vpn
  NLRI of received end-of-rib markers: inet-vpn-unicast l2vpn
  Table bgp.l3vpn.0 Bit: 10000
    RIB State: BGP restart in progress
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:           10
    Received prefixes:         10
    Suppressed due to damping:  0
  Table bgp.l2vpn.0 Bit: 20000
    RIB State: BGP restart in progress
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:           1
    Received prefixes:         1
    Suppressed due to damping:  0
  Table BGP-INET.inet.0 Bit: 30000
    RIB State: BGP restart in progress
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:           2
    Received prefixes:         2
```

```
    Suppressed due to damping:  0
  Table BGP-L.inet.0 Bit: 40000
    RIB State: BGP restart in progress
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            2
    Received prefixes:          2
    Suppressed due to damping:  0
  Table LDP.inet.0 Bit: 50000
    RIB State: BGP restart is complete
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            1
    Received prefixes:          1
    Suppressed due to damping:  0
  Table OSPF.inet.0 Bit: 60000
    RIB State: BGP restart is complete
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            2
    Received prefixes:          2
    Suppressed due to damping:  0
  Table RIP.inet.0 Bit: 70000
    RIB State: BGP restart is complete
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            2
    Received prefixes:          2
    Suppressed due to damping:  0
  Table STATIC.inet.0 Bit: 80000
    RIB State: BGP restart is complete
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            1
    Received prefixes:          1
    Suppressed due to damping:  0
  Table L2VPN.l2vpn.0 Bit: 90000
    RIB State: BGP restart is complete
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            1
    Received prefixes:          1
    Suppressed due to damping:  0
  Last traffic (seconds): Received 0    Sent 0    Checked 0
  Input messages:  Total 14     Updates 13      Refreshes 0     Octets 1053
  Output messages: Total 3      Updates 0       Refreshes 0     Octets 105
  Output Queue[0]: 0
  Output Queue[1]: 0
  Output Queue[2]: 0
  Output Queue[3]: 0
  Output Queue[4]: 0
  Output Queue[5]: 0
  Output Queue[6]: 0
  Output Queue[7]: 0
  Output Queue[8]: 0
```

show bgp neighbor (Layer 3 VPN)

```
user@host> show bgp neighbor
Peer: 4.4.4.4+179     AS 10045 Local: 5.5.5.5+1214    AS 10045
  Type: Internal    State: Established    Flags: <ImportEval>
```



```
Last State: OpenConfirm   Last Event: RecvKeepAlive
Last Error: None
Export: [ match-all ] Import: [ match-all ]
Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily
 Rib-group Refresh>
Address families configured: inet-vpn-unicast
Local Address: 5.5.5.5 Holdtime: 90 Preference: 170
Flags for NLRI inet-labeled-unicast: TrafficStatistics
Traffic Statistics: Options: all File: /var/log/bstat.log
                                       size 131072 files 10
Traffic Statistics Interval: 60
Number of flaps: 0
Peer ID: 192.168.1.110    Local ID: 192.168.1.111    Active Holdtime: 90
Keepalive Interval: 30
NLRI for restart configured on peer: inet-vpn-unicast
NLRI advertised by peer: inet-vpn-unicast
NLRI for this session: inet-vpn-unicast
Peer supports Refresh capability (2)
Restart time configured on the peer: 120
Stale routes from peer are kept for: 300
Restart time requested by this peer: 120
NLRI that peer supports restart for: inet-vpn-unicast
NLRI peer can save forwarding state: inet-vpn-unicast
NLRI that peer saved forwarding for: inet-vpn-unicast
NLRI that restart is negotiated for: inet-vpn-unicast
NLRI of received end-of-rib markers: inet-vpn-unicast
NLRI of all end-of-rib markers sent: inet-vpn-unicast
Table bgp.l3vpn.0 Bit: 10000
  RIB State: BGP restart is complete
  RIB State: VPN restart is complete
  Send state: in sync
  Active prefixes:            2
  Received prefixes:          2
  Suppressed due to damping:  0
Table vpn-green.inet.0 Bit: 20001
  RIB State: BGP restart is complete
  RIB State: VPN restart is complete
  Send state: in sync
  Active prefixes:            2
  Received prefixes:          2
  Suppressed due to damping:  0
Last traffic (seconds): Received 15   Sent 20   Checked 20
Input messages:  Total 40     Updates 2       Refreshes 0     Octets 856
Output messages: Total 44     Updates 2       Refreshes 0     Octets 1066
Output Queue[0]: 0
Output Queue[1]: 0
Trace options: detail packets
Trace file: /var/log/bgpgr.log size 131072 files 10
```

show bgp neighbor neighbor-address

```
user@host> show bgp neighbor 192.168.1.111
Peer: 10.255.245.12+179 AS 35  Local: 10.255.245.13+2884 AS 35
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference LocalAddress HoldTime Cluster AddressFamily Rib-group
  Refresh>
  Address families configured: inet-vpn-unicast inet-labeled-unicast
  Local Address: 10.255.245.13 Holdtime: 90 Preference: 170
  Flags for NLRI inet-vpn-unicast: AggregateLabel
```

```
    Flags for NLRI inet-labeled-unicast: AggregateLabel
    Number of flaps: 0
    Peer ID: 10.255.245.12    Local ID: 10.255.245.13    Active Holdtime: 90
    Keepalive Interval: 30
  BFD: disabled
    NLRI advertised by peer: inet-vpn-unicast inet-labeled-unicast
    NLRI for this session: inet-vpn-unicast inet-labeled-unicast
    Peer supports Refresh capability (2)
    Restart time configured on the peer: 300
    Stale routes from peer are kept for: 60
    Restart time requested by this peer: 300
    NLRI that peer supports restart for: inet-unicast inet6-unicast
    NLRI that restart is negotiated for: inet-unicast inet6-unicast
    NLRI of received end-of-rib markers: inet-unicast inet6-unicast
    NLRI of all end-of-rib markers sent: inet-unicast inet6-unicast
    Table inet.0 Bit: 10000
      RIB State: restart is complete
      Send state: in sync
      Active prefixes: 4
      Received prefixes: 6
      Suppressed due to damping: 0
    Table inet6.0 Bit: 20000
      RIB State: restart is complete
      Send state: in sync
      Active prefixes: 0
      Received prefixes: 2
      Suppressed due to damping: 0
    Last traffic (seconds): Received 3    Sent 3    Checked 3
    Input messages:  Total 9      Updates 6       Refreshes 0     Octets 403
    Output messages: Total 7      Updates 3       Refreshes 0     Octets 365
    Output Queue[0]: 0
    Output Queue[1]: 0
    Trace options: detail packets
    Trace file: /var/log/bgpgr size 131072 files 10
```

show bgp neighbor neighbor-address

```
user@host> show bgp neighbor 192.168.4.222
Peer: 192.168.4.222+4902 AS 65501 Local: 192.168.4.221+179 AS 65500
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: Cease
  Export: [ export-policy ] Import: [ import-policy ]
  Options: <Preference HoldTime AddressFamily PeerAS PrefixLimit Refresh>
  Address families configured: inet-unicast inet-multicast
  Holdtime: 60000 Preference: 170
  Number of flaps: 4
  Last flap event: RecvUpdate
  Error: 'Cease' Sent: 5 Recv: 0
  Peer ID: 10.255.245.6     Local ID: 10.255.245.5     Active Holdtime: 60000
  Keepalive Interval: 20000      Peer index: 0
  BFD: disabled, down
  Local Interface: fxp0.0
  NLRI advertised by peer: inet-unicast inet-multicast
  NLRI for this session: inet-unicast inet-multicast
  Peer supports Refresh capability (2)
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:            8
    Received prefixes:          10
```

```
    Accepted prefixes:            10
    Suppressed due to damping:    0
    Advertised prefixes:          3
  Table inet.2 Bit: 20000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 357  Sent 357  Checked 357
  Input messages:  Total 4 Updates 2  Refreshes 0  Octets 211
  Output messages: Total 4 Updates 1  Refreshes 0  Octets 147
  Output Queue[0]: 0
  Output Queue[1]: 0
  Trace options:  all
  Trace file: /var/log/bgp size 10485760 files 10
```

show bgp neighbor orf neighbor-address detail

```
user@host > show bgp neighbor orf 192.168.165.56 detail
Peer: 192.168.165.56+179 Type: External
  Group: ext1

  inet-unicast
    Filter updates recv:          1 Immediate:          1
    Filter: prefix-based  receive
      Received filter entries:
        seq 1: prefix 2.2.2.2/32: minlen 32: maxlen 32: match deny:

  inet6-unicast
    Filter updates recv:          0 Immediate:          1
    Filter: prefix-based  receive
      Received filter entries:
        *:*
```


show log

Syntax

show log
<*filename* | user <*username*>>

Syntax (QFabric System)

show log *filename*
<*device-type (device-id* | *device-alias*)>

Syntax (TX Matrix Routers)

show log
<all-lcc | lcc *number* | scc>
<*filename* | user <*username*>>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Option *device-type (device-id* | *device-alias*) is introduced in Junos OS Release 13.1 for the QFX Series.

Description

List log files, display log file contents, or display information about users who have logged in to the router or switch.

Options

none—List all log files.

<all-lcc | lcc *number* | scc>—(TX Matrix routers only) (Optional) Display logging information about all T640 routers (or line-card chassis) or a specific T640 router (replace ***number*** with a value from 0 through 3) connected to a TX Matrix router. Or, display logging information about the TX Matrix router (or switch-card chassis).

device-type—(QFabric system only) (Optional) Display log messages for only one of the following device types:

- **director-device**—Display logs for Director devices.
- **infrastructure-device**—Display logs for the logical components of the QFabric system infrastructure, including the diagnostic Routing Engine, fabric control Routing Engine, fabric manager Routing Engine, and the default network Node group and its backup (NW-NG-0 and NW-NG-0-backup).
- **interconnect-device**—Display logs for Interconnect devices.
- **node-device**—Display logs for Node devices.

NOTE: If you specify the **device-type** optional parameter, you must also specify either the **device-id** or **device-alias** optional parameter.

(*device-id* | *device-alias*)—If a device type is specified, display logs for a device of that type. Specify either the device ID or the device alias (if configured).

filename—(Optional) Display the log messages in the specified log file. For the routing matrix, the filename must include the chassis information.

NOTE: The *filename* parameter is mandatory for the QFabric system. If you did not configure a syslog filename, specify the default filename of messages.

user <*username*>—(Optional) Display logging information about users who have recently logged in to the router or switch. If you include ***username***, display logging information about the specified user.

Required Privilege Level trace

List of Sample Output

Sample Output

show log

```
user@host> show log
total 57518
-rw-r--r--  1 root  bin      211663 Oct  1 19:44 dcd
-rw-r--r--  1 root  bin      999947 Oct  1 19:41 dcd.0
-rw-r--r--  1 root  bin      999994 Oct  1 17:48 dcd.1
-rw-r--r--  1 root  bin      238815 Oct  1 19:44 rpd
-rw-r--r--  1 root  bin     1049098 Oct  1 18:00 rpd.0
-rw-r--r--  1 root  bin     1061095 Oct  1 12:13 rpd.1
-rw-r--r--  1 root  bin     1052026 Oct  1 06:08 rpd.2
-rw-r--r--  1 root  bin     1056309 Sep 30 18:21 rpd.3
-rw-r--r--  1 root  bin     1056371 Sep 30 14:36 rpd.4
-rw-r--r--  1 root  bin     1056301 Sep 30 10:50 rpd.5
-rw-r--r--  1 root  bin     1056350 Sep 30 07:04 rpd.6
-rw-r--r--  1 root  bin     1048876 Sep 30 03:21 rpd.7
-rw-rw-r--  1 root  bin       19656 Oct  1 19:37 wtmp
```

show log filename

```
user@host> show log rpd
Oct  1 18:00:18 trace_on: Tracing to ?/var/log/rpd? started
Oct  1 18:00:18 EVENT <MTU> ds-5/2/0.0 index 24 <Broadcast PointToPoint Multicast
Oct  1 18:00:18
Oct  1 18:00:19 KRT recv len 56 V9 seq 148 op add Type route/if af 2 addr
13.13.13.21 nhop type local nhop 13.13.13.21
Oct  1 18:00:19 KRT recv len 56 V9 seq 149 op add Type route/if af 2 addr
13.13.13.22 nhop type unicast nhop 13.13.13.22
Oct  1 18:00:19 KRT recv len 48 V9 seq 150 op add Type ifaddr index 24 devindex
43
Oct  1 18:00:19 KRT recv len 144 V9 seq 151 op chnge Type ifdev devindex 44
Oct  1 18:00:19 KRT recv len 144 V9 seq 152 op chnge Type ifdev devindex 45
Oct  1 18:00:19 KRT recv len 144 V9 seq 153 op chnge Type ifdev devindex 46
```

```
Oct  1 18:00:19 KRT recv len 1272 V9 seq 154 op chnge Type ifdev devindex 47
...
```

show log filename (QFabric System)

```
user@qfabric> show log messages
Mar 28 18:00:06 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:06 ED1486
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 1, jnxFruL3Index 0,
jnxFruName PIC: 48x 10G-SFP+ @ 0/0/*, jnxFruType 11, jnxFruSlot 0,
jnxFruOfflineReason 2, jnxFruLastPowerOff 0, jnxFruLastPowerOn 2159)
Mar 28 18:00:07 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:07 ED1486
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 2, jnxFruL3Index 0,
jnxFruName PIC:  @ 0/1/*, jnxFruType 11, jnxFruSlot 0, jnxFruOfflineReason 2,
jnxFruLastPowerOff 0, jnxFruLastPowerOn 2191)
Mar 28 18:00:07 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:07 ED1492
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 1, jnxFruL3Index 0,
jnxFruName PIC: 48x 10G-SFP+ @ 0/0/*, jnxFruType 11, jnxFruSlot 0,
jnxFruOfflineReason 2, jnxFruLastPowerOff 0, jnxFruLastPowerOn 242726)
Mar 28 18:00:07 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:07 ED1492
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 2, jnxFruL3Index 0,
jnxFruName PIC:  @ 0/1/*, jnxFruType 11, jnxFruSlot 0, jnxFruOfflineReason 2,
jnxFruLastPowerOff 0, jnxFruLastPowerOn 242757)
Mar 28 18:00:16 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:16 ED1486
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:00:27 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:27 ED1486
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:00:50 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:50
_DCF_default___NW-INE-0_RE0_ file: UI_COMMIT: User 'root' requested 'commit'
operation (comment: none)
Mar 28 18:00:50 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:50
_DCF_default___NW-INE-0_RE0_ file: UI_COMMIT: User 'root' requested 'commit'
operation (comment: none)
Mar 28 18:00:55 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:55 ED1492
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:01:10 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:01:10 ED1492
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:02:37 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:02:37 ED1491
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 1, jnxFruL3Index 0,
jnxFruName PIC: 48x 10G-SFP+ @ 0/0/*, jnxFruType 11, jnxFruSlot 0,
jnxFruOfflineReason 2, jnxFruLastPowerOff 0, jnxFruLastPowerOn 33809)
```

show log user

```
user@host> show log user
darius   mg2546                   Thu Oct  1 19:37   still logged in
darius   mg2529                   Thu Oct  1 19:08 - 19:36  (00:28)
darius   mg2518                   Thu Oct  1 18:53 - 18:58  (00:04)
root     mg1575                   Wed Sep 30 18:39 - 18:41  (00:02)
root     ttyp2    jun.site.per   Wed Sep 30 18:39 - 18:41  (00:02)
alex     ttyp1    192.168.1.2     Wed Sep 30 01:03 - 01:22  (00:19)
```


show (ospf | ospf3) overview

Syntax

show (ospf | ospf3) overview
<brief | extensive>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)>

Syntax (EX Series Switch and QFX Series)

show (ospf | ospf3) overview
<brief | extensive>
<instance *instance-name*>

Release Information

Command introduced in Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
realm option introduced in Junos OS Release 9.2.
Database protection introduced in Junos 10.2.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display Open Shortest Path First (OSPF) overview information.

Options

none—Display standard information about all OSPF neighbors for all routing instances.

brief | extensive—(Optional) Display the specified level of output.

instance *instance-name*—(Optional) Display all OSPF interfaces under the named routing instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)—(Optional) (OSPFv3 only) Display information about the specified OSPFv3 realm, or address family. Use the **realm** option to specify an address family for OSPFv3 other than IPv6 unicast, which is the default.

Required Privilege Level

view

List of Sample Output

show ospf overview on page 1821
show ospf overview (With Database Protection) on page 1822
show ospf3 overview (With Database Protection) on page 1822
show ospf overview extensive on page 1822

Output Fields

Table 155 on page 1819 lists the output fields for the **show ospf overview** command. Output fields are listed in the approximate order in which they appear.

Table 155: show ospf overview Output Fields

Field name	Field Description	Level of Output
Instance	OSPF routing instance.	All levels

Table 155: show ospf overview Output Fields *(continued)*

Field name	Field Description	Level of Output
Router ID	Router ID of the routing device.	All levels
Route table index	Route table index.	All levels
Configured overload	Overload capability is enabled. If the overload timer is also configured, display the time that remains before it is set to expire. This field is not displayed after the timer expires.	All levels
Toplogy	Topology identifier.	All levels
Prefix export count	Number of prefixes exported into OSPF.	All levels
Full SPF runs	Number of complete Shortest Path First calculations.	All levels
SPF delay	Delay before performing consecutive Shortest Path First calculations.	All levels
SPF holddown	Delay before performing additional Shortest Path First (SPF) calculations after the maximum number of consecutive SPF calculations is reached.	All levels
SPF rapid runs	Maximum number of Shortest Path First calculations that can be performed in succession before the hold-down timer begins.	All levels
LSA refresh time	Refresh period for link-state advertisement (in minutes).	All levels
Database protection state	Current state of database protection.	All levels
Warning threshold	Threshold at which a warning message is logged (percentage of maximum LSA count).	All levels
Non self-generated LSAs	Number of LSAs whose router ID is not equal to the local router ID: **Current**, **Warning** (threshold), and **Allowed**.	All levels
Ignore time	How long the database has been in the ignore state.	All levels
Reset time	How long the database must stay out of the ignore or isolated state before it returns to normal operations.	All levels
Ignore count	Number of times the database has been in the ignore state: **Current** and **Allowed**.	All levels
Restart	Graceful restart capability: **enabled** or **disabled**.	All levels
Restart duration	Time period for complete reacquisition of OSPF neighbors.	All levels
Restart grace period	Time period for which the neighbors should consider the restarting routing device as part of the topology.	All levels

Table 155: show ospf overview Output Fields *(continued)*

Field name	Field Description	Level of Output
Graceful restart helper mode	(OSPFv2) Standard graceful restart helper capability (based on RFC 3623): **enabled** or **disabled**.	All levels
Restart-signaling helper mode	(OSPFv2) Restart signaling-based graceful restart helper capability (based on RFC 4811, RFC 4812, and RFC 4813): **enabled** or **disabled**.	All levels
Helper mode	(OSPFv3) Graceful restart helper capability: **enabled** or **disabled**.	All levels
Trace options	OSPF-specific trace options.	**extensive**
Trace file	Name of the file to receive the output of the tracing operation.	**extensive**
Area	Area number. Area 0.0.0.0 is the backbone area.	All levels
Stub type	Stub type of area: **Normal Stub**, **Not Stub**, or **Not so Stubby Stub**.	All levels
Authentication Type	Type of authentication: **None**, **Password**, or **MD5**. NOTE: The **Authentication Type** field refers to the authentication configured at the **[edit protocols ospf area *area-id*]** level. Any authentication configured for an interface in this area will not affect the value of this field.	All levels
Area border routers	Number of area border routers.	All levels
Neighbors	Number of autonomous system boundary routers.	All levels

Sample Output

show ospf overview

```
user@host> show ospf overview
Instance: master
    Router ID: 10.255.245.6
    Route table index: 0
   Configured overload, expires in 118 seconds
    LSA refresh time: 50 minutes
  Restart: Enabled
     Restart duration: 20 sec
     Restart grace period: 40 sec
     Helper mode: enabled
  Area: 0.0.0.0
      Stub type: Not Stub
      Authentication Type: None
      Area border routers: 0, AS boundary routers: 0
      Neighbors
        Up (in full state): 0
    Topology: default (ID 0)
      Prefix export count: 0
      Full SPF runs: 1
      SPF delay: 0.200000 sec, SPF holddown: 5 sec, SPF rapid runs: 3
```


show ospf overview (With Database Protection)

```
user@host> show ospf overview
Instance: master
  Router ID: 10.255.112.218
  Route table index: 0
  LSA refresh time: 50 minutes
  Traffic engineering
  Restart: Enabled
    Restart duration: 180 sec
    Restart grace period: 210 sec
    Graceful restart helper mode: Enabled
    Restart-signaling helper mode: Enabled
  Database protection state: Normal
    Warning threshold: 70 percent
    Non self-generated LSAs: Current 582, Warning 700, Allowed 1000
    Ignore time: 30, Reset time: 60
    Ignore count: Current 0, Allowed 1
  Area: 0.0.0.0
    Stub type: Not Stub
    Authentication Type: None
    Area border routers: 0, AS boundary routers: 0
    Neighbors
      Up (in full state): 160
  Topology: default (ID 0)
    Prefix export count: 0
    Full SPF runs: 70
    SPF delay: 0.200000 sec, SPF holddown: 5 sec, SPF rapid runs: 3
    Backup SPF: Not Needed
```

show ospf3 overview (With Database Protection)

```
user@host> show ospf3 overview
Instance: master
  Router ID: 10.255.112.128
  Route table index: 0
  LSA refresh time: 50 minutes
  Database protection state: Normal
    Warning threshold: 80 percent
    Non self-generated LSAs: Current 3, Warning 8, Allowed 10
    Ignore time: 30, Reset time: 60
    Ignore count: Current 0, Allowed 2
  Area: 0.0.0.0
    Stub type: Not Stub
    Area border routers: 0, AS boundary routers: 0
    Neighbors
      Up (in full state): 1
  Topology: default (ID 0)
    Prefix export count: 0
    Full SPF runs: 7
    SPF delay: 0.200000 sec, SPF holddown: 5 sec, SPF rapid runs: 3
    Backup SPF: Not Needed
```

show ospf overview extensive

```
user@host> show ospf overview extensive
Instance: master
  Router ID: 1.1.1.103
  Route table index: 0
  Full SPF runs: 13, SPF delay: 0.200000 sec
  LSA refresh time: 50 minutes
```



```
Restart: Disabled
Trace options: lsa
Trace file: /var/log/ospf size 131072 files 10
Area: 0.0.0.0
  Stub type: Not Stub
  Authentication Type: None
  Area border routers: 0, AS boundary routers: 0
  Neighbors
    Up (in full state): 1
```

Operational Mode Commands for VRRP

- show vrrp

show vrrp

Syntax

show vrrp
<brief | detail | extensive | summary>
<interface *interface-name*>
<track interfaces>

Release Information

Statement introduced in Junos OS Release 10.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display information and status about VRRP groups.

Options

none—(Same as brief) Display brief status information about all VRRP interfaces.

brief | detail | extensive | summary—(Optional) Display the specified level of output.

interface *interface-name* —(Optional) Display information and status about the specified VRRP interface.

track interfaces—(Optional) Display information and status about VRRP track interfaces.

Required Privilege Level

view

Related Documentation

- *Configuring VRRP for IPv6 (CLI Procedure)*

List of Sample Output

Output Fields

Table 156 on page 1824 lists the output fields for the **show vrrp** command. Output fields are listed in the approximate order in which they appear.

Table 156: show vrrp Output Fields

Field Name	Field Description	Level of Output
Interface	Name of the logical interface.	**none, brief, extensive, summary**
Interface index	Physical interface index number, which reflects its initialization sequence.	**extensive**
Groups	Total number of VRRP groups configured on the interface.	**extensive**

Table 156: show vrrp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Active	Total number of VRRP groups that are active (that is, whose interface state is either up or down).	**extensive**
Interface VRRP PDU statistics	Nonerrored statistics for the logical interface: • **Advertisement sent**—Number of VRRP advertisement protocol data units (PDUs) that the interface has transmitted. • **Advertisement received**—Number of VRRP advertisement PDUs received by the interface. • **Packets received**—Number of VRRP packets received for VRRP groups on the interface. • **No group match received**—Number of VRRP packets received for VRRP groups that do not exist on the interface.	**extensive**
Interface VRRP PDU error statistics	Errored statistics for the logical interface: • **Invalid IPAH next type received**—Number of packets received that use the IP Authentication Header protocol (IPAH) and that do not encapsulate VRRP packets. • **Invalid VRRP ttl value received**—Number of packets received whose IP time-to-live (TTL) value is not 255. • **Invalid VRRP version received**—Number of packets received whose VRRP version is not 2. • **Invalid VRRP pdu type received**—Number of packets received whose VRRP PDU type is not 1. • **Invalid VRRP authentication type received**—Number of packets received whose VRRP authentication is not none, simple, or md5. • **Invalid VRRP IP count received**—Number of packets received whose VRRP IP count exceeds 8. • **Invalid VRRP checksum received**—Number of packets received whose VRRP checksum does not match the calculated value.	**extensive**
Physical interface	Name of the physical interface.	**detail, extensive**
Unit	Logical unit number.	All levels
Address	Address of the physical interface.	**none, brief, detail, extensive**
Index	Physical interface index number, which reflects its initialization sequence.	**detail, extensive**
SNMP ifIndex	SNMP index number for the physical interface.	**detail, extensive**
VRRP-Traps	Status of VRRP traps: **Enabled** or **Disabled**.	**detail, extensive**

Table 156: show vrrp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Type and Address	Identifier for the address and the address itself: • **lcl**—Configured local interface address. • **mas**—Address of the master virtual router. This address is displayed only when the local interface is acting as a backup router. • **vip**—Configured virtual IP addresses.	**none, brief, summary**
Interface state or **Int state**	State of the physical interface: • **down**—The device is present and the link is unavailable. • **not present**—The interface is configured, but no physical device is present. • **unknown**—The VRRP process has not had time to query the kernel about the state of the interface. • **up**—The device is present and the link is established.	**none, brief, extensive, summary**
Group	VRRP group number.	**none, brief, extensive, summary**
State	VRRP state: • **backup**—The interface is acting as the backup router interface. • **bringup**—VRRP is just starting, and the physical device is not yet present. • **idle**—VRRP is configured on the interface and is disabled. This can occur when VRRP is first enabled on an interface whose link is established. • **initializing**—VRRP is initializing. • **master**—The interface is acting as the master router interface. • **transition**—The interface is changing between being the backup and being the master router.	**extensive**
Priority	Configured VRRP priority for the interface.	**detail, extensive**
Advertisement interval	Configured VRRP advertisement interval.	**detail, extensive**
Authentication type	Configured VRRP authentication type: **none**, **simple**, or **md5**.	**detail, extensive**
Preempt	Whether preemption is allowed on the interface: **yes** or **no**.	**detail, extensive**
Accept-data mode	Whether the interface is configured to accept packets destined for the virtual IP address: **yes** or **no**.	**detail, extensive**
VIP count	Number of virtual IP addresses that have been configured on the interface.	**detail, extensive**
VIP	List of virtual IP addresses configured on the interface.	**detail, extensive**
Advertisement timer	Time until the advertisement timer expires.	**detail, extensive**

Table 156: show vrrp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Master router	IP address of the interface that is acting as the master. If the VRRP interface is down, the output is **N/A**.	**detail, extensive**
Virtual router uptime	Time that the virtual router has been up.	**detail, extensive**
Master router uptime	Time that the master router has been up.	**detail, extensive**
Virtual MAC	MAC address associated with the virtual IP address.	**detail, extensive**
Tracking	Whether tracking is **enabled** or **disabled**.	**detail, extensive**
Current priority	Current operational priority for being the VRRP master.	**detail, extensive**
Configured priority	Configured base priority for being the VRRP master.	**detail, extensive**
Priority hold-time	Minimum time interval, in seconds, between successive changes to the current priority. **Disabled** indicates no minimum interval.	**detail, extensive**
Remaining-time	(**track** option only) Displays the time remaining in the priority hold-time interval.	**detail**
Interface tracking	Whether interface tracking is enabled or disabled. When enabled, the output also displays the number of tracked interfaces.	**detail extensive**
Interface/Tracked interface	Name of the tracked interface.	**detail extensive**
Int state/Interface state	Current operational state of the tracked interface: **up** or **down**.	**detail, extensive**
Int speed/Speed	Current operational speed, in bits per second, of the tracked interface.	**detail, extensive**
Incurred priority cost	Operational priority cost incurred due to the state and speed of this tracked interface. This cost is applied to the configured priority to obtain the current priority.	**detail, extensive**
Threshold	Speed below which the corresponding priority cost is incurred. In other words, when the speed of the interface drops below the threshold speed, the corresponding priority cost is incurred. An entry of **down** means that the corresponding priority cost is incurred when the interface is down.	**detail, extensive**
Route tracking	Whether route tracking is enabled or disabled. When enabled, the output also displays the number of tracked routes.	**detail, extensive**
Route count	The number of routes being tracked.	**detail, extensive**

Table 156: show vrrp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Route	The IP address of the route being tracked.	**detail, extensive**
VRF name	The VPN routing and forwarding (VRF) routing instance that the tracked route is in.	**detail, extensive**
Route state	The state of the route being tracked: **up**, **down**, or **unknown**.	**detail, extensive**
Priority cost	Configured priority cost. This value is incurred when the interface speed drops below the corresponding threshold or when the tracked route goes down.	**detail, extensive**
Active	Whether the threshold is active (*). If the threshold is active, the corresponding priority cost is incurred.	**detail, extensive**
Group VRRP PDU statistics	Number of VRRP advertisements sent and received by the group.	**extensive**
Group VRRP PDU error statistics	Errored statistics for the VRRP group: • **Bad authentication type received**—Number of VRRP PDUs received with an invalid authentication type. The received authentication can be **none**, **simple**, or **md5** and must be the same for all routers in the VRRP group. • **Bad password received**—Number of VRRP PDUs received with an invalid key (password). The password for simple authentication must be the same for all routers in the VRRP group • **Bad MD5 digest received**—Number of VRRP PDUs received for which the MD5 digest computed from the VRRP PDU differs from the digest expected by the VRRP instance configured on the router. • **Bad advertisement timer received**—Number of VRRP PDUs received with an advertisement time interval that is inconsistent with the one in use among the routers in the VRRP group. • **Bad VIP count received**—Number of VRRP PDUs whose virtual IP address counts differ from the count that has been configured on the VRRP instance. • **Bad VIPADDR received**—Number of VRRP PDUs whose virtual IP addresses differ from the list of virtual IP addresses configured on the VRRP instance.	**extensive**
Group state transition statistics	State transition statistics for the VRRP group: • **Idle to master transitions**—Number of times that the VRRP instance transitioned from the idle state to the master state. • **Idle to backup transitions**—Number of times that the VRRP instance transitioned from the idle state to the backup state. • **Backup to master transitions**—Number of times that the VRRP instance transitioned from the backup state to the master state. • **Master to backup transitions**—Number of times that the VRRP instance transitioned from the master state to the backup state.	**extensive**
Vlan-id	ID of Vlan	**detail**

Table 156: show vrrp Output Fields *(continued)*

Field Name	Field Description	Level of Output
VR state	VRRP information: • **backup**—The interface is acting as the backup router interface. • **bringup**—VRRP is just starting, and the physical device is not yet present. • **idle**—VRRP is configured on the interface and is disabled. This can occur when VRRP is first enabled on an interface whose link is established. • **initializing**—VRRP is initializing. • **master**—The interface is acting as the master router interface. • **transition**—The interface is changing between being the backup and being the master router.	**none, brief**
Timer	VRRP timer information: • **A**—Time, in seconds, until the advertisement timer expires. • **D**—Time, in seconds, until the Master is Dead timer expires.	**none, brief**

Sample Output

show vrrp

```
user@host> show vrrp
Interface          State         Group    VR state     Timer   Type  Address
ge-0/0/0.121       up              1     master      A 1.052  lcl   gec0::12:1:1:1

                                                             vip   ge80::12:1:1:99

                                                             vip   gec0::12:1:1:99
ge-0/0/2.131      up                 1    master      A 0.364  lcl   gec0::13:1:1:1

                                                             vip   ge80::13:1:1:99

                                                             vip   gec0::13:1:1:99
```

show vrrp brief

The output for the **show vrrp brief** command is identical to that for the **show vrrp** command. For sample output, see show vrrp on page 1829.

show vrrp detail (IPv6)

```
user@host> show vrrp detail
Physical interface: ge-0/0/0, Unit: 121, Vlan-id: 212, Address: gec0::12:1:1:1/120

  Index: 67, SNMP ifIndex: 45, VRRP-Traps: enabled
  Interface state: up, Group: 1, State: master
  Priority: 200, Advertisement interval: 1, Authentication type: none
  Preempt: yes, Accept-data mode: no, VIP count: 2, VIP: ge80::12:1:1:99,
gec0::12:1:1:99
  Advertisement timer: 1.121s, Master router: ge80::12:1:1:1
  Virtual router uptime: 00:03:47, Master router uptime: 00:03:41
  Virtual MAC: 00:00:5e:00:02:01
  Tracking: disabled
```



```
Physical interface: ge-0/0/2, Unit: 131, Vlan-id: 213, Address: gec0::13:1:1:1/120

  Index: 69, SNMP ifIndex: 47, VRRP-Traps: enabled
  Interface state: up, Group: 1, State: master
  Priority: 200, Advertisement interval: 1, Authentication type: none
  Preempt: yes, Accept-data mode: no, VIP count: 2, VIP: ge80::13:1:1:99,
gec0::13:1:1:99
  Advertisement timer: 0.327s, Master router: ge80::13:1:1:1
  Virtual router uptime: 00:03:47, Master router uptime: 00:03:41
  Virtual MAC: 00:00:5e:00:02:01
  Tracking: disabled
```

show vrrp detail (Route Track)

```
user@host> show vrrp detail
Physical interface: ge-1/1/0, Unit: 0, Address: 30.30.30.30/24
  Index: 67, SNMP ifIndex: 379, VRRP-Traps: enabled
  Interface state: up, Group: 100, State: master
  Priority: 150, Advertisement interval: 1, Authentication type: none
  Preempt: yes, Accept-data mode: no, VIP count: 1, VIP: 30.30.30.100
  Advertisement timer: 1.218s, Master router: 30.30.30.30
  Virtual router uptime: 00:04:28, Master router uptime: 00:00:13
  Virtual MAC: 00:00:5e:00:01:64
  Tracking: enabled
    Current priority: 150, Configured priority: 150
    Priority hold-time: disabled
    Interface tracking: disabled
    Route tracking: enabled, Route count: 1
      Route                VRF name       Route state    Priority cost
      192.168.40.0/22      default        up             30
```

show vrrp extensive

```
user@host> show vrrp extensive
Interface: ge-0/0/0.121, Interface index: 67, Groups: 1, Active : 1
  Interface VRRP PDU statistics
    Advertisement sent                      :         188
    Advertisement received                  :           0
    Packets received                        :           0
    No group match received                 :           0
  Interface VRRP PDU error statistics
    Invalid IPAH next type received         :           0
    Invalid VRRP TTL value received         :           0
    Invalid VRRP version received           :           0
    Invalid VRRP PDU type received          :           0
    Invalid VRRP authentication type received:          0
    Invalid VRRP IP count received          :           0
    Invalid VRRP checksum received          :           0

Physical interface: ge-0/0/0, Unit: 121, Vlan-id: 212, Address: gec0::12:1:1:1/120

  Index: 67, SNMP ifIndex: 45, VRRP-Traps: enabled
  Interface state: up, Group: 1, State: master
  Priority: 200, Advertisement interval: 1, Authentication type: none
  Preempt: yes, Accept-data mode: no, VIP count: 2, VIP: ge80::12:1:1:99,
gec0::12:1:1:99
  Advertisement timer: 1.034s, Master router: ge80::12:1:1:1
  Virtual router uptime: 00:04:04, Master router uptime: 00:03:58
  Virtual MAC: 00:00:5e:00:02:01
  Tracking: disabled
  Group VRRP PDU statistics
```



```
    Advertisement sent              :         188
    Advertisement received          :           0
  Group VRRP PDU error statistics
    Bad authentication type received:           0
    Bad password received           :           0
    Bad MD5 digest received         :           0
    Bad advertisement timer received:           0
    Bad VIP count received          :           0
    Bad VIPADDR received            :           0
  Group state transition statistics
    Idle to master transitions      :           0
    Idle to backup transitions      :           1
    Backup to master transitions    :           1
    Master to backup transitions    :           0

Interface: ge-0/0/2.131, Interface index: 69, Groups: 1, Active : 1
  Interface VRRP PDU statistics
    Advertisement sent                       :         186
    Advertisement received                   :           0
    Packets received                         :           0
    No group match received                  :           0
  Interface VRRP PDU error statistics
    Invalid IPAH next type received          :           0
    Invalid VRRP TTL value received          :           0
    Invalid VRRP version received            :           0
    Invalid VRRP PDU type received           :           0
    Invalid VRRP authentication type received:           0
    Invalid VRRP IP count received           :           0
    Invalid VRRP checksum received           :           0

Physical interface: ge-0/0/2, Unit: 131, Vlan-id: 213, Address: gec0::13:1:1:1/120

  Index: 69, SNMP ifIndex: 47, VRRP-Traps: enabled
  Interface state: up, Group: 1, State: master
  Priority: 200, Advertisement interval: 1, Authentication type: none
  Preempt: yes, Accept-data mode: no, VIP count: 2, VIP: ge80::13:1:1:99,
gec0::13:1:1:99
  Advertisement timer: 0.396s, Master router: ge80::13:1:1:1
  Virtual router uptime: 00:04:04, Master router uptime: 00:03:58
  Virtual MAC: 00:00:5e:00:02:01
  Tracking: disabled
  Group VRRP PDU statistics
    Advertisement sent              :         186
    Advertisement received          :           0
  Group VRRP PDU error statistics
    Bad authentication type received:           0
    Bad password received           :           0
    Bad MD5 digest received         :           0
    Bad advertisement timer received:           0
    Bad VIP count received          :           0
    Bad VIPADDR received            :           0
  Group state transition statistics
    Idle to master transitions      :           0
    Idle to backup transitions      :           1
    Backup to master transitions    :           1
  Master to backup transitions    :           0
```

show vrrp interface

user@host> **show vrrp interface**

```
Interface: ge-0/0/0.121, Interface index: 67, Groups: 1, Active : 1
  Interface VRRP PDU statistics
    Advertisement sent                     :         205
    Advertisement received                 :           0
    Packets received                       :           0
    No group match received                :           0
  Interface VRRP PDU error statistics
    Invalid IPAH next type received        :           0
    Invalid VRRP TTL value received        :           0
    Invalid VRRP version received          :           0
    Invalid VRRP PDU type received         :           0
    Invalid VRRP authentication type received:         0
    Invalid VRRP IP count received         :           0
    Invalid VRRP checksum received         :           0

Physical interface: ge-0/0/0, Unit: 121, Vlan-id: 212, Address: gec0::12:1:1:1/120

  Index: 67, SNMP ifIndex: 45, VRRP-Traps: enabled
  Interface state: up, Group: 1, State: master
  Priority: 200, Advertisement interval: 1, Authentication type: none
  Preempt: yes, Accept-data mode: no, VIP count: 2, VIP: ge80::12:1:1:99,
gec0::12:1:1:99
  Advertisement timer: 0.789s, Master router: ge80::12:1:1:1
  Virtual router uptime: 00:04:26, Master router uptime: 00:04:20
  Virtual MAC: 00:00:5e:00:02:01
  Tracking: disabled
  Group VRRP PDU statistics
    Advertisement sent             :         205
    Advertisement received         :           0
  Group VRRP PDU error statistics
    Bad authentication type received:          0
    Bad password received          :           0
    Bad MD5 digest received        :           0
    Bad advertisement timer received:          0
    Bad VIP count received         :           0
    Bad VIPADDR received           :           0
  Group state transition statistics
    Idle to master transitions     :           0
    Idle to backup transitions     :           1
    Backup to master transitions   :           1
    Master to backup transitions   :           0
```

show vrrp summary

```
user@host> show vrrp summary
Interface     State      Group   VR state      Type   Address
ge-4/1/0.0    up             1   backup        lcl    10.57.0.2
                                               vip    10.57.0.100
```

show vrrp track detail

```
user@host> show vrrp track detail
Tracked interface: ae1.211
  State: up, Speed: 400m
  Incurred priority cost: 0
  Threshold     Priority cost   Active
  400m          10
  300m          60
  200m          110
  100m          160
  down          190
```



```
  Tracking VRRP interface: ae0.210, Group: 1
    VR State: master
    Current priority: 200, Configured priority: 200
    Priority hold-time: disabled,    Remaining-time: 50.351
```

show vrrp track summary

```
user@host> show vrrp track summary
Track if      State     Speed      VRRP if   Group   VR State   Current priority
ae1.211       up         400m       ae0.210    1      master     200
```

CHAPTER 22

Troubleshooting

Troubleshooting Procedures

Troubleshooting VRRP

Problem If you configure multiple VRRP groups on an interface (using multiple VLANs), traffic for some of the groups might be briefly dropped if a failover occurs. This can happen because the new master must send gratuitous ARP replies for each VRRP group to update the ARP tables in the connected devices, and there is a short delay between each gratuitous ARP reply. Traffic sent by devices that have not yet received the gratuitous ARP reply is dropped (until the device receives the reply and learns the MAC address of the new master).

Solution Configure a failover delay so that the new master delays sending gratuitous ARP replies for the period that you set. This allows the new master to send the ARP replies for all of the VRRP groups simultaneously.

Related Documentation

- failover-delay on page 1783

PART 8

Interfaces

CHAPTER 23

Overview

Interfaces Overview

Interfaces Overview

Juniper Networks QFX Series products have two types of interfaces: network interfaces and special interfaces. This topic provides brief information about these interfaces. For additional information, see the *Junos OS Network Interfaces Library for Routing Devices*.

Network Interfaces

Network interfaces connect to the network and carry network traffic. Table 157 on page 1839 lists the types of network interfaces supported on the QFX Series.

Table 157: Network Interface Types and Purposes

Type	Purpose
Aggregated Ethernet interfaces	You can group Ethernet interfaces at the physical layer to form a single link-layer interface, also known as a *link aggregation group (LAG)* or *bundle*. These aggregated Ethernet interfaces help to balance traffic and increase the uplink bandwidth.

Table 157: Network Interface Types and Purposes *(continued)*

Type	Purpose
Channelized Interfaces	40-Gbps QSFP+ ports can be configured to operate as four 10-Gigabit Ethernet (*xe*) interfaces. You can use QSFP+ to four SFP+ breakout cables or QSFP+ transceivers with fiber breakout cables to connect the 10-Gigabit Ethernet ports to other servers, storage, and switches. By default, the four 40-Gbps QSFP+ ports operate as 40-Gigabit Ethernet (*et*) ports. When an *et* port is channelized to four *xe* ports, a colon is used to signify the four separate channels. For example, on a QFX3500 standalone switch with port 2 on PIC 1 configured as four 10-Gigabit Ethernet ports, the interface names are *xe-0/1/2:0*, *xe-0/1/2:1*, *xe-0/1/2:2*, and *xe-0/1/2:3* NOTE: You cannot configure channelized interfaces to operate as Virtual Chassis ports.
Ethernet Interfaces	You can configure Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet interfaces to connect to other servers, storage, and switches. You can configure 40-Gigabit data plane uplink ports to connect a Node device to an Interconnect devices as well as for Virtual Chassis ports (VCPs).
Fibre Channel interfaces	You can use Fibre Channel interfaces to connect the switch to a Fibre Channel over Ethernet (FCoE) forwarder or a Fibre Channel switch in a storage area network (SAN). You can configure Fibre Channel interfaces only on ports 0 through 5 and 42 through 47 on QFX3500 devices. Fibre Channel interfaces do not forward Ethernet traffic.
LAN access interfaces	You can use these interfaces to connect to other servers, storage, and switches. When you power on a QFX Series product and use the factory-default configuration, the software automatically configures interfaces in access mode for each of the network ports.
Multichassis aggregated Ethernet (MC-AE) interfaces	You can group a LAG on one standalone switch with a LAG on another standalone switch to create a MC-AE. The MC-AE provides load balancing and redundancy across the two standalone switches.
Tagged-access mode interfaces	You can used tagged-access interfaces to connect a switch to an access layer device. Tagged-access interfaces can accept VLAN-tagged packets from multiple VLANs.
Trunk interfaces	You can use trunk interfaces to connect to other switches or routers. To use a port for this type of connection, you must explicitly configure the port interface for trunk mode. The interfaces from the switches or routers must also be configured for trunk mode. In this mode, the interface can be in multiple VLANs and accept tagged packets from multiple devices. Trunk interfaces typically connect to other switches and to routers on the LAN.
Virtual Chassis ports (VCPs)	You can use Virtual Chassis ports to send and receive Virtual Chassis Control Protocol (VCCP) traffic, and to create, monitor, and maintain the Virtual Chassis. On QFX3500 and QFX3600 standalone switches, you can configure 40-Gigabit Ethernet QSFP+ uplink ports (non-channelized) or fixed SFP+ 10-Gigabit Ethernet ports as VCPs by issuing the **request virtual-chassis-vc-port-set** CLI command.

Special Interfaces

Table 158 on page 1840 lists the types of special interfaces supported on the QFX Series.

Table 158: Special Interface Types and Purposes

Type	Purpose
Console port	Each QFX Series product has a serial port, labeled **CON** or **CONSOLE**, for connecting tty-type terminals to the switch using standard PC-type tty cables. The console port does not have a physical address or IP address associated with it. However, it is an interface in the sense that it provides access to the switch.

Table 158: Special Interface Types and Purposes *(continued)*

Type	Purpose
Loopback interface	All QFX Series products have this software-only virtual interface that is always up. The loopback interface provides a stable and consistent interface and IP address on the switch.
Management interface	The Juniper Networks Junos OS for the QFX Series includes management Ethernet interfaces. The management Ethernet interface provides an out-of-band method for connecting to a standalone switch and QFabric system.
Routed VLAN interfaces (RVI and IRB interfaces)	QFX Series products use a Layer 3 routed VLAN interface (called RVI in the original CLI, and called IRB in Enhanced Layer 2 Software) **vlan** to route traffic from one broadcast domain to another and to perform other Layer 3 functions such as traffic engineering. These functions are typically performed by a router interface in a traditional network. The RVI or IRB functions as a logical router, eliminating the need for having both a switch and a router. The RVI or IRB must be configured as part of a broadcast domain or virtual private LAN service (VPLS) routing instance for Layer 3 traffic to be routed out of it.

Related Documentation

- Understanding Aggregated Ethernet Interfaces and LACP on page 1843
- Understanding Interface Naming Conventions on page 1845
- Understanding Layer 3 Logical Interfaces on page 1851
- Understanding Management Interfaces on page 1852
- Understanding Routed VLAN Interfaces on page 1409
- Overview of Fibre Channel on the QFX Series on page 4786

Overview of Uplink Failure Detection

Uplink failure detection allows a switch to detect link failure on uplink interfaces and to propagate this information to the downlink interfaces, so that servers connected to those downlinks can switch over to secondary interfaces.

Uplink failure detection supports network adapter teaming and provides network redundancy. In network adapter teaming, all of the network interface cards (NICs) on a server are configured in a primary or secondary relationship and share the same IP address. When the primary link goes down, the server transparently shifts the connection to the secondary link. With uplink failure detection, the switch monitors uplink interfaces for link failures. When it detects a failure, it disables the downlink interfaces. When the server detects disabled downlink interfaces, it switches over to the secondary link to help ensure that the traffic of the failed link is not dropped.

This topic describes:

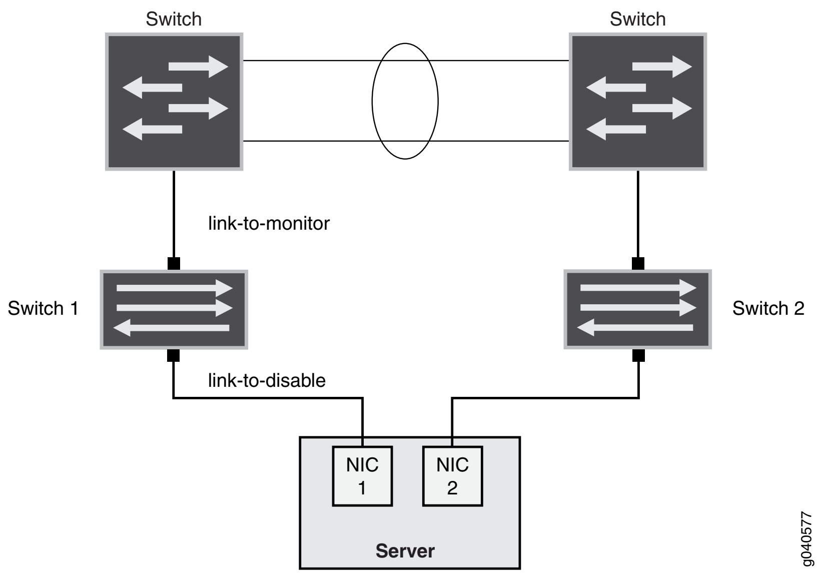
- Uplink Failure Detection Configuration on page 1842
- Failure Detection Pair on page 1842

Uplink Failure Detection Configuration

Uplink failure detection allows switches to monitor uplink interfaces to spot link failures. When a switch detects a link failure, it automatically disables the downlink interfaces bound to the uplink interface. A server that is connected to the disabled downlink interface triggers a network adapter failover to a secondary link to avoid any traffic loss.

Figure 24 on page 1842 illustrates a typical setup for uplink failure detection.

Figure 24: Uplink Failure Detection Configuration on Switches



For uplink failure detection, you specify a group of uplink interfaces to be monitored and downlink interfaces to be brought down when an uplink fails. The downlink interfaces are bound to the uplink interfaces within the group. If all uplink interfaces in a group go down, then the switch brings down all downlink interfaces within that group. If any uplink interface returns to service, then the switch brings all downlink interfaces in that group back to service.

The switch can monitor both physical interface links and logical interface links for uplink failures, but you must put the two types of interfaces into separate groups.

NOTE: **For logical interfaces, the server must send keepalives between the switch and the server to detect failure of logical links.**

Failure Detection Pair

Uplink failure detection requires that you create pairs of uplink and downlink interfaces in a group. Each pair includes one of each of the following:

- A link-to-monitor interface—The link-to-monitor interfaces specify the uplinks the switch monitors. You can configure a maximum of eight uplink interfaces as link-to-monitor interfaces for a group.
- A link-to-disable interface—The link-to-disable interfaces specify the downlinks the switch disables when the switch detects an uplink failure. You can configure a maximum of 48 downlinks to disable in the group.

The link-to-disable interfaces are bound to the link-to-monitor interfaces within the group. When a link-to-monitor interface returns to service, the switch automatically enables all link-to-disable interfaces in the group.

Related Documentation

- Configuring Interfaces for Uplink Failure Detection on page 2018
- Example: Configuring Interfaces for Uplink Failure Detection on page 1891

Understanding Aggregated Ethernet Interfaces and LACP

IEEE 802.3ad link aggregation enables you to group Ethernet interfaces to form a single, aggregated Ethernet interface, also known as a *link aggregation group (LAG)* or *bundle*.

Link aggregation is used to aggregate Ethernet interfaces between two devices. You can create a LAG between a QFX Series product and a router, switch, aggregation switch, server, or other devices. The aggregated Ethernet interfaces that participate in a LAG are called member links. Because a LAG is composed of multiple member links, even if one member link fails, the LAG continues to carry traffic over the remaining links.

Link Aggregation Contol Protocol (LACP) is a subcomponent of the IEEE 802.3ad standard and is used as a discovery protocol.

NOTE: **To ensure load balancing across the aggregated Ethernet (AE) interfaces on a redundant server Node group, the members of the AE must be equally distributed across the redundant server Node group.**

- Link Aggregation Group on page 1843
- Link Aggregation Control Protocol (LACP) on page 1844

Link Aggregation Group

To create a LAG:

1. Create a logical aggregated Ethernet interface.
2. Define the parameters associated with the logical aggregated Ethernet interface, such as a logical unit, interface properties, and Link Aggregation Control Protocol (LACP).
3. Define the member links to be contained within the aggregated Ethernet interface—for example, two 10-Gigabit Ethernet interfaces.
4. Configure LACP for link detection.

Keep in mind these hardware and software guidelines:

- Up to 32 Ethernet interfaces can be grouped to form a LAG on a QFX3500 switch, a redundant server Node group, a server Node group, and a network Node group on a QFabric system.

NOTE: If you try to commit a configuration containing more than 32 Ethernet interfaces in a LAG, you will receive an error message saying that the group limit of 32 has been exceeded, and the configuration checkout has failed.

- Up to 63 LAGs are supported on a QFX3500 switch.
- Up to 48 LAGs are supported on redundant server Node groups and server Node groups on a QFabric system, and up to 128 LAGs are supported on network Node groups on a QFabric system. You can configure LAGs across Node devices in redundant server Node groups, server Node groups, and network Node groups.
- The LAG must be configured on both sides of the link.
- The interfaces on either side of the link must be set to the same speed and be in full-duplex mode.

NOTE: Junos OS for the QFX Series assigns a unique ID and port priority to each port. The ID and priority are not configurable.

Link Aggregation Control Protocol (LACP)

LACP is one method of bundling several physical interfaces to form one logical aggregated Ethernet interface. The LACP mode can be active or passive. The transmitting link is known as the *actor*, and the receiving link is known as the *partner*. If the actor and partner are both in passive mode, they do not exchange LACP packets, and the aggregated Ethernet links do not come up. If either the actor or partner is active, they do exchange LACP packets. By default, LACP is in passive mode on aggregated Ethernet interfaces. To initiate transmission of LACP packets and response to LACP packets, you must enable LACP active mode. You can configure Ethernet links to actively transmit protocol data units (PDUs), or you can configure the links to passively transmit them, sending out LACP PDUs only when they receive them from another link. You can configure both VLAN-tagged and untagged aggregated Ethernet interfaces without LACP enabled. LACP is defined in IEEE 802.3ad, *Aggregation of Multiple Link Segments*.

LACP was designed to achieve the following:

- Automatic addition and deletion of individual links to the LAG without user intervention.
- Link monitoring to check whether both ends of the bundle are connected to the correct group.

When a dual-homed server is deployed with a switch, the network interface cards form a LAG with the switch. During a server upgrade, the server may not be able to exchange LACP PDUs. In such a situation you can configure an interface to be in the **up** state even if no PDUs are exchanged. Use the **force-up** statement to configure an interface when the peer has limited LACP capability. The interface selects the associated LAG by default, whether the switch and peer are both in active or passive mode. When there are no received PDUs, the partner is considered to be working in the passive mode. Therefore, LACP PDU transmissions are controlled by the transmitting link.

If the remote end of the LAG link is a security device, LACP might not be supported because security devices require a deterministic configuration. In this case, do not configure LACP. All links in the LAG are permanently operational unless the switch detects a link failure within the Ethernet physical layer or data link layers.

Related Documentation

- Configuring Link Aggregation on page 2019
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896
- Verifying the Status of a LAG Interface on page 2148

- *Junos OS Network Interfaces Library for Routing Devices*

Understanding Interface Naming Conventions

The QFX Series uses a naming convention for defining the interfaces that is similar to that of other platforms running under Juniper Networks Junos OS. This topic provides brief information about the naming conventions used for interfaces on the QFX Series.

This topic describes:

Physical Part of an Interface Name

Interfaces in Junos OS are specified as follows:

device-name:*type-fpc/pic/port*

QFX Series products apply this convention as follows:

- *device-name*—(QFabric systems only) The *device-name* is either the serial number or the alias of the QFabric system component, such as a Node device, Interconnect device, or QFabric infrastructure. The name can contain a maximum of 128 characters and cannot contain any colons.
- *type*—The QFX Series interfaces use the following media types:
  - **fc**—Fibre Channel interface
  - **ge**—Gigabit Ethernet interface
  - **xe**—10-Gigabit Ethernet interface

  - **xle**—40-Gigabit Ethernet interface (QFX3500 and QFX3600 switches running a QFabric software package)
  - **et**—40-Gigabit Ethernet interface (QFX3500, QFX3600, and QFX5100 switches running Enhanced Layer 2 Software)
  - **fte**—40-Gigabit data plane uplink interface (QFX3500 and QFX3600 switches running a QFabric software package)
  - **me**—Management interface
  - **em**—Management interface on QFX5100 switches.

- *fpc*—Flexible PIC Concentrator. QFX Series interfaces use the following convention for the FPC number in interface names:
  - On QFX3500 and QFX3600 devices running a QFabric software package, the FPC number is always **0**.

    The FPC number indicates the slot number of the line card that contains the physical interface.
  - On QFX3500 and QFX3600 switches running Enhanced Layer 2 Software, the member ID of a member in a Virtual Chassis determines the FPC number.

    NOTE: **Every member in a Virtual Chassis must have a unique member ID, otherwise the Virtual Chassis will not be created.**

  - On standalone QFX5100 switches, the FPC number is always **0**.

- *pic*—QFX Series interfaces use the following convention for the PIC (Physical Interface Card) number in interface names:
  - On a QFX3500 switch running a QFabric software package, PIC **0** can support 48 ports, PIC **1** can support 16 10-Gigabit Ethernet ports, and PIC **2** can support 4 40-Gigabit Ethernet ports.
  - On a QFX3500 switch running Enhanced Layer 2 software, PIC **0** can support 48 ports, and PIC **1** can support 16 10-Gigabit Ethernet ports, and 4 40-Gigabit Ethernet ports.
  - On a QFX3500 Node device running a QFabric software package, PIC **0** can support 48 ports and PIC **1** can support four 40-Gigabit data plane uplink ports.
  - On a QFX3600 switch running a QFabric software package, PIC **0** can support 64 10-Gigabit Ethernet ports, and PIC **1** can support 16 40-Gigabit Ethernet ports.
  - On a QFX3600 switch running Enhanced Layer 2 software, PIC **0** can support 64 10-Gigabit Ethernet ports and can also support 16 40-Gigabit Ethernet ports.
  - On a QFX3600 Node device running a QFabric software package, PIC **0** can support 56 10-Gigabit Ethernet ports, and PIC **1** can support 8 40-Gigabit data plane uplink ports, and up to 14 40-Gigabit Ethernet ports.

- On a QFX5100-48S switch running Enhanced Layer 2 software, PIC **0** provides six 40-Gbps QSFP+ ports and 48 10-Gigabit Ethernet interfaces.
- On a QFX5100-24Q switch running Enhanced Layer 2 software, PIC **0** provides 24 40-Gbps QSFP+ ports. PIC 1 and PIC 2 can each contain a QFX-EM-4Q expansion module, and each expansion module provides 4 40-Gbps QSFP+ ports
- On a QFX5100-96S switch running Enhanced Layer 2 software, PIC **0** provides 96 10-Gigabit Ethernet interfaces and 8 40-Gbps QSFP+ ports .

- *port*—QFX Series interfaces use the following convention for port numbers:
  - On a QFX3500 switch running a QFabric software package, there are 48 network access ports (10-Gigabit Ethernet) labeled 0 through 47 on PIC 0 and, 16 network access ports labeled 0 through 15 on PIC 1, and four 40-Gbps QSFP+ ports labeled Q0 through Q3 on PIC 2. You can use the QSFP+ ports to connect the Node device to Interconnect devices.

    By default, the 40-Gbps QSFP+ ports are configured to operate as 10-Gigabit Ethernet ports. You can use QSFP+ to four SFP+ copper breakout cables to connect the 10-Gigabit Ethernet ports to other servers, storage, and switches. Optionally, you can choose to configure the QSFP+ ports as 40-Gigabit Ethernet ports (see "Configuring the QSFP+ Port Type on QFX3500 Standalone Switches" on page 2034).
  - On a QFX3500 switch running Enhanced Layer 2 software, there are 48 network access ports labeled 0 through 47 on PIC 0 and 4 40-Gbps QSFP+ ports labeled Q0 through Q3 on PIC 1. See "Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches" on page 2028 for information on how to configure and channelize the 40-Gbps QSFP+ ports.
  - On a QFX3600 switch running a QFabric software package, there are 64 network access ports (10-Gigabit Ethernet) labeled Q0 through Q15 on PIC 0, and there are 16 network access ports (40-Gigabit Ethernet) labeled Q0 through Q15 on PIC **1**.

    By default, all the QSFP+ ports are configured to operate as 40-Gigabit Ethernet ports. Optionally, you can choose to configure the QSFP+ ports as 10-Gigabit Ethernet ports (see "Configuring the Port Type on QFX3600 Standalone Switches" on page 2032) and use QSFP+ to four SFP+ copper breakout cables to connect the 10-Gigabit Ethernet ports to other servers, storage, and switches.
  - On a QFX3600 Node device running a QFabric software package, PIC **0** can support up to 56 10-Gigabit Ethernet ports labeled Q2 through Q15, and PIC **1** can support up to 8 40-Gigabit data plane uplink ports labeled Q0 through Q7, and up to 14 40-Gigabit Ethernet ports labeled Q2 through Q15. See *Configuring the Port Type on QFX3600 Node Devices* for information on how to configure the 40-Gbps QSFP+ ports.

    On a QFX3600 Node device, by default, four 40-Gbps QSFP+ ports (labeled Q0 through Q3) are configured for uplink connections between your Node device and your Interconnect devices, and twelve 40-Gbps QSFP+ ports (labeled Q4 through Q15) use QSFP+ to four SFP+ copper breakout cables to support up to 48 10-Gigabit Ethernet ports for connections to either endpoint systems (such as servers and storage devices) or external networks. Optionally, you can choose to configure the first eight ports (Q0 through Q7) for uplink connections between your Node device and your Interconnect devices, and ports Q2 through Q15 for 10-Gigabit Ethernet or 40-Gigabit Ethernet connections to either endpoint systems or external networks (see *Configuring the Port Type on QFX3600 Node Devices*).

- On a QFX3600 switch running Enhanced Layer 2 software, PIC **0** can support 64 network access ports (10-Gigabit Ethernet ports) labeled Q0 through Q15 and 16 40-Gigabit Ethernet ports labeled Q0 through Q15. See "Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches" on page 2028 for information on how to configure and channelize the 40-Gbps QSFP+ ports.
- On a QFX5100-48S switch running Enhanced Layer 2 software, PIC **0** can support 48 network access ports (10-Gigabit Ethernet ports) labeled 0 through 47 and 6 40-Gbps QSFP+ ports labeled 48 through 53. See "Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches" on page 2028 for information on how to configure and channelize the 40-Gbps QSFP+ ports.
- On a QFX5100-24Q switch running Enhanced Layer 2 software, PIC **0** can support 24 40-Gbps QSFP+ ports labeled 0 through 24. PIC 1 and PIC 2 each support one 40-Gbps QSFP+ port, for a total of two 40-Gbps QSFP+ ports. See "Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches" on page 2028 for information on how to configure and channelize the 40-Gbps QSFP+ ports.

NOTE: **You cannot channelize the 40-Gbps QSFP+ ports provided in the two QFX-EM-4Q expansion modules. Also, even though there is a total of 128 physical ports, only 104 logical ports can be channelized.**

You can configure different system modes to achieve varying levels of port density on the QFX5100-24Q and QFX5100-96S switches. Depending on the system mode you configure, there are restrictions on which ports you can channelize. If you channelize ports that are restricted, the configuration is ignored. See "Configuring the System Mode on QFX5100 Switches" on page 2030 for information on how to configure the system mode.

- On a QFX5100-96S switch running Enhanced Layer 2 software, PIC **0** can support 96 10-Gigabit Ethernet ports labeled 0 through 95, and 8 40-Gbps QSFP+ ports labeled 96 through 103. See "Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches" on page 2028 for information on how to configure and channelize the 40-Gbps QSFP+ ports.

NOTE: **You can only channelize the 40-Gbps QSFP+ ports provided in ports 96 and 100, because only 104 logical ports can be channelized.**

You can configure different system modes to achieve varying levels of port density on the QFX5100-24Q and QFX5100-96S switches. Depending on the system mode you configure, there are restrictions on which ports you can channelize. If you channelize ports that are restricted, the configuration is ignored. See "Configuring the System Mode on QFX5100 Switches" on page 2030 for information on how to configure the system mode.

Logical Part of an Interface Name on a Switch Running QFabric Software Package

The logical unit part of the interface name corresponds to the logical unit number, which can be a number from 0 through 16384. In the virtual part of the name, a period (.) separates the port and logical unit numbers: *device-name* (QFabric systems only): *type-fpc/pic/port.logical-unit-number*. For example, if you issue the **show ethernet-switching interfaces** command on a system with a default VLAN, the resulting display shows the logical interfaces associated with the VLAN:

```
Interface                 State   VLAN members          Blocking
node-device1:xe-0/0/1.0   down     remote-analyzer       unblocked
node-device1:xe-0/0/2.0   down     default               unblocked
node-device1:xe-0/0/3.0   down     default               unblocked
```

When you configure aggregated Ethernet interfaces, you configure a logical interface, which is called a *bundle* or a *LAG*. Each LAG can include up to eight Ethernet interfaces, depending on the switch model.

Logical Part of a Channelized Interface Name on a Switch Running Enhanced Layer 2 Software

Channelizing enables you to configure four 10-Gigabit Ethernet interfaces from a 40-Gigabit Ethernet QSFP+ interface. By default, a 40-Gigabit Ethernet QSFP+ interface is named *et-fpc/pic/port*. The resulting 10-Gigabit Ethernet interfaces appear in the following format: *xe-fpc/pic/port:channel*, where channel can be a value of 0 through 3.

For example, if an *et* interface named **et-0/0/3** is channelized to four 10-Gigabit Ethernet interfaces, the resulting 10-Gigabit Ethernet interface names will be **xe-0/0/3:0**, **xe-0/0/3:1**, **xe-0/0/3:2**, and **xe-0/0/3:3**:

```
Interface               Admin Link Proto    Local        Remote
xe-0/0/3:0               up     down
xe-0/0/3:1               up     down
xe-0/0/3:2               up     down
xe-0/0/3:3               up     down
```

Wildcard Characters in Interface Names

In the **show interfaces** and **clear interfaces** commands, you can use wildcard characters in the ***interface-name*** option to specify groups of interface names without having to type each name individually. You must enclose all wildcard characters except the asterisk (*) in quotation marks (" ").

Related Documentation

- Interfaces Overview on page 1839
- Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches on page 2028
- Configuring the System Mode on QFX5100 Switches on page 2030
- Understanding Management Interfaces on page 1852
- Understanding Port Ranges and System Modes on page 1862
- *Rear Panel of a QFX3500 Device*
- *Front Panel of a QFX3600 Device*

- *Junos OS Network Interfaces Library for Routing Devices*

Understanding Interface Ranges on the QFX Series

You can use the interface ranges to group interfaces of the same type that share a common configuration profile. This helps reduce the time and effort in configuring interfaces on Juniper Networks QFX Series products. The configurations common to all the interfaces can be included in the interface range definition.

The interface range definition contains the name of the interface range defined, the names of the individual member interfaces that do not fall in a series of interfaces, a range of interfaces defined in the member range, and the configuration statements common to all the interfaces. An interface range defined with member ranges and individual members but without any common configurations is also a valid definition.

NOTE: **The interface range definition is supported only for Gigabit Ethernet, 10-Gigabit Ethernet, and Fibre Channel interfaces.**

The common configurations defined in the interface range will be overridden by the local configuration.

The defined interface ranges can be used at places where the **interface** statement is used in the following configuration hierarchies:

- **ethernet-switching-options analyzer *name* input egress interface**
- **ethernet-switching-options analyzer *name* input ingress interface**
- **ethernet-switching-options analyzer output interface**
- **ethernet-switching-options bpdu-block interface**
- **ethernet-switching-options interfaces**
- **ethernet-switching-options redundant-trunk-group group-name interface**
- **ethernet-switching-options secure-access-port interface**
- **ethernet-switching-options voip interface**
- **protocols igmp-snooping vlan *vlan-name* interface**
- **protocols isis interface**
- **protocols link-management peer lmp-control-channel interface**
- **protocols link-management te-link *name* interface**
- **protocols lldp interface**
- **protocols mstp interface**
- **protocols mstp msti-*id* interface**
- **protocols mstp msti-*id* vlan *vlan-id* interface**

- **protocols sflow interfaces**
- **protocols stp interface**
- **protocols vstp vlan *vlan-id* interface**
- **vlans *vlan-name* interface**

Related Documentation

- Interfaces Overview on page 1839
- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- Configuring Link Aggregation on page 2019
- Configuring a Layer 3 Logical Interface on page 2019
- *Junos OS Network Interfaces Library for Routing Devices*
- **interface-range on page 2073**

Understanding Layer 3 Logical Interfaces

A Layer 3 logical interface is a logical division of a physical interface that operates at the network level and therefore can receive and forward 802.1Q VLAN tags. You can use Layer 3 logical interfaces to route traffic among multiple VLANs along a single trunk line that connects a Juniper Networks QFX3500 Switch to a Layer 2 switch. Only one physical connection is required between the switches.

To create Layer 3 logical interfaces on a switch, enable VLAN tagging, partition the physical interface into logical partitions, and bind the VLAN ID to the logical interface.

We recommend that you use the VLAN ID as the logical interface number when you configure the logical interface. QFX Series systems support a maximum of 4089 VLANs, which includes the default VLAN. You can, however, assign a VLAN ID in the range of 1 to 4094, but five of these VLAN IDs are reserved for internal use.

VLAN tagging places the VLAN ID in the frame header, allowing each physical interface to handle multiple VLANs. Double-tagging, which is assigning more than one VLAN ID in the frame header, is not supported. When you configure multiple VLANs on an interface, you must also enable tagging on that interface. Junos OS on switches supports a subset of the 802.1Q standard for receiving and forwarding routed or bridged Ethernet frames with single VLAN tags and running Virtual Router Redundancy Protocol (VRRP) over 802.1Q-tagged interfaces.

Related Documentation

- Interfaces Overview on page 1839
- Configuring a Layer 3 Logical Interface on page 2019
- Configuring DHCP and BOOTP Relay on page 4733
- *Junos OS Network Interfaces Library for Routing Devices*

Understanding Management Interfaces

You use management interfaces to access devices remotely. Typically, a management interface is not connected to the in-band network, but is connected to a device in the internal network. Through a management interface, you can access the device over the network using utilities such as **ssh** and **telnet** and configure it from anywhere, regardless of its physical location. As a security feature, users cannot log in as **root** through a management interface. To access the device as **root**, you must use the console port.

Management interface port ranges vary based on device type:

- QFX3500 devices:

  The valid port range for a management interface (**me**) on a QFX3500 device is between 0 and 6, with a total of seven available ports. However, you can only configure me0 and me1 as management interfaces. The management interfaces are labeled **C0** and **C1**, and they correspond to me0 and me1.

- QFX3600 devices:

  There are two RJ-45 management interfaces (labeled **C0** and **C1**) and two SFP management interfaces (labeled **C0S** and **C1S**). On a QFX3600 standalone switch, the RJ-45 management interfaces and SFP management interfaces correspond to **me5** and **me6**. On a QFX3600 Node device, the RJ-45 management interfaces and SFP management interfaces correspond to **me0** and **me1**.

  NOTE: **On a QFX3600 device, you can use either the RJ-45 or the SFP management interfaces, but not both at the same time.**

  NOTE: **Before you can use the management interfaces on either the QFX3500 device or QFX3600 device, you must configure the logical interfaces with valid IP addresses. Juniper Networks does not support configuring two management interfaces in the same subnet.**

- QFabric system:

  On a QFabric system, there are management interfaces on the Node devices, Interconnect devices, and Director devices. However, you cannot access the management interfaces on the Node devices or Interconnect devices directly. You can only manage and configure these devices using the Director device. You can connect to the management interface over the network using utilities such as SSH.

- On the QFX3500 standalone switch and QFX3500 Node device, the management interfaces are labeled **C0** and **C1**, and they correspond to me0 and me1. You can use both management interfaces simultaneously.

- On the QFX3600 switch, there are two RJ-45 management interfaces (labeled **C0** and **C1**) and two SFP management interfaces (labeled **C0s** and **C1S**),resulting in four management interfaces. Each pair of management interfaces correspond to one

Ethernet interface—for example, both RJ-45 management interfaces (labeled **C0** and **C1**) can correspond to me0, and both SFP management interfaces (labeled **C0s** and **C1S**) can correspond to me1. By default, both RJ-45 management interfaces are active. If you insert an SFP interface into the SFP management port (**C0S**, for example), the SFP interface would become the active management interface, and the corresponding RJ-45 management interface (**C0**) is disabled.

- On QFX5100 switches, there is one RJ-45 management interface (labeled **C0** and one SFP management interface (labeled **C1**), and they correspond to em0 and em1. You can use both management interfaces simultaneously.

Related Documentation

- Interfaces Overview on page 1839

Understanding Multichassis Link Aggregation

NOTE: **Multichassis Link Aggregation (MC-LAG) is supported on QFX3500 and QFX3600 standalone switches running the original CLI and QFX5100 standalone switches running Enhanced Layer 2 Software.**

Layer 2 networks are increasing in scale mainly because of technologies such as virtualization. Protocol and control mechanisms that limit the disastrous effects of a topology loop in the network are necessary. Spanning Tree Protocol (STP) is the primary solution to this problem because it provides a loop-free Layer 2 environment. STP has gone through a number of enhancements and extensions, and although it scales to very large network environments, it still only provides one active path from one device to another, regardless of how many actual connections might exist in the network. Although STP is a robust and scalable solution to redundancy in a Layer 2 network, the single logical link creates two problems: At least half of the available system bandwidth is off-limits to data traffic, and network topology changes occur. The Rapid Spanning Tree Protocol (RSTP) reduces the overhead of the rediscovery process and allows a Layer 2 network to reconverge faster, but the delay is still high.

Link aggregation (IEEE 802.3ad) solves some of these problems by enabling users to use more than one link connection between switches. All physical connections are considered one logical connection. The problem with standard link aggregation is that the connections are point to point.

Multichassis link aggregation groups (MC-LAGs) enable a client device to form a logical LAG interface between two MC-LAG peers (QFX3500 and QFX3600 devices). An MC-LAG provides redundancy and load balancing between the two MC-LAG peers, multihoming support, and a loop-free Layer 2 network without running the Spanning Tree Protocol (STP).

On one end of an MC-LAG, there is an MC-LAG client device, such as a server, that has one or more physical links in a link aggregation group (LAG). This client device does not need to have an MC-LAG configured. On the other side of the MC-LAG, there are two MC-LAG peers. Each of the MC-LAG peers has one or more physical links connected to a single client device.

The MC-LAG peers use Interchassis Control Protocol (ICCP) to exchange control information and coordinate with each other to ensure that data traffic is forwarded properly.

Link Aggregation Contol Protocol (LACP) is a subcomponent of the IEEE 802.3ad standard. LACP is used to discover multiple links from a client device connected to an MC-LAG peer. LACP must be configured on all member links for an MC-LAG to work correctly.

NOTE: You must specify a service identifier (service-id) for each multichassis aggregated Ethernet interface that belongs to a link aggregation group (LAG), otherwise multichassis link aggregation will not work.

See Table 159 on page 1855 for information about ICCP failure scenarios.

The following sections provide an overview of the terms and features associated with MC-LAG:

Active-Active Mode

In active-active mode, all member links are active on the MC-LAG. In this mode, MAC addresses learned on one MC-LAG peer are propagated to the other MC-LAG peer. Active-active mode is the only mode supported at this time.

ICCP and ICL-PL

ICCP replicates control traffic and forwarding states across the MC-LAG peers and communicates the operational state of the MC-LAG members. Because ICCP uses TCP/IP to communicate between the peers, the two peers must be connected to each other. ICCP messages exchange MC-LAG configuration parameters and ensure that both peers use the correct LACP parameters.

The interchassis link-protection link (ICL-PL) provides redundancy when a link failure (for example, an MC-LAG trunk failure) occurs on one of the active links. The ICL-PL can be either a 10-Gigabit Ethernet interface or an aggregated Ethernet interface. You can configure only one ICL-PL between the two peers, although you can configure multiple MC-LAGs between them.

Failure Handling

Configuring ICCP adjacency over aggregated links mitigates the possibility of a split-brain state. A split brain state occurs when the ICL-PL configured between the MC-LAG peers goes down. To work around this problem, enable backup liveness detection. With backup liveness enbabled, the MC-LAG peers can communicate through the keepalive link.

During a split-brain state, the standby peer brings down local members in the MC-LAG links by changing the LACP system ID. When the ICCP connection is active, both of the MC-LAG peers use the configured LACP system ID. If the LACP system ID is changed during failures, the server that is connected over the MC-LAG removes these links from the aggregated Ethernet bundle.

When the ICL-PL is operationally down and the ICCP connection is active, the LACP state of the links with status control configured as standby is set to the standby state. When the LACP state of the links is changed to standby, the server that is connected over the MC-LAG makes these links inactive and does not use them for sending data.

Table 159 on page 1855 describes the different ICCP failure scenarios. The dash means that the item is not applicable.

Table 159: ICCP Failure Scenarios

ICCP Connection Status	ICL-PL Status	Backup Liveness Peer Status	Action on Multichassis Aggregated Ethernet (MC-AE) Interface with Status Set to Standby
Down	Down or Up	Not configured	LACP system ID is changed to default value.
Down	Down or Up	Active	LACP system ID is changed to default value.
Down	Down or Up	Inactive	No change in LACP system ID.
Up	Down	–	LACP state is set to standby. MUX state moves to waiting state.

Split-brain states bring down the MC-LAG link completely if the primary peer members are also down for other reasons. Recovery from the split-brain state occurs automatically when the ICCP adjacency comes up between the MC-LAG peers.

Multichassis Link Protection

Mutlichassis link protection provides link protection between the two MC-LAG peers hosting an MC-LAG. If the ICCP connection is up and the ICL-PL comes up, the peer configured as standby brings up the multichassis aggregated Ethernet (MC-AE) interfaces shared with the peer. Multichassis protection must be configured on each MC-LAG peer that is hosting an MC-LAG.

MC-LAG Packet Forwarding

To prevent the server from receiving multiple copies from both of the MC-LAG peers, a block mask is used to prevent forwarding of traffic received on the ICL-PL toward the MC-AE interface. Preventing forwarding of traffic received on the ICL-PL interface toward the MC-AE interface ensures that traffic received on MC-LAG links is not forwarded back to the same link on the other peer. The forwarding block mask for a given MC-LAG link is cleared if all of the local members of the MC-LAG link go down on the peer. To achieve faster convergence, if all local members of the MC-LAG link are down, outbound traffic on the MC-LAG is redirected to the ICL-PL interface on the data plane.

Layer 3 Routing

To provide Layer 3 routing functions to downstream clients, configure the same gateway address on both MC-LAG network peers. To upstream routers, the MC-LAG network peers could be viewed as either equal-cost multipath (ECMP) or two routes with different preference values.

Junos OS supports active-active MC-LAGs by using Virtual Router Redundancy Protocol (VRRP) over routed VLAN interfaces (RVIs). Junos OS also supports active-active MC-LAGs by using RVI MAC address synchronization. You must configure the RVI using the same IP address across MC-LAG peers.

Spanning Tree Protocol (STP) Guidelines

- Enable STP globally.

  STP might detect local miswiring loops within the peer or across MC-LAG peers.

  STP might not detect network loops introduced by MC-LAG peers.

- Disable STP on ICL-PL links; otherwise, it might block ICL-PL ports and disable protection.
- Disable STP on interfaces that are connected to aggregation switches.
- Do not enable bridge protocol data unit (BPDU) block on interfaces connected to aggregation switches.

For more information about BPDU block, see “Understanding BPDU Protection for STP, RSTP, and MSTP” on page 1423 .

MC-LAG Upgrade Guidelines

Upgrade the MC-LAG peers according to the following guidelines. See “Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches” on page 121 for exact details about how to perform a software upgrade.

NOTE: After a reboot, the MC-AE interfaces come up immediately and might start receiving packets from the server. If routing protocols are enabled, and the routing adjacencies have not been formed, packets might be dropped.

To prevent this scenario, issue the **set interfaces *interface-name*aggregated-ether-options mc-ae init-delay-time *time*** to set a time by which the routing adjacencies are formed.

1. Make sure that both of the MC-LAG peers (node1 and node2) are in the active-active state using the following command on any one of the MC-LAG peers:

   ```
   user@switch> show interfaces mc-ae id 1
   Member Link                  : ae0
    Current State Machine's State: mcae active state
    Local Status                 : active<<<<<<<
    Local State                  : up
    Peer Status                  : active<<<<<<<
    Peer State                   : up
        Logical Interface        : ae0.0
        Topology Type            : bridge
        Local State              : up
        Peer State               : up
        Peer Ip/MCP/State        : 20.1.1.2 ae2.0 up
   ```

2. Upgrade node1 of the MC-LAG.

   When node1 is upgraded it is rebooted, and all traffic is sent across the available LAG interfaces of node2, which is still up. The amount of traffic lost depends on how quickly the neighbor devices detect the link loss and rehash the flows of the LAG.

3. Verify that node1 is running the software you just installed. Issue the **show version** command.

4. Make sure that both nodes of the MC-LAG (node1 and node2) are in the active-active state after the reboot of node1.

5. Upgrade node2 of the MC-LAG.

   Repeat step 1 through step 3 to upgrade node2.

Layer 2 Unicast Features Supported

The following Layer 2 unicast features are supported:

- L2 unicast: learning and aging

- Learned MAC addresses are propagated across MC-LAG peers for all of the VLANs that are spawned across the peers.
- Aging of MAC addresses occurs when the MAC address is not seen on both of the peers.
- MAC learning is disabled on the ICL-PL automatically.
- MAC addresses learned on single-homed links are propagated across all of the VLANs that have MC-LAG links as members.

Layer 2 Multicast Features Supported

The following Layer 2 multicast features are supported:

- L2 multicast: unknown unicast and IGMP snooping
  - Flooding happens on all links across peers if both peers have virtual LAN membership. Only one of the peers forwards traffic on a given MC-LAG link.
  - Known and unknown multicast packets are forwarded across the peers by adding the ICL-PL port as a multicast router port.
  - IGMP membership learned on MC-LAG links is propagated across peers.
  - During an MC-LAG peer reboot, known multicast traffic is flooded until the IGMP snooping state is synced with the peer.

IGMP Snooping on an Active-Active MC-LAG

IGMP snooping controls multicast traffic in a switched network. When IGMP snooping is not enabled, the Layer 2 device broadcasts multicast traffic out of all of its ports, even if the hosts on the network do not want the multicast traffic. With IGMP snooping enabled, a Layer 2 device monitors the IGMP join and leave messages sent from each connected host to a multicast router. This enables the Layer 2 device to keep track of the multicast groups and associated member ports. The Layer 2 device uses this information to make intelligent decisions and to forward multicast traffic to only the intended destination hosts. IGMP uses Protocol Independent Multicast (PIM) to route the multicast traffic. PIM uses distribution trees to determine which traffic is forwarded.

In an active-active MC-LAG configuration, IGMP snooping replicates the Layer 2 multicast routes so that each MC-LAG peer has the same routes. If a device is connected to an MC-LAG peer by way of a single-homed interface, IGMP snooping replicates join message to its IGMP snooping peer. If a multicast source is connected to an MC-LAG by way of a Layer 3 device, the Layer 3 device passes this information to the RVI that is configured on the MC-LAG. The first hop DR is responsible for sending the register and register-stop messages for the multicast group. The last hop DR is responsible for sending PIM join and leave messages toward the rendezvous point and source for the multicast group. The routing device with the smallest preference metric forwards traffic on transit LANs.

Configure the ICL-PL interface as a router-facing interface. For the scenario in which traffic arrives by way of a Layer 3 interface, PIM and IGMP must be enabled on the RVI interface configured on the MC-LAG peers.

Layer 3 Unicast Features Supported

The following Layer 3 unicast features are supported:

- VRRP active-standby support enables Layer 3 routing over MC-AE interfaces.
- Routed VLAN interface (RVI) MAC address synchronization enables MC-LAG peers to forward Layer 3 packets arriving on MC-AE interfaces with either its own RVI MAC address or its peer's RVI MAC address.
- Address Resolution Protocol (ARP) synchronization enables ARP resolution on both of the MC-LAG peers.
- DHCP Relay with option 82 enables option 82 on the MC-LAG peers. Option 82 provides information about the network location of DHCP clients. The DHCP server uses this information to implement IP addresses or other parameters for the client.

VRRP Active-Standby Support

VRRP in active-standby mode enables Layer 3 routing over the MC-AE interfaces on the MC-LAG peers. In this mode, the MC-LAG peers act as virtual routers. The virtual routers share the virtual IP address that corresponds to the default route configured on the host or server connected to the MC-LAG. This virtual IP address, known as a routed VLAN interface (RVI), maps to either of the VRRP MAC addresses or the logical interfaces of the MC-LAG peers. The host or server uses the VRRP MAC address to send any Layer 3 upstream packets. At any time, one of the VRRP routers is the master (active), and the other is a backup (standby). Both VRRP active and VRRP backup routers forward Layer 3 traffic arriving on the MC-AE interface. If the master router fails, all the traffic shifts to the MC-AE link on the backup router.

NOTE: **You must configure VRRP on both MC-LAG peers in order for both the active and standby members to accept and route packets. Additionally, configure the VRRP backup router to send and receive ARP requests.**

Routing protocols run on the primary IP address of the RVI, and both of the MC-LAG peers run routing protocols independently. The routing protocols use the primary IP address of the RVI and the RVI MAC address to communicate with the MC-LAG peers. The RVI MAC address of each MC-LAG peer is replicated on the other MC-LAG peer and is installed as a MAC address that has been learned on the ICL-PL.

Routed VLAN Interface (RVI) MAC Address Synchronization

Routed VLAN interface (RVI) MAC address synchronization enables MC-LAG peers to forward Layer 3 packets arriving on MC-AE interfaces with either its own RVI MAC address or its peer's RVI MAC address. Each MC-LAG peer installs its own RVI MAC address as well as the peer's RVI MAC address in the hardware. Each MC-LAG peer treats the packet as if it were its own packet. If RVI MAC address synchronization is not enabled, the RVI MAC address is installed on the MC-LAG peer as if it was learned on the ICL-PL.

NOTE: If you need routing capability, configure both VRRP and routing protocols on each MC-LAG peer.

Control packets destined for a particular MC-LAG peer that arrive on an MC-AE interface of its MC-LAG peer are not forwarded on the ICL-PL interface. Additionally, using the gateway IP address as a source address when you issue either a ping, traceroute, telnet, or FTP request is not supported.

To enable RVI MAC address synchronization, issue the **set vlan *vlan-name* l3_interface *rvi-name* mcae-mac-synchronize** on each MC-LAG peer. Configure the same IP address on both MC-LAG peers. This IP address is used as the default gateway for the MC-LAG servers or hosts.

Address Resolution Protocol (ARP)

Address Resolution Protocol (ARP) maps IP addresses to MAC addresses. Without synchronization, if one MC-LAG peer sends an ARP request, and the other MC-LAG peer receives the response, ARP resolution is not successful. With synchronization, the MC-LAG peers synchronize the ARP resolutions by sniffing the packet at the MC-LAG peer receiving the ARP response and replicating this to the other MC-LAG peer. This ensures that the entries in ARP tables on the MC-LAG peers are consistent.

When one of the MC-LAG peers restarts, the ARP destinations on its MC-LAG peer are synchronized. Because the ARP destinations are already resolved, its MC-LAG peer can forward Layer 3 packets out of the MC-AE interface.

DHCP Relay with Option 82

DHCP relay with option 82 provides information about the network location of DHCP clients. The DHCP server uses this information to implement IP addresses or other parameters for the client. With DHCP relay enabled, DHCP request packets might take the path to the DHCP server through either of the MC-LAG peers. Because the MC-LAG peers have different host names, chassis MAC addresses, and interface names, you need to observe these requirements when you configure DHCP relay with option 82:

- Use the interface description instead of the interface name.
- Do not use the hostname as part of the circuit ID or remote ID strings.
- Do not use the chassis MAC address as part of the remote ID string.
- Do not enable the vendor ID.
- If the ICL-PL interface receives DHCP request packets, the packets are dropped to avoid duplicate packets in the network.

  A counter called *Due to received on ICL interface* has been added to the **show helper statistics** command, which tracks the packets that the ICL-PL interface drops.

  An example of the CLI output follows:

  ```
  user@switch> show helper statistics
  BOOTP:
    Received packets: 6
  ```

```
Forwarded packets: 0
Dropped packets: 6
  Due to no interface in DHCP Relay database: 0
  Due to no matching routing instance: 0
  Due to an error during packet read: 0
  Due to an error during packet send: 0
  Due to invalid server address: 0
  Due to no valid local address: 0
  Due to no route to server/client: 0
  Due to received on ICL interface: 6
```

The output shows that six packets received on the ICL-PL interface have been dropped.

Private VLAN (PVLAN)

Private VLANs allow you to split a broadcast domain into multiple isolated broadcast subdomains, essentially putting a VLAN inside of a VLAN. A PVLAN can span multiple peers on an MC-LAG.

When configuring a PVLAN, you must configure the ICL-PL interface as the PVLAN trunk interface for the PVLAN. This is essential for traffic to be switched to the required primary and secondary ports of the PVLAN across the MC-LAG peers.

Layer 3 Multicast

- PIM Operation With Normal Mode DR Election on page 1861
- PIM Operation with Dual-DR Mode on page 1862
- Configuration Guidelines and Caveats on page 1862

Protocol Independent Multicast (PIM) and Internet Group Management Protocol (IGMP) provide support for Layer 3 multicast, In addition to the standard mode of PIM operation, there is a special mode called PIM dual DR (designated router). PIM dual DR minimizes traffic loss in case of failures.

PIM Operation With Normal Mode DR Election

In normal mode DR election, the RVI interfaces on both of the MC-LAG peers are configured with PIM enabled. In this mode, one of the MC-LAG peers becomes the DR through the PIM DR election mechanism. The elected DR maintains the rendevous-point tree (RPT) and shortest-path tree (SPT) so it can receive data from the source device. The elected DR participates in periodic PIM join and prune activities toward the rendevous point (RP) or the source.

The trigger for initiating these join and prune activities is the IGMP membership reports that are received from interested receivers. IGMP reports received over MC-AE interfaces (potentially hashing on either of the MC-LAG peers) and single-homed links are synchronized to the MC-LAG peer through ICCP.

Both MC-LAG peers receive traffic on their incoming interface (IIF). The non-DR receives traffic by way of the ICL-PL interface, which acts as a multicast router (mrouter) interface.

If the DR fails, the non-DR has to build the entire forwarding tree (RPT and SPT), which can cause multicast traffic loss.

PIM Operation with Dual-DR Mode

In this mode, both of MC-LAG peers act as DRs (active and backup) and send periodic join and prune messages upstream towards the RP, or source, and eventually join the RPT or SPT.

The primary MC-LAG peer forwards the multicast traffic to the receiver devices even if the standby MC-LAG peer has a smaller preference metric.

The standby MC-LAG peer also joins the forwarding tree and receives the multicast data. The standby MC-LAG peer drops the data because it has an empty outgoing interface list (OIL). When the standby MC-LAG peer detects the primary MC-LAG peer failure, it adds the receiver VLAN to the OIL, and starts to forward the multicast traffic

To enable a multicast dual DR, issue the **set protocols pim interface interface-name dual-dr** command on the VLAN interfaces of each MC-LAG peer.

Configuration Guidelines and Caveats

- Configure the IP address on the active MC-LAG peer with a high IP address or a high DR priority. To ensure that the active MC-LAG peer retains the DR membership designation if PIM neighborship with the peer goes down.
- Using Bidirectional Forwarding Detection (BFD) and RVI MAC synchronization together is not supported because ARP fails.
- When using RVI MAC synchronization, make sure that you configure the primary IP address on both MC-LAG peers. Doing this ensures that both MC-LAG peers cannot become assert winners.
- The number of BFD sessions on RVIs with PIM enabled is restricted to 100. Also, If you have more than 100 RVIs configured, do not configure BFD, and make sure that the hello interval is 2 seconds.

Related Documentation

- Configuring Link Aggregation on page 2019
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896
- Example: Configuring Multichassis Link Aggregation on page 1904
- Example: Configuring Multichassis Link Aggregation for Layer 3 Multicast Using VRRP on page 1926
- *Example: Configuring Multichassis Link Aggregation for Layer 3 Unicast using MAC Address Synchronization*
- Example: Configuring Multichassis Link Aggregation for Layer 3 Unicast Using Virtual Router Redundancy Protocol (VRRP) on page 1983

Understanding Port Ranges and System Modes

QFX Series devices can support different port ranges depending on the device, media type of the interface, the software that is running on the device, and the system mode.

This topic describes:

Port Ranges for Different Media Types

The following media types support the following port ranges:

- The valid port range for a Fibre Channel (fc) interface is **0** through **5** and **42** through **47** on PIC **0**, with a total of 12 available Fibre Channel ports.

  NOTE: **Fibre Channel ports are not supported on QFX3500, QFX3600, and QFX5100 switches running Enhanced Layer 2 software.**

- The valid port range for a Gigabit Ethernet (ge) interface is **6** through **41** on PIC **0** because the ports between **0** and **5** and **42** and **47** are reserved as Fibre Channel ports. The total number of available Gigabit Ethernet ports is 36, because 12 of the remaining 48 ports are reserved for Fibre Channel and 10-Gigabit Ethernet interfaces. Fibre Channel ports cannot be configured as Gigabit Ethernet ports.
- The valid port range for a 10-Gigabit Ethernet (xe) interface is **0** through **47** on PIC **0**. The valid port range for a 10-Gigabit Ethernet (xe) interface is **0** through **15** on PIC **1**. The total number of available 10-Gigabit Ethernet ports is 64.
- The valid port range for a 40-Gigabit Ethernet is **0** through **3** on PIC **2**. There are four available ports.

  NOTE: **This port range is available on a QFX3500 standalone switch only.**

- On a QFX3500 device, see Table 160 on page 1864 and Table 161 on page 1868 for physical port to logical port mappings:
- On a QFX3600 Node device:
  - The valid port range for a 10-Gigabit Ethernet interface is **8** through **63** on PIC **0**. There are 56 available ports.
  - The valid port range for a 40-Gigabit Ethernet interface is **2** through **15** on PIC **1**. There are 14 available ports.
  - The valid port range for a 40-Gigabit data plane uplink interface is **0** through **7** on PIC **1**. There are eight available ports.

  See for Table 162 on page 1871 for physical port to logical port mappings.
- On a QFX3600 switch running Enhanced Layer 2 Software:
  - The valid port range for a 10-Gigabit Ethernet interface is **0** through **63** on PIC **0**. There are 64 available ports.
  - The valid port range for a 40-Gigabit Ethernet interface is **0** through **15** on PIC **0**. There are 16 available ports.

See for Table 163 on page 1874 for physical port to logical port mappings.

- On a QFX5100-48S switch running Enhanced Layer 2 Software:
  - The valid port range for a 10-Gigabit Ethernet interface is **0** through **47** on PIC **0**. There are 48 available ports. When you channelize the 6 40-Gbps QSFP+ ports on **48** through **53** on PIC **0**, there are 72 available ports.
  - The valid port range for a 40-Gbps QSFP+ port is **48** through **53** on PIC **0**. There are six available ports.

  See for Table 165 on page 1879for physical port to logical port mappings.
- For QFX5100-24Q and QFX5100-96S switches running Enhanced Layer 2 Software, see for physical port to logical port mappings for different system modes.

Table 160: Valid Port Ranges on QFX3500 Switches Running QFabric Software Package

Port Number	Fibre Channel Interfaces (On PIC 0)	Gigabit Ethernet Interfaces (On PIC 0)	10-Gigabit Ethernet Interfaces (On PIC 0 and 1)	40-Gigabit Ethernet Interfaces (On PIC 2)
0	fc-0/0/0	Not supported on this port	xe-0/0/0	Not supported on this port
1	fc-0/0/1	Not supported on this port	xe-0/0/1	Not supported on this port
2	fc-0/0/2	Not supported on this port	xe-0/0/2	Not supported on this port
3	fc-0/0/3	Not supported on this port	xe-0/0/3	Not supported on this port
4	fc-0/0/4	Not supported on this port	xe-0/0/4	Not supported on this port
5	fc-0/0/5	Not supported on this port	xe-0/0/5	Not supported on this port
6	Not supported on this port	ge-0/0/6	xe-0/0/6	Not supported on this port
7	Not supported on this port	ge-0/0/7	xe-0/0/7	Not supported on this port
8	Not supported on this port	ge-0/0/8	xe-0/0/8	Not supported on this port
9	Not supported on this port	ge-0/0/9	xe-0/0/9	Not supported on this port
10	Not supported on this port	ge-0/0/10	xe-0/0/10	Not supported on this port

Table 160: Valid Port Ranges on QFX3500 Switches Running QFabric Software Package *(continued)*

Port Number	Fibre Channel Interfaces (On PIC 0)	Gigabit Ethernet Interfaces (On PIC 0)	10-Gigabit Ethernet Interfaces (On PIC 0 and 1)	40-Gigabit Ethernet Interfaces (On PIC 2)
11	Not supported on this port	ge-0/0/11	xe-0/0/11	Not supported on this port
12	Not supported on this port	ge-0/0/12	xe-0/0/12	Not supported on this port
13	Not supported on this port	ge-0/0/13	xe-0/0/13	Not supported on this port
14	Not supported on this port	ge-0/0/14	xe-0/0/14	Not supported on this port
15	Not supported on this port	ge-0/0/15	xe-0/0/15	Not supported on this port
16	Not supported on this port	ge-0/0/16	xe-0/0/16	Not supported on this port
17	Not supported on this port	ge-0/0/17	xe-0/0/17	Not supported on this port
18	Not supported on this port	ge-0/0/18	xe-0/0/18	Not supported on this port
19	Not supported on this port	ge-0/0/19	xe-0/0/19	Not supported on this port
20	Not supported on this port	ge-0/0/20	xe-0/0/20	Not supported on this port
21	Not supported on this port	ge-0/0/21	xe-0/0/21	Not supported on this port
22	Not supported on this port	ge-0/0/22	xe-0/0/22	Not supported on this port
23	Not supported on this port	ge-0/0/23	xe-0/0/23	Not supported on this port
24	Not supported on this port	ge-0/0/24	xe-0/0/24	Not supported on this port
25	Not supported on this port	ge-0/0/25	xe-0/0/25	Not supported on this port

Table 160: Valid Port Ranges on QFX3500 Switches Running QFabric Software Package *(continued)*

Port Number	Fibre Channel Interfaces (On PIC 0)	Gigabit Ethernet Interfaces (On PIC 0)	10-Gigabit Ethernet Interfaces (On PIC 0 and 1)	40-Gigabit Ethernet Interfaces (On PIC 2)
26	Not supported on this port	ge-0/0/26	xe-0/0/26	Not supported on this port
27	Not supported on this port	ge-0/0/27	xe-0/0/27	Not supported on this port
28	Not supported on this port	ge-0/0/28	xe-0/0/28	Not supported on this port
29	Not supported on this port	ge-0/0/29	xe-0/0/29	Not supported on this port
30	Not supported on this port	ge-0/0/30	xe-0/0/30	Not supported on this port
31	Not supported on this port	ge-0/0/31	xe-0/0/31	Not supported on this port
32	Not supported on this port	ge-0/0/32	xe-0/0/32	Not supported on this port
33	Not supported on this port	ge-0/0/33	xe-0/0/33	Not supported on this port
34	Not supported on this port	ge-0/0/34	xe-0/0/34	Not supported on this port
35	Not supported on this port	ge-0/0/35	xe-0/0/35	Not supported on this port
36	Not supported on this port	ge-0/0/36	xe-0/0/36	Not supported on this port
37	Not supported on this port	ge-0/0/37	xe-0/0/37	Not supported on this port
38	Not supported on this port	ge-0/0/38	xe-0/0/38	Not supported on this port
39	Not supported on this port	ge-0/0/39	xe-0/0/39	Not supported on this port
40	Not supported on this port	ge-0/0/40	xe-0/0/40	Not supported on this port

Table 160: Valid Port Ranges on QFX3500 Switches Running QFabric Software Package *(continued)*

Port Number	Fibre Channel Interfaces (On PIC 0)	Gigabit Ethernet Interfaces (On PIC 0)	10-Gigabit Ethernet Interfaces (On PIC 0 and 1)	40-Gigabit Ethernet Interfaces (On PIC 2)
41	Not supported on this port	ge-0/0/41	xe-0/0/41	Not supported on this port
42	fc-0/0/42	Not supported on this port	xe-0/0/42	Not supported on this port
43	fc-0/0/43	Not supported on this port	xe-0/0/43	Not supported on this port
44	fc-0/0/44	Not supported on this port	xe-0/0/44	Not supported on this port
45	fc-0/0/45	Not supported on this port	xe-0/0/45	Not supported on this port
46	fc-0/0/46	Not supported on this port	xe-0/0/46	Not supported on this port
47	fc-0/0/47	Not supported on this port	xe-0/0/47	Not supported on this port
Q0	Not supported on this port	Not supported on this port	xe-0/1/0 xe-0/1/1 xe-0/1/2 xe-0/1/3 NOTE: Supported on QFX3500 standalone switch only.	xle-0/2/0 NOTE: Supported on QFX3500 standalone switch only.
Q1	Not supported on this port	Not supported on this port	xe-0/1/4 xe-0/1/5 xe-0/1/6 xe-0/1/7 NOTE: Supported on QFX3500 standalone switch only.	xle-0/2/1 NOTE: Supported on QFX3500 standalone switch only.

Table 160: Valid Port Ranges on QFX3500 Switches Running QFabric Software Package *(continued)*

Port Number	Fibre Channel Interfaces (On PIC 0)	Gigabit Ethernet Interfaces (On PIC 0)	10-Gigabit Ethernet Interfaces (On PIC 0 and 1)	40-Gigabit Ethernet Interfaces (On PIC 2)
Q2	Not supported on this port	Not supported on this port	xe-0/1/8 xe-0/1/9 xe-0/1/10 xe-0/1/11 NOTE: Supported on QFX3500 standalone switch only.	xle-0/2/2 NOTE: Supported on QFX3500 standalone switch only.
Q3	Not supported on this port	Not supported on this port	xe-0/1/12 xe-0/1/13 xe-0/1/14 xe-0/1/15 NOTE: Supported on QFX3500 standalone switch only.	xle-0/2/3 NOTE: Supported on QFX3500 standalone switch only.

Table 161: Valid Port Ranges on QFX3500 Switches Running Enhanced Layer 2 Software

Port Number	Gigabit Ethernet Interfaces (On PIC 0)	10-Gigabit Ethernet Interfaces (On PIC 0 and 1)	40-Gigabit Ethernet Interfaces (On PIC 1)
0	Not supported on this port	xe-0/0/0	Not supported on this port
1	Not supported on this port	xe-0/0/1	Not supported on this port
2	Not supported on this port	xe-0/0/2	Not supported on this port
3	Not supported on this port	xe-0/0/3	Not supported on this port
4	Not supported on this port	xe-0/0/4	Not supported on this port
5	Not supported on this port	xe-0/0/5	Not supported on this port
6	ge-0/0/6	xe-0/0/6	Not supported on this port
7	ge-0/0/7	xe-0/0/7	Not supported on this port
8	ge-0/0/8	xe-0/0/8	Not supported on this port

Table 161: Valid Port Ranges on QFX3500 Switches Running Enhanced Layer 2 Software *(continued)*

Port Number	Gigabit Ethernet Interfaces (On PIC 0)	10-Gigabit Ethernet Interfaces (On PIC 0 and 1)	40-Gigabit Ethernet Interfaces (On PIC 1)
9	ge-0/0/9	xe-0/0/9	Not supported on this port
10	ge-0/0/10	xe-0/0/10	Not supported on this port
11	ge-0/0/11	xe-0/0/11	Not supported on this port
12	ge-0/0/12	xe-0/0/12	Not supported on this port
13	ge-0/0/13	xe-0/0/13	Not supported on this port
14	ge-0/0/14	xe-0/0/14	Not supported on this port
15	ge-0/0/15	xe-0/0/15	Not supported on this port
16	ge-0/0/16	xe-0/0/16	Not supported on this port
17	ge-0/0/17	xe-0/0/17	Not supported on this port
18	ge-0/0/18	xe-0/0/18	Not supported on this port
19	ge-0/0/19	xe-0/0/19	Not supported on this port
20	ge-0/0/20	xe-0/0/20	Not supported on this port
21	ge-0/0/21	xe-0/0/21	Not supported on this port
22	ge-0/0/22	xe-0/0/22	Not supported on this port
23	ge-0/0/23	xe-0/0/23	Not supported on this port
24	ge-0/0/24	xe-0/0/24	Not supported on this port
25	ge-0/0/25	xe-0/0/25	Not supported on this port
26	ge-0/0/26	xe-0/0/26	Not supported on this port
27	ge-0/0/27	xe-0/0/27	Not supported on this port
28	ge-0/0/28	xe-0/0/28	Not supported on this port
29	ge-0/0/29	xe-0/0/29	Not supported on this port
30	ge-0/0/30	xe-0/0/30	Not supported on this port

Table 161: Valid Port Ranges on QFX3500 Switches Running Enhanced Layer 2 Software *(continued)*

Port Number	Gigabit Ethernet Interfaces (On PIC 0)	10-Gigabit Ethernet Interfaces (On PIC 0 and 1)	40-Gigabit Ethernet Interfaces (On PIC 1)
31	ge-0/0/31	xe-0/0/31	Not supported on this port
32	ge-0/0/32	xe-0/0/32	Not supported on this port
33	ge-0/0/33	xe-0/0/33	Not supported on this port
34	ge-0/0/34	xe-0/0/34	Not supported on this port
35	ge-0/0/35	xe-0/0/35	Not supported on this port
36	ge-0/0/36	xe-0/0/36	Not supported on this port
37	ge-0/0/37	xe-0/0/37	Not supported on this port
38	ge-0/0/38	xe-0/0/38	Not supported on this port
39	ge-0/0/39	xe-0/0/39	Not supported on this port
40	ge-0/0/40	xe-0/0/40	Not supported on this port
41	ge-0/0/41	xe-0/0/41	Not supported on this port
42	Not supported on this port	xe-0/0/42	Not supported on this port
43	Not supported on this port	xe-0/0/43	Not supported on this port
44	Not supported on this port	xe-0/0/44	Not supported on this port
45	Not supported on this port	xe-0/0/45	Not supported on this port
46	Not supported on this port	xe-0/0/46	Not supported on this port
47	Not supported on this port	xe-0/0/47	Not supported on this port
Q0	Not supported on this port	xe-0/1/0:0 xe-0/1/0:1 xe-0/1/0:2 xe-0/1/0:3	et-0/1/0

Table 161: Valid Port Ranges on QFX3500 Switches Running Enhanced Layer 2 Software *(continued)*

Port Number	Gigabit Ethernet Interfaces (On PIC 0)	10-Gigabit Ethernet Interfaces (On PIC 0 and 1)	40-Gigabit Ethernet Interfaces (On PIC 1)
Q1	Not supported on this port	xe-0/1/1:0 xe-0/1/1:1 xe-0/1/1:2 xe-0/1/1:3	et-0/1/1
Q2	Not supported on this port	xe-0/1/2:0 xe-0/1/2:1 xe-0/1/2:2 xe-0/1/2:3	et-0/1/2
Q3	Not supported on this port	xe-0/1/3:0 xe-0/1/3:1 xe-0/1/3:2 xe-0/1/3:3	et-0/1/3

Table 162: Valid Port Ranges on QFX3600 Switches Running QFabric Software Package

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 1)
Q0	xe-0/0/0 xe-0/0/1 xe-0/0/2 xe-0/0/3	xle-0/1/0
Q1	xe-0/0/4 xe-0/0/5 xe-0/0/6 xe-0/0/7	xle-0/1/1

Table 162: Valid Port Ranges on QFX3600 Switches Running QFabric Software Package *(continued)*

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 1)
Q2	xe-0/0/8 xe-0/0/9 xe-0/0/10 xe-0/0/11	xle-0/1/2
Q3	xe-0/0/12 xe-0/0/13 xe-0/0/14 xe-0/0/15	xle-0/1/3
Q4	xe-0/0/16 xe-0/0/17 xe-0/0/18 xe-0/0/19	xle-0/1/4
Q5	xe-0/0/20 xe-0/0/21 xe-0/0/22 xe-0/0/23	xle-0/1/5
Q6	xe-0/0/24 xe-0/0/25 xe-0/0/26 xe-0/0/27	xle-0/1/6
Q7	xe-0/0/28 xe-0/0/29 xe-0/0/30 xe-0/0/31	xle-0/1/7

Table 162: Valid Port Ranges on QFX3600 Switches Running QFabric Software Package *(continued)*

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 1)
Q8	xe-0/0/32 xe-0/0/33 xe-0/0/34 xe-0/0/35	xle-0/1/8
Q9	xe-0/0/36 xe-0/0/37 xe-0/0/38 xe-0/0/39	xle-0/1/9
Q10	xe-0/0/40 xe-0/0/41 xe-0/0/42 xe-0/0/43	xle-0/1/10
Q11	xe-0/0/44 xe-0/0/45 xe-0/0/46 xe-0/0/47	xle-0/1/11
Q12	xe-0/0/48 xe-0/0/49 xe-0/0/50 xe-0/0/51	xle-0/1/12
Q13	xe-0/0/52 xe-0/0/53 xe-0/0/54 xe-0/0/55	xle-0/1/13

Table 162: Valid Port Ranges on QFX3600 Switches Running QFabric Software Package *(continued)*

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 1)
Q14	xe-0/0/56 xe-0/0/57 xe-0/0/58 xe-0/0/59	xle-0/1/14
Q15	xe-0/0/60 xe-0/0/61 xe-0/0/62 xe-0/0/63	xle-0/1/15

Table 163: Valid Port Ranges on QFX3600 Switches Running Enhanced Layer 2 Software

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 0)
Q0	xe-0/0/0:0 xe-0/0/0:1 xe-0/0/0:2 xe-0/0/0:3	et-0/0/0
Q1	xe-0/0/1:0 xe-0/0/1:1 xe-0/0/1:2 xe-0/0/1:3	et-0/0/1
Q2	xe-0/0/2:0 xe-0/0/2:1 xe-0/0/2:2 xe-0/0/2:3	et-0/0/2

Table 163: Valid Port Ranges on QFX3600 Switches Running Enhanced Layer 2 Software *(continued)*

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 0)
Q3	xe-0/0/3:0 xe-0/0/3:1 xe-0/0/3:2 xe-0/0/3:3	et-0/0/3
Q4	xe-0/0/4:0 xe-0/0/4:1 xe-0/0/4:2 xe-0/0/4:3	et-0/0/4
Q5	xe-0/0/5:0 xe-0/0/5:1 xe-0/0/5:2 xe-0/0/5:3	et-0/0/5
Q6	xe-0/0/6:0 xe-0/0/6:1 xe-0/0/6:2 xe-0/0/6:3	et-0/0/6
Q7	xe-0/0/7:0 xe-0/0/7:1 xe-0/0/7:2 xe-0/0/7:3	et-0/0/7
Q8	xe-0/0/8:0 xe-0/0/8:1 xe-0/0/8:2 xe-0/0/8:3	et-0/0/8

Table 163: Valid Port Ranges on QFX3600 Switches Running Enhanced Layer 2 Software *(continued)*

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 0)
Q9	xe-0/0/9:0 xe-0/0/9:1 xe-0/0/9:2 xe-0/0/9:3	et-0/0/9
Q10	xe-0/0/10:0 xe-0/0/10:1 xe-0/0/10:2 xe-0/0/10:3	et-0/0/10
Q11	xe-0/0/11:0 xe-0/0/11:1 xe-0/0/11:2 xe-0/0/11:3	et-0/0/11
Q12	xe-0/0/12:0 xe-0/0/12:1 xe-0/0/12:2 xe-0/0/12:3	et-0/0/12
Q13	xe-0/0/13:0 xe-0/0/13:1 xe-0/0/13:2 xe-0/0/13:3	et-0/0/13
Q14	xe-0/0/14:0 xe-0/0/14:1 xe-0/0/14:2 xe-0/0/14:3	et-0/0/14

Table 163: Valid Port Ranges on QFX3600 Switches Running Enhanced Layer 2 Software *(continued)*

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 0)
Q15	xe-0/0/15:0 xe-0/0/15:1 xe-0/0/15:2 xe-0/0/15:3	et-0/0/15

Table 164: Valid Port Ranges on QFX3600 Node Devices Running QFabric Software Package

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Data Plane Uplink Interfaces (On PIC 1)	40-Gigabit Ethernet Interfaces (On PIC 1)
Q0	Not supported on this port	fte-0/1/0	Not supported on this port
Q1	Not supported on this port	fte-0/1/1	Not supported on this port
Q2	xe-0/0/8 xe-0/0/9 xe-0/0/10 xe-0/0/11	fte-0/1/2	xle-0/1/2
Q3	xe-0/0/12 xe-0/0/13 xe-0/0/14 xe-0/0/15	fte-0/1/3	xle-0/1/3
Q4	xe-0/0/16 xe-0/0/17 xe-0/0/18 xe-0/0/19	fte-0/1/4	xle-0/1/4
Q5	xe-0/0/20 xe-0/0/21 xe-0/0/22 xe-0/0/23	fte-0/1/5	xle-0/1/5

Table 164: Valid Port Ranges on QFX3600 Node Devices Running QFabric Software Package *(continued)*

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Data Plane Uplink Interfaces (On PIC 1)	40-Gigabit Ethernet Interfaces (On PIC 1)
Q6	xe-0/0/24 xe-0/0/25 xe-0/0/26 xe-0/0/27	fte-0/1/6	xle-0/1/6
Q7	xe-0/0/28 xe-0/0/29 xe-0/0/30 xe-0/0/31	fte-0/1/7	xle-0/1/7
Q8	xe-0/0/32 xe-0/0/33 xe-0/0/34 xe-0/0/35	Not supported on this port	xle-0/1/8
Q9	xe-0/0/36 xe-0/0/37 xe-0/0/38 xe-0/0/39	Not supported on this port	xle-0/1/9
Q10	xe-0/0/40 xe-0/0/41 xe-0/0/42 xe-0/0/43	Not supported on this port	xle-0/1/10
Q11	xe-0/0/44 xe-0/0/45 xe-0/0/46 xe-0/0/47	Not supported on this port	xle-0/1/11

Table 164: Valid Port Ranges on QFX3600 Node Devices Running QFabric Software Package *(continued)*

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Data Plane Uplink Interfaces (On PIC 1)	40-Gigabit Ethernet Interfaces (On PIC 1)
Q12	xe-0/0/48 xe-0/0/49 xe-0/0/50 xe-0/0/51	Not supported on this port	xle-0/1/12
Q13	xe-0/0/52 xe-0/0/53 xe-0/0/54 xe-0/0/55	Not supported on this port	xle-0/1/13
Q14	xe-0/0/56 xe-0/0/57 xe-0/0/58 xe-0/0/59	Not supported on this port	xle-0/1/14
Q15	xe-0/0/60 xe-0/0/61 xe-0/0/62 xe-0/0/63	Not supported on this port	xle-0/1/15

Table 165: Valid Port Ranges on QFX5100-48S Switches Running Enhanced Layer 2 Software

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 0)
0	xe-0/0/0	Not supported on this port
1	xe-0/0/01	Not supported on this port
2	xe-0/0/2	Not supported on this port
3	xe-0/0/3	Not supported on this port
4	xe-0/0/4	Not supported on this port
5	xe-0/0/5	Not supported on this port

Table 165: Valid Port Ranges on QFX5100-48S Switches Running Enhanced Layer 2 Software *(continued)*

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 0)
6	xe-0/0/6	Not supported on this port
7	xe-0/0/7	Not supported on this port
8	xe-0/0/8	Not supported on this port
9	xe-0/0/9	Not supported on this port
10	xe-0/0/10	Not supported on this port
11	xe-0/0/11	Not supported on this port
12	xe-0/0/12	Not supported on this port
13	xe-0/0/13	Not supported on this port
14	xe-0/0/14	Not supported on this port
15	xe-0/0/15	Not supported on this port
16	xe-0/0/16	Not supported on this port
17	xe-0/0/17	Not supported on this port
18	xe-0/0/18	Not supported on this port
19	xe-0/0/19	Not supported on this port
20	xe-0/0/20	Not supported on this port
21	xe-0/0/21	Not supported on this port
22	xe-0/0/22	Not supported on this port
23	xe-0/0/23	Not supported on this port
24	xe-0/0/24	Not supported on this port
25	xe-0/0/25	Not supported on this port
26	xe-0/0/26	Not supported on this port
27	xe-0/0/27	Not supported on this port

Table 165: Valid Port Ranges on QFX5100-48S Switches Running Enhanced Layer 2 Software *(continued)*

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 0)
28	xe-0/0/28	Not supported on this port
29	xe-0/0/29	Not supported on this port
30	xe-0/0/30	Not supported on this port
31	xe-0/0/31	Not supported on this port
32	xe-0/0/32	Not supported on this port
33	xe-0/0/33	Not supported on this port
34	xe-0/0/34	Not supported on this port
35	xe-0/0/35	Not supported on this port
36	xe-0/0/36	Not supported on this port
37	xe-0/0/37	Not supported on this port
38	xe-0/0/38	Not supported on this port
39	xe-0/0/39	Not supported on this port
40	xe-0/0/40	Not supported on this port
41	xe-0/0/41	Not supported on this port
42	xe-0/0/42	Not supported on this port
43	xe-0/0/43	Not supported on this port
44	xe-0/0/44	Not supported on this port
45	xe-0/0/45	Not supported on this port
46	xe-0/0/46	Not supported on this port
47	xe-0/0/47	Not supported on this port

Table 165: Valid Port Ranges on QFX5100-48S Switches Running Enhanced Layer 2 Software *(continued)*

Port Number	10-Gigabit Ethernet Interfaces (On PIC 0)	40-Gigabit Ethernet Interfaces (On PIC 0)
48	xe-0/0/48:0 xe-0/0/48:1 xe-0/0/48:2 xe-0/0/48:3	et-0/0/48
49	xe-0/0/49:0 xe-0/0/49:1 xe-0/0/49:2 xe-0/0/49:3	et-0/0/49
50	xe-0/0/50:0 xe-0/0/50:1 xe-0/0/50:2 xe-0/0/50:3	et-0/0/50
51	xe-0/0/51:0 xe-0/0/51:1 xe-0/0/51:2 xe-0/0/51:3	et-0/0/51
52	xe-0/0/52:0 xe-0/0/52:1 xe-0/0/52:2 xe-0/0/52:3	et-0/0/52
53	xe-0/0/53:0 xe-0/0/53:1 xe-0/0/53:2 xe-0/0/53:3	et-0/0/53

Supported System Modes

NOTE: There are restrictions on the ports you can channelize on the QFX5100-24Q and QFX5100-96S switches depending on the system mode you configure. If you try to channelize ports that are restricted, the configuration is ignored.

The following system modes are available on the QFX5100-24Q switch:

- Default mode
- Mode-104-port
- Flexi-PIC mode
- Non-oversubscribed mode

See Table 166 on page 1883 for more information regarding the supported system modes for your switch.

The following system modes are available on the QFX5100-96S switch:

- Default-mode
- Non-oversubscribed mode

See Table 166 on page 1883 for more information regarding the supported system modes for your switch.

Table 166: System Modes Supported on QFX5100 Switches Running Enhanced Layer 2 Software

	Default-mode	Mode-104port	Flexi-pic-mode	Non-oversubscribed-mode
QFX5100-48S	Not supported	Not supported	Not supported	Not supported
QFX5100-24Q	Supported You do not need to configure the switch to be in this mode. On PIC 0, you can channelize all 24 40-Gbps QSFP+ ports. On PIC 1 and PIC 2, the 40-Gbps QSFP+ ports in the expansion modules are supported but cannot be channelized. In this mode, you can have one of two port combinations: 32 40-Gbps QSFP+ ports, or 96 10-Gigabit Ethernet ports plus 8 40-Gbps QSFP+ ports.	Supported On PIC 0, all 24 40-Gbps QSFP+ ports are channelized by default, which provides 96 10-Gigabit Ethernet ports. 40-Gbps QSFP+ ports contained in an expansion module on PIC 1 are supported. On PIC 1, ports 0 and 2 are channelized by default, and ports 1 and 3 are disabled. If 40-Gbps QSFP+ ports contained in an expansion module are detected on PIC 2, they are ignored.	Supported On PIC 0, the first four ports (ports 0 through 3) cannot be channelized. 40-Gbps QSFP+ ports contained in expansion modules on PIC 1 and PIC 2 are supported but cannot be channelized.	Supported All 24 40-Gbps QSFP+ ports on PIC 0 can be channelized to 96 10-Gigabit Ethernet ports. 40-Gbps QSFP+ ports contained in the expansion modules on PIC 1 and PIC 2 are not supported and cannot be channelized. There is no packet loss for packets of any size in this mode.

Table 166: System Modes Supported on QFX5100 Switches Running Enhanced Layer 2 Software *(continued)*

	Default-mode	Mode-104port	Flexi-pic-mode	Non-oversubscribed-mode
QFX5100-96S	Supported You do not need to configure the switch to be in this mode. On PIC 0, all 96 10-Gigabit Ethernet ports are supported. You can only channelize the 40-GbpsQSFP+ interfaces to 10-Gibabit Ethernet interfaces on ports 96 and 100. When you channelize the interfaces on ports 96 and 100, ports 97, 98, 99, 101, 102 and 103 are disabled.	Not supported	Not supported	Supported On PIC 0, all 96 10-Gigabit Ethernet ports are supported. However, the eight 40-Gbps QSFP+ ports are not supported and cannot be channelized. There is no packet loss for packets of any size in this mode.

Related Documentation

- Interfaces Overview on page 1839
- Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches on page 2028
- Configuring the System Mode on QFX5100 Switches on page 2030

- *Rear Panel of a QFX3500 Device*
- *Front Panel of a QFX3600 Device*
- *Junos OS Network Interfaces Library for Routing Devices*

Understanding Redundant Trunk Links

In a typical enterprise network composed of distribution and access layers, a redundant trunk link provides a simple solution for network recovery when a trunk port on a switch goes down. In that case, traffic is routed to another trunk port, keeping network convergence time to a minimum.

To configure a redundant trunk link, create a redundant trunk group. The redundant trunk group is configured on the access switch and contains two links: a primary or active link, and a secondary link. If the active link fails, the secondary link automatically starts forwarding data traffic without waiting for normal spanning-tree protocol convergence.

Data traffic is forwarded only on the active link. Data traffic on the secondary link is dropped and shown as dropped packets when you issue the operational mode command **show interfaces *interface-name* extensive**.

While data traffic is blocked on the secondary link, Layer 2 control traffic is still permitted. For example, an LLDP session can be run between two switches on the secondary link.

Rapid Spanning Tree Protocol (RSTP) is enabled by default on the switches to create a loop-free topology, but an interface is not allowed to be in both a redundant trunk group and in a spanning-tree protocol topology at the same time. You must disable RSTP on an interface if a redundant trunk group is configured on that interface. For example, in Figure 25 on page 1886, in addition to disabling RSTP on the Switch 3 interfaces, you must also disable RSTP on the Switch 1 and Switch 2 interfaces connected to Switch 3. Spanning-tree protocols can, however, continue operating on other interfaces on those switches—for example on the link between Switch 1 and Switch 2.

Figure 25 on page 1886 shows three switches in a basic topology for redundant trunk links. Switch 1 and Switch 2 make up the distribution layer, and Switch 3 makes up the access layer. Switch 3 is connected to the distribution layer through trunk ports ge-0/0/9.0 (Link 1) and ge-0/0/10.0 (Link 2). Link 1 and Link 2 are in a redundant trunk group called group1. Link 1 is designated as the primary link. Traffic flows between Switch 3 in the access layer and Switch 1 in the distribution layer through Link 1. While Link 1 is active, Link 2 blocks traffic.

Figure 25: Redundant Trunk Group, Link 1 Active

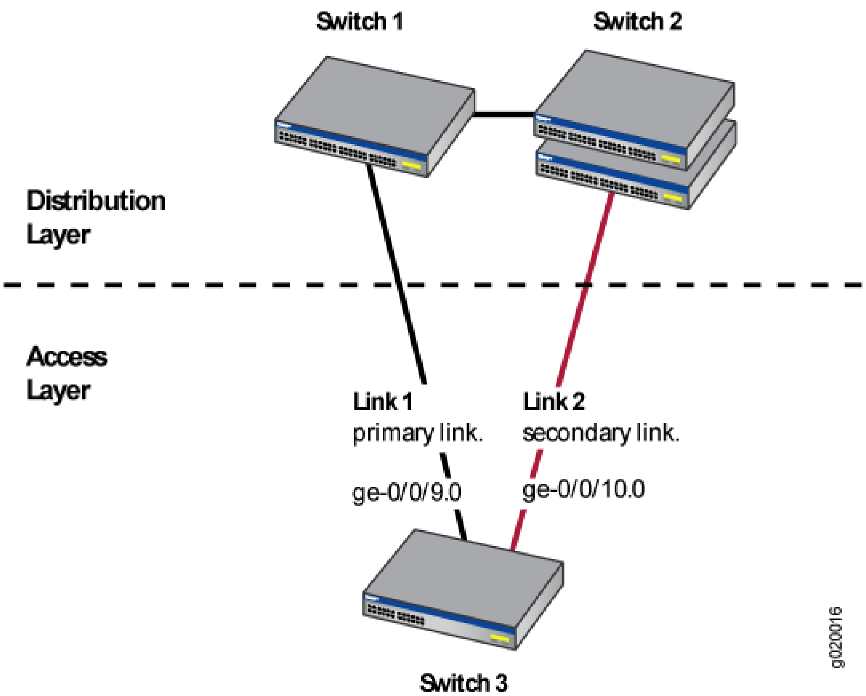
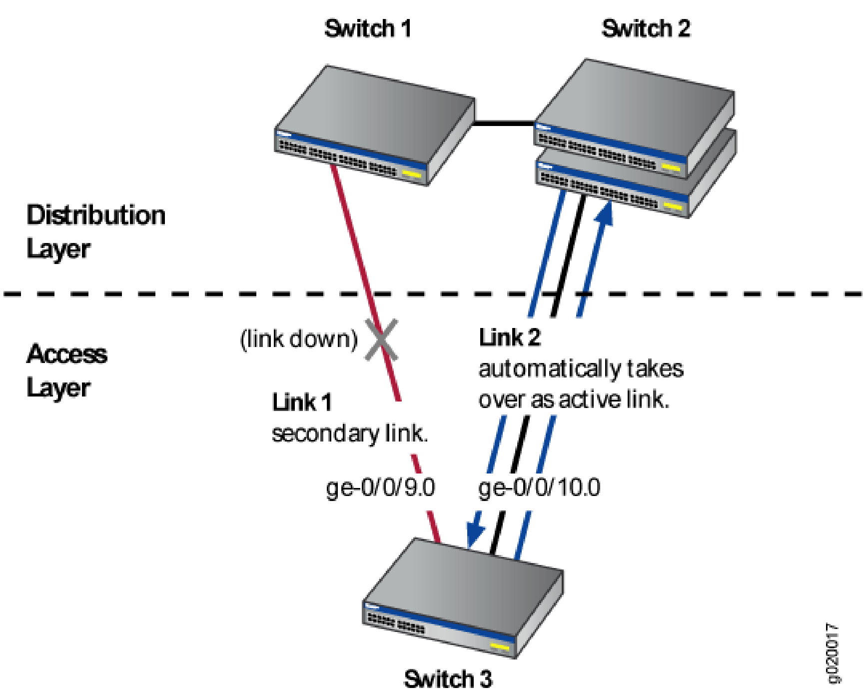


Figure 26 on page 1886 illustrates how the redundant trunk link topology works when the primary link goes down.

Figure 26: Redundant Trunk Group, Link 2 Active



When Link 1 between Switch 1 and Switch 3 goes down, Link 2 takes over as the active link. Traffic between the access layer and the distribution layer is then automatically switched to Link 2 between Switch 1 and Switch 2.

Related Documentation

- *Example: Configuring Redundant Trunk Links for Faster Recovery*
- Example: Configuring Redundant Trunk Links for Faster Recovery on page 2010

Understanding Generic Routing Encapsulation

Generic routing encapsulation (GRE) provides a private, secure path for transporting packets through an otherwise public network by encapsulating (or tunneling) the packets.

This topic describes:

Overview of GRE

GRE encapsulates data packets and redirects them to a device that de-encapsulates them and routes them to their final destination. This allows the source and destination switches to operate as if they have a virtual point-to-point connection with each other (because the outer header applied by GRE is transparent to the encapsulated payload packet). For example, GRE tunnels allow routing protocols such as RIP and OSPF to forward data packets from one switch to another switch across the Internet. In addition, GRE tunnels can encapsulate multicast data streams for transmission over the Internet.

GRE is described in RFC 2784 (obsoletes earlier RFCs 1701 and 1702). The switches support RFC 2784, but not completely. (For a list of limitations, see "Configuration Limitations" on page 1890.)

As a *tunnel source router*, the switch encapsulates a payload packet for transport through the tunnel to a destination network. The payload packet is first encapsulated in a GRE packet, and then the GRE packet is encapsulated in a delivery protocol. The switch performing the role of a *tunnel remote router* extracts the tunneled packet and forwards the packet to its destination.

GRE Tunneling

Data is routed by the system to the GRE endpoint over routes established in the route table. (These routes can be statically configured or dynamically learned by routing protocols such as RIP or OSPF.) When a data packet is received by the GRE endpoint, it is de-encapsulated and routed again to its destination address.

GRE tunnels are *stateless*-–that is, the endpoint of the tunnel contains no information about the state or availability of the remote tunnel endpoint. Therefore, the switch operating as a tunnel source router cannot change the state of the GRE tunnel interface to down if the remote endpoint is unreachable.

For details about GRE tunneling, see:

- Encapsulation and De-Encapsulation on the Switch on page 1888
- Number of Source and Destination Tunnels Allowed on a Switch on page 1888
- Class of Service on GRE Tunnels on page 1888
- Firewall Filters and GRE Tunnels on page 1889

Encapsulation and De-Encapsulation on the Switch

Encapsulation—A switch operating as a tunnel source router encapsulates and forwards GRE packets as follows:

1. When a switch receives a data packet (payload) to be tunneled, it sends the packet to the tunnel interface.
2. The tunnel interface encapsulates the data in a GRE packet and adds an outer IP header.
3. The IP packet is forwarded on the basis of the destination address in the outer IP header.

De-encapsulation—A switch operating as a tunnel remote router handles GRE packets as follows:

1. When the destination switch receives the IP packet from the tunnel interface, the outer IP header and GRE header are removed.
2. The packet is routed based on the inner IP header.

Number of Source and Destination Tunnels Allowed on a Switch

QFX5100 switches support as many as 512 GRE tunnels.

EX switches support as many as 500 GRE tunnels between switches transmitting IPv4 or IPv6 payload packets over GRE. If a passenger protocol in addition to IPv4 and IPv6 is used, you can configure up to 333 GRE tunnels between the switches.

An EX switch can have a maximum of 20 tunnel source IP addresses configured, and each tunnel source IP can be configured with up to 20 destination IP addresses on a second switch. As a result, the two connected switches can have a maximum of 400 GRE tunnels. If the first switch is also connected to a third switch, the possible maximum number of tunnels is 500.

Class of Service on GRE Tunnels

When a network experiences congestion and delay, some packets might be dropped. Junos OS class of service (CoS) divides traffic into classes to which you can apply different levels of throughput and packet loss when congestion occurs and thereby set rules for packet loss. For details about CoS, see Junos OS CoS for EX Series Switches Overview.

The following CoS components are available on a switch operating as a GRE tunnel source router or GRE tunnel remote router:

- At the GRE tunnel source—On a switch operating as a tunnel source router, you can apply CoS classifiers on an *ingress port* or on a *GRE port*, with the following results on CoS component support on tunneled packets:
  - Schedulers only—Based on the CoS classification on the ingress port, you can apply CoS schedulers on a GRE port of the switch to define output queues and control the transmission of packets through the tunnel after GRE encapsulation. However, you cannot apply CoS rewrite rules to these packets.
  - Schedulers and rewrite rules—Depending on the CoS classification on the GRE port, you can apply both schedulers and rewrite rules to the encapsulated packets transmitted through the tunnel.
- At the GRE tunnel endpoint—When the switch is a tunnel remote router, you can apply CoS classifiers on the GRE port and schedulers and rewrite rules on the egress port to control the transmission of a de-encapsulated GRE packet out from the egress port.

Firewall Filters and GRE Tunnels

Firewall filters provide rules that define whether to permit, deny, or forward packets that are transiting an interface on a switch. (For details, see Firewall Filters for EX Series Switches Overview.) Because of the encapsulation and de-encapsulation performed by GRE, you are constrained as to where you can apply a firewall filter to filter tunneled packets and which header will be affected. Table 167 on page 1889 identifies these constraints.

Table 167: Firewall Filter Application Points for Tunneled Packets

Endpoint Type	Ingress Interface	Egress Interface
Source (encapsulating)	inner header	outer header
Remote (de-encapsulating)	Cannot filter packets on ingress interface	inner header

Configuration Limitations

Table 168 on page 1890 lists features that are not supported with GRE.

Table 168: Features Not Supported with GRE

EX Switches	QFX Switches
MPLS over GRE tunnels	MPLS over GRE tunnels
GRE keepalives	GRE keepalives
GRE keys, payload packet fragmentation, and sequence numbers for fragmented packets	GRE keys, payload packet fragmentation, and sequence numbers for fragmented packets
BGP dynamic tunnels	BGP dynamic tunnels
Outer IP address must be IPv4	Outer IP address must be IPv4
Virtual routing instances	
Bidirectional Forwarding Detection (BFD) protocol over GRE distributed mode	
OSPF limitation—Enabling OSPF on a GRE interface creates two equal-cost routes to the destination: one through the Ethernet network or uplink interface and the other through the tunnel interface. If data is routed through the tunnel interface, the tunnel might fail. To keep the interface operational, we recommend that you use a static route, disable OSPF on the tunnel interface, or configure the peer not to advertise the tunnel destination over the tunnel interface.	

Related Documentation

- *Configuring Generic Routing Encapsulation Tunneling (CLI Procedure)*
- Configuring Generic Routing Encapsulation Tunneling on page 2025

CHAPTER 24

Configuration

Configuration Examples

Example: Configuring Interfaces for Uplink Failure Detection

Uplink failure detection allows a switch to detect link failure on uplink interfaces and to propagate the failure information to the downlink interfaces. All of the network interface cards (NICs) on a server are configured as being either the primary link or the secondary link and share the same IP address. When the primary link goes down, the server transparently shifts the connection to the secondary link to ensure that the traffic on the failed link is not dropped.

This example describes:

Requirements

This example uses the following software and hardware components:

- Junos OS Release 12.1 or later for the QFX Series
- Two QFX3500 switches
- Two aggregation switches
- One dual-homed server

Overview and Topology

The topology in this example illustrates how to configure uplink failure detection on Switch A and Switch B. Switch A and Switch B are both configured with a link-to-monitor interface (the uplink interface to the aggregation switch) and a link-to-disable interface (the downlink interface to the server). For simplicity, only one group of link-to-monitor interfaces and link-to-disable interfaces is configured for each switch. The server is dual-homed to both Switch A and Switch B. In this scenario, if the link-to-monitor interface to Switch A is disabled, the server uses the link-to-monitor interface to Switch B instead.

NOTE: **This example does not describe how to configure the dual-homed server or the aggregation switches. Please refer to the documentation for each of these devices for more information.**

Figure 24 on page 1842 illustrates a typical setup for uplink failure detection.

Figure 27: Uplink Failure Detection Configuration on Switches

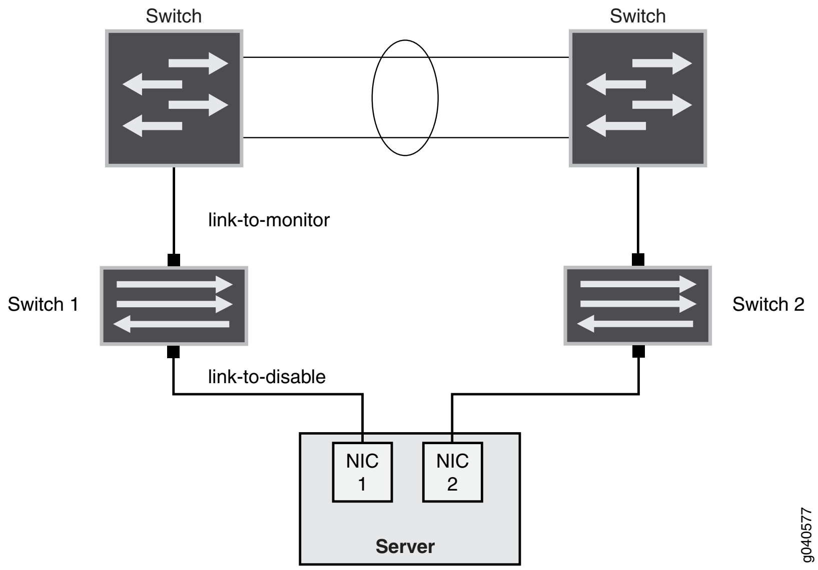


Table 169 on page 1893 lists uplink failure settings for each QFX3500 switch.

Table 169: Settings for Uplink Failure Protection Example

Switch A	Switch B
• Group name: Group1 • Link-to-monitor interface: **xe-0/0/0** • Link-to-disable interface: **xe-0/0/1**	• Group name: Group2 • Link-to-monitor interface: **xe-0/0/0** • Link-to-disable interface: **xe-0/0/1**

Configuring Uplink Failure Detection on Both Switches

To configure uplink failure detection on both switches, perform these tasks:

CLI Quick Configuration

To quickly configure uplink failure protection on Switch A and Switch B, copy the following commands and paste them into the switch terminal window:

```
[edit protocols]
set uplink-failure-detection group group1
set uplink-failure-detection group group2
set uplink-failure-detection group group1 link-to-monitor xe-0/0/0
set uplink-failure-detection group group2 link-to-monitor xe-0/0/0
set uplink-failure-detection group group1 link-to-disable xe-0/0/1
set uplink-failure-detection group group2 link-to-disable xe-0/0/1
```

Step-by-Step Procedure

To configure uplink failure protection on both switches:

1. Specify a name for the uplink failure detection group on Switch A:

   ```
   [edit protocols]
   user@switch# set uplink-failure-detection group group1
   ```

2. Add an uplink interface to the group on Switch A:

   ```
   [edit protocols]
   user@switch# set uplink-failure-detection group group1 link-to-monitor xe-0/0/0
   ```

3. Add a downlink interface to the group on Switch A:

   ```
   [edit protocols]
   user@switch# set uplink-failure-detection group group1 link-to-disable xe-0/0/1
   ```

4. Specify a name for the uplink failure detection group on Switch B:

   ```
   [edit protocols]
   user@switch# set uplink-failure-detection group group2
   ```

5. Add an uplink interface to the group on Switch B:

   ```
   [edit protocols]
   user@switch# set uplink-failure-detection group group2 link-to-monitor xe-0/0/0
   ```

6. Add a downlink interface to the group on Switch B:

   ```
   [edit protocols]
   user@switch# set uplink-failure-detection group group2 link-to-disable xe-0/0/1
   ```

Results Display the results of the configuration:

```
uplink-failure-detection {
  group {
    group1 {
      link-to-monitor {
        xe-0/0/0;
      }
      link-to-disable {
        xe-0/0/1;
      }
    }
    group2 {
      link-to-monitor {
        xe-0/0/0;
      }
      link-to-disable {
        xe-0/0/1;
      }
    }
  }
}
```

Verification

To verify that uplink failure detection is working correctly, perform the following tasks on Switch A and Switch B:

- Verifying That Uplink Failure Detection is Working Correctly on page 1894

Verifying That Uplink Failure Detection is Working Correctly

Purpose Verify that the switch disables the downlink interface when it detects an uplink failure.

Action

1. View the current uplink failure detection status:

```
user@switch> show uplink-failure-detection
Group                         : group1
Uplink                        :  xe-0/0/0*
Downlink                      :  xe-0/0/1*
Failure Action                :  Inactive
```

NOTE: The asterisk (*) indicates that the link is up.

2. Disable the uplink interface:

```
[edit]
user@switch# set interface xe-0/0/0 disable
```

3. Save the configuration on the switch.

4. View the current uplink failure detection status:

```
user@switch> show uplink-failure-detection
Group                         : group1
Uplink                        :  xe-0/0/0
Downlink                      :  xe-0/0/1
Failure Action                :  Active
```

Meaning

The output in Step 1 shows that the uplink interface is up, and hence that the downlink interface is also up, and that the status of **Failure Action** is **Inactive**.

The output in Step 4 shows that both the uplink and downlink interfaces are down (there are no asterisks after the interface name) and that the status of **Failure Action** is changed to **Active**. This output shows that uplink failure detection is working.

Related Documentation

- Overview of Uplink Failure Detection on page 1841
- Configuring Interfaces for Uplink Failure Detection on page 2018
- *Verifying That Uplink Failure Detection Is Working Correctly*

Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch

A QFX Series product allows you to combine multiple Ethernet links into one logical interface for higher bandwidth and redundancy. The ports that are combined in this manner are referred to as a link aggregation group (LAG) or bundle. The number of Ethernet links you can combine into a LAG depends on your QFX Series product model. You can configure LAGs to connect a QFX Series product to other switches, like aggregation switches, servers, or routers. This example describes how to configure LAGs to connect a QFX3500, QFX3600, or QFX5100 switch to an aggregation switch.

Requirements

This example uses the following software and hardware components:

- Junos OS Release 11.1 or later for the QFX3500 and QFX3600 switches, and Junos OS 13.2 or later for the QFX5100 switch.
- One QFX3500, QFX3600, or QFX5100 switch.

Overview and Topology

In this example, the switch has one LAG comprising two 10-Gigabit Ethernet interfaces. This LAG is configured in port mode trunk so that the switch and the VLAN to which it has been assigned can send and receive traffic.

Configuring the Ethernet interfaces as LAGs has the following advantages:

- If one physical port is lost for any reason (a cable is unplugged or a switch port fails), the logical port transparently continues to function over the remaining physical port.
- Link Aggregation Control Protocol (LACP) can optionally be configured for link monitoring and automatic addition and deletion of individual links without user intervention.

NOTE: If the remote end of the LAG link is a security device, LACP might not be supported because security devices require a deterministic configuration. In this case, do not configure LACP. All links in the LAG are permanently operational unless the switch detects a link failure within the Ethernet physical layer or data link layers.

The topology used in this example consists of one switch with a LAG configured between two of its 10-Gigabit Ethernet interfaces. The switch is connected to an aggregation switch.

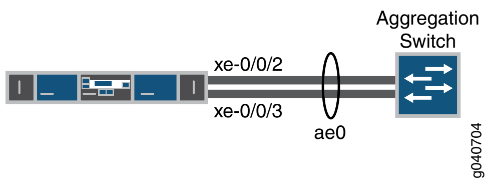


Table 170 on page 1897 details the topology used in this configuration example.

Table 170: Components of the Topology for Configuring a LAG Between a QFX3500 Switch and Aggregation Switch

Hostname	Base Hardware	Trunk Port
switch	QFX3500, QFX3600, or QFX5100 switch	**ae0** is configured as a trunk port and combines the following two interfaces: **xe-0/0/2** and **xe-0/0/3** .

Configuration

To configure a LAG between two 10-Gigabit Ethernet interfaces:

CLI Quick Configuration

To quickly configure a LAG between two 10-Gigabit Ethernet interfaces on a switch, copy the following commands and paste them into the switch terminal window:

NOTE: If you are configuring a LAG on the QFX5100 switch, use the **interface-mode** statement instead of the **port-mode** statement. For ELS details, see “Getting Started with Enhanced Layer 2 Software” on page 58.

```
[edit]
set chassis aggregated-devices ethernet device-count 1
set interfaces ae0 aggregated-ether-options minimum-links 1
set interfaces ae0 aggregated-ether-options link-speed 10g
set interfaces ae0 unit 0 family ethernet-switching vlan members green
set interfaces xe-0/0/2 ether-options 802.ad ae0
set interfaces xe-0/0/3 ether-options 802.ad ae0
set interfaces ae0 unit 0 family ethernet-switching port-mode trunk
set interfaces ae0 aggregated-ether-options lacp active
set interfaces ae0 aggregated-ether-options lacp periodic fast
```

Step-by-Step Procedure

To configure a LAG between a QFX Series switch and an aggregation switch:

1. Specify the number of LAGs to be created on the switch:

```
[edit chassis]
user@switch# set aggregated-devices ethernet device-count 1
```

2. Specify the number of links that need to be present for the **ae0** LAG interface to be **up**:

```
[edit interfaces]
user@switch# set ae0 aggregated-ether-options minimum-links 1
```

3. Specify the media speed of the **ae0** link:

```
[edit interfaces]
user@switch# set ae0 aggregated-ether-options link-speed 10g
```

4. Specify the members to be included within the aggregated Ethernet bundle:

```
[edit interfaces]
user@switch# set interfaces xe-0/0/2 ether-options 802.ad ae0
[edit interfaces]
user@switch# set interfaces xe-0/0/3 ether-options 802.ad ae0
```

5. Assign a port mode of trunk to the **ae0** link:

NOTE: If you are configuring a LAG on the QFX5100 switch, use the interface-mode statement instead of the port-mode statement. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching port-mode trunk
```

or

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching interface-mode trunk
```

6. Assign the LAG to a VLAN:

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching vlan members green vlan-id 200
```

7. (Optional): Designate one side of the LAG as active for LACP:

```
[edit interfaces]
user@switch# set ae0 aggregated-ether-options lacp active
```

8. (Optional): Designate the interval and speed at which the interfaces send LACP packets:

```
[edit interfaces]
user@switch# set ae0 aggregated-ether-options lacp periodic fast
```

Results

Display the results of the configuration on a QFX3500 or QFX3600 switch:

```
[edit]
chassis {
  aggregated-devices {
    ethernet {
      device-count 1;
    }
  }
}
green {
  vlan-id 200;
  }
}
interfaces {
```



```
  ae0 {
    aggregated-ether-options {
      link-speed 10g;
      minimum-links 1;
    }
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
          vlan {
          members green;
        }
    }
  }
  xe-0/0/2 {
    ether-options {
      802.ad ae0;
    }
  }
  xe-0/0/3 {
    ether-options {
      802.ad ae0;
    }
  }
}
```

Verification

To verify that switching is operational and one LAG has been created, perform these tasks:

- Verifying That LAG ae0.0 Has Been Created on page 1899
- Verifying That LAG ae0 Has Been Created on page 1899

Verifying That LAG ae0.0 Has Been Created

Purpose Verify that LAG **ae0.0** has been created on the switch.

Action **show interfaces ae0 terse**

```
Interface               Admin Link Proto    Local                 Remote
ae0                     up    up
ae0.0                   up    up eth-switch
```

Meaning The output confirms that the **ae0.0** link is up and shows the **family** and IP address assigned to this link.

Verifying That LAG ae0 Has Been Created

Purpose Verify that LAG **ae0** has been created on the switch

Action **show interfaces ae0 terse**

```
Interface               Admin Link Proto    Local                 Remote
ae0                     up    down
ae0.0                   up    down eth-switch
```


Meaning The output shows that the **ae0.0** link is down.

Troubleshooting

Troubleshooting a LAG That Is Down

Problem The **show interfaces terse** command shows that the LAG is **down**.

Solution Check the following:

- Verify that there is no configuration mismatch.
- Verify that all member ports are up.
- Verify that a LAG is part of family ethernet switching (Layer 2 LAG) or family inet (Layer 3 LAG).
- Verify that the LAG member is connected to the correct LAG at the other end.

Related Documentation

- Configuring Link Aggregation on page 2019
- Verifying the Status of a LAG Interface on page 2148
- Verifying That LACP Is Configured Correctly and Bundle Members Are Exchanging LACP Protocol Packets on page 2149
- Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch on page 1900
- **show lacp statistics interfaces (View) on page 2261**

Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch

QFX Series products allow you to combine multiple Ethernet links into one logical interface for higher bandwidth and redundancy. The ports that are combined in this manner are referred to as a link aggregation group (LAG) or bundle. The number of Ethernet links you can combine into a LAG depends on your QFX Series product model. On a standalone switch, you can group up to 32 Ethernet interfaces to form a LAG. On a QFabric system, you can group up to 8 Ethernet interfaces to form a LAG. QFX Series products allow you to further enhance these links by configuring Link Aggregation Control Protocol (LACP).

This example describes how to overlay LACP on the LAG configurations that were created in “Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch” on page 1896:

Requirements

This example uses the following software and hardware components:

- Junos OS Release 11.1 or later for the QFX3500 switch, Junos OS Release 12.1 or later for the QFX3600 switch, and Junos OS 13.2 or later for the QFX5100 switch.
- One QFX3500, QFX3600, or QFX5100 switch.

Before you configure LACP, be sure you have:

- Configured the ports on the switches as trunk ports.
- Configured the LAG.

Overview and Topology

The topology in this example is exactly the same as the topology used in the Configuring a LAG Between a QFX Switch and an Aggregation Switch example. This example shows how to use LACP to enhance the LAG functionality.

LACP exchanges are made between *actors* (the transmitting link) and *partners* (the receiving link). The LACP mode can be either active or passive.

NOTE: **If the actor and partner are both in passive mode, they do not exchange LACP packets, which results in the aggregated Ethernet links not coming up. By default, LACP is in passive mode. To initiate transmission of LACP packets and responses to LACP packets, you must enable LACP in active mode.**

By default, the actor and partner send LACP packets every second. You can configure the interval at which the interfaces send LACP packets by including the **periodic** statement at the **[edit interfaces *interface-name* aggregated-ether-options lacp]** hierarchy level.

The interval can be fast (every second) or slow (every 30 seconds).

Configuring LACP for the LAG on the QFX Series

To configure LACP for a QFX Series LAG, perform these tasks:

CLI Quick Configuration

To quickly configure LACP for the access switch LAGs, copy the following commands and paste them into the switch terminal window:

```
[edit]
set interfaces ae0 aggregated-ether-options lacp active periodic fast
```

Step-by-Step Procedure

To configure LACP for LAG **ae0** :

1. Specify the aggregated Ethernet options for the LAG:

```
[edit interfaces]
user@switch# set ae0 aggregated-ether-options lacp active periodic fast
```

Results

Display the results of the configuration:

```
[edit interfaces]
user@switch# show
ae0 {
  aggregated-ether-options {
    lacp {
      active;
      periodic fast;
    }
  }
}
```

Verification

To verify that LACP packets are being exchanged, perform the following tasks:

Verifying the LACP Settings

Purpose Verify that LACP has been set up correctly.

Action Use the **show lacp interfaces *interface-name*** command to check that LACP has been enabled as active on one end.

```
user@switch> show lacp interfaces xe-0/02

Aggregated interface: ae0

    LACP state:       Role    Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity

      xe-0/0/2      Actor     No   Yes    No   No   No   Yes     Fast    Active

      xe-0/0/2    Partner     No   Yes    No   No   No   Yes     Fast   Passive

    LACP protocol:   Receive State    Transmit State          Mux State

      xe-0/0/2          Defaulted     Fast periodic           Detached
```

Meaning The output indicates that LACP has been set up correctly and is active at one end.

Verifying That the LACP Packets Are Being Exchanged

Purpose Verify that LACP packets are being exchanged.

Action Use the **show interfaces ae*x* statistics** command to display LACP information.

```
user@switch> show interfaces ae0 statistics

Physical interface: ae0, Enabled, Physical link is Down
  Interface index: 153, SNMP ifIndex: 30
  Link-level type: Ethernet, MTU: 1514, Speed: Unspecified, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Disabled, Minimum links needed: 1,
  Minimum bandwidth needed: 0
  Device flags   : Present Running
```



```
Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
Current address: 02:19:e2:50:45:e0, Hardware address: 02:19:e2:50:45:e0
Last flapped   : Never
Statistics last cleared: Never
  Input packets : 0
  Output packets: 0
Input errors: 0, Output errors: 0

Logical interface ae0.0 (Index 71) (SNMP ifIndex 34)
  Flags: Hardware-Down Device-Down SNMP-Traps Encapsulation: ENET2
  Statistics        Packets        pps         Bytes          bps
  Bundle:
      Input :             0          0             0            0
      Output:             0          0             0            0
  Protocol inet
    Flags: None
    Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
      Destination: 10.10.10/24, Local: 10.10.10.1, Broadcast: 10.10.10.255
```

Meaning The output here shows that the link is down and that no PDUs are being exchanged.

Troubleshooting

To troubleshoot a nonworking LACP link, perform these tasks:

Troubleshooting a Nonworking LACP Link

Problem The LACP link is not working.

Solution Check the following:

- Remove the LACP configuration and verify whether the static LAG is up.
- Verify that LACP is configured at both ends.
- Verify that LACP is not passive at both ends.
- Verify whether LACP protocol data units (PDUs) are being exchanged by running the **monitor traffic-interface *lag-member* detail** command.

Related Documentation

- Configuring Link Aggregation on page 2019
- Verifying the Status of a LAG Interface on page 2148
- Verifying That LACP Is Configured Correctly and Bundle Members Are Exchanging LACP Protocol Packets on page 2149
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896
- **show lacp statistics interfaces (View) on page 2261**

Example: Configuring Multichassis Link Aggregation

NOTE: Multichassis Link Aggregation (MC-LAG) is supported on QFX3500 and QFX3600 standalone switches running the original CLI and QFX5100 standalone switches running Enhanced Layer 2 Software.

Multichassis link aggregation groups (MC-LAGs) enable a client device to form a logical LAG interface between two switches. An MC-LAG provides redundancy and load balancing between the two switches, multihoming support, and a loop-free Layer 2 network without running Spanning Tree Protocol (STP).

The peers in an MC-LAG use an interchassis control link-protection link (ICL-PL) to replicate forwarding information across the peers. The Interchassis Control Protocol (ICCP) exchanges the control information between two MC-LAG switches. Additionally, ICCP propagates the operational state of MC-LAG members through the ICL-PL.

On one end of an MC-LAG is an MC-LAG client device, such as a server, that has one or more physical links in a link aggregation group (LAG). This client device does not need to detect the MC-LAG. On the other side of an MC-LAG are two MC-LAG switches. Each of the switches has one or more physical links connected to a single client device. The switches coordinate with each other to ensure that data traffic is forwarded properly.

Requirements

This example uses the following hardware and software components:

- Junos OS Release 12.2 or later for the QFX3500 and QFX3600 standalone switches and Junos OS Release 13.2X51-D10 or later for the QFX5100 standalone switches.
- Two QFX3500 or QFX3600 standalone switches, or two QFX5100 standalone switches.

Before you configure an MC-LAG, be sure that you understand how to:

- Configure aggregated Ethernet interfaces on a switch. See “Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch” on page 1896.
- Configure the Link Aggregation Control Protocol (LACP) on aggregated Ethernet interfaces on a switch. See “Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch” on page 1900.

Overview

In this example, you configure an MC-LAG across two switches, consisting of two aggregated Ethernet interfaces, an interchassis control link-protection link (ICL-PL), multichassis protection link for the ICL-PL, ICCP for the peers hosting the MC-LAG, and Layer 3 connectivity between MC-LAG peers. Layer 3 connectivity is required for ICCP.

Topology

The topology used in this example consists of two switches hosting an MC-LAG. The two switches are connected to a server. Figure 28 on page 1905 shows the topology of this example.

Figure 28: Configuring a Multichassis LAG Between Switch A and Switch B

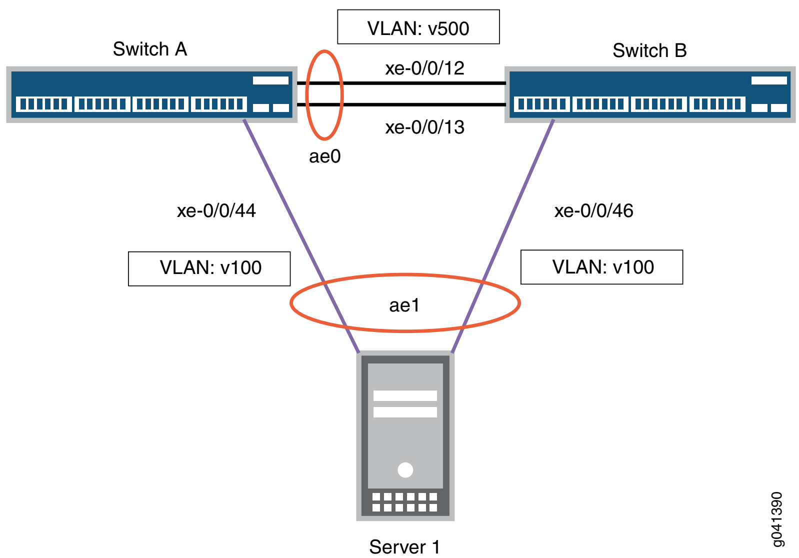


Table 170 on page 1897 details the topology used in this configuration example.

Table 171: Components of the Topology for Configuring a Multichassis LAG Between Two Switches

Hostname	Base Hardware	Multichassis Link Aggregation Group
Switch A Switch B	QFX3500 or QFX3600 standalone switch, or QFX5100 standalone switch QFX3500 or QFX3600 standalone switch, or QFX5100 standalone switch	**ae0** is configured as an aggregated Ethernet interface, and is used as an ICL-PL. The following interfaces are part of **ae0**: **xe-0/0/12** and **xe-0/0/13**Switch A and **xe-0/0/12** and **xe-0/0/13** on Switch B. **ae1** is configured as an MC-LAG, and the following two interfaces are part of **ae1**: **xe-0/0/44** on Switch A and **xe-0/0/46** on Switch B. .

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and paste the commands into the CLI at the **[edit]** hierarchy level of Switch A.

NOTE: This example shows how to configure MC-LAG using both the original CLI and Enhanced Layer 2 Software (ELS).

In ELS, there are three different statements and one different option from the original CLI:

- The **port-mode** statement in the **[edit interfaces** *interface-name* **unit** *number* **family ethernet-switching]** hierarchy is not supported. Use the **interface-mode** statement instead.
- The **vlan** statement in the **[edit interfaces** *interface-name***]** hierarchy is not supported. Use the **irb** statement instead.
- The **vlan.***logical-interface-number* option in the **[edit vlans** *vlan-name* **l3-interface]** option is not supported. Use the **irb.***logical-interface-number* option instead.
- The **service-id** statement in the **[edit switch-options]** hierarchy is required in the ELS CLI.

Original CLI

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/44 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching port-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 0
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control active
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces vlan unit 500 family inet address 3.3.3.2/24
set vlans v100 vlan-id 100
set vlans v500 vlan-id 500
set vlans v500 l3-interface vlan.500
set protocols iccp local-ip-addr 3.3.3.2
set protocols iccp peer 3.3.3.1 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
```

```
set protocols iccp peer 3.3.3.1 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
```

ELS

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/44 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 0
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control active
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces irb unit 500 family inet address 3.3.3.2/24
set vlans v100 vlan-id 100
set vlans v500 vlan-id 500
set vlans v500 l3-interface irb.500
set protocols iccp local-ip-addr 3.3.3.2
set protocols iccp peer 3.3.3.1 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.1 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
set switch-options service-id 10
```

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and paste the commands into the CLI at the **[edit]** hierarchy level of Switch B.

NOTE: This example shows how to configure MC-LAG using both the original CLI and Enhanced Layer 2 Software (ELS).

In ELS, there are three different statements and one different option from the original CLI:

- The **port-mode** statement in the **[edit interfaces *interface-name* unit *number* family ethernet-switching]** hierarchy is not supported. Use the **interface-mode** statement instead.
- The **vlan** statement in the **[edit interfaces *interface-name*]** hierarchy is not supported. Use the **irb** statement instead.
- The **vlan.*logical-interface-number*** option in the **[edit vlans *vlan-name* l3-interface]** option is not supported. Use the **irb.*logical-interface-number*** option instead.
- The **service-id** statement in the **[edit switch-options]** hierarchy is required in the ELS CLI.

Original CLI

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/46 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching port-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 1
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control standby
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces vlan unit 500 family inet address 3.3.3.1/24
set vlans v100 vlan-id 100
set vlans v500 vlan-id 500
set vlans v500 l3-interface vlan.500
set protocols iccp local-ip-addr 3.3.3.1
set protocols iccp peer 3.3.3.2 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.2 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
```

ELS

```
set chassis aggregated-devices ethernet device-count 2
```

```
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/46 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 1
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control standby
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces irb unit 500 family inet address 3.3.3.1/24
set vlans v100 vlan-id 100
set vlans v500 vlan-id 500
set vlans v500 l3-interface irb.500
set protocols iccp local-ip-addr 3.3.3.1
set protocols iccp peer 3.3.3.2 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.2 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
set switch-options service-id 10
```

Configuring MC-LAG on Two Switches

Step-by-Step Procedure

To enable multichassis protection link between MC-LAG peers:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Configure the number of LAGs on both Switch A and Switch B.

```
[edit chassis]
user@switch# set aggregated-devices ethernet device-count 2
```

2. Add member interfaces to the aggregated Ethernet interfaces on both Switch A and Switch B.

```
[edit interfaces]
user@switch# set xe-0/0/12 ether-options 802.3ad ae0
[edit interfaces]
user@switch# set xe-0/0/13 ether-options 802.3ad ae0
[edit interfaces]
user@switch# set xe-0/0/44 ether-options 802.3ad ae1
[edit interfaces]
user@switch# set xe-0/0/46 ether-options 802.3ad ae1
```

3. Configure a trunk interface between Switch A and Switch B.

NOTE: The **port-mode** statement is not supported on Enhanced Layer 2 Software (ELS). If you are running ELS, use the **interface-mode** statement.

Orignal CLI:

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching port-mode trunk
```

or

ELS:

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching interface-mode trunk
```

4. Configure a multichassis protection link between Switch A and Switch B.

   Switch A:

   ```
   [edit]
   user@switch# set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
   ```

   Switch B:

   ```
   [edit]
   user@switch# set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
   ```

Step-by-Step Procedure

To enable ICCP:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Configure the local IP address to be in the ICCP connection on Switch A and Switch B.

   Switch A:

   ```
   [edit protocols]
   user@switch# set iccp local-ip-addr 3.3.3.2
   ```

   Switch B:

   ```
   [edit protocols]
   user@switch# set iccp local-ip-addr 3.3.3.1
   ```

2. Configure the peer IP address and minimum receive interval for a (BFD) session for ICCP on Switch A and Switch B.

   Switch A:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
   ```

   Switch B:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.2 liveness-detection minimum-receive-interval 60
   ```


3. Configure the peer IP address and minimum transmit interval for Bidirectional Forwarding Detection (BFD) session for ICCP on Switch A and Switch B.

   Switch A:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.1 liveness-detection transmit-interval minimum-interval 60
   ```

   Switch B:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval 60
   ```

4. (Optional) Configure the time during which an ICCP connection must succeed between MC-LAG peers on Switch A and Switch B.

   NOTE: Configuring session establishment hold time helps in faster ICCP connection establishment. The recommended value is 50 seconds.

   Switch A:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.1 session-establishment-hold-time 50
   ```

   Switch B:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.2 session-establishment-hold-time 50
   ```

5. (Optional) Configure the backup IP address to be used for backup liveness detection on both Switch A and Switch B.

   NOTE: By default, backup liveness detection is not enabled. Configuring a backup IP address helps achieve sub-second traffic loss during a MC-LAG peer reboot.

   Switch A:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip 10.207.64.233
   ```

   Switch B:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.232
   ```

6. Configure Layer 3 connectivity between the MC-LAG peers on both Switch A and Switch B.

   ```
   [edit vlans]
   user@switch# set v500 vlan-id 500
   [edit vlans]
   user@switch# set v500 l3-interface vlan.500
   [edit vlans]
   user@switch# set v500 l3-interface irb.500
   ```

NOTE: The port-mode statement is not supported on Enhanced Layer 2 Software (ELS). If you are running ELS, use the interface-mode statement.

Original CLI:

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching port-mode trunk vlan members v500
```

or

ELS:

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching interface-mode trunk vlan members v500
```

Step-by-Step Procedure

To enable the MC-LAG interface:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Enable LACP on the MC-LAG interface on Switch A and Switch B.

   NOTE: At least one end needs to be active. The other end can be either active or passive.

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options lacp active
   ```
2. Specify the same multichassis aggregated Ethernet identification number on both MC-LAG peers on Switch A and Switch B.

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae mc-ae-id 3
   ```
3. Specify the same service ID on Switch A and Switch B.

   ELS:

   ```
   [edit]
   user@switch# set switch-options service-id 10
   ```
4. Specify a unique chassis ID for the MC-LAG on the MC-LAG peers on Switch A and Switch B.

   Switch A:

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae chassis-id 0
   ```

   Switch B:

   ```
   [edit interfaces]
   ```



```
user@switch# set ae1 aggregated-ether-options mc-ae chassis-id 1
```

5. Specify the operating mode of the MC-LAG on both Switch A and Switch B.

   NOTE: Only active-active mode is supported at this time.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae mode active-active
```

6. Specify the status control for MC-LAG on Switch A and Switch B.

   NOTE: You must configure status control on both Switch A and Switch B hosting the MC-LAG. If one peer is in active mode, the other must be in standby mode.

   Switch A:

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae status-control active
```

   Switch B:

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae status-control standby
```

7. Specify the number of seconds by which the bring-up of the MC-AE interface should be deferred after you reboot Switch A and Switch B.

   NOTE: The recommended value for maximum VLAN configuration (for example, 4,000 VLANS) is 240 seconds. If IGMP snooping is enabled on all of the VLANs, the recommended value is 420 seconds.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae init-delay-time 240
```

8. Specify the same LACP system ID for the MC-LAG on Switch A and Switch B.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options lacp system-ID 00:01:02:03:04:05
```

9. Specify the same LACP administration key on both Switch A and Switch B.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options lacp admin-key 3
```

10. Enable a VLAN on the MC-LAG on Switch A and Switch B.

    NOTE: The **port-mode** statement is not supported on Enhanced Layer 2 Software (ELS). If you are running ELS, use the **interface-mode** statement.

    Original CLI:

```
[edit interfaces]
user@switch# set ae1 unit 0 family ethernet-switching port-mode trunk
```

or

ELS:

```
[edit interfaces]
user@switch# set ae1 unit 0 family ethernet-switching interface-mode trunk
[edit]
user@switch# set vlans v100 vlan-id 100
[edit interfaces]
user@switch# set ae1 unit 0 family ethernet-switching vlan members v100
```

11. (Optional) Enable a private VLAN on the MC-LAG on Switch A and Switch B.

```
[edit]
user@switch# set vlans vlan100 pvlan isolation-vlan-id 200
extend-secondary-vlan-id
[edit]
user@switch# set vlans vlan100 interface ae0.0 pvlan-trunk
```

Step-by-Step Procedure

To enabled RSTP:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Enable RSTP globally on all interfaces on Switch A and Switch B.

```
[edit]
user@switch# set protocols rstp interface all mode point-to-point
```

2. Disable RSTP on the ICL-PL interfaces on Switch A and Switch B:

```
[edit]
user@switch# set protocols rstp interface ae0.0 disable
```

3. Configure the MC-LAG interfaces as edge ports on Switch A and Switch B.

NOTE: The ae1 interface is a downstream interface. This is why RSTP and bpdu-block-on-edge need to be configured.

```
[edit]
user@switch# set protocols rstp interface ae1.0 edge
```

4. Enable BPDU blocking on all interfaces except for the ICL-PL interfaces on Switch A and Switch B.

NOTE: The ae1 interface is a downstream interface. This is why RSTP and bpdu-block-on-edge need to be configured.

```
[edit]
user@switch# set protocols rstp bpdu-block-on-edge
```

Results

Display the results of the configuration on Switch A using the original CLI.


```
chassis {
   aggregated-devices {
      ethernet {
         device-count 2;
      }
   }
}
interfaces {
   xe-0/0/12 {
      ether-options {
         802.3ad ae0;
      }
   }
   xe-0/0/13 {
      ether-options {
         802.3ad ae0;
      }
   }
   xe-0/0/44 {
      ether-options {
         802.3ad ae1;
      }
   }
   ae0 {
      unit 0 {
         family ethernet-switching {
            port-mode trunk;
            vlan {
               members v500;
            }
         }
      }
   }
   ae1 {
      aggregated-ether-options {
         lacp {
            active;
            system-id 00:01:02:03:04:05;
            admin-key 3;
         }
         mc-ae {
            mc-ae-id 3;
            chassis-id 0;
            mode active-active;
            status-control active;
            init-delay-time 240
         }
      }
      unit 0 {
         family ethernet-switching {
            port-mode trunk;
            vlan {
               members v100;
            }
         }
      }
```

```
    }
    vlan {
        unit 500 {
            family inet {
                address 3.3.3.2/24;
            }
        }
    }
}
protocols {
    iccp {
        local-ip-addr 3.3.3.2;
        peer 3.3.3.1 {
            session-establishment-hold-time 50;
            backup-liveness-detection {
                backup-peer-ip 10.207.64.233;
            }
            liveness-detection {
                minimum-receive-interval 60;
                transmit-interval {
                    minimum-interval 60;
                }
            }
        }
    }
    rstp {
        interface ae0.0 {
            disable;
        }
        interface ae1.0 {
            edge;
        }
        interface all {
            mode point-to-point;
        }
        bpdu-block-on-edge;
    }
}
multi-chassis {
    multi-chassis-protection 3.3.3.1 {
        interface ae0;
    }
}
vlans {
    v100 {
        vlan-id 100;
    }
    v500 {
        vlan-id 500;
        l3-interface vlan.500;
    }
}
```

Display the results of the configuration on Switch A using the ELS CLI.

```
chassis {
```

```
  aggregated-devices {
    ethernet {
      device-count 2;
    }
  }
}
interfaces {
  xe-0/0/12 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/13 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/44 {
    ether-options {
      802.3ad ae1;
    }
  }
  ae0 {
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members v500;
        }
      }
    }
  }
  ae1 {
    aggregated-ether-options {
      lacp {
        active;
        system-id 00:01:02:03:04:05;
        admin-key 3;
      }
      mc-ae {
        mc-ae-id 3;
        chassis-id 0;
        mode active-active;
        status-control active;
        init-delay-time 240
      }
    }
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members v100;
        }
      }
    }
  }
```



```
  vlan {
    unit 500 {
      family inet {
        address 3.3.3.2/24;
      }
    }
  }
}
protocols {
  iccp {
    local-ip-addr 3.3.3.2;
    peer 3.3.3.1 {
      session-establishment-hold-time 50;
      backup-liveness-detection {
        backup-peer-ip 10.207.64.233;
      }
      liveness-detection {
        minimum-receive-interval 60;
        transmit-interval {
          minimum-interval 60;
        }
      }
    }
  }
  rstp {
    interface ae0.0 {
      disable;
    }
    interface ae1.0 {
      edge;
    }
    interface all {
      mode point-to-point;
    }
    bpdu-block-on-edge;
  }
}
multi-chassis {
  multi-chassis-protection 3.3.3.1 {
    interface ae0;
  }
}
switch-options {
  service-id 10;
}
vlans {
  v100 {
    vlan-id 100;
  }
  v500 {
    vlan-id 500;
    l3-interface irb.500;
  }
}
```

Display the results of the configuration on Switch B using the original CLI.


```
chassis {
  aggregated-devices {
    ethernet {
      device-count 2;
    }
  }
}
interfaces {
  xe-0/0/12 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/13 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/46 {
    ether-options {
      802.3ad ae1;
    }
  }
  ae0 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members v500;
        }
      }
    }
  }
  ae1 {
    aggregated-ether-options {
      lacp {
        active;
        system-id 00:01:02:03:04:05;
        admin-key 3;
      }
      mc-ae {
        mc-ae-id 3;
        chassis-id 1;
        mode active-active;
        status-control standby;
        init-delay-time 240
      }
    }
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members v100;
        }
      }
    }
```

```
    }
    vlan {
        unit 500 {
            family inet {
                address 3.3.3.1/24;
            }
        }
    }
}
protocols {
    iccp {
        local-ip-addr 3.3.3.1;
        peer 3.3.3.2 {
            session-establishment-hold-time 50;
            backup-liveness-detection {
                backup-peer-ip 10.207.64.233;
            }
            liveness-detection {
                minimum-receive-interval 60;
                transmit-interval {
                    minimum-interval 60;
                }
            }
        }
    }
    rstp {
        interface ae0.0 {
            disable;
        }
        interface ae1.0 {
            edge;
        }
        interface all {
            mode point-to-point;
        }
        bpdu-block-on-edge;
    }
}
multi-chassis {
    multi-chassis-protection 3.3.3.2 {
        interface ae0;
    }
}
vlans {
    v100 {
        vlan-id 100;
    }
    v500 {
        vlan-id 500;
        l3-interface vlan.500;
    }
}
```

Display the results of the configuration on Switch B using the ELS CLI.

```
chassis {
```



```
  aggregated-devices {
    ethernet {
      device-count 2;
    }
  }
}
interfaces {
  xe-0/0/12 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/13 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/46 {
    ether-options {
      802.3ad ae1;
    }
  }
  ae0 {
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members v500;
        }
      }
    }
  }
  ae1 {
    aggregated-ether-options {
      lacp {
        active;
        system-id 00:01:02:03:04:05;
        admin-key 3;
      }
      mc-ae {
        mc-ae-id 3;
        chassis-id 1;
        mode active-active;
        status-control standby;
        init-delay-time 240
      }
    }
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members v100;
        }
      }
    }
  }
```

```
    vlan {
        unit 500 {
            family inet {
                address 3.3.3.1/24;
            }
        }
    }
}
protocols {
    iccp {
        local-ip-addr 3.3.3.1;
        peer 3.3.3.2 {
            session-establishment-hold-time 50;
            backup-liveness-detection {
                backup-peer-ip 10.207.64.233;
            }
            liveness-detection {
                minimum-receive-interval 60;
                transmit-interval {
                    minimum-interval 60;
                }
            }
        }
    }
    rstp {
        interface ae0.0 {
            disable;
        }
        interface ae1.0 {
            edge;
        }
        interface all {
            mode point-to-point;
        }
        bpdu-block-on-edge;
    }
}
multi-chassis {
    multi-chassis-protection 3.3.3.2 {
        interface ae0;
    }
}
switch-options {
    service-id 10;
}
vlans {
    v100 {
        vlan-id 100;
    }
    v500 {
        vlan-id 500;
        l3-interface irb.500;
    }
}
```

Verification

To verify that the MC-LAG group has been created and is working properly, perform these tasks:

Verifying That ICCP Is Working on Switch A

Purpose Verify that ICCP is running on Switch A.

Action

```
[edit]
user@switch# show iccp
Redundancy Group Information for peer 3.3.3.1
  TCP Connection       : Established
  Liveliness Detection : Up

 Client Application: MCSNOOPD

 Client Application: eswd
```

Meaning This output shows that the TCP connection between the peers hosting the MC-LAG is up, liveness detection is up, and MCSNOOPD and ESWD client applications are running.

Verifying That ICCP Is Working on Switch B

Purpose Verify that ICCP is running on Switch B.

Action **show iccp**

```
[edit]
user@switch# show iccp
Redundancy Group Information for peer 3.3.3.2
  TCP Connection       : Established
  Liveliness Detection : Up

 Client Application: MCSNOOPD

 Client Application: eswd
```

Meaning This output shows that the TCP connection between the peers hosting the MC-LAG is up, liveness detection is up, and MCSNOOPD and ESWD client applications are running.

Verifying That LACP Is Active on Switch A

Purpose Verify that LACP is active on Switch A.

Action

```
[edit]
user@switch# show lacp interfaces
Aggregated interface: ae1
    LACP state:       Role   Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity
      xe-0/0/46      Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
      xe-0/0/46    Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active
    LACP protocol:       Receive State  Transmit State          Mux State
      xe-0/0/46                 Current   Fast periodic Collecting distributing
```

Meaning This output shows that Switch A is participating in LACP negotiation.

Verifying That LACP Is Active on Switch B

Purpose Verify that LACP is active on Switch B

Action

```
[edit]
user@switch# show lacp interfaces

Aggregated interface: ae1
    LACP state:       Role   Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity
      xe-0/0/44      Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
      xe-0/0/44    Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active
    LACP protocol:       Receive State  Transmit State          Mux State
      xe-0/0/44                 Current   Fast periodic Collecting distributing
```

Meaning This output shows that Switch B is participating in LACP negotiation.

Verifying That the MC-AE and ICL-PL Interfaces Are Up on Switch A

Purpose Verify that the MC-AE and ICL-PL interfaces are up on Switch A.

Action

```
[edit]
user@switch# show interfaces mc-ae
Member Link                  : ae1
 Current State Machine's State: mcae active state
 Local Status                 : active
 Local State                  : up
 Peer Status                  : active
 Peer State                   : up
     Logical Interface        : ae1.0
     Topology Type            : bridge
     Local State              : up
     Peer State               : up
     Peer Ip/MCP/State        : 3.3.3.1 ae0.0 up
```

Meaning This output shows that the MC-AE interface on Switch A is up and active.

Verifying That the MC-AE and ICL-PL Interfaces Are Up on Switch B

Purpose Verify that the MC-AE and ICL-PL interfaces are up on Switch B.

Action

```
[edit]
user@switch# show interfaces mc-ae
Member Link                  : ae1
 Current State Machine's State: mcae active state
 Local Status                 : active
 Local State                  : up
 Peer Status                  : active
 Peer State                   : up
     Logical Interface        : ae1.0
     Topology Type            : bridge
     Local State              : up
     Peer State               : up
     Peer Ip/MCP/State        : 3.3.3.2 ae0.0 up
```

Meaning This output shows that the MC-AE interface on Switch B is up and active.

Verifying that MAC Learning Is Occurring on Switch A

Purpose Verify that MAC learning is working on Switch A.

Action

```
[edit]
user@switch# show ethernet-switching table
Ethernet-switching table: 10 entries, 4 learned, 0 persistent entries
  VLAN             MAC address       Type         Age Interfaces
  V100             *                 Flood          - All-members
  V100             00:10:94:00:00:05 Learn(L)       33 ae0.0 (MCAE)
```

Meaning The output shows four learned MAC addresses entries.

Verifying that MAC Learning Is Occurring on Switch B

Purpose Verify that MAC learning is working on Switch B.

Action

```
[edit]
user@switch# show ethernet-switching table
Ethernet-switching table: 10 entries, 4 learned, 0 persistent entries
  VLAN             MAC address       Type         Age Interfaces
  V100             *                 Flood          - All-members
  V100             00:10:94:00:00:05 Learn(L)       33 ae0.0 (MCAE)
```

Meaning The output shows four learned MAC addresses entries.

Troubleshooting

Troubleshooting a LAG That Is Down

Problem The **show interfaces terse** command shows that the MC-LAG is **down**

Solution Check the following:

- Verify that there is no configuration mismatch.
- Verify that all member ports are up.

- Verify that the MC-LAG is part of family Ethernet switching (Layer 2 LAG).
- Verify that the MC-LAG member is connected to the correct MC-LAG member at the other end.

Related Documentation

- Understanding Multichassis Link Aggregation on page 1853
- Configuring Multichassis Link Aggregation on page 2022

Example: Configuring Multichassis Link Aggregation for Layer 3 Multicast Using VRRP

NOTE: Multichassis Link Aggregation (MC-LAG) is supported on QFX3500 and QFX3600 standalone switches running the original CLI and QFX5100 standalone switches running Enhanced Layer 2 Software (ELS).

There are two methods for enabling Layer 3 multicast functionality across a multichassis link aggregation group (MC-LAG). You can choose either to configure Virtual Router Redundancy Protocol (VRRP) or synchronize the MAC addresses for the Layer 3 interfaces of the switches participating in the MC-LAG. The procedure to configure VRRP for use in a Layer 3 multicast MC-LAG is included in this example.

Requirements

This example uses the following hardware and software components:

- Junos OS Release 12.3 or later for the QFX3500 and QFX3600 standalone switches and Junos OS Release 13.2X51-D10 or later for the QFX5100 standalone switches.
- Two QFX3500 or QFX3600 standalone switches, or two QFX5100 standalone switches.

Before you configure an MC-LAG for Layer 3 multicast using VRRP, be sure that you understand how to:

- Configure aggregated Ethernet interfaces on a switch. See "Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch" on page 1896.
- Configure the Link Aggregation Control Protocol (LACP) on aggregated Ethernet interfaces on a switch. See "Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch" on page 1900.

Overview

In this example, you configure two MC-LAGs across two switches, consisting of two aggregated Ethernet interfaces (ae1 and ae2). To support the MC-LAG, create a third aggregated Ethernet interface (ae0) for the interchassis control link-protection link

(ICL-PL). Configure a multichassis protection link for the ICL-PL, Interchassis Control Protocol (ICCP) for the peers hosting the MC-LAG, and Layer 3 connectivity between MC-LAG peers.

NOTE: Layer 3 connectivity is required for ICCP.

To complete the configuration, enable VRRP by completing the following steps for each MC-LAG:

- Create a routed VLAN interface (RVI)
- Create a VRRP group and assign a virtual IP address that is shared between each switch in the VRRP group
- Enable a member of a VRRP group to accept all packets destined for the virtual IP address if it is the master in the VRRP group
- Configure Layer 3 connectivity between the VRRP groups

Topology

The topology used in this example consists of two switches hosting two MC-LAGs—ae1 and ae2. The two switches are connected to a multicast source (Server 1) over the MC-LAG ae1, and a multicast receiver (Server 2) over the MC-LAG ae2. Figure 29 on page 1928 shows the topology of this example.

Figure 29: Configuring a Multichassis LAG for Layer 3 Multicast Using VRRP

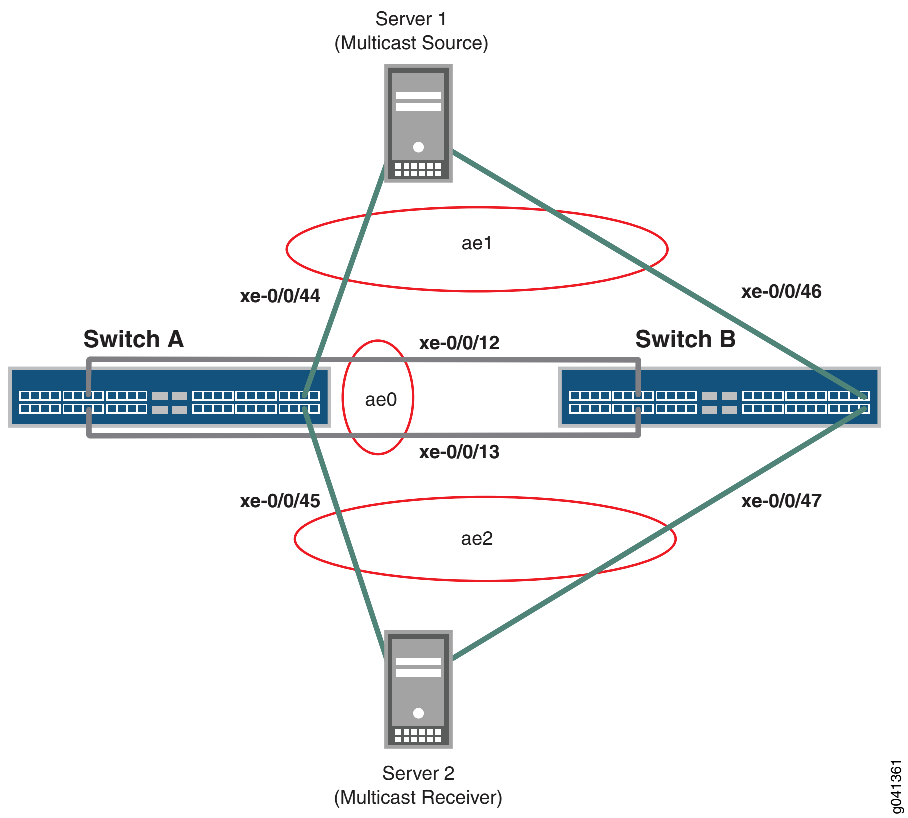


Table 172 on page 1928 details the topology used in this configuration example.

Table 172: Components of the Topology for Configuring a Multichassis LAG for Layer 3 Multicast Using VRRP

Hostname	Base Hardware	Multichassis Link Aggregation Group
Switch A Switch B	QFX3500 or QFX3600 standalone switch, or QFX5100 standalone switch QFX3500 or QFX3600 standalone switch, or QFX5100 standalone switch	• ae0 is configured as an aggregated Ethernet interface, and is used as an ICL-PL. The following two interfaces are part of ae0: xe-0/0/12 and xe-0/0/13 on Switch A and xe-0/0/12 and xe-0/0/13 on Switch B. • ae1 is configured as an MC-LAG for the multicast source (Server 1), and the following two interfaces are part of ae1: xe-0/0/44 on Switch A and xe-0/0/46 on Switch B. • ae2 is configured as an MC-LAG for the multicast receiver (Server 2), and the following two interfaces are part of ae2: xe-0/0/45 on Switch A and xe-0/0/47 on Switch B.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and paste the commands into the CLI at the **[edit]** hierarchy level of Switch A.

NOTE: This example shows how to configure MC-LAG using both the original CLI and Enhanced Layer 2 Software (ELS).

In ELS, there are three different statements and one different option from the original CLI:

- The **port-mode** statement in the **[edit interfaces *interface-name* unit *number* family ethernet-switching]** hierarchy is not supported. Use the **interface-mode** statement instead.
- The **vlan** statement in the **[edit interfaces *interface-name*]** hierarchy is not supported. Use the **irb** statement instead.
- The **vlan.*logical-interface-number*** option in the **[edit vlans *vlan-name* l3-interface]** option is not supported. Use the **irb.*logical-interface-number*** option instead.
- The **service-id** statement in the **[edit switch-options]** hierarchy is required in the ELS CLI.

Original CLI:

```
set chassis aggregated-devices ethernet device-count 3
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/44 ether-options 802.3ad ae1
set interfaces xe-0/0/45 ether-options 802.3ad ae2
set interfaces ae0 unit 0 family ethernet-switching port-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 0
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control active
set interfaces ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces ae2 aggregated-ether-options lacp active
set interfaces ae2 aggregated-ether-options lacp system-id 00:01:02:03:04:06
set interfaces ae2 aggregated-ether-options lacp admin-key 3
set interfaces ae2 aggregated-ether-options mc-ae mc-ae-id 4
set interfaces ae2 aggregated-ether-options mc-ae chassis-id 0
set interfaces ae2 aggregated-ether-options mc-ae mode active-active
set interfaces ae2 aggregated-ether-options mc-ae status-control active
```



```
set interfaces ae2 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae2 unit 0 family ethernet-switching port-mode trunk
set interfaces ae2 unit 0 family ethernet-switching vlan members v200
set interfaces vlan unit 100 family inet address 10.1.1.11/24 vrrp-group 1 virtual-address
  10.1.1.1
set interfaces vlan unit 100 family inet address 10.1.1.11/24 vrrp-group 1 priority 200
set interfaces vlan unit 100 family inet address 10.1.1.11/24 vrrp-group 1 accept-data
set interfaces vlan unit 200 family inet address 10.1.1.21/24 vrrp-group 2 virtual-address
  10.1.1.2
set interfaces vlan unit 200 family inet address 10.1.1.21/24 vrrp-group 2 priority 200
set interfaces vlan unit 200 family inet address 10.1.1.21/24 vrrp-group 2 accept-data
set interfaces vlan unit 500 family inet address 3.3.3.2/24
set vlans v100 vlan-id 100
set vlans v100 l3-interface vlan.100
set vlans v200 vlan-id 200
set vlans v200 l3-interface vlan.200
set vlans v500 vlan-id 500
set vlans v500 l3-interface vlan.500
set protocols iccp local-ip-addr 3.3.3.2
set protocols iccp peer 3.3.3.1 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.1 liveness-detection transmit-interval minimum-interval 60
set protocols igmp-snooping vlan all
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection
  minimum-receive-interval 700
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection transmit-interval
  threshold 500
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection
  minimum-receive-interval 700
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection transmit-interval
  threshold 500
set protocols pim rp static address 1.0.0.3 group-ranges 239.0.0.0/8
set protocols pim interface vlan.100 priority 200
set protocols pim interface vlan.100 dual-dr
set protocols pim interface vlan.100 bfd-liveness-detection minimum-receive-interval
  700
set protocols pim interface vlan.100 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols pim interface vlan.100 bfd-liveness-detection transmit-interval threshold
  500
set protocols pim interface vlan.200 priority 600
set protocols pim interface vlan.200 dual-dr
set protocols pim interface vlan.200 bfd-liveness-detection minimum-receive-interval
  700
set protocols pim interface vlan.200 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols pim interface vlan.200 bfd-liveness-detection transmit-interval threshold
  500
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface ae2.0 edge
```



```
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
```

ELS:

```
set chassis aggregated-devices ethernet device-count 3
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/44 ether-options 802.3ad ae1
set interfaces xe-0/0/45 ether-options 802.3ad ae2
set interfaces ae0 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 0
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control active
set interfaces ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces ae2 aggregated-ether-options lacp active
set interfaces ae2 aggregated-ether-options lacp system-id 00:01:02:03:04:06
set interfaces ae2 aggregated-ether-options lacp admin-key 3
set interfaces ae2 aggregated-ether-options mc-ae mc-ae-id 4
set interfaces ae2 aggregated-ether-options mc-ae chassis-id 0
set interfaces ae2 aggregated-ether-options mc-ae mode active-active
set interfaces ae2 aggregated-ether-options mc-ae status-control active
set interfaces ae2 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae2 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae2 unit 0 family ethernet-switching vlan members v200
set interfaces irb unit 100 family inet address 10.1.1.11/24 vrrp-group 1 virtual-address
  10.1.1.1
set interfaces irb unit 100 family inet address 10.1.1.11/24 vrrp-group 1 priority 200
set interfaces irb unit 100 family inet address 10.1.1.11/24 vrrp-group 1 accept-data
set interfaces irb unit 200 family inet address 10.1.1.21/24 vrrp-group 2 virtual-address
  10.1.1.2
set interfaces irb unit 200 family inet address 10.1.1.21/24 vrrp-group 2 priority 200
set interfaces irb unit 200 family inet address 10.1.1.21/24 vrrp-group 2 accept-data
set interfaces irb unit 500 family inet address 3.3.3.2/24
set vlans v100 vlan-id 100
set vlans v100 l3-interface irb.100
set vlans v200 vlan-id 200
set vlans v200 l3-interface irb.200
set vlans v500 vlan-id 500
set vlans v500 l3-interface irb.500
set protocols iccp local-ip-addr 3.3.3.2
set protocols iccp peer 3.3.3.1 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.1 liveness-detection transmit-interval minimum-interval 60
set protocols igmp-snooping vlan all
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection
  minimum-receive-interval 700
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection transmit-interval
  minimum-interval 350
```



```
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection transmit-interval
  threshold 500
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection
  minimum-receive-interval 700
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection transmit-interval
  threshold 500
set protocols pim rp static address 1.0.0.3 group-ranges 239.0.0.0/8
set protocols pim interface vlan.100 priority 200
set protocols pim interface vlan.100 dual-dr
set protocols pim interface vlan.100 bfd-liveness-detection minimum-receive-interval
  700
set protocols pim interface vlan.100 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols pim interface vlan.100 bfd-liveness-detection transmit-interval threshold
  500
set protocols pim interface vlan.200 priority 600
set protocols pim interface vlan.200 dual-dr
set protocols pim interface vlan.200 bfd-liveness-detection minimum-receive-interval
  700
set protocols pim interface vlan.200 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols pim interface vlan.200 bfd-liveness-detection transmit-interval threshold
  500
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface ae2.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
set switch-options service-id 10
```

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and paste the commands into the CLI at the **[edit]** hierarchy level of Switch B.

Original CLI:

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/46 ether-options 802.3ad ae1
set interfaces xe-0/0/47 ether-options 802.3ad ae2
set interfaces ae0 unit 0 family ethernet-switching port-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 1
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control standby
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces ae2 aggregated-ether-options lacp active
```

```
set interfaces ae2 aggregated-ether-options lacp system-id 00:01:02:03:04:06
set interfaces ae2 aggregated-ether-options lacp admin-key 3
set interfaces ae2 aggregated-ether-options mc-ae mc-ae-id 4
set interfaces ae2 aggregated-ether-options mc-ae chassis-id 1
set interfaces ae2 aggregated-ether-options mc-ae mode active-active
set interfaces ae2 aggregated-ether-options mc-ae status-control active
set interfaces ae2 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae2 unit 0 family ethernet-switching port-mode trunk
set interfaces ae2 unit 0 family ethernet-switching vlan members v200
set interfaces vlan unit 100 family inet address 10.1.1.10/24 vrrp-group 1 virtual-address
  10.1.1.1
set interfaces vlan unit 100 family inet address 10.1.1.10/24 vrrp-group 1 priority 150
set interfaces vlan unit 100 family inet address 10.1.1.10/24 vrrp-group 1 accept-data
set interfaces vlan unit 200 family inet address 10.1.1.20/24 vrrp-group 2 virtual-address
  10.1.1.2
set interfaces vlan unit 200 family inet address 10.1.1.20/24 vrrp-group 2 priority 150
set interfaces vlan unit 200 family inet address 10.1.1.20/24 vrrp-group 2 accept-data
set interfaces vlan unit 500 family inet address 3.3.3.1/24
set vlans v100 vlan-id 100
set vlans v100 l3-interface vlan.100
set vlans v200 vlan-id 200
set vlans v200 l3-interface vlan.200
set vlans v500 vlan-id 500
set vlans v500 l3-interface vlan.500
set protocols iccp local-ip-addr 3.3.3.1
set protocols iccp peer 3.3.3.2 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.2 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval 60
set protocols igmp-snooping vlan all
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection
  minimum-receive-interval 700
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection transmit-interval
  threshold 500
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection
  minimum-receive-interval 700
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection transmit-interval
  threshold 500
set protocols pim rp static address 1.0.0.3 group-ranges 239.0.0.0/8
set protocols pim interface vlan.100 priority 100
set protocols pim interface vlan.100 dual-dr
set protocols pim interface vlan.100 bfd-liveness-detection minimum-receive-interval
  700
set protocols pim interface vlan.100 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols pim interface vlan.100 bfd-liveness-detection transmit-interval threshold
  500
set protocols pim interface vlan.200 priority 500
set protocols pim interface vlan.200 dual-dr
set protocols pim interface vlan.200 bfd-liveness-detection minimum-receive-interval
  700
```



```
set protocols pim interface vlan.200 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols pim interface vlan.200 bfd-liveness-detection transmit-interval threshold
  500
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface ae2.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
```

ELS:

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/46 ether-options 802.3ad ae1
set interfaces xe-0/0/47 ether-options 802.3ad ae2
set interfaces ae0 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 1
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control standby
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces ae2 aggregated-ether-options lacp active
set interfaces ae2 aggregated-ether-options lacp system-id 00:01:02:03:04:06
set interfaces ae2 aggregated-ether-options lacp admin-key 3
set interfaces ae2 aggregated-ether-options mc-ae mc-ae-id 4
set interfaces ae2 aggregated-ether-options mc-ae chassis-id 1
set interfaces ae2 aggregated-ether-options mc-ae mode active-active
set interfaces ae2 aggregated-ether-options mc-ae status-control active
set interfaces ae2 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae2 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae2 unit 0 family ethernet-switching vlan members v200
set interfaces irb unit 100 family inet address 10.1.1.10/24 vrrp-group 1 virtual-address
  10.1.1.1
set interfaces irb unit 100 family inet address 10.1.1.10/24 vrrp-group 1 priority 150
set interfaces irb unit 100 family inet address 10.1.1.10/24 vrrp-group 1 accept-data
set interfaces irb unit 200 family inet address 10.1.1.20/24 vrrp-group 2 virtual-address
  10.1.1.2
set interfaces irb unit 200 family inet address 10.1.1.20/24 vrrp-group 2 priority 150
set interfaces irb unit 200 family inet address 10.1.1.20/24 vrrp-group 2 accept-data
set interfaces irb unit 500 family inet address 3.3.3.1/24
set vlans v100 vlan-id 100
set vlans v100 l3-interface irb.100
set vlans v200 vlan-id 200
set vlans v200 l3-interface irb.200
set vlans v500 vlan-id 500
set vlans v500 l3-interface irb.500
set protocols iccp local-ip-addr 3.3.3.1
set protocols iccp peer 3.3.3.2 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.233
```



```
set protocols iccp peer 3.3.3.2 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval 60
set protocols igmp-snooping vlan all
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection
  minimum-receive-interval 700
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols ospf area 0.0.0.0 interface vlan.100 bfd-liveness-detection transmit-interval
  threshold 500
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection
  minimum-receive-interval 700
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols ospf area 0.0.0.0 interface vlan.200 bfd-liveness-detection transmit-interval
  threshold 500
set protocols pim rp static address 1.0.0.3 group-ranges 239.0.0.0/8
set protocols pim interface vlan.100 priority 100
set protocols pim interface vlan.100 dual-dr
set protocols pim interface vlan.100 bfd-liveness-detection minimum-receive-interval
  700
set protocols pim interface vlan.100 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols pim interface vlan.100 bfd-liveness-detection transmit-interval threshold
  500
set protocols pim interface vlan.200 priority 500
set protocols pim interface vlan.200 dual-dr
set protocols pim interface vlan.200 bfd-liveness-detection minimum-receive-interval
  700
set protocols pim interface vlan.200 bfd-liveness-detection transmit-interval
  minimum-interval 350
set protocols pim interface vlan.200 bfd-liveness-detection transmit-interval threshold
  500
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface ae2.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
set switch-options service-id 10
```

Configuring MC-LAG for Layer 3 Multicast Using VRRP on Two Switches

Step-by-Step Procedure

To enable multichassis protection link between MC-LAG peers:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Configure the number of LAGs on both Switch A and Switch B.

   ```
   [edit chassis]
   user@switch# set aggregated-devices ethernet device-count 3
   ```

2. Add member interfaces to the aggregated Ethernet interfaces on both Switch A and Switch B.

Switch A and Switch B

```
[edit interfaces]
user@switch# set xe-0/0/12 ether-options 802.3ad ae0
user@switch# set xe-0/0/13 ether-options 802.3ad ae0
```

Switch A

```
[edit interfaces]
user@switch# set xe-0/0/44 ether-options 802.3ad ae1
user@switch# set xe-0/0/45 ether-options 802.3ad ae2
```

Switch B

```
[edit interfaces]
user@switch# set xe-0/0/46 ether-options 802.3ad ae1
user@switch# set xe-0/0/47 ether-options 802.3ad ae2
```

3. Configure ae0 as the trunk interface between Switch A and Switch B.

Switch A and Switch B

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching port-mode trunk
```

Switch A and Switch B Using ELS

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switchinginterface-mode trunk
```

4. Configure ae0 as the multichassis protection link between Switch A and Switch B.

Switch A

```
[edit]
user@switch# set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
```

Switch B

```
[edit]
user@switch# set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
```

Step-by-Step Procedure

To enable ICCP:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Configure the local IP address to be in the ICCP connection on Switch A and Switch B.

Switch A

```
[edit protocols]
user@switch# set iccp local-ip-addr 3.3.3.2
```

Switch B

```
[edit protocols]
```

```
user@switch# set iccp local-ip-addr 3.3.3.1
```

2. Configure the peer IP address, minimum receive interval, and minimum transmit interval for a Bidirectional Forwarding Detection (BFD) session for ICCP on Switch A and Switch B.

   Switch A

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
   user@switch# set iccp peer 3.3.3.1 liveness-detection transmit-interval
     minimum-interval 60
   ```

   Switch B

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.2 liveness-detection minimum-receive-interval
     60
   user@switch# set iccp peer 3.3.3.2 liveness-detection transmit-interval
     minimum-interval 60
   ```

3. (Optional) Configure the time during which an ICCP connection must succeed between MC-LAG peers on Switch A and Switch B.

   NOTE: Configuring session establishment hold time helps in faster ICCP connection establishment. The recommended value is 50 seconds.

   Switch A

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.1 session-establishment-hold-time 50
   ```

   Switch B

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.2 session-establishment-hold-time 50
   ```

4. (Optional) Configure the backup IP address to be used for backup liveness detection on both Switch A and Switch B.

   NOTE: By default, backup liveness detection is not enabled. Configuring a backup IP address helps achieve sub-second traffic loss during a MC-LAG peer reboot.

   Switch A

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip
     10.207.64.233
   ```

Switch B

```
[edit protocols]
user@switch# set iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip
  10.207.64.232
```

5. Configure Layer 3 connectivity between the MC-LAG peers on both Switch A and Switch B.

NOTE: In ELS, use the irb.*logical-interface-number* instead.

Switch A and Switch B

```
[edit vlans]
user@switch# set v500 vlan-id 500
user@switch# set v500 l3-interface vlan.500
```

Switch A and Switch B Using ELS

```
[edit vlans]
user@switch# set v500 vlan-id 500
user@switch# set v500 l3-interface irb.500
```

Switch A and Switch B

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching vlan members v500
```

Switch A

```
[edit interfaces]
user@switch# set vlan unit 500 family inet address 3.3.3.2/24
```

Switch A Using ELS

```
[edit interfaces]
user@switch# set irbunit 500 family inet address 3.3.3.2/24
```

Switch B

```
[edit interfaces]
user@switch# set vlan unit 500 family inet address 3.3.3.1/24
```

Switch B Using ELS

```
[edit interfaces]
user@switch# set irb unit 500 family inet address 3.3.3.1/24
```

Step-by-Step Procedure

To enable the ae1 and ae2 MC-LAG interfaces:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Enable LACP on the MC-LAG interfaces on Switch A and Switch B.

NOTE: At least one end needs to be active. The other end can be either active or passive.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options lacp active
user@switch# set ae2 aggregated-ether-options lacp active
```

2. Specify the same multichassis aggregated Ethernet (MC-AE) identification number for each MC-LAG peer on Switch A and Switch B.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae mc-ae-id 3
user@switch# set ae2 aggregated-ether-options mc-ae mc-ae-id 4
```

3. Specify the same service ID on Switch A and Switch B.

   ELS:

```
[edit]
set switch-options service-id 10
```

4. Specify a unique chassis ID for the MC-LAG on the MC-LAG peers on Switch A and Switch B.

   Switch A

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae chassis-id 0
user@switch# set ae2 aggregated-ether-options mc-ae chassis-id 0
```

   Switch B

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae chassis-id 1
user@switch# set ae2 aggregated-ether-options mc-ae chassis-id 1
```

5. Specify the operating mode of the MC-LAGs on both Switch A and Switch B.

   NOTE: Only active-active mode is supported at this time.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae mode active-active
user@switch# set ae2 aggregated-ether-options mc-ae mode active-active
```

6. Specify the status control for the MC-LAGs on Switch A and Switch B.

   NOTE: You must configure status control on both Switch A and Switch B hosting the MC-LAGs. If one peer is in active mode, the other must be in standby mode.

Switch A

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae status-control active
user@switch# set ae2 aggregated-ether-options mc-ae status-control active
```

Switch B

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae status-control standby
user@switch# set ae2 aggregated-ether-options mc-ae status-control standby
```

7. Specify the number of seconds by which the bring-up of the MC-LAG interfaces should be deferred after you reboot Switch A or Switch B.

   NOTE: The recommended value for maximum VLAN configuration (for example, 4,000 VLANS) is 240 seconds. If IGMP snooping is enabled on all of the VLANs, the recommended value is 420 seconds.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae init-delay-time 420
user@switch# set ae2 aggregated-ether-options mc-ae init-delay-time 420
```

8. Specify the same LACP system ID for each MC-LAG on Switch A and Switch B.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options lacp system-ID 00:01:02:03:04:05
user@switch# set ae2 aggregated-ether-options lacp system-ID 00:01:02:03:04:06
```

9. Specify the same LACP administration key on both Switch A and Switch B.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options lacp admin-key 3
user@switch# set ae2 aggregated-ether-options lacp admin-key 3
```

10. Enable a VLAN for each MC-LAG on Switch A and Switch B.

```
[edit vlans]
user@switch# set v100 vlan-id 100
user@switch# set v200 vlan-id 200
```

```
[edit interfaces]
user@switch# set ae1 unit 0 family ethernet-switching vlan members v100
user@switch# set ae2 unit 0 family ethernet-switching vlan members v200
```

11. Configure ae1 and ae2 as trunk interfaces between Switch A and Switch B.

```
[edit interfaces]
user@switch# set ae1 unit 0 family ethernet-switching port-mode trunk
user@switch# set ae2 unit 0 family ethernet-switching port-mode trunk
```

ELS:

```
[edit interfaces]
user@switch# set ae1 unit 0 family ethernet-switching interface-mode trunk
user@switch# set ae2 unit 0 family ethernet-switching interface-mode trunk
```


Step-by-Step Procedure

To enable VRRP on the MC-LAGs on Switch A and Switch B:

1. Create a routed VLAN interface (RVI) for each MC-LAG, assign a virtual IP address that is shared between each switch in the VRRP groups, and assign an individual IP address for each switch in the VRRP groups.

   Switch A

   ```
   [edit interfaces]
   user@switch# set vlan unit 100 family inet address 10.1.1.11/24 vrrp-group 1
     virtual-address 10.1.1.1
   user@switch# set vlan unit 200 family inet address 10.1.1.21/24 vrrp-group 2
     virtual-address 10.1.1.2
   ```

   Switch A Using ELS

   ```
   [edit interfaces]
   user@switch# set irb unit 100 family inet address 10.1.1.11/24 vrrp-group 1
     virtual-address 10.1.1.1
   user@switch# set irb unit 200 family inet address 10.1.1.21/24 vrrp-group 2
     virtual-address 10.1.1.2
   ```

   Switch B

   ```
   [edit interfaces]
   user@switch# set vlan unit 100 family inet address 10.1.1.10/24 vrrp-group 1
     virtual-address 10.1.1.1
   user@switch# set vlan unit 200 family inet address 10.1.1.20/24 vrrp-group 2
     virtual-address 10.1.1.2
   ```

   Switch B Using ELS

   ```
   [edit interfaces]
   user@switch# set irb unit 100 family inet address 10.1.1.10/24 vrrp-group 1
     virtual-address 10.1.1.1
   user@switch# set irb unit 200 family inet address 10.1.1.20/24 vrrp-group 2
     virtual-address 10.1.1.2
   ```

2. Assign the priority for each switch in the VRRP groups:

   NOTE: The switch configured with the highest priority is the master.

   Switch A

   ```
   [edit interfaces]
   user@switch# set vlan unit 100 family inet address 10.1.1.11/24 vrrp-group 1 priority
     200
   user@switch# set vlan unit 200 family inet address 10.1.1.21/24 vrrp-group 2 priority
     200
   ```

   Switch A Using ELS

   ```
   [edit interfaces]
   user@switch# set irb unit 100 family inet address 10.1.1.11/24 vrrp-group 1 priority
     200
   ```


user@switch# **set irb unit 200 family inet address 10.1.1.21/24 vrrp-group 2 priority 200**

Switch B

[edit interfaces]
user@switch# **set vlan unit 100 family inet address 10.1.1.10/24 vrrp-group 1 priority 150**
user@switch# **set vlan unit 200 family inet address 10.1.1.20/24 vrrp-group 2 priority 150**

Switch B Using ELS

[edit interfaces]
user@switch# **set irb unit 100 family inet address 10.1.1.10/24 vrrp-group 1 priority 150**
user@switch# **set irb unit 200 family inet address 10.1.1.20/24 vrrp-group 2 priority 150**

3. Enable the switch to accept all packets destined for the virtual IP address if it is the master in a VRRP group:

Switch A

[edit interfaces]
user@switch# **set vlan unit 100 family inet address 10.1.1.11/24 vrrp-group 1 accept-data**
user@switch# **set vlan unit 200 family inet address 10.1.1.21/24 vrrp-group 2 accept-data**

Switch A Using ELS

[edit interfaces]
user@switch# **set irb unit 100 family inet address 10.1.1.11/24 vrrp-group 1 accept-data**
user@switch# **set irb unit 200 family inet address 10.1.1.21/24 vrrp-group 2 accept-data**

Switch B

[edit interfaces]
user@switch# **set vlan unit 100 family inet address 10.1.1.10/24 vrrp-group 1 accept-data**
user@switch# **set vlan unit 200 family inet address 10.1.1.20/24 vrrp-group 2 accept-data**

Switch B Using ELS

[edit interfaces]
user@switch# **set irb unit 100 family inet address 10.1.1.10/24 vrrp-group 1 accept-data**
user@switch# **set irb unit 200 family inet address 10.1.1.20/24 vrrp-group 2 accept-data**

4. Configure Layer 3 connectivity between Switch A and Switch B.

[edit interfaces]
user@switch# **set v100 l3-interface vlan.100**
user@switch# **set v200 l3-interface vlan.200**

ELS:

[edit interfaces]
user@switch# **set v100 l3-interface irb.100**
user@switch# **set v200 l3-interface irb.200**

Step-by-Step Procedure

To enable IGMP snooping:

1. Enable IGMP snooping for all VLANs on Switch A and Switch B.

   [edit protocols]
   user@switch# **set igmp-snooping vlan all**

Step-by-Step Procedure

To configure OSPF as the Layer 3 protocol:

1. Configure an OSPF area on Switch A and Switch B.

   [edit protocols ospf]
   user@switch# **set area 0.0.0.0**

2. Assign the VLAN interfaces for the MC-LAGs as interfaces to the OSPF area on Switch A and Switch B.

   [edit protocols ospf area 0.0.0.0]
   user@switch# **set interface vlan.100**
   user@switch# **set interface vlan.200**

3. Configure the minimum receive interval, minimum transmit interval, and transmit interval threshold for a Bidirectional Forwarding Detection (BFD) session for the OSPF interfaces on Switch A and Switch B.

   NOTE: On a QFX5100 switch, the minimum transmit interval must be 1000 milliseconds or greater. Sub-second timers are not supported in Junos OS 13.2X51-D10 and later. If you configure the minimum transmit interval timer lower than 1000 milliseconds, the state of the MC-LAG can be affected.

   [edit protocols ospf area 0.0.0.0]
   user@switch# **set interface vlan.100 bfd-liveness-detection minimum-receive-interval 700**
   user@switch# **set interface vlan.100 bfd-liveness-detection transmit-interval minimum-interval 350**
   user@switch# **set interface vlan.100 bfd-liveness-detection transmit-interval threshold 500**
   user@switch# **set interface vlan.200 bfd-liveness-detection minimum-receive-interval 700**
   user@switch# **set interface vlan.200 bfd-liveness-detection transmit-interval minimum-interval 350**
   user@switch# **set interface vlan.200 bfd-liveness-detection transmit-interval threshold 500**

Step-by-Step Procedure

To configure PIM as the multicast protocol:

1. Configure a static rendezvous point (RP) address on Switch A and Switch B.

   ```
   [edit protocols pim]
   user@switch# set rp static address 1.0.0.3
   ```

2. Configure the address ranges of the multicast groups for which Switch A and Switch B can be a rendezvous point (RP).

   ```
   [edit protocols pim rp static address 1.0.0.3]
   user@switch# set group-ranges 239.0.0.0/8
   ```

3. Enable PIM on the VLAN interfaces for the MC-LAGs on Switch A and Switch B.

   ```
   [edit protocols pim]
   user@switch# set interface vlan.100 dual-dr
   user@switch# set interface vlan.200 dual-dr
   ```

4. Configure each PIM interface's priority for being selected as the designated router (DR).

   An interface with a higher priority value has a higher probability of being selected as the DR.

   Switch A

   ```
   [edit protocols pim]
   user@switch# set interface vlan.100 priority 200
   user@switch# set interface vlan.200 priority 600
   ```

   Switch B

   ```
   [edit protocols pim]
   user@switch# set interface vlan.100 priority 100
   user@switch# set interface vlan.200 priority 500
   ```

5. Configure the minimum receive interval, minimum transmit interval, and transmit interval threshold for a Bidirectional Forwarding Detection (BFD) session for the PIM interfaces on Switch A and Switch B.

   ```
   [edit protocols pim]
   user@switch# set interface vlan.100 bfd-liveness-detection
     minimum-receive-interval 700
   user@switch# set interface vlan.100 bfd-liveness-detection transmit-interval
     minimum-interval 350
   user@switch# set interface vlan.100 bfd-liveness-detection transmit-interval
     threshold 500
   user@switch# set interface vlan.200 bfd-liveness-detection
     minimum-receive-interval 700
   user@switch# set interface vlan.200 bfd-liveness-detection transmit-interval
     minimum-interval 350
   user@switch# set interface vlan.200 bfd-liveness-detection transmit-interval
     threshold 500
   ```


Step-by-Step Procedure

To enable RSTP:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Enable RSTP globally on all interfaces on Switch A and Switch B.

   ```
   [edit protocols rstp]
   user@switch# set interface all mode point-to-point
   ```

2. Disable RSTP on the ICL-PL interfaces on Switch A and Switch B.

   ```
   [edit protocols rstp]
   user@switch# set interface ae0.0 disable
   ```

3. Configure the MC-LAG interfaces as edge ports on Switch A and Switch B.

   NOTE: The ae1 and ae2 interfaces are downstream interfaces. This is why RSTP and bpdu-block-on-edge need to be configured.

   ```
   [edit protocols rstp]
   user@switch# set interface ae1.0 edge
   user@switch# set interface ae2.0 edge
   ```

4. Enable BPDU blocking on all interfaces except for the ICL-PL interfaces on Switch A and Switch B.

   NOTE: The ae1 and ae2 interfaces are downstream interfaces. This is why RSTP and bpdu-block-on-edge need to be configured.

   ```
   [edit protocols rstp]
   user@switch# set bpdu-block-on-edge
   ```

Results

From configuration mode on Switch A, confirm your configuration by entering the **show chassis**, **show interfaces**, **show multi-chassis**, **show protocols**, and **show vlans** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Original CLI:

```
chassis {
  aggregated-devices {
    ethernet {
      device-count 3;
    }
  }
}
interfaces {
  xe-0/0/12 {
    ether-options {
```

```
        802.3ad ae0;
      }
    }
    xe-0/0/13 {
      ether-options {
        802.3ad ae0;
      }
    }
    xe-0/0/44 {
      ether-options {
        802.3ad ae1;
      }
    }
    xe-0/0/45 {
      ether-options {
        802.3ad ae2;
      }
    }
    ae0 {
      unit 0 {
        family ethernet-switching {
          port-mode trunk;
          vlan {
            members v500;
          }
        }
      }
    }
    ae1 {
      aggregated-ether-options {
        lacp {
          active;
          system-id 00:01:02:03:04:05;
          admin-key 3;
        }
        mc-ae {
          mc-ae-id 3;
          chassis-id 0;
          mode active-active;
          status-control active;
          init-delay-time 240;
        }
      }
      unit 0 {
        family ethernet-switching {
          port-mode trunk;
          vlan {
            members v100;
          }
        }
      }
    }
    ae2 {
      aggregated-ether-options {
        lacp {
          active;
```

```
            system-id 00:01:02:03:04:06;
            admin-key 3;
        }
        mc-ae {
            mc-ae-id 4;
            chassis-id 0;
            mode active-active;
            status-control active;
            init-delay-time 240;
        }
    }
    unit 0 {
        family ethernet-switching {
            port-mode trunk;
            vlan {
                members v200;
            }
        }
    }
}
vlan {
    unit 100 {
        family inet {
            address 10.1.1.11/24 {
                vrrp-group 1 {
                    virtual-address 10.1.1.1;
                    priority 200;
                    accept-data;
                }
            }
        }
    }
    unit 200 {
        family inet {
            address 10.1.1.21/24 {
                vrrp-group 2 {
                    virtual-address 10.1.1.2;
                    priority 200;
                    accept-data;
                }
            }
        }
    }
    unit 500 {
        family inet {
            address 3.3.3.2/24;
        }
    }
}
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface vlan.100 {
                bfd-liveness-detection {
                    minimum-receive-interval 700;
```

```
            transmit-interval {
              minimum-interval 350;
              threshold 500;
            }
          }
        }
        interface vlan.200 {
          bfd-liveness-detection {
            minimum-receive-interval 700;
            transmit-interval {
              minimum-interval 350;
              threshold 500;
            }
          }
        }
      }
    }
    pim {
      rp {
        static {
          address 1.0.0.3 {
            group-ranges {
              239.0.0.0/8;
            }
          }
        }
      }
      interface vlan.100 {
        priority 200;
        dual-dr;
        bfd-liveness-detection { ## Warning: 'bfd-liveness-detection' is deprecated
          minimum-receive-interval 700;
          transmit-interval {
            minimum-interval 350;
            threshold 500;
          }
        }
      }
      interface vlan.200 {
        priority 600;
        dual-dr;
        bfd-liveness-detection { ## Warning: 'bfd-liveness-detection' is deprecated
          minimum-receive-interval 700;
          transmit-interval {
            minimum-interval 350;
            threshold 500;
          }
        }
      }
    }
    iccp {
      local-ip-addr 3.3.3.2;
      peer 3.3.3.1 {
        session-establishment-hold-time 50;
        backup-liveness-detection {
          backup-peer-ip 10.207.64.233;
```

```
        }
        liveness-detection {
          minimum-receive-interval 60;
          transmit-interval {
            minimum-interval 60;
          }
        }
      }
    }
    igmp-snooping {
      vlan all;
    }
    rstp {
      interface ae0.0 {
        disable;
      }
      interface ae1.0 {
        edge;
      }
      interface ae2.0 {
        edge;
      }
      interface all {
        mode point-to-point;
      }
      bpdu-block-on-edge;
    }
  }
  multi-chassis {
    multi-chassis-protection 3.3.3.1 {
      interface ae0;
    }
  }
  vlans {
    v100 {
      vlan-id 100;
      l3-interface vlan.100;
    }
    v200 {
      vlan-id 200;
      l3-interface vlan.200;
    }
    v500 {
      vlan-id 500;
      l3-interface vlan.500;
    }
  }
```

ELS:

```
  chassis {
    aggregated-devices {
      ethernet {
        device-count 3;
      }
    }
  }
  interfaces {
```

```
xe-0/0/12 {
   ether-options {
      802.3ad ae0;
   }
}
xe-0/0/13 {
   ether-options {
      802.3ad ae0;
   }
}
xe-0/0/44 {
   ether-options {
      802.3ad ae1;
   }
}
xe-0/0/45 {
   ether-options {
      802.3ad ae2;
   }
}
ae0 {
   unit 0 {
      family ethernet-switching {
         interface-mode trunk;
         vlan {
            members v500;
         }
      }
   }
}
ae1 {
   aggregated-ether-options {
      lacp {
         active;
         system-id 00:01:02:03:04:05;
         admin-key 3;
      }
      mc-ae {
         mc-ae-id 3;
         chassis-id 0;
         mode active-active;
         status-control active;
         init-delay-time 240;
      }
   }
   unit 0 {
      family ethernet-switching {
         interface-mode trunk;
         vlan {
            members v100;
         }
      }
   }
}
ae2 {
   aggregated-ether-options {
```



```
                lacp {
                    active;
                    system-id 00:01:02:03:04:06;
                    admin-key 3;
                }
                mc-ae {
                    mc-ae-id 4;
                    chassis-id 0;
                    mode active-active;
                    status-control active;
                    init-delay-time 240;
                }
            }
            unit 0 {
                family ethernet-switching {
                    interface-mode trunk;
                    vlan {
                        members v200;
                    }
                }
            }
        }
        irb {
            unit 100 {
                family inet {
                    address 10.1.1.11/24 {
                        vrrp-group 1 {
                            virtual-address 10.1.1.1;
                            priority 200;
                            accept-data;
                        }
                    }
                }
            }
            unit 200 {
                family inet {
                    address 10.1.1.21/24 {
                        vrrp-group 2 {
                            virtual-address 10.1.1.2;
                            priority 200;
                            accept-data;
                        }
                    }
                }
            }
            unit 500 {
                family inet {
                    address 3.3.3.2/24;
                }
            }
        }
    }
    protocols {
        ospf {
            area 0.0.0.0 {
                interface vlan.100 {
```

```
            bfd-liveness-detection {
                minimum-receive-interval 700;
                transmit-interval {
                    minimum-interval 350;
                    threshold 500;
                }
            }
        }
        interface vlan.200 {
            bfd-liveness-detection {
                minimum-receive-interval 700;
                transmit-interval {
                    minimum-interval 350;
                    threshold 500;
                }
            }
        }
    }
}
pim {
    rp {
        static {
            address 1.0.0.3 {
                group-ranges {
                    239.0.0.0/8;
                }
            }
        }
    }
    interface vlan.100 {
        priority 200;
        dual-dr;
        bfd-liveness-detection {
            minimum-receive-interval 700;
            transmit-interval {
                minimum-interval 350;
                threshold 500;
            }
        }
    }
    interface vlan.200 {
        priority 600;
        dual-dr;
        bfd-liveness-detection {
            minimum-receive-interval 700;
            transmit-interval {
                minimum-interval 350;
                threshold 500;
            }
        }
    }
}
iccp {
    local-ip-addr 3.3.3.2;
    peer 3.3.3.1 {
        session-establishment-hold-time 50;
```

```
            backup-liveness-detection {
                backup-peer-ip 10.207.64.233;
            }
            liveness-detection {
                minimum-receive-interval 60;
                transmit-interval {
                    minimum-interval 60;
                }
            }
        }
    }
    igmp-snooping {
        vlan all;
    }
    rstp {
        interface ae0.0 {
            disable;
        }
        interface ae1.0 {
            edge;
        }
        interface ae2.0 {
            edge;
        }
        interface all {
            mode point-to-point;
        }
        bpdu-block-on-edge;
    }
}
multi-chassis {
    multi-chassis-protection 3.3.3.1 {
        interface ae0;
    }
}
switch-options {
    service-id 10;
}
vlans {
    v100 {
        vlan-id 100;
        l3-interface irb.100;
    }
    v200 {
        vlan-id 200;
        l3-interface irb.200;
    }
    v500 {
        vlan-id 500;
        l3-interfac irb.500;
    }
}
```

From configuration mode on Switch B, confirm your configuration by entering the **show chassis**, **show interfaces**, **show multi-chassis**, **show protocols**, and **show vlans** commands.

If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Original CLI:

```
chassis {
  aggregated-devices {
    ethernet {
      device-count 3;
    }
  }
}
interfaces {
  xe-0/0/12 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/13 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/46 {
    ether-options {
      802.3ad ae1;
    }
  }
  xe-0/0/47 {
    ether-options {
      802.3ad ae2;
    }
  }
  ae0 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members v500;
        }
      }
    }
  }
  ae1 {
    aggregated-ether-options {
      lacp {
        active;
        system-id 00:01:02:03:04:05;
        admin-key 3;
      }
      mc-ae {
        mc-ae-id 3;
        chassis-id 1;
        mode active-active;
        status-control standby;
      }
    }
    unit 0 {
```



```
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members v100;
        }
      }
    }
  }
  ae2 {
    aggregated-ether-options {
      lacp {
        active;
        system-id 00:01:02:03:04:06;
        admin-key 3;
      }
      mc-ae {
        mc-ae-id 4;
        chassis-id 1;
        mode active-active;
        status-control active;
        init-delay-time 240;
      }
    }
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members v200;
        }
      }
    }
  }
  vlan {
    unit 100 {
      family inet {
        address 10.1.1.10/24 {
          vrrp-group 1 {
            virtual-address 10.1.1.1;
            priority 150;
            accept-data;
          }
        }
      }
    }
    unit 200 {
      family inet {
        address 10.1.1.20/24 {
          vrrp-group 2 {
            virtual-address 10.1.1.2;
            priority 150;
            accept-data;
          }
        }
      }
    }
    unit 500 {
```

```
            family inet {
               address 3.3.3.1/24;
            }
         }
      }
   }
   protocols {
      ospf {
         area 0.0.0.0 {
            interface vlan.100 {
               bfd-liveness-detection {
                  minimum-receive-interval 700;
                  transmit-interval {
                     minimum-interval 350;
                     threshold 500;
                  }
               }
            }
            interface vlan.200 {
               bfd-liveness-detection {
                  minimum-receive-interval 700;
                  transmit-interval {
                     minimum-interval 350;
                     threshold 500;
                  }
               }
            }
         }
      }
      pim {
         rp {
            static {
               address 1.0.0.3 {
                  group-ranges {
                     239.0.0.0/8;
                  }
               }
            }
         }
         interface vlan.100 {
            priority 100;
            dual-dr;
            bfd-liveness-detection { ## Warning: 'bfd-liveness-detection' is deprecated
               minimum-receive-interval 700;
               transmit-interval {
                  minimum-interval 350;
                  threshold 500;
               }
            }
         }
         interface vlan.200 {
            priority 500;
            dual-dr;
            bfd-liveness-detection { ## Warning: 'bfd-liveness-detection' is deprecated
               minimum-receive-interval 700;
               transmit-interval {
```



```
              minimum-interval 350;
              threshold 500;
            }
          }
        }
      }
      iccp {
        local-ip-addr 3.3.3.1;
        peer 3.3.3.2 {
          session-establishment-hold-time 50;
          backup-liveness-detection {
            backup-peer-ip 10.207.64.233;
          }
          liveness-detection {
            minimum-receive-interval 60;
            transmit-interval {
              minimum-interval 60;
            }
          }
        }
      }
      igmp-snooping {
        vlan all;
      }
      rstp {
        interface ae0.0 {
          disable;
        }
        interface ae1.0 {
          edge;
        }
        interface ae2.0 {
          edge;
        }
        interface all {
          mode point-to-point;
        }
        bpdu-block-on-edge;
      }
    }
    multi-chassis {
      multi-chassis-protection 3.3.3.2 {
        interface ae0;
      }
    }
    vlans {
      v100 {
        vlan-id 100;
        l3-interface vlan.100;
      }
      v200 {
        vlan-id 200;
        l3-interface vlan.200;
      }
      v500 {
        vlan-id 500;
```

```
        l3-interface vlan.500;
    }
}
```

ELS:

```
chassis {
    aggregated-devices {
        ethernet {
            device-count 3;
        }
    }
}
interfaces {
    xe-0/0/12 {
        ether-options {
            802.3ad ae0;
        }
    }
    xe-0/0/13 {
        ether-options {
            802.3ad ae0;
        }
    }
    xe-0/0/46 {
        ether-options {
            802.3ad ae1;
        }
    }
    xe-0/0/47 {
        ether-options {
            802.3ad ae2;
        }
    }
    ae0 {
        unit 0 {
            family ethernet-switching {
                interface-mode trunk;
                vlan {
                    members v500;
                }
            }
        }
    }
    ae1 {
        aggregated-ether-options {
            lacp {
                active;
                system-id 00:01:02:03:04:05;
                admin-key 3;
            }
            mc-ae {
                mc-ae-id 3;
                chassis-id 1;
                mode active-active;
                status-control standby;
            }
        }
```



```
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members v100;
        }
      }
    }
  }
  ae2 {
    aggregated-ether-options {
      lacp {
        active;
        system-id 00:01:02:03:04:06;
        admin-key 3;
      }
      mc-ae {
        mc-ae-id 4;
        chassis-id 1;
        mode active-active;
        status-control active;
        init-delay-time 240;
      }
    }
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members v200;
        }
      }
    }
  }
  irb {
    unit 100 {
      family inet {
        address 10.1.1.10/24 {
          vrrp-group 1 {
            virtual-address 10.1.1.1;
            priority 150;
            accept-data;
          }
        }
      }
    }
    unit 200 {
      family inet {
        address 10.1.1.20/24 {
          vrrp-group 2 {
            virtual-address 10.1.1.2;
            priority 150;
            accept-data;
          }
        }
      }
    }
```

```
        unit 500 {
          family inet {
            address 3.3.3.1/24;
          }
        }
      }
    }
    protocols {
      ospf {
        area 0.0.0.0 {
          interface vlan.100 {
            bfd-liveness-detection {
              minimum-receive-interval 700;
              transmit-interval {
                minimum-interval 350;
                threshold 500;
              }
            }
          }
          interface vlan.200 {
            bfd-liveness-detection {
              minimum-receive-interval 700;
              transmit-interval {
                minimum-interval 350;
                threshold 500;
              }
            }
          }
        }
      }
      pim {
        rp {
          static {
            address 1.0.0.3 {
              group-ranges {
                239.0.0.0/8;
              }
            }
          }
        }
        interface vlan.100 {
          priority 100;
          dual-dr;
          bfd-liveness-detection {
            minimum-receive-interval 700;
            transmit-interval {
              minimum-interval 350;
              threshold 500;
            }
          }
        }
        interface vlan.200 {
          priority 500;
          dual-dr;
          bfd-liveness-detection {
            minimum-receive-interval 700;
```

```
                transmit-interval {
                    minimum-interval 350;
                    threshold 500;
                }
            }
        }
    }
    iccp {
        local-ip-addr 3.3.3.1;
        peer 3.3.3.2 {
            session-establishment-hold-time 50;
            backup-liveness-detection {
                backup-peer-ip 10.207.64.233;
            }
            liveness-detection {
                minimum-receive-interval 60;
                transmit-interval {
                    minimum-interval 60;
                }
            }
        }
    }
    igmp-snooping {
        vlan all;
    }
    rstp {
        interface ae0.0 {
            disable;
        }
        interface ae1.0 {
            edge;
        }
        interface ae2.0 {
            edge;
        }
        interface all {
            mode point-to-point;
        }
        bpdu-block-on-edge;
    }
}
multi-chassis {
    multi-chassis-protection 3.3.3.2 {
        interface ae0;
    }
}
switch-options {
    service-id 10;
}
vlans {
    v100 {
        vlan-id 100;
        l3-interface irb.100;
    }
    v200 {
        vlan-id 200;
```

```
        l3-interface irb.200;
      }
      v500 {
        vlan-id 500;
        l3-interface irb.500;
      }
    }
```

Verification

To verify that the MC-LAG group has been created and is working properly, perform these tasks:

- Verifying That Switch A is the Master Designated Router on page 1962
- Verifying That Switch B is the Backup Designated Router on page 1962

Verifying That Switch A is the Master Designated Router

Purpose Verify that Switch A is the master designated router (DR).

Action From operational mode, enter the **show pim interfaces** command.

```
user@switch> show pim interfaces
Stat = Status, V = Version, NbrCnt = Neighbor Count,
S = Sparse, D = Dense, B = Bidirectional,
DR = Designated Router, P2P = Point-to-point link,
Active = Bidirectional is active, NotCap = Not Bidirectional Capable

Name                Stat Mode IP V State        NbrCnt JoinCnt(sg/*g) DR address
pime.32769          Down S     4 2   P2P,NotCap        0 0/0
vlan.100            Up   S     4 2  DDR-DR,NotCap     1 0/0           10.1.1.11
vlan.200            Up   S     4 2  DDR-DR,NotCap     2 0/0           10.1.1.21
```

Meaning The DDR-DR state of the VLAN interfaces in the output shows that Switch A is the master designated router.

Verifying That Switch B is the Backup Designated Router

Purpose Verify that Switch B is the backup designated router (BDR).

Action From operational mode, enter the **show pim interfaces** command.

```
user@switch> show pim interfaces
Stat = Status, V = Version, NbrCnt = Neighbor Count,
S = Sparse, D = Dense, B = Bidirectional,
DR = Designated Router, P2P = Point-to-point link,
Active = Bidirectional is active, NotCap = Not Bidirectional Capable

Name                Stat Mode IP V State        NbrCnt JoinCnt(sg/*g) DR address
pime.32769          Down S     4 2   P2P,NotCap        0 0/0
vlan.100            Up   S     4 2  DDR-BDR,NotCap    1 0/0           10.1.1.11
vlan.200            Up   S     4 2  DDR-BDR,NotCap    2 0/0           10.1.1.21
```

Meaning The DDR-BDR state of the VLAN interfaces in the output shows that Switch B is the backup designated router.

Related Documentation

- Understanding Multichassis Link Aggregation on page 1853
- Configuring Multichassis Link Aggregation on page 2022

Example: Configuring Multichassis Link Aggregation with Layer 3 MAC Address Synchronization

NOTE: Multichassis Link Aggregation (MC-LAG) is supported on QFX3500 and QFX3600 standalone switches running the original CLI and QFX5100 standalone switches running Enhanced Layer 2 Software.

There are 2 methods for enabling Layer 3 unicast functionality across a multichassis link aggregation group (MC-LAG). You can choose either to synchronize the MAC addresses between the switches for the participating MC-LAG interfaces, or you can configure Virtual Router Redundancy Protocol (VRRP). The procedure to configure MAC address synchronization is included in this example. For more information on configuring VRRP for use in a Layer 3 unicast MC-LAG, see "Example: Configuring Multichassis Link Aggregation for Layer 3 Unicast Using Virtual Router Redundancy Protocol (VRRP)" on page 1983.

Requirements

This example uses the following hardware and software components:

- Junos OS Release 12.3 or later for the QFX3500 and QFX3600 standalone switches and Junos OS Release 13.2X51-D10 or later for the QFX5100 standalone switches.
- Two QFX3500 or QFX3600 standalone switches, or two QFX5100 standalone switches.

Before you configure an MC-LAG for Layer 3 unicast, be sure that you understand how to:

- Configure aggregated Ethernet interfaces on a switch. See "Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch" on page 1896.
- Configure the Link Aggregation Control Protocol (LACP) on aggregated Ethernet interfaces on a switch. See "Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch" on page 1900.

Overview

In this example, you configure an MC-LAG across two switches, consisting of two aggregated Ethernet interfaces, an interchassis control link-protection link (ICL-PL), multichassis protection link for the ICL-PL, ICCP for the peers hosting the MC-LAG, and Layer 3 connectivity between MC-LAG peers. Layer 3 connectivity is required for ICCP.

Topology

The topology used in this example consists of two switches hosting an MC-LAG. The two switches are connected to a server. Figure 28 on page 1905 shows the topology of this example.

Figure 30: Configuring a Multichassis LAG Between Switch A and Switch B

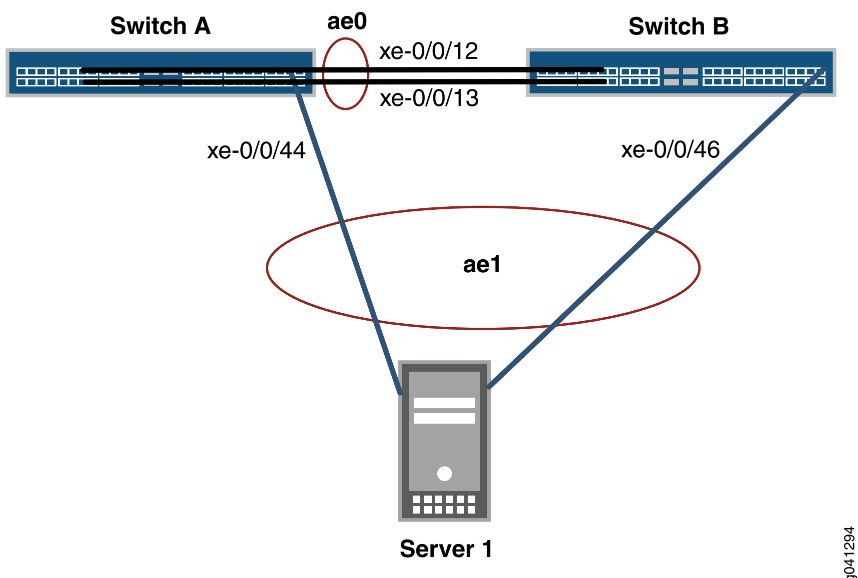


Table 170 on page 1897 details the topology used in this configuration example.

Table 173: Components of the Topology for Configuring a Multichassis LAG Between Two Switches

Hostname	Base Hardware	Multichassis Link Aggregation Group
Switch A Switch B	QFX3500 or QFX3600 standalone switch, or QFX5100 standalone switch QFX3500 or QFX3600 standalone switch, or QFX5100 standalone switch	**ae0** is configured as an aggregated Ethernet interface, and is used as an ICL-PL. The following interfaces are part of **ae0**: **xe-0/0/12** and **xe-0/0/13**Switch A and **xe-0/0/12** and **xe-0/0/13** on Switch B. **ae1** is configured as an MC-LAG, and the following two interfaces are part of **ae1**: **xe-0/0/44** on Switch A and **xe-0/0/46** on Switch B. .

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and paste the commands into the CLI at the **[edit]** hierarchy level of Switch A.

NOTE: This example shows how to configure MC-LAG using both the original CLI and Enhanced Layer 2 Software (ELS).

In ELS, there are three different statements and one different option from the original CLI:

- The **port-mode** statement in the **[edit interfaces *interface-name* unit *number* family ethernet-switching]** hierarchy is not supported. Use the **interface-mode** statement instead.
- The **vlan** statement in the **[edit interfaces *interface-name*]** hierarchy is not supported. Use the **irb** statement instead.
- The **vlan.*logical-interface-number*** option in the **[edit vlans *vlan-name* l3-interface]** option is not supported. Use the **irb.*logical-interface-number*** option instead.
- The **service-id** statement in the **[edit switch-options]** hierarchy is required in the ELS CLI.

Original CLI on Switch A:

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/44 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching port-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 0
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control active
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces vlan unit 500 family inet address 3.3.3.2/24
set vlans v100 vlan-id 100
set vlans v500 vlan-id 500
set vlans v500 l3-interface vlan.500
set protocols iccp local-ip-addr 3.3.3.2
set protocols iccp peer 3.3.3.1 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.1 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
```


ELS on Switch A:

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/44 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 0
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control active
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces irb unit 500 family inet address 3.3.3.2/24
set vlans v100 vlan-id 100
set vlans v500 vlan-id 500
set vlans v500 l3-interface irb.500
set protocols iccp local-ip-addr 3.3.3.2
set protocols iccp peer 3.3.3.1 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.1 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
set switch-options service-id 10
```

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and paste the commands into the CLI at the **[edit]** hierarchy level of Switch B.

Original CLI on Switch B:

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/46 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching port-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 1
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control standby
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces vlan unit 500 family inet address 3.3.3.1/24
set vlans v100 vlan-id 100
set vlans v500 vlan-id 500
```

```
set vlans v500 l3-interface vlan.500
set protocols iccp local-ip-addr 3.3.3.1
set protocols iccp peer 3.3.3.2 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.2 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
```

ELS on Switch B:

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/46 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 1
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control standby
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces irb unit 500 family inet address 3.3.3.1/24
set vlans v100 vlan-id 100
set vlans v500 vlan-id 500
set vlans v500 l3-interface irb.500
set protocols iccp local-ip-addr 3.3.3.1
set protocols iccp peer 3.3.3.2 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.2 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
set switch-options service-id 10
```

Configuring MC-LAG on Two Switches

Step-by-Step Procedure

To enable multichassis protection link between MC-LAG peers:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Configure the number of LAGs on both Switch A and Switch B.

```
[edit chassis]
user@switch# set aggregated-devices ethernet device-count 2
```

2. Add member interfaces to the aggregated Ethernet interfaces on both Switch A and Switch B.

```
[edit interfaces]
user@switch# set xe-0/0/12 ether-options 802.3ad ae0
[edit interfaces]
user@switch# set xe-0/0/13 ether-options 802.3ad ae0
[edit interfaces]
user@switch# set xe-0/0/44 ether-options 802.3ad ae1
[edit interfaces]
user@switch# set xe-0/0/46 ether-options 802.3ad ae1
```

3. Configure a trunk interface between Switch A and Switch B.

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching port-mode trunk
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching interface-mode trunk
```

4. Configure a multichassis protection link between Switch A and Switch B.

   Switch A:

```
[edit]
user@switch# set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
```

   Switch B:

```
[edit]
user@switch# set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
```

Step-by-Step Procedure

To enable ICCP:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Configure the local IP address to be in the ICCP connection on Switch A and Switch B.

   Switch A:

```
[edit protocols]
user@switch# set iccp local-ip-addr 3.3.3.2
```

   Switch B:

```
[edit protocols]
user@switch# set iccp local-ip-addr 3.3.3.1
```

2. Configure the peer IP address and minimum receive interval for a (BFD) session for ICCP on Switch A and Switch B.

   Switch A:

```
[edit protocols]
user@switch# set iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
```

   Switch B:

```
[edit protocols]
user@switch# set iccp peer 3.3.3.2 liveness-detection minimum-receive-interval 60
```

3. Configure the peer IP address and minimum transmit interval for Bidirectional Forwarding Detection (BFD) session for ICCP on Switch A and Switch B.

   Switch A:


```
[edit protocols]
user@switch# set iccp peer 3.3.3.1 liveness-detection transmit-interval minimum-interval
60
```

Switch B:

```
[edit protocols]
user@switch# set iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval
60
```

4. (Optional) Configure the time during which an ICCP connection must succeed between MC-LAG peers on Switch A and Switch B.

   NOTE: Configuring session establishment hold time helps in faster ICCP connection establishment. The recommended value is 50 seconds.

   Switch A:

```
[edit protocols]
user@switch# set iccp peer 3.3.3.1 session-establishment-hold-time 50
```

   Switch B:

```
[edit protocols]
user@switch# set iccp peer 3.3.3.2 session-establishment-hold-time 50
```

5. (Optional) Configure the backup IP address to be used for backup liveness detection on both Switch A and Switch B.

   NOTE: By default, backup liveness detection is not enabled. Configuring a backup IP address helps achieve sub-second traffic loss during a MC-LAG peer reboot.

   Switch A:

```
[edit protocols]
user@switch# set iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip 10.207.64.233
```

   Switch B:

```
[edit protocols]
user@switch# set iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.232
```

6. Configure Layer 3 connectivity between the MC-LAG peers on both Switch A and Switch B using the original CLI:

```
[edit vlans]
user@switch# set v500 vlan-id 500
[edit vlans]
user@switch# set v500 l3-interface vlan.500
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching port-mode trunk vlan members
v500
```

7. Configure Layer 3 connectivity between the MC-LAG peers on both Switch A and Switch B using ELS:

```
[edit vlans]
```

```
user@switch# set v500 vlan-id 500
[edit vlans]
user@switch# set v500 l3-interface irb.500
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching interface-mode trunk vlan members
v500
```

Step-by-Step Procedure

To enable the MC-LAG interface:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Enable LACP on the MC-LAG interface on Switch A and Switch B.

   NOTE: At least one end needs to be active. The other end can be either active or passive.

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options lacp active
   ```
2. Specify the same multichassis aggregated Ethernet identification number on both MC-LAG peers on Switch A and Switch B.

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae mc-ae-id 3
   ```
3. Specify the same service ID on Switch A and Switch B.

   ELS:

   ```
   [edit]
   user@switch# set switch-options service-id 10
   ```
4. Specify a unique chassis ID for the MC-LAG on the MC-LAG peers on Switch A and Switch B.

   Switch A:

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae chassis-id 0
   ```

   Switch B:

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae chassis-id 1
   ```
5. Specify the operating mode of the MC-LAG on both Switch A and Switch B.

   NOTE: Only active-active mode is supported at this time.

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae mode active-active
   ```
6. Specify the status control for MC-LAG on Switch A and Switch B.

NOTE: You must configure status control on both Switch A and Switch B hosting the MC-LAG. If one peer is in active mode, the other must be in standby mode.

Switch A:

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae status-control active
```

Switch B:

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae status-control standby
```

7. Specify the number of seconds by which the bring-up of the MC-AE interface should be deferred after you reboot Switch A and Switch B.

   NOTE: The recommended value for maximum VLAN configuration (for example, 4,000 VLANS) is 240 seconds. If IGMP snooping is enabled on all of the VLANs, the recommended value is 420 seconds.

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae init-delay-time 240
   ```

8. Specify the same LACP system ID for the MC-LAG on Switch A and Switch B.

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options lacp system-ID 00:01:02:03:04:05
   ```

9. Specify the same LACP administration key on both Switch A and Switch B.

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options lacp admin-key 3
   ```

10. Enable a VLAN on the MC-LAG on Switch A and Switch B using the original CLI:

    ```
    [edit interfaces]
    user@switch# set ae1 unit 0 family ethernet-switching port-mode trunk
    [edit]
    user@switch# set vlans v100 vlan-id 100
    [edit interfaces]
    user@switch# set ae1 unit 0 family ethernet-switching vlan members v100
    ```

11. Enable a VLAN on the MC-LAG on Switch A and Switch B using ELS:

    ```
    [edit interfaces]
    user@switch# set ae1 unit 0 family ethernet-switching interface-mode trunk
    [edit]
    user@switch# set vlans v100 vlan-id 100
    [edit interfaces]
    user@switch# set ae1 unit 0 family ethernet-switching vlan members v100
    ```


Step-by-Step Procedure

To enabled RSTP:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Enable RSTP globally on all interfaces on Switch A and Switch B.

   ```
   [edit]
   user@switch# set protocols rstp interface all mode point-to-point
   ```
2. Disable RSTP on the ICL-PL interfaces on Switch A and Switch B:

   ```
   [edit]
   user@switch# set protocols rstp interface ae0.0 disable
   ```
3. Configure the MC-LAG interfaces as edge ports on Switch A and Switch B.

   ```
   [edit]
   user@switch# set protocols rstp interface ae1.0 edge
   ```
4. Enable BPDU blocking on all interfaces except for the ICL-PL interfaces on Switch A and Switch B.

   ```
   [edit]
   user@switch# set protocols rstp bpdu-block-on-edge
   ```

Results

Display the results of the configuration on Switch A using the original CLI.

```
chassis {
  aggregated-devices {
    ethernet {
      device-count 2;
    }
  }
}
interfaces {
  xe-0/0/12 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/13 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/44 {
    ether-options {
      802.3ad ae1;
    }
  }
  ae0 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members v500;
        }
```



```
                }
            }
        }
        ae1 {
            aggregated-ether-options {
                lacp {
                    active;
                    system-id 00:01:02:03:04:05;
                    admin-key 3;
                }
                mc-ae {
                    mc-ae-id 3;
                    chassis-id 0;
                    mode active-active;
                    status-control active;
                    init-delay-time 240
                }
            }
            unit 0 {
                family ethernet-switching {
                    port-mode trunk;
                    vlan {
                        members v100;
                    }
                }
            }
        }
        vlan {
            unit 500 {
                family inet {
                    address 3.3.3.2/24;
                }
            }
        }
    }
    protocols {
        iccp {
            local-ip-addr 3.3.3.2;
            peer 3.3.3.1 {
                session-establishment-hold-time 50;
                backup-liveness-detection {
                    backup-peer-ip 10.207.64.233;
                }
                liveness-detection {
                    minimum-receive-interval 60;
                    transmit-interval {
                        minimum-interval 60;
                    }
                }
            }
        }
        rstp {
            interface ae0.0 {
                disable;
            }
            interface ae1.0 {
```



```
            edge;
          }
          interface all {
            mode point-to-point;
          }
          bpdu-block-on-edge;
        }
      }
      multi-chassis {
        multi-chassis-protection 3.3.3.1 {
          interface ae0;
        }
      }
      vlans {
        v100 {
          vlan-id 100;
        }
        v500 {
          vlan-id 500;
          l3-interface vlan.500;
        }
      }
```

Display the results of the configuration on Switch A using ELS.

```
chassis {
  aggregated-devices {
    ethernet {
      device-count 2;
    }
  }
}
interfaces {
  xe-0/0/12 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/13 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/44 {
    ether-options {
      802.3ad ae1;
    }
  }
  ae0 {
    unit 0 {
      family ethernet-switching {
        interface-mode trunk;
        vlan {
          members v500;
        }
      }
```



```
        }
      }
      ae1 {
        aggregated-ether-options {
          lacp {
            active;
            system-id 00:01:02:03:04:05;
            admin-key 3;
          }
          mc-ae {
            mc-ae-id 3;
            chassis-id 0;
            mode active-active;
            status-control active;
            init-delay-time 240
          }
        }
        unit 0 {
          family ethernet-switching {
            interface-mode trunk;
            vlan {
              members v100;
            }
          }
        }
      }
      vlan {
        unit 500 {
          family inet {
            address 3.3.3.2/24;
          }
        }
      }
    }
    protocols {
      iccp {
        local-ip-addr 3.3.3.2;
        peer 3.3.3.1 {
          session-establishment-hold-time 50;
          backup-liveness-detection {
            backup-peer-ip 10.207.64.233;
          }
          liveness-detection {
            minimum-receive-interval 60;
            transmit-interval {
              minimum-interval 60;
            }
          }
        }
      }
      rstp {
        interface ae0.0 {
          disable;
        }
        interface ae1.0 {
          edge;
```

```
    }
    interface all {
      mode point-to-point;
    }
    bpdu-block-on-edge;
  }
}
multi-chassis {
  multi-chassis-protection 3.3.3.1 {
    interface ae0;
  }
}
switch-options {
  service-id 10;
}
vlans {
  v100 {
    vlan-id 100;
  }
  v500 {
    vlan-id 500;
    l3-interface irb.500;
  }
}
```

Display the results of the configuration on Switch B using the original CLI.

```
chassis {
  aggregated-devices {
    ethernet {
      device-count 2;
    }
  }
}
interfaces {
  xe-0/0/12 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/13 {
    ether-options {
      802.3ad ae0;
    }
  }
  xe-0/0/46 {
    ether-options {
      802.3ad ae1;
    }
  }
  ae0 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members v500;
```

```
            }
          }
        }
      }
      ae1 {
        aggregated-ether-options {
          lacp {
            active;
            system-id 00:01:02:03:04:05;
            admin-key 3;
          }
          mc-ae {
            mc-ae-id 3;
            chassis-id 1;
            mode active-active;
            status-control standby;
            init-delay-time 240
          }
        }
        unit 0 {
          family ethernet-switching {
            port-mode trunk;
            vlan {
              members v100;
            }
          }
        }
      }
      vlan {
        unit 500 {
          family inet {
            address 3.3.3.1/24;
          }
        }
      }
    }
    protocols {
      iccp {
        local-ip-addr 3.3.3.1;
        peer 3.3.3.2 {
          session-establishment-hold-time 50;
          backup-liveness-detection {
            backup-peer-ip 10.207.64.233;
          }
          liveness-detection {
            minimum-receive-interval 60;
            transmit-interval {
              minimum-interval 60;
            }
          }
        }
      }
      rstp {
        interface ae0.0 {
          disable;
        }
```

```
        interface ae1.0 {
            edge;
        }
        interface all {
            mode point-to-point;
        }
        bpdu-block-on-edge;
    }
}
multi-chassis {
    multi-chassis-protection 3.3.3.2 {
        interface ae0;
    }
}
vlans {
    v100 {
        vlan-id 100;
    }
    v500 {
        vlan-id 500;
        l3-interface vlan.500;
    }
}
```

Display the results of the configuration on Switch B using ELS.

```
chassis {
    aggregated-devices {
        ethernet {
            device-count 2;
        }
    }
}
interfaces {
    xe-0/0/12 {
        ether-options {
            802.3ad ae0;
        }
    }
    xe-0/0/13 {
        ether-options {
            802.3ad ae0;
        }
    }
    xe-0/0/46 {
        ether-options {
            802.3ad ae1;
        }
    }
    ae0 {
        unit 0 {
            family ethernet-switching {
                interface-mode trunk;
                vlan {
                    members v500;
                }
```

```
        }
      }
    }
    ae1 {
      aggregated-ether-options {
        lacp {
          active;
          system-id 00:01:02:03:04:05;
          admin-key 3;
        }
        mc-ae {
          mc-ae-id 3;
          chassis-id 1;
          mode active-active;
          status-control standby;
          init-delay-time 240
        }
      }
      unit 0 {
        family ethernet-switching {
          interface-mode trunk;
          vlan {
            members v100;
          }
        }
      }
    }
    vlan {
      unit 500 {
        family inet {
          address 3.3.3.1/24;
        }
      }
    }
  }
  protocols {
    iccp {
      local-ip-addr 3.3.3.1;
      peer 3.3.3.2 {
        session-establishment-hold-time 50;
        backup-liveness-detection {
          backup-peer-ip 10.207.64.233;
        }
        liveness-detection {
          minimum-receive-interval 60;
          transmit-interval {
            minimum-interval 60;
          }
        }
      }
    }
    rstp {
      interface ae0.0 {
        disable;
      }
      interface ae1.0 {
```

```
            edge;
        }
        interface all {
            mode point-to-point;
        }
        bpdu-block-on-edge;
    }
}
multi-chassis {
    multi-chassis-protection 3.3.3.2 {
        interface ae0;
    }
}
switch-options {
    service-id 10;
}
vlans {
    v100 {
        vlan-id 100;
    }
    v500 {
        vlan-id 500;
        l3-interface irb.500;
    }
}
```

Verification

To verify that the MC-LAG group has been created and is working properly, perform these tasks:

Verifying That ICCP Is Working on Switch A

Purpose Verify that ICCP is running on Switch A.

Action

```
[edit]
user@switch# show iccp
Redundancy Group Information for peer 3.3.3.1
  TCP Connection       : Established
  Liveliness Detection : Up

 Client Application: MCSNOOPD

 Client Application: eswd
```

Meaning This output shows that the TCP connection between the peers hosting the MC-LAG is up, liveness detection is up, and MCSNOOPD and ESWD client applications are running.

Verifying That ICCP Is Working on Switch B

Purpose Verify that ICCP is running on Switch B.

Action show iccp

```
[edit]
user@switch# show iccp
Redundancy Group Information for peer 3.3.3.2
  TCP Connection       : Established
  Liveliness Detection : Up

 Client Application: MCSNOOPD

 Client Application: eswd
```

Meaning This output shows that the TCP connection between the peers hosting the MC-LAG is up, liveness detection is up, and MCSNOOPD and ESWD client applications are running.

Verifying That LACP Is Active on Switch A

Purpose Verify that LACP is active on Switch A.

Action

```
[edit]
user@switch# show lacp interfaces
Aggregated interface: ae1
    LACP state:       Role   Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity
      xe-0/0/46      Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
      xe-0/0/46    Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active
    LACP protocol:        Receive State  Transmit State          Mux State
      xe-0/0/46                 Current   Fast periodic Collecting distributing
```

Meaning This output shows that Switch A is participating in LACP negotiation.

Verifying That LACP Is Active on Switch B

Purpose Verify that LACP is active on Switch B

Action

```
[edit]
user@switch# show lacp interfaces

Aggregated interface: ae1
    LACP state:       Role   Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity
      xe-0/0/44      Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
      xe-0/0/44    Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active
    LACP protocol:        Receive State  Transmit State          Mux State
      xe-0/0/44                 Current   Fast periodic Collecting distributing
```

Meaning This output shows that Switch B is participating in LACP negotiation.

Verifying That the MC-AE and ICL-PL Interfaces Are Up on Switch A

Purpose Verify that the MC-AE and ICL-PL interfaces are up on Switch A.

Action

```
[edit]
user@switch# show interfaces mc-ae
Member Link                  : ae1
 Current State Machine's State: mcae active state
 Local Status                 : active
 Local State                  : up
 Peer Status                  : active
 Peer State                   : up
     Logical Interface        : ae1.0
     Topology Type            : bridge
     Local State              : up
     Peer State               : up
     Peer Ip/MCP/State        : 3.3.3.1 ae0.0 up
```

Meaning This output shows that the MC-AE interface on Switch A is up and active.

Verifying That the MC-AE and ICL-PL Interfaces Are Up on Switch B

Purpose Verify that the MC-AE and ICL-PL interfaces are up on Switch B.

Action

```
[edit]
user@switch# show interfaces mc-ae
Member Link                  : ae1
 Current State Machine's State: mcae active state
 Local Status                 : active
 Local State                  : up
 Peer Status                  : active
 Peer State                   : up
     Logical Interface        : ae1.0
     Topology Type            : bridge
     Local State              : up
     Peer State               : up
     Peer Ip/MCP/State        : 3.3.3.2 ae0.0 up
```

Meaning This output shows that the MC-AE interface on Switch B is up and active.

Verifying that MAC Learning Is Occurring on Switch A and Switch B

Purpose Verify that MAC learning is working on Switch A and B.

Action

```
[edit]
user@switch# show ethernet-switching table
Ethernet-switching table: 10 entries, 4 learned, 0 persistent entries
  VLAN              MAC address       Type         Age Interfaces
  v222              *                 Flood          - All-members
  v222              00:00:5e:00:01:01 Static         - Router
  v222              00:10:94:00:00:05 Learn(L)      33 ae0.0 (MCAE)
  v222              84:18:88:df:ac:ae Learn(R)       0 ae2.0
```

Meaning The output shows four learned MAC addresses entries.

Troubleshooting

Troubleshooting a LAG That Is Down

Problem The **show interfaces terse** command shows that the MC-LAG is **down**

Solution Check the following:

- Verify that there is no configuration mismatch.
- Verify that all member ports are up.
- Verify that the MC-LAG is part of family Ethernet switching (Layer 2 LAG).
- Verify that the MC-LAG member is connected to the correct MC-LAG member at the other end.

Related Documentation

- Understanding Multichassis Link Aggregation on page 1853
- Configuring Multichassis Link Aggregation on page 2022
- Example: Configuring Multichassis Link Aggregation for Layer 3 Multicast Using VRRP on page 1926

Example: Configuring Multichassis Link Aggregation for Layer 3 Unicast Using Virtual Router Redundancy Protocol (VRRP)

There are two methods for enabling Layer 3 unicast functionality across a multichassis link aggregation group (MC-LAG). You can choose either to configure Virtual Router Redundancy Protocol (VRRP) or synchronize the MAC addresses for the Layer 3 interfaces of the switches participating in the MC-LAG. The procedure to configure VRRP for use in a Layer 3 unicast MC-LAG is included in this example. For more information on configuring MAC address synchronization, see *Example: Configuring Multichassis Link Aggregation for Layer 3 Unicast using MAC Address Synchronization*.

Requirements

This example uses the following hardware and software components:

- Junos OS Release 12.3 or later for the QFX Series
- Two QFX3500 or QFX3600 or QFX5100 switches

Before you configure an MC-LAG, be sure that you understand how to:

- Configure aggregated Ethernet interfaces on a switch. See "Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch" on page 1896.
- Configure the Link Aggregation Control Protocol (LACP) on aggregated Ethernet interfaces on a switch. See "Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch" on page 1900.
- Configure Virtual Router Redundancy Protocol (VRRP) on a switch. See "Configuring Basic VRRP Support" on page 1752.

Overview

In this example, you configure an MC-LAG across two switches by including interfaces from both switches in an aggregated Ethernet interface (ae1). To support the MC-LAG, create a second aggregated Ethernet interface (ae0) for the interchassis control link-protection link (ICL-PL). Configure a multichassis protection link for the ICL-PL, Interchassis Control Protocol (ICCP) for the peers hosting the MC-LAG, and Layer 3 connectivity between MC-LAG peers.

NOTE: Layer 3 connectivity is required for ICCP.

To complete the configuration, enable VRRP by completing the following steps:

- Create a routed VLAN interface (RVI)
- Create a VRRP group and assign a virtual IP address that is shared between each switch in the VRRP group
- Enable a member of a VRRP group to accept all packets destined for the virtual IP address if it is the master in the VRRP group
- Configure Layer 3 connectivity between the VRRP groups

Topology

The topology used in this example consists of two switches hosting an MC-LAGs. The two switches are connected to a server. Figure 31 on page 1985 shows the topology of this example.

Figure 31: Configuring a Multichassis LAG Between Switch A and Switch B

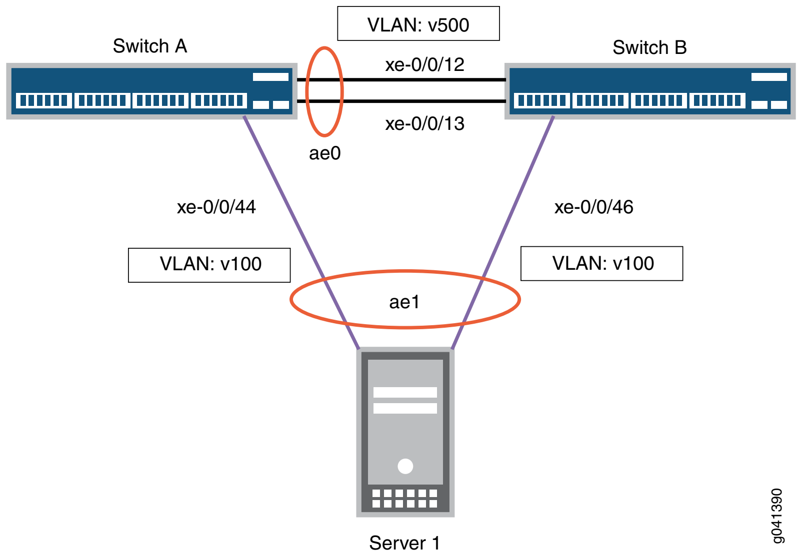


Table 170 on page 1897 details the topology used in this configuration example.

Table 174: Components of the Topology for Configuring a Multichassis LAG Between Two Switches

Hostname	Base Hardware	Multichassis Link Aggregation Group
Switch A Switch B	QFX3500, QFX3600, or QFX5100 switch	**ae0** is configured as an aggregated Ethernet interface, and is used as an ICL-PL. The following interfaces are part of **ae0**: **xe-0/0/12** and **xe-0/0/13**Switch A and **xe-0/0/12** and **xe-0/0/13** on Switch B. **ae1** is configured as an MC-LAG, and the following two interfaces are part of **ae1**: **xe-0/0/44** on Switch A and **xe-0/0/46** on Switch B. .

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and paste the commands into the CLI at the **[edit]** hierarchy level of Switch A.

NOTE: This example shows how to configure MC-LAG using both the original CLI and Enhanced Layer 2 Software (ELS).

In ELS, there are three different statements and one different option from the original CLI:

- The **port-mode** statement in the **[edit interfaces *interface-name* unit *number* family ethernet-switching]** hierarchy is not supported. Use the **interface-mode** statement instead.
- The **vlan** statement in the **[edit interfaces *interface-name*]** hierarchy is not supported. Use the **irb** statement instead.
- The **vlan.*logical-interface-number*** option in the **[edit vlans *vlan-name* l3-interface]** option is not supported. Use the **irb.*logical-interface-number*** option instead.
- The **service-id** statement in the **[edit switch-options]** hierarchy is required in the ELS CLI.

Original CLI:

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/44 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching port-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 0
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control active
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces vlan unit 100 family inet address 100.1.1.11/24 vrrp-group 1 virtual-address 100.1.1.1
set interfaces vlan unit 100 family inet address 100.1.1.11/24 vrrp-group 1 priority 200
set interfaces vlan unit 100 family inet address 100.1.1.11/24 vrrp-group 1 accept-data
set interfaces vlan unit 500 family inet address 3.3.3.2/24
set vlans v100 vlan-id 100
set vlans v100 l3-interface vlan.100
set vlans v500 vlan-id 500
set vlans v500 l3-interface vlan.500
set protocols iccp local-ip-addr 3.3.3.2
set protocols iccp peer 3.3.3.1 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.1 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
```



```
set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
```

ELS:

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/44 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 0
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control active
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces irb unit 100 family inet address 100.1.1.11/24 vrrp-group 1 virtual-address 100.1.1.1
set interfaces irb unit 100 family inet address 100.1.1.11/24 vrrp-group 1 priority 200
set interfaces irb unit 100 family inet address 100.1.1.11/24 vrrp-group 1 accept-data
set interfaces irb unit 500 family inet address 3.3.3.2/24
set vlans v100 vlan-id 100
set vlans v100 l3-interface irb.100
set vlans v500 vlan-id 500
set vlans v500 l3-interface irb.500
set protocols iccp local-ip-addr 3.3.3.2
set protocols iccp peer 3.3.3.1 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.1 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
set switch-options service-id 10
```

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and paste the commands into the CLI at the **[edit]** hierarchy level of Switch B.

Original CLI:

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/46 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching port-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 1
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control standby
set ae1 aggregated-ether-options mc-ae init-delay-time 240
```

```
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces vlan unit 100 family inet address 100.1.1.10/24 vrrp-group 1 virtual-address 100.1.1.1
set interfaces vlan unit 100 family inet address 100.1.1.10/24 vrrp-group 1 priority 150
set interfaces vlan unit 100 family inet address 100.1.1.10/24 vrrp-group 1 accept-data
set interfaces vlan unit 500 family inet address 3.3.3.1/24
set vlans v100 vlan-id 100
set vlans v100 l3-interface vlan.100
set vlans v500 vlan-id 500
set vlans v500 l3-interface vlan.500
set protocols iccp local-ip-addr 3.3.3.1
set protocols iccp peer 3.3.3.2 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.2 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
```

ELS:

```
set chassis aggregated-devices ethernet device-count 2
set interfaces xe-0/0/12 ether-options 802.3ad ae0
set interfaces xe-0/0/13 ether-options 802.3ad ae0
set interfaces xe-0/0/46 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae0 unit 0 family ethernet-switching vlan members v500
set interfaces ae1 aggregated-ether-options lacp active
set interfaces ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
set interfaces ae1 aggregated-ether-options lacp admin-key 3
set interfaces ae1 aggregated-ether-options mc-ae mc-ae-id 3
set interfaces ae1 aggregated-ether-options mc-ae chassis-id 1
set interfaces ae1 aggregated-ether-options mc-ae mode active-active
set interfaces ae1 aggregated-ether-options mc-ae status-control standby
set ae1 aggregated-ether-options mc-ae init-delay-time 240
set interfaces ae1 unit 0 family ethernet-switching interface-mode trunk
set interfaces ae1 unit 0 family ethernet-switching vlan members v100
set interfaces irb unit 100 family inet address 100.1.1.10/24 vrrp-group 1 virtual-address 100.1.1.1
set interfaces irb unit 100 family inet address 100.1.1.10/24 vrrp-group 1 priority 150
set interfaces irb unit 100 family inet address 100.1.1.10/24 vrrp-group 1 accept-data
set interfaces irb unit 500 family inet address 3.3.3.1/24
set vlans v100 vlan-id 100
set vlans v100 l3-interface irb.100
set vlans v500 vlan-id 500
set vlans v500 l3-interface irb.500
set protocols iccp local-ip-addr 3.3.3.1
set protocols iccp peer 3.3.3.2 session-establishment-hold-time 50
set protocols iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.233
set protocols iccp peer 3.3.3.2 liveness-detection minimum-receive-interval 60
set protocols iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval 60
set protocols rstp interface ae0.0 disable
set protocols rstp interface ae1.0 edge
set protocols rstp interface all mode point-to-point
set protocols rstp bpdu-block-on-edge
set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
set switch-options service-id 10
```


Configuring MC-LAG on Two Switches

Step-by-Step Procedure

To enable multichassis protection link between MC-LAG peers:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Configure the number of LAGs on both Switch A and Switch B.

```
[edit chassis]
user@switch# set aggregated-devices ethernet device-count 2
```

2. Add member interfaces to the aggregated Ethernet interfaces on both Switch A and Switch B.

```
[edit interfaces]
user@switch# set xe-0/0/12 ether-options 802.3ad ae0
[edit interfaces]
user@switch# set xe-0/0/13 ether-options 802.3ad ae0
[edit interfaces]
user@switch# set xe-0/0/44 ether-options 802.3ad ae1
[edit interfaces]
user@switch# set xe-0/0/46 ether-options 802.3ad ae1
```

3. Configure a trunk interface between Switch A and Switch B using the original CLI.

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching port-mode trunk
```

4. Configure a trunk interface between Switch A and Switch B using ELS.

```
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching interface-mode trunk
```

5. Configure a multichassis protection link between Switch A and Switch B.

   Switch A:

```
[edit]
user@switch# set multi-chassis multi-chassis-protection 3.3.3.2 interface ae0
```

   Switch B:

```
[edit]
user@switch# set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
```

Step-by-Step Procedure

To enable ICCP:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Configure the local IP address to be in the ICCP connection on Switch A and Switch B.

   Switch A:

   ```
   [edit protocols]
   user@switch# set iccp local-ip-addr 3.3.3.2
   ```

   Switch B:

   ```
   [edit protocols]
   user@switch# set iccp local-ip-addr 3.3.3.1
   ```

2. Configure the peer IP address and minimum receive interval for a (BFD) session for ICCP on Switch A and Switch B.

   Switch A:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.1 liveness-detection minimum-receive-interval 60
   ```

   Switch B:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.2 liveness-detection minimum-receive-interval 60
   ```

3. Configure the peer IP address and minimum transmit interval for Bidirectional Forwarding Detection (BFD) session for ICCP on Switch A and Switch B.

   Switch A:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.1 liveness-detection transmit-interval minimum-interval
   60
   ```

   Switch B:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval
   60
   ```

4. (Optional) Configure the time during which an ICCP connection must succeed between MC-LAG peers on Switch A and Switch B.

   NOTE: Configuring session establishment hold time helps in faster ICCP connection establishment. The recommended value is 50 seconds.

   Switch A:

   ```
   [edit protocols]
   user@switch# set iccp peer 3.3.3.1 session-establishment-hold-time 50
   ```

   Switch B:

   ```
   [edit protocols]
   ```



```
user@switch# set iccp peer 3.3.3.2 session-establishment-hold-time 50
```

5. (Optional) Configure the backup IP address to be used for backup liveness detection on both Switch A and Switch B.

NOTE: By default, backup liveness detection is not enabled. Configuring a backup IP address helps achieve sub-second traffic loss during a MC-LAG peer reboot.

Switch A:

```
[edit protocols]
user@switch# set iccp peer 3.3.3.1 backup-liveness-detection backup-peer-ip 10.207.64.233
```

Switch B:

```
[edit protocols]
user@switch# set iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.232
```

6. Configure Layer 3 connectivity between the MC-LAG peers on both Switch A and Switch B using the original CLI.

```
[edit vlans]
user@switch# set v500 vlan-id 500
[edit vlans]
user@switch# set v500 l3-interface vlan.500
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching port-mode trunk vlan members
v500
```

7. Configure Layer 3 connectivity between the MC-LAG peers on both Switch A and Switch B using ELS.

```
[edit vlans]
user@switch# set v500 vlan-id 500
[edit vlans]
user@switch# set v500 l3-interface irb.500
[edit interfaces]
user@switch# set ae0 unit 0 family ethernet-switching interface-mode trunk vlan members
v500
```


Step-by-Step Procedure

To enable the MC-LAG interface:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Enable LACP on the MC-LAG interface on Switch A and Switch B.

   NOTE: At least one end needs to be active. The other end can be either active or passive.

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options lacp active
   ```
2. Specify the same multichassis aggregated Ethernet identification number on both MC-LAG peers on Switch A and Switch B.

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae mc-ae-id 3
   ```
3. Specify the same service ID on Switch A and Switch B.

   ELS:

   ```
   [edit]
   user@switch# set switch-options service-id 10
   ```
4. Specify a unique chassis ID for the MC-LAG on the MC-LAG peers on Switch A and Switch B.

   Switch A:

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae chassis-id 0
   ```
   Switch B:

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae chassis-id 1
   ```
5. Specify the operating mode of the MC-LAG on both Switch A and Switch B.

   NOTE: Only active-active mode is supported at this time.

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae mode active-active
   ```
6. Specify the status control for MC-LAG on Switch A and Switch B.

   NOTE: You must configure status control on both Switch A and Switch B hosting the MC-LAG. If one peer is in active mode, the other must be in standby mode.

   Switch A:

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae status-control active
```

Switch B:

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae status-control standby
```

7. Specify the number of seconds by which the bring-up of the MC-AE interface should be deferred after you reboot Switch A and Switch B.

NOTE: The recommended value for maximum VLAN configuration (for example, 4,000 VLANS) is 240 seconds. If IGMP snooping is enabled on all of the VLANs, the recommended value is 420 seconds.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae init-delay-time 240
```

8. Specify the same LACP system ID for the MC-LAG on Switch A and Switch B.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options lacp system-ID 00:01:02:03:04:05
```

9. Specify the same LACP administration key on both Switch A and Switch B.

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options lacp admin-key 3
```

10. Enable a VLAN on the MC-LAG on Switch A and Switch B using the original CLI.

```
[edit interfaces]
user@switch# set ae1 unit 0 family ethernet-switching port-mode trunk
[edit]
user@switch# set vlans v100 vlan-id 100
[edit interfaces]
user@switch# set ae1 unit 0 family ethernet-switching vlan members v100
```

11. Enable a VLAN on the MC-LAG on Switch A and Switch B using ELS.

```
[edit interfaces]
user@switch# set ae1 unit 0 family ethernet-switching interface-mode trunk
[edit]
user@switch# set vlans v100 vlan-id 100
[edit interfaces]
user@switch# set ae1 unit 0 family ethernet-switching vlan members v100
```

12. Enable VRRP on the MC-LAG on Switch A and Switch B:

    - Create a routed VLAN interface (RVI), assign a virtual IP address that is shared between each switch in the VRRP group, and assign an individual IP address for each switch in the VRRP group:

      Switch A:

      ```
      [edit interfaces]
      user@switch# set vlan unit 100 family inet address 100.1.1.11/24 vrrp-group 1
      virtual-address 100.1.1.1
      ```

      Switch B:

      ```
      [edit interfaces]
      user@switch# set vlan unit 100 family inet address 100.1.1.10/24 vrrp-group 1
      virtual-address 100.1.1.1
      ```

    - Assign the priority for each switch in the VRRP group:

NOTE: The switch configured with the highest priority is the master.

Switch A:

```
[edit interfaces]
user@switch# set vlan unit 100 family inet address 100.1.1.11/24 vrrp-group 1 priority 200
```

Switch B:

```
[edit interfaces]
user@switch# set vlan unit 100 family inet address 100.1.1.10/24 vrrp-group 1 priority 150
```

- Enable the switch to accept all packets destined for the virtual IP address if it is the master in the VRRP group:

  Switch A:

```
[edit interfaces]
user@switch# set vlan unit 100 family inet address 100.1.1.11/24 vrrp-group 1 accept-data
```

  Switch B:

```
[edit interfaces]
user@switch# set vlan unit 100 family inet address 100.1.1.10/24 vrrp-group 1 accept-data
```

- Configure Layer 3 connectivity between Switch A and Switch B.

```
[edit interfaces]
user@switch# set vlans v100 l3-interface vlan.100
```

13. Enable VRRP on the MC-LAG on Switch A and Switch B using ELS:

- Create a routed VLAN interface (RVI), assign a virtual IP address that is shared between each switch in the VRRP group, and assign an individual IP address for each switch in the VRRP group:

  Switch A:

```
[edit interfaces]
user@switch# set irb unit 100 family inet address 100.1.1.11/24 vrrp-group 1 virtual-address
100.1.1.1
```

  Switch B:

```
[edit interfaces]
user@switch# set irb unit 100 family inet address 100.1.1.10/24 vrrp-group 1 virtual-address
100.1.1.1
```

- Assign the priority for each switch in the VRRP group:

NOTE: The switch configured with the highest priority is the master.

  Switch A:

```
[edit interfaces]
user@switch# set irb unit 100 family inet address 100.1.1.11/24 vrrp-group 1 priority 200
```

  Switch B:

```
[edit interfaces]
user@switch# set irb unit 100 family inet address 100.1.1.10/24 vrrp-group 1 priority 150
```

- Enable the switch to accept all packets destined for the virtual IP address if it is the master in the VRRP group:

  Switch A:

  ```
  [edit interfaces]
  user@switch# set irb unit 100 family inet address 100.1.1.11/24 vrrp-group 1 accept-data
  ```

  Switch B:

  ```
  [edit interfaces]
  user@switch# set irb unit 100 family inet address 100.1.1.10/24 vrrp-group 1 accept-data
  ```

- Configure Layer 3 connectivity between Switch A and Switch B.

  ```
  [edit interfaces]
  user@switch# set irb v100 l3-interface irb.100
  ```

Step-by-Step Procedure

To enabled RSTP:

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Enable RSTP globally on all interfaces on Switch A and Switch B.

   ```
   [edit]
   user@switch# set protocols rstp interface all mode point-to-point
   ```

2. Disable RSTP on the ICL-PL interfaces on Switch A and Switch B:

   ```
   [edit]
   user@switch# set protocols rstp interface ae0.0 disable
   ```

3. Configure the MC-LAG interfaces as edge ports on Switch A and Switch B.

   NOTE: The ae1 interface is a downstream interface. This is why RSTP and bpdu-block-on-edge need to be configured.

   ```
   [edit]
   user@switch# set protocols rstp interface ae1.0 edge
   ```

4. Enable BPDU blocking on all interfaces except for the ICL-PL interfaces on Switch A and Switch B.

   NOTE: The ae1 interface is a downstream interface. This is why RSTP and bpdu-block-on-edge need to be configured.

   ```
   [edit]
   user@switch# set protocols rstp bpdu-block-on-edge
   ```

Results

Display the results of the configuration on Switch A using the original CLI.

```
chassis {
  aggregated-devices {
    ethernet {
      device-count 2;
    }
  }
}
  interfaces {
    xe-0/0/12 {
      ether-options {
        802.3ad ae0;
      }
    }
    xe-0/0/13 {
      ether-options {
        802.3ad ae0;
      }
    }
    xe-0/0/44 {
      ether-options {
        802.3ad ae1;
      }
    }
    ae0 {
      unit 0 {
        family ethernet-switching {
          port-mode trunk;
          vlan {
            members v500;
          }
        }
      }
    }
    ae1 {
      aggregated-ether-options {
        lacp {
          active;
          system-id 00:01:02:03:04:05;
          admin-key 3;
        }
        mc-ae {
          mc-ae-id 3;
          chassis-id 0;
          mode active-active;
          status-control active;
          init-delay-time 240;
        }
      }
      unit 0 {
        family ethernet-switching {
          port-mode trunk;
          vlan {
            members v100;
          }
        }
      }
```



```
    }
    vlan {
      unit 100 {
        family inet {
          address 100.1.1.11/24 {
            vrrp-group 1 {
              virtual-address 100.1.1.1;
              priority 200;
              accept-data;
            }
          }
        }
      }
      unit 500 {
        family inet {
          address 3.3.3.2/24;
        }
      }
    }
  }
  protocols {
    iccp {
      local-ip-addr 3.3.3.2;
      peer 3.3.3.1 {
        session-establishment-hold-time 50;
        backup-liveness-detection {
          backup-peer-ip 10.207.64.233;
        }
        liveness-detection {
          minimum-receive-interval 60;
          transmit-interval {
            minimum-interval 60;
          }
        }
      }
    }
    rstp {
      interface ae0.0 {
        disable;
      }
      interface ae1.0 {
        edge;
      }
      interface all {
        mode point-to-point;
      }
      bpdu-block-on-edge;
    }
  }
  multi-chassis {
    multi-chassis-protection 3.3.3.1 {
      interface ae0;
    }
  }
  vlans {
    v100 {
```

```
            vlan-id 100;
            l3-interface vlan.100;
        }
        v500 {
            vlan-id 500;
            l3-interface vlan.500;
        }
    }
```

Display the results of the configuration on Switch A using ELS.

```
chassis {
    aggregated-devices {
        ethernet {
            device-count 2;
        }
    }
}
    interfaces {
        xe-0/0/12 {
            ether-options {
                802.3ad ae0;
            }
        }
        xe-0/0/13 {
            ether-options {
                802.3ad ae0;
            }
        }
        xe-0/0/44 {
            ether-options {
                802.3ad ae1;
            }
        }
        ae0 {
            unit 0 {
                family ethernet-switching {
                    interface-mode trunk;
                    vlan {
                        members v500;
                    }
                }
            }
        }
        ae1 {
            aggregated-ether-options {
                lacp {
                    active;
                    system-id 00:01:02:03:04:05;
                    admin-key 3;
                }
                mc-ae {
                    mc-ae-id 3;
                    chassis-id 0;
                    mode active-active;
                    status-control active;
```



```
            init-delay-time 240;
        }
    }
    unit 0 {
        family ethernet-switching {
            interface-mode trunk;
            vlan {
                members v100;
            }
        }
    }
}
vlan {
    unit 100 {
        family inet {
            address 100.1.1.11/24 {
                vrrp-group 1 {
                    virtual-address 100.1.1.1;
                    priority 200;
                    accept-data;
                }
            }
        }
    }
    unit 500 {
        family inet {
            address 3.3.3.2/24;
        }
    }
}
}
protocols {
    iccp {
        local-ip-addr 3.3.3.2;
        peer 3.3.3.1 {
            session-establishment-hold-time 50;
            backup-liveness-detection {
                backup-peer-ip 10.207.64.233;
            }
            liveness-detection {
                minimum-receive-interval 60;
                transmit-interval {
                    minimum-interval 60;
                }
            }
        }
    }
    rstp {
        interface ae0.0 {
            disable;
        }
        interface ae1.0 {
            edge;
        }
        interface all {
            mode point-to-point;
```

```
        }
        bpdu-block-on-edge;
      }
    }
    multi-chassis {
      multi-chassis-protection 3.3.3.1 {
        interface ae0;
      }
    }
    switch-options {
      service-id 10;
    }
    vlans {
      v100 {
        vlan-id 100;
        l3-interface irb.100;
      }
      v500 {
        vlan-id 500;
        l3-interface irb.500;
      }
    }
```

Display the results of the configuration on Switch B using the original CLI.

```
chassis {
  aggregated-devices {
    ethernet {
      device-count 2;
    }
  }
}
  interfaces {
    xe-0/0/12 {
      ether-options {
        802.3ad ae0;
      }
    }
    xe-0/0/13 {
      ether-options {
        802.3ad ae0;
      }
    }
    xe-0/0/44 {
      ether-options {
        802.3ad ae1;
      }
    }
    ae0 {
      unit 0 {
        family ethernet-switching {
          port-mode trunk;
          vlan {
            members v500;
          }
        }
```



```
    }
  }
  ae1 {
    aggregated-ether-options {
      lacp {
        active;
        system-id 00:01:02:03:04:05;
        admin-key 3;
      }
      mc-ae {
        mc-ae-id 3;
        chassis-id 1;
        mode active-active;
        status-control active;
        init-delay-time 240;
      }
    }
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members v100;
        }
      }
    }
  }
  vlan {
    unit 100 {
      family inet {
        address 100.1.1.10/24 {
          vrrp-group 1 {
            virtual-address 100.1.1.1;
            priority 200;
            accept-data;
          }
        }
      }
    }
    unit 500 {
      family inet {
        address 3.3.3.1/24;
      }
    }
  }
}
protocols {
  iccp {
    local-ip-addr 3.3.3.1;
    peer 3.3.3.2 {
      session-establishment-hold-time 50;
      backup-liveness-detection {
        backup-peer-ip 10.207.64.233;
      }
      liveness-detection {
        minimum-receive-interval 60;
        transmit-interval {
```

```
                minimum-interval 60;
              }
            }
          }
        }
        rstp {
          interface ae0.0 {
            disable;
          }
          interface ae1.0 {
            edge;
          }
          interface all {
            mode point-to-point;
          }
          bpdu-block-on-edge;
        }
      }
      multi-chassis {
        multi-chassis-protection 3.3.3.2 {
          interface ae0;
        }
      }
      vlans {
        v100 {
          vlan-id 100;
          l3-interface vlan.100;
        }
        v500 {
          vlan-id 500;
          l3-interface vlan.500;
        }
      }
```

Display the results of the configuration on Switch B using ELS.

```
chassis {
  aggregated-devices {
    ethernet {
      device-count 2;
    }
  }
}
  interfaces {
    xe-0/0/12 {
      ether-options {
        802.3ad ae0;
      }
    }
    xe-0/0/13 {
      ether-options {
        802.3ad ae0;
      }
    }
    xe-0/0/44 {
      ether-options {
```



```
802.3ad ae1;
}
}
ae0 {
unit 0 {
family ethernet-switching {
interface-mode trunk;
vlan {
members v500;
}
}
}
}
ae1 {
aggregated-ether-options {
lacp {
active;
system-id 00:01:02:03:04:05;
admin-key 3;
}
mc-ae {
mc-ae-id 3;
chassis-id 1;
mode active-active;
status-control active;
init-delay-time 240;
}
}
unit 0 {
family ethernet-switching {
interface-mode trunk;
vlan {
members v100;
}
}
}
}
vlan {
unit 100 {
family inet {
address 100.1.1.10/24 {
vrrp-group 1 {
virtual-address 100.1.1.1;
priority 200;
accept-data;
}
}
}
}
unit 500 {
family inet {
address 3.3.3.1/24;
}
}
}
}
```

```
protocols {
   iccp {
      local-ip-addr 3.3.3.1;
      peer 3.3.3.2 {
         session-establishment-hold-time 50;
         backup-liveness-detection {
            backup-peer-ip 10.207.64.233;
         }
         liveness-detection {
            minimum-receive-interval 60;
            transmit-interval {
               minimum-interval 60;
            }
         }
      }
   }
   rstp {
      interface ae0.0 {
         disable;
      }
      interface ae1.0 {
         edge;
      }
      interface all {
         mode point-to-point;
      }
      bpdu-block-on-edge;
   }
}
multi-chassis {
   multi-chassis-protection 3.3.3.2 {
      interface ae0;
   }
}
switch-options {
   service-id 10;
}
vlans {
   v100 {
      vlan-id 100;
      l3-interface irb.100;
   }
   v500 {
      vlan-id 500;
      l3-interface irb.500;
   }
}
```

Verification

To verify that the MC-LAG group has been created and is working properly, perform these tasks:

- Verifying That ICCP Is Working on Switch A on page 2005
- Verifying That ICCP Is Working on Switch B on page 2005

Verifying That ICCP Is Working on Switch A

Purpose Verify that ICCP is running on Switch A.

Action

```
[edit]
user@switch# show iccp
Redundancy Group Information for peer 3.3.3.1
  TCP Connection       : Established
  Liveliness Detection : Up

 Client Application: MCSNOOPD

 Client Application: eswd
```

Meaning This output shows that the TCP connection between the peers hosting the MC-LAG is up, liveness detection is up, and MCSNOOPD and ESWD client applications are running.

Verifying That ICCP Is Working on Switch B

Purpose Verify that ICCP is running on Switch B.

Action **show iccp**

```
[edit]
user@switch# show iccp
Redundancy Group Information for peer 3.3.3.2
  TCP Connection       : Established
  Liveliness Detection : Up

 Client Application: MCSNOOPD

 Client Application: eswd
```

Meaning This output shows that the TCP connection between the peers hosting the MC-LAG is up, liveness detection is up, and MCSNOOPD and ESWD client applications are running.

Verifying That LACP Is Active on Switch A

Purpose Verify that LACP is active on Switch A.

Action

```
[edit]
user@switch# show lacp interfaces
Aggregated interface: ae1
    LACP state:       Role   Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity
      xe-0/0/46      Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
      xe-0/0/46    Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active
    LACP protocol:       Receive State  Transmit State          Mux State
      xe-0/0/46                Current   Fast periodic Collecting distributing
```

Meaning This output shows that Switch A is participating in LACP negotiation.

Verifying That LACP Is Active on Switch B

Purpose Verify that LACP is active on Switch B

Action

```
[edit]
user@switch# show lacp interfaces

Aggregated interface: ae1
    LACP state:       Role   Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity
      xe-0/0/44      Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
      xe-0/0/44    Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active
    LACP protocol:       Receive State  Transmit State          Mux State
      xe-0/0/44                Current   Fast periodic Collecting distributing
```

Meaning This output shows that Switch B is participating in LACP negotiation.

Verifying That the MC-AE and ICL-PL Interfaces Are Up on Switch A

Purpose Verify that the MC-AE and ICL-PL interfaces are up on Switch A.

Action

```
[edit]
user@switch# show interfaces mc-ae
Member Link                  : ae1
 Current State Machine's State: mcae active state
 Local Status                 : active
 Local State                  : up
 Peer Status                  : active
 Peer State                   : up
     Logical Interface        : ae1.0
     Topology Type            : bridge
     Local State              : up
     Peer State               : up
     Peer Ip/MCP/State        : 3.3.3.1 ae0.0 up
```

Meaning This output shows that the MC-AE interface on Switch A is up and active.

Verifying That the MC-AE and ICL-PL Interfaces Are Up on Switch B

Purpose Verify that the MC-AE and ICL-PL interfaces are up on Switch B.

Action

```
[edit]
user@switch# show interfaces mc-ae
Member Link                   : ae1
 Current State Machine's State: mcae active state
 Local Status                 : active
 Local State                  : up
 Peer Status                  : active
 Peer State                   : up
     Logical Interface        : ae1.0
     Topology Type            : bridge
     Local State              : up
     Peer State               : up
     Peer Ip/MCP/State        : 3.3.3.2 ae0.0 up
```

Meaning This output shows that the MC-AE interface on Switch B is up and active.

Verifying that MAC Learning Is Occurring on Switch A

Purpose Verify that MAC learning is working on Switch A.

Action

```
[edit]
user@switch# show ethernet-switching table
Ethernet-switching table: 6 entries, 1 learned, 0 persistent entriesC
  VLAN             MAC address       Type         Age Interfaces
  v100             *                 Flood          - All-members
  v100             00:00:5e:00:01:01 Static         - Router
  v100             78:fe:3d:5a:07:42 Static         - Router
  v100             78:fe:3d:5b:ad:c2 Learn(R)        0 ae0.0
  v500             *                 Flood          - All-members
  v500             78:fe:3d:5a:07:42 Static         - Router
```

Meaning The output shows two static MAC address in VLAN v100 and one static MAC address in VLAN v500. These addresses belong to the Layer 3 RVI addresses on both Switch A and Switch B that you configured in the MC-LAG. The ICL-PL interface configured on the VRRP master member learned the VLAN v100 Learn (R) MAC address of the VRRP backup member.

Verifying that MAC Learning Is Occurring on Switch B

Purpose Verify that MAC learning is working on Switch B.

Action

```
[edit]
user@switch# show ethernet-switching table
Ethernet-switching table: 7 entries, 1 learned, 0 persistent entries
  VLAN              MAC address       Type         Age Interfaces
  v100              *                 Flood          - All-members
  v100              00:00:5e:00:01:01 Static         - Router
  v100              78:fe:3d:5a:07:42 Learn(R)        0 ae0.0
  v100              78:fe:3d:5b:ad:c2 Static         - Router
  v200              78:fe:3d:5b:ad:c2 Static         - Router
  v500              *                 Flood          - All-members
  v500              78:fe:3d:5b:ad:c2 Static         - Router
```

Meaning The output shows two static MAC address in VLAN v100 and one static MAC address in VLAN v500. These addresses belong to the Layer 3 RVI addresses on both Switch A and Switch B that you configured in the MC-LAG. The ICL-PL interface configured on the VRRP backup member learned the VLAN v100 Learn (R) MAC address of the VRRP master member.

Verifying that Switch A is the Master in the VRRP Group

Purpose Verify that Switch A is the master member in the VRRP group.

Action

```
[edit]
user@switch# show vrrp
Interface     State       Group   VR state VR Mode   Timer    Type   Address
vlan.100      up             1   master   Active      A  0.605 lcl    100.1.1.11

                                                                vip    100.1.1.1
```

Meaning The output shows that Switch A is the master member in the VRRP group.

Verifying that Switch B is the Backup Member in the VRRP Group

Purpose Verify that Switch B is the backup member in the VRRP group.

Action

```
[edit]
user@switch# show vrrp
Interface     State       Group   VR state VR Mode   Timer    Type   Address
vlan.100      up             1   backup   Active      A  0.605 lcl    100.1.1.10

                                                                vip    100.1.1.1
```

Meaning The output shows that Switch B is the backup member in the VRRP group.

Verifying that the Virtual IP Address is Attached to an Individual Address on Switch A

Action

```
[edit]
user@switch# run show interfaces terse vlan
Interface               Admin Link Proto    Local                 Remote
vlan                    up    up
vlan.100                up    up   inet     100.1.1.1/24
                                            100.1.1.11/24
vlan.500                up    up   inet     3.3.3.2/24
```

Meaning The output shows that the virtual IP address (100.1.1.1/24) is bound to the individual IP address (100.1.1.11/24) on Switch A.

Verifying that the Virtual IP Address is Attached to an Individual Address on Switch B

Action

```
[edit]
user@switch# run show interfaces terse vlan
Interface               Admin Link Proto    Local                 Remote
vlan                    up    up
vlan.100                up    up   inet     100.1.1.1/24
                                            100.1.1.10/24
vlan.500                up    up   inet     3.3.3.1/24
```

Meaning The output shows that the virtual IP address (100.1.1.1/24) is bound to the individual IP address (100.1.1.10/24) on Switch B.

Troubleshooting

Troubleshooting a LAG That Is Down

Problem The **show interfaces terse** command shows that the MC-LAG is **down**

Solution Check the following:

- Verify that there is no configuration mismatch.
- Verify that all member ports are up.
- Verify that the MC-LAG is part of family Ethernet switching (Layer 2 LAG).
- Verify that the MC-LAG member is connected to the correct MC-LAG member at the other end.

Related Documentation

- Understanding Multichassis Link Aggregation on page 1853
- Configuring Multichassis Link Aggregation on page 2022

Example: Configuring Redundant Trunk Links for Faster Recovery

NOTE: This example uses Junos OS for EX Series switches or QFX Series with support for the Enhanced Layer 2 Software (ELS) configuration style. If your EX Series switch runs software that does not support ELS, see *Example: Configuring Redundant Trunk Links for Faster Recovery*. For ELS details, see “Getting Started with Enhanced Layer 2 Software” on page 58.

You can manage network convergence by configuring both a primary link and a secondary link on a switch; this is called a redundant trunk group (RTG). If the primary link in a redundant trunk group fails, it passes its known MAC address locations to the secondary link, which automatically takes over after one minute.

This example describes how to create a redundant trunk group with a primary and a secondary link:

Requirements

This example uses the following hardware and software components:

- Two EX Series or QFX Series distribution switches
- One EX Series or QFX Series access switch
- The appropriate software release for your platform:
  - For EX Series switches: Junos OS Release 13.2X50-D10 or later
  - For the QFX Series: Junos OS Release 13.2X50-D15 or later

Before you configure the redundant trunk links network on the access and distribution switches, be sure you have:

- Configured interfaces ge-0/0/9 and ge-0/0/10 on the access switch, Switch 3, as trunk interfaces. .
- Configured one trunk interface on each distribution switch, Switch 1 and Switch 2.
- Connected the three switches as shown in the topology for this example (see Figure 32 on page 2012).

Overview and Topology

In a typical enterprise network composed of distribution and access layers, a redundant trunk link provides a simple solution for trunk interface network recovery. When a trunk interface fails, data traffic is routed to another trunk interface after one minute, thereby keeping network convergence time to a minimum.

This example shows the configuration of a redundant trunk group that includes one primary link (and its interface) and one unspecified link (and its interface) that serves as the secondary link.

A second type of redundant trunk group, not illustrated in the example, consists of two unspecified links (and their interfaces); in this case, neither of the links is primary. The software selects an active link by comparing the port numbers of the two links and activating the link with the higher port number. For example, if the two link interfaces use interfaces ge-0/1/0 and ge-0/1/1, the software activates ge-0/1/1. (In the interface names, the final number is the port number.)

The two links in a redundant trunk group generally operate the same way, whether they are configured as primary/unspecified or unspecified/unspecified. Data traffic initially passes through the active link but is blocked on the inactive link. While data traffic is blocked on the secondary link, note that Layer 2 control traffic is still permitted if the link is active. For example, an LLDP session can be run between two switches on the secondary link. If the active link either goes down or is disabled administratively, it broadcasts a list of its known MAC addresses for data traffic; the other link immediately picks up and adds the MAC addresses to its address table, becomes active, and begins forwarding traffic.

The one difference in operation between the two types of redundant trunk groups occurs when a primary link is active, goes down, is replaced by the secondary link, and then reactivates. When a primary link is re-enabled like this while the secondary link is active, the primary link waits 2 minutes (you can change the time interval by using the preempt cutover timer to accommodate your network) and then takes over as the active link. In other words, the primary link has priority and is always activated if it is available. This differs from the behavior of two unspecified links, both of which act as equals. Because the unspecified links are equal, the active link remains active until it either goes down or is disabled administratively; this is the only time that the other unspecified link learns the MAC addresses and immediately becomes active.

The example given here illustrates a primary/unspecified configuration for a redundant trunk group because that configuration gives you more control and is more commonly used.

NOTE: **Rapid Spanning Tree Protocol (RSTP) is enabled by default on the switches to create a loop-free topology, but an interface is not allowed to be in both a redundant trunk group and in a spanning-tree protocol topology at the same time. You will need to disable RSTP on the two distribution switches in the example, Switch 1 and Switch 2. Spanning-tree protocols can, however, continue operating in other parts of the network—for example, between the distribution switches and also in links between distribution switches and the enterprise core.**

Figure 32 on page 2012 displays an example topology containing three switches. Switch 1 and Switch 2 make up the distribution layer, and Switch 3 makes up the access layer.

Switch 3 is connected to the distribution layer through trunk interfaces ge-0/0/9.0 (Link 1) and ge-0/0/10.0 (Link 2).

Table 175 on page 2012 lists the components used in this redundant trunk group.

Because RSTP and RTGs cannot operate simultaneously on a switch, you disable RSTP on Switch 1 and Switch 2 in the first configuration task, and you disable RSTP on Switch 3 in the second task.

The second configuration task creates a redundant trunk group called example 1 on Switch 3. The trunk interfaces ge-0/0/9.0 and ge-0/0/10.0 are the two links configured in the second configuration task. You configure the trunk interface ge-0/0/9.0 as the primary link. You configure the trunk interface ge-0/0/10.0 as an unspecified link, which becomes the secondary link by default.

Figure 32: Topology for Configuring the Redundant Trunk Links

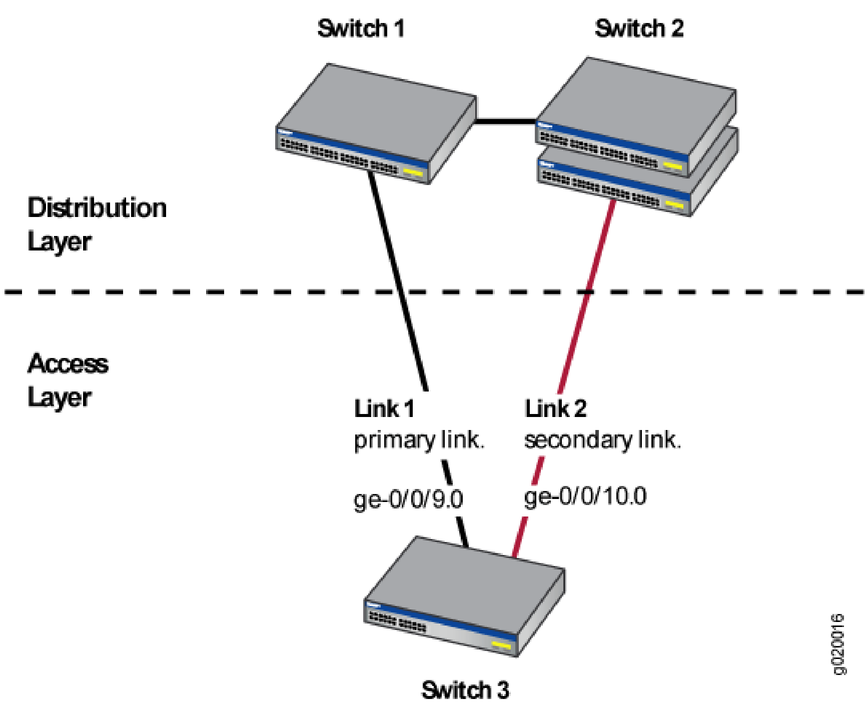


Table 175: Components of the Redundant Trunk Link Topology

Property	Settings
Switch hardware	• Switch 1–1 EX Series or QFX Series distribution switch • Switch 2–1 EX Series or QFX Series distribution switch • Switch 3–1 EX Series or QFX Series access switch
Trunk interfaces	On Switch 3 (access switch): ge-0/0/9.0 and ge-0/0/10.0
Redundant trunk group	example1

Disabling RSTP on Switches 1 and 2

To disable RSTP on Switch 1 and Switch 2, perform this task on each switch:

CLI Quick Configuration

To quickly disable RSTP on Switch 1 and Switch 2, copy the following command and paste it into each switch terminal window:

```
[edit]
set protocols rstp disable
```

Step-by-Step Procedure

To disable RSTP on Switch 1 and Switch 2:

1. Disable RSTP on Switch 1 and Switch 2:

   ```
   [edit]
   user@switch# set protocols rstp disable
   ```

Results

Check the results of the configuration:

```
[edit]
user@switch# show
protocols {
  rstp {
    disable;
  }
}
```

Configuring Redundant Trunk Links on Switch 3

To configure redundant trunk links on Switch 3, perform this task:

CLI Quick Configuration

To quickly configure the redundant trunk group example1 on Switch 3, copy the following commands and paste them into the switch terminal window:

```
[edit]
set protocols rstp disable
set switch-options redundant-trunk-group group example1 interface ge-0/0/9.0 primary
set switch-options redundant-trunk-group group example1 interface ge-0/0/10.0
set redundant-trunk-group group example1 preempt-cutover-timer 60
```

Step-by-Step Procedure

Configure the redundant trunk group example1 on Switch 3.

1. Turn off RSTP:

   ```
   [edit]
   user@switch# set protocols rstp disable
   ```

2. Name the redundant trunk group example1 while configuring trunk interface ge-0/0/9.0 as the primary link and ge-0/0/10 as an unspecified link to serve as the secondary link:

   ```
   [edit switch-options]
   user@switch#  set redundant-trunk-group group example1 interface ge-0/0/9.0 primary
   user@switch#  set redundant-trunk-group group example1 interface ge-0/0/10.0
   ```

3. (Optional) Change the time interval (from the default 120 seconds) that a re-enabled primary link waits to take over for an active secondary link:

   ```
   [edit switch-options]
   user@switch#  set redundant-trunk-group group example1 preempt-cutover-timer 60
   ```

Results Check the results of the configuration:

```
[edit]
user@switch# show
switch-options
  redundant-trunk-group {
    group example1 {
      preempt-cutover-timer 60;
      interface ge-0/0/9.0 {
        primary;
      }
      interface ge-0/0/10.0;
    }
  }
protocols {
  rstp {
    disable;
  }
}
```

Verification

To confirm that the configuration is set up correctly, perform this task:

- Verifying That a Redundant Trunk Group Was Created on page 2014

Verifying That a Redundant Trunk Group Was Created

Purpose Verify that the redundant trunk group example1 has been created on Switch 1 and that trunk interfaces are members of the redundant trunk group.

Action List all redundant trunk groups configured on the switch:

```
user@switch> show redundant-trunk-group
Group      Interface    State      Time of last flap          Flap
name                                                          count

example1   ge-0/0/9.0   Up/Pri     Never                        0
           ge-0/0/10.0  Up         Never                        0
```

Meaning The **show redundant-trunk-group** command lists all redundant trunk groups configured on the switch as well as the interface names and their current states (up or down for an unspecified link, and up or down and primary for a primary link). For this configuration example, the output shows that the redundant trunk group example1 is configured on the switch. The **Up** beside the interfaces indicates that both link cables are physically connected. The **Pri** beside trunk interface ge-0/0/9.0 indicates that it is configured as the primary link.

Related Documentation

- Understanding Redundant Trunk Links on page 1885

Configuration Tasks

Configuring Gigabit and 10-Gigabit Ethernet Interfaces

QFX Series products include a factory default configuration that:

- Enables all 10-Gigabit Ethernet network interfaces on the switch
- Sets a default port mode (access)
- Sets default link settings
- Specifies a logical unit (**unit 0**) and assigns it to **family ethernet-switching**
- Configures Storm Control on all 10-Gigabit Ethernet network interfaces
- Provides basic Rapid Spanning Tree Protocol (RSTP) and Link Layer Discovery Protocol (LLDP) configuration

This topic describes:

Configuring Port Mode

If you are connecting a switch to other switches and to routers on the LAN, you need to assign the interface to a logical port and you need to configure the logical port as a trunk port.

To configure a Gigabit Ethernet or 10-Gigabit interface for trunk port mode:

```
[edit]
user@switch# set interfaces interface-name unit logical-unit-number family ethernet-switching
port-mode trunk
```

Configuring the Link Settings for Gigabit Ethernet and 10-Gigabit Ethernet Interfaces

QFX Series products include a factory default configuration that enables Gigabit Ethernet and 10-Gigabit Ethernet and interfaces with applicable link settings.

The following default configurations are available on Gigabit Ethernet interfaces:

- The speed for Gigabit Ethernet interfaces is set to 1000 Mbps by default.
- Gigabit Ethernet interfaces operate in full-duplex mode by default, and autonegotiation is supported. If you want to disable autonegotation, you need to manually set the speed to 1g.

The following default configurations are available on 10-Gigabit Ethernet interfaces:

- The speed for 10-Gigabit Ethernet interfaces is set to 10 Gbps by default. The speed cannot be configured.
- 10-Gigabit Ethernet interfaces operate in full-duplex mode by default. Autonegotiation is not supported.

The **ether-options** statement enables you to modify the following options:

- **802.3ad**—Specify an aggregated Ethernet bundle for both Gigabit Ethernet and 10-Gigabit Ethernet interfaces.
- **autonegotiation**—Enable or disable autonegotation of flow control, link mode, and speed for Gigabit Ethernet interfaces.
- **link-mode**—Specify **full-duplex**, **half-duplex**, or **automatic** for Gigabit Ethernet interfaces.
- **loopback**—Enable or disable a loopback interface for both Gigabit Ethernet and 10-Gigabit Ethernet interfaces.

To set **ether-options** for both Gigabit Ethernet and 10-Gigabit Ethernet interfaces:

```
[edit]
user@switch# set interfaces interface-name ether-options
```

Configuring the IP Options

To specify an IP address for the logical unit:

```
[edit]
user@switch# set interfaces interface-name unit logical-unit-number family inet address ip-address
```

Related Documentation

- Monitoring Interface Status and Traffic on page 309
- show interfaces xe on page 2238
- *show interfaces ge-*

- Understanding Interface Naming Conventions on page 1845

Configuring Aggregated Ethernet LACP

For aggregated Ethernet interfaces on the QFX Series, you can configure the Link Aggregation Control Protocol (LACP). LACP is one method of bundling several physical interfaces to form one logical interface. You can configure aggregated Ethernet with or without LACP enabled.

Before you configure LACP, be sure you have configured the aggregated Ethernet bundles—also known as link aggregation groups (LAGs).

When LACP is enabled, the local and remote sides of the aggregated Ethernet links exchange protocol data units (PDUs), containing information about the state of the link. You can configure Ethernet links to actively transmit PDUs, or you can configure the links to passively transmit them, sending out LACP PDUs only when they receive them from another link. One side of the link must be configured as **active** for the link to be up.

NOTE: **Do not add LACP to a LAG if the remote end of the LAG link is a security device, unless the security device supports LACP. Security devices often do not support LACP because they require a deterministic configuration.**

To configure LACP:

1. Enable the LACP mode:

   ```
   [edit interfaces]
   user@switch# set aex aggregated-ether-options lacp mode
   ```

   For example, to specify the mode as active, execute the following command:

   ```
   [edit interfaces]
   user@switch# set aex aggregated-ether-options lacp active
   ```
2. Specify the interval and speed at which the interfaces send LACP packets:

   ```
   [edit interfaces]
   user@switch# set aex aggregated-ether-options lacp periodic interval
   ```

   For example, to specify the interval as fast, execute the following command:

   ```
   [edit interfaces]
   user@switch# set aex aggregated-ether-options lacp periodic fast
   ```

Related Documentation

- Verifying the Status of a LAG Interface on page 2148
- Verifying That LACP Is Configured Correctly and Bundle Members Are Exchanging LACP Protocol Packets on page 2149
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896

  Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch on page 1900
- **show lacp statistics interfaces (View) on page 2261**

Configuring Ethernet Loopback Capability

To place an interface in loopback mode, include the **loopback** statement:

```
loopback;
```

To return to the default—that is, to disable loopback mode—delete the **loopback** statement from the configuration:

```
[edit]
user@switch# delete interfaces interface-name ether-options loopback
```

To explicitly disable loopback mode, include the **no-loopback** statement:

```
no-loopback;
```

You can include the **loopback** and **no-loopback** statements at the following hierarchy levels:

- **[edit interfaces *interface-name* aggregated-ether-options]**
- **[edit interfaces *interface-name* ether-options]**

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015

Configuring Interfaces for Uplink Failure Detection

You can configure uplink failure detection on the QFX Series to help ensure balanced traffic flow. Using this feature, switches can monitor and detect link failure on uplink interfaces and can propagate the failure information to downlink interfaces, so that servers connected to those downlinks can switch over to secondary interfaces.

Follow these configuration guidelines:

- Configure an interface in only one group.
- Configure a maximum of eight groups for each switch.
- Configure a maximum of eight uplinks to monitor and a maximum of 48 downlinks to disable in each group.
- Configure physical links and logical links in separate groups.

To configure uplink failure detection on a switch:

1. Specify a name for an uplink failure detection group:

   ```
   [edit protocols]
   user@switch# set uplink-failure-detection group group-name
   ```
2. Add an uplink interface to the group:

   ```
   [edit protocols]
   user@switch# set uplink-failure-detection group group-name link-to-monitor interface-name
   ```
3. Repeat Step 2 for each uplink interface you add to the group.
4. Add a downlink interface to the group:

```
[edit protocols]
user@switch# set uplink-failure-detection group group-name link-to-disable interface-name
```

5. Repeat Step 4 for each downlink interface you add to the group.

NOTE: After you have configured an uplink failure detection group, use the **show uplink-failure-detection** ***group (Uplink Failure Detection) group-name*** command to verify that all interfaces in the group are up. If the interfaces are down, uplink failure detection does not work.

Related Documentation

- Overview of Uplink Failure Detection on page 1841
- Example: Configuring Interfaces for Uplink Failure Detection on page 1891
- *Verifying That Uplink Failure Detection Is Working Correctly*

Configuring a Layer 3 Logical Interface

QFX Series systems use Layer 3 logical interfaces to divide a physical interface into multiple logical interfaces, each corresponding to a VLAN. Layer 3 logical interfaces route traffic between subnets.

To configure Layer 3 logical interfaces, enable VLAN tagging and partition one or more physical ports into multiple logical interfaces, each corresponding to a VLAN ID.

Before you begin, make sure you set up your VLANs. See "Configuring VLANs" on page 1534.

To configure Layer 3 logical interfaces:

1. Enable VLAN tagging:

```
[edit interfaces interface-name]
user@switch# set vlan-tagging
```

2. Bind each VLAN ID to a logical interface:

```
[edit interfaces interface-name]
user@switch# set unit logical-unit-number vlan-id vlan-id-number
```

Related Documentation

- Understanding Layer 3 Logical Interfaces on page 1851
- Verifying That Layer 3 Logical Interfaces Are Working on page 2148

Configuring Link Aggregation

Use the link aggregation feature to aggregate one or more links to form a virtual link or aggregation group. The MAC client can treat this virtual link as if it were a single link. Link aggregation increases bandwidth, provides graceful degradation as failure occurs, and increases link availability.

NOTE: An interface with an already configured IP address cannot form part of the aggregation group.

Creating an Aggregated Ethernet Interface

To create an aggregated Ethernet interface:

1. Specify the number of aggregated Ethernet interfaces to be created:

   ```
   [edit chassis]
   user@switch# set aggregated-devices interfaces device-count device-count
   ```

   For example, to specify 5:

   ```
   [edit chassis]
   user@switch#  set aggregated-devices interfaces device-count
   ```
2. Specify the minimum number of links for the aggregated Ethernet interface (ae*x*), that is, the defined bundle, to be labeled “up”:

   NOTE: By default only one link must be up for the bundle to be labeled “up”.

   ```
   [edit interfaces]
   user@switch# set interface-name aggregated-ether-options minimum-links minimum-links
   ```

   For example, to specify 5:

   ```
   [edit interfaces]
   user@switch#  set interface-name aggregated-ether-options minimum-links 5
   ```
3. Specify the link speed for the aggregated Ethernet bundle:

   ```
   [edit interfaces]
   user@switch# set interface-name aggregated-ether-options link-speed link-speed
   ```

   For example, to specify 10g:

   ```
   [edit interfaces]
   user@switch#  set interface-name aggregated-ether-options link-speed 10g
   ```
4. Specify the members to be included within the aggregated Ethernet bundle:

   ```
   [edit interfaces]
   user@switch#  set interface-name ether-options 802.3ad aex
   user@switch#  set interface-name ether-options 802.3ad aex
   ```

Configuring the VLAN Name and VLAN ID Number

```
[edit vlans]
user@switch# set vlan-name vlan-id vlan-id-number
```

For example, 100.

Configuring Aggregated Ethernet LACP

For aggregated Ethernet interfaces on the QFX Series, you can configure the Link Aggregation Control Protocol (LACP). LACP is one method of bundling several physical interfaces to form one logical interface. You can configure aggregated Ethernet with or without LACP enabled.

Before you configure LACP, be sure you have configured the aggregated Ethernet bundles—also known as link aggregation groups (LAGs).

When LACP is enabled, the local and remote sides of the aggregated Ethernet links exchange protocol data units (PDUs), containing information about the state of the link. You can configure Ethernet links to actively transmit PDUs, or you can configure the links to passively transmit them, sending out LACP PDUs only when they receive them from another link. One side of the link must be configured as **active** for the link to be up.

NOTE: Do not add LACP to a LAG if the remote end of the LAG link is a security device, unless the security device supports LACP. Security devices often do not support LACP because they require a deterministic configuration.

To configure LACP:

1. Enable the LACP mode:

   ```
   [edit interfaces]
   user@switch# set aex aggregated-ether-options lacp mode
   ```

   For example, to specify the mode as active, execute the following command:

   ```
   [edit interfaces]
   user@switch# set aex aggregated-ether-options lacp active
   ```

2. Specify the interval and speed at which the interfaces send LACP packets:

   ```
   [edit interfaces]
   user@switch# set aex aggregated-ether-options lacp periodic interval
   ```

   For example, to specify the interval as fast, execute the following command:

   ```
   [edit interfaces]
   user@switch# set aex aggregated-ether-options lacp periodic fast
   ```

Related Documentation

- Understanding Interface Naming Conventions on page 1845
- Verifying the Status of a LAG Interface on page 2148
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896

Configuring Multichassis Link Aggregation

NOTE: Multichassis Link Aggregation (MC-LAG) is supported on QFX3500 and QFX3600 standalone switches running the original CLI and QFX5100 standalone switches running Enhanced Layer 2 Software.

Multichassis link aggregation groups (MC-LAGs) enable a client device to form a logical LAG interface between two switches. An MC-LAG provides redundancy and load balancing between the two switches, multihoming support, and a loop-free Layer 2 network without running the Spanning Tree Protocol (STP).

The MC-LAG switches use the Interchassis Control Protocol (ICCP) to exchange the control information between two MC-LAG switches.

On one end of an MC-LAG is an MC-LAG client device, such as a server, that has one or more physical links in a link aggregation group (LAG). This client device does not need to detect the MC-LAG. On the other side of MC-LAG are two MC-LAG switches. Each of the switches has one or more physical links connected to a single client device. The switches coordinate with each other to ensure that data traffic is forwarded properly.

NOTE: An interface with an already configured IP address cannot form part of the aggregated Ethernet interface or multichassis aggregated Ethernet interface group.

Perform the following steps on each switch that is hosting an MC-LAG:

1. Specify the same multichassis aggregated Ethernet identification number for the MC-LAG that the aggregated Ethernet interface belongs to on each switch.

   ```
   [edit interfaces]
   user@switch# set aeX aggregated-ether-options mc-ae mc-ae-id number
   ```

   For example:

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae mc-ae-id 3
   ```
2. Specify a unique chassis ID for the MC-LAG that the aggregated Ethernet interface belongs to on each switch.

   ```
   [edit interfaces]
   user@switch# set aeX aggregated-ether-options mc-ae chassis-id number
   ```

   For example:

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae chassis-id 0
   ```
3. Specify the mode of the MC-LAG the aggregated Ethernet interface belongs to.

   NOTE: Only active-active mode is supported at this time.

   ```
   [edit interfaces]
   ```



```
user@switch# set aeX aggregated-ether-options mc-ae mode mode
```

For example:

```
[edit interfaces]
user@switch# set ae1 aggregated-ether-options mc-ae mode active-active
```

4. Specify whether the aggregated Ethernet interface participating in the MC-LAG is primary or secondary. Primary is **active**, and secondary is **standby**.

   NOTE: You must configure status control on both switches hosting the MC-LAG. If one switch is in active mode, the other must be in standby mode.

   ```
   [edit interfaces]
   user@switch# set aeX aggregated-ether-options mc-ae status-control (active | standby)
   ```

   For example:

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options mc-ae status-control active
   ```

5. Specify the same LACP system ID on each switch.

   ```
   [edit interfaces]
   user@switch# set aeX aggregated-ether-options lacp system-id mac-address
   ```

   For example:

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options lacp system-id 00:01:02:03:04:05
   ```

6. Specify the same LACP administration key on each switch.

   ```
   [edit interfaces]
   user@switch# set aeX aggregated-ether-options lacp admin-key number
   ```

   For example:

   ```
   [edit interfaces]
   user@switch# set ae1 aggregated-ether-options lacp admin-key 3
   ```

7. Configure ICCP by doing the following on each switch hosting the MC-LAG:

   a. Configure the local IP address to be used by all switches hosting the MC-LAG.

      ```
      [edit protocols]
      user@switch# set iccp local-ip-addr local-ip-address
      ```

      For example:

      ```
      [edit protocols]
      user@switch# set iccp local-ip-addr 3.3.3.1
      ```

   b. (Optional) Configure the IP address of the switch and the time during which an ICCP connection must succeed between the switches hosting the MC-LAG.

      Configured session establishment hold time results in faster ICCP connection establishment. The recommended value is 50 seconds.

      ```
      [edit protocols]
      user@switch# set iccp peer peer-ip-address session-establishment-hold-time seconds
      ```

      For example:

      ```
      [edit protocols]
      user@switch# set iccp peer 3.3.3.2 session-establishment-hold-time 50
      ```

c. (Optional) Configure the IP address to be used for backup liveness detection:

NOTE: By default, backup liveness detection is not enabled. Configure backup liveness detection if you require minimal traffic loss during a reboot. Backup liveness detection helps achieve sub-second traffic loss during an MC-LAG reboot.

```
[edit protocols]
user@switch# set iccp peer peer-ip-address backup-liveness-detection backup-peer-ip ip-address
```

For example:

```
[edit protocols]
user@switch# set iccp peer 3.3.3.2 backup-liveness-detection backup-peer-ip 10.207.64.232
```

d. Configure the minimum interval at which the switch must receive a reply from the other switch with which it has established a Bidirectional Forwarding Detection (BFD) session.

NOTE: Configuring the minimum receive interval is required to enable BFD.

```
[edit protocols]
user@switch# set iccp peer peer-ip-address liveness-detection minimum-receive-interval seconds
```

For example:

```
[edit protocols]
user@switch# set iccppeer 3.3.3.2 liveness-detection minimum-receive-interval 60
```

e. Configure the minimum transmit interval during which a switch must receive a reply from a switch with which it has established a BFD session.

```
[edit protocols]
user@switch# set iccp peer peer-ip-address liveness-detection transmit-interval minimum-interval seconds
```

For example:

```
[edit protocols]
user@switch# set iccp peer 3.3.3.2 liveness-detection transmit-interval minimum-interval 60
```

8. Configure a multichassis protection link between the switches.

```
[edit]
user@switch# set multi-chassis multi-chassis-protection peer-ip-address interface interface-name
```

For example:

```
[edit protocols]
user@switch# set multi-chassis multi-chassis-protection 3.3.3.1 interface ae0
```

9. If you are using ELS, configure the **service-id** on both switches.

The **service-id** must be the same number on both switches.


```
[edit]
user@switch# set switch-options service-id number
```

For example:

```
[edit]
user@switch# set switch-options service-id 10
```

10. Enable RSTP globally on all interfaces.

```
[edit]
user@switch# set protocols rstp interface all mode point-to-point
```

11. Disable RSTP on the ICL-PL interfaces on both switches.

```
[edit]
user@switch# set protocols rstp interface interface-name disable
```

For example:

```
[edit]
user@switch# set protocols rstp interface ae0.0 disable
```

12. Configure the MC-LAG interfaces as edge ports on both switches.

set protocols rstp interface *interface-name*

For example:

```
[edit]
user@switch# set protocols rstp interface ae1.0
```

13. Enable BPDU block on all interfaces except for the ICL-PL interfaces on both switches.

```
[edit]
user@switch# set protocols rstp bpdu-block-on-edge
```

For example:

```
[edit]
user@switch# set protocols rstp bpdu-block-on-edge
```

Related Documentation

- Understanding Multichassis Link Aggregation on page 1853
- Example: Configuring Multichassis Link Aggregation on page 1904
- *Example: Configuring Multichassis Link Aggregation for Layer 3 Unicast using MAC Address Synchronization*
- Example: Configuring Multichassis Link Aggregation for Layer 3 Unicast Using Virtual Router Redundancy Protocol (VRRP) on page 1983
- Example: Configuring Multichassis Link Aggregation for Layer 3 Multicast Using VRRP on page 1926

Configuring Generic Routing Encapsulation Tunneling

Generic routing encapsulation (GRE) provides a private, secure path for transporting packets through an otherwise public network by encapsulating (or tunneling) the packets. GRE tunneling is accomplished through tunnel endpoints that encapsulate or de-encapsulate traffic.

This topic describes:

1. Configuring a GRE Tunnel on page 2026

Configuring a GRE Tunnel

To configure a GRE tunnel interface:

1. Create a GRE interface with a unit number and address:

   [edit interfaces]
   user@switch# **set gr-0/0/0 unit** ***number*** **family inet** ***address***

   NOTE: The base name of the interface must be gr-0/0/0.

   This is a pseudo interface, and the address you specify can be any IP address. The routing table must specify **gr-0/0/0.*x*** as the outgoing interface for any packets that will be tunneled.

2. Specify the tunnel source address for the logical interface:

   [edit interfaces]
   user@switch# **set gr-0/0/0 unit** ***number*** tunnel source ***source-address***

3. Specify the destination address:

   [edit interfaces]
   user@switch# **set gr-0/0/0 unit** ***number*** tunnel destination ***destination-address***

   The destination address must be reachable through static or dynamic routing. If you use static routing, you must get the destination MAC address (for example, by using **ping**) before user traffic can be forwarded through the tunnel.

Related Documentation

- Verifying That Generic Routing Encapsulation Tunneling Is Working Correctly on page 2150
- Understanding Generic Routing Encapsulation on page 1887

Configuring IPv6 Addresses with /65 to /127 Prefix Lengths

If you want to use more than 16 IPv6 addresses with prefixes in the range /65 through /127 you must enter and commit the following statement:

```
[edit]
user@switch# set chassis forwarding-options profile-name num-65-127-prefix value
```

in which *value* can be a value in the range 1 through 128. Each increment adds support for 16 IPv6 addresses with prefixes between /65 and /127, for a maximum of 2048 such addresses (16 x 128 = 2048). The system supports 16 of these addresses by default, so to increase the number of supported addresses, you must enter a value of 2 or greater. For example, if you enter **2**, the system will support 32 IPv6 addresses with prefixes in the range /65 through /127.

Each increment that you add for IPv6 addresses with prefixes in the range /65 through /127 reduces the number of forwarding table entries that are available for IPv4 addresses and IPv6 addresses with prefixes outside this range. If you enter **128** to configure support for the maximum number of IPv6 addresses with prefixes in the range /65 through /127, the portion of the longest prefix match section of the forwarding table available to IPv4 addresses and IPv6 addresses with prefixes outside the /65 through /127 range is reduced by 8K.

NOTE: When you configure the **num-65-127-prefix** value, all the data interfaces on the switch restart. The management interfaces are unaffected.

Related Documentation

- Understanding the Unified Forwarding Table on page 1415
- Configuring the Unified Forwarding Table on page 1548

Configuration Tasks (ELS Only)

Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches

The QFX3500, QFX3600, and QFX5100 switches provide 40-Gbps QSFP+ ports that can be channelized. Channelization allows you to configure 40-Gbps QSFP+ ports to operate as four 10-Gigabit Ethernet (*xe*) interfaces. You can use QSFP+ to four SFP+ breakout cables or QSFP+ transceivers with fiber breakout cables to connect the 10-Gigabit Ethernet ports to other servers, storage, and switches. By default, the four 40-Gbps QSFP+ ports operate as 40-Gigabit Ethernet (*et*) ports. When an *et* port is channelized to four *xe* ports, a colon is used to signify the four separate channels. For example, on a QFX3500 standalone switch with port 2 on PIC 1 configured as four 10-Gigabit Ethernet ports, the interface names are *xe-0/1/2:0*, *xe-0/1/2:1*, *xe-0/1/2:2*, and *xe-0/1/2:3*.

By default, the 40-Gbps QSFP+ ports on QFX5100 switches are channelized automatically (auto-channelized) if any of the four channels on a 40-Gbps QSFP+ port receive data, unless you have configured channelization either at the chassis level or at the port level. Auto-channelization is not supported on interfaces contained in expansion modules or on Virtual Chassis ports.

You can disable auto-channelization by including the **disable-auto-speed-detection** statement at the **[edit chassis fpc *slot-number* pic *pic-number* (port *port-number* | port-range *port-range-low port-range-high*) channel-speed]** hierarchy.

There are restrictions on the ports you can channelize on the QFX5100-24Q and QFX5100-96S switches, depending on the system mode you enable. If you try to channelize ports that are restricted, the configuration is ignored. See "Configuring the System Mode on QFX5100 Switches" on page 2030 for more information.

CAUTION: The Packet Forwarding Engine on the switch is restarted when you configure or delete a port. As a result, you might experience packet loss on the device. When you channelize a 40-Gbps QSFP+ port on the master of a Virtual Chassis, traffic might be disrupted on the master as well as on the line card members, and a mastership switchover occurs.

The following steps describe how to configure a block of ports or an individual port to operate as 10-Gigabit Ethernet ports.

1. To configure a block of 40-Gigabit Ethernet (*et*) ports to operate as 10-Gigabit Ethernet ports, specify a port range and channel speed:

   [edit chassis fpc *fpc-slot* pic *pic-slot*]
   user@switch# **set port-range *port–range-low port-range-high* channel-speed** *speed*

   For example, to configure ports 0 through 3 on PIC 1 to operate as 10-Gigabit Ethernet ports:

   [edit chassis fpc 0 pic 1]
   user@switch# **set port-range 0 3 channel-speed 10g**

2. To configure an individual 40-Gigabit Ethernet (*et*) port to operate as 10-Gigabit Ethernet (xe) ports, specify a port number and channel speed:


```
[edit chassis fpc 0 pic 0]
user@switch# set port port-number channel-speed speed
```

For example, to configure port 2 to operate as 10-Gigabit Ethernet ports:

```
[edit chassis fpc 0 pic 0]
user@switch# set port 2 channel-speed 10g
```

3. Review your configuration and issue the **commit** command.

```
[edit]
user@switch# commit
commit complete
```

4. To return a range of ports to the default 40-Gigabit Ethernet configuration, delete the 10g statement:

```
[edit chassis fpc 0 pic 1]
user@switch# delete port-range port-range-low port-range-high channel-speed speed
```

For example, to return ports 0 through 3 to the default 40-Gigabit Ethernet configuration:

```
[edit chassis fpc 0 pic 1]
user@switch# delete port-range 0 3 channel-speed 10g
```

5. Review your configuration and issue the **commit** command.

```
[edit]
user@switch# commit
commit complete
```

6. To return a port to the default 40-Gigabit Ethernet configuration, delete the 10g statement:

```
[edit chassis fpc 0 pic 0]
user@switch# delete port port-number channel-speed speed
```

For example, to return port 2 to the default 40-Gigabit Ethernet configuration:

```
[edit chassis fpc 0 pic 0]
user@switch# delete port 2 channel-speed 10g
```

7. Review your configuration and issue the **commit** command.

```
[edit]
user@switch# commit
commit complete
```

The following steps describe how to disable auto-channelization at the the port level.

1. To disable auto-channelization at the port level, include the **disable** statement:

```
[edit]
user@switch# set chassis fpc slot-number pic pic-number (port port-number |
   port-range port-range-low port-range-high) channel-speed
   disable-auto-speed-detection
```

For example, to disable auto-channelization for one port:

```
[edit]
```



```
user@switch# set chassis fpc 0 pic 0 port 2 channel-speed
  disable-auto-speed-detection
```

For example, to disable auto-channelization for a range of ports:

```
[edit]
user@switch# set chassis fpc 0 pic 0 port-range 2 4 channel-speed
  disable-auto-speed-detection
```

2. Review your configuration and issue the **commit** command.

```
[edit]
user@switch# commit
commit complete
```

Related Documentation

- Configuring the System Mode on QFX5100 Switches on page 2030
- channel-speed on page 2124
- fpc on page 2131
- pic on page 2133

Configuring the System Mode on QFX5100 Switches

You can configure different system modes to achieve varying levels of port density on the QFX5100-24Q and QFX5100-96S switches. Depending on the system mode you configure, there are restrictions on which ports you can channelize. If you channelize ports that are restricted, the configuration is ignored. By default, all QSFP+ interfaces are auto-channelized. Auto-channelization is not supported on interfaces contained in expansion modules or on Virtual Chassis ports. To disable auto-channelization, see "Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches" on page 2028 for more information.

NOTE: When you request the system mode change, you must reboot for the system mode to take effect.

CAUTION: The Packet Forwarding Engine on the switch is restarted when you issue system mode changes. As a result, you might experience packet loss on the switch.

The following system modes are available on the QFX5100-24Q switch:

- Default-mode
- Mode-104-port
- Flexi-PIC mode
- Non-oversubscribed mode

The following system modes are available on the QFX5100-96S switch:

- Default-mode
- Non-oversubscribed mode

See Table 176 on page 2031 for more information regarding the supported system modes for your switch.

Table 176: System Modes Supported on QFX5100 Switches Running Enhanced Layer 2 Software

	Default-mode	Mode-104port	Flexi-pic-mode	Non-oversubscribed-mode
QFX5100-48S	Not supported	Not supported	Not supported	Not supported
QFX5100-24Q	Supported You do not need to configure the switch to be in this mode. On PIC 0, you can channelize all 24 40-Gbps QSFP+ ports. On PIC 1 and PIC 2, the 40-Gbps QSFP+ ports in the expansion modules are supported but cannot be channelized. In this mode, you can have one of two port combinations: 32 40-Gbps QSFP+ ports, or 96 10-Gigabit Ethernet ports plus 8 40-Gbps QSFP+ ports.	Supported On PIC 0, all 24 40-Gbps QSFP+ ports are channelized by default, which provides 96 10-Gigabit Ethernet ports. 40-Gbps QSFP+ ports contained in an expansion module on PIC 1 are supported. On PIC 1, ports 0 and 2 are channelized by default, and ports 1 and 3 are disabled. If 40-Gbps QSFP+ ports contained in an expansion module are detected on PIC 2, they are ignored.	Supported On PIC 0, the first four ports (ports 0 through 3) cannot be channelized. 40-Gbps QSFP+ ports contained in expansion modules on PIC 1 and PIC 2 are supported but cannot be channelized.	Supported All 24 40-Gbps QSFP+ ports on PIC 0 can be channelized to 96 10-Gigabit Ethernet ports. 40-Gbps QSFP+ ports contained in the expansion modules on PIC 1 and PIC 2 are not supported and cannot be channelized. There is no packet loss for packets of any size in this mode.
QFX5100-96S	Supported You do not need to configure the switch to be in this mode. On PIC 0, all 96 10-Gigabit Ethernet ports are supported. You can only channelize the 40-GbpsQSFP+ interfaces to 10-Gibabit Ethernet interfaces on ports 96 and 100. When you channelize the interfaces on ports 96 and 100, ports 97, 98, 99, 101, 102 and 103 are disabled.	Not supported	Not supported	Supported On PIC 0, all 96 10-Gigabit Ethernet ports are supported. However, the eight 40-Gbps QSFP+ ports are not supported and cannot be channelized. There is no packet loss for packets of any size in this mode.

The following steps describe how to change the system mode.

1. To change the system mode, issue the following operational command:

```
{master:0}
root> request chassis system-mode mode
```

For example:

```
{master:0}
root> request chassis system-mode non-oversubscribed-mode
```

2. To return to the default mode (default-mode), issue the following operational command:

```
{master:0}
root> request chassis system-mode default-mode
```

3. To see which system mode is configured, issue the following operational command:

```
{master:0}
root> show chassis system-mode
```

Related Documentation

- Understanding Interface Naming Conventions on page 1845
- Understanding Port Ranges and System Modes on page 1862
- Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches on page 2028

Configuration Tasks (Original CLI Only)

Configuring the Port Type on QFX3600 Standalone Switches

The QFX3600 standalone switch provides 16 40-Gbps QSFP+ ports. By default, all 16 ports operate as 40-Gigabit Ethernet (*xle*) ports. Optionally, you can choose to configure the 40-Gbps ports to operate as four 10-Gigabit Ethernet (*xe*) ports. You can use QSFP+ to four SFP+ breakout cables or QSFP+ transceivers with fiber breakout cables to connect the 10-Gigabit Ethernet ports to other servers, storage, and switches. You can configure up to 64 10-Gigabit Ethernet ports on ports **Q0** through **Q15**.

This topic explains how to configure the port type on QFX3600 standalone switches.

CAUTION: The Packet Forwarding Engine on the QFX3600 standalone switch is restarted when you commit the port type configuration changes. As a result, you might experience packet loss on the switch.

The following message may be displayed in the system log file when the Packet Forwarding Engine is restarted. You can ignore this message.

Pipe write error: Broken pipe

flush operation failed

The following steps describe how to configure either a block of ports or an individual port to operate as 10-Gigabit Ethernet (xe) ports, as well as how to delete a 10-Gigabit Ethernet (xe) port configuration.

NOTE: When you delete the xe port type configuration for an individual port or a block of ports, the ports return to operating as 40-Gigabit Ethernet (xle) ports.

1. To configure a block of ports to operate as 10-Gigabit Ethernet (xe) ports, specify a port range:

   [edit chassis fpc 0 pic 0]
   user@switch# **set xe port-range** ***port-range-low port-range-high***

   For example, to configure ports Q4 through Q7 to operate as 10-Gigabit Ethernet ports:

   [edit chassis fpc 0 pic 0]
   user@switch# **set xe port-range 4 7**

2. To configure an individual port to operate as a 10-Gigabit Ethernet (xe) port, specify a port number:

   [edit chassis fpc 0 pic 0]
   user@switch# **set xe port** ***port-number***

   For example, to configure port Q4 to operate as a 10-Gigabit Ethernet port:

   [edit chassis fpc 0 pic 0]
   user@switch# **set xe port 4**

3. Review your configuration and issue the **commit** command.

   [edit chassis fpc 0 pic 0]
   user@switch# **commit**
   commit complete

4. To delete the 10-Gigabit Ethernet (xe) port configuration for a block of ports (and return to the default 40-Gigabit Ethernet configuration), specify a port range:

   [edit chassis fpc 0 pic 0]
   user@switch# **delete xe port-range** ***port-range-low port-range-high***

   For example, to delete the 10-Gigabit Ethernet port configuration for ports Q4 through Q7:

   [edit chassis fpc 0 pic 0]
   user@switch# **delete xe port-range 4 7**

5. To delete the 10-Gigabit Ethernet (xe) port configuration for an individual port (and return to the default 40-Gigabit Ethernet configuration), specify a port number:

   [edit chassis fpc 0 pic 0]
   user@switch# **delete xe port** ***port-number***

   For example, to delete the 10-Gigabit Ethernet port configuration for port Q4:

   [edit chassis fpc 0 pic 0]
   user@switch# **delete xe port 4**

Related Documentation

- Understanding Interface Naming Conventions on page 1845
- pic on page 2140

Configuring the QSFP+ Port Type on QFX3500 Standalone Switches

By default, the four 40-Gbps QSFP+ ports are configured to operate as 10-Gigabit Ethernet (*xe*) ports. You can use QSFP+ to four SFP+ breakout cables or QSFP+ transceivers with fiber breakout cables to connect the 10-Gigabit Ethernet ports to other servers, storage, and switches. You can, however, configure the four 40-Gbps QSFP+ ports to operate as 40-Gigabit Ethernet (*xle*) ports.

NOTE: Port Q0 supports only three (not the typical four) 10-Gigabit Ethernet ports, because one port is reserved.

CAUTION: The Packet Forwarding Engine on the QFX3500 standalone switch is restarted when you commit port type configuration changes (for example, configuring or deleting an xle port). As a result, you might experience packet loss on the device.

The following steps describe how to configure either a block of ports or an individual port to operate as 40-Gigabit Ethernet (xle) ports, as well as how to delete a 40-Gigabit Ethernet (xle) configuration.

NOTE: When you delete an xle block of ports or individual port, the ports return to operating as 10-Gigabit Ethernet ports.

1. To configure a block of ports to operate as 40-Gigabit Ethernet (xle) ports, specify a port range:

   [edit chassis fpc 0 pic 2]
   user@switch# **set xle port-range** ***port–range-low port-range-high***

   For example, to configure ports Q0 through Q3 to operate as 40-Gigabit Ethernet ports:

   [edit chassis fpc 0 pic 2]
   user@switch# **set xle port-range 0 3**

2. To configure an individual port to operate as a 40-Gigabit Ethernet (xle) port, specify a port number:

   [edit chassis fpc 0 pic 2]
   user@switch# **set xle port** ***port-number***

   For example, to configure port Q2 to operate as a 40-Gigabit Ethernet port:

   [edit chassis fpc 0 pic 2]
   user@switch# **set xle port 2**

3. Review your configuration and issue the **commit** command.

   [edit]
   user@switch# **commit**
   commit complete

4. To delete a block of ports configured as 40-Gigabit Ethernet (xle) ports (and return to the default 10-Gigabit Ethernet configuration), specify a port range:

   [edit chassis fpc 0 pic 2]
   user@switch# **delete xle port-range** ***port-range-low port-range-high***

   For example, to delete the 40-Gigabit Ethernet (xle) port configuration for ports Q0 through Q3 (and return to the default 10-Gigabit Ethernet configuration):

   [edit chassis fpc 0 pic 2]
   user@switch# **delete xle port-range 0 3**

5. To delete an individual port configured as a 40-Gigabit Ethernet (xle) port (and return to the default 10-Gigabit Ethernet configuration), specify an individual port:

   [edit chassis fpc 0 pic 2]
   user@switch# **delete xle port** ***port-number***

   For example, to delete the 40-Gigabit Ethernet (xle) port configuration for port Q2 (and return to the default 10-Gigabit Ethernet configuration):

   [edit chassis fpc 0 pic 2]
   user@switch# **delete xle port 2**

6. Review your configuration and issue the **commit** command.

   [edit]
   user@switch# **commit**
   commit complete

Related Documentation

- Understanding Interface Naming Conventions on page 1845
- **pic on page 2140**

Configuration Statements

- tunnel on page 2111
- tunnel-port on page 2112
- tx-buffers on page 2113
- unit on page 2115
- uplink-failure-detection on page 2116
- version (Liveness Detection) on page 2116
- vlan-id on page 2117
- vlan-tagging on page 2117

802.3ad

Syntax

```
802.3ad aex;
  lacp {
    force-up;
    (primary | backup);
  }
  port-priority;
}
```

Hierarchy Level [edit interfaces *interface-name* ether-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the aggregated Ethernet logical interface number.

NOTE: The port-priority statement is not supported on QFabric systems.

Options **ae*x***—Aggregated Ethernet logical interface number.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Link Aggregation on page 2019
- Configuring Aggregated Ethernet LACP on page 2017
- Understanding Aggregated Ethernet Interfaces and LACP on page 1843
- Troubleshooting an Aggregated Ethernet Interface on page 1119
- *Junos OS Network Interfaces Library for Routing Devices*

address

Syntax

address *address* {
  arp *ip-address* (mac | multicast-mac) *mac-address* <publish>;
  broadcast *address*;
  destination *address*;
  destination-profile *name*;
  eui-64;
  master-only;
  multipoint-destination *address* dlci *dlci-identifier*;
  multipoint-destination *address* {
    epd-threshold *cells*;
    inverse-arp;
    oam-liveness {
      up-count *cells*;
      down-count *cells*;
    }
    oam-period (disable | *seconds*);
    shaping {
      (cbr *rate* | rtvbr peak *rate* sustained *rate* burst *length* | vbr peak *rate* sustained *rate* burst
        length);
      queue-length *number*;
    }
    vci *vpi-identifier.vci-identifier*;
  }
  primary;
  preferred;
  (vrrp-group | vrrp-inet6-group) *group-number* {
    (accept-data | no-accept-data);
    advertise–interval *seconds*;
    authentication-type *authentication*;
    authentication-key *key*;
    fast-interval *milliseconds*;
    (preempt | no-preempt) {
      hold-time *seconds*;
    }
    priority-number *number*;
    track {
      priority-cost seconds;
      priority-hold-time *interface-name* {
        interface *priority*;
        bandwidth-threshold *bits-per-second* {
          priority;
        }
      }
      route *ip-address/mask* routing-instance *instance-name* priority-cost *cost*;
    }
    virtual-address [*addresses*];
  }
}

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*
  family *family*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the interface address.

Options ***address***—Address of the interface.

The remaining statements are explained separately.

NOTE: The **edit logical-systems** hierarchy is not available on QFabric systems.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Protocol Family*
- *negotiate-address*
- *unnumbered-address (Ethernet)*
- *Junos OS Administration Library for Routing Devices*
- *family*

aggregated-devices

Syntax

```
aggregated-devices {
  ethernet {
    device-count number;
  }
}
```

Hierarchy Level [edit chassis],
[edit chassis node-group *name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure properties for aggregated devices on the switch.

The remaining statements are explained separately.

Default Aggregated devices are disabled.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Understanding Aggregated Ethernet Interfaces and LACP on page 1843
- Configuring Link Aggregation on page 2019
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896

- *Junos OS Network Interfaces Library for Routing Devices*

aggregated-ether-options

Syntax

```
aggregated-ether-options {
  configured-flow-control {
    rx-buffers (on | off);
    tx-buffers (on | off);
  }
  ethernet-switch-profile {
  tag-protocol-id;
  (flow-control | no-flow-control);
  lacp mode {
    admin-key key;
    periodic interval;
    system-id mac-address;
    }
  }
  (link-protection | no-link-protection);
  link-speed speed;
  (loopback | no-loopback);
  mc-ae {
    chassis-id chassis-id;
    mc-ae-id mc-ae-id;
    mode (active-active);
    status-control (active | standby);
  }
  minimum-links number;
  rebalance-periodic;
  source-address-filter filter;
  (source-filtering | no-source-filtering);
  }
}
```

Hierarchy Level [edit interfaces ae*x*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure properties specific to a specific aggregated Ethernet interface.

The statements are explained separately.

Default Options are not enabled.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Understanding Aggregated Ethernet Interfaces and LACP on page 1843
- Configuring Aggregated Ethernet LACP on page 2017
- Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch on page 1900
- *Junos OS Network Interfaces Library for Routing Devices*

alarm (chassis)

Syntax

```
alarm {
  interface-type {
    alarm-name (ignore |red | yellow);
  }
}
```

Hierarchy Level

[edit chassis],
[edit chassis interconnect-device *name*],
[edit chassis node-group *name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 12.2 for the ACX Series.

Description

Configure the chassis alarms and whether they trigger a red or yellow alarm, or whether they are ignored. Red alarm conditions light the **RED ALARM** LED on either the router's craft interface or the switch's LCD screen and trigger an audible alarm if one is connected to the contact on the craft interface or LCD screen. Yellow alarm conditions light the **YELLOW ALARM** LED on either the router's craft interface or the switch's LCD screen and trigger an audible alarm if one is connected to the craft interface or LCD screen.

To configure more than one alarm, include multiple ***alarm-name*** lines.

Options

alarm-name—Alarm condition. For a list of conditions, see *System-Wide Alarms and Alarms for Each Interface Type*.

ignore—The specified alarm condition does not set off any alarm.

interface-type—Type of interface on which you are configuring the alarm: **atm**, **ethernet**, **sonet**, or **t3**.

red—The specified alarm condition sets off a red alarm.

yellow—The specified alarm condition sets off a yellow alarm.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Understanding Alarms on page 6429
- *Chassis Conditions That Trigger Alarms*
- Chassis Alarm Messages on a QFX3500 Device on page 6430
- Interface Alarm Messages on page 6433

authentication-key (ICCP)

Syntax authentication-key *key*;

Hierarchy Level [edit protocols iccp peer <*peer-IP-address*>],
[edit protocols iccp]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Specify the authentication key (password). The QFX3500 device uses this password to verify the authenticity of packets sent from the peers hosting a multichass link aggregation group (MC-LAG). Peer-level authentication takes precedence over global-level authentication.

Interchassis Control Protocol (ICCP) uses MD5 authentication.

Options *key*—Authentication password. It can be 1 through 16 contiguous digits or letters. Separate decimal digits with periods. Separate hexadecimal digits with periods and precede the string with 0x. If you include spaces in the password, enclose the entire password in quotation marks (" ").

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

auto-negotiation

Syntax (auto-negotiation | no-auto-negotiation);

Hierarchy Level [edit interfaces *interface-name* ether-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Explicitly enable or disable autonegotiation.

- **auto-negotiation**—Enable autonegotiation.
- **no-auto-negotiation**—Disable autonegotiation. When autonegotiation is disabled, you must explicitly configure link mode and speed options.

Default Autonegotiation is automatically enabled for Gigabit Ethernet interfaces. Autonegotation is not an option for 10-Gigabit Ethernet interfaces. No explicit action is taken after the autonegotiation is complete or if the negotiation fails.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- speed on page 2106
- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- *Junos OS Network Interfaces Library for Routing Devices*

backup-liveness-detection

Syntax
backup-liveness-detection {
  backup-peer-ip *ip4-address*

Hierarchy Level
[edit protocols iccp peer]

Release Information
Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 13.2R1 for EX Series switches.

Description
Backup liveness detection determines the peer status (whether it is up or down) by exchanging keep alive messages (UDP-based packets) over the management link between the two Interchassis Control Protocol (ICCP) peers. When an ICCP connection is operationally down, the status of the peers hosting a multichassis link aggregation group (MC-LAG) is detected by sending liveness detection requests to each other. Peers must respond to liveness detection requests within a specified amount of time. If the responses are not received within that time for a given number of consecutive attempts, the liveness detection check fails, and a failure action is implemented. Backup liveness detection must be configured on both peers hosting the MC-LAG.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

backup-peer-ip

Syntax
backup-peer-ip *ip4-address*;

Hierarchy Level
[edit protocols iccp peer backup-liveness-detection]

Release Information
Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 13.2R1 for EX Series switches.

Description
Specify the IP address of the peer being used as a backup peer in the Bidirectional Forwarding Detection (BFD) configuration.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

chassis

Syntax

```
chassis {
  routing-engine {
  redundancy {
    failover {
      on-disk-failure {
      disk-failure-action (halt | reboot);
      }
      on-loss-of-keepalives;
    }
    graceful-switchover;
  }
  aggregated-devices {
    ethernet {
      device-count number;
    }
    alarm {
      interface-type {
        alarm-name (red | yellow | ignore);
      }
    }
  }
  forwarding-options profile-name {
    num-65-127-prefix value
  }
  fpc slot {
    auto-speed-detection disable
      pic pic-number{
      port port-number{
        tunnel-port port-number tunnel-services;
        channel-speed speed;
      }
      port-range port-range-low port-range-high {
        channel-speed speed;
      }
    }
  }
  maximum-ecmp next-hops;
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure chassis-specific properties for the switch.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Link Aggregation on page 2019

chassis-id

Syntax chassis-id *chassis-id*;

Hierarchy Level [edit**interfaces aggregated-ether-options mc-ae**]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Specify the chassis ID of the multichassis aggregated Ethernet interface device. LACP uses the chassis ID to calculate the port number of the multichassis link aggregation group (MC-LAG) physical member links.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

configured-flow-control

Syntax

```
configured-flow-control {
  rx-buffers (on | off);
  tx-buffers (on | off);
}
```

Hierarchy Level [edit interfaces *interface-name* ether-options]

Description Configure Ethernet PAUSE asymmetric flow control on an interface. You can set an interface to generate and send PAUSE messages, and you can set an interface to respond to PAUSE messages sent by the connected peer. You must set both the **rx-buffers** and the **tx-buffers** values when you configure asymmetric flow control.

Use the **flow-control** and **no-flow-control** statements to enable and disable symmetric PAUSE on an interface. Symmetric flow control and asymmetric flow control are mutually exclusive features. If you attempt to configure both, the switch returns a commit error.

NOTE: Ethernet PAUSE temporarily stops transmitting all traffic on a link when the buffers fill to a certain threshold. To temporarily pause traffic on individual “lanes” of traffic (each lane contains the traffic associated with a particular IEEE 802.1p code point, so there can be eight lanes of traffic on a link), use priority-based flow control (PFC) by applying a congestion notification profile to the interface.

Ethernet PAUSE and PFC are mutually exclusive features, so you cannot configure both of them on the same interface. If you attempt to configure both Ethernet PAUSE and PFC on an interface, the switch returns a commit error.

Default Flow control is disabled. You must explicitly configure Ethernet PAUSE flow control on interfaces.

Options The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- congestion-notification-profile on page 5729
- flow-control on page 2060

container-devices

Syntax

```
container-devices {
  device-count number;
}
```

Hierarchy Level

[edit chassis]
[edit chassis interconnect-device *name*]
[edit chassis node-group *name*]

Release Information Statement introduced in Junos OS Release 11.3 for QFX Series switches.

Description Specify the container devices configuration. The **number** option specifies the number of sequentially numbered container interfaces, from **ci0** to **ci127** maximum.

Options **number**—Number of container devices.

Range: 1 through 128

Required Privilege Level chassis—To view this statement in the configuration.
chassis-control—To add this statement to the configuration.

craft-lockout

Syntax

```
craft-lockout {
  alarm {
    interface-type {
      link-down (red | yellow | ignore);
    }
  }
  container-devices {
    device-count number;
      }
    }
  fpc slot {
    pic pic-number {
      fibre-channel {
        port-range {
          port-range-low port-range-high;
        }
      }
    }
  }
  routing-engine {
    on-disk-failure {
      disk-failure-action (halt | reboot);
      }
    }
  }
}
```

Hierarchy Level [edit chassis interconnect-device]

Release Information Statement introduced in Junos Release 11.3 for the QFX Series.

Description Disable the physical operation of the craft interface front panel.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Junos OS to Disable the Physical Operation of the Craft Interface*

description (Interfaces)

Syntax description *text*;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.

Description Provide a textual description of the interface or the logical unit. Any descriptive text you include is displayed in the output of the **show interfaces** commands, and is also exposed in the **ifAlias** Management Information Base (MIB) object. It has no effect on the operation of the interface on the router or switch.

The textual description can also be included in the extended DHCP relay option 82 Agent Circuit ID suboption.

Options *text*—Text to describe the interface. If the text includes spaces, enclose the entire text in quotation marks.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Interface Description*
- *Adding a Logical Unit Description to the Configuration*
- *Configuring Gigabit Ethernet Interfaces (CLI Procedure)*
- *Configuring Gigabit Ethernet Interfaces (CLI Procedure)*
- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- *Enabling and Disabling Insertion of Option 82 Information*
- *Junos OS Network Interfaces Library for Routing Devices*
- *Example: Connecting Access Switches to a Distribution Switch*

destination (Tunnels)

Syntax destination *address*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*],
[edit interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number* tunnel],
[edit logical-systems *logical-system-name* interfaces interface-name unit *logical-unit-number* family inet address *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* tunnel]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description For encrypted, PPP-encapsulated, and tunnel interfaces, specify the remote address of the connection.

Options *address*—Address of the remote side of the connection.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Interface Address*
- *Configuring Generic Routing Encapsulation Tunneling (CLI Procedure)*
- *Junos OS Services Interfaces Library for Routing Devices*
- *point-to-point*

detection-time (Liveness Detection)

Syntax

```
detection-time {
  milliseconds;
}
```

Hierarchy Level [edit protocols iccp peer liveness-detection]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description The Bidirectional Forwarding Detection (BFD) timers are adaptive and can be adjusted to be faster or slower.

The remaining statement is explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

device-count

Syntax device-count *number*;

Hierarchy Level [edit chassis aggregated-devices ethernet],
[edit chassis node-group *name* aggregated-devices ethernet]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the number of aggregated Ethernet logical devices available to the switch.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Link Aggregation on page 2019
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896

disk-failure-action

Syntax disk-failure-action (halt | reboot);

Hierarchy Level [edit chassis redundancy on-disk-failure]
[edit chassis routing-engine on-disk-failure]

Release Information Statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the Routing Engine to halt or reboot when the Routing Engine hard disk fails.

Options **halt**—Specify the Routing Engine to halt.

reboot—Specify the Routing Engine to reboot.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- graceful-switchover on page 1775
- *Configuring the Junos OS to Enable a Routing Engine to Reboot on Hard Disk Errors*
- *Installing Software on an EX Series Switch with Redundant Routing Engines (CLI Procedure)*
- *High Availability Features for EX Series Switches Overview*

ethernet

Syntax

```
ethernet {
  device-count number;
}
```

Hierarchy Level [edit chassis aggregated-devices],
[edit chassis node-group aggregated-devices]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure properties for aggregated Ethernet devices on the switch.

The remaining statement is explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Link Aggregation on page 2019
- *Junos OS Network Interfaces Library for Routing Devices*

ethernet (Alarm)

Syntax

```
ethernet {
  link-down (red | yellow | ignore);
}
```

Hierarchy Level

[edit chassis alarm],
[edit chassis interconnect-device *name* alarm],
[edit chassis node-group *name* alarm]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure alarms for an Ethernet interface.

Options **The remaining statement is explained separately.—**

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Understanding Alarms on page 6429
- Interface Alarm Messages on page 6433

ether-options

Syntax

```
ether-options {
  802.3ad aex {
    lacp {
      force-up;
      (primary |backup);
    }
  }
  (auto-negotiation| no-auto-negotiation);
  configured-flow-control {
    rx-buffers (on | off);
    tx-buffers (on | off);
  }
  (flow-control | no-flow-control);
  link-mode mode;
  (loopback | no-loopback);
  speed (auto-negotiation | no-auto-negotiation);
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure **ether-options** properties for a Gigabit Ethernet or 10-Gigabit Ethernet interface.

The statements are explained separately.

Default Enabled.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- *Junos OS Network Interfaces Library for Routing Devices*

eui-64

Syntax eui-64;

Hierarchy Level [edit interfaces *interface-name* unit *number* family inet6 address *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description For interfaces that carry IP version 6 (IPv6) traffic, automatically generate the host number portion of interface addresses.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- *Configuring the Interface Address*

fibre-channel (Alarm)

Syntax

```
fibre-channel {
  link-down (red | yellow | ignore);
}
```

Hierarchy Level [edit chassis alarm],
[edit chassis interconnect-device *name* alarm],
[edit chassis node-group *name* alarm]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure alarms for a Fibre Channel interface.

Options **The remaining statement is explained separately.—**

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- Understanding Alarms on page 6429
- Interface Alarm Messages on page 6433

filter

Syntax

```
filter {
  group filter-group-number;
  input filter-name;
  input-list [ filter-names ];
  output filter-name;
  output-list [ filter-names ];
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Apply a filter to an interface. You can also use filters for encrypted traffic. When you configure filters, you can configure them under the **family ethernet-switching**, **inet**, **inet6**, **mpls**, or **vpls** only.

NOTE: On QFX3500 and QFX3600 switches running Enhanced Layer 2 Software, VPLS is not supported.

Options

group *filter-group-number*—Define an interface to be part of a filter group.

Range: 1 through 255

input *filter-name*—Name of one filter to evaluate when packets are received on the interface.

output *filter-name*—Name of one filter to evaluate when packets are transmitted on the interface.

The remaining statements are explained separately.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Applying a Filter to an Interface*
- *Junos OS Services Interfaces Library for Routing Devices*
- *Routing Policy Feature Guide for Routing Devices*
- *Junos OS Administration Library for Routing Devices*
- *Configuring Gigabit Ethernet Interfaces (CLI Procedure)*
- *Configuring Gigabit Ethernet Interfaces (CLI Procedure)*

- *Configuring Firewall Filters (CLI Procedure)*
- *Configuring Firewall Filters and Policers for VPLS*
- *family*
- *family*

flow-control

Syntax (flow-control | no-flow-control);

Hierarchy Level [edit interfaces *interface-name* ether-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Explicitly enable or disable symmetric Ethernet PAUSE flow control, which regulates the flow of packets from the switch to the remote side of the connection by pausing all traffic flows on a link during periods of network congestion. Symmetric flow control means that Ethernet PAUSE is enabled in both directions. The interface generates and sends Ethernet PAUSE messages when the receive buffers fill to a certain threshold and the interface responds to PAUSE messages received from the connected peer. By default, flow control is disabled.

You can configure asymmetric flow control by including the **configured-flow-control** statement at the **[edit interfaces *interface-name* ether-options** hierarchy level. Symmetric flow control and asymmetric flow control are mutually exclusive features. If you attempt to configure both, the switch returns a commit error.

NOTE: Ethernet PAUSE temporarily stops transmitting all traffic on a link when the buffers fill to a certain threshold. To temporarily pause traffic on individual "lanes" of traffic (each lane contains the traffic associated with a particular IEEE 802.1p code point, so there can be eight lanes of traffic on a link), use priority-based flow control (PFC).

Ethernet PAUSE and PFC are mutually exclusive features, so you cannot configure both of them on the same interface. If you attempt to configure both Ethernet PAUSE and PFC on an interface, the switch returns a commit error.

- **flow-control**—Enable flow control; flow control is useful when the remote device is a Gigabit Ethernet switch.
- **no-flow-control**—Disable flow control.

Default Flow control is disabled.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- **configured-flow-control on page 2048**
- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- *Junos OS Network Interfaces Library for Routing Devices*

force-up

Syntax force-up;

Hierarchy Level [edit interfaces *interface-name* ether-options 802.3ad lacp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the state of the interface as up when the peer has limited LACP capability.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Understanding Aggregated Ethernet Interfaces and LACP on page 1843
- Configuring Aggregated Ethernet LACP on page 2017
- Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch on page 1900
- *Junos OS Network Interfaces Library for Routing Devices*

fpc

Syntax

```
fpc slot {
  pic pic-number {
    fibre-channel {
      port-range {
        port-range-low port-range-high;
      }
    }
    tunnel-port port-number tunnel-services;
    xe {
      (port port-number | port-range port-range-low port-range-high);
    }
    xle {
      (port port-number | port-range port-range-low port-range-high);
    }
  }
```

Hierarchy Level

[edit chassis],
[edit chassis interconnect-device *name*]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure the FPC slot number. For QFX3500 switches, the slot is a line card slot.

For generic routing encapsulation (GRE) tunneling, use the **tunnel-port** statement to specify the port that you want to convert to a GRE tunnel port.

Options

slot—Number of the FPC slot. For QFX3500 and QFX3600 devices, the slot number is always **0**.

The remaining statements are explained separately.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- show chassis fpc on page 597
- *Configuring Generic Routing Encapsulation Tunneling (CLI Procedure)*

gratuitous-arp-reply

Syntax (gratuitous-arp-reply | no-gratuitous-arp-reply);

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces interface-range *interface-range-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Enable processing of ARP updates received via gratuitous ARP reply messages.

Default Updating of the ARP cache is disabled on all Ethernet interfaces.

Options **gratuitous-arp-reply**—Update the ARP cache.

no-gratuitous-arp-reply—Do not update the ARP cache.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

group

Syntax

```
group group-name {
  link-to-monitor interface-name;
  link-to-disable interface-name;
}
```

Hierarchy Level [edit protocols uplink-failure-detection]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure a group of uplink and downlink interfaces for uplink failure detection.

Options ***group-name***—Name of the uplink failure detection group.

The remaining statements are explained separately.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Overview of Uplink Failure Detection on page 1841
- Configuring Interfaces for Uplink Failure Detection on page 2018
- Example: Configuring Interfaces for Uplink Failure Detection on page 1891

group (Redundant Trunk Groups)

Syntax

```
group name {
  interface interface-name <primary>;
    interface interface-name;
  preempt-cutover-timer seconds;
}
```

Hierarchy Level

- For platforms with ELS:

  [edit switch-options redundant-trunk-group]

- For platforms without ELS:

  [edit ethernet-switching-optionsredundant-trunk-group]

Release Information

Statement introduced in Junos OS Release 9.0 for EX Series switches.
Hierarchy level **[edit switch-options]** introduced in Junos OS Release 13.2X50-D10 (ELS). (See “Getting Started with Enhanced Layer 2 Software” on page 58 for information about ELS.)
Statement introduced in Junos OS Release 13.2X50-D15 for the QFX Series.

Description

Create a redundant trunk group.

Options

name—The name of the redundant trunk group. The group name must start with a letter and can consist of letters, numbers, dashes, and underscores.

The remaining statements are explained separately.

Required Privilege Level

system—To view this statement in the configuration.
system–control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Redundant Trunk Links for Faster Recovery*
- Example: Configuring Redundant Trunk Links for Faster Recovery on page 2010
- Understanding Redundant Trunk Links on page 1885

hold-time (Physical Interface)

Syntax hold-time up *milliseconds* down *milliseconds*;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces interface-range *interface-range-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 10.4R5 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.

Description Specify the hold-time value to use to damp interface transitions. When an interface goes from up to down, it is not advertised to the rest of the system as being down until it has remained down for the hold-time period. Similarly, an interface is not advertised as being up until it has remained up for the hold-time period.

NOTE:

- We recommend that you configure the **hold-time** value after determining an appropriate value by performing repeated tests in the actual hardware environment. This is because the appropriate value for **hold-time** depends on the hardware (XFP, SFP, SR, ER, or LR) used in the networking environment.
- The **hold-time** option is not available for controller interfaces.

Default Interface transitions are not damped.

Options **down *milliseconds***—Hold time to use when an interface transitions from up to down. Junos OS advertises the transition within 100 milliseconds of the time value you specify.

Range: 0 through 4,294,967,295 milliseconds

Default: 0 milliseconds (interface transitions are not damped)

up *milliseconds*—Hold time to use when an interface transitions from down to up. Junos OS advertises the transition within 100 milliseconds of the time value you specify.

Range: 0 through 4,294,967,295 milliseconds

Default: 0 milliseconds (interface transitions are not damped)

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *advertise-interval*
- *interfaces (for EX Series switches)*

iccp

Syntax

```
iccp {
  authentication-key string;
  local-ip-addr local-ip-addr;
  peer ip-address{
    authentication-key string;
    backup-liveness-detection {
      backup-peer-ip ip-address;
    }
    liveness-detection {
      detection-time {
        threshold milliseconds;
      }
      minimum-interval milliseconds;
      minimum-receive-interval milliseconds;
      multiplier number;
      no-adaptation;
      transmit-interval {
        minimum-interval milliseconds;
        threshold milliseconds;
      }
      version (1 | automatic);
    }
    local-ip-addr ipv4-address;
    session-establishment-hold-time seconds;
  }
  session-establishment-hold-time seconds;
  traceoptions {
    file <filename> <files number> <match regular-expression> <microsecond-stamp>
      <size size> <world-readable | no-world-readable>;
    flag flag;
    no-remote-trace;
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Configure Interchassis Control Protocol (ICCP) between the multichassis link aggregation group (MC-LAG) peers. ICCP replicates forwarding information, validates configurations, and propagates the operational state of the MC-LAG members.

The remaining statement are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

irb (Interfaces)

Syntax

```
irb {
  accounting-profile name;
  description  text;
  disable;

  (gratuitous-arp-reply | no-gratuitous-arp-reply);
  hold-time up milliseconds down milliseconds;
  mtu bytes;
  no-gratuitous-arp-request;

  traceoptions {
    flag flag;
  }
  (traps | no-traps);
  unit logical-unit-number {
    accounting-profile name;
    bandwidth rate;
    description text;
    disable;
    encapsulation type;
    family inet {
      accounting {
        destination-class-usage;
        source-class-usage {
          input;
          output;
        }
      }
      address ipv4-address {
        arp ip-address (mac | multicast-mac) mac-address <publish>;
        broadcast address;
        preferred;
        primary;
        vrrp-group group-number {
          (accept-data | no-accept-data);
          advertise–interval seconds;
          advertisements-threshold number;
          authentication-key key;
          authentication-type authentication;
          fast-interval milliseconds;
          (preempt | no-preempt) {
            hold-time seconds;
          }
          priority number;
          track {
            interface interface-name {
              bandwidth-threshold bandwidth;
              priority-cost number;
            }
            priority-hold-time seconds;
            route ip-address/mask routing-instance instance-name priority-cost cost;
          }
```

```
            virtual-address [ addresses ];
            vrrp-inherit-from {
                active-group group-number;
                active-interface interface-name;
            }
        }
    }
    filter {
        input filter-name;
        output filter-name;
    }
    mtu bytes;
    no-neighbor-learn;
    no-redirects;
    primary;
    rpf-check {
        fail-filter filter-name;
        mode {
            loose;
        }
    }
    targeted-broadcast {
        forward-and-send-to-re;
        forward-only;
    }
}
family inet6 {
    accounting {
        destination-class-usage;
        source-class-usage {
            input;
            output;
        }
    }
    address address {
        eui-64;
        ndp ip-address (mac | multicast-mac) mac-address <publish>;
        preferred;
        primary;
        vrrp-inet6-group group-id {
            accept-data | no-accept-data;
            advertisements-threshold number;
            authentication-key key;
            authentication-type authentication;
            fast-interval milliseconds;
            inet6-advertise-interval milliseconds;
            preempt | no-preempt {
                hold-time seconds;
            }
            priority number;
            track {
                interface interface-name {
                    bandwidth-threshold bandwidth priority-cost number;
                    priority-cost number;
                }
                priority-hold-time seconds;
```



```
                route ip-address/mask routing-instance instance-name priority-cost cost;
              }
              virtual-inet6-address [addresses];
              virtual-link-local-address ipv6–address;
              vrrp-inherit-from {
                active-group group-number;
                active-interface interface-name;
              }
            }
          }
          (dad-disable | no-dad-disable);
          filter {
            input filter-name;
            output filter-name;
          }
          mtu bytes;
          nd6-stale-time seconds;
          no-neighbor-learn;
          no-redirects;
          policer {
            input policer-name;
            output policer-name;
          }
          rpf-check {
            fail-filter filter-name;
            mode {
              loose;
            }
          }
        }
        family iso {
          address interface-address;
          mtu bytes;
        }
        family mpls {
          filter {
            input filter-name;
            output filter-name;
          }
          mtu bytes;
          policer {
            input policer-name;
            output policer-name;
          }
        }
        native-inner-vlan-id vlan-id;
        proxy-arp (restricted | unrestricted);
        (traps | no-traps);
        vlan-id-list [vlan-id’s];
        vlan-id-range [vlan-id-range];
      }
    }
```

Hierarchy Level [edit interfaces *interface-name*

Release Information Statement introduced in Junos OS Release 12.3R2 for EX Series switches.
irb option introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure the properties of a specific integrated bridging and routing (IRB) interface.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *[edit interfaces] Hierarchy Level*
- *[edit interfaces] Configuration Statement Hierarchy on EX Series Switches*

inet (interfaces)

Syntax

```
inet {
  address address {
    primary;
  filter input filter-name;
  filter output filter-name;
  targeted-broadcast;
  }
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family],
[edit interfaces interface-range *interface-name* unit *logical-unit-number* family]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the primary IP address for the logical interface.

Default You must configure a logical interface to be able to use the physical device.

Options **The remaining statements are explained separately.—**

Required Privilege Level interface—To view this statement in the configuration.interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015

inet6 (interfaces)

Syntax

```
inet6 {
  address address {
    eui-64
      preferred
    primary;
  filter input filter-name;
  filter output filter-name;
  }
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family],
[edit interfaces interface-range *interface-name* unit *logical-unit-number* family]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Configure the primary IP address for the logical interface.

Default You must configure a logical interface to be able to use the physical device.

Options **The remaining statements are explained separately.—**

Required Privilege Level interface—To view this statement in the configuration.interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015

interface (Multichassis Protection)

Syntax interface *interface-name*;

Hierarchy Level [edit multi-chassis multi-chassis-protection peer]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Specify the name of the interface that is being used as an interchassis link-protection link (ICL-PL). The two switches hosting a multichassis link aggregation group (MC-LAG) use this link to pass Interchassis Control Protocol (ICCP) and data traffic.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interface (Redundant Trunk Groups)

Syntax

interface *interface-name* <primary>;
interface *interface-name*;

Hierarchy Level

For platforms with ELS:

[edit switch-options redundant-trunk-group group *name*]

For platforms without ELS:

[edit ethernet-switching-options redundant-trunk-group group *name*]

Release Information

Statement introduced in Junos OS Release 9.0 for EX Series switches.
Hierarchy level **[edit switch-options]** introduced in Junos OS Release 13.2X50-D10 (ELS). (See “Getting Started with Enhanced Layer 2 Software” on page 58 for information about ELS.)
Statement introduced in Junos OS Release 13.2X50-D15 for the QFX Series.

Description

Configure a primary link and secondary link on trunk ports. If the primary link fails, the secondary link automatically takes over as the primary link without waiting for normal STP convergence.

Options

interface ***interface-name***—A logical interface or an aggregated interface containing multiple ports.

primary—(Optional) Specify one of the interfaces in the redundant group as the primary link. The interface without this option is the secondary link in the redundant group. If a link is not specified as **primary**, the software compares the two links and selects the link with the highest port number as the active link. For example, if the two interfaces are **ge-0/1/0** and **ge-0/1/1**, the software assigns **ge-0/1/1** as the active link.

Required Privilege Level

system—To view this statement in the configuration.
system–control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Redundant Trunk Links for Faster Recovery*
- Example: Configuring Redundant Trunk Links for Faster Recovery on page 2010
- Understanding Redundant Trunk Links on page 1885

interface-range

Syntax

```
interface-range interface-range-name {
   disable;
   description text;
   ether-options {
      802.3ad aex {
         lacp {
            force-up;
         }
      }
      (auto-negotiation| no-auto-negotiation);
      (flow-control | no-flow-control);
      link-mode mode;
      speed (auto-negotiation | speed);
   }
   hold-time milliseconds down milliseconds;
   member interface-name;
   member-range starting-interface-name to ending-interface-name;
   mtu bytes;
   unit logical-unit-number {
      description text;
      disable;
      family family-name {...}
      (traps | no traps);
      vlan-id vlan-id-number;
   }
}
```

Hierarchy Level [edit interfaces]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX series.

Description Group interfaces that share a common configuration profile.

NOTE: The interface range definition is supported only for Gigabit Ethernet, 10-Gigabit Ethernet, and Fibre Channel interfaces.

Options *interface-range-name*—Name of the interface range.

NOTE: You can use regular expressions and wildcards to specify the interfaces in the member range configuration. Do not use wildcards for interface types.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.interface-control—To add this statement to the configuration.

Related Documentation

- Understanding Interface Ranges on the QFX Series on page 1850
- Interfaces Overview on page 1839
- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- *Junos OS Network Interfaces Library for Routing Devices*

interfaces

Syntax

```
interfaces {
  aex {
    disable;
      aggregated-ether-options {
      configured-flow-control {
        rx-buffers (on | off);
        tx-buffers (on | off);
      }
      (flow-control | no-flow-control);
      lacp mode {
        admin-key key;
        periodic interval;
        system-id mac-address;
      }
      link-speed speed;
      loopback;
      no-loopback;
      minimum-links number;
    }
      mc-ae {
        chassis-id chassis-id;
        mc-ae-id mc-ae-id;
        mode (active-active);
        status-control (active | standby);
      }
    description text;
    gratuitous-arp-reply | no-gratuitous-arp-reply)
    hold-time down milliseconds up milliseconds;
    mtu bytes;
    no-gratuitous-arp-request;
    traceoptions;
    (traps | no traps);
    unit logical-unit-number {
      disable;
      description text;
      family {
        ethernet-switching {
          filter input filter-name;
          filter output filter-name;
          native-vlan-id vlan-id;
          port-mode mode;
          reflective-relay;
          vlan {
            members [ (all | names | vlan-ids) ];
          }
        }
        inet {
          address address {
            primary;
          }
          filter input filter-name;
          filter output filter-name;
```

```
            primary;
            targeted-broadcast;
          }
        (traps | no traps);
        vlan-id vlan-id-number;
      }
      vlan-tagging;
    }
    interface-range interface-range-name {
      disable;
      description text;
      ether-options {
        802.3ad aex {
          lacp {
            force-up;
          }
        }
        (auto-negotiation| no-auto-negotiation);
        configured-flow-control {
          rx-buffers (on | off);
          tx-buffers (on | off);
        }
        (flow-control | no-flow-control);
        link-mode mode;
        speed (auto-negotiation | speed);
      }
      hold-time milliseconds down milliseconds;
      member interface-name;
      member-range starting-interface-name to  ending-interface-name;
      mtu bytes;
      unit logical-unit-number {
        disable;
        description text;
        family family-name {...}
        (traps | no traps);
        vlan-id vlan-id-number;
      }
    }
    lo0 {
      disable;
      description text;
      hold-time milliseconds down milliseconds;
      traceoptions;
      (traps | no traps);
      unit logical-unit-number {
        disable;
        description text;
        family {
          inet {
            address address {
              primary;
            }
            filter input filter-name;
            filter output filter-name;
            primary;
            targeted-broadcast;
```



```
        }
      (traps | no traps);
    }
  }
  mex {
    disable;
    description text;
    hold-time milliseconds down milliseconds;
    (gratuitous-arp-reply | no-gratuitous-arp-reply);
    no-gratuitous-arp-request;
    traceoptions;
    traps;
    unit logical-unit-number {
      disable;
    description text;
      family {
        ethernet-switching {
          filter input filter-name;
          filter output filter-name;
          native-vlan-id vlan-id;
          port-mode mode;
          reflective-relay;
          vlan {
            members [ (all | names | vlan-ids) ];
          }
        }
        inet {
          address address {
          primary;
          filter input filter-name;
          filter output filter-name;
          primary;
          targeted-broadcast;
          }
        }
    traps;
    vlan-id vlan-id-number;
    }
  vlan-tagging;
  vlan {
    disable;
    description  text;
    (gratuitous-arp-reply| no-gratuitous-arp-reply);
    hold-time milliseconds down milliseconds;
    mtu bytes;
    no-gratuitous-arp-request;
    traceoptions;
    (traps | no traps);
    unit logical-unit-number {
      description text;
      disable;
      family {
        inet {
          address address {
            primary;
          }
```

```
                filter input filter-name;
                filter output filter-name;
                primary;
                targeted-broadcast;
            }
        (traps | no traps);
    }
}
fc-0/0/port {
    fibrechannel-options {
        bb-sc-n;
        (loopback | no-loopback);
        speed (auto-negotiation | 2g | 4g | 8g);
    }
    unit logical-unit-number {
        disable;
        description text;
        family {
            fibre-channel {
                port-mode np-port;
            }
        (traps | no traps);
    }
ge-0/0/port {
    disable;
    description text;
    ether-options {
        802.3ad aex {
            lacp {
                force-up;
                primary;
            }
        }
        (auto-negotiation | no-auto-negotiation);
        configured-flow-control {
            rx-buffers (on | off);
            tx-buffers (on | off);
        }
        (flow-control | no-flow-control);
        link-mode mode;
        loopback;
        no-loopback;
        speed (auto-negotiation | speed);
    }
    gratuitous-arp-reply| no-gratuitous-arp-reply);
    hold-time milliseconds down milliseconds;
    mtu bytes;
    no-gratuitous-arp-request;
    traceoptions;
    (traps | no traps);
    unit logical-unit-number {
        description text;
        disable;
        family {
            ethernet-switching {
                filter input filter-name;
```



```
                filter output filter-name;
                native-vlan-id vlan-id;
                port-mode mode;
                reflective-relay;
                vlan {
                    members [ (all | names | vlan-ids) ];
                }
            }
            inet {
                address address {
                    primary;
                }
                filter input filter-name;
                filter output filter-name;
                primary;
                targeted-broadcast;
            }
        (traps | no traps);
        vlan-id vlan-id-number;
    }
    vlan-tagging;
}
vrrp-group group-id {
    (accept-data | no-accept-data);
    advertise-interval seconds;
    authentication-key key;
    authentication-type authentication;
    fast-interval milliseconds;
    (preempt | no-preempt) {
        hold-time seconds;
    }
    priority number;
    track {
        interface interface-name {
            bandwidth-threshold bits-per-second priority-cost priority;
            priority-cost priority;
        }
        priority-hold-time seconds;
        route prefix/prefix-length routing-instance instance-name priority-cost priority;
        }
    }
    virtual-address [ addresses ];
}
xe-0/0/port {
    disable;
    description text;
    ether-options {
        802.3ad aex {
            lacp {
                force-up;
                (primary | backup);
            }
        }
        configured-flow-control {
            rx-buffers (on | off);
            tx-buffers (on | off);
```

```
            }
            (flow-control | no-flow-control);
            loopback;
            no-loopback;
        }
        (gratuitous-arp-reply| no-gratuitous-arp-reply
        hold-time milliseconds down milliseconds;
        mtu bytes;
        no-gratuitous-arp-request;
        traceoptions;
        (traps | no traps);
        unit logical-unit-number {
            disable;
            description text;
            family {
                ethernet-switching {
                    filter input filter-name;
                    filter output filter-name;
                    native-vlan-id vlan-id;
                    port-mode mode;
                    reflective-relay;
                    vlan {
                        members [ (all | names | vlan-ids) ];
                    }
                }
                fibre-channel {
                    port-mode (f-port | np-port);
                }
                inet {
                    address address {
                        primary;
                    }
                    filter input filter-name;
                    filter output filter-name;
                    primary;
                    targeted-broadcast;
                }
            (traps | no traps);
            vlan-id vlan-id-number;
        }
        vlan-tagging;
    }
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the interfaces on the QFX Series.

Most standard Junos OS configuration statements are available in the Junos OS for a switch. This topic lists Junos OS statements that you commonly use when configuring a switch as well as statements added to support switches only.

Options **aex**—Configure an aggregated Ethernet interface.

xe-0/0/*port/*—Configure a 10-Gigabit Ethernet interface.

ge-0/0/*port/*—Configure a Gigabit Ethernet interface.

fc-0/0/*port/*—Configure a Fibre Channel interface.

me*X/*—Configure a management interface.

mc-ae—Configure a multichassis aggregated Ethernet (MC-AE) interface.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Interfaces Overview on page 1839
- Understanding Interface Ranges on the QFX Series on page 1850
- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- Configuring Link Aggregation on page 2019
- Configuring a Layer 3 Logical Interface on page 2019

lacp (802.3ad)

Syntax

```
lacp {
  force-up;
  (primary |backup);
  port-priority;
}
```

Hierarchy Level [edit interfaces *interface-name* ether-options 802.3ad]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the Link Aggregation Control Protocol (LACP) parameters for interfaces. The remaining statement is explained separately.

NOTE: **The port-priority statement is not supported on QFabric systems.**

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Link Aggregation on page 2019
- Configuring Aggregated Ethernet LACP on page 2017
- Understanding Aggregated Ethernet Interfaces and LACP on page 1843

lacp (Aggregated Ethernet)

Syntax

```
lacp (active | passive) {
  admin-key key;
  periodic (fast | slow);
  system-ID mac-address;
}
```

Hierarchy Level [edit interfaces *interface-name*aggregated-ether-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the Link Aggregation Control Protocol (LACP) parameters for interfaces. The remaining statement is explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Link Aggregation on page 2019
- Configuring Aggregated Ethernet LACP on page 2017
- Understanding Aggregated Ethernet Interfaces and LACP on page 1843

link-to-disable

Syntax link-to-disable *interface-name*;

Hierarchy Level [edit protocols uplink-failure-detection group *group-name*]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the downlink interfaces to be disabled when the switch detects an uplink failure. The switch can monitor a maximum of eight downlink interfaces in a group.

Options *interface-name*—Name of the downlink interface in an uplink failure detection group. The interface can be a physical interface or a logical interface.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Overview of Uplink Failure Detection on page 1841
- Configuring Interfaces for Uplink Failure Detection on page 2018
- Example: Configuring Interfaces for Uplink Failure Detection on page 1891

link-to-monitor

Syntax link-to-monitor *interface-name*;

Hierarchy Level [edit protocols uplink-failure-detection group *group-name*]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the uplink interfaces to be monitored for uplink failure detection. The switch can monitor a maximum of eight uplink interfaces in a group.

Options ***interface-name***—Name of the uplink interface in an uplink failure detection group. The interface can be a physical interface or a logical interface.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Overview of Uplink Failure Detection on page 1841
- Configuring Interfaces for Uplink Failure Detection on page 2018
- Example: Configuring Interfaces for Uplink Failure Detection on page 1891

link-down

Syntax

link-down (red | yellow | ignore);

Hierarchy Level

[edit chassis alarm ethernet],
[edit chassis alarm fibre-channel],
[edit chassis interconnect-device *name* alarm ethernet],
[edit chassis node-group *name* alarm fibre-channel]

Release Information

Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Specify either red, yellow, or ignore to display when the link is down.

Options

red—Indicates that one or more hardware components have failed or exceeded temperature thresholds, or an alarm condition configured on an interface has triggered a critical warning.

yellow—Indicates a noncritical condition on the device that, if left unchecked, might cause an interruption in service or degradation in performance. A yellow alarm condition requires monitoring or maintenance.

ignore—Suppresses or ignores the alarm.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

link-mode

Syntax link-mode *mode*;

Hierarchy Level [edit interfaces *interface-name* ether-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the device's link-connection characteristic.

Default The **full-duplex** mode is enabled.

Options *mode* —Link characteristic:

- **full-duplex**—Connection is full duplex.
- **half-duplex**—Connection is half duplex.
- **automatic**—Link mode is negotiated.

If **no-auto-negotiation** is specified in the **ether-options** option, you can select only **full-duplex** or **half-duplex**. If **auto-negotiation** is specified in the **ether-options** option, you can select any mode.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- *Junos OS Network Interfaces Library for Routing Devices*

link-speed

Syntax link-speed *speed*;

Hierarchy Level [edit interfaces ae*x* aggregated-ether-options]

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description For aggregated Ethernet interfaces only, set the required link speed.

Options *speed*—For aggregated Ethernet links, you can specify the speed in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation **k** (1000), **m** (1,000,000), or **g** (1,000,000,000).

Aggregated Ethernet links on the QFX Series can have one of the following speed values:

- **1g**—Links are 1 Gbps.
- **10g**—Links are 10 Gbps.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Link Aggregation on page 2019

liveness-detection

Syntax

```
liveness-detection {
  detection-time {
    threshold milliseconds;
  }
  minimum-interval milliseconds;
  minimum-receive-interval milliseconds;
  multiplier number;
  no-adaptation;
  transmit-interval {
    minimum-interval milliseconds;
    threshold milliseconds;
  }
  version (1 | automatic);
}
```

Hierarchy Level [edit protocols iccp peer]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Enable Bidirectional Forwarding Detection (BFD). BFD enables rapid detection of communication failures between peers.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

local-ip-addr (ICCP)

Syntax local-ip-addr *local-ip-address*;

Hierarchy Level [edit protocols iccp],
[edit protocols iccp peer *peer-IP-address*]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Specify the local IP address of the interchassis link (ICL) interface that Interchassis Control Protocol (ICCP) uses to communicate to the peers that host a multichassis link aggregation group (MC-LAG).

Options ***local-ip-address***—Default local IP address to be used by all peers.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

loopback (Aggregated Ethernet, Gigabit Ethernet, and 10-Gigabit Ethernet)

Syntax (loopback | no-loopback);

Hierarchy Level [edit interfaces *interface-name* aggregated-ether-options],
[edit interfaces *interface-name* ether-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For aggregated Ethernet, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces, enable or disable loopback mode.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Ethernet Loopback Capability on page 2018

management-ethernet (Alarm)

Syntax

```
management-ethernet {
  link-down (red | yellow | ignore);
}
```

Hierarchy Level [edit chassis alarm],
[edit chassis interconnect-device *name* alarm],
[edit chassis node-group *name* alarm]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Configure alarms for a management Ethernet interface.

NOTE: **If you configure a yellow alarm on the Interconnect device, it will be handled as a red alarm.**

Options **The remaining statement is explained separately.—**

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Understanding Alarms on page 6429
- Interface Alarm Messages on page 6433

member

Syntax member *interface-name*;

Hierarchy Level [edit interfaces interface-range *interface-range-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the name of the member interface belonging to an interface range on the QFX Series switch.

Options ***interface-name***—Name of the interface.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- Interfaces Overview on page 1839
- *Junos OS Network Interfaces Library for Routing Devices*

member-range

Syntax member-range *starting-interface-name ending-interface-name*;

Hierarchy Level [edit interfaces interface-range *interface-range-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the names of the first and last members of a sequence of interfaces belonging to an interface range.

Options ***starting interface-name ending interface-name***—Name of the first member and the name of the last member in the interface sequence.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Understanding Interface Ranges on the QFX Series on page 1850
- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- Interfaces Overview on page 1839
- *Junos OS Network Interfaces Library for Routing Devices*

mc-ae

Syntax

```
mc-ae {
  chassis-id chassis-id;
  mc-ae-id mc-ae-id;
  mode (active-active);
  status-control (active | standby);
}
```

Hierarchy Level [edit interfaces aggregated-ether-options]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Specify the multichassis aggregated Ethernet interface configuration.

Options

chassis-id—Specify the chassis ID for LACP to calculate the port number of the MC-LAG physical member links.

mc-ae-id—Specify the identification number of MC-LAG device. The two MC-LAG QFX3500 devices that manage a given MC-LAG must have the same **mc-lag-id**.

mode (active | active)—Specify that the MC-LAG is in active-active mode. In this mode, if a member interface of the MC-LAG goes down, traffic can still be forwarded to the QFX3500 devices hosting the MC-LAG using the interchassis link-protection link (ICL-PL). The links from the client-device connected to both of the QFX3500 devices will remain active. Only active-active mode is supported at this time.

status-control (active | standby)—Specify if a peer is in active or standby mode. In active mode, the peer is considered the primary device, and in standby mode it is considered the secondary device. If the ICL-PL goes down, the peer in standby mode will bring its member links to standby state. If the Interchassis Control Protocol (ICCP) connection goes down, the peer in standby mode will change the LACP system ID to the default value on its member links.

NOTE: You cannot have both peers hosting an MC-LAG be in active or standby mode. One peer must be in active mode, and the other peer must be in standby mode.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

mc-ae-id

Syntax mc-ae-id *mc-ae-id*;

Hierarchy Level [edit interfaces aggregated-ether-options mc-ae]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Specify the multichassis aggregated Ethernet (MC-AE) identification number of the MC-AE that a given aggregated Ethernet interface belongs to. The two peers that host a given multichassis link aggregation group (MC-LAG) must have the same multichassis aggregated Ethernet ID.

Options **Range:** 1 through 65535.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

minimum-interval (Liveness Detection)

Syntax minimum-interval *milliseconds*;

Hierarchy Level [edit protocols iccp peer liveness-detection]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Configure simultaneously the minimum interval at which the peer transmits liveness detection requests and the minimum interval at which the peer expects to receive a reply from a peer with which it has established a Bidirectional Forwarding Detection (BFD) session. Optionally, instead of using this statement, you can specify the minimum transmit and receive intervals separately by using the **transmit-interval minimal-interval** and **minimum-receive-interval** statements, respectively.

Options *milliseconds*—Specify the minimum interval value for Bidirectional Forwarding Detection (BFD).

Range: 1 through 255,000

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

minimum-links

Syntax minimum-links *number*;

Hierarchy Level [edit interfaces ae*x* aggregated-ether-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For an aggregated Ethernet interface, set the minimum number of links that must be up for the bundle to be labeled up.

Options *number*—Number of links.

Range: 1 through 8

Default: 1

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Link Aggregation on page 2019

minimum-receive-interval (Liveness Detection)

Syntax minimum-receive-interval *milliseconds*;

Hierarchy Level [edit protocols iccp peer liveness-detection]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Configure the minimum interval at which the peer must receive a reply from a peer with which it has established a Bidirectional Forwarding Detection (BFD) session.

Options *milliseconds*—Specify the minimum interval value.

Range: 1 through 255,000

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

mode (QFX Series)

Syntax mode active-active ;

Hierarchy Level [edit interfaces aggregated-ether-options mc-ae]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Configure the multichassis link aggregation group (MC-LAG) to be in active-active mode. In active-active mode, all of the members of the MC-LAG will be active on both routing or switching devices. Only active-active mode is supported at this time.

Options **active-active**—Specify that all of the members of the MC-LAG will be active on both routing or switching devices.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

multi-chassis

Syntax

```
multi-chassis {
  multi-chassis-protection peer-ip-address {
    interface interface-name;
  }
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Configure an interchassis link-protection link (ICL-PL) between the two peers that host a multichassis link aggregation group (MC-LAG). You can configure either an aggregated Ethernet interface or a 10-Gigabit Ethernet interface to be an ICL-PL.

Options **interface *interface-name***—Specify the logical interface name of the peer.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

multi-chassis-protection

Syntax

```
multi-chassis-protection peer-ip-address {
  interface interface-name;
}
```

Hierarchy Level [edit multi-chassis]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Configure multichassis link protection between the two peers that host a multichassis link aggregation group (MC-LAG). If the Interchassis Control Protocol (ICCP) connection is up and the interchassis link (ICL) comes up, the peer configured as standby brings up the multichassis aggregated Ethernet (MC-AE) interfaces shared with the peer. Multichassis protection must be configured on one interface for each peer.

The remaining statements are explained separately.

Options **interface *interface-name***—Specify the logical interface name of the peer.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

multiplier (Liveness Detection)

Syntax multiplier *number*;

Hierarchy Level [edit protocols iccp peer liveness-detection]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Configure the number of liveness detection requests not received by the peer before Bidirectional Forwarding Detection (BFD) declares the peer is down.

Options **number**—Maximum allowable number of liveness detection requests missed by the peer.

Range: 1 through 255

Default: 3

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

mtu

Syntax mtu *bytes*;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces interface-range *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the maximum transmission unit (MTU) size for the media. Changing the media MTU size causes an interface to be deleted and added again. On a QFX3500 switch, either standalone or as part of the QFabric system, the maximum MTU value on an untagged packet transiting through an ingress Gigabit Ethernet interface must be no more than the currently configured MTU value plus four, whereas the maximum MTU value on a tagged packet transiting through an ingress Gigabit Ethernet interface must be no more than the currently configured MTU value plus eight. The maximum MTU value on an untagged or tagged packet transiting through an ingress 10-Gigabit Ethernet interface must be no more than the currently configured MTU value plus eight.

Options *bytes* —MTU size.

Range: 64 through 9216 bytes

Default: 1514 bytes

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- *Junos OS Network Interfaces Library for Routing Devices*

no-adaptation (Liveness Detection)

Syntax no-adaptation;

Hierarchy Level [edit protocols iccp peer liveness-detection]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Configure Bidirectional Forwarding Detection (BFD) sessions to not adapt to changing network conditions.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

no-gratuitous-arp-request

Syntax no-gratuitous-arp-request;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces interface-range *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the switch not to respond to gratuitous ARP requests. You can disable responses to gratuitous ARP requests on both Layer 2 Ethernet switching interfaces and routed VLAN interfaces (RVIs).

Default Gratuitous ARP responses are enabled on all Ethernet switching interfaces and RVIs.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Routed VLAN Interfaces on page 1532

on-disk-failure

Syntax

```
on-disk-failure {
  disk-failure-action (halt | reboot);
}
```

Hierarchy Level [edit chassis redundancy]
[edit chassis routing-engine]

Release Information Statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Instruct the router to halt or reboot if it detects hard disk errors on the Routing Engine.

Options The remaining statement is explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- graceful-switchover on page 1775
- *Configuring the Junos OS to Enable a Routing Engine to Reboot on Hard Disk Errors*
- *Installing Software on an EX Series Switch with Redundant Routing Engines (CLI Procedure)*
- *High Availability Features for EX Series Switches Overview*

on-loss-of-keepalives

Syntax on-loss-of-keepalives;

Hierarchy Level [edit chassis redundancy failover]

Release Information Statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Instruct the backup router to take mastership if it detects a loss of keepalive signal from the master Routing Engine.

Default The **on-loss-of-keepalives** statement must be included at the **[edit chassis redundancy failover]** hierarchy level for failover to occur.

When the **on-loss-of-keepalives** statement is included but graceful Routing Engine switchover *is not* configured, failover occurs after 300 seconds (5 minutes).

When the **on-loss-of-keepalives** statement is included and graceful Routing Engine switchover *is* configured, the keepalive signal is automatically enabled and the failover time is set to 2 seconds.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- graceful-switchover on page 1775
- *keepalive-time*
- *Installing Software on an EX Series Switch with Redundant Routing Engines (CLI Procedure)*
- *High Availability Features for EX Series Switches Overview*

peer (ICCP)

Syntax

```
peer ip-address {
  authentication-key string;
  backup-liveness-detection {
    backup-peer-ip ip-address;
  }
  liveness-detection {
    detection-time {
      threshold milliseconds;
    }
    minimum-intervalmilliseconds;
    minimum-receive-interval milliseconds;
    multiplier number;
    no-adaptation;
    transmit-interval {
      minimum-interval milliseconds;
      threshold milliseconds;
    }
    version (1 | automatic);
  }
  local-ip-addr ipv4-address;
  session-establishment-hold-time seconds;
}
```

Hierarchy Level [edit protocols iccp]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Configure the peers that host a multichassis link aggregation group (MC-LAG). You must configure Interchassis Control Protocol (ICCP) for both peers that host the MC-LAG.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

peer (Multichassis)

Syntax
peer *ip-address* {
  interface *interface-name*;
}

Hierarchy Level [edit multi-chassis]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Configure the IP address of the peer that is part of the interchassis link-protection link (ICL-PL). If the Interchassis Control Connection Protocol (ICCP) is up and the interchassis link (ICL) comes up, the peer configured as standby will bring up the MC-AE interfaces shared with the active peer specified by the **peer** statement. You must specify the physical interface of the peer.

Options **interface *interface-name***—Specify the logical interface name of the peer.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

periodic

Syntax periodic (fast | slow);

Hierarchy Level [edit interfaces ae*x* aggregated-ether-options lacp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the interval for periodic transmission of LACP packets.

Default fast

Options ***interval***—Interval at which to periodically transmit LACP packets:

- **fast**—Receive packets every second. This is the default.
- **slow**—Receive packets every 30 seconds.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- Understanding Aggregated Ethernet Interfaces and LACP on page 1843
- *Junos OS Network Interfaces Library for Routing Devices*

preempt-cutover-timer

Syntax preempt-cutover-timer *seconds*;

Hierarchy Level

- For platforms with ELS:

  [edit switch-options redundant-trunk-group group *name*]

- For platforms without ELS:

  [edit ethernet-switching-optionsredundant-trunk-group group *name*]

Release Information Statement introduced in Junos OS Release 11.1 for EX Series switches.
Hierarchy level **[edit switch-options]** introduced in Junos OS Release 13.2X50-D10 (ELS). (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)
Statement introduced in Junos OS Release 13.2X50-D15 for the QFX Series.

Description Change the length of time that a re-enabled primary link waits to take over from an active secondary link in a redundant trunk group.

Default If you do not change the time with the **preempt-cutover-timer** statement, a re-enabled primary link takes over from the active secondary link after 120 seconds.

Options **seconds**—Number of seconds that the primary link waits to take over from the active secondary link.

Range: 1 through 600 seconds

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Redundant Trunk Links for Faster Recovery*
- Example: Configuring Redundant Trunk Links for Faster Recovery on page 2010
- Understanding Redundant Trunk Links on page 1885

redundancy (Graceful Switchover)

Syntax

```
redundancy {
  failover {
    on-disk-failure;
    on-loss-of-keepalives;
  }
  graceful-switchover;
}
```

Hierarchy Level [edit chassis]

Release Information Statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Enable redundant Routing Engines on a Virtual Chassis with two or more member switches or on a standalone EX6200 or EX8200 switch with more than one Routing Engine.

The remaining statements are explained separately.

Default Redundancy is enabled for the Routing Engines.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- graceful-switchover on page 1775
- Configuring Graceful Routing Engine Switchover in a Virtual Chassis (CLI Procedure) on page 1746
- *Installing Software on an EX Series Switch with Redundant Routing Engines (CLI Procedure)*
- *High Availability Features for EX Series Switches Overview*

redundant-trunk-group

Syntax

```
redundant-trunk-group {
  group name {
    interface interface-name <primary>;
    interface interface-name;
    preempt-cutover-timer seconds;
  }
}
```

Hierarchy Level

- For platforms with ELS:

  [edit switch-options]

- For platforms without ELS:

  [edit ethernet-switching-options]

Release Information

Statement introduced in Junos OS Release 9.0 for EX Series switches.
Hierarchy level **[edit switch-options]** introduced in Junos OS Release 13.2X50-D10 (ELS). (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)
Statement introduced in Junos OS Release 13.2X50-D15 for the QFX Series.

Description

Configure a primary link and secondary link on trunk ports. If the primary link fails, the secondary link automatically takes over without waiting for normal spanning-tree protocol convergence.

The remaining statements are explained separately.

Required Privilege Level

system—To view this statement in the configuration.
system–control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Redundant Trunk Links for Faster Recovery*
- Example: Configuring Redundant Trunk Links for Faster Recovery on page 2010
- Understanding Redundant Trunk Links on page 1885

rx-buffers

Syntax rx-buffers (on | off);

Hierarchy Level [edit interfaces *interface-name* ether-options configured-flow-control]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable or disable an interface to generate and send Ethernet PAUSE messages. If you enable the receive buffers to generate and send PAUSE messages, when the receive buffers reach a certain level of fullness, the interface sends a PAUSE message to the connected peer. If the connected peer is properly configured, it stops transmitting frames to the interface on the entire link. When the interface receive buffer empties below a certain threshold, the interface sends a message to the connected peer to resume sending frames.

Ethernet PAUSE prevents buffers from overflowing and dropping packets during periods of network congestion. If the other devices in the network are also configured to support PAUSE, PAUSE supports lossless operation. Use the **rx-buffers** statement with the **tx-buffers** statement to configure asymmetric Ethernet PAUSE on an interface. (Use the **flow-control** statement to enable symmetric PAUSE and the **no-flow-control** statement to disable symmetric PAUSE on an interface. Symmetric flow control and asymmetric flow control are mutually exclusive features. If you attempt to configure both, the switch returns a commit error.)

NOTE: Ethernet PAUSE temporarily stops transmitting all traffic on a link when the buffers fill to a certain threshold. To temporarily pause traffic on individual “lanes” of traffic (each lane contains the traffic associated with a particular IEEE 802.1p code point, so there can be eight lanes of traffic on a link), use priority-based flow control (PFC).

Ethernet PAUSE and PFC are mutually exclusive features, so you cannot configure both of them on the same interface. If you attempt to configure both Ethernet PAUSE and PFC on an interface, the switch returns a commit error.

Default Flow control is disabled. You must explicitly configure Ethernet PAUSE flow control on interfaces.

Options **on | off**—Enable or disable an interface to generate and send Ethernet PAUSE messages.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- flow-control on page 2060
- tx-buffers on page 2113

- Enabling and Disabling CoS Symmetric Ethernet PAUSE Flow Control on page 5688
- Configuring CoS Asymmetric Ethernet PAUSE Flow Control on page 5689
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

routing-engine

Syntax

```
routing-engine {
  on-disk-failure {
    disk-failure-action (halt | reboot);
  }
}
```

Hierarchy Level [edit chassis]
[edit chassis interconnect-device *name*],
[edit chassis node-group *name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a Routing Engine to halt or reboot automatically when a hard disk error occurs. A hard disk error may cause a Routing Engine to enter a state in which it responds to local pings and interfaces remain up, but no other processes are responding. Rebooting or halting prevents this.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Junos OS to Enable a Routing Engine to Reboot on Hard Disk Errors*
- *Junos OS High Availability Library for Routing Devices*

session-establishment-hold-time

Syntax session-establishment-hold-time *seconds*;

Hierarchy Level [edit protocols iccp peer],
[edit protocols iccp]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Specify the time during which an Interchassis Control Protocol (ICCP) connection must be established between peers.

Options **seconds**—Time (in seconds) within which a successful ICCP connection must be established.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

source

Syntax source *source-address*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* tunnel]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Specify the source address of the tunnel.

Default If you do not specify a source address, the tunnel uses the unit's primary address as the source address of the tunnel.

Options ***source-address***—Address of the local side of the tunnel. This is the address that is placed in the outer IP header's source field.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Generic Routing Encapsulation Tunneling (CLI Procedure)*

speed

Syntax speed (auto-negotiation | *speed*);

Hierarchy Level [edit interfaces *interface-name* ether-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the speed of the interface.

Default Autonegotiation is automatically enabled for Gigabit Ethernet interfaces. Autonegotation is not an option for 10-Gigabit Ethernet interfaces. No explicit action is taken after the autonegotiation is complete or if the negotiation fails. If the **autonegotiation** statement at the **[edit interfaces *interface-name* ether-options]** hierarchy level is enabled, the **auto-negotiation** option is enabled by default.

Options

- **auto-negotiation**—Automatically negotiate the speed based on the speed of the other end of the link. Autonegotiation is automatically enabled for Gigabit Ethernet interfaces. Autonegotation is not an option for 10-Gigabit Ethernet interfaces. No explicit action is taken after the autonegotiation is complete or if the negotiation fails.
- ***speed*** —Specify the interface speed. This value sets the speed that is used on the link. If the **auto-negotiation** statement is enabled on a Gigabit Ethernet interface, configure the value to advertise to the interface at the other end of the link. If you disable autonegotation on a Gigabit Ethernet interface, you must explicitly configure the speed to 1g.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- auto-negotiation on page 2044
- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015

- *Junos OS Network Interfaces Library for Routing Devices*

status-control

Syntax status-control (active | standby);

Hierarchy Level [edit interfaces aggregated-ether-options mc-ae]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description Specify whether a peer hosting a multichassis link aggregation group (MC-LAG) is primary or secondary. Primary is considered active, and secondary is considered standby.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

targeted-broadcast

Syntax targeted-broadcast;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit interfaces interface-range *interface-range-name* unit *logical-unit-number* family inet]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify whether the IP packets destined for a Layer 3 broadcast need to be forwarded to both an egress interface and the Routing Engine, or to an egress interface only. The packets are broadcast only if the egress interface is a LAN interface.

Default When this statement is not included, broadcast packets are sent to the Routing Engine only.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring IP Directed Broadcast on an EX Series Switch*
- *Configuring IP Directed Broadcast (CLI Procedure)*
- *Understanding IP Directed Broadcast for EX Series Switches*

threshold (Detection Time)

Syntax threshold *milliseconds*;

Hierarchy Level [edit protocols iccp peer liveness-detection detection-time]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Specify the threshold for the adaptation of the detection time for a Bidirectional Forwarding Detection (BFD) session. When the detection time adapts to a value equal to or greater than the threshold, a single trap and a single system log message are sent.

NOTE: **The threshold time must be greater than or equal to the minimum-interval or the minimum-receive-interval. values.**

Options *milliseconds*— Value for the detection time adaptation threshold.

Range: 1 through 255,000

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

traceoptions (ICCP)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <disable>;
}
```

Hierarchy Level [edit protocols iccp]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Set Interchassis Control Protocol (ICCP) tracing options.

Default Tracing operations are disabled.

Options **disable**—(Optional) Disable the tracing operation. One use of this option is to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *name*—Name of the file to receive the output of the tracing operation. Enclose the name in quotation marks. By default, the log file is stored in **/var/log/**.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten.

If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 1 trace file only

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

The following are the tracing options:

- **all**—All tracing operations
- **config-internal**—Trace configuration internals.
- **general**—Trace general events.
- **normal**—All normal events.

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **parse**—Trace configuration parsing.
- **policy**—Trace policy operations and actions.

- **route**—Trace routing table changes.
- **state**—Trace state transitions.
- **task**—Trace protocol task processing.
- **timer**—Trace protocol task timer processing.

no-world-readable—(Optional) Prevent any user from reading the log file.

size ***size***—(Optional) Maximum size of each trace file, in kilobytes (KB) or megabytes (MB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

transmit-interval (Liveness Detection)

Syntax

```
transmit-interval {
  minimum-interval milliseconds;
  threshold milliseconds;
}
```

Hierarchy Level [edit protocols iccp peer liveness-detection]

Release Information
Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description
Configure the Bidirectional Forwarding Detection (BFD) transmit interval. The negotiated transmit interval for a peer is the interval between the sending of BFD liveness detection requests to peers. The receive interval for a peer is the minimum interval between receiving packets sent from its peer; the receive interval is not negotiated between peers. To determine the transmit interval, each peer compares its configured minimum transmit interval with its peer's minimum receive interval. The larger of the two numbers is accepted as the transmit interval for that peer.

The remaining statements are explained separately.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

traceoptions (Individual Interfaces)

Syntax

```
traceoptions {
  flag flag;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define tracing operations for individual interfaces.

To specify more than one tracing operation, include multiple **flag** statements.

The **traceoptions** statement for interfaces does not support a trace file. The logging is done by the kernel, so the tracing information is placed in the system **syslog** file in the directory **/var/log**.

NOTE: The traceoptions statement is not supported on the QFX3000 QFabric system.

Default If you do not include this statement, no interface-specific tracing operations are performed.

Options *flag*—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements. The following are the interface-specific tracing options.

- **all**—All interface tracing operations
- **event**—Interface events
- **ipc**—Interface interprocess communication (IPC) messages
- **media**—Interface media changes
- **q921**—ISDN Q.921 frames
- **q931**—ISDN Q.931 frames

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Tracing Operations of an Individual Router or Switch Interface*

traps

Syntax (traps | no-traps);

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit interfaces interface-range *interface-range-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Enable or disable the sending of SNMP notifications when the state of the connection changes.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Enabling or Disabling SNMP Notifications on Physical Interfaces*
- *Enabling or Disabling SNMP Notifications on Logical Interfaces*

tunnel

Syntax

```
tunnel {
  destination destination-address;
  source source-address;
  ttl number;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure a tunnel. You can use the tunnel for unicast and multicast traffic or just for multicast traffic. You can also use tunnels for encrypted traffic.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Generic Routing Encapsulation Tunneling (CLI Procedure)*

tunnel-port

Syntax tunnel-port *port-number* tunnel-services;

Hierarchy Level [edit chassis fpc *slot* pic *pic-number*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure the port number for generic routing encapsulation (GRE) tunneling.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Generic Routing Encapsulation Tunneling (CLI Procedure)*

tx-buffers

Syntax tx-buffers (on | off);

Hierarchy Level [edit interfaces *interface-name* ether-options configured-flow-control]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable or disable an interface to respond to received Ethernet PAUSE messages. If you enable the transmit buffers to respond to PAUSE messages, when the interface receives a PAUSE message from the connected peer, the interface stops transmitting frames on the entire link. When the receive buffer on the connected peer empties below a certain threshold, the peer interface sends a message to the paused interface to resume sending frames.

Ethernet PAUSE prevents buffers from overflowing and dropping packets during periods of network congestion. If the other devices in the network are also configured to support PAUSE, PAUSE supports lossless operation. Use the **tx-buffers** statement with the **rx-buffers** statement to configure asymmetric Ethernet PAUSE on an interface. (Use the **flow-control** statement to enable symmetric PAUSE and the **no-flow-control** statement to disable symmetric PAUSE on an interface. Symmetric flow control and asymmetric flow control are mutually exclusive features. If you attempt to configure both, the switch returns a commit error.)

NOTE: Ethernet PAUSE temporarily stops transmitting all traffic on a link when the buffers fill to a certain threshold. To temporarily pause traffic on individual “lanes” of traffic (each lane contains the traffic associated with a particular IEEE 802.1p code point, so there can be eight lanes of traffic on a link), use priority-based flow control (PFC).

Ethernet PAUSE and PFC are mutually exclusive features, so you cannot configure both of them on the same interface. If you attempt to configure both Ethernet PAUSE and PFC on an interface, the switch returns a commit error.

Default Flow control is disabled. You must explicitly configure Ethernet PAUSE flow control on interfaces.

Options **on | off**—Enable or disable an interface to respond to an Ethernet PAUSE message.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- flow-control on page 2060
- rx-buffers on page 2103

- Enabling and Disabling CoS Symmetric Ethernet PAUSE Flow Control on page 5688
- Configuring CoS Asymmetric Ethernet PAUSE Flow Control on page 5689
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

unit

Syntax

```
unit logical-unit-number {
  family {
    ethernet-switching {
      filter input filter-name;
      filter output filter-name;
      native-vlan-id vlan-id;
      port-mode mode;
      vlan {
        members [ (all | names | vlan-ids) ];
      }
    }
    fibre-channel {
      port-mode (f-port | np-port);
    }
    inet {
      address address {
        primary;
      }
      filter input filter-name;
      filter output filter-name;
      primary;
      targeted-broadcast;
    }
```

Hierarchy Level

[edit interfaces *interface-name*],
[edit interfaces interface-range *interface-range-name*]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure a logical interface on the physical device. You must configure a logical interface to be able to use the physical device.

Default

You must configure a logical interface to be able to use the physical device.

Options

logical-unit-number—Number of the logical unit.

Range: 0 through 16,384

The remaining statements are explained separately.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- Configuring Link Aggregation on page 2019
- *Junos OS Network Interfaces Library for Routing Devices*

uplink-failure-detection

Syntax

```
uplink-failure-detection {
  group group-name {
    link-to-monitor interface-name;
    link-to-disable interface-name;
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure uplink and downlink interfaces in a group to monitor uplink failures and to propagate uplink failure information to the downlink interfaces.

The remaining statements are explained separately.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Overview of Uplink Failure Detection on page 1841
- Configuring Interfaces for Uplink Failure Detection on page 2018
- Example: Configuring Interfaces for Uplink Failure Detection on page 1891

version (Liveness Detection)

Syntax version (1 | automatic);

Hierarchy Level [edit protocols iccp peer liveness-detection]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Configure the Bidirectional Forwarding Detection (BFD) protocol version to detect.

Options **1**—Use BFD protocol version 1.

automatic—Autodetect the BFD protocol version.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

vlan-id

Syntax vlan-id *vlan-id-number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For 10-Gigabit Ethernet and aggregated Ethernet interfaces only, bind an 802.1Q VLAN tag ID to a logical interface.

NOTE: The VLAN tag ID cannot be configured on logical interface unit 0. The logical unit number must be 1 or higher.

Options *vlan-id-number*—Valid VLAN identifier.

Range: 1 through 4094

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- vlan-tagging on page 1627
- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- Configuring a Layer 3 Logical Interface on page 2019
- *Junos OS Network Interfaces Library for Routing Devices*

vlan-tagging

Syntax vlan-tagging;

Hierarchy Level [edit interfaces *interface-name*]
[edit interfaces interface-range *interface-range-name*]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Enable VLAN tagging. The platform receives and forwards single-tag frames with 802.1Q VLAN tags.

Default VLAN tagging is disabled by default.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- vlan-id on page 2117
- Configuring a Layer 3 Logical Interface on page 2019

Configuration Statements (ELS Only)

[edit interfaces et] Configuration Statement Hierarchy on the QFX Series

This topic lists supported and unsupported configuration statements in the **[edit interfaces et]** hierarchy level on EX Series switches.

- *Supported* statements are those that you can use to configure some aspect of a software feature on the switch.
- *Unsupported* statements are those that appear in the command-line interface (CLI) on the switch, but that have no effect on switch operation if you configure them.
- Not all features are supported on all switch platforms. For detailed information about feature support on specific QFX Series platforms, see *QFX Series Virtual Chassis Software Features Overview*.

This topic lists:

Supported Statements in the [edit interfaces et] Hierarchy Level

The following hierarchy shows the **[edit interfaces et]** configuration statements supported on EX Series switches.

```
interfaces {
  et-fpc/pic/port {
    accounting-profile name;
    description text;
    disable;
    encapsulation type;
    ether-options {
      802.3ad {
        aex;
        (backup | primary);
        lacp {
          force-up;
          port-priority number;
```

```
            }
        }
        ethernet-switch-profile {
            tag-protocol-id [tpids];
        }
        (flow-control | no-flow-control);
        (loopback | no-loopback);
        no-auto-mdix;
    }
    flexible-vlan-tagging;
    (gratuitous-arp-reply | no-gratuitous-arp-reply);
    hold-time up milliseconds down milliseconds;
    mtu bytes;
    native-vlan-id
    no-gratuitous-arp-request;
    traceoptions {
        flag flag;
    }
    (traps | no-traps);
    unit logical-unit-number {
        accounting-profile name;
        bandwidth rate;
        description text;
        disable;
        encapsulation type;
        family ccc;
            filter {
                group group-number;
                input filter-name;
                input-list [filter-names];
                output filter-name;
                output-list [filter-names];
            }
            policer {
                input policer-name;
                output policer-name;
            }
        }
        family ethernet-switching {
            filter {
                input filter-name;
                output filter-name;
            }
            interface-mode (access | trunk);
            recovery-timeout seconds;
            storm-control profile-name;
            vlan {
                members (vlan-name |[-vlan-names] | all);
            }
        }
        family inet {
            accounting {
                destination-class-usage;
                source-class-usage {
                    input;
                    output;
```

```
        }
      }
      address ipv4-address {
        arp ip-address (mac | multicast-mac) mac-address <publish>;
        broadcast address;
        preferred;
        primary;
        vrrp-group group-number {
          (accept-data | no-accept-data);
          advertise–interval seconds;
          advertisements-threshold number;
          authentication-key key;
          authentication-type authentication;
          fast-interval milliseconds;
          (preempt | no-preempt) {
            hold-time seconds;
          }
          priority number;
          track {
            interface interface-name {
              priority-cost number;
            }
            priority-hold-time seconds;
            route ip-address/mask routing-instance instance-name priority-cost cost;
          }
          virtual-address [addresses];
          vrrp-inherit-from {
            active-group group-number;
            active-interface interface-name;
          }
        }
      }
      filter {
        input filter-name;
        output filter-name;
      }
      mtu bytes;
      no-neighbor-learn;
      no-redirects;
      primary;
      rpf-check {
        fail-filter filter-name;
        mode {
          loose;
        }
      }
    }
    family inet6 {
      accounting {
        destination-class-usage;
        source-class-usage {
          input;
          output;
        }
      }
      address address {
```



```
    eui-64;
    ndp ip-address (mac | multicast-mac) mac-address <publish>;
    preferred;
    primary;
    vrrp-inet6-group group-id {
      accept-data | no-accept-data;
      advertisements-threshold number;
      authentication-key key;
      authentication-type authentication;
      fast-interval milliseconds;
      inet6-advertise-interval milliseconds;
      preempt | no-preempt {
        hold-time seconds;
      }
      priority number;
      track {
        interface interface-name {
          priority-cost number;
        }
        priority-hold-time seconds;
        route ip-address/mask routing-instance instance-name priority-cost cost;
      }
      virtual-inet6-address [addresses];
      virtual-link-local-address ipv6–address;
      vrrp-inherit-from {
        active-group group-name;
        active-interface interface-name;
      }
    }
  }
  (dad-disable | no-dad-disable);
  filter {

    input filter-name;

    output filter-name;

  }
  mtu bytes;
  nd6-stale-time time;
  no-neighbor-learn;
  no-redirects;
  policer {
    input policer-name;
    output policer-name;
  }
  rpf-check {
    fail-filter filter-name;
    mode {
      loose;
    }
  }
}
family iso {
  address interface-address;
```



```
            mtu bytes;
          }
          input-vlan-map action;
          output-vlan-map action;
          proxy-arp (restricted | unrestricted);
          swap-by-poppush;
          (traps | no-traps);
          vlan-id vlan-id-number;
          vlan-id-list [vlan-id vlan-id–vlan-id];
        }
        vlan-tagging;
      }
    }
```

Unsupported Statements in the [edit interfaces et] Hierarchy Level

All statements in the **[edit interfaces et]** hierarchy level that are displayed in the command-line interface (CLI) on the switch are supported on the switch and operate as documented with the following exceptions:

Table 177: Unsupported [edit interfaces et] Configuration Statements for the QFX Series

Statement	Hierarchy
passive-monitor-mode	[edit interfaces et]
stacked-vlan-tagging	[edit interfaces et]
asynchronous-notification	[edit interfaces et ether-options]
ignore-l3-incompletes	[edit interfaces et ether-options]
mpls	[edit interfaces et ether-options]
source-address-filter	[edit interfaces et ether-options]
source-filtering	[edit interfaces et ether-options]
no-source-filtering	[edit interfaces et ether-options]
accept-source-mac	[edit interfaces et unit]
layer2-policer	[edit interfaces et unit]
native-inner-vlan-id	[edit interfaces et unit]
vlan-id-range	[edit interfaces et unit]
vlan-tags	[edit interfaces et unit]
mpls	[edit interfaces et unit family]
tcc	[edit interfaces et unit family]

Table 177: Unsupported [edit interfaces et] Configuration Statements for the QFX Series *(continued)*

Statement	Hierarchy
vpls	[edit interfaces et unit family]
bridge-domain-type	[edit interfaces et unit family ethernet-switching]
inner-vlan-id-list	[edit interfaces et unit family ethernet-switching]
vlan-rewrite	[edit interfaces et unit family ethernet-switching]
policer	[edit interfaces et unit family inet]
sampling	[edit interfaces et unit family inet]
service	[edit interfaces et unit family inet]
targeted-broadcast	[edit interfaces et unit family inet]
unnumbered-address	[edit interfaces et unit family inet]
bandwidth-threshold	[edit interfaces et unit family inet address vrrp-group track interface]
service	[edit interfaces et unit family inet6]
bandwidth-threshold	[edit interfaces et unit family inet6 address vrrp-group track interface]
group	[edit interfaces et unit family inet6 filter]

Related Documentation

- *QFX Series Virtual Chassis Software Features Overview*

channel-speed

Syntax channel-speed (10g;|disable-auto-speed-detection) ;

Hierarchy Level [edit chassis fpc *slot-number* pic *pic-number* (port *port-number* | port-range *port-range-low* *port-range-high*)]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description (QFX3500, QFX3600, and QFX5100 standalone switches running Enhanced Layer 2 Software only)—Enable the specified port on the Physical Interface Card (PIC) to perform in the specified channel speed. Additionally, you can disable auto-speed detection.

Default **40g** (40-Gigabit Ethernet).

Options **10g**—Set the channel speed to 10g (10-Gigabit Ethernet).

disable-auto-speed-detection—Disable auto-speed detection.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches on page 2028

chassis

Syntax

```
chassis {
  routing-engine {
  redundancy {
    failover {
      on-disk-failure {
      disk-failure-action (halt | reboot);
      }
      on-loss-of-keepalives;
    }
    graceful-switchover;
  }
  aggregated-devices {
    ethernet {
      device-count number;
    }
    alarm {
      interface-type {
        alarm-name (red | yellow | ignore);
      }
    }
  }
  forwarding-options profile-name {
    num-65-127-prefix value
  }
  fpc slot {
    auto-speed-detection disable
      pic pic-number{
      port port-number{
        tunnel-port port-number tunnel-services;
        channel-speed speed;
      }
      port-range port-range-low port-range-high {
        channel-speed speed;
      }
    }
  }
  maximum-ecmp next-hops;
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure chassis-specific properties for the switch.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Link Aggregation on page 2019

ethernet-switching

Syntax

```
ethernet-switching {
  filter {
    group filter-group-number;
    input filter-name;
    input-list [ filter-names ];
    output filter-name;
    output-list [ filter-names ];
  }
  interface-mode (access | trunk);
  recovery-timeout seconds;
  storm-control profile-name;
  vlan {
    members (vlan-name |[-vlan-names] | all);
  }
}
```

Hierarchy Level [edit interfaces ge-*chassis/slot/port* unit *logical-unit-number*] family

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Ethernet switching protocol family information for the logical interface.

The remaining statements are explained separately.

Default You must configure a logical interface to be able to use the physical device.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- *JUNOS Software Network Interfaces Configuration Guide*

family

Syntax

```
family {
  ethernet-switching {
    filter {
      group filter-group-number;
      input filter-name;
      input-list [ filter-names ];
      output filter-name;
      output-list [ filter-names ];
    }
    interface-mode (access | trunk);
    recovery-timeout seconds;
    storm-control profile-name;
    vlan {
      members (vlan-name |[-vlan-names] | all);
    }
  }
  inet {
    accounting {
      destination-class-usage;
      source-class-usage {
        input;
        output;
      }
    }
    address ipv4-address {
      arp ip-address (mac | multicast-mac) mac-address <publish>;
      broadcast address;
      preferred;
      primary;
      vrrp-group group-number {
        (accept-data | no-accept-data);
        advertise–interval seconds;
        advertisements-threshold number;
        authentication-key key;
        authentication-type authentication;
        fast-interval milliseconds;
        (preempt | no-preempt) {
          hold-time seconds;
        }
        priority number;
        track {
          interface interface-name {
            priority-cost number;
          }
          priority-hold-time seconds;
          route ip-address/mask routing-instance instance-name priority-cost cost;
        }
        virtual-address [addresses];
        vrrp-inherit-from {
          active-group group-number;
          active-interface interface-name;
        }
```

```
    }
  }
  filter {
    group filter-group-number;
    input filter-name;
    input-list [ filter-names ];
    output filter-name;
    output-list [ filter-names ];
  }
  mtu bytes;
  no-neighbor-learn;
  no-redirects;
  primary;
  rpf-check {
    fail-filter filter-name;
    mode {
      loose;
    }
  }
}
inet6 {
  accounting {
    destination-class-usage;
    source-class-usage {
      input;
      output;
    }
  }
  address address {
    eui-64;
    ndp ip-address (mac | multicast-mac) mac-address <publish>;
    preferred;
    primary;
    vrrp-inet6-group group-id {
      accept-data | no-accept-data;
      advertisements-threshold number;
      authentication-key key;
      authentication-type authentication;
      fast-interval milliseconds;
      inet6-advertise-interval milliseconds;
      preempt | no-preempt {
        hold-time seconds;
      }
      priority number;
      track {
        interface interface-name {
          priority-cost number;
        }
        priority-hold-time seconds;
        route ip-address/mask routing-instance instance-name priority-cost cost;
      }
      virtual-inet6-address [addresses];
      virtual-link-local-address ipv6–address;
      vrrp-inherit-from {
        active-group group-name;
        active-interface interface-name;
```



```
            }
          }
        }
        (dad-disable | no-dad-disable);
        filter {
          group filter-group-number;
          input filter-name;
          input-list [ filter-names ];
          output filter-name;
          output-list [ filter-names ];
        }
        mtu bytes;
        nd6-stale-time time;
        no-neighbor-learn;
        no-redirects;
        policer {
          input policer-name;
          output policer-name;
        }
        rpf-check {
          fail-filter filter-name;
          mode {
            loose;
          }
        }
        mpls {
          filter {
            group filter-group-number;
            input filter-name;
            input-list [ filter-names ];
            output filter-name;
            output-list [ filter-names ];
          }
        mtu bytes;
        }
      }
    }
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit interfaces interface-range *interface-name* unit *logical-unit-number* family]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure protocol family information for the logical interface on the QFX Series product.

Default Access interfaces on the QFX Series are set to **family ethernet-switching** by default. If you are going to change the family setting for an interface, you might have to delete this default setting or any user-configured family setting first.

You must configure a logical interface to be able to use the physical device.

Options

Interface types on the switch are:

- Aggregated Ethernet (**ae**)
- Gigabit Ethernet (**ge**)
- Loopback (**lo0**)
- Management Ethernet (**me0**)
- Routed VLAN interface (RVI) (**vlan**)
- 10-Gigabit Ethernet (**xe**)

Not all interface types support all **family** substatements. Check your switch CLI for supported substatements for a particular protocol family configuration.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- Configuring Link Aggregation on page 2019
- Configuring Routed VLAN Interfaces on page 1532
- *Junos OS Network Interfaces Library for Routing Devices*

fpc

Syntax

```
fpc slot {
  auto-speed-detection disable;
  pic pic-number{
    tunnel-port port-number tunnel-services;
    port port-number{
      channel-speed (speed|disable-auto-speed-detection) ;
    }
    port-range port-range-low port-range-high {
      channel-speed (speed|disable-auto-speed-detection);
    }
  }
}
```

Hierarchy Level [edit chassis]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the FPC slot number. For QFX3500 switches, the slot is a line card slot.

For generic routing encapsulation (GRE) tunneling, use the **tunnel-port** statement to specify the port that you want to convert to a GRE tunnel port.

Options *slot*—Number of the FPC slot. For QFX3500 and QFX3600 devices, the slot number is always **0**.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- show chassis fpc on page 597
- *Configuring Generic Routing Encapsulation Tunneling (CLI Procedure)*

interface-mode

Syntax interface-mode (access | trunk);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family bridge],
[edit interfaces *interface-name* unit *logical-unit-number* family ethernet-switching],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family bridge]

Release Information Statement introduced in Junos OS Release 9.2.
Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description

NOTE: This statement supports the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see port-mode. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

(QFX Series 3500 and 3600 standalone switches)—Determine whether the logical interface accepts or discards packets based on VLAN tags. Specify the **trunk** option to accept packets with a VLAN ID that matches the list of VLAN IDs specified in the **vlan-id** or **vlan-id-list** statement, then forward the packet within the bridge domain or VLAN configured with the matching VLAN ID. Specify the **access** option to accept packets with no VLAN ID, then forward the packet within the bridge domain or VLAN configured with the VLAN ID that matches the VLAN ID specified in the **vlan-id** statement.

NOTE: On MX Series routers, if you want IGMP snooping to be functional for a bridge domain, then you should not configure interface-mode and irb for that bridge. Such a configuration commit succeeds, but IGMP snooping is not functional, and a message informing the same is displayed. For more information, see *Configuring a Trunk Interface on a Bridge Network*.

Options **access**—Configure a logical interface to accept untagged packets. Specify the VLAN to which this interface belongs using the **vlan-id** statement.

trunk—Configure a single logical interface to accept packets tagged with any VLAN ID specified with the **vlan-id** or **vlan-id-list** statement.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring a Logical Interface for Access Mode*
- *Configuring a Logical Interface for Trunk Mode*

- *Example: Connecting Access Switches to a Distribution Switch*

pic

Syntax

```
pic pic-number{
  tunnel-port port-number tunnel-services;
  port port-number{
    channel-speed (speed|disable-auto-speed-detection) ;
  }
  port-range port-range-low port-range-high {
    channel-speed (speed|disable-auto-speed-detection) ;
  }
}
```

Hierarchy Level [edit chassis fpc *slot*]

Release Information Option **channel-speed** introduced in Junos OS Release 13.2 for the QFX Series.

Description (QFX3500, QFX3600, and QFX5100 standalone switches running Enhanced Layer 2 Software only)—Configure a specific port or a range of ports to operate as 10-Gigabit Ethernet ports or 40-Gigabit Ethernet ports.

Options **pic *pic-number***—(QFX3500 standalone switch only) Number of the physical interface card (PIC) on which you want to configure port types. Specify **1** to configure 10-Gigabit Ethernet or 40-Gigabit Ethernet type ports.

(QFX3600 standalone switch only) Number of the physical interface card (PIC) on which you want to configure port types. Specify **0** to configure 10-Gigabit Ethernet or 40-Gigabit Ethernet type ports.

port *physical-port-number*—Port number on which you want to configure the port type.

port-range-low—Lowest-numbered port in the range of ports.

port-range-high—Highest-numbered port in the range of ports.

channel-speed (*speed* |disable-auto-speed-detection) —Configure *10g* for 10-Gigabit Ethernet type ports, and configure disable-auto-speed-detection) to disable auto-channelization.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Channelizing Interfaces on QFX3500, QFX3600, and QFX5100 Switches on page 2028

service-id

Syntax service-id *number*;

Hierarchy Level [edit switch-options]
[edit vlans *vlan-name*]

Release Information Statement introduced in Junos OS Release 12.3R2 for EX Series switches and MX Series routers.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Specify a service identifier for each multichassis aggregated Ethernet interface that belongs to a link aggregation group (LAG).

Options number—A number that identifies a particular service.

Range: 1 through 65535

Required Privilege Level system—To view this statement in the configuration.
system control—To add this statement to the configuration.

Configuration Statements (Original CLI Only)

ethernet-switch-profile

Syntax

```
ethernet-switch-profile {
  ethernet-policer-profile {
    input-priority-map {
      ieee802.1p premium [values];
    }
    output-priority-map {
      classifier {
        premium {
          forwarding-class class-name {
            loss-priority (high | low);
          }
        }
      }
    }
    policer cos-policer-name {
      aggregate {
        bandwidth-limit bps;
        burst-size-limit bytes;
      }
      premium {
        bandwidth-limit bps;
        burst-size-limit bytes;
      }
    }
    tag-protocol-id tpid;
  }
  (mac-learn-enable | no-mac-learn-enable);
}
```

Hierarchy Level

[edit interfaces *interface-name* gigether-options],
[edit interfaces *interface-name* aggregated-ether-options],
[edit interfaces *interface-name* aggregated-ether-options],
[edit interfaces *interface-name* ether-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.
Statement introduced in Junos OS Release 13.2 for the QFX Series.
Statement introduced in Junos OS Release 13.2X50-D15 for the EX Series switches.

Description

NOTE: On QFX Series standalone switches, the **ethernet-policer-profile** CLI hierarchy and the **mac-learn-enable** statement are supported only on the Enhanced Layer 2 Switching CLI.

For Gigabit Ethernet IQ, 10-Gigabit Ethernet IQ2 and IQ2-E, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC, aggregated Ethernet with Gigabit Ethernet IQ interfaces, the built-in Gigabit Ethernet port on the M7i router); 100-Gigabit Ethernet Type 5 PIC with CFP; and Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit

Ethernet, and aggregated Ethernet interfaces on EX Series switches, configure VLAN tag and MAC address accounting and filtering properties.

The remaining statements are explained separately.

NOTE: When you gather interfaces into a bridge domain, the **no-mac-learn-enable** statement at the **[edit interfaces *interface-name* gigether-options ethernet-switch-profile]** hierarchy level is not supported. You must use the **no-mac-learning** statement at the **[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name*]** hierarchy level to disable MAC learning on an interface in a bridge domain. For information on disabling MAC learning for a bridge domain, see the *MX Series Layer 2 Configuration Guide*.

Default If the **ethernet-switch-profile** statement is not configured, Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i router) behave like Gigabit Ethernet interfaces.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Gigabit Ethernet Policers*
- *Configuring MAC Address Filtering*
- *Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview*
- *Configuring Q-in-Q Tunneling (CLI Procedure)*

ethernet-switching

Syntax

```
ethernet-switching {
  filter input filter-name;
  filter output filter-name;
  native-vlan-id vlan-id;
  port-mode mode;
  reflective-relay;
  vlan {
    members [ (all | names | vlan-ids) ];
  }
}
```

Hierarchy Level [edit interfaces ge-*chassis/slot/port* unit *logical-unit-number*] family

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Ethernet switching protocol family information for the logical interface.

The remaining statements are explained separately.

Default You must configure a logical interface to be able to use the physical device.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- *JUNOS Software Network Interfaces Configuration Guide*

family

Syntax

```
family {
  ethernet-switching {
    filter input filter-name;
    filter output filter-name;
    native-vlan-id vlan-id;
    port-mode mode;
    vlan {
      members [ (all | names | vlan-ids) ];
    }
  }
  fibre-channel {
    port-mode (f-port | np-port);
  }
  inet {
    address address {
      primary;
    }
    filter input filter-name;
    filter output filter-name;
    targeted-broadcast;
  }
  inet6 {
    address address {
      eui-64
        preferred
      primary;
    filter input filter-name;
    filter output filter-name;
    }
  }
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit interfaces interface-range *interface-name* unit *logical-unit-number* family]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure protocol family information for the logical interface on the QFX Series product.

Default Access interfaces on the QFX Series are set to **family ethernet-switching** by default. If you are going to change the family setting for an interface, you might have to delete this default setting or any user-configured family setting first.

You must configure a logical interface to be able to use the physical device.

Options See Table 178 on page 2139 for protocol families available on the QFX Series interfaces. Different protocol families support different subsets of the interface types on the QFX Series.

Interface types on the switch are:

- Aggregated Ethernet (**ae**)

- Gigabit Ethernet (**ge**)
- Loopback (**lo0**)
- Management Ethernet (**me0**)
- Routed VLAN interface (RVI) (**vlan**)
- 10-Gigabit Ethernet (**xe**)

Not all interface types support all **family** substatements. Check your switch CLI for supported substatements for a particular protocol family configuration.

Table 178: Protocol Families and Supported Interface Types

		Supported Interface Types					
Family	Description	ae	lo0	me0	vlan	ge	xe
ethernet-switching	Ethernet switching protocol family	✓		✓	✓	✓	✓
fibre-channel	Fibre Channel protocol family	✓			✓		✓
inet	IPv4 protocol family	✓	✓	✓	✓	✓	✓

The remaining statements are explained separately.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- Configuring Link Aggregation on page 2019
- Configuring Routed VLAN Interfaces on page 1532
- *Junos OS Network Interfaces Library for Routing Devices*

pic

Syntax

```
pic pic-number {
  fibre-channel {
    port-range {
      port-range-low port-range-high;
    }
  }
  xe {
    (port port-number | port-range port-range-low port-range-high);
  }
  xle {
    (port port-number | port-range port-range-low port-range-high);
  }
```

Hierarchy Level [edit chassis fpc *slot*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Options **xe** and **xle** introduced in Junos OS 12.2X50-D20 for the QFX Series.

Description (QFX3500 and QFX3600 standalone switches only) Enable the specified port on the Physical Interface Card (PIC) to perform in the specified operating mode.

Options *pic-number*—Number of the PIC.

- On a QFX3500 standalone switch, specify **0** if the port type is **fiber-channel**, and **2** if the port type is **xle**.
- On a QFX3600 standalone switch, specify **0** if the port type is **xe**, and **1** if the port type is **xle**.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring the QSFP+ Port Type on QFX3500 Standalone Switches on page 2034
- Configuring the Port Type on QFX3600 Standalone Switches on page 2032

port-mode

Syntax port-mode (access | tagged-access | trunk);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family ethernet-switching]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

NOTE: This statement does not support the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see interface-mode. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

Configure whether an interface on the switch operates in access, tagged access, or trunk mode.

Default All switch interfaces are in access mode.

Options

access—Have the interface operate in access mode. In this mode, the interface can be in a single VLAN only. Access interfaces typically connect to network devices such as PCs, printers, IP telephones, and IP cameras.

tagged-access—Have the interface operate in access mode. In this mode, the interface can be in multiple VLANs. Access interfaces typically connect to network devices such as PCs, printers, IP telephones, and IP cameras.

trunk—Have the interface operate in trunk mode. In this mode, the interface can be in multiple VLANs and can multiplex traffic between different VLANs. Trunk interfaces typically connect to other switches and to routers on the LAN.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Reflective Relay*
- *Example: Configuring Reflective Relay for Use with VEPA Technology*

xe (Port)

Syntax

```
xe {
  (port port-number | port-range port-range-low port-range-high);
}
```

Hierarchy Level [edit chassis fpc *slot* pic *pic-number*]

Release Information Statement introduced in Junos OS Release 12.2X50-D20 for the QFX Series.

Description (QFX3600 standalone switch only) Configure a specific port or a range of ports to operate as four 10-Gigabit Ethernet (*xe*) type ports.

CAUTION: The Packet Forwarding Engine on the switch is restarted when you commit the port type configuration changes. As a result, you might experience packet loss on the switch.

NOTE: Port Q0 supports only three (not the typical four)10-Gigabit Ethernet ports. Therefore, you can configure up to 63 (not 64) 10-Gigabit Ethernet ports on ports Q0 through Q15.

Options

port-number—Port number on which you want to configure the port type. Valid values are 0 through 15.

port-range-low—Lowest-numbered port in the range of ports. The lowest possible value is 0.

port-range-high—Highest-numbered port in the range of ports. The highest possible value is 15.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Port Type on QFX3600 Standalone Switches on page 2032

xle (Port)

Syntax

```
xle {
  (port port-number | port-range port-range-low port-range-high);
}
```

Hierarchy Level [edit chassis fpc *slot* pic *pic-number*]

Release Information Statement introduced in Junos OS Release 12.2X50-D20 for the QFX Series.

Description (QFX3500 and QFX3600 standalone switches only) Configure a specific QSFP+ port or a range of QSFP+ ports to operate as 40-Gigabit Ethernet (*xle*) type ports.

CAUTION: The Packet Forwarding Engine on the switch is restarted when you commit the port type configuration changes. As a result, you might experience packet loss on the switch.

Options ***port-number***—Port number on which you want to configure the port type. On a QFX3500 standalone switch, specify a value from 0 through 3. On a QFX3600 standalone switch, specify a value from 0 through 15.

port-range-low—Lowest-numbered port in the range of ports. The lowest possible value is 0.

port-range-high—Highest-numbered port in the range of ports. The highest possible value is 3 on QFX3500 standalone switches, and 15 on QFX3600 standalone switches.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the QSFP+ Port Type on QFX3500 Standalone Switches on page 2034
- Configuring the Port Type on QFX3600 Standalone Switches on page 2032

CHAPTER 25

Administration

Routine Monitoring

Monitoring System Process Information

Purpose View the processes running on the QFX Series.

Action To view the software processes running on the QFX Series:

[edit system]

user@switch> **show system processes**

Meaning Table 49 on page 307 summarizes the output fields in the system process information display.

The display includes the total CPU load and total memory utilization.

Table 179: Summary of System Process Information Output Fields

Field	Values
PID	Identifier of the process.

Table 179: Summary of System Process Information Output Fields *(continued)*

Field	Values
Name	Owner of the process.
State	Current state of the process.
CPU Load	Percentage of the CPU that is being used by the process.
Memory Utilization	Amount of memory that is being used by the process.
Start Time	Time of day when the process started.

Related Documentation

- Monitoring System Properties on page 308
- show system uptime on page 1025

Monitoring System Properties

Purpose View system properties such as the name and IP address of a QFX Series product and resource usage.

Action To monitor system properties in the CLI, enter the following commands:

- show system uptime
- show system users
- show system storage

Meaning Table 50 on page 308 summarizes key output fields in the system properties display.

Table 180: Summary of Key System Properties Output Fields

Field	Values	Additional Information
General Information		
Serial Number	Serial number for a QFX Series product.	
Junos OS Version	Version of Junos OS active on the switch, including whether the software is for domestic or export use.	Export software is for use outside the USA and Canada.
Hostname	Name of the QFX Series product.	
IP Address	IP address of the QFX Series product.	
Loopback Address	Loopback address.	

Table 180: Summary of Key System Properties Output Fields *(continued)*

Field	Values	Additional Information
Domain Name Server	Address of the domain name server.	
Time Zone	Time zone on the QFX Series product.	
Time		
Current Time	Current system time, in Coordinated Universal Time (UTC).	
System Booted Time	Date and time when the QFX Series product was last booted and how long it has been running.	
Protocol Started Time	Date and time when the protocols were last started and how long they have been running.	
Last Configured Time	Date and time when a configuration was last committed. This field also shows the name of the user who issued the last **commit** command.	
Load Average	CPU load average for 1, 5, and 15 minutes.	
Storage Media		
Internal Flash Memory	Usage details of internal flash memory.	
External Flash Memory	Usage details of external USB flash memory.	
Logged in Users Details		
User	Username of any user logged in to the switch.	
Terminal	Terminal through which the user is logged in.	
From	System from which the user has logged in. A hyphen indicates that the user is logged in through the console.	
Login Time	Time when the user logged in.	This is the **user@switch** field in **show system users** command output.
Idle Time	How long the user has been idle.	

Related Documentation

- Monitoring System Process Information on page 307
- **show system processes on page 941**

Monitoring Interface Status and Traffic

Purpose View interface status to monitor interface bandwidth utilization and traffic statistics on the QFX Series product.

Action

- To view interface status for all the interfaces, enter show interfaces xe.
- To view status and statistics for a specific interface, enter show interfaces xe ***interface-name***.
- To view status and traffic statistics for all interfaces, enter either show interfaces xe **detail** or show interfaces xe **extensive**.

Meaning For details about output from the CLI commands, see show interfaces xe.

Verifying That Layer 3 Logical Interfaces Are Working

Purpose After configuring Layer 3 logical interfaces, verify that they are set up properly and transmitting data.

Action

1. To determine if you have successfully created the logical interfaces and the links are up:

```
[edit interfaces]
user@switch> show interfaces interface-name terse
Interface               Admin Link Proto    Local                 Remote
ge-0/0/0                up    up
ge-0/0/0.0              up    up   inet     1.1.1.1/24
ge-0/0/0.1              up    up   inet     2.1.1.1/24
ge-0/0/0.2              up    up   inet     3.1.1.1/24
ge-0/0/0.3              up    up   inet     4.1.1.1/24
ge-0/0/0.4              up    up   inet     5.1.1.1/24
ge-0/0/0.32767          up    up
```

2. Use the **ping** command from a device on one subnet to an address on another subnet to determine if packets were transmitted correctly on the logical interface VLANs:

```
user@switch> ping ip-address
PING 1.1.1.1 (1.1.1.1): 56 data bytes
64 bytes from 1.1.1.1: icmp_seq=0 ttl=64 time=0.157 ms
64 bytes from 1.1.1.1: icmp_seq=1 ttl=64 time=0.238 ms
64 bytes from 1.1.1.1: icmp_seq=2 ttl=64 time=0.255 ms
64 bytes from 1.1.1.1: icmp_seq=3 ttl=64 time=0.128 ms
--- 1.1.1.1 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
```

Meaning The output confirms that the logical interfaces have been created and the links are up.

Related Documentation

- Configuring a Layer 3 Logical Interface on page 2019

Verifying the Status of a LAG Interface

Purpose Verify that a link aggregation group (LAG) (**ae0**) has been created on the switch.

Action To verify that the **ae0** LAG has been created:

```
[edit interfaces]
show interfaces ae0 terse
```

```
Interface              Admin    Link  Proto      Local              Remote


ae0                      up       up

ae0.0                    up       up     inet     10.10.10.2/24
```

Meaning The output confirms that the **ae0** link is up and shows the family and IP address assigned to this link.

Related Documentation

- Configuring Link Aggregation on page 2019
- Verifying That LACP Is Configured Correctly and Bundle Members Are Exchanging LACP Protocol Packets on page 2149
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896

  Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch on page 1900
- **show lacp statistics interfaces (View) on page 2261**

Verifying That LACP Is Configured Correctly and Bundle Members Are Exchanging LACP Protocol Packets

Verify that LACP has been set up correctly and that the bundle members are transmitting LACP protocol packets.

1. Verifying the LACP Setup on page 2149
2. Verifying That LACP Packets Are Being Exchanged on page 2150

Verifying the LACP Setup

Purpose Verify that the LACP has been set up correctly.

Action To verify that LACP has been enabled as active on one end:

```
user@switch>show lacp interfaces xe-0/0/0
Aggregated interface: ae0
LACP state:       Role   Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity
xe-0/1/0          Actor  No    Yes   No   No   No   Yes     Fast    Active
xe-0/1/0          PartnerNo    Yes   No   No   No   Yes     Fast    Passive
LACP protocol:    Receive State    Transmit State          Mux     State
xe-0/1/0          Defaulted        Fast periodic           Detached
```

Meaning This example shows that LACP has been configured with one side as active and the other as passive. When LACP is enabled, one side must be set as active in order for the bundled link to be up.

Verifying That LACP Packets Are Being Exchanged

Purpose

Verify that LACP packets are being exchanged between interfaces.

Action

Use the **show lacp statistics interfaces *interface-name*** command to display LACP BPDU exchange information.

show lacp statistics interfaces ae0

```
Aggregated interface: ae0
    LACP Statistics:       LACP Rx     LACP Tx   Unknown Rx   Illegal Rx
      xe-0/0/2                1352        2035            0            0
      xe-0/0/3                1352        2056            0            0
```

Meaning

The output here shows that the link is up and that PDUs are being exchanged.

Related Documentation

- Configuring Link Aggregation on page 2019
- Verifying the Status of a LAG Interface on page 2148
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896
- Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch on page 1900
- **show lacp statistics interfaces (View) on page 2261**

Verifying That Generic Routing Encapsulation Tunneling Is Working Correctly

Purpose

Verify that the generic routing encapsulation (GRE) interface is sending tunneled traffic.

Action

Display status information about the specified GRE interface by using the command **show interfaces**.

```
user@switch> show interfaces gr-0/0/0.0
Physical interface: gr-0/0/0, Enabled, Physical link is Up
Interface index: 132, SNMP ifIndex: 26
  Type: GRE, Link-level type: GRE, MTU: Unlimited, Speed: 800mbps
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)

  Logical interface gr-0/0/0.0 (Index 68) (SNMP ifIndex 47)
    Flags: Point-To-Point SNMP-Traps 16384
    IP-Header 1.1.1.2:1.1.1.1:47:df:64:0000000000000000 Encapsulation: GRE-NULL
  Input packets : 0
  Output packets: 0
    Protocol inet, MTU: 1476
      Flags: None
      Addresses, Flags: Is-Primary
        Local: 1.10.1.1
```

Meaning

The output indicates that the GRE interface gr-0/0/0 is up. The output displays the name of the physical interface and the traffic statistics for this interface---the number of and the rate at which input and output bytes and packets are received and transmitted on the physical interface.

Related Documentation

- *Configuring Generic Routing Encapsulation Tunneling (CLI Procedure)*

Monitoring Commands

- monitor interface
- show iccp
- show interfaces diagnostics optics
- show interfaces ge
- show interfaces (GRE)
- show interfaces mc-ae
- show interfaces queue
- show interfaces xe
- show lacp interfaces
- show lacp statistics interfaces (View)
- show redundant-trunk-group
- show uplink-failure-detection

monitor interface

Syntax

monitor interface
<*interface-name* | traffic <detail>>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display real-time statistics about interfaces, updating the statistics every second. Check for and display common interface failures, such as SONET/SDH and T3 alarms, loopbacks detected, and increases in framing errors.

NOTE: This command is not supported on the QFX3000 QFabric system.

Options

none—Display real-time statistics for all interfaces.

detail—(Optional) With traffic option only, display detailed output.

interface-name—(Optional) Display real-time statistics for the specified interface. In a TX Matrix or TX Matrix Plus router, display real-time statistics for the physical interfaces on the specified line-card chassis (LCC) only.

traffic—(Optional) Display traffic data for all active interfaces. In a TX Matrix or TX Matrix Plus router, display real-time statistics for the physical interfaces on the specified LCC only.

Additional Information

The output of this command shows how much each field has changed since you started the command or since you cleared the counters by pressing the c key. For a description of the statistical information provided in the output of this command, see the **show interfaces extensive** command for a particular interface type in the CLI Explorer. To control the output of the **monitor interface** command while it is running, use the keys listed in Table 181 on page 2152. The keys are not case-sensitive.

Table 181: Output Control Keys for the monitor interface Command

Key	Action
c	Clears (returns to zero) the delta counters since **monitor interface** was started. This does not clear the accumulative counter. To clear the accumulative counter, use the **clear interfaces interval** command.
f	Freezes the display, halting the display of updated statistics and delta counters.
i	Displays information about a different interface. The command prompts you for the name of a specific interface.

Table 181: Output Control Keys for the monitor interface Command *(continued)*

Key	Action
n	Displays information about the next interface. The **monitor interface** command displays the physical or logical interfaces in the same order as the **show interfaces terse** command.
q or Esc	Quits the command and returns to the command prompt.
t	Thaws the display, resuming the update of the statistics and delta counters.

To control the output of the **monitor interface traffic** command while it is running, use the keys listed in Table 182 on page 2153. The keys are not case-sensitive.

Table 182: Output Control Keys for the monitor interface traffic Command

Key	Action
b	Displays the statistics in units of bytes and bits per second (bps).
c	Clears (return to 0) the delta counters in the **Current Delta** column. The statistics counters are not cleared.
d	Displays the **Current Delta** column (instead of the rate column) in Bps or packets per second (pps).
p	Displays the statistics in units of packets and packets per second (pps).
q or Esc	Quits the command and returns to the command prompt.
r	Displays the rate column (instead of the **Current Delta** column) in Bps and pps.

Required Privilege Level trace

List of Sample Output

monitor interface (Physical) on page 2155
monitor interface (OTN Interface) on page 2156
monitor interface (Logical) on page 2157
monitor interface (QFX3500 Switch) on page 2157
monitor interface traffic on page 2158
monitor interface traffic (QFX3500 Switch) on page 2158
monitor interface traffic detail (QFX3500 Switch) on page 2159

Output Fields Table 183 on page 2154 describes the output fields for the **monitor interface** command. Output fields are listed in the approximate order in which they appear.

Table 183: monitor interface Output Fields

Field Name	Field Description	Level of Output
router1	Hostname of the router.	All levels
Seconds	How long the monitor interface command has been running or how long since you last cleared the counters.	All levels
Time	Current time (UTC).	All levels
Delay ***x/y/z***	Time difference between when the statistics were displayed and the actual clock time. • *x*—Time taken for the last polling (in milliseconds). • *y*—Minimum time taken across all pollings (in milliseconds). • *z*—Maximum time taken across all pollings (in milliseconds).	All levels
Interface	Short description of the interface, including its name, status, and encapsulation.	All levels
Link	State of the link: **Up**, **Down**, or **Test**.	All levels
Current delta	Cumulative number for the counter in question since the time shown in the Seconds field, which is the time since you started the command or last cleared the counters.	All levels
Local Statistics	(Logical interfaces only) Number and rate of bytes and packets destined to the router or switch through the specified interface. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. It usually takes less than 1 second for this counter to stabilize. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface. • **Output packets**—Number of packets transmitted on the interface.	All levels
Remote Statistics	(Logical interfaces only) Statistics for traffic transiting the router or switch. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. It usually takes less than 1 second for this counter to stabilize. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface. • **Output packets**—Number of packets transmitted on the interface.	All levels

Table 183: monitor interface Output Fields *(continued)*

Field Name	Field Description	Level of Output
Traffic statistics	Total number of bytes and packets received and transmitted on the interface. These statistics are the sum of the local and remote statistics. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. It usually takes less than 1 second for this counter to stabilize. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface. • **Output packets**—Number of packets transmitted on the interface.	All levels
Description	With the **traffic** option, displays the interface description configured at the **[edit interfaces *interface-name*]** hierarchy level.	**detail**

Sample Output

monitor interface (Physical)

```
user@host> monitor interface so-0/0/0
router1                          Seconds: 19                 Time: 15:46:29

Interface: so-0/0/0, Enabled, Link is Up
Encapsulation: PPP, Keepalives, Speed: OC48
Traffic statistics:                                         Current Delta
  Input packets:                   6045 (0 pps)                      [11]
  Input bytes:                  6290065 (0 bps)                   [13882]
  Output packets:                 10376 (0 pps)                      [10]
  Output bytes:                10365540 (0 bps)                    [9418]
Encapsulation statistics:
  Input keepalives:                1901                               [2]
  Output keepalives:               1901                               [2]
  NCP state: Opened
  LCP state: Opened
Error statistics:
  Input errors:                       0                               [0]
  Input drops:                        0                               [0]
  Input framing errors:               0                               [0]
  Policed discards:                   0                               [0]
  L3 incompletes:                     0                               [0]
  L2 channel errors:                  0                               [0]
  L2 mismatch timeouts:               0                               [0]
  Carrier transitions:                1                               [0]
  Output errors:                      0                               [0]
  Output drops:                       0                               [0]
  Aged packets:                       0                               [0]
Active alarms : None
Active defects: None
SONET error counts/seconds:
  LOS count                           1                               [0]
  LOF count                           1                               [0]
  SEF count                           1                               [0]
  ES-S                                0                               [0]
  SES-S                               0                               [0]
SONET statistics:
  BIP-B1                         458871                               [0]
```



```
  BIP-B2                           460072                             [0]
  REI-L                            465610                             [0]
  BIP-B3                           458978                             [0]
  REI-P                            458773                             [0]
Received SONET overhead:
  F1      : 0x00  J0        : 0x00  K1        : 0x00
  K2      : 0x00  S1        : 0x00  C2        : 0x00
  C2(cmp) : 0x00  F2        : 0x00  Z3        : 0x00
  Z4      : 0x00  S1(cmp)   : 0x00
Transmitted SONET overhead:
  F1      : 0x00  J0        : 0x01  K1        : 0x00
  K2      : 0x00  S1        : 0x00  C2        : 0xcf
  F2      : 0x00  Z3        : 0x00  Z4        : 0x00

Next='n', Quit='q' or ESC, Freeze='f', Thaw='t', Clear='c', Interface='i'
```

monitor interface (OTN Interface)

`user@host>` **monitor interface ge-7/0/0**

```
Interface: ge-7/0/0, Enabled, Link is Up
Encapsulation: Ethernet, Speed: 10000mbps
Traffic statistics:
  Input bytes:                        0 (0 bps)
  Output bytes:                       0 (0 bps)
  Input packets:                      0 (0 pps)
  Output packets:                     0 (0 pps)
Error statistics:
  Input errors:                       0
  Input drops:                        0
  Input framing errors:               0
  Policed discards:                   0
  L3 incompletes:                     0
  L2 channel errors:                  0
  L2 mismatch timeouts:               0
  Carrier transitions:                5
  Output errors:                      0
  Output drops:                       0
  Aged packets:                       0
Active alarms : None
Active defects: None
Input MAC/Filter statistics:
  Unicast packets                     0
  Broadcast packets                   0
  Multicast packets                   0
  Oversized frames                    0
  Packet reject count                 0
  DA rejects                          0
  SA rejects                          0
Output MAC/Filter Statistics:
  Unicast packets                     0
  Broadcast packets                   0
  Multicast packets                   0
  Packet pad count                    0
  Packet error count                  0
OTN Link 0
  OTN Alarms: OTU_BDI, OTU_TTIM, ODU_BDI
  OTN Defects: OTU_BDI, OTU_TTIM, ODU_BDI, ODU_TTIM
  OTN OC - Seconds
    LOS                               2
```



```
    LOF                          9
  OTN OTU - FEC Statistics
    Corr err ratio             N/A
    Corr bytes                   0
    Uncorr words                 0
  OTN OTU - Counters
    BIP                          0
    BBE                          0
    ES                           0
    SES                          0
    UAS                        422
  OTN ODU - Counters
    BIP                          0
    BBE                          0
    ES                           0
    SES                          0
    UAS                        422
  OTN ODU - Received Overhead    APSPCC 0-3:              0
```

monitor interface (Logical)

```
user@host> monitor interface so-1/0/0.0
host name                Seconds: 16                  Time: 15:33:39
                                                               Delay: 0/0/1
Interface: so-1/0/0.0, Enabled, Link is Down
Flags: Hardware-Down Point-To-Point SNMP-Traps
Encapsulation: PPP
Local statistics:                                           Current delta
  Input bytes:                    0                                   [0]
  Output bytes:                   0                                   [0]
  Input packets:                  0                                   [0]
  Output packets:                 0                                   [0]
Remote statistics:
  Input bytes:                    0 (0 bps)                           [0]
  Output bytes:                   0 (0 bps)                           [0]
  Input packets:                  0 (0 pps)                           [0]
  Output packets:                 0 (0 pps)                           [0]
Traffic statistics:
  Destination address: 192.168.8.193, Local: 192.168.8.21

Next='n', Quit='q' or ESC, Freeze='f', Thaw='t', Clear='c', Interface='i'
```

monitor interface (QFX3500 Switch)

```
user@switch> monitor interface ge-0/0/0
Interface: ge-0/0/0, Enabled, Link is Down
Encapsulation: Ethernet, Speed: Unspecified
Traffic statistics:                                         Current delta
  Input bytes:                   0 (0 bps)                            [0]
  Output bytes:                  0 (0 bps)                            [0]
  Input packets:                 0 (0 pps)                            [0]
  Output packets:                0 (0 pps)                            [0]
Error statistics:
  Input errors:                  0                                    [0]
  Input drops:                   0                                    [0]
  Input framing errors:          0                                    [0]
  Policed discards:              0                                    [0]
  L3 incompletes:                0                                    [0]
  L2 channel errors:             0                                    [0]
  L2 mismatch timeouts:          0                                    [0]
  Carrier transitions:           0                                    [0]
```



```
  Output errors:                   0                                [0]
  Output drops:                    0                                [0]
  Aged packets:                    0                                [0]
Active alarms : LINK
Active defects: LINK
Input MAC/Filter statistics:
  Unicast packets                  0                                [0]
  Broadcast packets                0  Multicast packet              [0]

Interface warnings:
  o Outstanding LINK alarm
```

monitor interface traffic

```
user@host> monitor interface traffic
host name                Seconds: 15                Time: 12:31:09

Interface     Link  Input packets         (pps)     Output packets        (pps)
 so-1/0/0     Down              0           (0)                  0          (0)
 so-1/1/0     Down              0           (0)                  0          (0)
 so-1/1/1     Down              0           (0)                  0          (0)
 so-1/1/2     Down              0           (0)                  0          (0)
 so-1/1/3     Down              0           (0)                  0          (0)
 t3-1/2/0     Down              0           (0)                  0          (0)
 t3-1/2/1     Down              0           (0)                  0          (0)
 t3-1/2/2     Down              0           (0)                  0          (0)
 t3-1/2/3     Down              0           (0)                  0          (0)
 so-2/0/0       Up         211035           (1)              36778          (0)
 so-2/0/1       Up         192753           (1)              36782          (0)
 so-2/0/2       Up         211020           (1)              36779          (0)
 so-2/0/3       Up         211029           (1)              36776          (0)
 so-2/1/0       Up         189378           (1)              36349          (0)
 so-2/1/1     Down              0           (0)              18747          (0)
 so-2/1/2     Down              0           (0)              16078          (0)
 so-2/1/3       Up              0           (0)              80338          (0)
 at-2/3/0       Up              0           (0)                  0          (0)
 at-2/3/1     Down              0           (0)                  0          (0)

Bytes=b, Clear=c, Delta=d, Packets=p, Quit=q or ESC, Rate=r, Up=^U, Down=^D
```

monitor interface traffic (QFX3500 Switch)

```
user@switch> monitor interface traffic
switch                            Seconds: 7                 Time: 16:04:37

Interface     Link  Input packets         (pps)     Output packets        (pps)
 ge-0/0/0     Down              0           (0)                  0          (0)
 ge-0/0/1       Up         392187           (0)             392170          (0)
 ge-0/0/2     Down              0           (0)                  0          (0)
 ge-0/0/3     Down              0           (0)                  0          (0)
 ge-0/0/4     Down              0           (0)                  0          (0)
 ge-0/0/5     Down              0           (0)                  0          (0)
 ge-0/0/6     Down              0           (0)                  0          (0)
 ge-0/0/7     Down              0           (0)                  0          (0)
 ge-0/0/8     Down              0           (0)                  0          (0)
 ge-0/0/9       Up         392184           (0)             392171          (0)
 ge-0/0/10    Down              0           (0)                  0          (0)
 ge-0/0/11    Down              0           (0)                  0          (0)
 ge-0/0/12    Down              0           (0)                  0          (0)
 ge-0/0/13    Down              0           (0)                  0          (0)
 ge-0/0/14    Down              0           (0)                  0          (0)
```



```
 ge-0/0/15   Down            0          (0)               0          (0)
 ge-0/0/16   Down            0          (0)               0          (0)
 ge-0/0/17   Down            0          (0)               0          (0)
 ge-0/0/18   Down            0          (0)               0          (0)
 ge-0/0/19   Down            0          (0)               0          (0)
 ge-0/0/20   Down            0          (0)               0          (0)
 ge-0/0/21   Down            0          (0)               0          (0)
 ge-0/0/22     Up       392172          (0)          392187          (0)
 ge-0/0/23     Up       392185          (0)          392173          (0)
 vcp-0       Down            0                            0
 vcp-1       Down            0                            0
 ae0         Down            0          (0)               0          (0)
 bme0          Up            0                      1568706
```

monitor interface traffic detail (QFX3500 Switch)

```
user@switch> monitor interface traffic detail
switch                                                   Seconds: 74
        Time: 16:03:02

Interface     Link  Input packets        (pps)     Output packets        (pps)
Description
 ge-0/0/0    Down            0          (0)               0          (0)
 ge-0/0/1      Up       392183          (0)          392166          (0)
 ge-0/0/2    Down            0          (0)               0          (0)
 ge-0/0/3    Down            0          (0)               0          (0)
 ge-0/0/4    Down            0          (0)               0          (0)
 ge-0/0/5    Down            0          (0)               0          (0)
 ge-0/0/6    Down            0          (0)               0          (0)
 ge-0/0/7    Down            0          (0)               0          (0)
 ge-0/0/8    Down            0          (0)               0          (0)
 ge-0/0/9      Up       392181          (0)          392168          (0)
 ge-0/0/10   Down            0          (0)               0          (0)
 ge-0/0/11   Down            0          (0)               0          (0)
 ge-0/0/12   Down            0          (0)               0          (0)
 ge-0/0/13   Down            0          (0)               0          (0)
 ge-0/0/14   Down            0          (0)               0          (0)
 ge-0/0/15   Down            0          (0)               0          (0)
 ge-0/0/16   Down            0          (0)               0          (0)
 ge-0/0/17   Down            0          (0)               0          (0)
 ge-0/0/18   Down            0          (0)               0          (0)
 ge-0/0/19   Down            0          (0)               0          (0)
 ge-0/0/20   Down            0          (0)               0          (0)
 ge-0/0/21   Down            0          (0)               0          (0)
 ge-0/0/22     Up       392169          (0)          392184          (1)
 ge-0/0/23     Up       392182          (0)          392170          (0)
 vcp-0       Down            0                            0
 vcp-1       Down            0                            0
 ae0         Down            0          (0)               0          (0)
 bme0          Up            0                      1568693
```

show iccp

Syntax show iccp <brief | detail>

Release Information Command introduced in Junos OS Release 12.2 for the QFX Series.

Description Display Interchassis Control Protocol (ICCP) information about the multichassis link aggregation group (MC-LAG) peers, including the state of the TCP connection, Bidirectional Forwarding Detection protocol, backup liveness peer status, and MCSNOOPD, LACPD, and ESWD applications.

Options none—Display ICCP information about the MC-LAG peers, including the state of the TCP connection and Bidirectional Forwarding Detection protocol, and MCSNOOPD, LACPD, and ESWD applications.

brief—Display brief ICCP information about the MC-LAG peers, including the state of the TCP connection and Bidirectional Forwarding Detection protocol, and MCSNOOPD, LACPD, and ESWD applications.

detail—Display detailed ICCP information about the MC-LAG peers, including the state of the TCP connection and Bidirectional Forwarding Detection protocol, and MCSNOOPD, LACPD, and ESWD applications.

Required Privilege Level view

Related Documentation

- iccp on page 2066
- Understanding Multichassis Link Aggregation on page 1853

List of Sample Output show iccp on page 2161

Output Fields Table 184 on page 2160 lists the output fields for the **show iccp** command. Output fields are listed in the approximate order in which they appear.

Table 184: show iccp

Field Name	Field Description
Redundancy Group Information for peer	Aggregated Ethernet interface name.
TCP Connection	Specifies if the TCP connection between the peers hosting the MC-LAG is up or down.
Liveness Detection	Specifies if liveness detection, also known as Bidirectional Forwarding Detection (BFD), is up or down.
Client Application	Specifies information regarding the state of the MCSNOOPD and ESWD client applications.

Sample Output

show iccp

```
user@switch> show iccp
Redundancy Group Information for peer 3.3.3.2
  TCP Connection       : Established
  Liveliness Detection : Up

Client Application: MCSNOOPD

Client Application: eswd
```

show interfaces diagnostics optics

Syntax show interfaces diagnostics optics *interface-name*

Release Information Command introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 13.2X50-D15 for the QFX Series.

Description Display diagnostics data and alarms for Gigabit Ethernet optical transceivers (SFP, SFP+, XFP, QSFP+, or CFP) installed in EX Series or QFX Series switches. The information provided by this command is known as digital optical monitoring (DOM) information. For a list of transceivers supported on EX Series switches and their specifications, including DOM support, see *Pluggable Transceivers Supported on EX Series Switches*.

Thresholds that trigger a high alarm, low alarm, high warning, or low warning are set by the transponder vendors. Generally, a high alarm or low alarm indicates that the optics module is not operating properly. This information can be used to diagnose why a transceiver is not working.

Options ***interface-name***—Name of the interface associated with the port in which the transceiver is installed: ge-*fpc/pic/port*, xe-*fpc/pic/port*, or et-*fpc/pic/port*.

Required Privilege Level view

Related Documentation

- *Monitoring Interface Status and Traffic*
- Monitoring Interface Status and Traffic on page 309
- *Installing a Transceiver in an EX Series Switch*
- *Installing a Transceiver in a QFX Series Device*
- *Removing a Transceiver from an EX Series Switch*
- *Removing a Transceiver from a QFX Series Device*
- *Junos OS Ethernet Interfaces Configuration Guide*

List of Sample Output

show interfaces diagnostics optics ge-0/1/0 (SFP Transceiver) on page 2169
show interfaces diagnostics optics xe-0/1/0 (SFP+ Transceiver) on page 2170
show interfaces diagnostics optics xe-0/1/0 (XFP Transceiver) on page 2171
show interfaces diagnostics optics et-3/0/0 (QSFP+ Transceiver) on page 2172
show interfaces diagnostics optics et-4/1/0 (CFP Transceiver) on page 2173

Output Fields Table 76 on page 840 lists the output fields for the **show interfaces diagnostics optics** command. Output fields are listed in the approximate order in which they appear.

Table 185: show interfaces diagnostics optics Output Fields

Field Name	Field Description
Physical interface	Displays the name of the physical interface.

Table 185: show interfaces diagnostics optics Output Fields *(continued)*

Field Name	Field Description
Laser bias current	Displays the magnitude of the laser bias power setting current, in milliamperes. The laser bias provides direct modulation of laser diodes and modulates currents.
Laser output power (Not available for QSFP+ transceivers)	Displays the laser output power, in milliwatts (mW) and decibels referred to 1.0 mW (dBm).
Laser temperature (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays the laser temperature, in Celsius and Fahrenheit.
Module temperature	Displays the temperature, in Celsius and Fahrenheit.
Module voltage (Not available for XFP transceivers)	Displays the voltage, in Volts.
Laser rx power (Not available for SFP, SFP+, QSFP+, and CFP transceivers)	Displays the laser received optical power, in milliwatts (mW) and decibels referred to 1.0 mW (dBm).
Receiver signal average optical power (Not available for XFP, QSFP+, and CFP transceivers)	Displays the receiver signal average optical power, in milliwatts (mW) and decibels referred to 1.0 mW (dBm).
Laser bias current high alarm	Displays whether the laser bias power setting high alarm is **On** or **Off**.
Laser bias current low alarm	Displays whether the laser bias power setting low alarm is **On** or **Off**.
Laser bias current high warning	Displays whether the laser bias power setting high warning is **On** or **Off**.
Laser bias current low warning	Displays whether the laser bias power setting low warning is **On** or **Off**.
Laser output power high alarm (Not available for QSFP+ transceivers)	Displays whether the laser output power high alarm is **On** or **Off**.
Laser output power low alarm (Not available for QSFP+ transceivers)	Displays whether the laser output power low alarm is **On** or **Off**.
Laser output power high warning (Not available for QSFP+ transceivers)	Displays whether the laser output power high warning is **On** or **Off**.

Table 185: show interfaces diagnostics optics Output Fields *(continued)*

Field Name	Field Description
Laser output power low warning (Not available for QSFP+ transceivers)	Displays whether the laser output power low warning is **On** or **Off**.
Laser temperature high alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the laser temperature high alarm is **On** or **Off**.
Laser temperature low alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the laser temperature low alarm is **On** or **Off**.
Laser temperature high warning (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the laser temperature high warning is **On** or **Off**.
Laser temperature low warning (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the laser temperature low warning is **On** or **Off**.
Module temperature high alarm (Not available for QSFP+ transceivers)	Displays whether the module temperature high alarm is **On** or **Off**.
Module temperature low alarm (Not available for QSFP+ transceivers)	Displays whether the module temperature low alarm is **On** or **Off**.
Module temperature high warning (Not available for QSFP+ transceivers)	Displays whether the module temperature high warning is **On** or **Off**.
Module temperature low warning (Not available for QSFP+ transceivers)	Displays whether the module temperature low warning is **On** or **Off**.
Module voltage high alarm (Not available for XFP and QSFP+ transceivers)	Displays whether the module voltage high alarm is **On** or **Off**.
Module voltage low alarm (Not available for XFP and QSFP+ transceivers)	Displays whether the module voltage low alarm is **On** or **Off**.
Module voltage high warning (Not available for XFP and QSFP+ transceivers)	Displays whether the module voltage high warning is **On** or **Off**.
Module voltage low warning (Not available for XFP and QSFP+ transceivers)	Displays whether the module voltage low warning is **On** or **Off**.

Table 185: show interfaces diagnostics optics Output Fields *(continued)*

Field Name	Field Description
Laser rx power high alarm (Not available for QSFP+ and CFP transceivers)	Displays whether the receive laser power high alarm is **On** or **Off**.
Laser rx power low alarm (Not available for QSFP+ and CFP transceivers)	Displays whether the receive laser power low alarm is **On** or **Off**.
Laser rx power high warning (Not available for QSFP+ and CFP transceivers)	Displays whether the receive laser power high warning is **On** or **Off**.
Laser rx power low warning (Not available for QSFP+ and CFP transceivers)	Displays whether the receive laser power low warning is **On** or **Off**.
Laser bias current high alarm threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser bias current high alarm.
Module not ready alarm (Not available for SFP, SFP+, and QSFP+ transceivers)	Displays whether the module not ready alarm is **On** or **Off**. When the output is **On**, the module has an operational fault.
Module low power alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the module low power alarm is **On** or **Off**.
Module initialization incomplete alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the module initialization incomplete alarm is **On** or **Off**.
Module fault alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the module fault alarm is **On** or **Off**.
PLD Flash initialization fault alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the PLD Flash initialization fault alarm is **On** or **Off**.
Power supply fault alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the power supply fault alarm is **On** or **Off**.
Checksum fault alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the checksum fault alarm is **On** or **Off**.
Tx laser disabled alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the Tx laser disabled alarm is **On** or **Off**.

Table 185: show interfaces diagnostics optics Output Fields *(continued)*

Field Name	Field Description
Module power down alarm (Not available for SFP, SFP+, QSFP+, and CFP transceivers)	Displays whether the module power down alarm is **On** or **Off**. When the output is **On**, module is in a limited power mode, low for normal operation.
Tx data not ready alarm (Not available for SFP, SFP+, QSFP+, and CFP transceivers)	Any condition leading to invalid data on the transmit path. Displays whether the Tx data not ready alarm is **On** or **Off**.
Tx not ready alarm (Not available for SFP, SFP+, QSFP+, and CFP transceivers)	Any condition leading to invalid data on the transmit path. Displays whether the Tx not ready alarm is **On** or **Off**.
Tx laser fault alarm (Not available for SFP, SFP+, QSFP+, and CFP transceivers)	Laser fault condition. Displays whether the Tx laser fault alarm is **On** or **Off**.
Tx CDR loss of lock alarm (Not available for SFP, SFP+, and QSFP+ transceivers)	Transmit clock and data recovery (CDR) loss of lock. Loss of lock on the transmit side of the CDR. Displays whether the Tx CDR loss of lock alarm is **On** or **Off**.
Rx not ready alarm (Not available for SFP, SFP+, QSFP+, and CFP transceivers)	Any condition leading to invalid data on the receive path. Displays whether the Rx not ready alarm is **On** or **Off**.
Rx loss of signal alarm (Not available for SFP and SFP+ transceivers)	Receive loss of signal alarm. When the output is **On**, indicates insufficient optical input power to the module. Displays whether the Rx loss of signal alarm is **On** or **Off**.
Rx CDR loss of lock alarm (Not available for SFP, SFP+, and QSFP+ transceivers)	Receive CDR loss of lock. Loss of lock on the receive side of the CDR. Displays whether the Rx CDR loss of lock alarm is **On** or **Off**.
Laser bias current low alarm threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser bias current low alarm.
Laser bias current high warning threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser bias current high warning.
Laser bias current low warning threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser bias current low warning.
Laser output power high alarm threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser output power high alarm.
Laser output power low alarm threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser output power low alarm.

Table 185: show interfaces diagnostics optics Output Fields *(continued)*

Field Name	Field Description
Laser output power high warning threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser output power high warning.
Laser output power low warning threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser output power low warning.
Module temperature high alarm threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the module temperature high alarm.
Module temperature low alarm threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the module temperature low alarm.
Module temperature high warning threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the module temperature high warning.
Module temperature low warning threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the module temperature low warning.
Module voltage high alarm threshold (Not available for XFP and QSFP+ transceivers)	Displays the vendor-specified threshold for the module voltage high alarm.
Module voltage low alarm threshold (Not available for XFP and QSFP+ transceivers)	Displays the vendor-specified threshold for the module voltage low alarm.
Module voltage high warning threshold (Not available for XFP and QSFP+ transceivers)	Displays the vendor-specified threshold for the module voltage high warning.
Module voltage low warning threshold (Not available for XFP and QSFP+ transceivers)	Displays the vendor-specified threshold for the module voltage low warning.
Laser rx power high alarm threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser rx power high alarm.
Laser rx power low alarm threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser rx power low alarm.
Laser rx power high warning threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser rx power high warning.

Table 185: show interfaces diagnostics optics Output Fields *(continued)*

Field Name	Field Description
Laser rx power low warning threshold (Not available for QSFP+ transceivers)	Displays the vendor-specified threshold for the laser rx power low warning.
Laser temperature high alarm threshold (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays the vendor-specified threshold for the laser temperature high alarm, in Celsius and Fahrenheit.
Laser temperature low alarm threshold (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays the vendor-specified threshold for the laser temperature low alarm, in Celsius and Fahrenheit.
Laser temperature high warning threshold (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays the vendor-specified threshold for the laser temperature high warning, in Celsius and Fahrenheit.
Laser temperature low warning threshold (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays the vendor-specified threshold for the laser temperature low warning, in Celsius and Fahrenheit.
SOA bias current high alarm threshold (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays the vendor-specified threshold for SOA bias current high alarm.
SOA bias current low alarm threshold (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays the vendor-specified threshold for SOA bias current low alarm.
SOA bias current high warning threshold (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays the vendor-specified threshold for SOA bias current high warning.
SOA bias current low warning threshold (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays the vendor-specified threshold for SOA bias current low warning.
Laser receiver power high alarm (Not available for SFP, SFP+, and XFP transceivers)	Displays whether the laser receiver power high alarm is **On** or **Off**.
Laser receiver power low alarm (Not available for SFP, SFP+, and XFP transceivers)	Displays whether the laser receiver power low alarm is **On** or **Off**.
Laser receiver power high warning (Not available for SFP, SFP+, and XFP transceivers)	Displays whether the laser receiver power high warning is **On** or **Off**.
Laser receiver power low warning (Not available for SFP, SFP+, and XFP transceivers)	Displays whether the laser receiver power low warning is **On** or **Off**.

Table 185: show interfaces diagnostics optics Output Fields *(continued)*

Field Name	Field Description
Laser receiver power (Not available for SFP, SFP+, and XFP transceivers)	Displays the laser receiver power, in milliwatts (mW) and decibels referred to 1.0 mW (dBm).
Tx loss of signal functionality alarm (Not available for SFP, SFP+, and XFP transceivers)	Displays whether the Tx loss of signal functionality alarm is **On** or **Off**.
APD supply fault alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the APD supply fault alarm is **On** or **Off**.
TEC fault alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the TEC fault alarm is **On** or **Off**.
Wavelength unlocked alarm (Not available for SFP, SFP+, XFP, and QSFP+ transceivers)	Displays whether the Wavelength unlocked alarm is **On** or **Off**.

Sample Output

show interfaces diagnostics optics ge-0/1/0 (SFP Transceiver)

```
user@switch> show interfaces diagnostics optics ge-0/1/0
Physical interface: ge-0/1/0
    Laser bias current                        :  5.444 mA
    Laser output power                        :  0.3130 mW / -5.04 dBm
    Module temperature                        :  36 degrees C / 97 degrees F
    Module voltage                            :  3.2120 V
    Receiver signal average optical power     :  0.3840 mW / -4.16 dBm
    Laser bias current high alarm             :  Off
    Laser bias current low alarm              :  Off
    Laser bias current high warning           :  Off
    Laser bias current low warning            :  Off
    Laser output power high alarm             :  Off
    Laser output power low alarm              :  Off
    Laser output power high warning           :  Off
    Laser output power low warning            :  Off
    Module temperature high alarm             :  Off
    Module temperature low alarm              :  Off
    Module temperature high warning           :  Off
    Module temperature low warning            :  Off
    Module voltage high alarm                 :  Off
    Module voltage low alarm                  :  Off
    Module voltage high warning               :  Off
    Module voltage low warning                :  Off
    Laser rx power high alarm                 :  Off
    Laser rx power low alarm                  :  Off
    Laser rx power high warning               :  Off
    Laser rx power low warning                :  Off
    Laser bias current high alarm threshold   :  15.000 mA
    Laser bias current low alarm threshold    :  1.000 mA
    Laser bias current high warning threshold :  12.000 mA
```



```
    Laser bias current low warning threshold  :  2.000 mA
    Laser output power high alarm threshold   :  0.6300 mW / -2.01 dBm
    Laser output power low alarm threshold    :  0.0660 mW / -11.80 dBm
    Laser output power high warning threshold :  0.6300 mW / -2.01 dBm
    Laser output power low warning threshold  :  0.0780 mW / -11.08 dBm
    Module temperature high alarm threshold   :  109 degrees C / 228 degrees F
    Module temperature low alarm threshold    :  -29 degrees C / -20 degrees F
    Module temperature high warning threshold :  103 degrees C / 217 degrees F
    Module temperature low warning threshold  :  -13 degrees C / 9 degrees F
    Module voltage high alarm threshold       :  3.900 V
    Module voltage low alarm threshold        :  2.700 V
    Module voltage high warning threshold     :  3.700 V
    Module voltage low warning threshold      :  2.900 V
    Laser rx power high alarm threshold       :  1.2589 mW / 1.00 dBm
    Laser rx power low alarm threshold        :  0.0100 mW / -20.00 dBm
    Laser rx power high warning threshold     :  0.7939 mW / -1.00 dBm
    Laser rx power low warning threshold      :  0.0157 mW / -18.04 dBm
```

Sample Output

show interfaces diagnostics optics xe-0/1/0 (SFP+ Transceiver)

```
user@switch> show interfaces diagnostics optics xe-0/1/0
Physical interface: xe-0/1/0
    Laser bias current                        :  4.968 mA
    Laser output power                        :  0.4940 mW / -3.06 dBm
    Module temperature                        :  27 degrees C / 81 degrees F
    Module voltage                            :  3.2310 V
    Receiver signal average optical power     :  0.0000
    Laser bias current high alarm             :  Off
    Laser bias current low alarm              :  Off
    Laser bias current high warning           :  Off
    Laser bias current low warning            :  Off
    Laser output power high alarm             :  Off
    Laser output power low alarm              :  Off
    Laser output power high warning           :  Off
    Laser output power low warning            :  Off
    Module temperature high alarm             :  Off
    Module temperature low alarm              :  Off
    Module temperature high warning           :  Off
    Module temperature low warning            :  Off
    Module voltage high alarm                 :  Off
    Module voltage low alarm                  :  Off
    Module voltage high warning               :  Off
    Module voltage low warning                :  Off
    Laser rx power high alarm                 :  Off
    Laser rx power low alarm                  :  On
    Laser rx power high warning               :  Off
    Laser rx power low warning                :  On
    Laser bias current high alarm threshold   :  10.500 mA
    Laser bias current low alarm threshold    :  2.000 mA
    Laser bias current high warning threshold :  9.000 mA
    Laser bias current low warning threshold  :  2.500 mA
    Laser output power high alarm threshold   :  1.4120 mW / 1.50 dBm
    Laser output power low alarm threshold    :  0.0740 mW / -11.31 dBm
    Laser output power high warning threshold :  0.7070 mW / -1.51 dBm
    Laser output power low warning threshold  :  0.1860 mW / -7.30 dBm
    Module temperature high alarm threshold   :  75 degrees C / 167 degrees F
    Module temperature low alarm threshold    :  -5 degrees C / 23 degrees F
    Module temperature high warning threshold :  70 degrees C / 158 degrees F
    Module temperature low warning threshold  :  0 degrees C / 32 degrees F
```

```
    Module voltage high alarm threshold       :  3.630 V
    Module voltage low alarm threshold        :  2.970 V
    Module voltage high warning threshold     :  3.465 V
    Module voltage low warning threshold      :  3.135 V
    Laser rx power high alarm threshold       :  1.5849 mW / 2.00 dBm
    Laser rx power low alarm threshold        :  0.0407 mW / -13.90 dBm
    Laser rx power high warning threshold     :  0.7943 mW / -1.00 dBm
    Laser rx power low warning threshold      :  0.1023 mW / -9.90 dBm
```

Sample Output

show interfaces diagnostics optics xe-0/1/0 (XFP Transceiver)

```
user@switch> show interfaces diagnostics optics xe-0/1/0
Physical interface: xe-0/1/0
    Laser bias current                        :  8.029 mA
    Laser output power                        :  0.6430 mW / -1.92 dBm
    Module temperature                        :  4 degrees C / 39 degrees F
    Laser rx power                            :  0.0012 mW / -29.21 dBm
    Laser bias current high alarm             :  Off
    Laser bias current low alarm              :  Off
    Laser bias current high warning           :  Off
    Laser bias current low warning            :  Off
    Laser output power high alarm             :  Off
    Laser output power low alarm              :  Off
    Laser output power high warning           :  Off
    Laser output power low warning            :  Off
    Module temperature high alarm             :  Off
    Module temperature low alarm              :  Off
    Module temperature high warning           :  Off
    Module temperature low warning            :  Off
    Laser rx power high alarm                 :  Off
    Laser rx power low alarm                  :  On
    Laser rx power high warning               :  Off
    Laser rx power low warning                :  On
    Module not ready alarm                    :  On
    Module power down alarm                   :  Off
    Tx data not ready alarm                   :  Off
    Tx not ready alarm                        :  Off
    Tx laser fault alarm                      :  Off
    Tx CDR loss of lock alarm                 :  Off
    Rx not ready alarm                        :  On
    Rx loss of signal alarm                   :  On
    Rx CDR loss of lock alarm                 :  On
    Laser bias current high alarm threshold   :  13.000 mA
    Laser bias current low alarm threshold    :  2.000 mA
    Laser bias current high warning threshold :  12.000 mA
    Laser bias current low warning threshold  :  3.000 mA
    Laser output power high alarm threshold   :  0.8310 mW / -0.80 dBm
    Laser output power low alarm threshold    :  0.1650 mW / -7.83 dBm
    Laser output power high warning threshold :  0.7410 mW / -1.30 dBm
    Laser output power low warning threshold  :  0.1860 mW / -7.30 dBm
    Module temperature high alarm threshold   :  90 degrees C / 194 degrees F
    Module temperature low alarm threshold    :  0 degrees C / 32 degrees F
    Module temperature high warning threshold :  85 degrees C / 185 degrees F
    Module temperature low warning threshold  :  0 degrees C / 32 degrees F
    Laser rx power high alarm threshold       :  0.8912 mW / -0.50 dBm
    Laser rx power low alarm threshold        :  0.0912 mW / -10.40 dBm
    Laser rx power high warning threshold     :  0.7943 mW / -1.00 dBm
    Laser rx power low warning threshold      :  0.1023 mW / -9.90 dBm
```

Sample Output

show interfaces diagnostics optics et-3/0/0 (QSFP+ Transceiver)

```
user@switch> show interfaces diagnostics optics et-3/0/0
Physical interface: et-3/0/0
    Module temperature                          :  33 degrees C / 92 degrees F
    Module voltage                              :  3.3060 V
  Lane 0
    Laser bias current                          :  7.182 mA
    Laser receiver power                        :  0.743 mW / -1.29 dBm
    Laser bias current high alarm               :  Off
    Laser bias current low alarm                :  Off
    Laser bias current high warning             :  Off
    Laser bias current low warning              :  Off
    Laser receiver power high alarm             :  Off
    Laser receiver power low alarm              :  Off
    Laser receiver power high warning           :  Off
    Laser receiver power low warning            :  Off
    Tx loss of signal functionality alarm       :  Off
    Rx loss of signal alarm                     :  Off
  Lane 1
    Laser bias current                          :  7.326 mA
    Laser receiver power                        :  0.752 mW / -1.24 dBm
    Laser bias current high alarm               :  Off
    Laser bias current low alarm                :  Off
    Laser bias current high warning             :  Off
    Laser bias current low warning              :  Off
    Laser receiver power high alarm             :  Off
    Laser receiver power low alarm              :  Off
    Laser receiver power high warning           :  Off
    Laser receiver power low warning            :  Off
    Tx loss of signal functionality alarm       :  Off
    Rx loss of signal alarm                     :  Off
  Lane 2
    Laser bias current                          :  7.447 mA
    Laser receiver power                        :  0.790 mW / -1.03 dBm
    Laser bias current high alarm               :  Off
    Laser bias current low alarm                :  Off
    Laser bias current high warning             :  Off
    Laser bias current low warning              :  Off
    Laser receiver power high alarm             :  Off
    Laser receiver power low alarm              :  Off
    Laser receiver power high warning           :  Off
    Laser receiver power low warning            :  Off
    Tx loss of signal functionality alarm       :  Off
    Rx loss of signal alarm                     :  Off
  Lane 3
    Laser bias current                          :  7.734 mA
    Laser receiver power                        :  0.768 mW / -1.15 dBm
    Laser bias current high alarm               :  Off
    Laser bias current low alarm                :  Off
    Laser bias current high warning             :  Off
    Laser bias current low warning              :  Off
    Laser receiver power high alarm             :  Off
    Laser receiver power low alarm              :  Off
    Laser receiver power high warning           :  Off
    Laser receiver power low warning            :  Off
    Tx loss of signal functionality alarm       :  Off
    Rx loss of signal alarm                     :  Off
```

Sample Output

show interfaces diagnostics optics et-4/1/0 (CFP Transceiver)

```
user@switch> show interfaces diagnostics optics et-4/1/0
Physical interface: et-4/1/0
    Module temperature                        :  38 degrees C / 101 degrees F
    Module voltage                            :  3.2500 V
    Module temperature high alarm             :  Off
    Module temperature low alarm              :  Off
    Module temperature high warning           :  Off
    Module temperature low warning            :  Off
    Module voltage high alarm                 :  Off
    Module voltage low alarm                  :  Off
    Module voltage high warning               :  Off
    Module voltage low warning                :  Off
    Module not ready alarm                    :  Off
    Module low power alarm                    :  Off
    Module initialization incomplete alarm    :  Off
    Module fault alarm                        :  Off
    PLD Flash initialization fault alarm      :  Off
    Power supply fault alarm                  :  Off
    Checksum fault alarm                      :  Off
    Tx laser disabled alarm                   :  Off
    Tx loss of signal functionality alarm     :  Off
    Tx CDR loss of lock alarm                 :  Off
    Rx loss of signal alarm                   :  Off
    Rx CDR loss of lock alarm                 :  Off
    Module temperature high alarm threshold   :  75 degrees C / 167 degrees F
    Module temperature low alarm threshold    :  -5 degrees C / 23 degrees F
    Module temperature high warning threshold :  70 degrees C / 158 degrees F
    Module temperature low warning threshold  :  0 degrees C / 32 degrees F
    Module voltage high alarm threshold       :  3.5000 V
    Module voltage low alarm threshold        :  3.0990 V
    Module voltage high warning threshold     :  3.4000 V
    Module voltage low warning threshold      :  3.2000 V
    Laser bias current high alarm threshold   :  250.000 mA
    Laser bias current low alarm threshold    :  37.500 mA
    Laser bias current high warning threshold :  225.000 mA
    Laser bias current low warning threshold  :  50.000 mA
    Laser output power high alarm threshold   :  3.9800 mW / 6.00 dBm
    Laser output power low alarm threshold    :  0.4670 mW / -3.31 dBm
    Laser output power high warning threshold :  3.5480 mW / 5.50 dBm
    Laser output power low warning threshold  :  0.5240 mW / -2.81 dBm
    Laser rx power high alarm threshold       :  3.5481 mW / 5.50 dBm
    Laser rx power low alarm threshold        :  0.0616 mW / -12.10 dBm
    Laser rx power high warning threshold     :  3.1622 mW / 5.00 dBm
    Laser rx power low warning threshold      :  0.0691 mW / -11.61 dBm
    Laser temperature high alarm threshold    :  67 degrees C / 153 degrees F
    Laser temperature low alarm threshold     :  35 degrees C / 95 degrees F
    Laser temperature high warning threshold  :  62 degrees C / 144 degrees F
    Laser temperature low warning threshold   :  40 degrees C / 104 degrees F
    SOA bias current high alarm threshold     :  0.000 mA
    SOA bias current low alarm threshold      :  0.000 mA
    SOA bias current high warning threshold   :  0.000 mA
    SOA bias current low warning threshold    :  0.000 mA
  Lane 0
    Laser bias current                        :  131.684 mA
    Laser output power                        :  1.002 mW / 0.01 dBm
    Laser temperature                         :  54 degrees C / 128 degrees F
    Laser receiver power                      :  0.497 mW / -3.03 dBm
```

```
    Laser bias current high alarm            :  Off
    Laser bias current low alarm             :  Off
    Laser bias current high warning          :  Off
    Laser bias current low warning           :  Off
    Laser output power high alarm            :  Off
    Laser output power low alarm             :  Off
    Laser output power high warning          :  Off
    Laser output power low warning           :  Off
    Laser temperature high alarm             :  Off
    Laser temperature low alarm              :  Off
    Laser temperature high warning           :  Off
    Laser temperature low warning            :  Off
    Laser receiver power high alarm          :  Off
    Laser receiver power low alarm           :  Off
    Laser receiver power high warning        :  Off
    Laser receiver power low warning         :  Off
    Tx loss of signal functionality alarm    :  Off
    Tx CDR loss of lock alarm                :  Off
    Rx loss of signal alarm                  :  Off
    Rx CDR loss of lock alarm                :  Off
    APD supply fault alarm                   :  Off
    TEC fault alarm                          :  Off
    Wavelength unlocked alarm                :  Off
  Lane 1
    Laser bias current                       :  122.345 mA
    Laser output power                       :  1.002 mW / 0.01 dBm
    Laser temperature                        :  51 degrees C / 124 degrees F
    Laser receiver power                     :  0.611 mW / -2.14 dBm
    Laser bias current high alarm            :  Off
    Laser bias current low alarm             :  Off
    Laser bias current high warning          :  Off
    Laser bias current low warning           :  Off
    Laser output power high alarm            :  Off
    Laser output power low alarm             :  Off
    Laser output power high warning          :  Off
    Laser output power low warning           :  Off
    Laser temperature high alarm             :  Off
    Laser temperature low alarm              :  Off
    Laser temperature high warning           :  Off
    Laser temperature low warning            :  Off
    Laser receiver power high alarm          :  Off
    Laser receiver power low alarm           :  Off
    Laser receiver power high warning        :  Off
    Laser receiver power low warning         :  Off
    Tx loss of signal functionality alarm    :  Off
    Tx CDR loss of lock alarm                :  Off
    Rx loss of signal alarm                  :  Off
    Rx CDR loss of lock alarm                :  Off
    APD supply fault alarm                   :  Off
    TEC fault alarm                          :  Off
    Wavelength unlocked alarm                :  Off
  Lane 2
    Laser bias current                       :  112.819 mA
    Laser output power                       :  1.000 mW / 0.00 dBm
    Laser temperature                        :  50 degrees C / 122 degrees F
    Laser receiver power                     :  0.540 mW / -2.67 dBm
    Laser bias current high alarm            :  Off
    Laser bias current low alarm             :  Off
    Laser bias current high warning          :  Off
    Laser bias current low warning           :  Off
    Laser output power high alarm            :  Off
```



```
    Laser output power low alarm            :  Off
    Laser output power high warning         :  Off
    Laser output power low warning          :  Off
    Laser temperature high alarm            :  Off
    Laser temperature low alarm             :  Off
    Laser temperature high warning          :  Off
    Laser temperature low warning           :  Off
    Laser receiver power high alarm         :  Off
    Laser receiver power low alarm          :  Off
    Laser receiver power high warning       :  Off
    Laser receiver power low warning        :  Off
    Tx loss of signal functionality alarm   :  Off
    Tx CDR loss of lock alarm               :  Off
    Rx loss of signal alarm                 :  Off
    Rx CDR loss of lock alarm               :  Off
    APD supply fault alarm                  :  Off
    TEC fault alarm                         :  Off
    Wavelength unlocked alarm               :  Off
  Lane 3
    Laser bias current                      :  100.735 mA
    Laser output power                      :  1.002 mW / 0.01 dBm
    Laser temperature                       :  50 degrees C / 122 degrees F
    Laser receiver power                    :  0.637 mW / -1.96 dBm
    Laser bias current high alarm           :  Off
    Laser bias current low alarm            :  Off
    Laser bias current high warning         :  Off
    Laser bias current low warning          :  Off
    Laser output power high alarm           :  Off
    Laser output power low alarm            :  Off
    Laser output power high warning         :  Off
    Laser output power low warning          :  Off
    Laser temperature high alarm            :  Off
    Laser temperature low alarm             :  Off
    Laser temperature high warning          :  Off
    Laser temperature low warning           :  Off
    Laser receiver power high alarm         :  Off
    Laser receiver power low alarm          :  Off
    Laser receiver power high warning       :  Off
    Laser receiver power low warning        :  Off
    Tx loss of signal functionality alarm   :  Off
    Tx CDR loss of lock alarm               :  Off
    Rx loss of signal alarm                 :  Off
    Rx CDR loss of lock alarm               :  Off
    APD supply fault alarm                  :  Off
    TEC fault alarm                         :  Off
    Wavelength unlocked alarm               :  Off
```

show interfaces ge

Syntax

show interfaces *device-name*:*type-fpc/pic/port*
<brief | detail | extensive | terse>
<descriptions>
<media>
<routing-instance (all | *instance-name*)>
<snmp-index *snmp-index*>
<statistics>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display status information about the specified Gigabit Ethernet interface. This command does not display statistics for routed VLAN interfaces.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output.

device-name*:*type-fpc/pic/port—The device name is either the serial number or the alias of the QFabric system component, such as a Node device, Interconnect device, or QFabric infrastructure. The name can contain a maximum of 128 characters and cannot contain any colons.

descriptions—(Optional) Display interface description strings.

media—(Optional) Display media-specific information about network interfaces.

routing instance (all | *instance-name*)—(Optional) Display the name of an individual routing-instance or display all routing-instances.

snmp-index *snmp-index*—(Optional) Display information for the specified SNMP index of the interface.

statistics—(Optional) Display static interface statistics.

Required Privilege Level

view

Related Documentation

- Monitoring Interface Status and Traffic on page 309
- Troubleshooting Network Interfaces on page 1118
- Troubleshooting an Aggregated Ethernet Interface on page 1119
- *Junos OS Network Interfaces Library for Routing Devices*

List of Sample Output

show interfaces on page 2184
show interfaces brief on page 2184
show interfaces detail (Symmetric Flow Control and Autonegotiation Enabled) on page 2184
show interfaces detail (Asymmetric Flow Control and Autonegotiation Enabled) on page 2185

show interfaces extensive (Symmetric Flow Control and Autonegotiation Enabled) on page 2186
show interfaces extensive (Asymmetric Flow Control and Autonegotiation Enabled) on page 2188
show interfaces terse on page 2190
show interfaces terse (QFabric Systems) on page 2190

Output Fields Table 186 on page 2177 lists the output fields for the **show interfaces ge** command. Output fields are listed in the approximate order in which they appear.

Table 186: show interfaces ge Output Fields

Field Name	Field Description	Level of Output
Physical Interface		
Physical interface	Name of the physical interface.	All levels
Enabled	State of the interface: **Enabled** or **Disabled**.	All levels
Interface index	Index number of the physical interface, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP index number for the physical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Description	Optional user-specified description.	**brief detail extensive**
Link-level type	Encapsulation being used on the physical interface.	All levels
MTU	Maximum transmission unit size on the physical interface. The default is 1514.	All levels
Speed	Speed at which the interface is running.	All levels
Loopback	Loopback status: **Enabled** or **Disabled**. If loopback is enabled, type of loopback: **Local** or **Remote**.	All levels
Source filtering	Source filtering status: **Enabled** or **Disabled**.	All levels
Flow control	Flow control status: **Enabled** or **Disabled**. NOTE: This field is only displayed if asymmetric flow control is not configured.	detail extensive
Configured-flow-control	Configured flow control for the interface transmit buffers (**tx-buffers**) and receive buffers (**rx-buffers**): • **tx-buffers—On** if the interface is configured to respond to Ethernet PAUSE messages received from the connected peer. **Off** if the interface is not configured to respond to received PAUSE messages. • **rx-buffers—On** if the interface is configured to generate and send Ethernet PAUSE messages to the connected peer. **Off** if the interface is not configured to generate and send PAUSE messages. NOTE: This field is only displayed if asymmetric flow control is configured.	detail extensive

Table 186: show interfaces ge Output Fields *(continued)*

Field Name	Field Description	Level of Output
Auto-negotiation	Autonegotiation status: **Enabled** or **Disabled**.	All levels
Remote-fault	Remote fault status: • **Online**—Autonegotiation is manually configured as online. • **Offline**—Autonegotiation is manually configured as offline.	All levels
Device flags	Information about the physical device.	All levels
Interface flags	Information about the interface.	All levels
Link flags	Information about the link.	All levels
CoS queues	Number of CoS queues configured.	**detail extensive** none
Hold-times	Current interface hold-time up and hold-time down, in milliseconds.	**detail extensive**
Current address	Configured MAC address.	**detail extensive** none
Hardware address	MAC address of the hardware.	**detail extensive** none
Last flapped	Date, time, and how long ago the interface went from down to up. The format is **Last flapped:** ***year-month-day hour:minute:second timezone*** **(*hour:minute:second* ago)**. For example, **Last flapped: 2008–01–16 10:52:40 UTC (3d 22:58 ago).**	**detail extensive** none
Statistics last cleared	Time when the statistics for the interface were last set to zero.	**detail extensive**
Traffic statistics	Number and rate of bytes and packets received and transmitted on the physical interface. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface • **Output packets**—Number of packets transmitted on the interface. NOTE: The bandwidth bps counter is not enabled on the switch.	**detail extensive**

Table 186: show interfaces ge Output Fields *(continued)*

Field Name	Field Description	Level of Output
Input errors	Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: • **Errors**—Sum of the incoming frame aborts and FCS errors. • **Drops**—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • **Framing errors**—Number of packets received with an invalid frame checksum (FCS). • **Runts**—Number of frames received that are smaller than the runt threshold. • **Policed discards**—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that Junos OS does not handle. • **L3 incompletes**—Number of incoming packets discarded because they failed Layer 3 sanity checks of the headers. For example, a frame with less than 20 bytes of available IP header is discarded. • **L2 channel errors**—Number of times the software did not find a valid logical interface for an incoming frame. • **L2 mismatch timeouts**—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable. • **FIFO errors**—Number of FIFO errors in the receive direction that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning. • **Resource errors**—Sum of transmit drops.	**extensive**

Table 186: show interfaces ge Output Fields *(continued)*

Field Name	Field Description	Level of Output
Output errors	Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: • **Carrier transitions**—Number of times the interface has gone from **down** to **up**. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the PIC or PIM is malfunctioning. • **Errors**—Sum of the outgoing frame aborts and FCS errors. • **Drops**—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • **Collisions**—Number of Ethernet collisions. The Gigabit Ethernet PIC supports only full-duplex operation, so for Gigabit Ethernet PICs, this number should always remain 0. If it is nonzero, there is a software bug. • **Aged packets**—Number of packets that remained in shared packet SDRAM so long that the system automatically purged them. The value in this field should never increment. If it does, it is most likely a software bug or possibly malfunctioning hardware. • **FIFO errors**—Number of FIFO errors in the send direction as reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning. • **HS link CRC errors**—Number of errors on the high-speed links between the ASICs responsible for handling the switch interfaces. • **MTU errors**—Number of packets whose size exceeded the MTU of the interface. • **Resource errors**—Sum of transmit drops.	**extensive**
Egress queues	Total number of egress queues supported on the specified interface.	**detail extensive**
Queue counters (Egress)	CoS queue number and its associated user-configured forwarding class name. • **Queued packets**—Number of queued packets. • **Transmitted packets**—Number of transmitted packets. • **Dropped packets**—Number of packets dropped by the ASIC's RED mechanism.	**detail extensive**
Queue Number	The CoS queue number and the forwarding classes mapped to the queue number. The **Mapped forwarding class** column lists the forwarding classes mapped to each CoS queue.	**detail extensive**
Active alarms and Active defects	Ethernet-specific defects that can prevent the interface from passing packets. When a defect persists for a certain amount of time, it is promoted to an alarm. Based on the switch configuration, an alarm can ring the red or yellow alarm bell on the switch or turn on the red or yellow alarm LED on the front of the switch. These fields can contain the value **None** or **Link**. • **None**—There are no active defects or alarms. • **Link**—Interface has lost its link state, which usually means that the cable is unplugged, the far-end system has been turned off, or the PIC is malfunctioning.	**detail extensive** none

Table 186: show interfaces ge Output Fields *(continued)*

Field Name	Field Description	Level of Output
MAC statistics	**Receive** and **Transmit** statistics reported by the PIC's MAC subsystem. • **Total octets** and **total packets**—Total number of octets and packets. For Gigabit Ethernet IQ PICs, the received octets count varies by interface type. • **Unicast packets, Broadcast packets,** and **Multicast packets**—Number of unicast, broadcast, and multicast packets. • **CRC/Align errors**—Total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, and had either a bad FCS with an integral number of octets (FCS Error) or a bad FCS with a nonintegral number of octets (Alignment Error). • **FIFO error**—Number of FIFO errors that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning. • **MAC control frames**—Number of MAC control frames. • **MAC pause frames**—Number of MAC control frames with **pause** operational code. • **Oversized frames**—Number of packets that exceeds the configured MTU. • **Jabber frames**—Number of frames that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error. This definition of jabber is different from the definition in IEEE-802.3 section 8.2.1.5 (10BASE5) and section 10.3.1.4 (10BASE2). These documents define jabber as the condition in which any packet exceeds 20 ms. The allowed range to detect jabber is from 20 ms to 150 ms. • **Fragment frames**—Total number of packets that were less than 64 octets in length (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error. Fragment frames normally increment because both runts (which are normal occurrences caused by collisions) and noise hits are counted. • **VLAN tagged frames**—Number of frames that are VLAN tagged. The system uses the TPID of 0x8100 in the frame to determine whether a frame is tagged or not. This counter is not supported on EX Series switches and is always displayed as 0. • **Code violations**—Number of times an event caused the PHY to indicate “Data reception error” or “invalid data symbol error.”	**extensive**
Filter Statistics	**Receive** and **Transmit** statistics reported by the PIC's MAC address filter subsystem.	**extensive**

Table 186: show interfaces ge Output Fields *(continued)*

Field Name	Field Description	Level of Output

Autonegotiation information	Information about link autonegotiation:
	• **Negotiation status:**
	  ◦ **Incomplete**—Ethernet interface has the speed or link mode configured.
	  ◦ **No autonegotiation**—Remote Ethernet interface has the speed or link mode configured or does not perform autonegotiation.
	  ◦ **Complete**—Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.
	• **Link partner status**—**OK** when the Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.
	• **Link partner:**
	  ◦ **Link mode**—Depending on the capability of the attached Ethernet device, either **Full-duplex** or **Half-duplex**.
	  ◦ **Flow control**—Types of flow control supported by the remote Ethernet device. For Gigabit Ethernet interfaces, types are **Symmetric** (link partner supports **PAUSE** on receive and transmit), **Asymmetric** (link partner supports **PAUSE** on transmit), and **Symmetric/Asymmetric** (link partner supports **PAUSE** on both receive and transmit or **PAUSE** only on receive).
	  ◦ **Remote fault**—Remote fault information from the link partner—**Failure** indicates a receive link error. **OK** indicates that the link partner is receiving. **Negotiation error** indicates a negotiation error. **Offline** indicates that the link partner is going offline.
	  ◦ **Link partner speed**—Speed of the link partner.
	• **Local resolution**:
	  ◦ **Flow control**—Types of flow control supported by the remote Ethernet device. For Gigabit Ethernet interfaces, types are **Symmetric** (link partner supports **PAUSE** on receive and transmit), **Asymmetric** (link partner supports **PAUSE** on transmit), and **Symmetric/Asymmetric** (link partner supports **PAUSE** on both receive and transmit or **PAUSE** only on receive). For asymmetric **PAUSE**, shows if the PAUSE transmit and **PAUSE** receive states on the interface are **enable** or **disable**.
	  ◦ **Remote fault**—Remote fault information. **Link OK** (no error detected on receive), **Offline** (local interface is offline), and **Link Failure** (link error detected on receive).
		extensive

Packet Forwarding Engine configuration	Information about the configuration of the Packet Forwarding Engine: • **Destination slot**—FPC slot number.	**extensive**
Logical Interface		
Logical interface	Name of the logical interface.	All levels
Index	Index number of the logical interface, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP interface index number for the logical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Flags	Information about the logical interface.	All levels

Table 186: show interfaces ge Output Fields *(continued)*

Field Name	Field Description	Level of Output
Encapsulation	Encapsulation on the logical interface.	All levels
Protocol	Protocol family.	**detail extensive** none
Traffic statistics	Number and rate of bytes and packets received (input) and transmitted (output) on the specified interface.	**detail extensive**
IPv6 transit statistics	If IPv6 statistics tracking is enabled, number of IPv6 bytes and packets received and transmitted on the logical interface.	**extensive**
Local statistics	Number and rate of bytes and packets destined to and from the switch.	**extensive**
Transit statistics	Number and rate of bytes and packets transiting the switch.	**extensive**
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Route Table	Route table in which the logical interface address is located. For example, **0** refers to the routing table **inet.0**.	**detail extensive** none
Input Filters	Names of any input filters applied to this interface.	**detail extensive**
Output Filters	Names of any output filters applied to this interface.	**detail extensive**
Flags	Information about protocol family flags. If unicast reverse-path forwarding (RPF) is explicitly configured on the specified interface, the uRPF flag is displayed. If unicast RPF was configured on a different interface (and therefore is enabled on all switch interfaces) but was not explicitly configured on the specified interface, the uRPF flag is not displayed even though unicast RPF is enabled.	**detail extensive**
protocol-family	Protocol family configured on the logical interface. If the protocol is **inet**, the IP address of the interface is also displayed.	**brief**
Flags	Information about the address flags.	**detail extensive** none
Destination	IP address of the remote side of the connection.	**detail extensive** none
Local	IP address of the logical interface.	**detail extensive** none
Broadcast	Broadcast address of the logical interlace.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**

Sample Output

show interfaces

```
user@switch> show interfaces ge-0/0/9
Physical interface: ge-0/0/9, Enabled, Physical link is Down
  Interface index: 129, SNMP ifIndex: 21
  Link-level type: Ethernet, MTU: 1514, Speed: Unspecified, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled
  Remote fault: Online
  Device flags   : Present Running Down
  Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
  CoS queues     : 8 supported, 8 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:19:e2:50:3f:41, Hardware address: 00:19:e2:50:3f:41
  Last flapped   : 2008-01-16 11:40:53 UTC (4d 02:30 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Ingress rate at Packet Forwarding Engine      : 0 bps (0 pps)
  Ingress drop rate at Packet Forwarding Engine : 0 bps (0 pps)
  Active alarms  : None
  Active defects : None

  Logical interface ge-0/0/9.0 (Index 65) (SNMP ifIndex 22)
    Flags: SNMP-Traps
    Encapsulation: ENET2
    Input packets : 0
    Output packets: 0
    Protocol eth-switch
      Flags: None
```

show interfaces brief

```
user@switch> show interfaces ge-0/0/9 brief
Physical interface: ge-0/0/9, Enabled, Physical link is Down
  Description: voice priority and tcp and icmp traffic rate-limiting filter at i
ngress port
  Link-level type: Ethernet, MTU: 1514, Speed: Unspecified, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled,
  Remote fault: Online
  Device flags   : Present Running Down
  Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
  Link flags     : None

  Logical interface ge-0/0/9.0
    Flags: Device-Down SNMP-Traps Encapsulation: ENET2
    eth-switch
```

show interfaces detail (Symmetric Flow Control and Autonegotiation Enabled)

```
user@switch> show interfaces ge-0/0/9 detail
Physical interface: ge-0/0/9, Enabled, Physical link is Up
  Interface index: 193, SNMP ifIndex: 206, Generation: 196
  Link-level type: Ethernet, MTU: 1514, Speed: Auto, Duplex: Auto,
  BPDU Error: None, MAC-REWRITE Error: None, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled,
  Remote fault: Online
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
```

```
Hold-times     : Up 0 ms, Down 0 ms
Current address: 00:1f:12:30:ff:40, Hardware address: 00:1f:12:30:ff:40
Last flapped   : 2009-05-05 06:03:05 UTC (00:22:13 ago)
Statistics last cleared: Never
Traffic statistics:
 Input  bytes  :                    0                    0 bps
 Output bytes  :                    0                    0 bps
 Input  packets:                    0                    0 pps
 Output packets:                    0                    0 pps
 IPv6 transit statistics:
  Input  bytes  :                   0
  Output bytes  :                   0
  Input  packets:                   0
  Output packets:                   0
Egress queues: 8 supported, 4 in use
Queue counters:       Queued packets  Transmitted packets      Dropped packets

  0 best-effort                    0                    0                    0

  1 assured-forw                   0                    0                    0

  5 expedited-fo                   0                    0                    0

  7 network-cont                   0                    0                    0

Active alarms  : None
Active defects : None

Logical interface ge-0/0/9.0 (Index 65) (SNMP ifIndex 235) (Generation 130)
  Flags: SNMP-Traps Encapsulation: ENET2
  Bandwidth: 0
  Traffic statistics:
   Input  bytes  :                  0
   Output bytes  :                  0
   Input  packets:                  0
   Output packets:                  0
  Local statistics:
   Input  bytes  :                  0
   Output bytes  :                  0
   Input  packets:                  0
   Output packets:                  0
  Transit statistics:
   Input  bytes  :                  0                    0 bps
   Output bytes  :                  0                    0 bps
   Input  packets:                  0                    0 pps
   Output packets:                  0                    0 pps
  Protocol eth-switch, Generation: 146, Route table: 0
    Flags: Is-Primary
    Input Filters: f1,
    Output Filters: f2,,,,
```

show interfaces detail (Asymmetric Flow Control and Autonegotiation Enabled)

```
user@switch> show interfaces ge-0/0/9 detail
Physical interface: ge-0/0/9, Enabled, Physical link is Up
  Interface index: 193, SNMP ifIndex: 206, Generation: 196
  Link-level type: Ethernet, MTU: 1514, Speed: Auto, Duplex: Auto,
  BPDU Error: None, MAC-REWRITE Error: None, Loopback: Disabled,
  Source filtering: Disabled,  Configured-flow-control  tx-buffers: off
rx-buffers: on ,
  Auto-negotiation: Enabled,
```

```
Remote fault: Online
Device flags   : Present Running
Interface flags: SNMP-Traps Internal: 0x0
Link flags     : None
CoS queues     : 8 supported, 8 maximum usable queues
Hold-times     : Up 0 ms, Down 0 ms
Current address: 00:1f:12:30:ff:40, Hardware address: 00:1f:12:30:ff:40
Last flapped   : 2009-05-05 06:03:05 UTC (00:22:13 ago)
Statistics last cleared: Never
Traffic statistics:
 Input  bytes  :                    0                    0 bps
 Output bytes  :                    0                    0 bps
 Input  packets:                    0                    0 pps
 Output packets:                    0                    0 pps
 IPv6 transit statistics:
  Input  bytes  :                   0
  Output bytes  :                   0
  Input  packets:                   0
  Output packets:                   0
Egress queues: 8 supported, 4 in use
Queue counters:       Queued packets  Transmitted packets      Dropped packets

  0 best-effort                    0                    0                    0

  1 assured-forw                   0                    0                    0

  5 expedited-fo                   0                    0                    0

  7 network-cont                   0                    0                    0

Active alarms  : None
Active defects : None

Logical interface ge-0/0/9.0 (Index 65) (SNMP ifIndex 235) (Generation 130)
  Flags: SNMP-Traps Encapsulation: ENET2
  Bandwidth: 0
  Traffic statistics:
   Input  bytes  :                  0
   Output bytes  :                  0
   Input  packets:                  0
   Output packets:                  0
  Local statistics:
   Input  bytes  :                  0
   Output bytes  :                  0
   Input  packets:                  0
   Output packets:                  0
  Transit statistics:
   Input  bytes  :                  0                    0 bps
   Output bytes  :                  0                    0 bps
   Input  packets:                  0                    0 pps
   Output packets:                  0                    0 pps
  Protocol eth-switch, Generation: 146, Route table: 0
    Flags: Is-Primary
    Input Filters: f1,
    Output Filters: f2,,,,
```

show interfaces extensive (Symmetric Flow Control and Autonegotiation Enabled)

```
user@switch> show interfaces ge-0/0/12 extensive
interface: ge-0/0/12, Enabled, Physical link is Down
  Interface index: 49164, SNMP ifIndex: 574, Generation: 142
```



```
Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps, Duplex: Full-Duplex,
BPDU Error: None, MAC-REWRITE Error: None, Loopback: Disabled,
Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled,
Remote fault: Online
Device flags   : Present Running Down
Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
Link flags     : None
CoS queues     : 8 supported, 8 maximum usable queues
Hold-times     : Up 0 ms, Down 0 ms
Current address: 00:22:83:2a:d8:dc, Hardware address: 00:22:83:2a:d8:dc
Last flapped   : 2011-02-25 00:45:03 UTC (22:42:48 ago)
Statistics last cleared: Never
Traffic statistics:
 Input  bytes  :                   0                    0 bps
 Output bytes  :                   0                    0 bps
 Input  packets:                   0                    0 pps
 Output packets:                   0                    0 pps
 IPv6 transit statistics:
  Input  bytes  :                  0
  Output bytes  :                  0
  Input  packets:                  0
  Output packets:                  0
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
  L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
  FIFO errors: 0, Resource errors: 0
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,

  FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 8 in use
Queue counters:       Queued packets  Transmitted packets      Dropped packets

  0 best-effort                    0                    0                    0

  2 no-loss                        0                    0                    0

  3 fcoe                           0                    0                    0

  7 network-cont                   0                    0                    0

Queue number:         Mapped forwarding classes
  0                   best-effort
  2                   no-loss
  3                   fcoe
  7                   network-control
Active alarms  : LINK
Active defects : LINK
MAC statistics:                      Receive         Transmit
  Total octets                             0                0
  Total packets                            0                0
  Unicast packets                          0                0
  Broadcast packets                        0                0
  Multicast packets                        0                0
  CRC/Align errors                         0                0
  FIFO errors                              0                0
  MAC control frames                       0                0
  MAC pause frames                         0                0
  Oversized frames                         0
  Jabber frames                            0
  Fragment frames                          0
```

```
    VLAN tagged frames                          0
    Code violations                             0
  MAC Priority Flow Control Statistics:
    Priority :  0                                0                 0
    Priority :  1                                0                 0
    Priority :  2                                0                 0
    Priority :  3                                0                 0
    Priority :  4                                0                 0
    Priority :  5                                0                 0
    Priority :  6                                0                 0
    Priority :  7                                0                 0
  Filter statistics:
    Input packet count                          0
    Input packet rejects                        0
    Input DA rejects                            0
    Input SA rejects                            0
    Output packet count                                          0
    Output packet pad count                                      0
    Output packet error count                                    0
    CAM destination filters: 1, CAM source filters: 0
  Autonegotiation information:
    Negotiation status: Incomplete
  Packet Forwarding Engine configuration:
    Destination slot: 0
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %            bps     %           usec
    0 best-effort            75      750000000    75              0       low
none
    7 network-control         5       50000000     5              0       low
none
    8 mcast-be               15      150000000    15              0       low
none
    11 mcast-nc               5       50000000     5              0       low
none
```

show interfaces extensive (Asymmetric Flow Control and Autonegotiation Enabled)

```
user@switch> show interfaces ge-0/0/12 extensive
interface: ge-0/0/12, Enabled, Physical link is Down
  Interface index: 49164, SNMP ifIndex: 574, Generation: 142
  Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps, Duplex: Full-Duplex,
  BPDU Error: None, MAC-REWRITE Error: None, Loopback: Disabled,
  Source filtering: Disabled,  Configured-flow-control  tx-buffers: off
rx-buffers: on
  Auto-negotiation: Enabled,
  Remote fault: Online
  Device flags   : Present Running Down
  Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:22:83:2a:d8:dc, Hardware address: 00:22:83:2a:d8:dc
  Last flapped   : 2011-02-25 00:45:03 UTC (22:42:48 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                 0                    0 bps
   Output bytes  :                 0                    0 bps
   Input  packets:                 0                    0 pps
```



```
 Output packets:                  0                    0 pps
 IPv6 transit statistics:
  Input  bytes  :                 0
  Output bytes  :                 0
  Input  packets:                 0
  Output packets:                 0
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
  L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
  FIFO errors: 0, Resource errors: 0
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,

  FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 8 in use
Queue counters:       Queued packets  Transmitted packets      Dropped packets

  0 best-effort                  0                    0                    0

  2 no-loss                      0                    0                    0

  3 fcoe                         0                    0                    0

  7 network-cont                 0                    0                    0

Queue number:         Mapped forwarding classes
  0                   best-effort
  2                   no-loss
  3                   fcoe
  7                   network-control
Active alarms  : LINK
Active defects : LINK
MAC statistics:                      Receive         Transmit
  Total octets                             0                0
  Total packets                            0                0
  Unicast packets                          0                0
  Broadcast packets                        0                0
  Multicast packets                        0                0
  CRC/Align errors                         0                0
  FIFO errors                              0                0
  MAC control frames                       0                0
  MAC pause frames                         0                0
  Oversized frames                         0
  Jabber frames                            0
  Fragment frames                          0
  VLAN tagged frames                       0
  Code violations                          0
MAC Priority Flow Control Statistics:
  Priority :  0                             0                0
  Priority :  1                             0                0
  Priority :  2                             0                0
  Priority :  3                             0                0
  Priority :  4                             0                0
  Priority :  5                             0                0
  Priority :  6                             0                0
  Priority :  7                             0                0
Filter statistics:
  Input packet count                       0
  Input packet rejects                     0
  Input DA rejects                         0
  Input SA rejects                         0
```



```
    Output packet count                                        0
    Output packet pad count                                    0
    Output packet error count                                  0
    CAM destination filters: 1, CAM source filters: 0
  Autonegotiation information:
    Negotiation status: Complete
    Link Partner:
      Link mode: Full-duplex, Flow control: None, Remote fault: OK,
      Link partner Speed: 1000 Mbps
    Local resolution:
      Flow control: enable  PAUSE transmit and Disable PAUSE receive, Remote
fault: Link OK
  Packet Forwarding Engine configuration:
    Destination slot: 0
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %            bps     %            usec
    0 best-effort            75      750000000    75               0       low
none
    7 network-control         5       50000000     5               0       low
none
    8 mcast-be               15      150000000    15               0       low
none
    11 mcast-nc               5       50000000     5               0       low
none
```

show interfaces terse

```
user@switch> show interfaces ge-0/0/12 terse
Interface               Admin Link Proto    Local                 Remote
ge-0/0/12               up    up
```

show interfaces terse (QFabric Systems)

```
user@switch> show interfaces node1:ge-0/0/0 terse
Physical interface: node1:ge-0/0/0, Enabled, Physical link is Down
  Interface index: 129, SNMP ifIndex: 2884086
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None,
  Loopback: Disabled, Source filtering: Disabled, Flow control: Enabled
  Interface flags: Internal: 0x4000
  CoS queues     : 8 supported, 8 maximum usable queues
  Current address: 02:00:09:03:00:00, Hardware address: 02:00:09:03:00:00
  Last flapped   : Never
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
```


show interfaces (GRE)

Syntax

show interfaces *interface-type*
<brief | detail | extensive | terse>
<descriptions>
<media>
<snmp-index *snmp-index*>
<statistics>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description

Display status information about the specified generic routing encapsulation (GRE) interface.

Options

interface-type—On M Series and T Series routers and EX Series switches, the interface type is **gr-*fpc/pic/port***. On J Series routers, the interface type is **gr-*pim*/0/*port***.

brief | detail | extensive | terse—(Optional) Display the specified output level of interface information.

descriptions—(Optional) Display interface description strings.

media—(Optional) Display media-specific information about network interfaces.

snmp-index *snmp-index*—(Optional) Display information for the specified SNMP index of the interface.

statistics—(Optional) Display static interface statistics.

NOTE: You can configure generic routing encapsulation (GRE) interfaces (gre-x/y/z) only for GMPLS control channels. GRE interfaces are not supported or configurable for other applications. For more information about GMPLS, see the *Junos OS MPLS Applications Library for Routing Devices* and the *Junos OS Feature Guides*.

Required Privilege Level

view

List of Sample Output

show interfaces (GRE) on page 2195
show interfaces brief (GRE) on page 2195
show interfaces detail (GRE) on page 2195
show interfaces detail (GRE) on an EX4200 Virtual Chassis Member Switch on page 2196
show interfaces extensive (GRE) on page 2197

Output Fields

Table 187 on page 2192 lists the output fields for the **show interfaces** (GRE) command. Output fields are listed in the approximate order in which they appear.

Table 187: GRE show interfaces Output Fields

Field Name	Field Description	Level of Output
Physical Interface		
Physical interface	Name of the physical interface.	All levels
Enabled	State of the interface. Possible values are described in the “Enabled Field” section under *Common Output Fields Description*.	All levels
Interface index	Physical interface's index number, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP index number for the physical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Type	Type of interface.	All levels
Link-level type	Encapsulation used on the physical interface.	All levels
MTU	MTU size on the physical interface.	All levels
Speed	Speed at which the interface is running.	All levels
Hold-times	Current interface hold-time up and hold-time down, in milliseconds.	**detail extensive**
Device Flags	Information about the physical device. Possible values are described in the “Device Flags” section under *Common Output Fields Description*.	All levels
Interface Flags	Information about the interface. Possible values are described in the “Interface Flags” section under *Common Output Fields Description*.	All levels
Input rate	Input rate in bits per second (bps) and packets per second (pps).	None specified
Output rate	Output rate in bps and pps.	None specified
Statistics last cleared	Time when the statistics for the interface were last set to zero.	**detail extensive**
Traffic statistics	The number of and the rate at which input and output bytes and packets are received and transmitted on the physical interface. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface. • **Output packets**—Number of packets transmitted on the interface.	**detail extensive**
Logical Interface		
Logical interface	Name of the logical interface.	All levels
Index	Logical interface index number, which reflects its initialization sequence.	**detail extensive** none

Table 187: GRE show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
SNMP ifIndex	Logical interface SNMP interface index number.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support.	**detail extensive**
Flags	Information about the logical interface. Possible values listed in the “Logical Interface Flags” section under *Common Output Fields Description*. describe general information about the logical interface. GRE-specific information about the logical interface is indicated by the presence or absence of the following value in this field: • **Reassemble-Pkts**—If the **Flags** field includes this string, the GRE tunnel is configured to reassemble tunnel packets that were fragmented after tunnel encapsulation.	All levels
IP-Header	IP header of the logical interface. If the **tunnel key** statement is configured, this information is included in the **IP Header** entry. GRE-specific information about the logical interface is indicated by the presence or absence of the following value in this field: • **df**—If the **IP-Header** field includes this string immediately following the 16 bits of identification information (that is, if **:df:** displays after the twelfth byte), the GRE tunnel is configured to allow fragmentation of GRE packets after encapsulation.	All levels
Encapsulation	Encapsulation on the logical interface.	All levels
Copy-tos-to-outer-ip-header	Status of type of service (ToS) bits in the GRE packet header: • **On**—ToS bits were copied from the payload packet header into the header of the IP packet sent through the GRE tunnel. • **Off**—ToS bits were not copied from the payload packet header and are set to 0 in the GRE packet header. NOTE: EX Series switches do not support copying ToS bits to the encapsulated packet, so the value of this field is always **Off** in switch output.	**detail extensive**
Gre keepalives configured	Indicates whether a GRE keepalive time and hold time are configured for the GRE tunnel. NOTE: EX Series switches do not support configuration of GRE tunnel keepalive times and hold times, so the value of this field is always **Off** in switch output.	**detail extensive**
Gre keepalives adjacency state	Status of the other end of the GRE tunnel: **Up** or **Down**. If keepalive messages are not received by either end of the GRE tunnel within the hold-time period, the GRE keepalive adjacency state is down even when the GRE tunnel is up.	**detail extensive**
Input packets	Number of packets received on the logical interface.	None specified
Output packets	Number of packets transmitted on the logical interface.	None specified

Table 187: GRE show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Traffic statistics	Rate of bytes and packets received and transmitted on the logical interface. These statistics are the sum of the local and transit statistics. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. It takes awhile (generally, less than 1 second) for this counter to stabilize. • **Input rate**—Rate of bits and packets received on the interface. • **Output rate**—Rate of bits and packets transmitted on the interface.	**detail extensive**
Local statistics	Statistics for traffic received from and transmitted to the Routing Engine. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. It takes awhile (generally, less than 1 second) for this counter to stabilize.	**detail extensive**
Transit statistics	Statistics for traffic transiting the router. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. It takes awhile (generally, less than 1 second) for this counter to stabilize.	**detail extensive** none
Protocol	Protocol family configured on the logical interface, such as **iso**, **inet6**, or **mpls**.	**detail extensive none**
protocol-family	Protocol family configured on the logical interface. If the protocol is **inet**, the IP address of the interface is also displayed.	**brief**
MTU	MTU size on the logical interface.	**detail extensive none**
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Route table	Routing table in which the logical interface address is located. For example, **0** refers to the routing table inet.0.	**detail extensive**
Flags	Information about the protocol family flags. Possible values are described in the “Family Flags” section under *Common Output Fields Description*.	**detail extensive** none
Addresses, Flags	Information about the address flags. Possible values are described in the “Addresses Flags” section under *Common Output Fields Description*.	**detail extensive** none
Destination	IP address of the remote side of the connection.	**detail extensive** none
Local	IP address of the logical interface.	**detail extensive** none
Broadcast	Broadcast address of the logical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**

Sample Output

show interfaces (GRE)

```
user@host> show interfaces gr-1/2/0
Physical interface: gr-0/0/0, Enabled, Physical link is Up
  Interface index: 132, SNMP ifIndex: 26
  Type: GRE, Link-level type: GRE, MTU: Unlimited, Speed: 800mbps
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)

  Logical interface gr-0/0/0.0 (Index 68) (SNMP ifIndex 47)
    Flags: Point-To-Point SNMP-Traps 16384
    IP-Header 1.1.1.2:1.1.1.1:47:df:64:0000000000000000 Encapsulation: GRE-NULL
  Input packets : 0
  Output packets: 0
    Protocol inet, MTU: 1476
      Flags: None
      Addresses, Flags: Is-Primary
        Local: 1.10.1.1
```

show interfaces brief (GRE)

```
user@host> show interfaces gr-1/2/0 brief
Physical interface: gr-1/2/0, Enabled, Physical link is Up
  Type: GRE, Link-level type: GRE, MTU: Unlimited, Speed: 800mbps
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps

  Logical interface gr-1/2/0.0
    Flags: Hardware-Down Point-To-Point SNMP-Traps 0x4000
    IP-Header 10.10.0.2:10.10.0.1:47:df:64:0000000000000000
    Encapsulation: GRE-NULL
    inet  10.100.0.1/30
    mpls
```

show interfaces detail (GRE)

```
user@host> show interfaces gr-1/2/0 detail
Physical interface: gr-0/0/0, Enabled, Physical link is Up
  Interface index: 132, SNMP ifIndex: 26, Generation: 13
  Type: GRE, Link-level type: GRE, MTU: Unlimited, Speed: 800mbps
  Hold-times     : Up 0 ms, Down 0 ms
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :                    0                    0 bps
   Input  packets:                    0                    0 pps
   Output packets:                    0                    0 pps

  Logical interface gr-0/0/0.0 (Index 68) (SNMP ifIndex 47) (Generation 8)
    Flags: Point-To-Point SNMP-Traps 16384
    IP-Header 1.1.1.2:1.1.1.1:47:df:64:0000000000000000 Encapsulation: GRE-NULL
    Traffic statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
```

```
 Output packets:                    0
Local statistics:
 Input  bytes  :                    0
 Output bytes  :                    0
 Input  packets:                    0
 Output packets:                    0
Transit statistics:
 Input  bytes  :                    0                    0 bps
 Output bytes  :                    0                    0 bps
 Input  packets:                    0                    0 pps
 Output packets:                    0                    0 pps
Protocol inet, MTU: 1476, Generation: 12, Route table: 0
  Flags: None
  Addresses, Flags: Is-Primary
    Destination: Unspecified, Local: 1.10.1.1, Broadcast: Unspecified,
    Generation: 15
```

show interfaces detail (GRE) on an EX4200 Virtual Chassis Member Switch

```
user@switch> show interfaces gr-2/0/15 detail
Physical interface: gr-2/0/15, Enabled, Physical link is Up
  Interface index: 195, SNMP ifIndex: 846, Generation: 198
  Type: GRE, Link-level type: GRE, MTU: Unlimited, Speed: 1000mbps
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:1f:12:38:0f:d2, Hardware address: 00:1f:12:38:0f:d2
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps
  Statistics last cleared: 2011-09-14 17:43:15 UTC (00:00:18 ago)
  Traffic statistics:
   Input  bytes  :              5600636                    0 bps
   Output bytes  :              5600636                    0 bps
   Input  packets:                20007                    0 pps
   Output packets:                20007                    0 pps
   IPv6 transit statistics:
    Input  bytes  :                   0
    Output bytes  :                   0
    Input  packets:                   0
    Output packets:                   0

  Logical interface gr-2/0/15.0 (Index 75) (SNMP ifIndex 847) (HW Token 4093)
  (Generation 140)
    Flags: Point-To-Point SNMP-Traps 0x0
    IP-Header 180.20.30.2:180.20.20.3:47:df:64:0000000000000000
    Encapsulation: GRE-NULL
    Copy-tos-to-outer-ip-header: Off
    Gre keepalives configured: Off, Gre keepalives adjacency state: down
    Traffic statistics:
     Input  bytes  :              5600886
     Output bytes  :              2881784
     Input  packets:                20010
     Output packets:                10018
    Local statistics:
     Input  bytes  :                  398
     Output bytes  :                  264
     Input  packets:                    5
     Output packets:                    3
    Transit statistics:
     Input  bytes  :              5600488                    0 bps
     Output bytes  :              2881520                    0 bps
     Input  packets:                20005                    0 pps
     Output packets:                10015                    0 pps
```



```
  Protocol inet, Generation: 159, Route table: 0
    Flags: None
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 90.90.90/24, Local: 90.90.90.10, Broadcast: 90.90.90.255,
      Generation: 144

Logical interface gr-2/0/15.1 (Index 80) (SNMP ifIndex 848) (HW Token 4088)
(Generation 150)
  Flags: Point-To-Point SNMP-Traps 0x0
  IP-Header 160.20.40.2:160.20.30.1:47:df:64:0000000000000000
  Encapsulation: GRE-NULL
  Copy-tos-to-outer-ip-header: Off
  Gre keepalives configured: Off, Gre keepalives adjacency state: down
  Traffic statistics:
   Input  bytes  :                  260
   Output bytes  :              2880148
   Input  packets:                    4
   Output packets:                10002
  Local statistics:
   Input  bytes  :                  112
   Output bytes  :                    0
   Input  packets:                    2
   Output packets:                    0
  Transit statistics:
   Input  bytes  :                  148                    0 bps
   Output bytes  :              2880148                    0 bps
   Input  packets:                    2                    0 pps
   Output packets:                10002                    0 pps
  Protocol inet, Generation: 171, Route table: 0
    Flags: None
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 70.70.70/24, Local: 70.70.70.10, Broadcast: 70.70.70.255,
      Generation: 160
```

show interfaces extensive (GRE)

The output for the **show interfaces extensive** command is identical to that for the **show interfaces detail** command. For sample output, see show interfaces detail (GRE) on page 2195 and show interfaces detail (GRE) on an EX4200 Virtual Chassis Member Switch on page 2196.

show interfaces mc-ae

Syntax **show interfaces mc-ae id *identifier* unit *number***

Release Information Command introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description On peers with multi-chassis aggregated Ethernet (**mc-ae*X***) interfaces, use this command to display information about the **mc-ae*X*** interfaces.

Options ***identifier***—(Optional) Name of the multichassis aggregated Ethernet interface.

number—(Optional) Specify the logical interface by unit number.

Required Privilege Level view

Related Documentation

- Understanding Multichassis Link Aggregation on page 1853 (QFX Series Switches)
- *Understanding Multichassis Link Aggregation* (EX Series Switches)
- Configuring Multichassis Link Aggregation on page 2022 (QFX Series Switches)
- *Configuring Multichassis Link Aggregation* (EX Series Switches)
- Example: Configuring Multichassis Link Aggregation on page 1904 (QFX Series Switches)
- Example: Configuring Multichassis Link Aggregation with Layer 3 MAC Address Synchronization on page 1963 (QFX Series Switches)
- *Example: Configuring Multichassis Link Aggregation for Layer 3 Unicast using MAC Address Synchronization* (QFX Series Switches)
- Example: Configuring Multichassis Link Aggregation for Layer 3 Unicast Using Virtual Router Redundancy Protocol (VRRP) on page 1983 (QFX Series Switches)
- *Example: Configuring Multichassis Link Aggregation for Layer 3 Unicast Using VRRP* (EX Series Switches)
- Example: Configuring Multichassis Link Aggregation for Layer 3 Multicast Using VRRP on page 1926 (QFX Series Switches)
- *Example: Configuring Multichassis Link Aggregation for Layer 3 Multicast Using VRRP* (EX Series Switches)

List of Sample Output show interfaces mc-ae on page 2199

Output Fields Table 188 on page 2198 lists the output fields for the **show interfaces mc-ae** command. Output fields are listed in the approximate order in which they appear.

Table 188: show interfaces mc-ae Output Fields

Output Field Name	Field Description
Current State Machine's State	Specifies the state of the MC-LAG initialization state machine.

Table 188: show interfaces mc-ae Output Fields *(continued)*

Output Field Name	Field Description
Member Link	Specifies the identifiers of the configured multichassis link aggregated interface members.
Local Status	Specifies the status of the local link: **active** or **standby**.
Peer Status	Specifies the status of the peer link: **active** or **standby**.
Peer State	Specifies the status of the local and peer links in an **active/active** MC-LAG configuration
Logical Interface	Specifies the identifier and unit of the AE interface.
Topology Type	Specifies the bridge configured on the AE.
Local State	Specifies if the local device is up or down.
Peer State	Specifies if the peer device is up or down.
Peer Ip/MCP/State	Specifies the multichassis protection (MCP) link or the interchassis link-protection link (ICL-PL) for all of the multichassis aggregated Ethernet (MC-AE) interfaces that are part of the peer.

Sample Output

show interfaces mc-ae

```
user@host> show interfaces mc-ae ae1 512
Member Link                  : ae0
 Current State Machine's State: mcae active state
 Local Status                 : active
 Local State                  : up
 Peer Status                  : active
 Peer State                   : up
     Logical Interface        : ae0.0
     Topology Type            : bridge
     Local State              : up
     Peer State               : up
     Peer Ip/MCP/State        : 3.3.3.2 ae1.0 up
```


show interfaces queue

Syntax

show interfaces queue
<aggregate | remaining-traffic>
<both-ingress-egress>
<egress>
<forwarding-class *forwarding-class*>
<ingress>
<interface-name *interface-name*>
<l2-statistics>

Release Information

Command introduced before Junos OS Release 7.4.
both-ingress-egress, **egress**, and **ingress** options introduced in Junos OS Release 7.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.
l2-statistics option introduced in Junos OS Release 12.1.

Description

Display class-of-service (CoS) queue information for physical interfaces.

Options

none—Show detailed CoS queue statistics for all physical interfaces.

aggregate—(Optional) Display the aggregated queuing statistics of all logical interfaces that have traffic-control profiles configured. (Not on the QFX Series.)

both-ingress-egress—(Optional) On Gigabit Ethernet Intelligent Queuing 2 (IQ2) PICs, display both ingress and egress queue statistics. (Not on the QFX Series.)

egress—(Optional) Display egress queue statistics.

forwarding-class ***forwarding-class***—(Optional) Forwarding class name for this queue. Shows detailed CoS statistics for the queue associated with the specified forwarding class.

ingress—(Optional) On Gigabit Ethernet IQ2 PICs, display ingress queue statistics. (Not on the QFX Series.)

interface-name ***interface-name***—(Optional) Show detailed CoS queue statistics for the specified interface.

l2-statistics—(Optional) Display Layer 2 statistics for MLPPP, FRF.15, and FRF.16 bundles

remaining-traffic—(Optional) Display the remaining-traffic queue statistics of all logical interfaces that have traffic-control profiles configured.

Overhead for Layer 2 Statistics

Transmitted packets and transmitted byte counts are displayed for the Layer 2 level with the addition of encapsulation overheads applied for fragmentation, as shown in Table 189 on page 2201. Others counters, such as packets and bytes queued (input) and drop counters, are displayed at the Layer 3 level. In the case of link fragmentation and interleaving (LFI) for which fragmentation is not applied, corresponding Layer 2 overheads are added, as shown in Table 189 on page 2201.

Table 189: Layer 2 Overhead, Transmitted Packets/Bytes

Protocol	Fragmentation		LFI
	First fragmentation	Second to n fragmentations	
	Bytes	Bytes	
MLPPP (Long)	13	12	8
MLPPP (short)	11	10	8
MLFR (FRF15)	12	10	8
MFR (FRF16)	10	8	-
MCMLPPP(Long)	13	12	-
MCMLPPP(Short)	11	10	-

Layer 2 Statistics - Fragmentation Overhead Calculation

```
MLPPP/MC-MLPPP Overhead details:
   ===============================
   Fragment 1:

    Outer PPP header                          : 4 bytes
    Long or short sequence MLPPP header       : 4 bytes or 2 bytes
    Inner PPP header                          : 1 byte
    HDLC flag and FCS bytes                   : 4 bytes

   Fragments 2 .. n :

    Outer PPP header                          : 4 bytes
    Long or short sequence MLPPP header       : 4 bytes or 2 bytes
    HDLC flag and FCS bytes                   : 4 bytes


   MLFR (FRF15) Overhead details:
   =============================
   Fragment 1:
       Framerelay header     :  2 bytes
       Control,NLPID         :  2 bytes
       Fragmentaion header   :  2 bytes
       Inner proto           :  2 bytes
       HDLC flag and  FCS    :  4 bytes

   Fragments 2 ...n :

       Framerelay header     :  2 bytes
       Control,NLPID         :  2 bytes
       Fragmentaion header   :  2 bytes
       HDLC flag and  FCS    :  4 bytes


   MFR (FRF16) Overhead details:
   ==============================
```



```
   Fragment 1:
      Fragmentaion header   :  2 bytes
      Framerelay header     :  2 bytes
      Inner proto           :  2 bytes
      HDLC flag and  FCS    :  4 bytes

   Fragments 2 ...n :
      Fragmentaion header   :  2 bytes
      Framerelay header     :  2 bytes
      HDLC flag and  FCS    :  4 bytes
```

Overhead with LFI

```
MLPPP(Long & short sequence):
   ============================
       Outer PPP header      :  4 bytes
       HDLC flag and  FCS    :  4 bytes

  MLFR (FRF15):
  =============
       Framerelay header     :  2 bytes
       Control,NLPID         :  2 bytes
       HDLC flag and  FCS    :  4 bytes
```

The following examples show overhead for different cases:

- A 1000-byte packet is sent to a mlppp bundle without any fragmentation. At the Layer 2 level, bytes transmitted is 1013 in 1 packet. This overhead is for MLPPP long sequence encap.
- A 1000-byte packet is sent to a mlppp bundle with a fragment threshold of 250byte. At the Layer 2 level, bytes transmitted is 1061 bytes in 5 packets.
- A 1000-byte LFI packet is sent to an mlppp bundle. At the Layer 2 level, bytes transmitted is 1008 in 1 packet.

remaining-traffic—(Optional) Display the queuing statistics of all logical interfaces that do not have traffic-control profiles configured. (Not on the QFX Series.)

Additional Information

For rate-limited interfaces hosted on Modular Interface Cards (MICs) or Modular Port Concentrators (MPCs), rate-limit packet-drop operations occur *before* packets are queued for transmission scheduling. For such interfaces, the statistics for queued traffic do not include the packets that have already been dropped due to rate limiting, and consequently the displayed statistics for queued traffic are the same as the displayed statistics for transmitted traffic.

NOTE: For rate-limited interfaces hosted on other types of hardware, rate-limit packet-drop operations occur *after* packets are queued for transmission scheduling. For these other interface types, the statistics for queued traffic include the packets that are later dropped due to rate limiting, and consequently the displayed statistics for queued traffic equals the sum of the statistics for transmitted and rate-limited traffic.

On M Series routers (except for the M320 and M120 routers), this command is valid only for a PIC installed on an enhanced Flexible PIC Concentrator (FPC).

Queue statistics for aggregated interfaces are supported on the M Series and T Series routers only. Statistics for an aggregated interface are the summation of the queue statistics of the child links of that aggregated interface. You can view the statistics for a child interface by using the **show interfaces statistics** command for that child interface.

When you configure tricolor marking on a 10-port 1-Gigabit Ethernet PIC, for queues 6 and 7 only, the output does not display the number of queued bytes and packets, or the number of bytes and packets dropped because of RED. If you do not configure tricolor marking on the interface, these statistics are available for all queues.

For the 4-port Channelized OC12 IQE PIC and 1-port Channelized OC48 IQE PIC, the **Packet Forwarding Engine Chassis Queues** field represents traffic bound for a particular physical interface on the PIC. For all other PICs, the **Packet Forwarding Engine Chassis Queues** field represents the total traffic bound for the PIC.

For Gigabit Ethernet IQ2 PICs, the **show interfaces queue** command output does not display the number of tail-dropped packets. This limitation does not apply to Packet Forwarding Engine chassis queues.

When fragmentation occurs on the egress interface, the first set of packet counters shows the postfragmentation values. The second set of packet counters (under the **Packet Forwarding Engine Chassis Queues** field) shows the prefragmentation values.

The behavior of the **egress** queues for the **Routing Engine-Generated Traffic** is not same as the configured queue for MLPPP and MFR configurations.

For information about how to configure CoS, see the *Junos OS Network Interfaces Library for Routing Devices*. For related CoS operational mode commands, see the CLI Explorer.

Required Privilege Level view

List of Sample Output

Output Fields Table 190 on page 2204 lists the output fields for the **show interfaces queue** command. Output fields are listed in the approximate order in which they appear.

Table 190: show interfaces queue Output Fields

Field Name	Field Description
Physical interface	Name of the physical interface.
Enabled	State of the interface. Possible values are described in the “Enabled Field” section under *Common Output Fields Description*.
Interface index	Physical interface's index number, which reflects its initialization sequence.
SNMP ifIndex	SNMP index number for the interface.
Forwarding classes supported	Total number of forwarding classes supported on the specified interface.
Forwarding classes in use	Total number of forwarding classes in use on the specified interface.
Ingress queues supported	On Gigabit Ethernet IQ2 PICs only, total number of ingress queues supported on the specified interface.
Ingress queues in use	On Gigabit Ethernet IQ2 PICs only, total number of ingress queues in use on the specified interface.
Output queues supported	Total number of output queues supported on the specified interface.
Output queues in use	Total number of output queues in use on the specified interface.
Egress queues supported	Total number of egress queues supported on the specified interface.
Egress queues in use	Total number of egress queues in use on the specified interface.
Queue counters (Ingress)	CoS queue number and its associated user-configured forwarding class name. Displayed on IQ2 interfaces. • **Queued packets**—Number of queued packets. • **Transmitted packets**—Number of transmitted packets. • **Dropped packets**—Number of packets dropped by the ASIC's RED mechanism.
Burst size	(Logical interfaces on IQ PICs only) Maximum number of bytes up to which the logical interface can burst. The burst size is based on the shaping rate applied to the interface.
The following output fields are applicable to both interface component and Packet Forwarding component in the **show interfaces queue** command:	
Queue	Queue number.
Forwarding classes	Forwarding class name.

Table 190: show interfaces queue Output Fields *(continued)*

Field Name	Field Description
Queued Packets	Number of packets queued to this queue. NOTE: For Gigabit Ethernet IQ2 interfaces, the Queued Packets count is calculated by the Junos OS interpreting one frame buffer as one packet. If the queued packets are very large or very small, the calculation might not be completely accurate for transit traffic. The count is completely accurate for traffic terminated on the router. For rate-limited interfaces hosted on MICs or MPCs only, this statistic does not include traffic dropped due to rate limiting. For more information, see “Additional Information” on page 2202.
Queued Bytes	Number of bytes queued to this queue. The byte counts vary by interface hardware. For more information, see Table 191 on page 2207. For rate-limited interfaces hosted on MICs or MPCs only, this statistic does not include traffic dropped due to rate limiting. For more information, see “Additional Information” on page 2202.
Transmitted Packets	Number of packets transmitted by this queue. When fragmentation occurs on the egress interface, the first set of packet counters shows the postfragmentation values. The second set of packet counters (displayed under the **Packet Forwarding Engine Chassis Queues** field) shows the prefragmentation values. NOTE: For Layer 2 statistics, see “Overhead for Layer 2 Statistics” on page 2200
Transmitted Bytes	Number of bytes transmitted by this queue. The byte counts vary by interface hardware. For more information, see Table 191 on page 2207. NOTE: On MX Series routers, this number can be inaccurate when you issue the command for a physical interface repeatedly and in quick succession, because the statistics for the child nodes are collected infrequently. Wait ten seconds between successive iterations to avoid this situation. NOTE: For Layer 2 statistics, see “Overhead for Layer 2 Statistics” on page 2200
Tail-dropped packets	Number of packets dropped because of tail drop.
RL-dropped packets	Number of packets dropped due to rate limiting. For rate-limited interfaces hosted on MICs or MPCs only, this statistic is not included in the queued traffic statistics. For more information, see “Additional Information” on page 2202.
RL-dropped bytes	Number of bytes dropped due to rate limiting. For rate-limited interfaces hosted on MICs or MPCs only, this statistic is not included in the queued traffic statistics. For more information, see “Additional Information” on page 2202.

Table 190: show interfaces queue Output Fields *(continued)*

<table>
<tr><th>Field Name</th><th>Field Description</th></tr>
<tr><td>RED-dropped packets</td><td>Number of packets dropped because of random early detection (RED).
(M Series and T Series routers only) On M320 and M120 routers and the T Series routers, the total number of dropped packets is displayed. On all other M Series routers, the output classifies dropped packets into the following categories:
Low, non-TCP—Number of low-loss priority non-TCP packets dropped because of RED.
Low, TCP—Number of low-loss priority TCP packets dropped because of RED.
High, non-TCP—Number of high-loss priority non-TCP packets dropped because of RED.
High, TCP—Number of high-loss priority TCP packets dropped because of RED.
(J Series routers and MX Series routers with enhanced DPCs, and T Series routers with enhanced FPCs only) The output classifies dropped packets into the following categories:
Low—Number of low-loss priority packets dropped because of RED.
Medium-low—Number of medium-low loss priority packets dropped because of RED.
Medium-high—Number of medium-high loss priority packets dropped because of RED.
High—Number of high-loss priority packets dropped because of RED.
NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), this field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.</td></tr>
<tr><td>RED-dropped bytes</td><td>Number of bytes dropped because of RED. The byte counts vary by interface hardware. For more information, see Table 191 on page 2207.
(M Series and T Series routers only) On M320 and M120 routers and the T Series routers, only the total number of dropped bytes is displayed. On all other M Series routers, the output classifies dropped bytes into the following categories:
Low, non-TCP—Number of low-loss priority non-TCP bytes dropped because of RED.
Low, TCP—Number of low-loss priority TCP bytes dropped because of RED.
High, non-TCP—Number of high-loss priority non-TCP bytes dropped because of RED.
High, TCP—Number of high-loss priority TCP bytes dropped because of RED.
(J Series routers only) The output classifies dropped bytes into the following categories:
Low—Number of low-loss priority bytes dropped because of RED.
Medium-low—Number of medium-low loss priority bytes dropped because of RED.
Medium-high—Number of medium-high loss priority bytes dropped because of RED.
High—Number of high-loss priority bytes dropped because of RED.
NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), this field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.</td></tr>
</table>

Byte counts vary by interface hardware. Table 191 on page 2207 shows how the byte counts on the outbound interfaces vary depending on the interface hardware. Table 191 on page 2207 is based on the assumption that outbound interfaces are sending IP traffic with 478 bytes per packet.

Table 191: Byte Count by Interface Hardware

<table>
<tr><th>Interface Hardware</th><th>Output Level</th><th>Byte Count Includes</th><th>Comments</th></tr>
<tr><td>Gigabit Ethernet IQ and IQE PICs</td><td>Interface</td><td>Queued: 490 bytes per packet, representing 478 bytes of Layer 3 packet + 12 bytes

Transmitted: 490 bytes per packet, representing 478 bytes of Layer 3 packet + 12 bytes

RED dropped: 496 bytes per packet representing 478 bytes of Layer 3 packet + 18 bytes</td><td>The 12 additional bytes include 6 bytes for the destination MAC address + 4 bytes for the VLAN + 2 bytes for the Ethernet type.

For RED dropped, 6 bytes are added for the source MAC address.</td></tr>
<tr><td></td><td>Packet forwarding component</td><td>Queued: 478 bytes per packet, representing 478 bytes of Layer 3 packet

Transmitted: 478 bytes per packet, representing 478 bytes of Layer 3 packet</td><td>–</td></tr>
<tr><td>Non-IQ PIC</td><td>Interface</td><td>T Series, TX Series, T1600, and MX Series routers:
• Queued: 478 bytes of Layer 3 packet.
• Transmitted: 478 bytes of Layer 3 packet.

T4000 routers with Type 5 FPCs :
• Queued: 478 bytes of Layer 3 packet + the full Layer 2 overhead including 4 bytes CRC + the full Layer 1 overhead 8 bytes preamble + 12 bytes Inter frame Gap.
• Transmitted: 478 bytes of Layer 3 packet + the full Layer 2 overhead including 4 bytes CRC + the full Layer 1 overhead 8 bytes preamble + 12 bytes Interframe Gap.

M Series routers:
• Queued: 478 bytes of Layer 3 packet.
• Transmitted: 478 bytes of Layer 3 packet + the full Layer 2 overhead.

PTX Series Packet Transport Routers:
• Queued: 478 bytes of Layer 3 packet + the full Layer 2 overhead including 4 bytes FCS + the full Layer 1 overhead of the MAC header DA + SA + EtherType (non-VLAN).
• Transmitted: 478 bytes of Layer 3 packet + the full Layer 2 overhead including 4 bytes CRC + the full Layer 1 overhead of the MAC header DA + SA + EtherType (non-VLAN).
• RED dropped: 478 bytes of Layer 3 packet + 22 bytes special header. To the TQ, this packet has 4 bytes more than queued or transmitted.</td><td>The Layer 2 overhead is 14 bytes for non-VLAN traffic and 18 bytes for VLAN traffic.</td></tr>
</table>

Table 191: Byte Count by Interface Hardware *(continued)*

Interface Hardware	Output Level	Byte Count Includes	Comments
IQ and IQE PICs with a SONET/SDH interface	Interface	Queued: 482 bytes per packet, representing 478 bytes of Layer 3 packet + 4 bytes Transmitted: 482 bytes per packet, representing 478 bytes of Layer 3 packet + 4 bytes RED dropped: 482 bytes per packet, representing 478 bytes of Layer 3 packet + 4 bytes	The additional 4 bytes are for the Layer 2 Point-to-Point Protocol (PPP) header.
	Packet forwarding component	Queued: 478 bytes per packet, representing 478 bytes of Layer 3 packet Transmitted: 486 bytes per packet, representing 478 bytes of Layer 3 packet + 8 bytes	For transmitted packets, the additional 8 bytes includes 4 bytes for the PPP header and 4 bytes for a cookie.
Non-IQ PIC with a SONET/SDH interface	Interface	T Series, TX Series, T1600, and MX Series routers: • Queued: 478 bytes of Layer 3 packet. • Transmitted: 478 bytes of Layer 3 packet. M Series routers: • Queued: 478 bytes of Layer 3 packet. • Transmitted: 483 bytes per packet, representing 478 bytes of Layer 3 packet + 5 bytes • RED dropped: 478 bytes per packet, representing 478 bytes of Layer 3 packet	For transmitted packets, the additional 5 bytes includes 4 bytes for the PPP header and 1 byte for the packet loss priority (PLP).
Interfaces configured with Frame Relay Encapsulation	Interface	The default Frame Relay overhead is 7 bytes. If you configure the Frame Check Sequence (FCS) to 4 bytes, then the overhead increases to 10 bytes.	
1-port 10-Gigabit Ethernet IQ2 and IQ2–E PICs 4-port 1G IQ2 and IQ2-E PICs 8-port 1G IQ2 and IQ2-E PICs	Interface	Queued: 478 bytes of Layer 3 packet + the full Layer 2 overhead including CRC. Transmitted: 478 bytes of Layer 3 packet + the full Layer 2 overhead including CRC.	The Layer 2 overhead is 18 bytes for non-VLAN traffic and 22 bytes for VLAN traffic.
	Packet forwarding component	Queued: 478 bytes of Layer 3 packet. Transmitted: 478 bytes of Layer 3 packet.	–

Sample Output

show interfaces queue (Rate-Limited Interface on a Gigabit Ethernet MIC in an MPC)

The following example shows queue information for the rate-limited interface ge-4/2/0 on a Gigabit Ethernet MIC in an MPC. For rate-limited queues for interfaces hosted on MICs or MPCs, rate-limit packet drops occur prior to packet output queuing. In the command output, the nonzero statistics displayed in the **RL-dropped packets** and **RL-dropped bytes** fields quantify the traffic dropped to rate-limit queue 0 output to 10 percent of 1 gigabyte (100 megabits) per second. Because the RL-dropped traffic is not included in the **Queued** statistics, the statistics displayed for queued traffic are the same as the statistics for transmitted traffic.

```
user@host> show interfaces queue ge-4/2/0
Physical interface: ge-4/2/0, Enabled, Physical link is Up
  Interface index: 203, SNMP ifIndex: 1054
Forwarding classes: 16 supported, 4 in use
Egress queues: 8 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :             131300649                141751 pps
    Bytes                :           11287964840              99793248 bps
  Transmitted:
    Packets              :             131300649                141751 pps
    Bytes                :           11287964840              99793248 bps
    Tail-dropped packets :                     0                     0 pps
    RL-dropped packets   :             205050862                602295 pps
    RL-dropped bytes     :           13595326612             327648832 bps
    RED-dropped packets  :                     0                     0 pps
     Low                 :                     0                     0 pps
     Medium-low          :                     0                     0 pps
     Medium-high         :                     0                     0 pps
     High                :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
     Low                 :                     0                     0 bps
     Medium-low          :                     0                     0 bps
     Medium-high         :                     0                     0 bps
     High                :                     0                     0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
```

show interfaces queue (Aggregated Ethernet on a T320 Router)

The following example shows that the aggregated Ethernet interface, **ae1**, has traffic on queues **af1** and **af12**:

```
user@host> show interfaces queue ae1
Physical interface: ae1, Enabled, Physical link is Up
Interface index: 158, SNMP ifIndex: 33 Forwarding classes: 8 supported, 8 in use
Output queues: 8 supported, 8 in use
Queue: 0, Forwarding classes: be
  Queued:
    Packets              :                     5                     0 pps
    Bytes                :                   242                     0 bps
  Transmitted:
    Packets              :                     5                     0 pps
    Bytes                :                   242                     0 bps
    Tail-dropped packets :                     0                     0 pps
    RED-dropped packets  :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
Queue: 1, Forwarding classes: af1
  Queued:
    Packets              :              42603765                595484 pps
```

```
    Bytes                :          5453281920              609776496 bps
  Transmitted:
    Packets              :            42603765                 595484 pps
    Bytes                :          5453281920              609776496 bps
    Tail-dropped packets :                   0                      0 pps
    RED-dropped packets  :                   0                      0 pps
    RED-dropped bytes    :                   0                      0 bps
Queue: 2, Forwarding classes: ef1
  Queued:
    Packets              :                   0                      0 pps
    Bytes                :                   0                      0 bps
  Transmitted:
    Packets              :                   0                      0 pps
    Bytes                :                   0                      0 bps
    Tail-dropped packets :                   0                      0 pps
    RED-dropped packets  :                   0                      0 pps
    RED-dropped bytes    :                   0                      0 bps
Queue: 3, Forwarding classes: nc
  Queued:
    Packets              :                  45                      0 pps
    Bytes                :                3930                      0 bps
  Transmitted:
    Packets              :                  45                      0 pps
    Bytes                :                3930                      0 bps
    Tail-dropped packets :                   0                      0 pps
    RED-dropped packets  :                   0                      0 pps
    RED-dropped bytes    :                   0                      0 bps
Queue: 4, Forwarding classes: af11
  Queued:
    Packets              :                   0                      0 pps
    Bytes                :                   0                      0 bps
  Transmitted:
    Packets              :                   0                      0 pps
    Bytes                :                   0                      0 bps
    Tail-dropped packets :                   0                      0 pps
    RED-dropped packets  :                   0                      0 pps
    RED-dropped bytes    :                   0                      0 bps
Queue: 5, Forwarding classes: ef11
  Queued:
    Packets              :                   0                      0 pps
    Bytes                :                   0                      0 bps
  Transmitted:
    Packets              :                   0                      0 pps
    Bytes                :                   0                      0 bps
    Tail-dropped packets :                   0                      0 pps
    RED-dropped packets  :                   0                      0 pps
    RED-dropped bytes    :                   0                      0 bps
Queue: 6, Forwarding classes: af12
  Queued:
    Packets              :            31296413                 437436 pps
    Bytes                :          4005940864              447935200 bps
  Transmitted:
    Packets              :            31296413                 437436 pps
    Bytes                :          4005940864              447935200 bps
    Tail-dropped packets :                   0                      0 pps
    RED-dropped packets  :                   0                      0 pps
    RED-dropped bytes    :                   0                      0 bps
Queue: 7, Forwarding classes: nc2
  Queued:
    Packets              :                   0                      0 pps
    Bytes                :                   0                      0 bps
```

```
  Transmitted:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                   0                    0 pps
    RED-dropped bytes    :                   0                    0 bps
```

show interfaces queue (Fast Ethernet on a J4300 Router)

```
user@host> show interfaces queue fe-4/0/0.0
Logical interface fe-4/0/0.0 (Index 71) (SNMP ifIndex 42)
Forwarding classes: 8 supported, 8 in use
Output queues: 8 supported, 8 in use
Queue: 0, Forwarding classes: be
  Queued:
    Packets             :              5240762                 3404 pps
    Bytes               :           3020710354             15934544 bps
  Transmitted:
    Packets             :              5240762                 3404 pps
    Bytes               :           3020710354             15934544 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                   0                    0 pps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes    :                   0                    0 bps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
Queue: 1, Forwarding classes: af1
  Queued:
    Packets             :              2480391                 1650 pps
    Bytes               :           1304685666              6945704 bps
  Transmitted:
    Packets             :              2478740                 1650 pps
    Bytes               :           1303817240              6945704 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                1651                    0 pps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                 1651                    0 pps
    RED-dropped bytes    :              868426                    0 bps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :               868426                    0 pps
```

show interfaces queue (Gigabit Ethernet on a T640 Router)

```
user@host> show interfaces queue
Physical interface: ge-7/0/1, Enabled, Physical link is Up
   Interface index: 150, SNMP ifIndex: 42
 Forwarding classes: 8 supported, 8 in use
 Output queues: 8 supported, 8 in use
 Queue: 0, Forwarding classes: be
   Queued:
```

```
      Packets            :                  13                   0 pps
      Bytes              :                 622                   0 bps
    Transmitted:
      Packets            :                  13                   0 pps
      Bytes              :                 622                   0 bps
      Tail-dropped packets :                 0                   0 pps
      RED-dropped packets  :                 0                   0 pps
      RED-dropped bytes    :                 0                   0 bps
  Queue: 1, Forwarding classes: af1
    Queued:
      Packets            :          1725947945              372178 pps
      Bytes              :        220921336960           381110432 bps
    Transmitted:
      Packets            :          1725947945              372178 pps
      Bytes              :        220921336960           381110432 bps
      Tail-dropped packets :                 0                   0 pps
      RED-dropped packets  :                 0                   0 pps
      RED-dropped bytes    :                 0                   0 bps
  Queue: 2, Forwarding classes: ef1
    Queued:
      Packets            :                   0                   0 pps
      Bytes              :                   0                   0 bps
    Transmitted:
      Packets            :                   0                   0 pps
      Bytes              :                   0                   0 bps
      Tail-dropped packets :                 0                   0 pps
      RED-dropped packets  :                 0                   0 pps
      RED-dropped bytes    :                 0                   0 bps
  Queue: 3, Forwarding classes: nc
    Queued:
      Packets            :                 571                   0 pps
      Bytes              :               49318                 336 bps
    Transmitted:
      Packets            :                 571                   0 pps
      Bytes              :               49318                 336 bps
      Tail-dropped packets :                 0                   0 pps
      RED-dropped packets  :                 0                   0 pps
      RED-dropped bytes    :                 0                   0 bps
```

show interfaces queue aggregate (Gigabit Ethernet Enhanced DPC)

```
user@host> show interfaces queue ge-2/2/9 aggregate
Physical interface: ge-2/2/9, Enabled, Physical link is Up
  Interface index: 238, SNMP ifIndex: 71
Forwarding classes: 16 supported, 4 in use
Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :           148450735              947295 pps
    Bytes                :          8016344944           409228848 bps
  Transmitted:
    Packets              :            76397439              487512 pps
    Bytes                :          4125461868           210602376 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :            72053285              459783 pps
     Low                 :            72053285              459783 pps
     Medium-low          :                   0                   0 pps
     Medium-high         :                   0                   0 pps
     High                :                   0                   0 pps
    RED-dropped bytes    :          3890877444           198626472 bps
```

```
      Low               :          3890877444           198626472 bps
      Medium-low        :                   0                   0 bps
      Medium-high       :                   0                   0 bps
      High              :                   0                   0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets             :                   0                   0 pps
    Bytes               :                   0                   0 bps
  Transmitted:
    Packets             :                   0                   0 pps
    Bytes               :                   0                   0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                  0                   0 pps
     Low                :                   0                   0 pps
     Medium-low         :                   0                   0 pps
     Medium-high        :                   0                   0 pps
     High               :                   0                   0 pps
    RED-dropped bytes   :                   0                   0 bps
     Low                :                   0                   0 bps
     Medium-low         :                   0                   0 bps
     Medium-high        :                   0                   0 bps
     High               :                   0                   0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets             :           410278257              473940 pps
    Bytes               :         22156199518           204742296 bps
  Transmitted:
    Packets             :             4850003                4033 pps
    Bytes               :           261900162             1742256 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :          405425693              469907 pps
     Low                :           405425693              469907 pps
     Medium-low         :                   0                   0 pps
     Medium-high        :                   0                   0 pps
     High               :                   0                   0 pps
    RED-dropped bytes   :         21892988124           203000040 bps
     Low                :         21892988124           203000040 bps
     Medium-low         :                   0                   0 bps
     Medium-high        :                   0                   0 bps
     High               :                   0                   0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets             :                   0                   0 pps
    Bytes               :                   0                   0 bps
  Transmitted:
    Packets             :                   0                   0 pps
    Bytes               :                   0                   0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                  0                   0 pps
     Low                :                   0                   0 pps
     Medium-low         :                   0                   0 pps
     Medium-high        :                   0                   0 pps
     High               :                   0                   0 pps
    RED-dropped bytes   :                   0                   0 bps
     Low                :                   0                   0 bps
     Medium-low         :                   0                   0 bps
     Medium-high        :                   0                   0 bps
     High               :                   0                   0 bps
Forwarding classes: 16 supported, 4 in use
Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
```



```
  Queued:
    Packets             :             76605230               485376 pps
    Bytes               :           5209211400            264044560 bps
  Transmitted:
    Packets             :             76444631               484336 pps
    Bytes               :           5198235612            263478800 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :               160475                 1040 pps
     Low                :               160475                 1040 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes   :             10912300               565760 bps
     Low                :             10912300               565760 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
  Transmitted:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes   :                    0                    0 bps
     Low                :                    0                    0 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets             :              4836136                 3912 pps
    Bytes               :            333402032              2139056 bps
  Transmitted:
    Packets             :              3600866                 1459 pps
    Bytes               :            244858888               793696 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :              1225034                 2450 pps
     Low                :              1225034                 2450 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes   :             83302312              1333072 bps
     Low                :             83302312              1333072 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
  Transmitted:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
    Tail-dropped packets : Not Available
```



```
      RED-dropped packets  :                    0                    0 pps
       Low                 :                    0                    0 pps
       Medium-low          :                    0                    0 pps
       Medium-high         :                    0                    0 pps
       High                :                    0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
       Low                 :                    0                    0 bps
       Medium-low          :                    0                    0 bps
       Medium-high         :                    0                    0 bps
       High                :                    0                    0 bps

  Packet Forwarding Engine Chassis Queues:
  Queues: 4 supported, 4 in use
  Queue: 0, Forwarding classes: best-effort
    Queued:
      Packets              :             77059796               486384 pps
      Bytes                :           3544750624            178989576 bps
    Transmitted:
      Packets              :             77059797               486381 pps
      Bytes                :           3544750670            178988248 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  :                    0                    0 pps
       Low                 :                    0                    0 pps
       Medium-low          :                    0                    0 pps
       Medium-high         :                    0                    0 pps
       High                :                    0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
       Low                 :                    0                    0 bps
       Medium-low          :                    0                    0 bps
       Medium-high         :                    0                    0 bps
       High                :                    0                    0 bps
  Queue: 1, Forwarding classes: expedited-forwarding
    Queued:
      Packets              :                    0                    0 pps
      Bytes                :                    0                    0 bps
    Transmitted:
      Packets              :                    0                    0 pps
      Bytes                :                    0                    0 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  :                    0                    0 pps
       Low                 :                    0                    0 pps
       Medium-low          :                    0                    0 pps
       Medium-high         :                    0                    0 pps
       High                :                    0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
       Low                 :                    0                    0 bps
       Medium-low          :                    0                    0 bps
       Medium-high         :                    0                    0 bps
       High                :                    0                    0 bps
  Queue: 2, Forwarding classes: assured-forwarding
    Queued:
      Packets              :              4846580                 3934 pps
      Bytes                :            222942680              1447768 bps
    Transmitted:
      Packets              :              4846580                 3934 pps
      Bytes                :            222942680              1447768 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  :                    0                    0 pps
       Low                 :                    0                    0 pps
       Medium-low          :                    0                    0 pps
       Medium-high         :                    0                    0 pps
```



```
      High             :                    0                     0 pps
    RED-dropped bytes  :                    0                     0 bps
      Low              :                    0                     0 bps
      Medium-low       :                    0                     0 bps
      Medium-high      :                    0                     0 bps
      High             :                    0                     0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets            :                    0                     0 pps
    Bytes              :                    0                     0 bps
  Transmitted:
    Packets            :                    0                     0 pps
    Bytes              :                    0                     0 bps
    Tail-dropped packets :                  0                     0 pps
    RED-dropped packets  :                  0                     0 pps
      Low              :                    0                     0 pps
      Medium-low       :                    0                     0 pps
      Medium-high      :                    0                     0 pps
      High             :                    0                     0 pps
    RED-dropped bytes  :                    0                     0 bps
      Low              :                    0                     0 bps
      Medium-low       :                    0                     0 bps
      Medium-high      :                    0                     0 bps
      High             :                    0                     0 bps
```

show interfaces queue (Gigabit Ethernet IQ2 PIC)

```
user@host> show interfaces queue ge-7/1/3
Physical interface: ge-7/1/3, Enabled, Physical link is Up
  Interface index: 170, SNMP ifIndex: 70 Forwarding classes: 16 supported, 4 in
use Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets            :            418390039                    10 pps
    Bytes              :          38910269752                  7440 bps
  Transmitted:
    Packets            :            418390039                    10 pps
    Bytes              :          38910269752                  7440 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                  0                     0 pps
    RED-dropped bytes  :                    0                     0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets            :                    0                     0 pps
    Bytes              :                    0                     0 bps
  Transmitted:
    Packets            :                    0                     0 pps
    Bytes              :                    0                     0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                  0                     0 pps
    RED-dropped bytes  :                    0                     0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets            :                    0                     0 pps
    Bytes              :                    0                     0 bps
  Transmitted:
    Packets            :                    0                     0 pps
    Bytes              :                    0                     0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                  0                     0 pps
```



```
    RED-dropped bytes    :                   0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              :                7055                    1 pps
    Bytes                :              451552                  512 bps
  Transmitted:
    Packets              :                7055                    1 pps
    Bytes                :              451552                  512 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                   0                    0 pps
    RED-dropped bytes    :                   0                    0 bps
Forwarding classes: 16 supported, 4 in use Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :                1031                    0 pps
    Bytes                :              143292                    0 bps
  Transmitted:
    Packets              :                1031                    0 pps
    Bytes                :              143292                    0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                   0                    0 pps
    RL-dropped bytes     :                   0                    0 bps
    RED-dropped packets  :                   0                    0 pps
    RED-dropped bytes    :                   0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :                   0                    0 pps
    Bytes                :                   0                    0 bps
  Transmitted:
    Packets              :                   0                    0 pps
    Bytes                :                   0                    0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                   0                    0 pps
    RL-dropped bytes     :                   0                    0 bps
    RED-dropped packets  :                   0                    0 pps
    RED-dropped bytes    :                   0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              :                   0                    0 pps
    Bytes                :                   0                    0 bps
  Transmitted:
    Packets              :                   0                    0 pps
    Bytes                :                   0                    0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                   0                    0 pps
    RL-dropped bytes     :                   0                    0 bps
    RED-dropped packets  :                   0                    0 pps
    RED-dropped bytes    :                   0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              :               77009                   11 pps
    Bytes                :             6894286                 7888 bps
  Transmitted:
    Packets              :               77009                   11 pps
    Bytes                :             6894286                 7888 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                   0                    0 pps
    RL-dropped bytes     :                   0                    0 bps
    RED-dropped packets  :                   0                    0 pps
    RED-dropped bytes    :                   0                    0 bps
```



```
Packet Forwarding Engine Chassis Queues:
Queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :                 1031                     0 pps
    Bytes                :               147328                     0 bps
  Transmitted:
    Packets              :                 1031                     0 pps
    Bytes                :               147328                     0 bps
    Tail-dropped packets :                    0                     0 pps
    RED-dropped packets  :                    0                     0 pps
     Low, non-TCP        :                    0                     0 pps
     Low, TCP            :                    0                     0 pps
     High, non-TCP       :                    0                     0 pps
     High, TCP           :                    0                     0 pps
    RED-dropped bytes    :                    0                     0 bps
     Low, non-TCP        :                    0                     0 bps
     Low, TCP            :                    0                     0 bps
     High, non-TCP       :                    0                     0 bps
     High, TCP           :                    0                     0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :                    0                     0 pps
    Bytes                :                    0                     0 bps
  Transmitted:
    Packets              :                    0                     0 pps
    Bytes                :                    0                     0 bps
    Tail-dropped packets :                    0                     0 pps
    RED-dropped packets  :                    0                     0 pps
     Low, non-TCP        :                    0                     0 pps
     Low, TCP            :                    0                     0 pps
     High, non-TCP       :                    0                     0 pps
     High, TCP           :                    0                     0 pps
    RED-dropped bytes    :                    0                     0 bps
     Low, non-TCP        :                    0                     0 bps
     Low, TCP            :                    0                     0 bps
     High, non-TCP       :                    0                     0 bps
     High, TCP           :                    0                     0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              :                    0                     0 pps
    Bytes                :                    0                     0 bps
  Transmitted:
    Packets              :                    0                     0 pps
    Bytes                :                    0                     0 bps
    Tail-dropped packets :                    0                     0 pps
    RED-dropped packets  :                    0                     0 pps
     Low, non-TCP        :                    0                     0 pps
     Low, TCP            :                    0                     0 pps
     High, non-TCP       :                    0                     0 pps
     High, TCP           :                    0                     0 pps
    RED-dropped bytes    :                    0                     0 bps
     Low, non-TCP        :                    0                     0 bps
     Low, TCP            :                    0                     0 bps
     High, non-TCP       :                    0                     0 bps
     High, TCP           :                    0                     0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              :                94386                    12 pps
    Bytes                :             13756799                  9568 bps
  Transmitted:
```



```
    Packets              :              94386                12 pps
    Bytes                :           13756799              9568 bps
    Tail-dropped packets :                  0                 0 pps
    RED-dropped packets  :                  0                 0 pps
     Low, non-TCP        :                  0                 0 pps
     Low, TCP            :                  0                 0 pps
     High, non-TCP       :                  0                 0 pps
     High, TCP           :                  0                 0 pps
    RED-dropped bytes    :                  0                 0 bps
     Low, non-TCP        :                  0                 0 bps
     Low, TCP            :                  0                 0 bps
     High, non-TCP       :                  0                 0 bps
     High, TCP           :                  0                 0 bps
```

show interfaces queue both-ingress-egress (Gigabit Ethernet IQ2 PIC)

```
user@host> show interfaces queue ge-6/2/0 both-ingress-egress
Physical interface: ge-6/2/0, Enabled, Physical link is Up
  Interface index: 175, SNMP ifIndex: 121
Forwarding classes: 8 supported, 4 in use
Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              : Not Available
    Bytes                :                  0                 0 bps
  Transmitted:
    Packets              :                254                 0 pps
    Bytes                :              16274                 0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                  0                 0 pps
    RED-dropped bytes    :                  0                 0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                  0                 0 bps
  Transmitted:
    Packets              :                  0                 0 pps
    Bytes                :                  0                 0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                  0                 0 pps
    RED-dropped bytes    :                  0                 0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                  0                 0 bps
  Transmitted:
    Packets              :                  0                 0 pps
    Bytes                :                  0                 0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                  0                 0 pps
    RED-dropped bytes    :                  0                 0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              : Not Available
    Bytes                :                  0                 0 bps
  Transmitted:
    Packets              :                  0                 0 pps
    Bytes                :                  0                 0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                  0                 0 pps
```

```
    RED-dropped bytes    :                    0                    0 bps
Forwarding classes: 8 supported, 4 in use
Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    3                    0 pps
    Bytes                :                  126                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Packet Forwarding Engine Chassis Queues:
Queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :             80564692                    0 pps
    Bytes                :           3383717100                    0 bps
  Transmitted:
    Packets              :             80564692                    0 pps
    Bytes                :           3383717100                    0 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :             80564685                    0 pps
    Bytes                :           3383716770                    0 bps
  Transmitted:
    Packets              :             80564685                    0 pps
```

```
      Bytes                :          3383716770                  0 bps
      Tail-dropped packets :                   0                  0 pps
      RED-dropped packets  :                   0                  0 pps
      RED-dropped bytes    :                   0                  0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
      Packets              :                   0                  0 pps
      Bytes                :                   0                  0 bps
  Transmitted:
      Packets              :                   0                  0 pps
      Bytes                :                   0                  0 bps
      Tail-dropped packets :                   0                  0 pps
      RED-dropped packets  :                   0                  0 pps
      RED-dropped bytes    :                   0                  0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
      Packets              :                9397                  0 pps
      Bytes                :             3809052                232 bps
  Transmitted:
      Packets              :                9397                  0 pps
      Bytes                :             3809052                232 bps
      Tail-dropped packets :                   0                  0 pps
      RED-dropped packets  :                   0                  0 pps
      RED-dropped bytes    :                   0                  0 bps
```

show interfaces queue ingress (Gigabit Ethernet IQ2 PIC)

```
user@host> show interfaces queue ge-6/2/0 ingress
Physical interface: ge-6/2/0, Enabled, Physical link is Up
  Interface index: 175, SNMP ifIndex: 121
Forwarding classes: 8 supported, 4 in use
Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
      Packets              : Not Available
      Bytes                :                   0                  0 bps
  Transmitted:
      Packets              :                 288                  0 pps
      Bytes                :               18450                  0 bps
      Tail-dropped packets : Not Available
      RED-dropped packets  :                   0                  0 pps
      RED-dropped bytes    :                   0                  0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
      Packets              : Not Available
      Bytes                :                   0                  0 bps
  Transmitted:
      Packets              :                   0                  0 pps
      Bytes                :                   0                  0 bps
      Tail-dropped packets : Not Available
      RED-dropped packets  :                   0                  0 pps
      RED-dropped bytes    :                   0                  0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
      Packets              : Not Available
      Bytes                :                   0                  0 bps
  Transmitted:
      Packets              :                   0                  0 pps
      Bytes                :                   0                  0 bps
      Tail-dropped packets : Not Available
```



```
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
```

show interfaces queue egress (Gigabit Ethernet IQ2 PIC)

```
user@host> show interfaces queue ge-6/2/0 egress
Physical interface: ge-6/2/0, Enabled, Physical link is Up
  Interface index: 175, SNMP ifIndex: 121
Forwarding classes: 8 supported, 4 in use
Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    3                    0 pps
    Bytes                :                  126                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
```

```
Packet Forwarding Engine Chassis Queues:
Queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :            80564692                    0 pps
    Bytes                :          3383717100                    0 bps
  Transmitted:
    Packets              :            80564692                    0 pps
    Bytes                :          3383717100                    0 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                   0                    0 pps
    RED-dropped bytes    :                   0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :            80564685                    0 pps
    Bytes                :          3383716770                    0 bps
  Transmitted:
    Packets              :            80564685                    0 pps
    Bytes                :          3383716770                    0 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                   0                    0 pps
    RED-dropped bytes    :                   0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              :                   0                    0 pps
    Bytes                :                   0                    0 bps
  Transmitted:
    Packets              :                   0                    0 pps
    Bytes                :                   0                    0 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                   0                    0 pps
    RED-dropped bytes    :                   0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              :                9538                    0 pps
    Bytes                :             3819840                    0 bps
  Transmitted:
    Packets              :                9538                    0 pps
    Bytes                :             3819840                    0 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                   0                    0 pps
    RED-dropped bytes    :                   0                    0 bps
```

show interfaces queue remaining-traffic (Gigabit Ethernet Enhanced DPC)

```
user@host> show interfaces queue ge-2/2/9 remaining-traffic
Physical interface: ge-2/2/9, Enabled, Physical link is Up
  Interface index: 238, SNMP ifIndex: 71
Forwarding classes: 16 supported, 4 in use
Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :           110208969               472875 pps
    Bytes                :          5951284434            204282000 bps
  Transmitted:
    Packets              :           110208969               472875 pps
    Bytes                :          5951284434            204282000 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                   0                    0 pps
     Low                 :                   0                    0 pps
```

```
     Medium-low          :                     0                     0 pps
     Medium-high         :                     0                     0 pps
     High                :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
     Low                 :                     0                     0 bps
     Medium-low          :                     0                     0 bps
     Medium-high         :                     0                     0 bps
     High                :                     0                     0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
  Transmitted:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                     0                     0 pps
     Low                 :                     0                     0 pps
     Medium-low          :                     0                     0 pps
     Medium-high         :                     0                     0 pps
     High                :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
     Low                 :                     0                     0 bps
     Medium-low          :                     0                     0 bps
     Medium-high         :                     0                     0 bps
     High                :                     0                     0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
  Transmitted:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                     0                     0 pps
     Low                 :                     0                     0 pps
     Medium-low          :                     0                     0 pps
     Medium-high         :                     0                     0 pps
     High                :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
     Low                 :                     0                     0 bps
     Medium-low          :                     0                     0 bps
     Medium-high         :                     0                     0 bps
     High                :                     0                     0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
  Transmitted:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                     0                     0 pps
     Low                 :                     0                     0 pps
     Medium-low          :                     0                     0 pps
     Medium-high         :                     0                     0 pps
     High                :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
     Low                 :                     0                     0 bps
     Medium-low          :                     0                     0 bps
     Medium-high         :                     0                     0 bps
```



```
      High              :                    0                    0 bps
Forwarding classes: 16 supported, 4 in use
Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets             :            109355853               471736 pps
    Bytes               :           7436199152            256627968 bps
  Transmitted:
    Packets             :            109355852               471736 pps
    Bytes               :           7436198640            256627968 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes   :                    0                    0 bps
     Low                :                    0                    0 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
  Transmitted:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes   :                    0                    0 bps
     Low                :                    0                    0 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
  Transmitted:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes   :                    0                    0 bps
     Low                :                    0                    0 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
```



```
 Transmitted:
   Packets              :                    0                    0 pps
   Bytes                :                    0                    0 bps
   Tail-dropped packets : Not Available
   RED-dropped packets  :                    0                    0 pps
    Low                 :                    0                    0 pps
    Medium-low          :                    0                    0 pps
    Medium-high         :                    0                    0 pps
    High                :                    0                    0 pps
   RED-dropped bytes    :                    0                    0 bps
    Low                 :                    0                    0 bps
    Medium-low          :                    0                    0 bps
    Medium-high         :                    0                    0 bps
    High                :                    0                    0 bps
```

show interfaces queue (Channelized OC12 IQE Type 3 PIC in SONET Mode)

```
user@host> show interfaces queue t3-1/1/0:7
 Physical interface: t3-1/1/0:7, Enabled, Physical link is Up

   Interface index: 192, SNMP ifIndex: 1948

   Description: full T3 interface connect to 6ce13 t3-3/1/0:7 for FR testing -
Lam

 Forwarding classes: 16 supported, 9 in use

 Egress queues: 8 supported, 8 in use

 Queue: 0, Forwarding classes: DEFAULT

   Queued:

     Packets              :               214886                13449 pps

     Bytes                :              9884756              5164536 bps

   Transmitted:

     Packets              :               214886                13449 pps

     Bytes                :              9884756              5164536 bps

     Tail-dropped packets :                    0                    0 pps

     RED-dropped packets  :                    0                    0 pps

      Low                 :                    0                    0 pps

      Medium-low          :                    0                    0 pps

      Medium-high         :                    0                    0 pps

      High                :                    0                    0 pps

     RED-dropped bytes    :                    0                    0 bps

      Low                 :                    0                    0 bps

      Medium-low          :                    0                    0 bps
```



```
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps
 Queue: 1, Forwarding classes: REALTIME
   Queued:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
   Transmitted:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                   0                    0 pps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes   :                    0                    0 bps
     Low                :                    0                    0 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps
 Queue: 2, Forwarding classes: PRIVATE
   Queued:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
   Transmitted:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                   0                    0 pps
     Low                :                    0                    0 pps
```



```
      Medium-low          :                      0                      0 pps
      Medium-high         :                      0                      0 pps
      High                :                      0                      0 pps
     RED-dropped bytes    :                      0                      0 bps
      Low                 :                      0                      0 bps
      Medium-low          :                      0                      0 bps
      Medium-high         :                      0                      0 bps
      High                :                      0                      0 bps
Queue: 3, Forwarding classes: CONTROL
  Queued:
    Packets             :                     60                      0 pps
    Bytes               :                   4560                      0 bps
  Transmitted:
    Packets             :                     60                      0 pps
    Bytes               :                   4560                      0 bps
    Tail-dropped packets :                     0                      0 pps
    RED-dropped packets  :                     0                      0 pps
     Low                :                      0                      0 pps
     Medium-low         :                      0                      0 pps
     Medium-high        :                      0                      0 pps
     High               :                      0                      0 pps
    RED-dropped bytes   :                      0                      0 bps
     Low                :                      0                      0 bps
     Medium-low         :                      0                      0 bps
     Medium-high        :                      0                      0 bps
     High               :                      0                      0 bps
Queue: 4, Forwarding classes: CLASS_B_OUTPUT
  Queued:
    Packets             :                      0                      0 pps
    Bytes               :                      0                      0 bps
  Transmitted:
```

```
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets :                     0                     0 pps
    RED-dropped packets  :                     0                     0 pps
     Low                 :                     0                     0 pps
     Medium-low          :                     0                     0 pps
     Medium-high         :                     0                     0 pps
     High                :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
     Low                 :                     0                     0 bps
     Medium-low          :                     0                     0 bps
     Medium-high         :                     0                     0 bps
     High                :                     0                     0 bps
Queue: 5, Forwarding classes: CLASS_C_OUTPUT
  Queued:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
  Transmitted:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets :                     0                     0 pps
    RED-dropped packets  :                     0                     0 pps
     Low                 :                     0                     0 pps
     Medium-low          :                     0                     0 pps
     Medium-high         :                     0                     0 pps
     High                :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
     Low                 :                     0                     0 bps
     Medium-low          :                     0                     0 bps
     Medium-high         :                     0                     0 bps
```



```
     High               :                     0                     0 bps
Queue: 6, Forwarding classes: CLASS_V_OUTPUT
  Queued:
    Packets             :                     0                     0 pps
    Bytes               :                     0                     0 bps
  Transmitted:
    Packets             :                     0                     0 pps
    Bytes               :                     0                     0 bps
    Tail-dropped packets :                    0                     0 pps
    RED-dropped packets  :                    0                     0 pps
     Low                :                     0                     0 pps
     Medium-low         :                     0                     0 pps
     Medium-high        :                     0                     0 pps
     High               :                     0                     0 pps
    RED-dropped bytes   :                     0                     0 bps
     Low                :                     0                     0 bps
     Medium-low         :                     0                     0 bps
     Medium-high        :                     0                     0 bps
     High               :                     0                     0 bps
Queue: 7, Forwarding classes: CLASS_S_OUTPUT, GETS
  Queued:
    Packets             :                     0                     0 pps
    Bytes               :                     0                     0 bps
  Transmitted:
    Packets             :                     0                     0 pps
    Bytes               :                     0                     0 bps
    Tail-dropped packets :                    0                     0 pps
    RED-dropped packets  :                    0                     0 pps
     Low                :                     0                     0 pps
     Medium-low         :                     0                     0 pps
     Medium-high        :                     0                     0 pps
```



```
      High              :                    0                    0 pps
     RED-dropped bytes  :                    0                    0 bps
      Low               :                    0                    0 bps
      Medium-low        :                    0                    0 bps
      Medium-high       :                    0                    0 bps
      High              :                    0                    0 bps

Packet Forwarding Engine Chassis Queues:
Queues: 8 supported, 8 in use
Queue: 0, Forwarding classes: DEFAULT
  Queued:
    Packets             :               371365                23620 pps
    Bytes               :             15597330              7936368 bps
  Transmitted:
    Packets             :               371365                23620 pps
    Bytes               :             15597330              7936368 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets :                    0                    0 pps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes   :                    0                    0 bps
     Low                :                    0                    0 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps
Queue: 1, Forwarding classes: REALTIME
  Queued:
    Packets             :                    0                    0 pps
```

```
    Bytes                :              0                   0 bps
  Transmitted:
    Packets              :              0                   0 pps
    Bytes                :              0                   0 bps
    Tail-dropped packets :              0                   0 pps
    RED-dropped packets  :              0                   0 pps
     Low                 :              0                   0 pps
     Medium-low          :              0                   0 pps
     Medium-high         :              0                   0 pps
     High                :              0                   0 pps
    RED-dropped bytes    :              0                   0 bps
     Low                 :              0                   0 bps
     Medium-low          :              0                   0 bps
     Medium-high         :              0                   0 bps
     High                :              0                   0 bps
Queue: 2, Forwarding classes: PRIVATE
  Queued:
    Packets              :              0                   0 pps
    Bytes                :              0                   0 bps
  Transmitted:
    Packets              :              0                   0 pps
    Bytes                :              0                   0 bps
    Tail-dropped packets :              0                   0 pps
    RED-dropped packets  :              0                   0 pps
     Low                 :              0                   0 pps
     Medium-low          :              0                   0 pps
     Medium-high         :              0                   0 pps
     High                :              0                   0 pps
    RED-dropped bytes    :              0                   0 bps
     Low                 :              0                   0 bps
     Medium-low          :              0                   0 bps
```

```
      Medium-high        :                     0                    0 bps
      High               :                     0                    0 bps
  Queue: 3, Forwarding classes: CONTROL
    Queued:
      Packets            :                 32843                    0 pps
      Bytes              :               2641754                   56 bps
    Transmitted:
      Packets            :                 32843                    0 pps
      Bytes              :               2641754                   56 bps
      Tail-dropped packets :                   0                    0 pps
      RED-dropped packets  :                   0                    0 pps
       Low               :                     0                    0 pps
       Medium-low        :                     0                    0 pps
       Medium-high       :                     0                    0 pps
       High              :                     0                    0 pps
      RED-dropped bytes  :                     0                    0 bps
       Low               :                     0                    0 bps
       Medium-low        :                     0                    0 bps
       Medium-high       :                     0                    0 bps
       High              :                     0                    0 bps
  Queue: 4, Forwarding classes: CLASS_B_OUTPUT
    Queued:
      Packets            :                     0                    0 pps
      Bytes              :                     0                    0 bps
    Transmitted:
      Packets            :                     0                    0 pps
      Bytes              :                     0                    0 bps
      Tail-dropped packets :                   0                    0 pps
      RED-dropped packets  :                   0                    0 pps
       Low               :                     0                    0 pps
```



```
        Medium-low          :                    0                    0 pps
        Medium-high         :                    0                    0 pps
        High                :                    0                    0 pps
      RED-dropped bytes     :                    0                    0 bps
        Low                 :                    0                    0 bps
        Medium-low          :                    0                    0 bps
        Medium-high         :                    0                    0 bps
        High                :                    0                    0 bps
Queue: 5, Forwarding classes: CLASS_C_OUTPUT
  Queued:
      Packets               :                    0                    0 pps
      Bytes                 :                    0                    0 bps
  Transmitted:
      Packets               :                    0                    0 pps
      Bytes                 :                    0                    0 bps
      Tail-dropped packets  :                    0                    0 pps
      RED-dropped packets   :                    0                    0 pps
        Low                 :                    0                    0 pps
        Medium-low          :                    0                    0 pps
        Medium-high         :                    0                    0 pps
        High                :                    0                    0 pps
      RED-dropped bytes     :                    0                    0 bps
        Low                 :                    0                    0 bps
        Medium-low          :                    0                    0 bps
        Medium-high         :                    0                    0 bps
        High                :                    0                    0 bps
Queue: 6, Forwarding classes: CLASS_V_OUTPUT
  Queued:
      Packets               :                    0                    0 pps
      Bytes                 :                    0                    0 bps
  Transmitted:
```



```
      Packets             :                  0                    0 pps
      Bytes               :                  0                    0 bps
      Tail-dropped packets :                 0                    0 pps
      RED-dropped packets  :                 0                    0 pps
       Low                :                  0                    0 pps
       Medium-low         :                  0                    0 pps
       Medium-high        :                  0                    0 pps
       High               :                  0                    0 pps
      RED-dropped bytes    :                 0                    0 bps
       Low                :                  0                    0 bps
       Medium-low         :                  0                    0 bps
       Medium-high        :                  0                    0 bps
       High               :                  0                    0 bps
  Queue: 7, Forwarding classes: CLASS_S_OUTPUT, GETS
    Queued:
      Packets             :                  0                    0 pps
      Bytes               :                  0                    0 bps
    Transmitted:
      Packets             :                  0                    0 pps
      Bytes               :                  0                    0 bps
      Tail-dropped packets :                 0                    0 pps
      RED-dropped packets  :                 0                    0 pps
       Low                :                  0                    0 pps
       Medium-low         :                  0                    0 pps
       Medium-high        :                  0                    0 pps
       High               :                  0                    0 pps
      RED-dropped bytes    :                 0                    0 bps
       Low                :                  0                    0 bps
       Medium-low         :                  0                    0 bps
       Medium-high        :                  0                    0 bps
```

```
High                    :                     0                     0 bps
```

show interfaces queue (QFX Series)

```
user@switch> show interfaces queue xe-0/0/15
   Physical interface: xe-0/0/15, Enabled, Physical link is Up
     Interface index: 49165, SNMP ifIndex: 539
   Forwarding classes: 12 supported, 8 in use
   Egress queues: 12 supported, 8 in use
   Queue: 0, Forwarding classes: best-effort
     Queued:
       Packets              :                     0                     0 pps
       Bytes                :                     0                     0 bps
     Transmitted:
       Packets              :                     0                     0 pps
       Bytes                :                     0                     0 bps
       Tail-dropped packets : Not Available
       Total-dropped packets:                     0                     0 pps
       Total-dropped bytes  :                     0                     0 bps
   Queue: 3, Forwarding classes: fcoe
     Queued:
       Packets              :                     0                     0 pps
       Bytes                :                     0                     0 bps
     Transmitted:
       Packets              :                     0                     0 pps
       Bytes                :                     0                     0 bps
       Tail-dropped packets : Not Available
       Total-dropped packets:                     0                     0 pps
       Total-dropped bytes  :                     0                     0 bps
0 bps
   Queue: 4, Forwarding classes: no-loss
     Queued:
       Packets              :                     0                     0 pps
       Bytes                :                     0                     0 bps
     Transmitted:
       Packets              :                     0                     0 pps
       Bytes                :                     0                     0 bps
       Tail-dropped packets : Not Available
       Total-dropped packets:                     0                     0 pps
       Total-dropped bytes  :                     0                     0 bps
   Queue: 7, Forwarding classes: network-control
     Queued:
       Packets              :                     0                     0 pps
       Bytes                :                     0                     0 bps
     Transmitted:
       Packets              :                     0                     0 pps
       Bytes                :                     0                     0 bps
       Tail-dropped packets : Not Available
       Total-dropped packets:                     0                     0 pps
       Total-dropped bytes  :                     0                     0 bps
   Queue: 8, Forwarding classes: mcast
     Queued:
       Packets              :                     0                     0 pps
       Bytes                :                     0                     0 bps
     Transmitted:
       Packets              :                     0                     0 pps
       Bytes                :                     0                     0 bps
       Tail-dropped packets : Not Available
```



```
          Total-dropped packets:                    0                    0 pps
          Total-dropped bytes  :                    0                    0 bps
```

show interfaces queue l2-statistics (lsq interface)

```
user@switch> show interfaces queue lsq-2/2/0.2 l2-statistics
Logical interface lsq-2/2/0.2 (Index 69) (SNMP ifIndex 1598)
Forwarding classes: 16 supported, 4 in use
Egress queues: 8 supported, 4 in use
Burst size: 0
Queue: 0, Forwarding classes: be
  Queued:
    Packets              :                    1                    0 pps
    Bytes                :                 1001                    0 bps
  Transmitted:
    Packets              :                    5                     0 pps
    Bytes                :                 1062                    0 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: ef
  Queued:
    Packets              :                    1                    0 pps
    Bytes                :                 1500                    0 bps
  Transmitted:
    Packets              :                    6                     0 pps
    Bytes                :                 1573                    0 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 2, Forwarding classes: af
  Queued:
    Packets              :                    1                    0 pps
    Bytes                :                  512                    0 bps
  Transmitted:
    Packets              :                    3                     0 pps
    Bytes                :                  549                    0 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 3, Forwarding classes: nc
  Queued:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                     0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
=========
```

show interfaces xe

Syntax

show interfaces *device-name*:*type-fpc/pic/port*
<brief | detail | extensive | terse>
<descriptions>
<media>
<routing-instance (all | *instance-name*)>
<snmp-index *snmp-index*>
<statistics>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display status information about the specified 10-Gigabit Ethernet interface. This command does not display statistics for routed VLAN interfaces.

Options

device-name*:*type-fpc/pic/port—(QFabric systems only) The device name is either the serial number or the alias of the QFabric system component, such as a Node device, Interconnect device, or QFabric infrastructure. The name must contain a maximum of 128 characters and not contain any colons.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

descriptions—(Optional) Display interface description strings.

media—(Optional) Display media-specific information about network interfaces.

routing-instance (all | *instance-name*)—(Optional) Display the name of an individual routing instance or display all routing instances.

snmp-index *snmp-index*—(Optional) Display information for the specified SNMP index of the interface.

statistics—(Optional) Display static interface statistics.

Required Privilege Level

view

Related Documentation

- Monitoring Interface Status and Traffic on page 309
- Troubleshooting Network Interfaces on page 1118
- Troubleshooting an Aggregated Ethernet Interface on page 1119

- *Junos OS Network Interfaces Library for Routing Devices*

List of Sample Output

show interfaces on page 2246
show interfaces (Asymmetric Flow Control) on page 2247
show interfaces brief on page 2247
show interfaces detail on page 2247
show interfaces detail (Asymmetric Flow Control) on page 2249
show interfaces extensive on page 2250
show interfaces extensive (Asymmetric Flow Control) on page 2252

show interfaces terse on page 2254
show interfaces (QFabric System) on page 2254

Output Fields Table 192 on page 2239 lists the output fields for the **show interfaces xe** command. Output fields are listed in the approximate order in which they appear.

Table 192: show interfaces xe Output Fields

Field Name	Field Description	Level of Output
Physical Interface		
Physical interface	Name of the physical interface.	All levels
Enabled	State of the interface.	All levels
Interface index	Index number of the physical interface, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP index number for the physical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Link-level type	Encapsulation being used on the physical interface.	All levels
MTU	Maximum transmission unit size on the physical interface.	All levels
Speed	Speed at which the interface is running.	All levels
Duplex	Duplex mode of the interface, either **Full-Duplex** or **Half-Duplex**.	All levels
Loopback	Loopback status: **Enabled** or **Disabled**. If loopback is enabled, type of loopback: **Local** or **Remote**.	All levels
Source filtering	Source filtering status: **Enabled** or **Disabled**.	All levels
LAN-PHY mode	10-Gigabit Ethernet interface operating in Local Area Network Physical Layer Device (LAN PHY) mode. LAN PHY allows 10-Gigabit Ethernet wide area links to use existing Ethernet applications.	All levels
Unidirectional	Unidirectional link mode status for 10-Gigabit Ethernet interface: **Enabled** or **Disabled** for parent interface; **Rx-only** or **Tx-only** for child interfaces.	All levels
Flow control	Flow control status: **Enabled** or **Disabled**. NOTE: This field is only displayed if asymmetric flow control is not configured.	All levels

Table 192: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Configured-flow-control	Configured flow control for the interface transmit buffers (**tx-buffers**) and receive buffers (**rx-buffers**): • **tx-buffers—On** if the interface is configured to respond to Ethernet PAUSE messages received from the connected peer. **Off** if the interface is not configured to respond to received PAUSE messages. • **rx-buffers—On** if the interface is configured to generate and send Ethernet PAUSE messages to the connected peer. **Off** if the interface is not configured to generate and send PAUSE messages. NOTE: This field is only displayed if asymmetric flow control is configured.	All levels
Auto-negotiation	Autonegotiation status: **Enabled** or **Disabled**.	All levels
Remote-fault	Remote fault status: • **Online**—Autonegotiation is manually configured as online. • **Offline**—Autonegotiation is manually configured as offline.	All levels
Device flags	Information about the physical device.	All levels
Interface flags	Information about the interface.	All levels
Link flags	Information about the link.	All levels
Wavelength	Configured wavelength, in nanometers (nm).	All levels
Frequency	Frequency associated with the configured wavelength, in terahertz (THz).	All levels
CoS queues	Number of CoS queues configured.	**detail extensive** none
Schedulers	Number of CoS schedulers configured.	**extensive**
Hold-times	Current interface hold-time up and hold-time down, in milliseconds.	**detail extensive**
Current address	Configured MAC address.	**detail extensive** none
Hardware address	Hardware MAC address.	**detail extensive** none
Last flapped	Date, time, and how long ago the interface went from down to up. The format is **Last flapped:** ***year-month-day hour:*** ***:minute*****:*****second*****:*****timezone*** **(*****hour*****:*****minute*****:*****second*** **ago)**. For example, **Last flapped: 2008–01–16 10:52:40 UTC (3d 22:58 ago).**	**detail extensive** none
Input Rate	Input rate in bits per second (bps) and packets per second (pps).	None specified
Output Rate	Output rate in bps and pps.	None specified
Statistics last cleared	Time when the statistics for the interface were last set to zero.	**detail extensive**

Table 192: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Traffic statistics	Number and rate of bytes and packets received and transmitted on the physical interface. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface. • **Output packets**—Number of packets transmitted on the interface. NOTE: The bandwidth bps counter is not enabled.	**detail extensive**
Input errors	Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: • **Errors**—Sum of the incoming frame aborts and FCS errors. • **Drops**—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • **Framing errors**—Number of packets received with an invalid frame checksum (FCS). • **Runts**—Number of frames received that are smaller than the runt threshold. • **Policed discards**—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that Junos OS does not handle. • **L3 incompletes**—Number of incoming packets discarded because they failed Layer 3 sanity checks of the header. For example, a frame with less than 20 bytes of available IP header is discarded. L3 incomplete errors can be ignored if you configure the **ignore-l3-incompletes** statement. • **L2 channel errors**—Number of times the software did not find a valid logical interface for an incoming frame. • **L2 mismatch timeouts**—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable. • **FIFO errors**—Number of FIFO errors in the receive direction that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning. • **Resource errors**—Sum of transmit drops.	**extensive**

Table 192: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Output errors	Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: • **Carrier transitions**—Number of times the interface has gone from **down** to **up**. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the PIC or PIM is malfunctioning. • **Errors**—Sum of the outgoing frame aborts and FCS errors. • **Drops**—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • **Collisions**—Number of Ethernet collisions. The Gigabit Ethernet PIC supports only full-duplex operation, so for Gigabit Ethernet PICs, this number should always remain 0. If it is nonzero, there is a software bug. • **Aged packets**—Number of packets that remained in shared packet SDRAM so long that the system automatically purged them. The value in this field should never increment. If it does, it is most likely a software bug or possibly malfunctioning hardware. • **FIFO errors**—Number of FIFO errors in the send direction as reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning. • **HS link CRC errors**—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces. • **MTU errors**—Number of packets whose size exceeded the MTU of the interface. • **Resource errors**—Sum of transmit drops.	**extensive**
Egress queues	Total number of egress queues supported on the specified interface.	**detail extensive**
Queue counters (Egress)	CoS queue number and its associated user-configured forwarding class name. • **Queued packets**—Number of queued packets. • **Transmitted packets**—Number of transmitted packets. • **Dropped packets**—Number of packets dropped by the ASIC's RED mechanism.	**detail extensive**
Queue Number	The CoS queue number and the forwarding classes mapped to the queue number. The **Mapped forwarding class** column lists the forwarding classes mapped to each CoS queue.	**detail extensive**
Ingress queues	Total number of ingress queues supported on the specified interface.	**extensive**
Queue counters (Ingress)	CoS queue number and its associated user-configured forwarding class name. • **Queued packets**—Number of queued packets. • **Transmitted packets**—Number of transmitted packets. • **Dropped packets**—Number of packets dropped by the ASIC's RED mechanism.	**extensive**

Table 192: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Active alarms and Active defects	Ethernet-specific defects that can prevent the interface from passing packets. When a defect persists for a certain amount of time, it is promoted to an alarm. Based on the switch configuration, an alarm can ring the red or yellow alarm bell on the switch, or turn on the red or yellow alarm LED on the craft interface. These fields can contain the value **None** or **Link**. • **None**—There are no active defects or alarms. • **Link**—Interface has lost its link state, which usually means that the cable is unplugged, the far-end system has been turned off, or the PIC is malfunctioning.	**detail extensive** none
PCS statistics	Physical Coding Sublayer (PCS) fault conditions from the LAN PHY device.	**detail extensive**
MAC statistics	**Receive** and **Transmit** statistics reported by the PIC's MAC subsystem. • **Total octets** and **total packets**—Total number of octets and packets. For Gigabit Ethernet IQ PICs, the received octets count varies by interface type. • **Unicast packets, Broadcast packets,** and **Multicast packets**—Number of unicast, broadcast, and multicast packets. • **CRC/Align errors**—Total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, and had either a bad FCS with an integral number of octets (FCS Error) or a bad FCS with a nonintegral number of octets (Alignment Error). • **FIFO error**—Number of FIFO errors that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning. • **MAC control frames**—Number of MAC control frames. • **MAC pause frames**—Number of MAC control frames with **pause** operational code. • **Oversized frames**—Number of packets that exceeds the configured MTU. • **Jabber frames**—Number of frames that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error. This definition of jabber is different from the definition in IEEE-802.3 section 8.2.1.5 (10BASE5) and section 10.3.1.4 (10BASE2). These documents define jabber as the condition in which any packet exceeds 20 ms. The allowed range to detect jabber is from 20 ms to 150 ms. • **Fragment frames**—Total number of packets that were less than 64 octets in length (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error. Fragment frames normally increment because both runts (which are normal occurrences caused by collisions) and noise hits are counted. • **VLAN tagged frames**—Number of frames that are VLAN tagged. The system uses the TPID of 0x8100 in the frame to determine whether a frame is tagged or not. This counter is not supported on EX Series switches and is always displayed as 0. • **Code violations**—Number of times an event caused the PHY to indicate "Data reception error" or "invalid data symbol error."	**extensive**
Filter statistics	**Receive** and **Transmit** statistics reported by the PIC's MAC address filter subsystem.	**extensive**

Table 192: show interfaces xe Output Fields *(continued)*

<table>
<tr><th>Field Name</th><th>Field Description</th><th>Level of Output</th></tr>
<tr><td>Autonegotiation information</td><td>Information about link autonegotiation.

Negotiation status:

Incomplete—Ethernet interface has the speed or link mode configured.
No autonegotiation—Remote Ethernet interface has the speed or link mode configured, or does not perform autonegotiation.
Complete—Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.

Link partner status—OK when the Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.
Link partner:

Link mode—Depending on the capability of the attached Ethernet device, either Full-duplex or Half-duplex.
Flow control—Types of flow control supported by the remote Ethernet device. For Fast Ethernet interfaces, the type is None. For Gigabit Ethernet interfaces, types are Symmetric (link partner supports PAUSE on receive and transmit), Asymmetric (link partner supports PAUSE on transmit), and Symmetric/Asymmetric (link partner supports both PAUSE on receive and transmit or only PAUSE receive).
Remote fault—Remote fault information from the link partner—Failure indicates a receive link error. OK indicates that the link partner is receiving. Negotiation error indicates a negotiation error. Offline indicates that the link partner is going offline.

Local resolution:

Flow control—Types of flow control supported by the remote Ethernet device. For Gigabit Ethernet interfaces, types are Symmetric (link partner supports PAUSE on receive and transmit), Asymmetric (link partner supports PAUSE on transmit), and Symmetric/Asymmetric (link partner supports both PAUSE on receive and transmit or only PAUSE receive).
For asymmetric PAUSE, shows if the PAUSE transmit and PAUSE receive states on the interface are enable or disable.
Remote fault—Remote fault information. Link OK (no error detected on receive), Offline (local interface is offline), and Link Failure (link error detected on receive).

</td><td>extensive</td></tr>
</table>

Table 192: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Packet Forwarding Engine configuration	Information about the configuration of the Packet Forwarding Engine: • **Destination slot**—FPC slot number. • **CoS transmit queue**—Queue number and its associated user-configured forwarding class name. • **Bandwidth %**—Percentage of bandwidth allocated to the queue. • **Bandwidth bps**—Bandwidth allocated to the queue (in bps). • **Buffer %**—Percentage of buffer space allocated to the queue. • **Buffer usec**—Amount of buffer space allocated to the queue, in microseconds. This value is nonzero only if the buffer size is configured in terms of time. • **Priority**—Queue priority: **low** or **high**. • **Limit**—Displayed if rate limiting is configured for the queue. Possible values are **none** and **exact**. If **exact** is configured, the queue transmits only up to the configured bandwidth, even if excess bandwidth is available. If **none** is configured, the queue transmits beyond the configured bandwidth if bandwidth is available.	**extensive**
Logical Interface		
Logical interface	Name of the logical interface.	All levels
Index	Index number of the logical interface, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP interface index number for the logical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Flags	Information about the logical interface.	All levels
Encapsulation	Encapsulation on the logical interface.	All levels
Protocol	Protocol family.	**detail extensive** none
Traffic statistics	Number and rate of bytes and packets received (input) and transmitted (output) on the specified interface.	**detail extensive**
IPv6 transit statistics	If IPv6 statics tracking is enabled, number of IPv6 bytes and packets received and transmitted on the logical interface.	**extensive**
Local statistics	Number and rate of bytes and packets destined to and from the switch.	**extensive**
Transit statistics	Number and rate of bytes and packets transiting the switch.	**extensive**
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Route Table	Route table in which the logical interface address is located. For example, **0** refers to the routing table inet.0.	**detail extensive** none

Table 192: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Input Filters	Names of any input filters applied to this interface.	**detail extensive**
Output Filters	Names of any output filters applied to this interface.	**detail extensive**
Flags	Information about protocol family flags. If unicast Reverse Path Forwarding (uRPF) is explicitly configured on the specified interface, the uRPF flag appears. If uRPF was configured on a different interface (and therefore is enabled on all switch interfaces) but was not explicitly configured on the specified interface, the uRPF flag does not appear even though uRPF is enabled.	**detail extensive**
Addresses, Flags	Information about the address flags.	**detail extensive** none
protocol-family	Protocol family configured on the logical interface. If the protocol is **inet**, the IP address of the interface is also displayed.	**brief**
Flags	Information about the address flag.	**detail extensive** none
Destination	IP address of the remote side of the connection.	**detail extensive** none
Local	IP address of the logical interface.	**detail extensive** none
Broadcast	Broadcast address of the logical interlace.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**

Sample Output

show interfaces

```
user@switch> show interfaces xe-0/0/1
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Flow control: Disabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 12 supported, 12 maximum usable queues
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
  Last flapped   : 2011-06-01 00:42:03 PDT (00:02:42 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Active alarms  : None
  Active defects : None

  Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Input packets : 0
```



```
    Output packets: 0
    Protocol eth-switch, MTU: 0
      Flags: Trunk-Mode
```

show interfaces (Asymmetric Flow Control)

user@switch> **show interfaces xe-0/0/1**

```
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Configured-flow-control  tx-buffers: off  rx-buffers: on
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 12 supported, 12 maximum usable queues
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
  Last flapped   : 2011-06-01 00:42:03 PDT (00:02:42 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Active alarms  : None
  Active defects : None

  Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Input packets : 0
    Output packets: 0
    Protocol eth-switch, MTU: 0
      Flags: Trunk-Mode
```

show interfaces brief

user@switch> **show interfaces xe-0/0/1 brief**

```
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None

  Logical interface xe-0/0/1.0
    Flags: SNMP-Traps Encapsulation: ENET2
    eth-switch
```

show interfaces detail

user@switch> **show interfaces xe-0/0/1 detail**

```
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591, Generation: 169
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Flow control: Disabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 12 supported, 12 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
```

```
Last flapped   : 2011-06-01 00:42:03 PDT (00:02:50 ago)
Statistics last cleared: 2011-06-01 00:44:39 PDT (00:00:14 ago)
Traffic statistics:
 Input  bytes  :                   0                    0 bps
 Output bytes  :                   0                    0 bps
 Input  packets:                   0                    0 pps
 Output packets:                   0                    0 pps
 IPv6 transit statistics:
  Input  bytes  :                  0
  Output bytes  :                  0
  Input  packets:                  0
  Output packets:                  0
Egress queues: 12 supported, 9 in use
Queue counters:       Queued packets  Transmitted packets      Dropped packets

  0 best-effort                    0                    0                    0

  1 fc7                            0                    0                    0

  2 no-loss                        0                    0                    0

  3 fcoe                           0                    0                    0

  4 fc4                            0                    0                    0

  5 fc5                            0                    0                    0

  6 fc6                            0                    0                    0

  7 network-cont                   0                    0                    0

  8 mcast                          0                    0                    0

Queue number:         Mapped forwarding classes
  0                   best-effort
  1                   fc7
  2                   no-loss
  3                   fcoe
  4                   fc4
  5                   fc5
  6                   fc6
  7                   network-control
  8                   mcast
Active alarms  : None
Active defects : None

Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523) (Generation 143)
  Flags: SNMP-Traps 0x0 Encapsulation: ENET2
  Traffic statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Local statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Transit statistics:
   Input  bytes  :                   0                    0 bps
   Output bytes  :                   0                    0 bps
```



```
    Input  packets:                    0                    0 pps
    Output packets:                    0                    0 pps
   Protocol eth-switch, MTU: 0, Generation: 170, Route table: 0
     Flags: Trunk-Mode
```

show interfaces detail (Asymmetric Flow Control)

```
user@switch> show interfaces xe-0/0/1 detail
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591, Generation: 169
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Configured-flow-control  tx-buffers: off  rx-buffers: on
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 12 supported, 12 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
  Last flapped   : 2011-06-01 00:42:03 PDT (00:02:50 ago)
  Statistics last cleared: 2011-06-01 00:44:39 PDT (00:00:14 ago)
  Traffic statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :                    0                    0 bps
   Input  packets:                    0                    0 pps
   Output packets:                    0                    0 pps
   IPv6 transit statistics:
    Input  bytes  :                   0
    Output bytes  :                   0
    Input  packets:                   0
    Output packets:                   0
  Egress queues: 12 supported, 9 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 best-effort                    0                    0                    0

    1 fc7                            0                    0                    0

    2 no-loss                        0                    0                    0

    3 fcoe                           0                    0                    0

    4 fc4                            0                    0                    0

    5 fc5                            0                    0                    0

    6 fc6                            0                    0                    0

    7 network-cont                   0                    0                    0

    8 mcast                          0                    0                    0

  Queue number:         Mapped forwarding classes
    0                   best-effort
    1                   fc7
    2                   no-loss
    3                   fcoe
    4                   fc4
    5                   fc5
    6                   fc6
```



```
    7                   network-control
    8                   mcast
  Active alarms  : None
  Active defects : None

  Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523) (Generation 143)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Local statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Transit statistics:
     Input  bytes  :                    0                     0 bps
     Output bytes  :                    0                     0 bps
     Input  packets:                    0                     0 pps
     Output packets:                    0                     0 pps
    Protocol eth-switch, MTU: 0, Generation: 170, Route table: 0
      Flags: Trunk-Mode
```

show interfaces extensive

```
user@switch> show interfaces xe-0/0/1 extensive
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591, Generation: 169
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Flow control: Disabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 12 supported, 12 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
  Last flapped   : 2011-06-01 00:42:03 PDT (00:03:08 ago)
  Statistics last cleared: 2011-06-01 00:44:39 PDT (00:00:32 ago)
  Traffic statistics:
   Input  bytes  :                    0                     0 bps
   Output bytes  :                    0                     0 bps
   Input  packets:                    0                     0 pps
   Output packets:                    0                     0 pps
   IPv6 transit statistics:
    Input  bytes  :                   0
    Output bytes  :                   0
    Input  packets:                   0
    Output packets:                   0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
 FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
  Egress queues: 12 supported, 9 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets
```



```
  0 best-effort                0                    0                    0

  1 fc7                        0                    0                    0

  2 no-loss                    0                    0                    0

  3 fcoe                       0                    0                    0

  4 fc4                        0                    0                    0

  5 fc5                        0                    0                    0

  6 fc6                        0                    0                    0

  7 network-cont               0                    0                    0

  8 mcast                      0                    0                    0

Queue number:         Mapped forwarding classes
  0                   best-effort
  1                   fc7
  2                   no-loss
  3                   fcoe
  4                   fc4
  5                   fc5
  6                   fc6
  7                   network-control
  8                   mcast
Active alarms  : None
Active defects : None
MAC statistics:                      Receive         Transmit
  Total octets                             0                0
  Total packets                            0                0
  Unicast packets                          0                0
  Broadcast packets                        0                0
  Multicast packets                        0                0
  CRC/Align errors                         0                0
  FIFO errors                              0                0
  MAC control frames                       0                0
  MAC pause frames                         0                0
  Oversized frames                         0
  Jabber frames                            0
  Fragment frames                          0
  VLAN tagged frames                       0
  Code violations                          0
MAC Priority Flow Control Statistics:
  Prioity :  0                             0                0
  Prioity :  1                             0                0
  Prioity :  2                             0                0
  Prioity :  3                             0                0
  Prioity :  4                             0                0
  Prioity :  5                             0                0
  Prioity :  6                             0                0
  Prioity :  7                             0                0
Filter statistics:
  Input packet count                       0
  Input packet rejects                     0
  Input DA rejects                         0
  Input SA rejects                         0
  Output packet count                                       0
```



```
    Output packet pad count                                    0
    Output packet error count                                  0
    CAM destination filters: 1, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %            bps     %            usec
    0 best-effort            75     7500000000    75               0       low
none
    7 network-control         5      500000000     5               0       low
none
    8 mcast                  20     2000000000    20               0       low
none

  Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523) (Generation 143)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                  0
     Output bytes  :                  0
     Input  packets:                  0
     Output packets:                  0
    Local statistics:
     Input  bytes  :                  0
     Output bytes  :                  0
     Input  packets:                  0
     Output packets:                  0
    Transit statistics:
     Input  bytes  :                  0                    0 bps
     Output bytes  :                  0                    0 bps
     Input  packets:                  0                    0 pps
     Output packets:                  0                    0 pps
    Protocol eth-switch, MTU: 0, Generation: 170, Route table: 0
      Flags: Trunk-Mode
```

show interfaces extensive (Asymmetric Flow Control)

```
user@switch> show interfaces xe-0/0/1 extensive
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591, Generation: 169
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Configured-flow-control  tx-buffers: off  rx-buffers: on
  Device flags    : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags      : None
  CoS queues      : 12 supported, 12 maximum usable queues
  Hold-times      : Up 0 ms, Down 0 ms
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
  Last flapped    : 2011-06-01 00:42:03 PDT (00:03:08 ago)
  Statistics last cleared: 2011-06-01 00:44:39 PDT (00:00:32 ago)
  Traffic statistics:
   Input  bytes  :                  0                    0 bps
   Output bytes  :                  0                    0 bps
   Input  packets:                  0                    0 pps
   Output packets:                  0                    0 pps
   IPv6 transit statistics:
    Input  bytes  :                 0
```



```
    Output bytes  :                  0
    Input  packets:                  0
    Output packets:                  0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
 FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
  Egress queues: 12 supported, 9 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 best-effort                    0                    0                    0

    1 fc7                            0                    0                    0

    2 no-loss                        0                    0                    0

    3 fcoe                           0                    0                    0

    4 fc4                            0                    0                    0

    5 fc5                            0                    0                    0

    6 fc6                            0                    0                    0

    7 network-cont                   0                    0                    0

    8 mcast                          0                    0                    0

  Queue number:         Mapped forwarding classes
    0                   best-effort
    1                   fc7
    2                   no-loss
    3                   fcoe
    4                   fc4
    5                   fc5
    6                   fc6
    7                   network-control
    8                   mcast
  Active alarms  : None
  Active defects : None
  MAC statistics:                      Receive         Transmit
    Total octets                             0                0
    Total packets                            0                0
    Unicast packets                          0                0
    Broadcast packets                        0                0
    Multicast packets                        0                0
    CRC/Align errors                         0                0
    FIFO errors                              0                0
    MAC control frames                       0                0
    MAC pause frames                         0                0
    Oversized frames                         0
    Jabber frames                            0
    Fragment frames                          0
    VLAN tagged frames                       0
    Code violations                          0
  MAC Priority Flow Control Statistics:
    Prioity :  0                             0                0
    Prioity :  1                             0                0
```

```
    Prioity :  2                              0                0
    Prioity :  3                              0                0
    Prioity :  4                              0                0
    Prioity :  5                              0                0
    Prioity :  6                              0                0
    Prioity :  7                              0                0
  Filter statistics:
    Input packet count                        0
    Input packet rejects                      0
    Input DA rejects                          0
    Input SA rejects                          0
    Output packet count                                        0
    Output packet pad count                                    0
    Output packet error count                                  0
    CAM destination filters: 1, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0
  CoS information:
    Direction : Output
    CoS transmit queue             Bandwidth          Buffer Priority   Limit
                            %            bps     %      usec
    0 best-effort          75     7500000000    75         0       low    none
    7 network-control       5      500000000     5         0       low    none
    8 mcast                20     2000000000    20         0       low    none

  Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523) (Generation 143)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Local statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Transit statistics:
     Input  bytes  :                    0                    0 bps
     Output bytes  :                    0                    0 bps
     Input  packets:                    0                    0 pps
     Output packets:                    0                    0 pps
    Protocol eth-switch, MTU: 0, Generation: 170, Route table: 0
      Flags: Trunk-Mode
```

show interfaces terse

```
user@switch> show interfaces xe-0/0/1 terse
Interface               Admin Link Proto    Local                 Remote

xe-0/0/1                up    up
xe-0/0/1.0              up    up   eth-switch
```

show interfaces (QFabric System)

```
user@switch> show interfaces node1:xe-0/0/0
Physical interface: node1:xe-0/0/0, Enabled, Physical link is Down
  Interface index: 129, SNMP ifIndex: 2884086
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None,
  Loopback: Disabled, Source filtering: Disabled, Flow control: Enabled
```



```
Interface flags: Internal: 0x4000
CoS queues     : 8 supported, 8 maximum usable queues
Current address: 02:00:09:03:00:00, Hardware address: 02:00:09:03:00:00
Last flapped   : Never
Input rate     : 0 bps (0 pps)
Output rate    : 0 bps (0 pps)
```

show lacp interfaces

Syntax

show lacp interfaces
<*interface-name*>

Release Information

Command introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Link Aggregation Control Protocol (LACP) information about the specified aggregated Ethernet or Gigabit Ethernet interface.

Options

none—Display LACP information for all interfaces.

interface-name—(Optional) Display LACP information for the specified interface:

- Aggregated Ethernet—**ae*x***
- Gigabit Ethernet—**ge-*fpc/pic/port***
- 10-Gigabit Ethernet—**xe-*fpc/pic/port***

Required Privilege Level

view

Related Documentation

- *Example: Configuring Aggregated Ethernet High-Speed Uplinks Between an EX4200 Virtual Chassis Access Switch and an EX4200 Virtual Chassis Distribution Switch*
- *Example: Configuring Aggregated Ethernet High-Speed Uplinks with LACP Between an EX4200 Virtual Chassis Access Switch and an EX4200 Virtual Chassis Distribution Switch*
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896
- *Configuring Aggregated Ethernet Links (CLI Procedure)*
- Configuring Link Aggregation on page 2019
- *Configuring Aggregated Ethernet LACP (CLI Procedure)*
- Configuring Aggregated Ethernet LACP on page 2017
- *Configuring LACP Link Protection of Aggregated Ethernet Interfaces (CLI Procedure)*
- *Understanding Aggregated Ethernet Interfaces and LACP*
- Understanding Aggregated Ethernet Interfaces and LACP on page 1843
- *Junos OS Interfaces Fundamentals Configuration Guide*

List of Sample Output

show lacp interfaces (EX Series Switches) on page 2258
show lacp interfaces (QFX Series) on page 2259

Output Fields

Table 184 on page 2160 lists the output fields for the **show lacp interfaces** command. Output fields are listed in the approximate order in which they appear.

Table 193: show lacp interfaces Output Fields

Field Name	Field Description
Aggregated interface	Aggregated Ethernet interface name.

LACP State	LACP state information for each aggregated Ethernet interface:
	• For a child interface configured with the **force-up** statement, LACP state displays **FUP** along with the interface name.
	• **Role**—Role played by the interface. It can be one of the following:
	  ◦ **Actor**—Local device participating in the LACP negotiation.
	  ◦ **Partner**—Remote device participating in the LACP negotiation.
	• **Exp**—Expired state. **Yes** indicates that the actor or partner is in an expired state. **No** indicates that the actor or partner is not in an expired state.
	• **Def**—Default. **Yes** indicates that the actor's receive machine is using the default operational partner information, which is administratively configured for the partner. **No** indicates that the operational partner information in use has been received in an LACP PDU.
	• **Dist**—Distribution of outgoing frames. **No** indicates that the distribution of outgoing frames on the link is currently disabled and is not expected to be enabled. Otherwise, the value is **Yes**.
	• **Col**—Collection of incoming frames. **Yes** indicates that the collection of incoming frames on the link is currently enabled and is not expected to be disabled. Otherwise, the value is **No**.
	• **Syn**—Synchronization. If the value is **Yes**, the link is considered to be synchronized. The link has been allocated to the correct link aggregation group, the group has been associated with a compatible aggregator, and the identity of the link aggregation group is consistent with the system ID and operational key information transmitted. If the value is **No**, the link is not synchronized. The link is currently not in the right aggregation.
	• **Aggr**—Ability of the aggregation port to aggregate (**Yes**) or to operate only as an individual link (**No**).
	• **Timeout**—LACP timeout preference. Periodic transmissions of LACP PDUs occur at either a slow or a fast transmission rate, depending upon the expressed LACP timeout preference (**Long Timeout** or **Short Timeout**).
	• **Activity**—Actor's or partner's port activity. **Passive** indicates the port's preference for not transmitting LAC PDUs unless its partner's control value is **Active**. **Active** indicates the port's preference to participate in the protocol regardless of the partner's control value.

Table 193: show lacp interfaces Output Fields *(continued)*

<table>
<tr><th>Field Name</th><th>Field Description</th></tr>
<tr><td>LACP Protocol</td><td>LACP protocol information for each aggregated interface:

Link state (active or standby) indicated in parentheses next to the interface when link protection is configured.
Receive State—One of the following values:

Current—The state machine receives an LACP PDU and enters the Current state.
Defaulted—If no LACP PDU is received before the timer for the Current state expires a second time, the state machine enters the Defaulted state.
Expired—If no LACP PDU is received before the timer for the Current state expires once, the state machine enters the Expired state.
Initialize—When the physical connectivity of a link changes or a Begin event occurs, the state machine enters the Initialize state.
LACP Disabled—If the port is operating in half duplex, the operation of LACP is disabled on the port, forcing the state to LACP Disabled. This state is similar to the Defaulted state, except that the port is forced to operate as an individual port.
Port Disabled—If the port becomes inoperable and a Begin event has not occurred, the state machine enters the Port Disabled state.

Transmit State—Transmit state of the state machine. The transmit state is one of the following values:

Fast periodic—Periodic transmissions are enabled at a fast transmission rate.
No periodic—Periodic transmissions are disabled.
Periodic timer—Transitory state entered when the periodic timer expires.
Slow periodic—Periodic transmissions are enabled at a slow transmission rate.

Mux State—State of the multiplexer state machine for the aggregation port. The state is one of the following values:

Attached—The multiplexer state machine initiates the process of attaching the port to the selected aggregator.
Collecting—Yes indicates that the receive function of this link is enabled with respect to its participation in an aggregation. Received frames are passed to the aggregator for collection. No indicates the receive function of this link is not enabled.
Collecting distributing—Collecting and distributing states are merged together to form a combined state (coupled control). Because independent control is not possible, the coupled control state machine does not wait for the partner to signal that collection has started before enabling both collection and distribution.
Detached—Process of detaching the port from the aggregator is in progress.
Distributing—Yes indicates that the transmit function of this link is enabled with respect to its participation in an aggregation. Frames can be passed down from the aggregator's distribution function for transmission. No indicates the transmit function of this link is not enabled.
Waiting—The multiplexer state machine is in a holding process, awaiting an outcome.

</td></tr>
</table>

Sample Output

show lacp interfaces (EX Series Switches)

```
user@switch> show lacp interfaces ae5
Aggregated interface: ae5
    LACP state:       Role   Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity
      xe-2/0/7       Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
      xe-2/0/7     Partner    No    No   Yes  Yes  Yes   Yes     Fast   Passive
```



```
xe-4/0/7        Actor     No     No     No    No    No    Yes      Fast     Active
xe-4/0/7      Partner     No     No     No   Yes   Yes    Yes      Fast     Passive


LACP protocol:        Receive State  Transmit State          Mux State
xe-2/0/7(Active)          Current    Fast periodic Collecting distributing
xe-34/0/7(Standby)        Current    Fast periodic           Waiting
```

show lacp interfaces (QFX Series)

```
user@switch> show lacp interfaces nodegroup1:ae0 extensive
 Aggregated interface: nodegroup1:ae0
    LACP state:       Role    Exp   Def  Dist  Col  Syn  Aggr  Timeout    Activity

      node1:xe-0/0/1FUP    Actor     No    Yes    No    No    No    Yes     Fast
 Active
      node1xe-0/0/1FUP  Partner    No    Yes    No    No    No    Yes     Fast
Passive
      node2:xe-0/0/2       Actor     No    Yes    No    No    No    Yes     Fast
 Active
      node2:xe-0/0/2     Partner     No    Yes    No    No    No    Yes     Fast
 Passive
```

```
      LACP protocol:             Receive State    Transmit State      Mux State
      node1:xe-0/0/1FUP             Current       Fast periodic      Collecting
distributing
      node2:xe-0/0/2                Current       Fast periodic      Collecting
distributing
      node1:xe-0/0/1 (active)       Current       Fast periodic      Collecting
distributing
      node2:xe-0/0/2 (standby)      Current       Fast periodic      WAITING
```


show lacp statistics interfaces (View)

Syntax **show lacp statistics interfaces** *interface-name*

Release Information Command modified in Release 10.2 of Junos OS.
Command introduced in Release 11.1 of Junos OS for the QFX Series.

Description Display Link Aggregation Control Protocol (LACP) statistics about the specified aggregated Ethernet interface or redundant Ethernet interface. If you do not specify an interface name, LACP statistics for all interfaces are displayed.

Options *interface-name*—(Optional) Name of an interface.

Required Privilege Level view

Related Documentation

- Configuring Link Aggregation on page 2019
- Verifying the Status of a LAG Interface on page 2148
- Verifying That LACP Is Configured Correctly and Bundle Members Are Exchanging LACP Protocol Packets on page 2149
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896
- Example: Configuring Link Aggregation with LACP Between a QFX Series Product and an Aggregation Switch on page 1900

List of Sample Output
show lacp statistics interfaces on page 2262
show lacp statistics interfaces (QFX Series) on page 2262
show lacp statistics interfaces (QFabric Systems) on page 2262

Output Fields Table 194 on page 2261 lists the output fields for the **show lacp statistics interfaces** command. Output fields are listed in the approximate order in which they appear.

Table 194: show lacp statistics interfaces Output Fields

Field Name	Field Description
Aggregated interface	Aggregated interface value.
LACP Statistics	LACP statistics provide the following information: • **LACP Rx**—LACP received counter that increments for each normal hello. • **LACP Tx**—Number of LACP transmit packet errors logged. • **Unknown Rx**—Number of unrecognized packet errors logged. • **Illegal Rx**—Number of invalid packets received.

Sample Output

show lacp statistics interfaces

```
user@host> show lacp statistics interfaces ae0
Aggregated interface: ae0
    LACP Statistics:       LACP Rx     LACP Tx   Unknown Rx   Illegal Rx
      ge-2/0/0                1352        2035            0            0
      ge-2/0/1                1352        2056            0            0
      ge-2/2/0                1352        2045            0            0
      ge-2/2/1                1352        2043            0            0
```

show lacp statistics interfaces (QFX Series)

```
user@host> show lacp statistics interfaces ae0
Aggregated interface: ae0
    LACP Statistics:       LACP Rx     LACP Tx   Unknown Rx   Illegal Rx
      xe-0/0/2                1352        2035            0            0
      xe-0/0/3                1352        2056            0            0
```

show lacp statistics interfaces (QFabric Systems)

```
user@host> show lacp statistics interfaces nodegroup1:ae0
Aggregated interface: nodegroup1:ae0
    LACP Statistics:       LACP Rx     LACP Tx   Unknown Rx   Illegal Rx
      node1:xe-0/0/2                1352        2035            0            0
      node2:xe-0/0/3                1352        2056            0            0
```


show redundant-trunk-group

Syntax **show redundant-trunk-group <group-name *group-name*>**

Release Information Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 13.2X50-D15 for the QFX Series.

Description Display information about redundant trunk groups.

Options **group-name *group-name***—Display information about the specified redundant trunk group.

Required Privilege Level view

Related Documentation

- *Example: Configuring Redundant Trunk Links for Faster Recovery*
- Example: Configuring Redundant Trunk Links for Faster Recovery on page 2010
- Understanding Redundant Trunk Links on page 1885

List of Sample Output show redundant-trunk-group group-name Group1 on page 2263

Output Fields Table 195 on page 2263 lists the output fields for the **show redundant-trunk-group** command. Output fields are listed in the approximate order in which they appear.

Table 195: show redundant-trunk-group Output Fields

Field Name	Field Description
Group name	Name of the redundant trunk port group.
Interface	Name of an interface belonging to the trunk port group.
State	Operating state of the interface. • **Up** denotes the interface is up. • **Down** denotes the interface is down. • **Pri** denotes a primary interface. • **Act** denotes an active interface.
Time of last flap	Date and time at which the advertised link became unavailable, and then, available again.
Flap count	Total number of flaps since the last switch reboot.

Sample Output

show redundant-trunk-group group-name Group1

```
user@switch> show redundant-trunk-group group-name Group1

Group      Interface       State         Time of last flap        Flap
name                                                              Count
```

```
Group1     ge-0/0/45.0     UP/Pri/Act     Never                    0
           ge-0/0/47.0     UP             Never                    0
```

show uplink-failure-detection

Syntax

show uplink-failure-detection
<group *group-name*>

Release Information Command introduced in Junos OS Release 11.1 for EX Series switches.

Description Display information about the uplink-failure-detection group, the member interfaces, and their status.

Options **none**—Display information about all groups configured for uplink failure detection.

group ***group-name***—(Optional) Display information about the specified group only.

Required Privilege Level view

Related Documentation

- Overview of Uplink Failure Detection on page 1841
- Configuring Interfaces for Uplink Failure Detection on page 2018
- Example: Configuring Interfaces for Uplink Failure Detection on page 1891

List of Sample Output show uplink-failure-detection on page 2265

Output Fields Table 196 on page 2265 lists the output fields for the **show uplink-failure-detection** command. Output fields are listed in the approximate order in which they appear.

Table 196: show uplink-failure-detection Output Fields

Field Name	Field Description
Group	Name of the group.
Uplink	The uplink interface or interfaces configured as link-to-monitor. NOTE: The asterisk (*) indicates that the link is up.
Downlink	The downlink interface or interfaces configured as link-to-disable. NOTE: The asterisk (*) indicates that the link is up.
Failure Action	Status of uplink failure detection: • Active—The switch has detected an uplink failure and has brought the downlink down. • Inactive—The uplink or uplinks are up.

Sample Output

show uplink-failure-detection

user@switch> **show uplink-failure-detection**

```
Group              : group1
Uplink             :  ge-0/0/0*
Downlink           :  ge-0/0/1*
Failure Action     :  Inactive

Group              : group2
Uplink             :  ge-0/0/3.0
Downlink           :  ge-0/0/4.0
Failure Action     :  Active
```

Monitoring Commands (ELS CLI Only)

- show interfaces irb

show interfaces irb

Syntax

show interfaces irb
<brief | detail | extensive | terse>
<descriptions>
<media>
<routing-instance *instance-name*>
<snmp-index *snmp-index*>
<statistics>

Release Information

Command introduced in Junos OS Release 12.3R2.
Command introduced in Junos OS Release 12.3R2 for EX Series switches.
Command introduced in Junos OS Release 13.2 for the QFX Series

Description

Display integrated routing and bridging interfaces information.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output.

descriptions—(Optional) Display interface description strings.

media—(Optional) Display media-specific information about network interfaces.

routing-instance ***instance-name***—(Optional) Display information for the interface with the specified SNMP index.

snmp-index ***snmp-index***—(Optional) Display information for the interface with the specified SNMP index.

statistics—(Optional) Display static interface statistics.

Additional Information

Integrated routing and bridging (IRB) provides simultaneous support for Layer 2 bridging and Layer 3 IP routing on the same interface. IRB enables you to route local packets to another routed interface or to another VLAN that has a Layer 3 protocol configured.

Required Privilege Level

view

List of Sample Output

show interfaces irb extensive on page 2271
show interfaces irb snmp-index on page 2272

Output Fields

Table 197 on page 2267 lists the output fields for the **show interfaces irb** command. Output fields are listed in the approximate order in which they appear.

Table 197: show interfaces irb Output Fields

Field Name	Field Description	Level of Output
Physical Interface		
Physical interface	Name of the physical interface.	All levels
Enabled	State of the physical interface. Possible values are described in the “Enabled Field” section under *Common Output Fields Description*.	All levels

Table 197: show interfaces irb Output Fields *(continued)*

Field Name	Field Description	Level of Output
Proto	Protocol configured on the interface.	**terse**
Interface index	Physical interface index number, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP index number for the physical interface.	**detail extensive** none
Type	Physical interface type.	**detail extensive** none
Link-level type	Encapsulation being used on the physical interface.	**detail extensive brief** none
MTU	MTU size on the physical interface.	**detail extensive brief** none
Clocking	Reference clock source: **Internal** or **External**. Always unspecified on IRB interfaces.	**detail extensive brief**
Speed	Speed at which the interface is running. Always unspecified on IRB interfaces.	**detail extensive brief**
Device flags	Information about the physical device. Possible values are described in the "Device Flags" section under *Common Output Fields Description*.	**detail extensive brief** none
Interface flags	Information about the interface. Possible values are described in the "Interface Flags" section under *Common Output Fields Description*.	**detail extensive brief** none
Link type	Physical interface link type: **full duplex** or **half duplex**.	**detail extensive** none
Link flags	Information about the link. Possible values are described in the "Links Flags" section under *Common Output Fields Description*.	**detail extensive** none
Physical Info	Physical interface information.	All levels
Hold-times	Current interface hold-time up and hold-time down, in milliseconds.	**detail extensive**
Current address	Configured MAC address.	**detail extensive** none
Hardware address	MAC address of the hardware.	**detail extensive** none
Alternate link address	Backup address of the link.	**detail extensive**
Last flapped	Date, time, and how long ago the interface went from down to up. The format is **Last flapped: year-month-day hours:minutes:seconds timezone (hours:minutes:seconds ago)**. For example, **Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)**.	**detail extensive** none
Statistics last cleared	Time when the statistics for the interface were last set to zero.	**detail extensive**

Table 197: show interfaces irb Output Fields *(continued)*

Field Name	Field Description	Level of Output
Traffic statistics	Number and rate of bytes and packets received and transmitted on the physical interface. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface • **Output packets**—Number of packets transmitted on the interface.	**detail extensive**
IPv6 transit statistics	Number of IPv6 transit bytes and packets received and transmitted on the physical interface if IPv6 statistics tracking is enabled. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface. • **Output packets**—Number of packets transmitted on the interface.	**detail extensive**
Input errors	Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: • **Errors**—Sum of the incoming frame aborts and FCS errors. • **Drops**—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • **Framing errors**—Number of packets received with an invalid frame checksum (FCS). • **Runts**—Number of frames received that are smaller than the runt threshold. • **Giants**—Number of frames received that are larger than the giant threshold. • **Policed discards**—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that the Junos OS does not handle. • **Resource errors**—Sum of transmit drops.	**detail extensive**
Output errors	Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: • **Carrier transitions**—Number of times the interface has gone from **down** to **up**. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the DPC is malfunctioning. • **Errors**—Sum of the outgoing frame aborts and FCS errors. • **Drops**—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • **MTU errors**—Number of packets whose size exceeded the MTU of the interface. • **Resource errors**—Sum of transmit drops.	**detail extensive**
Logical Interface		

Table 197: show interfaces irb Output Fields *(continued)*

Field Name	Field Description	Level of Output
Logical interface	Name of the logical interface.	All levels
Index	Index number of the logical interface (which reflects its initialization sequence).	**detail extensive** none
SNMP ifIndex	SNMP interface index number of the logical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Flags	Information about the logical interface. Possible values are described in the “Logical Interface Flags” section under *Common Output Fields Description*.	**detail extensive**
Encapsulation	Encapsulation on the logical interface.	**detail extensive**
Bandwidth	Speed at which the interface is running.	**detail extensive**
Routing Instance	Routing instance IRB is configured under.	**detail extensive**
Bridging Domain	Bridging domain IRB is participating in.	**detail extensive**
Traffic statistics	Number and rate of bytes and packets received and transmitted on the logical interface. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface • **Output packets**—Number of packets transmitted on the interface.	**detail extensive**
IPv6 transit statistics	Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface. • **Output packets**—Number of packets transmitted on the interface.	**detail extensive**
Local statistics	Statistics for traffic received from and transmitted to the Routing Engine.	**detail extensive**
Transit statistics	Statistics for traffic transiting the router.	**detail extensive**
Protocol	Protocol family configured on the local interface. Possible values are described in the “Protocol Field” section under *Common Output Fields Description*.	**detail extensive**
MTU	Maximum transmission unit size on the logical interface.	**detail extensive**
Maximum labels	Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.	**detail extensive** none

Table 197: show interfaces irb Output Fields *(continued)*

Field Name	Field Description	Level of Output
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Route table	Routing table in which the logical interface address is located. For example, **0** refers to the routing table inet.0.	**detail extensive**
Addresses, Flags	Information about address flags. Possible values are described in the "Addresses Flags" section under *Common Output Fields Description*.	**detail extensive**
Policer	The policer that is to be evaluated when packets are received or transmitted on the interface.	**detail extensive**
Flags	Information about the logical interface. Possible values are described in the "Logical Interface Flags" section under *Common Output Fields Description*.	**detail extensive**

Sample Output

show interfaces irb extensive

```
user@host> show interfaces irb extensive
Physical interface: irb, Enabled, Physical link is Up
  Interface index: 129, SNMP ifIndex: 23, Generation: 130
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514, Clocking: Unspecified,
Speed: Unspecified
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Full-Duplex
  Link flags     : None
  Physical info  : Unspecified
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 02:00:00:00:00:30, Hardware address: 02:00:00:00:00:30
  Alternate link address: Unspecified
  Last flapped   : Never
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                    0
   Output bytes  :                    0
   Input  packets:                    0
   Output packets:                    0
   IPv6 transit statistics:
    Input  bytes  :                   0
    Output bytes  :                   0
    Input  packets:                   0
    Output packets:                   0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0, Policed discards:
 0, Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0, Resource errors:
 0

  Logical interface irb.0 (Index 68) (SNMP ifIndex 70) (Generation 143)
    Flags: Hardware-Down SNMP-Traps 0x4000 Encapsulation: ENET2
    Bandwidth: 1000mbps
    Routing Instance: customer_0 Bridging Domain: bd0
```



```
    Traffic statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
     IPv6 transit statistics:
      Input  bytes  :                   0
      Output bytes  :                   0
      Input  packets:                   0
      Output packets:                   0
    Local statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Transit statistics:
     Input  bytes  :                    0                    0 bps
     Output bytes  :                    0                    0 bps
     Input  packets:                    0                    0 pps
     Output packets:                    0                    0 pps
     IPv6 transit statistics:
      Input  bytes  :                   0
      Output bytes  :                   0
      Input  packets:                   0
      Output packets:                   0
    Protocol inet, MTU: 1500, Generation: 154, Route table: 0
      Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
        Destination: 10.51.1/24, Local: 10.51.1.2, Broadcast: 10.51.1.255,
        Generation: 155
    Protocol multiservice, MTU: 1500, Generation: 155, Route table: 0
      Flags: Is-Primary
      Policer: Input: __default_arp_policer
```

show interfaces irb snmp-index

```
user@host> show interfaces irb snmp-index 25
Physical interface: irb, Enabled, Physical link is Up
  Interface index: 128, SNMP ifIndex: 25
  Type: Ethernet, Link-level type: Ethernet, MTU: 1514
  Device flags   : Present Running
  Interface flags: SNMP-Traps
  Link type      : Full-Duplex
  Link flags     : None
  Current address: 02:00:00:00:00:30, Hardware address: 02:00:00:00:00:30
  Last flapped   : Never
    Input packets : 0
    Output packets: 0

  Logical interface irb.0 (Index 68) (SNMP ifIndex 70)
    Flags: Hardware-Down SNMP-Traps 0x4000 Encapsulation: ENET2
    Bandwidth: 1000mbps
    Routing Instance: customer_0 Bridging Domain: bd0
    Input packets : 0
    Output packets: 0
    Protocol inet, MTU: 1500
      Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
        Destination: 10.51.1/24, Local: 10.51.1.2, Broadcast: 10.51.1.255
    Protocol multiservice, MTU: 1500
      Flags: Is-Primary
```


Monitoring Commands (Original CLI Only)

- show interfaces xle

show interfaces xle

Syntax

show interfaces *device-name*:*type-fpc/pic/port*
<brief | detail | extensive | terse>
<descriptions>
<media>
<routing-instance (all | *instance-name*)>
<snmp-index *snmp-index*>
<statistics>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display status information about the specified 10-Gigabit Ethernet interface. This command does not display statistics for routed VLAN interfaces.

Options

device-name*:*type-fpc/pic/port—(QFabric systems only) The device name is either the serial number or the alias of the QFabric system component, such as a Node device, Interconnect device, or QFabric infrastructure. The name must contain a maximum of 128 characters and not contain any colons.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

descriptions—(Optional) Display interface description strings.

media—(Optional) Display media-specific information about network interfaces.

routing-instance (all | *instance-name*)—(Optional) Display the name of an individual routing instance or display all routing instances.

snmp-index *snmp-index*—(Optional) Display information for the specified SNMP index of the interface.

statistics—(Optional) Display static interface statistics.

Required Privilege Level

view

Related Documentation

- Monitoring Interface Status and Traffic on page 309
- Troubleshooting Network Interfaces on page 1118
- Troubleshooting an Aggregated Ethernet Interface on page 1119

- *Junos OS Network Interfaces Library for Routing Devices*

List of Sample Output

show interfaces on page 2282
show interfaces (Asymmetric Flow Control) on page 2283
show interfaces brief on page 2283
show interfaces detail on page 2283
show interfaces detail (Asymmetric Flow Control) on page 2285
show interfaces extensive on page 2286
show interfaces extensive (Asymmetric Flow Control) on page 2288

show interfaces terse on page 2290
show interfaces (QFabric System) on page 2290

Output Fields Table 192 on page 2239 lists the output fields for the **show interfaces xe** command. Output fields are listed in the approximate order in which they appear.

Table 198: show interfaces xe Output Fields

Field Name	Field Description	Level of Output
Physical Interface		
Physical interface	Name of the physical interface.	All levels
Enabled	State of the interface.	All levels
Interface index	Index number of the physical interface, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP index number for the physical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Link-level type	Encapsulation being used on the physical interface.	All levels
MTU	Maximum transmission unit size on the physical interface.	All levels
Speed	Speed at which the interface is running.	All levels
Duplex	Duplex mode of the interface, either **Full-Duplex** or **Half-Duplex**.	All levels
Loopback	Loopback status: **Enabled** or **Disabled**. If loopback is enabled, type of loopback: **Local** or **Remote**.	All levels
Source filtering	Source filtering status: **Enabled** or **Disabled**.	All levels
LAN-PHY mode	10-Gigabit Ethernet interface operating in Local Area Network Physical Layer Device (LAN PHY) mode. LAN PHY allows 10-Gigabit Ethernet wide area links to use existing Ethernet applications.	All levels
Unidirectional	Unidirectional link mode status for 10-Gigabit Ethernet interface: **Enabled** or **Disabled** for parent interface; **Rx-only** or **Tx-only** for child interfaces.	All levels
Flow control	Flow control status: **Enabled** or **Disabled**. NOTE: This field is only displayed if asymmetric flow control is not configured.	All levels

Table 198: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Configured-flow-control	Configured flow control for the interface transmit buffers (**tx-buffers**) and receive buffers (**rx-buffers**): • **tx-buffers—On** if the interface is configured to respond to Ethernet PAUSE messages received from the connected peer. **Off** if the interface is not configured to respond to received PAUSE messages. • **rx-buffers—On** if the interface is configured to generate and send Ethernet PAUSE messages to the connected peer. **Off** if the interface is not configured to generate and send PAUSE messages. NOTE: This field is only displayed if asymmetric flow control is configured.	All levels
Auto-negotiation	Autonegotiation status: **Enabled** or **Disabled**.	All levels
Remote-fault	Remote fault status: • **Online**—Autonegotiation is manually configured as online. • **Offline**—Autonegotiation is manually configured as offline.	All levels
Device flags	Information about the physical device.	All levels
Interface flags	Information about the interface.	All levels
Link flags	Information about the link.	All levels
Wavelength	Configured wavelength, in nanometers (nm).	All levels
Frequency	Frequency associated with the configured wavelength, in terahertz (THz).	All levels
CoS queues	Number of CoS queues configured.	**detail extensive** none
Schedulers	Number of CoS schedulers configured.	**extensive**
Hold-times	Current interface hold-time up and hold-time down, in milliseconds.	**detail extensive**
Current address	Configured MAC address.	**detail extensive** none
Hardware address	Hardware MAC address.	**detail extensive** none
Last flapped	Date, time, and how long ago the interface went from down to up. The format is **Last flapped:** *year-month-day hour:* :*minute*:*second*:*timezone* (*hour*:*minute*:*second* **ago**). For example, **Last flapped: 2008–01–16 10:52:40 UTC (3d 22:58 ago).**	**detail extensive** none
Input Rate	Input rate in bits per second (bps) and packets per second (pps).	None specified
Output Rate	Output rate in bps and pps.	None specified
Statistics last cleared	Time when the statistics for the interface were last set to zero.	**detail extensive**

Table 198: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Traffic statistics	Number and rate of bytes and packets received and transmitted on the physical interface. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface. • **Output packets**—Number of packets transmitted on the interface. NOTE: The bandwidth bps counter is not enabled.	**detail extensive**
Input errors	Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: • **Errors**—Sum of the incoming frame aborts and FCS errors. • **Drops**—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • **Framing errors**—Number of packets received with an invalid frame checksum (FCS). • **Runts**—Number of frames received that are smaller than the runt threshold. • **Policed discards**—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that Junos OS does not handle. • **L3 incompletes**—Number of incoming packets discarded because they failed Layer 3 sanity checks of the header. For example, a frame with less than 20 bytes of available IP header is discarded. L3 incomplete errors can be ignored if you configure the **ignore-l3-incompletes** statement. • **L2 channel errors**—Number of times the software did not find a valid logical interface for an incoming frame. • **L2 mismatch timeouts**—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable. • **FIFO errors**—Number of FIFO errors in the receive direction that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning. • **Resource errors**—Sum of transmit drops.	**extensive**

Table 198: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Output errors	Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: • **Carrier transitions**—Number of times the interface has gone from **down** to **up**. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the PIC or PIM is malfunctioning. • **Errors**—Sum of the outgoing frame aborts and FCS errors. • **Drops**—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • **Collisions**—Number of Ethernet collisions. The Gigabit Ethernet PIC supports only full-duplex operation, so for Gigabit Ethernet PICs, this number should always remain 0. If it is nonzero, there is a software bug. • **Aged packets**—Number of packets that remained in shared packet SDRAM so long that the system automatically purged them. The value in this field should never increment. If it does, it is most likely a software bug or possibly malfunctioning hardware. • **FIFO errors**—Number of FIFO errors in the send direction as reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning. • **HS link CRC errors**—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces. • **MTU errors**—Number of packets whose size exceeded the MTU of the interface. • **Resource errors**—Sum of transmit drops.	**extensive**
Egress queues	Total number of egress queues supported on the specified interface.	**detail extensive**
Queue counters (Egress)	CoS queue number and its associated user-configured forwarding class name. • **Queued packets**—Number of queued packets. • **Transmitted packets**—Number of transmitted packets. • **Dropped packets**—Number of packets dropped by the ASIC's RED mechanism.	**detail extensive**
Queue Number	The CoS queue number and the forwarding classes mapped to the queue number. The **Mapped forwarding class** column lists the forwarding classes mapped to each CoS queue.	**detail extensive**
Ingress queues	Total number of ingress queues supported on the specified interface.	**extensive**
Queue counters (Ingress)	CoS queue number and its associated user-configured forwarding class name. • **Queued packets**—Number of queued packets. • **Transmitted packets**—Number of transmitted packets. • **Dropped packets**—Number of packets dropped by the ASIC's RED mechanism.	**extensive**

Table 198: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Active alarms and Active defects	Ethernet-specific defects that can prevent the interface from passing packets. When a defect persists for a certain amount of time, it is promoted to an alarm. Based on the switch configuration, an alarm can ring the red or yellow alarm bell on the switch, or turn on the red or yellow alarm LED on the craft interface. These fields can contain the value **None** or **Link**. • **None**—There are no active defects or alarms. • **Link**—Interface has lost its link state, which usually means that the cable is unplugged, the far-end system has been turned off, or the PIC is malfunctioning.	**detail extensive** none
PCS statistics	Physical Coding Sublayer (PCS) fault conditions from the LAN PHY device.	**detail extensive**
MAC statistics	**Receive** and **Transmit** statistics reported by the PIC's MAC subsystem. • **Total octets** and **total packets**—Total number of octets and packets. For Gigabit Ethernet IQ PICs, the received octets count varies by interface type. • **Unicast packets, Broadcast packets,** and **Multicast packets**—Number of unicast, broadcast, and multicast packets. • **CRC/Align errors**—Total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, and had either a bad FCS with an integral number of octets (FCS Error) or a bad FCS with a nonintegral number of octets (Alignment Error). • **FIFO error**—Number of FIFO errors that are reported by the ASIC on the PIC. If this value is ever nonzero, the PIC is probably malfunctioning. • **MAC control frames**—Number of MAC control frames. • **MAC pause frames**—Number of MAC control frames with **pause** operational code. • **Oversized frames**—Number of packets that exceeds the configured MTU. • **Jabber frames**—Number of frames that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error. This definition of jabber is different from the definition in IEEE-802.3 section 8.2.1.5 (10BASE5) and section 10.3.1.4 (10BASE2). These documents define jabber as the condition in which any packet exceeds 20 ms. The allowed range to detect jabber is from 20 ms to 150 ms. • **Fragment frames**—Total number of packets that were less than 64 octets in length (excluding framing bits, but including FCS octets), and had either an FCS error or an alignment error. Fragment frames normally increment because both runts (which are normal occurrences caused by collisions) and noise hits are counted. • **VLAN tagged frames**—Number of frames that are VLAN tagged. The system uses the TPID of 0x8100 in the frame to determine whether a frame is tagged or not. This counter is not supported on EX Series switches and is always displayed as 0. • **Code violations**—Number of times an event caused the PHY to indicate "Data reception error" or "invalid data symbol error."	**extensive**
Filter statistics	**Receive** and **Transmit** statistics reported by the PIC's MAC address filter subsystem.	**extensive**

Table 198: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output

Autonegotiation information	Information about link autonegotiation.
	• **Negotiation status:**
	  ◦ **Incomplete**—Ethernet interface has the speed or link mode configured.
	  ◦ **No autonegotiation**—Remote Ethernet interface has the speed or link mode configured, or does not perform autonegotiation.
	  ◦ **Complete**—Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.
	• **Link partner status**—**OK** when the Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.
	• **Link partner:**
	  ◦ **Link mode**—Depending on the capability of the attached Ethernet device, either **Full-duplex** or **Half-duplex**.
	  ◦ **Flow control**—Types of flow control supported by the remote Ethernet device. For Fast Ethernet interfaces, the type is **None**. For Gigabit Ethernet interfaces, types are **Symmetric** (link partner supports **PAUSE** on receive and transmit), **Asymmetric** (link partner supports **PAUSE** on transmit), and **Symmetric/Asymmetric** (link partner supports both **PAUSE** on receive and transmit or only **PAUSE** receive).
	  ◦ **Remote fault**—Remote fault information from the link partner—**Failure** indicates a receive link error. **OK** indicates that the link partner is receiving. **Negotiation error** indicates a negotiation error. **Offline** indicates that the link partner is going offline.
	• **Local resolution**:
	  ◦ **Flow control**—Types of flow control supported by the remote Ethernet device. For Gigabit Ethernet interfaces, types are **Symmetric** (link partner supports **PAUSE** on receive and transmit), **Asymmetric** (link partner supports **PAUSE** on transmit), and **Symmetric/Asymmetric** (link partner supports both **PAUSE** on receive and transmit or only **PAUSE** receive).
	For asymmetric **PAUSE**, shows if the PAUSE transmit and **PAUSE** receive states on the interface are **enable** or **disable**.
	  ◦ **Remote fault**—Remote fault information. **Link OK** (no error detected on receive), **Offline** (local interface is offline), and **Link Failure** (link error detected on receive).
		extensive

Table 198: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Packet Forwarding Engine configuration	Information about the configuration of the Packet Forwarding Engine: • **Destination slot**—FPC slot number. • **CoS transmit queue**—Queue number and its associated user-configured forwarding class name. • **Bandwidth %**—Percentage of bandwidth allocated to the queue. • **Bandwidth bps**—Bandwidth allocated to the queue (in bps). • **Buffer %**—Percentage of buffer space allocated to the queue. • **Buffer usec**—Amount of buffer space allocated to the queue, in microseconds. This value is nonzero only if the buffer size is configured in terms of time. • **Priority**—Queue priority: **low** or **high**. • **Limit**—Displayed if rate limiting is configured for the queue. Possible values are **none** and **exact**. If **exact** is configured, the queue transmits only up to the configured bandwidth, even if excess bandwidth is available. If **none** is configured, the queue transmits beyond the configured bandwidth if bandwidth is available.	**extensive**
Logical Interface		
Logical interface	Name of the logical interface.	All levels
Index	Index number of the logical interface, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP interface index number for the logical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Flags	Information about the logical interface.	All levels
Encapsulation	Encapsulation on the logical interface.	All levels
Protocol	Protocol family.	**detail extensive** none
Traffic statistics	Number and rate of bytes and packets received (input) and transmitted (output) on the specified interface.	**detail extensive**
IPv6 transit statistics	If IPv6 statics tracking is enabled, number of IPv6 bytes and packets received and transmitted on the logical interface.	**extensive**
Local statistics	Number and rate of bytes and packets destined to and from the switch.	**extensive**
Transit statistics	Number and rate of bytes and packets transiting the switch.	**extensive**
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Route Table	Route table in which the logical interface address is located. For example, **0** refers to the routing table inet.0.	**detail extensive** none

Table 198: show interfaces xe Output Fields *(continued)*

Field Name	Field Description	Level of Output
Input Filters	Names of any input filters applied to this interface.	**detail extensive**
Output Filters	Names of any output filters applied to this interface.	**detail extensive**
Flags	Information about protocol family flags. If unicast Reverse Path Forwarding (uRPF) is explicitly configured on the specified interface, the uRPF flag appears. If uRPF was configured on a different interface (and therefore is enabled on all switch interfaces) but was not explicitly configured on the specified interface, the uRPF flag does not appear even though uRPF is enabled.	**detail extensive**
Addresses, Flags	Information about the address flags.	**detail extensive** none
protocol-family	Protocol family configured on the logical interface. If the protocol is **inet**, the IP address of the interface is also displayed.	**brief**
Flags	Information about the address flag.	**detail extensive** none
Destination	IP address of the remote side of the connection.	**detail extensive** none
Local	IP address of the logical interface.	**detail extensive** none
Broadcast	Broadcast address of the logical interlace.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**

Sample Output

show interfaces

```
user@switch> show interfaces xe-0/0/1
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Flow control: Disabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 12 supported, 12 maximum usable queues
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
  Last flapped   : 2011-06-01 00:42:03 PDT (00:02:42 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Active alarms  : None
  Active defects : None

  Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Input packets : 0
```



```
    Output packets: 0
    Protocol eth-switch, MTU: 0
      Flags: Trunk-Mode
```

show interfaces (Asymmetric Flow Control)

```
user@switch> show interfaces xe-0/0/1
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Configured-flow-control  tx-buffers: off  rx-buffers: on
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 12 supported, 12 maximum usable queues
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
  Last flapped   : 2011-06-01 00:42:03 PDT (00:02:42 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Active alarms  : None
  Active defects : None

  Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Input packets : 0
    Output packets: 0
    Protocol eth-switch, MTU: 0
      Flags: Trunk-Mode
```

show interfaces brief

```
user@switch> show interfaces xe-0/0/1 brief
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Link-level type: Ethernet, MTU: 1514, Speed: 1000mbps, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None

  Logical interface xe-0/0/1.0
    Flags: SNMP-Traps Encapsulation: ENET2
    eth-switch
```

show interfaces detail

```
user@switch> show interfaces xe-0/0/1 detail
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591, Generation: 169
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Flow control: Disabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 12 supported, 12 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
```



```
Last flapped   : 2011-06-01 00:42:03 PDT (00:02:50 ago)
Statistics last cleared: 2011-06-01 00:44:39 PDT (00:00:14 ago)
Traffic statistics:
 Input  bytes  :                   0                    0 bps
 Output bytes  :                   0                    0 bps
 Input  packets:                   0                    0 pps
 Output packets:                   0                    0 pps
 IPv6 transit statistics:
  Input  bytes  :                  0
  Output bytes  :                  0
  Input  packets:                  0
  Output packets:                  0
Egress queues: 12 supported, 9 in use
Queue counters:       Queued packets  Transmitted packets      Dropped packets

  0 best-effort                  0                    0                    0

  1 fc7                          0                    0                    0

  2 no-loss                      0                    0                    0

  3 fcoe                         0                    0                    0

  4 fc4                          0                    0                    0

  5 fc5                          0                    0                    0

  6 fc6                          0                    0                    0

  7 network-cont                 0                    0                    0

  8 mcast                        0                    0                    0

Queue number:         Mapped forwarding classes
  0                   best-effort
  1                   fc7
  2                   no-loss
  3                   fcoe
  4                   fc4
  5                   fc5
  6                   fc6
  7                   network-control
  8                   mcast
Active alarms  : None
Active defects : None

Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523) (Generation 143)
  Flags: SNMP-Traps 0x0 Encapsulation: ENET2
  Traffic statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Local statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Transit statistics:
   Input  bytes  :                   0                    0 bps
   Output bytes  :                   0                    0 bps
```



```
    Input  packets:                    0                    0 pps
    Output packets:                    0                    0 pps
  Protocol eth-switch, MTU: 0, Generation: 170, Route table: 0
    Flags: Trunk-Mode
```

show interfaces detail (Asymmetric Flow Control)

```
user@switch> show interfaces xe-0/0/1 detail
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591, Generation: 169
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Configured-flow-control  tx-buffers: off  rx-buffers: on
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 12 supported, 12 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
  Last flapped   : 2011-06-01 00:42:03 PDT (00:02:50 ago)
  Statistics last cleared: 2011-06-01 00:44:39 PDT (00:00:14 ago)
  Traffic statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :                    0                    0 bps
   Input  packets:                    0                    0 pps
   Output packets:                    0                    0 pps
   IPv6 transit statistics:
    Input  bytes  :                   0
    Output bytes  :                   0
    Input  packets:                   0
    Output packets:                   0
  Egress queues: 12 supported, 9 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 best-effort                    0                    0                    0

    1 fc7                            0                    0                    0

    2 no-loss                        0                    0                    0

    3 fcoe                           0                    0                    0

    4 fc4                            0                    0                    0

    5 fc5                            0                    0                    0

    6 fc6                            0                    0                    0

    7 network-cont                   0                    0                    0

    8 mcast                          0                    0                    0

  Queue number:         Mapped forwarding classes
    0                   best-effort
    1                   fc7
    2                   no-loss
    3                   fcoe
    4                   fc4
    5                   fc5
    6                   fc6
```



```
    7                   network-control
    8                   mcast
  Active alarms  : None
  Active defects : None

  Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523) (Generation 143)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Local statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Transit statistics:
     Input  bytes  :                    0                    0 bps
     Output bytes  :                    0                    0 bps
     Input  packets:                    0                    0 pps
     Output packets:                    0                    0 pps
    Protocol eth-switch, MTU: 0, Generation: 170, Route table: 0
      Flags: Trunk-Mode
```

show interfaces extensive

```
user@switch> show interfaces xe-0/0/1 extensive
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591, Generation: 169
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Flow control: Disabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 12 supported, 12 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
  Last flapped   : 2011-06-01 00:42:03 PDT (00:03:08 ago)
  Statistics last cleared: 2011-06-01 00:44:39 PDT (00:00:32 ago)
  Traffic statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :                    0                    0 bps
   Input  packets:                    0                    0 pps
   Output packets:                    0                    0 pps
   IPv6 transit statistics:
    Input  bytes  :                   0
    Output bytes  :                   0
    Input  packets:                   0
    Output packets:                   0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
 FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
  Egress queues: 12 supported, 9 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets
```



```
  0 best-effort                0                    0                    0

  1 fc7                        0                    0                    0

  2 no-loss                    0                    0                    0

  3 fcoe                       0                    0                    0

  4 fc4                        0                    0                    0

  5 fc5                        0                    0                    0

  6 fc6                        0                    0                    0

  7 network-cont               0                    0                    0

  8 mcast                      0                    0                    0

Queue number:         Mapped forwarding classes
  0                   best-effort
  1                   fc7
  2                   no-loss
  3                   fcoe
  4                   fc4
  5                   fc5
  6                   fc6
  7                   network-control
  8                   mcast
Active alarms  : None
Active defects : None
MAC statistics:                      Receive         Transmit
  Total octets                             0                0
  Total packets                            0                0
  Unicast packets                          0                0
  Broadcast packets                        0                0
  Multicast packets                        0                0
  CRC/Align errors                         0                0
  FIFO errors                              0                0
  MAC control frames                       0                0
  MAC pause frames                         0                0
  Oversized frames                         0
  Jabber frames                            0
  Fragment frames                          0
  VLAN tagged frames                       0
  Code violations                          0
MAC Priority Flow Control Statistics:
  Prioity :  0                             0                0
  Prioity :  1                             0                0
  Prioity :  2                             0                0
  Prioity :  3                             0                0
  Prioity :  4                             0                0
  Prioity :  5                             0                0
  Prioity :  6                             0                0
  Prioity :  7                             0                0
Filter statistics:
  Input packet count                       0
  Input packet rejects                     0
  Input DA rejects                         0
  Input SA rejects                         0
  Output packet count                                       0
```



```
    Output packet pad count                                   0
    Output packet error count                                 0
    CAM destination filters: 1, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                             %            bps     %            usec
    0 best-effort           75     7500000000    75               0       low
none
    7 network-control        5      500000000     5               0       low
none
    8 mcast                 20     2000000000    20               0       low
none

  Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523) (Generation 143)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                  0
     Output bytes  :                  0
     Input  packets:                  0
     Output packets:                  0
    Local statistics:
     Input  bytes  :                  0
     Output bytes  :                  0
     Input  packets:                  0
     Output packets:                  0
    Transit statistics:
     Input  bytes  :                  0                    0 bps
     Output bytes  :                  0                    0 bps
     Input  packets:                  0                    0 pps
     Output packets:                  0                    0 pps
    Protocol eth-switch, MTU: 0, Generation: 170, Route table: 0
      Flags: Trunk-Mode
```

show interfaces extensive (Asymmetric Flow Control)

```
user@switch> show interfaces xe-0/0/1 extensive
Physical interface: xe-0/0/1, Enabled, Physical link is Up
  Interface index: 49195, SNMP ifIndex: 591, Generation: 169
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None, Loopback: Disabled, Source filtering:
Disabled,
  Configured-flow-control  tx-buffers: off  rx-buffers: on
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 12 supported, 12 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:1d:b5:f7:4e:e1, Hardware address: 00:1d:b5:f7:4e:e1
  Last flapped   : 2011-06-01 00:42:03 PDT (00:03:08 ago)
  Statistics last cleared: 2011-06-01 00:44:39 PDT (00:00:32 ago)
  Traffic statistics:
   Input  bytes  :                  0                    0 bps
   Output bytes  :                  0                    0 bps
   Input  packets:                  0                    0 pps
   Output packets:                  0                    0 pps
   IPv6 transit statistics:
    Input  bytes  :                 0
```



```
    Output bytes  :                  0
    Input  packets:                  0
    Output packets:                  0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
 FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
  Egress queues: 12 supported, 9 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 best-effort                    0                    0                    0

    1 fc7                            0                    0                    0

    2 no-loss                        0                    0                    0

    3 fcoe                           0                    0                    0

    4 fc4                            0                    0                    0

    5 fc5                            0                    0                    0

    6 fc6                            0                    0                    0

    7 network-cont                   0                    0                    0

    8 mcast                          0                    0                    0

  Queue number:         Mapped forwarding classes
    0                   best-effort
    1                   fc7
    2                   no-loss
    3                   fcoe
    4                   fc4
    5                   fc5
    6                   fc6
    7                   network-control
    8                   mcast
  Active alarms  : None
  Active defects : None
  MAC statistics:                      Receive         Transmit
    Total octets                             0                0
    Total packets                            0                0
    Unicast packets                          0                0
    Broadcast packets                        0                0
    Multicast packets                        0                0
    CRC/Align errors                         0                0
    FIFO errors                              0                0
    MAC control frames                       0                0
    MAC pause frames                         0                0
    Oversized frames                         0
    Jabber frames                            0
    Fragment frames                          0
    VLAN tagged frames                       0
    Code violations                          0
  MAC Priority Flow Control Statistics:
    Prioity :  0                             0                0
    Prioity :  1                             0                0
```



```
    Prioity :  2                            0                0
    Prioity :  3                            0                0
    Prioity :  4                            0                0
    Prioity :  5                            0                0
    Prioity :  6                            0                0
    Prioity :  7                            0                0
  Filter statistics:
    Input packet count                      0
    Input packet rejects                    0
    Input DA rejects                        0
    Input SA rejects                        0
    Output packet count                                      0
    Output packet pad count                                  0
    Output packet error count                                0
    CAM destination filters: 1, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth           Buffer Priority   Limit
                              %            bps     %       usec
    0 best-effort            75     7500000000    75          0      low    none
    7 network-control         5      500000000     5          0      low    none
    8 mcast                  20     2000000000    20          0      low    none

  Logical interface xe-0/0/1.0 (Index 73) (SNMP ifIndex 523) (Generation 143)
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Local statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Transit statistics:
     Input  bytes  :                    0                    0 bps
     Output bytes  :                    0                    0 bps
     Input  packets:                    0                    0 pps
     Output packets:                    0                    0 pps
    Protocol eth-switch, MTU: 0, Generation: 170, Route table: 0
      Flags: Trunk-Mode
```

show interfaces terse

```
user@switch> show interfaces xe-0/0/1 terse
Interface               Admin Link Proto    Local                 Remote

xe-0/0/1                up    up
xe-0/0/1.0              up    up   eth-switch
```

show interfaces (QFabric System)

```
user@switch> show interfaces node1:xe-0/0/0
Physical interface: node1:xe-0/0/0, Enabled, Physical link is Down
  Interface index: 129, SNMP ifIndex: 2884086
  Link-level type: Ethernet, MTU: 1514, Speed: 10Gbps, Duplex: Full-Duplex, BPDU
 Error: None, MAC-REWRITE Error: None,
  Loopback: Disabled, Source filtering: Disabled, Flow control: Enabled
```



```
Interface flags: Internal: 0x4000
CoS queues     : 8 supported, 8 maximum usable queues
Current address: 02:00:09:03:00:00, Hardware address: 02:00:09:03:00:00
Last flapped   : Never
Input rate     : 0 bps (0 pps)
Output rate    : 0 bps (0 pps)
```

CHAPTER 26

Troubleshooting

Troubleshooting Procedures

Troubleshooting an Aggregated Ethernet Interface

Problem The **show interfaces terse** command shows that the LAG is down.

Solution Check the following:

- Verify that there is no configuration mismatch.
- Verify that all member ports are up.
- Verify that a LAG is part of family ethernet-switching (Layer 2 LAG) or family inet (Layer 3 LAG).
- Verify that the LAG member is connected to the correct LAG at the other end.
- Verify that the LAG members belong to the same switch.

Related Documentation

- Verifying the Status of a LAG Interface on page 2148
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896

Troubleshooting Multichassis Link Aggregation

Use the following information to troubleshoot multichassis link aggregation configuration.

MAC Addresses Learned on MC-AE Interfaces Are Not Removed from the MAC Address Table

Problem When both of the mulitchassis aggregated Ethernet (MC-AE) interfaces on both connected multichassis link aggregation group (MC-LAG) peers are down, the MAC addresses learned on the MC-AE interfaces are not removed from the MAC address table.

For example, if you disable the MC-AE interface (ae0) on both MC-LAG peers by issuing the **set interfaces ae0 disable** command and commit the configuration, the MAC table still shows the MAC addresses as being learned on the MC-AE interfaces of both MC-LAG peers:

```
user@switchA> show ethernet-switching table
Ethernet-switching table: 6 entries, 2 learned, 0 persistent entries
  VLAN             MAC address       Type         Age Interfaces
  v10               *                 Flood          - All-members
  v10               00:10:94:00:00:01 Learn(L)     3:55 ae0.0 (MCAE)
  v10               00:10:94:00:00:02 Learn(R)        0 xe-0/0/9.0
  v20               *                 Flood          - All-members
  v30               *                 Flood          - All-members
  v30               84:18:88:de:b1:2e Static         - Router


user@switchB> show ethernet-switching table
Ethernet-switching table: 6 entries, 2 learned, 0 persistent entries
  VLAN             MAC address       Type         Age Interfaces
```



```
  v10                 *                 Flood          - All-members
  v10                 00:10:94:00:00:01 Learn(R)        0 ae0.0 (MCAE)
  v10                 00:10:94:00:00:02 Learn         40 xe-0/0/10.0
  v20                 *                 Flood          - All-members
  v30                 *                 Flood          - All-members
  v30                 84:18:88:df:83:0a Static         - Router
```

Solution This is expected behavior.

MC-LAG Peer Does Not Go into Standby Mode

Problem A multichassis link aggregation group (MC-LAG) peer does not go into standby mode if the MC-LAG peer IP address specified in the Interchassis Control Protocol (ICCP) configuration and the IP address specified in the multichassis protection configuration are different.

Solution To prevent failure to enter standby mode, make sure the peer IP address in the ICCP configurations and the IP address in multichassis protection configurations are the same.

Secondary MC-LAG Peer with Status Control Set to Standby Becomes Inactive

Problem When the interchassis control link-protection link (ICL-PL) and multichassis aggregated Ethernet (MC-AE) interfaces go down on the primary multichassis link aggregation group (MC-LAG) peer, the secondary MC-LAG peer's MC-AE interfaces with status control set to standby become inactive instead of active.

Solution This is expected behavior.

Redirect Filters Take Priority over User-Defined Filters

Problem Multichassis link aggregation group (MC-LAG) implicit failover redirection filters take precedence over user-configured explicit filters. This is expected behavior.

Solution This is expected behavior.

Operational Command Output Is Wrong

Problem After you deactivate the Interchassis Control Protocol (ICCP), the **show iccp** operational command output still shows registered client daemons, such as mcsnoopd, lacpd, and eswd.

For example:

```
user@switch> show iccp
Client Application: MCSNOOPD
  Redundancy Group IDs Joined: None

Client Application: lacpd
  Redundancy Group IDs Joined: 1
```

```
Client Application: eswd
  Redundancy Group IDs Joined: 1
```

The **show iccp** command output always shows registered modules regardless of whether or not ICCP peers are configured.

Solution This is expected behavior.

ICCP Connection Might Take Up to 60 Seconds to Become Active

Problem When the Interchassis Control Protocol (ICCP) configuration and the routed VLAN interface (RVI) configuration are committed together, the ICCP connection might take up to 60 seconds to become active.

Solution This is expected behavior.

MAC Address Age Learned on an MC-AE Interface Is Reset to Zero

Problem When you activate and then deactivate an interchassis control link-protection link (ICL-PL), the MAC address age learned on the multichassis aggregated Ethernet (MC-AE) interface is reset to zero. The next-hop interface changes trigger MAC address updates in the hardware, which then triggers aging updates in the Packet Forwarding Engine (PFE). The result is that the MAC address age is updated to zero.

For example, the ICL-PL has been deactivated, and the **show ethernet-switching table** command output shows that the MAC addresses have an age of 0.

```
user@switch> show ethernet-switching table
Ethernet-switching table: 3 entries, 2 learned, 0 persistent entries
  VLAN              MAC address       Type         Age Interfaces
  v100              *                 Flood          - All-members
  v100              00:10:00:00:00:01 Learn(L)     0 ae0.0 (MCAE)
  v100              00:10:00:00:00:02 Learn(L)     0 ae0.0 (MCAE)
```

Solution This is expected behavior.

MAC Address Is Not Learned Remotely in a Default VLAN

Problem If a multichassis link aggregation group (MC-LAG) peer learns a MAC address in the default VLAN, the Interchassis Control Protocol (ICCP) does not synchronize the MAC address with the MAC address of the other MC-LAG peer.

Solution This is expected behavior.

Snooping Entries Learned on MC-AE Interfaces Are Not Removed

Problem When multichassis aggregated Ethernet (MC-AE) interfaces are configured on a VLAN that is enabled for multicast snooping, the membership entries learned on the MC-AE interfaces on the VLAN are not cleared when the MC-AE interfaces go down. This is done to speed up convergence time when the interfaces come up, or come up and go down.

Solution This is expected behavior.

ICCP Does Not Come Up After You Add or Delete an Authentication Key

Problem The Interchassis Control Protocol (ICCP) connection is not established when you add an authentication key and then delete it only at the global ICCP level. However, authentication works correctly at the ICCP peer level.

Solution Delete the ICCP configuration , and then add the ICCP configuration.

Local Status Is Standby When It Should Be Active

Problem If the multichassis aggregated Ethernet (MC-AE) interface is down when the state machine is in a synchronized state, the multichassis link aggregation group (MC-LAG) peer local status is standby. If the MC-AE interface goes down after the state machine is in an active state, then the local status remains active, and the local state indicates that the interface is down.

Solution This is expected behavior.

Packets Loop on the Server When ICCP Fails

Problem When you enable backup liveness detection for a multichassis link aggregation group (MC-LAG), and the backup liveness detection packets are lost because of a temporary failure on the MC-LAG, then both of the peers in the MC-LAG remain active. If this happens, both of the MC-LAG peers send packets to the connected server.

Solution This is expected behavior.

Both MC-LAG Peers Use the Default System ID After a Reboot or an ICCP Configuration Change

Problem After a reboot or after a new Interchassis Control Protocol (ICCP) configuration has been committed, and the ICCP connection does not become active, the Link Aggregation Control Protocol (LACP) messages transmitted over the multichassis aggregated Ethernet (MC-AE) interfaces use the default system ID. The configured system ID is used instead of the default system ID only after the MC-LAG peers synchronize with each other.

Solution This is expected behavior.

No Commit Checks Are Done for ICL-PL Interfaces

Problem There are no commit checks on the interface being configured as an interchassis control link-protection link (ICL-PL), so you must provide a valid interface name for the ICL-PL.

Solution This is expected behavior.

Double Failover Scenario

Problem If the following events happen in this exact order—the Interchassis Control Protocol (ICCP) goes down, and the multichassis aggregated Ethernet (MC-AE) interface on the multichassis link aggregation group (MC-LAG) peer in active mode goes down—a double failover occurs. In this scenario, the MC-LAG peer in standby mode does not detect what happens on the active MC-LAG peer. The MC-LAG peer in standby mode operates as if the MC-AE interface on the MC-LAG in active mode were up and blocks the interchassis control protocol-protection link (ICL-PL) traffic. The ICL-PL traffic is not forwarded.

Solution This is expected behavior.

Multicast Traffic Floods the VLAN When the ICL-PL Interface Goes Down and Up

Problem When the interchassis control link-protection link (ICL-PL) goes down and up, multicast traffic is flooded to all of the interfaces in the VLAN. The Packet Forwarding Engine (PFE) flag Ip4McastFloodMode for the VLAN is changed to MCAST_FLOOD_ALL. This problem only occurs when a multichassis link aggregation group (MC-LAG) is configured for Layer 2.

Solution This is expected behavior.

Layer 3 Traffic Sent to the Standby MC-LAG Peer Is Not Redirected to Active MC-LAG Peer

Problem When the Interchassis Control Protocol (ICCP) is down, the status of a remote MC-LAG peer is unknown. Even if the MC-LAG peer is configured as standby, the traffic is not redirected to this peer because it is assumed that this peer is down.

Solution This is expected behavior.

AE Interfaces Go Down

Problem When a multichassis aggregated Ethernet (MC-AE) interface is converted to an aggregated Ethernet (AE) interface, it retains some MC-AE properties. For example, the AE interface might retain the administrative key of the MC-AE. When this happens, the AE interface goes down.

Solution Restart the Link Aggregation Control Protocol (LACP) on the multichassis link aggregation group (MC-LAG) peer hosting the AE interface to bring up the AE interface. Restarting LACP removes the MC-AE properties of the AE interface.

Flooding of Upstream Traffic

Problem When MAC synchronization is enabled, the multichassis link aggregation group (MC-LAG) peer can resolve Address Resolution Protocol (ARP) entries for the MC-LAG routed VLAN interface (RVI) with either of the MC-LAG peer MAC addresses. If the downstream traffic is sent with one MAC address (MAC1) but the peer has resolved the MAC address with a different MAC address (MAC2), the MAC2 address might not be learned by any of the access layer switches. Flooding of the upstream traffic for the MAC2 address might then occur.

Solution Make sure that downstream traffic is sent from the MC-LAG peers periodically to prevent the MAC addresses from aging out.

Related Documentation

- Understanding Multichassis Link Aggregation on page 1853
- Example: Configuring Multichassis Link Aggregation on page 1904
- Configuring Multichassis Link Aggregation on page 2022

Troubleshooting Network Interfaces

The interface on the port in which an SFP or SFP+ transceiver is installed in an SFP or SFP+ module is down

Problem The QFX Series has an SFP or SFP+ module installed. The interface on the port in which an SFP or SFP+ transceiver is installed is down.

When you check the status with the CLI command **show interfaces** ***interface-name*** , the disabled port is not listed.

Cause By default, the SFP or SFP+ module operates in the 10-Gigabit Ethernet mode and supports only SFP or SFP+ transceivers. The operating mode for the module is incorrectly set.

Solution Only SFP or SFP+ transceivers can be installed in SFP or SFP+ modules. You must configure the operating mode of the SFP or SFP+ module to match the type of transceiver you want to use. For SFP+ transceivers, configure 10-Gigabit Ethernet operating mode.

PART 9

Routing Options

CHAPTER 27

Overview

Routing Options Overview

Overview of Routing Options

In addition to dynamic routing protocols, you can configure static routing on QFX Series switches. You can also configure a variety of protocol-independent routing properties, such as

- Per-packet load balancing (equal cost multipath routing)
- Autonomous system numbers
- Autonomous system confederation members
- Router identifiers
- Routing table groups
- Multicast scoping

Related Documentation

- Understanding Distributed Periodic Packet Management on page 2304
- Understanding Virtual Router Routing Instances on page 2304

Understanding Virtual Router Routing Instances

Virtual router routing instances allow administrators to divide a QFX Series switch into multiple independent virtual routers, each with its own routing table. Virtual router routing instances enable you to isolate traffic without using multiple devices to segment your network. You can create routing instances for unicast routing protocols and PIM sparse mode.

Each virtual router routing instance consists of sets of the following:

- Routing tables
- Interfaces that belong to these routing tables
- Routing protocol configurations
- Routing option configurations

You can use virtual router routing instances to isolate customer traffic on a network and to bind customer-specific routing instances to customer-owned interfaces. Each interface can belong to only one routing instance. QFX 3500 and QFX3600 switches and QFabric systems support as many as 256 virtual router routing instances. QFX 5100 switches support as many as 512 virtual router routing instances.

Related Documentation

- Configuring Virtual Router Routing Instances on page 2313

Understanding Distributed Periodic Packet Management

Periodic packet management (PPM) is responsible for processing a variety of time-sensitive periodic tasks for particular processes so that other processes on the QFX Series can more optimally direct their resources. PPM is responsible for the periodic transmission of packets on behalf of its various client processes, which include the processes that control the Link Aggregation Control Protocol (LACP) and Bidirectional Forwarding Detection (BFD) protocol, and also for receiving packets on behalf of these client processes. PPM also gathers some statistics and sends process-specific packets. PPM cannot be disabled and is always running on any operational switch.

The responsibility for PPM processing on the switch is distributed between the Routing Engine and the access interfaces for all protocols that use PPM by default. This distributed model provides a faster response time for protocols that use PPM than the response time provided by the nondistributed model.

If distributed PPM is disabled, the PPM process runs on the Routing Engine only.

You can disable distributed PPM for all protocols that use PPM. You can also disable distributed PPM for LACP packets only.

BEST PRACTICE: **We generally recommend that you disable distributed PPM only if Juniper Networks Customer Service advises you to do so. You should disable distributed PPM only if you have a compelling reason to disable it.**

Related Documentation

- Configuring Distributed Periodic Packet Management on page 2312

Understanding Bidirectional Forwarding Detection (BFD)

The Bidirectional Forwarding Detection (BFD) protocol is a simple mechanism that detects failures in a network and works in a wide variety of network environments and topologies. In BFD operation, switches exchanges BFD hello packets at a specified interval and detect a neighbor failure if they do not receive a reply after a specified interval. The BFD failure detection timers support shorter time limits than the static route failure detection mechanisms, so they can provide faster detection of failures.

To configure faster failure detection, use lower BFD timer values. The timers can automatically adapt to a higher value if an adjacency fails, and they also adapt to a higher value when a BFD session flap occurs more than three times in a span of 15 seconds. In this case, a back-off algorithm increases the receive interval by two if the local BFD instance is the reason for the session flap and increases the transmission interval by two if the remote BFD instance is the reason for the session flap.

You can use the **clear bfd adaptation** command to return BFD interval timers to their configured values. This command is hitless, meaning that it does not affect traffic flow.

NOTE: QFX switches do not support BFD timer values of less than 1 second.

Related Documentation

- Examples: Configuring BFD for Static Routes on page 2315
- Example: Configuring BFD Authentication for Static Routes on page 2330

Understanding the Unified Forwarding Table

On the QFX5100 switch, you can control the allocation of forwarding table memory available to store the following:

- MAC addresses
- Layer 3 host entries
- Longest prefix match (LPM) table entries

This feature gives you the flexibility to configure your QFX5100 to match the needs of your particular network environment.

You configure the mix that best meets your needs by choosing the appropriate profile. Table 122 on page 1416 lists the profiles you can choose and the associated maximum values for each type of table entry.

Table 199: Unified Forwarding Table Profiles

Profile Name	MAC Table	Host Table (unicast and multicast addresses)						LPM Table	
	MAC Addresses	IPv4 unicast	IPv6 unicast	IPv4 (*, G)	IPv4 (S, G)	IPv6 (*, G)	IPv6 (S, G)	IPv4 Entries	IPv6 Entries (prefix <= 64)
l2-profile-one	288K	16K	8K	8K	8K	4K	4K	16K	8K
l2-profile-two	224K	80K	40K	40K	40K	20K	20K	16K	8K
l2-profile-three (default)	160K	144K	72K	72K	72K	36K	36K	16K	8K
l3-profile	96K	208K	104K	104K	104K	52K	52K	16K	8K
lpm-profile (Do not use for IPv6)	32K	16K	8K	8K	8K	4K	4K	128K	64K

Note that if the host or LPM table stores the maximum number of entries for any given type, the entire shared table is full and is unable to accommodate *any* entries of any other type. As you can see, different entry types occupy different amounts of memory. For example, an IPv6 unicast address occupies twice as much memory as an IPv4 unicast address, and an IPv6 multicast address occupies four times as much memory as an IPv4 unicast address. Table 123 on page 1416 lists various valid combinations that the host table can store if you use the **l2-profile-one** profile. Each row in the table represents a case in which the host table is full and cannot accommodate any more entries.

Table 200: Example Host Table Combinations Using l2-profile-one

IPv4 unicast	IPv6 unicast	IPv4 multicast (*, G)	IPv4 multicast (S, G)	IPv6 multicast (*, G)	IPv6 multicast (S, G)
16K	0	0	0	0	0
12K	2K	0	0	0	0
12K	0	2	2	0	0
8K	4K	0	0	0	0
4K	2K	2	2	0	0
0	4K	0	0	1K	1K

The LPM table is also shared and the same principles apply. Table 124 on page 1417 provides examples of valid combinations that the LPM table can store, also using the **l2-profile-one** profile. Once again, each row in the table represents a case in which the table is full and cannot accommodate any more entries.

Table 201: Example LPM Table Combinations Using l2-profile-one

IPv4 entries	IPv6 Entries (prefix <= 64)
16K	0
0	8K
8K	4K
4K	6K

NOTE: If you want to use more than 16 IPv6 addresses with prefix lengths greater than 64, you must follow the instructions at "Configuring the Unified Forwarding Table" on page 1548. As that topic explains, if you increase the number of addresses with prefix lengths greater than 64, you reduce the amount of LPM-table memory available to store IPv6 addresses with prefixes less than or equal to 64.

Related Documentation

- Configuring the Unified Forwarding Table on page 1548

CHAPTER 28

Configuration

Configuration Tasks

Configuring Static Routing

Static routes are routes that are manually configured and entered into the routing table.

The switch uses static routes:

- When the switch does not have a route to a destination that has a better (lower) *preference* value. The preference is an arbitrary value in the range from 0 through 255 that the software uses to rank routes received from different protocols, interfaces, or remote systems. The routing protocol process generally determines the active route by selecting the route with the lowest preference value. In the given range, **0** is the lowest and **255** is the highest.
- When the switch cannot determine the route to a destination.
- When the switch is forwarding unroutable packets.

To configure basic static route options using the CLI:

- To configure the switch's default gateway:

```
[edit]
user@switch# set routing–options static route 0.0.0.0/0 next-hop 10.0.1.1
```

- To configure a static route and specify the next address to be used when routing traffic to the static route:

```
[edit]
user@switch# set routing-options static route 20.0.0.0/24 next-hop 10.0.0.2.1
```

- To always keep the static route in the forwarding table:

```
[edit]
user@switch# set routing-options static route 20.0.0.0/24 retain
```

- To prevent the static route from being readvertised:

```
[edit]
user@switch# set routing-options static route 20.0.0.0/24 no-readvertise
```

- To remove inactive routes from the forwarding table:

```
[edit]
user@switch# set routing-options static route 20.0.0.0/24 active
```

Related Documentation

- Monitoring Routing Information on page 2441

Configuring Per-Packet Load Balancing

When there are multiple equal-cost paths to the same destination for the active route, Junos OS chooses one of the next-hop addresses to install into the forwarding table in a random fashion by default. Whenever the set of next hops for a destination changes in any way, the next-hop address is chosen again, also in a random fashion.

You can configure Junos OS so that, for the active route, all next-hop addresses for a destination are installed in the forwarding table. This is called per-packet load balancing. You can use this feature to spread traffic across multiple paths.

When per-packet load balancing is configured, traffic is divided into individual flows (up to a maximum of 16). Packets for an individual flow are sent out a single interface. To determine flows, the switch examines each of the following packet fields:

- Source IP address
- Destination IP address
- Protocol
- Source port number
- Destination port number
- Source interface index
- Type of service (ToS)

The switch recognizes packets in which all of these parameters are identical and ensures that these packets are sent out through the same interface. This prevents problems that might otherwise occur with packets arriving at their destination out of their original sequence.

NOTE: Load balancing is not supported on management interfaces.

The following steps shows how to configure per-packet load balancing:

1. Define a load-balancing routing policy by including one or more **policy-statement** statements at the **[edit policy-options]** hierarchy level, defining an action of **load-balance per-packet**:

```
policy-statement policy-name {
  from {
    match-conditions;
    route-filter destination-prefix match-type <actions>;
    prefix-list name;
  }
  then {
    load-balance per-packet;
  }
}
```

2. Apply the policy to routes exported from the routing table to the forwarding table. To do this, include the **forwarding-table** and **export** statements:

```
forwarding-table {
  export policy-name;
}
```

When you enable per-packet load balancing on a QFabric system, packets might be switched across the fabric even though there is a local port with a same-cost route to the destination. For example, if per-packet load balancing is enabled and a packet arrives at network Node device A, it might be switched to network Node device B and forwarded from there even if there is a same-cost route through a port on Node device A to the destination. In this case, traffic transits the fabric needlessly. you can configure a QFabric system to choose a locally switched route if one is available. To enable this feature, include the **ecmp-do-local-lookup** statement at the **[edit forwarding-options]** hierarchy level.

Related Documentation

- Examples: Configuring Per-Packet Load Balancing on page 2315

Configuring Distributed Periodic Packet Management

Periodic packet management (PPM) is responsible for processing a variety of time-sensitive periodic tasks so that other processes on the QFX Series can more optimally direct their resources.

The responsibility for PPM processing on the switch is distributed between the Routing Engine and the access interfaces for all protocols that use PPM by default. This distributed model provides a faster response time for protocols that use PPM than the response time provided by the nondistributed model.

If distributed PPM is disabled, the PPM process runs on the Routing Engine only.

You can disable distributed PPM for all protocols that use PPM. You can also disable distributed PPM for Link Aggregation Control Protocol (LACP) packets only.

BEST PRACTICE: **We generally recommend that you disable distributed PPM only if Juniper Networks Customer Service advises you to do so. You should disable distributed PPM only if you have a compelling reason to disable it.**

This topic describes:

- Disabling or Enabling Distributed Periodic Packet Management Globally on page 2312
- Disabling or Enabling Distributed Periodic Packet Management for LACP Packets on page 2312

Disabling or Enabling Distributed Periodic Packet Management Globally

Distributed PPM is enabled by default. Disable distributed PPM if you need to move all PPM processing to the Routing Engine. Enable distributed PPM if it was previously disabled and you need to run distributed PPM.

To disable distributed PPM:

```
[edit routing-options]
user@switch# set ppm no-delegate-processing
```

To enable distributed PPM if it was previously disabled:

```
[edit routing-options]
user@switch# delete ppm no-delegate-processing
```

Disabling or Enabling Distributed Periodic Packet Management for LACP Packets

Distributed PPM is enabled by default. Disable distributed PPM for only LACP packets if you need to move all PPM processing for LACP packets to the Routing Engine.

To disable distributed PPM for LACP packets:

```
[edit protocols]
user@switch# set lacp ppm centralized
```

To enable distributed PPM for LACP packets if it was previously disabled:

```
[edit protocols]
user@switch# delete lacp ppm centralized
```

Related Documentation

- Understanding Distributed Periodic Packet Management on page 2304
- Understanding Aggregated Ethernet Interfaces and LACP on page 1843

Configuring Virtual Router Routing Instances

Use virtual router routing instances to divide a QFX Series switch into multiple independent virtual routers, each with its own routing table. Virtual router routing instances enable you to isolate traffic without using multiple devices to segment your network. You can create routing instances for unicast routing protocols and PIM sparse mode.

To configure virtual router routing instances:

1. Create a routing instance:

   ```
   [edit routing-instances]user@switch# set routing-instance-name instance-type virtual-router
   ```

   NOTE: The default routing instance, master, refers to the main inet.0 routing table. The master routing instance is reserved and cannot be specified as a routing instance.

2. Bind each routing instance to the corresponding interfaces:

   ```
   [edit routing-instances]user@switch# set routing-instance-name interface
   device-name:type-fpc/pic/port.logical-unit-number
   ```

   NOTE:
   - You must bind routing instances to interfaces from the Node devices assigned to the network Node group only. If you try to bind routing instances to interfaces from the Node devices assigned to server Node groups, the configuration does not commit.
   - You can bind an interface to one routing instance only.

3. Create each of the logical interfaces bound to each routing instance:

   ```
   [edit interfaces]user@switch# set device-name:type-fpc/pic/port unit logical-unit-number
   family inet address ip-address
   ```

   NOTE: Do not create a logical interface using the family ethernet-switching option in this step. Binding an interface using the family ethernet-switching option to a routing instance can cause the interface to shut down.

4. (Optional) Configure routing protocols for the routing instance at the **[edit routing-instances *routing-instance-name* protocols]** hierarchy level.
5. (Optional) Configure routing options for the routing instance at the **[edit routing-instances *routing-instance-name* routing-options]** hierarchy level.

Related Documentation

- Understanding Virtual Router Routing Instances on page 2304
- *Understanding Interfaces on the QFabric System*
- *Understanding Node Groups*
- Verifying That Virtual Router Routing Instances Are Working on page 2442

Configuring the Unified Forwarding Table

On the QFX5100 switch, you can control the allocation of memory available to store the following:

- MAC addresses
- Layer 3 host entries
- Longest prefix match table entries

You configure the mix that best meets your needs by choosing the appropriate profile. Table 135 on page 1548 lists the profiles you can choose and the associated values for each type of entry.

Table 202: Unified Forwarding Table Profiles

Profile Name	Maximum Number of MAC Addresses	Maximum Number of Layer 3 Hosts	Maximum Number of LPM Table Entries
l2-profile-one	288K	16K	16K
l2-profile-two	224K	80K	16K
l2-profile-three	160K	144K	16K
l3-profile	96K	120K	16K
lpm-profile	32K	208K	128K

To configure the profile that you want, enter and commit the following statement:

```
[edit]
user@switch# set forwarding–options chassis profile-name
```

The settings for **l2-profile-three** are configured by default. That is, if you do not enter a **set forwarding–options chassis *profile-name*** statement, these settings are configured.

Related Documentation

-

Configuration Examples

Examples: Configuring Per-Packet Load Balancing

Perform per-packet load balancing for all routes:

```
[edit]
policy-options {
  policy-statement load-balancing-policy {
    then {
      load-balance per-packet;
    }
  }
}
routing-options {
  forwarding-table {
    export load-balancing-policy;
  }
}
```

Perform per-packet load balancing for a limited set of routes:

```
[edit]
policy-options {
  policy-statement load-balancing-policy {
    from {
      route-filter 192.168.10/24 orlonger;
      route-filter 9.114/16 orlonger;
    }
    then {
      load-balance per-packet;
    }
  }
}
routing-options {
  forwarding-table {
    export load-balancing-policy;
  }
}
```

Related Documentation

- Configuring Per-Packet Load Balancing on page 2310

Examples: Configuring BFD for Static Routes

Understanding BFD for Static Routes

The Bidirectional Forwarding Detection (BFD) protocol is a simple hello mechanism that detects failures in a network. BFD works with a wide variety of network environments and topologies. A pair of routing devices exchanges BFD packets. Hello packets are sent at a specified, regular interval. A neighbor failure is detected when the routing device stops receiving a reply after a specified interval. The BFD failure detection timers have shorter time limits than the static route failure detection mechanisms, so they provide faster detection.

The BFD failure detection timers are adaptive and can be adjusted to be faster or slower. The lower the BFD failure detection timer value, the faster the failure detection and vice versa. For example, the timers can adapt to a higher value if the adjacency fails (that is, the timer detects failures more slowly). Or a neighbor can negotiate a higher value for a timer than the configured value. The timers adapt to a higher value when a BFD session flap occurs more than three times in a span of 15 seconds. A back-off algorithm increases the receive (Rx) interval by two if the local BFD instance is the reason for the session flap. The transmission (Tx) interval is increased by two if the remote BFD instance is the reason for the session flap. You can use the **clear bfd adaptation** command to return BFD interval timers to their configured values. The **clear bfd adaptation** command is hitless, meaning that the command does not affect traffic flow on the routing device.

By default, BFD is supported on single-hop static routes. In Junos OS Release 8.2 and later, BFD also supports multihop static routes.

To enable failure detection, include the bfd-liveness-detection statement in the static route configuration.

In Junos OS Release 9.1 and later, the BFD protocol is supported for IPv6 static routes. Global unicast and link-local IPv6 addresses are supported for static routes. The BFD protocol is not supported on multicast or anycast IPv6 addresses. For IPv6, the BFD protocol supports only static routes and only in Junos OS Release 9.3 and later. IPv6 for BFD is not supported for any other protocol.

To configure the BFD protocol for IPv6 static routes, include the **bfd-liveness-detection** statement at the **[edit routing-options rib inet6.0 static route *destination-prefix*]** hierarchy level.

In Junos OS Release 8.5 and later, you can configure a hold-down interval to specify how long the BFD session must remain up before a state change notification is sent.

To specify the hold-down interval, include the **holddown-interval** statement in the BFD configuration.

You can configure a number in the range from 0 through 255,000 milliseconds. The default is 0. If the BFD session goes down and then comes back up during the hold-down interval, the timer is restarted.

NOTE: If a single BFD session includes multiple static routes, the hold-down interval with the highest value is used.

To specify the minimum transmit and receive intervals for failure detection, include the **minimum-interval** statement in the BFD configuration.

This value represents both the minimum interval after which the local routing device transmits hello packets and the minimum interval after which the routing device expects to receive a reply from the neighbor with which it has established a BFD session. You can configure a number in the range from 1 through 255,000 milliseconds. Optionally, instead of using this statement, you can configure the minimum transmit and receive intervals separately using the **transmit-interval minimum-interval** and **minimum-receive-interval** statements.

NOTE: BFD is an intensive protocol that consumes system resources. Specifying a minimum interval for BFD of less than 100 ms for Routing Engine-based sessions and 10 ms for distributed BFD sessions can cause undesired BFD flapping.

Depending on your network environment, these additional recommendations might apply:

- For large-scale network deployments with a large number of BFD sessions, specify a minimum interval of 300 ms for Routing Engine-based sessions and 100 ms for distributed BFD sessions.
- For very large-scale network deployments with a large number of BFD sessions, contact Juniper Networks customer support for more information.
- For BFD sessions to remain up during a Routing Engine switchover event when nonstop active routing (NSR) is configured, specify a minimum interval of 2500 ms for Routing Engine-based sessions. For distributed BFD sessions with NSR configured, the minimum interval recommendations are unchanged and depend only on your network deployment.

NOTE: SRX Series devices do not support distributed BFD.

To specify the minimum receive interval for failure detection, include the **minimum-receive-interval** statement in the BFD configuration. This value represents the minimum interval after which the routing device expects to receive a reply from a neighbor with which it has established a BFD session. You can configure a number in the range from 1 through 255,000 milliseconds. Optionally, instead of using this statement, you can configure the minimum receive interval using the **minimum-interval** statement at the **[edit routing-options static route *destination-prefix* bfd-liveness-detection]** hierarchy level.

To specify the number of hello packets not received by the neighbor that causes the originating interface to be declared down, include the **multiplier** statement in the BFD configuration.

The default value is 3. You can configure a number in the range from 1 through 255.

To specify a threshold for detecting the adaptation of the detection time, include the **threshold** statement in the BFD configuration.

When the BFD session detection time adapts to a value equal to or higher than the threshold, a single trap and a system log message are sent. The detection time is based on the multiplier of the **minimum-interval** or the **minimum-receive-interval** value. The threshold must be a higher value than the multiplier for either of these configured values. For example if the **minimum-receive-interval** is 300 ms and the **multiplier** is 3, the total detection time is 900 ms. Therefore, the detection time threshold must have a value higher than 900.

To specify the minimum transmit interval for failure detection, include the **transmit-interval minimum-interval** statement in the BFD configuration.

This value represents the minimum interval after which the local routing device transmits hello packets to the neighbor with which it has established a BFD session. You can configure a value in the range from 1 through 255,000 milliseconds. Optionally, instead of using this statement, you can configure the minimum transmit interval using the **minimum-interval** statement at the **[edit routing-options static route *destination-prefix* bfd-liveness-detection]** hierarchy level.

To specify the threshold for the adaptation of the transmit interval, include the **transmit-interval threshold** statement in the BFD configuration.

The threshold value must be greater than the transmit interval. When the BFD session transmit time adapts to a value greater than the threshold, a single trap and a system log message are sent. The detection time is based on the multiplier of the value for the **minimum-interval** or the **minimum-receive-interval** statement at the **[edit routing-options static route *destination-prefix* bfd-liveness-detection]** hierarchy level. The threshold must be a higher value than the multiplier for either of these configured values.

To specify the BFD version, include the **version** statement in the BFD configuration. The default is to have the version detected automatically.

To include an IP address for the next hop of the BFD session, include the **neighbor** statement in the BFD configuration.

NOTE: You must configure the **neighbor** statement if the next hop specified is an interface name. If you specify an IP address as the next hop, that address is used as the neighbor address for the BFD session.

In Junos OS Release 9.0 and later, you can configure BFD sessions not to adapt to changing network conditions.

To disable BFD adaptation, include the **no-adaptation** statement in the BFD configuration.

NOTE: We recommend that you not disable BFD adaptation unless it is preferable not to have BFD adaptation in your network.

NOTE: If BFD is configured only on one end of a static route, the route is removed from the routing table. BFD establishes a session when BFD is configured on both ends of the static route.

BFD is not supported on ISO address families in static routes. BFD does support IS-IS.

If you configure graceful Routing Engine switchover (GRES) at the same time as BFD, GRES does not preserve the BFD state information during a failover.

Junos OS also supports BFD over multihop static routes. For example, you can configure BFD over a Layer 3 path to provide path integrity over that path. You can limit the number of hops by specifying the time to live (TTL).

To configure BFD over multihop static routes, include the following statements:

```
static route destination-prefix {
  bfd-liveness-detection {
    local-address ip-address;
    minimum-receive-ttl number;
  }
}
```

To specify the source address for the multihop static route and to enable multihop BFD support, include the **local-address** statement.

To specify the number of hops, include the **minimum-receive-ttl** statement. You must configure this statement for a multihop BFD session. You can configure a value in the range from 1 through 255. It is optional for a single-hop BFD session. If you configure the **minimum-receive-ttl** statement for a single-hop session, the value must be 255.

On M Series and T Series platforms only, starting in Junos OS Release 12.3, multihop BFD runs on the CPU in the FPC, DPC, or MPC. This is referred to as *distributed BFD*. Previously, multihop BFD ran from the Routing Engine.

Example: Configuring BFD for Static Routes

This example shows how to configure Bidirectional Forwarding Detection (BFD) for static routes.

- Requirements on page 2319
- Overview on page 2320
- Configuration on page 2320
- Verification on page 2323

Requirements

In this example, no special configuration beyond device initialization is required.

Overview

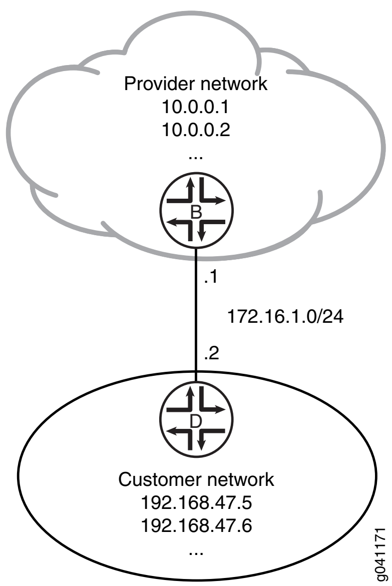
There are many practical applications for static routes. Static routing is often used at the network edge to support attachment to stub networks, which, given their single point of entry and egress, are well suited to the simplicity of a static route. In Junos OS, static routes have a global preference of 5. Static routes are activated if the specified next hop is reachable.

In this example, you configure the static route 192.168.47.0/24 from the provider network to the customer network, using the next-hop address of 172.16.1.2. You also configure a static default route of 0.0.0.0/0 from the customer network to the provider network, using a next-hop address of 172.16.1.1.

For demonstration purposes, some loopback interfaces are configured on Device B and Device D. These loopback interfaces provide addresses to ping and thus verify that the static routes are working.

Figure 33 on page 2320 shows the sample network.

Figure 33: Customer Routes Connected to a Service Provider



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device B

```
set interfaces ge-1/2/0 unit 0 description B->D
set interfaces ge-1/2/0 unit 0 family inet address 172.16.1.1/24
set interfaces lo0 unit 57 family inet address 10.0.0.1/32
set interfaces lo0 unit 57 family inet address 10.0.0.2/32
set routing-options static route 192.168.47.0/24 next-hop 172.16.1.2
```

set routing-options static route 192.168.47.0/24 bfd-liveness-detection minimum-interval 1000
set protocols bfd traceoptions file bfd-trace
set protocols bfd traceoptions flag all

Device D

set interfaces ge-1/2/0 unit 1 description D->B
set interfaces ge-1/2/0 unit 1 family inet address 172.16.1.2/24
set interfaces lo0 unit 2 family inet address 192.168.47.5/32
set interfaces lo0 unit 2 family inet address 192.168.47.6/32
set routing-options static route 0.0.0.0/0 next-hop 172.16.1.1
set routing-options static route 0.0.0.0/0 bfd-liveness-detection minimum-interval 1000
set protocols bfd traceoptions file bfd-trace
set protocols bfd traceoptions flag all

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure BFD for static routes:

1. On Device B, configure the interfaces.

   [edit interfaces]
   user@B# **set ge-1/2/0 unit 0 description B->D**
   user@B# **set ge-1/2/0 unit 0 family inet address 172.16.1.1/24**
   user@B# **set lo0 unit 57 family inet address 10.0.0.1/32**
   user@B# **set lo0 unit 57 family inet address 10.0.0.2/32**

2. On Device B, create a static route and set the next-hop address.

   [edit routing-options]
   user@B# **set static route 192.168.47.0/24 next-hop 172.16.1.2**

3. On Device B, configure BFD for the static route.

   [edit routing-options]
   user@B# **set static route 192.168.47.0/24 bfd-liveness-detection minimum-interval 1000**

4. On Device B, configure tracing operations for BFD.

   [edit protocols]
   user@B# **set bfd traceoptions file bfd-trace**
   user@B# **set bfd traceoptions flag all**

5. If you are done configuring Device B, commit the configuration.

   [edit]
   user@B# **commit**

6. On Device D, configure the interfaces.

   [edit interfaces]
   user@D# **set ge-1/2/0 unit 1 description D->B**
   user@D# **set ge-1/2/0 unit 1 family inet address 172.16.1.2/24**
   user@D# **set lo0 unit 2 family inet address 192.168.47.5/32**
   user@D# **set lo0 unit 2 family inet address 192.168.47.6/32**

7. On Device D, create a static route and set the next-hop address.

```
[edit routing-options]
user@D# set static route 0.0.0.0/0 next-hop 172.16.1.1
```

8. On Device D, configure BFD for the static route.

```
[edit routing-options]
user@D# set static route 0.0.0.0/0 bfd-liveness-detection minimum-interval 1000
```

9. On Device D, configure tracing operations for BFD.

```
[edit protocols]
user@D# set bfd traceoptions file bfd-trace
user@D# set bfd traceoptions flag all
```

10. If you are done configuring Device D, commit the configuration.

```
[edit]
user@D# commit
```

Results

Confirm your configuration by issuing the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Device B

```
user@B# show interfaces
ge-1/2/0 {
  unit 0 {
    description B->D;
    family inet {
      address 172.16.1.1/24;
    }
  }
}
lo0 {
  unit 57 {
    family inet {
      address 10.0.0.1/32;
      address 10.0.0.2/32;
    }
  }
}

user@D# show protocols
bfd {
  traceoptions {
    file bfd-trace;
    flag all;
  }
}

user@B# show routing-options
static {
  route 192.168.47.0/24 {
    next-hop 172.16.1.2;
    bfd-liveness-detection {
      minimum-interval 1000;
    }
```

```
  }
}
```

Device D

```
user@D# show interfaces
ge-1/2/0 {
  unit 1 {
    description D->B;
    family inet {
      address 172.16.1.2/24;
    }
  }
}
lo0 {
  unit 2 {
    family inet {
      address 192.168.47.5/32;
      address 192.168.47.6/32;
    }
  }
}
```

```
user@D# show routing-options
static {
  route 0.0.0.0/0 {
    next-hop 172.16.1.1;
    bfd-liveness-detection {
      minimum-interval 1000;
    }
  }
}
```

Verification

Confirm that the configuration is working properly.

- Verifying That BFD Sessions Are Up on page 2323
- Viewing Detailed BFD Events on page 2324

Verifying That BFD Sessions Are Up

Purpose Verify that the BFD sessions are up, and view details about the BFD sessions.

Action From operational mode, enter the **show bfd session extensive** command.

```
user@B> show bfd session extensive
                                                  Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
172.16.1.2               Up        lt-1/2/0.0     3.000     1.000        3
 Client Static, TX interval 1.000, RX interval 1.000
 Session up time 00:14:30
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 Replicated, routing table index 172
 Min async interval 1.000, min slow interval 1.000
 Adaptive async TX interval 1.000, RX interval 1.000
 Local min TX interval 1.000, minimum RX interval 1.000, multiplier 3
 Remote min TX interval 1.000, min RX interval 1.000, multiplier 3
```



```
 Local discriminator 2, remote discriminator 1
 Echo mode disabled/inactive

1 sessions, 1 clients
Cumulative transmit rate 1.0 pps, cumulative receive rate 1.0 pps
```

```
user@D> show bfd session extensive
                                                 Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
172.16.1.1               Up        lt-1/2/0.1     3.000     1.000       3
 Client Static, TX interval 1.000, RX interval 1.000
 Session up time 00:14:35
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 Replicated, routing table index 170
 Min async interval 1.000, min slow interval 1.000
 Adaptive async TX interval 1.000, RX interval 1.000
 Local min TX interval 1.000, minimum RX interval 1.000, multiplier 3
 Remote min TX interval 1.000, min RX interval 1.000, multiplier 3
 Local discriminator 1, remote discriminator 2
 Echo mode disabled/inactive

1 sessions, 1 clients
Cumulative transmit rate 1.0 pps, cumulative receive rate 1.0 pps
```

Meaning The **TX interval 1.000, RX interval 1.000** output represents the setting configured with the **minimum-interval** statement. All of the other output represents the default settings for BFD. To modify the default settings, include the optional statements under the bfd-liveness-detection statement.

Viewing Detailed BFD Events

Purpose View the contents of the BFD trace file to assist in troubleshooting, if needed.

Action From operational mode, enter the **file show /var/log/bfd-trace** command.

```
user@B> file show /var/log/bfd-trace
Nov 23 14:26:55    Data (9) len 35: (hex) 42 46 44 20 70 65 72 69 6f 64 69 63 20
 78 6d 69 74 20 72
Nov 23 14:26:55 PPM Trace: BFD periodic xmit rt tbl index 172
Nov 23 14:26:55 Received Downstream TraceMsg (22) len 108:
Nov 23 14:26:55    IfIndex (3) len 4: 0
Nov 23 14:26:55    Protocol (1) len 1: BFD
Nov 23 14:26:55    Data (9) len 83: (hex) 70 70 6d 64 5f 62 66 64 5f 73 65 6e 64
 6d 73 67 20 3a 20
Nov 23 14:26:55 PPM Trace: ppmd_bfd_sendmsg : socket 12 len 24, ifl 78 src
172.16.1.1 dst 172.16.1.2 errno 65
Nov 23 14:26:55 Received Downstream TraceMsg (22) len 93:
Nov 23 14:26:55    IfIndex (3) len 4: 0
Nov 23 14:26:55    Protocol (1) len 1: BFD
Nov 23 14:26:55    Data (9) len 68: (hex) 42 46 44 20 70 65 72 69 6f 64 69 63 20
 78 6d 69 74 20 74
```

Meaning BFD messages are being written to the trace file.

Example: Enabling BFD on Qualified Next Hops in Static Routes

This example shows how to configure a static route with multiple possible next hops. Each next hop has Bidirectional Forwarding Detection (BFD) enabled.

Requirements

In this example, no special configuration beyond device initialization is required.

Overview

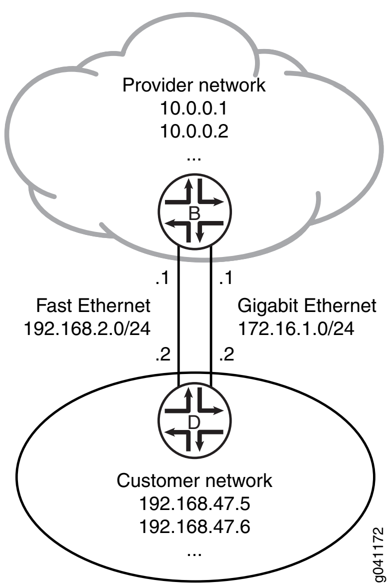
In this example, Device B has the static route **192.168.47.0/24** with two possible next hops. The two next hops are defined using two **qualified-next-hop** statements. Each next hop has BFD enabled.

BFD is also enabled on Device D because BFD must be enabled on both ends of the connection.

A next hop is included in the routing table if the BFD session is up. The next hop is removed from the routing table if the BFD session is down.

See Figure 34 on page 2325.

Figure 34: BFD Enabled on Qualified Next Hops



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network

configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device B

```
set interfaces fe-0/1/0 unit 2 description secondary-B->D
set interfaces fe-0/1/0 unit 2 family inet address 192.168.2.1/24
set interfaces ge-1/2/0 unit 0 description B->D
set interfaces ge-1/2/0 unit 0 family inet address 172.16.1.1/24
set routing-options static route 192.168.47.0/24 qualified-next-hop 192.168.2.2
  bfd-liveness-detection minimum-interval 60
set routing-options static route 192.168.47.0/24 qualified-next-hop 172.16.1.2
  bfd-liveness-detection minimum-interval 60
```

Device D

```
set interfaces fe-0/1/0 unit 3 description secondary-D->B
set interfaces fe-0/1/0 unit 3 family inet address 192.168.2.2/24
set interfaces ge-1/2/0 unit 1 description D->B
set interfaces ge-1/2/0 unit 1 family inet address 172.16.1.2/24
set routing-options static route 0.0.0.0/0 qualified-next-hop 192.168.2.1
set routing-options static route 0.0.0.0/0 qualified-next-hop 172.16.1.1
set routing-options static route 0.0.0.0/0 bfd-liveness-detection minimum-interval 60
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure a static route with two possible next hops, both with BFD enabled:

1. On Device B, configure the interfaces.

   ```
   [edit interfaces fe-0/1/0]
   user@B# set unit 2 description secondary-B->D
   user@B# set unit 2 family inet address 192.168.2.1/24

   [edit interfaces ge-1/2/0]
   user@B# set unit 0 description B->D
   user@B# set unit 0 family inet address 172.16.1.1/24
   ```

2. On Device B, configure the static route with two next hops, both with BFD enabled.

   ```
   [edit routing-options static route 192.168.47.0/24]
   user@B# set qualified-next-hop 192.168.2.2 bfd-liveness-detection minimum-interval
     60
   user@B# set qualified-next-hop 172.16.1.2 bfd-liveness-detection minimum-interval
     60
   ```

3. On Device D, configure the interfaces.

   ```
   [edit interfaces fe-0/1/0]
   user@D# set unit 3 description secondary-D->B
   user@D# set unit 3 family inet address 192.168.2.2/24

   [edit interfaces ge-1/2/0]
   user@D# set unit 1 description D->B
   user@D# set unit 1 family inet address 172.16.1.2/24
   ```

4. On Device D, configure a BFD-enabled default static route with two next hops to the provider network.

In this case, BFD is enabled on the route, not on the next hops.

```
[edit routing-options static route 0.0.0.0/0]
user@D# set qualified-next-hop 192.168.2.1
user@D# set qualified-next-hop 172.16.1.1
user@D# set bfd-liveness-detection minimum-interval 60
```

Results Confirm your configuration by issuing the **show interfaces** and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@B# show interfaces
fe-0/1/0 {
  unit 2 {
    description secondary-B->D;
    family inet {
      address 192.168.2.1/24;
    }
  }
}
ge-1/2/0 {
  unit 0 {
    description B->D;
    family inet {
      address 172.16.1.1/24;
    }
  }
}
```

```
user@B# show routing-options
static {
  route 192.168.47.0/24 {
    qualified-next-hop 192.168.2.2 {
      bfd-liveness-detection {
        minimum-interval 60;
      }
    }
    qualified-next-hop 172.16.1.2 {
      bfd-liveness-detection {
        minimum-interval 60;
      }
    }
  }
}
```

```
user@D# show interfaces
fe-0/1/0 {
  unit 3 {
    description secondary-D->B;
    family inet {
      address 192.168.2.2/24;
    }
  }
}
ge-1/2/0 {
  unit 1 {
```

```
            description D->B;
            family inet {
                address 172.16.1.2/24;
            }
        }
    }
    user@D# show routing-options
    static {
        route 0.0.0.0/0 {
            qualified-next-hop 192.168.2.1;
            qualified-next-hop 172.16.1.1;
            bfd-liveness-detection {
                minimum-interval 60;
            }
        }
    }
```

If you are done configuring the devices, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the Routing Tables on page 2328
- Verifying the BFD Sessions on page 2329
- Removing BFD from Device D on page 2329
- Removing BFD from One Next Hop on page 2329

Checking the Routing Tables

Purpose Make sure that the static route appears in the routing table on Device B with two possible next hops.

Action

```
user@B> show route 192.168.47.0 extensive
inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
192.168.47.0/24 (1 entry, 1 announced)
TSI:
KRT in-kernel 192.168.47.0/24 -> {192.168.2.2}
        *Static Preference: 5
                Next hop type: Router
                Address: 0x9334010
                Next-hop reference count: 1
                Next hop: 172.16.1.2 via ge-1/2/0.0
                Next hop: 192.168.2.2 via fe-0/1/0.2, selected
                State: <Active Int Ext>
                Age: 9
                Task: RT
                Announcement bits (1): 3-KRT
                AS path: I
```

Meaning Both next hops are listed. The next hop 192.168.2.2 is the selected route.

Verifying the BFD Sessions

Purpose Make sure that the BFD sessions are up.

Action `user@B>` **show bfd session**

```
                                                Detect   Transmit
Address          State     Interface            Time     Interval  Multiplier
172.16.1.2       Up        ge-1/2/0.0           0.720     0.240        3
192.168.2.2      Up        fe-0/1/0.2           0.720     0.240        3

2 sessions, 2 clients
Cumulative transmit rate 8.3 pps, cumulative receive rate 8.3 pps
```

Meaning The output shows that the BFD sessions are up.

Removing BFD from Device D

Purpose Demonstrate what happens when the BFD session is down for both next hops.

Action

1. Deactivate BFD on Device D.

   [edit routing-options static route 0.0.0.0/0]
   user@D# **deactivate bfd-liveness-detection**
   user@D# **commit**

2. Rerun the **show bfd session** command on Device B.

   `user@B>` **show bfd session**

   ```
                                                   Detect   Transmit
   Address                 State     Interface      Time     Interval  Multiplier
   172.16.1.2               Down      ge-1/2/0.0     3.000     1.000        3
   192.168.2.2              Down      fe-0/1/0.2     3.000     1.000        3

   2 sessions, 2 clients
   Cumulative transmit rate 2.0 pps, cumulative receive rate 2.0 pps
   ```

3. Rerun the **show route 192.168.47.0** command on Device B.

   `user@B>` **show route 192.168.47.0**

Meaning As expected, when the BFD sessions are down, the static route is removed from the routing table.

Removing BFD from One Next Hop

Purpose Demonstrate what happens when only one next hop has BFD enabled.

Action

1. If it is not already deactivated, deactivate BFD on Device D.

   [edit routing-options static route 0.0.0.0/0]
   user@D# **deactivate bfd-liveness-detection**
   user@D# **commit**

2. Deactivate BFD on one of the next hops on Device B.

[edit routing-options static route 192.168.47.0/24 qualified-next-hop 172.16.1.2]
user@B# **deactivate bfd-liveness-detection**
user@B# **commit**

3. Rerun the **show bfd session** command on Device B.

   `user@B>` **show bfd session**

```
                                           Detect   Transmit
Address       State      Interface         Time     Interval  Multiplier
192.168.2.2    Down       fe-0/1/0.2        3.000     1.000        3
```

4. Rerun the **show route 192.168.47.0 extensive** command on Device B.

   `user@B>` **show route 192.168.47.0 extensive**

```
inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
192.168.47.0/24 (1 entry, 1 announced)
TSI:
KRT in-kernel 192.168.47.0/24 -> {172.16.1.2}
        *Static Preference: 5
                Next hop type: Router, Next hop index: 624
                Address: 0x92f0178
                Next-hop reference count: 3
                Next hop: 172.16.1.2 via ge-1/2/0.0, selected
                State: <Active Int Ext>
                Age: 2:36
                Task: RT
                Announcement bits (1): 3-KRT
                AS path: I
```

Meaning As expected, the BFD session is down for the 192.168.2.2 next hop. The 172.16.1.2 next hop remains in the routing table, and the route remains active, because BFD is not a condition for this next hop to remain valid.

Related Documentation

- Example: Configuring BFD Authentication for Static Routes on page 2330
- Example: Configuring BFD for OSPF on page 3451
- Example: Configuring BFD for BGP on page 2844

- *Example: Configuring BFD for IS-IS*
- *Configuring PIM and the Bidirectional Forwarding Detection (BFD) Protocol*

Example: Configuring BFD Authentication for Static Routes

- Understanding BFD Authentication for Static Routes on page 2330
- Example: Configuring BFD Authentication for Static Routes on page 2332

Understanding BFD Authentication for Static Routes

Bidirectional Forwarding Detection (BFD) enables rapid detection of communication failures between adjacent systems. By default, authentication for BFD sessions is disabled. However, when you run BFD over Network Layer protocols, the risk of service attacks can be significant.

NOTE: We strongly recommend using authentication if you are running BFD over multiple hops or through insecure tunnels.

Beginning with Junos OS Release 9.6, Junos OS supports authentication for BFD sessions running over IPv4 and IPv6 static routes. BFD authentication is not supported on MPLS OAM sessions. BFD authentication is only supported in the Canada and United States version of the Junos OS image and is not available in the export version.

You authenticate BFD sessions by specifying an authentication algorithm and keychain, and then associating that configuration information with a security authentication keychain using the keychain name.

The following sections describe the supported authentication algorithms, security keychains, and level of authentication that can be configured:

- BFD Authentication Algorithms on page 2331
- Security Authentication Keychains on page 2332
- Strict Versus Loose Authentication on page 2332

BFD Authentication Algorithms

Junos OS supports the following algorithms for BFD authentication:

- **simple-password**—Plain-text password. One to 16 bytes of plain text are used to authenticate the BFD session. One or more passwords can be configured. This method is the least secure and should be used only when BFD sessions are not subject to packet interception.
- **keyed-md5**—Keyed Message Digest 5 hash algorithm for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed MD5 uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than or equal to the last sequence number received. Although more secure than a simple password, this method is vulnerable to replay attacks. Increasing the rate at which the sequence number is updated can reduce this risk.
- **meticulous-keyed-md5**—Meticulous keyed Message Digest 5 hash algorithm. This method works in the same manner as keyed MD5, but the sequence number is updated with every packet. Although more secure than keyed MD5 and simple passwords, this method might take additional time to authenticate the session.
- **keyed-sha-1**—Keyed Secure Hash Algorithm I for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed SHA uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. The key is not carried within the packets. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than the last sequence number received.
- **meticulous-keyed-sha-1**—Meticulous keyed Secure Hash Algorithm I. This method works in the same manner as keyed SHA, but the sequence number is updated with

every packet. Although more secure than keyed SHA and simple passwords, this method might take additional time to authenticate the session.

NOTE: **Nonstop active routing (NSR) is not supported with meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.**

Security Authentication Keychains

The security authentication keychain defines the authentication attributes used for authentication key updates. When the security authentication keychain is configured and associated with a protocol through the keychain name, authentication key updates can occur without interrupting routing and signaling protocols.

The authentication keychain contains one or more keychains. Each keychain contains one or more keys. Each key holds the secret data and the time at which the key becomes valid. The algorithm and keychain must be configured on both ends of the BFD session, and they must match. Any mismatch in configuration prevents the BFD session from being created.

BFD allows multiple clients per session, and each client can have its own keychain and algorithm defined. To avoid confusion, we recommend specifying only one security authentication keychain.

Strict Versus Loose Authentication

By default, strict authentication is enabled, and authentication is checked at both ends of each BFD session. Optionally, to smooth migration from nonauthenticated sessions to authenticated sessions, you can configure *loose checking*. When loose checking is configured, packets are accepted without authentication being checked at each end of the session. This feature is intended for transitional periods only.

Example: Configuring BFD Authentication for Static Routes

This example shows how to configure Bidirectional Forwarding Detection (BFD) authentication for static routes.

Requirements

Junos OS Release 9.6 or later (Canda and United States version).

BFD authentication is only supported in the Canada and United States version of the Junos OS image and is not available in the export version.

Overview

You can configure authentication for BFD sessions running over IPv4 and IPv6 static routes. Routing instances and logical systems are also supported.

The following steps are needed to configure authentication on a BFD session:

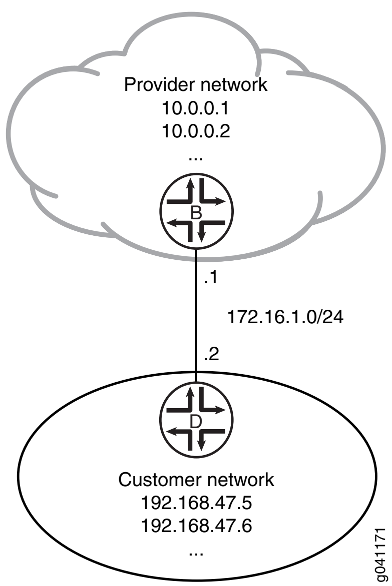
1. Specify the BFD authentication algorithm for the static route.
2. Associate the authentication keychain with the static route.
3. Configure the related security authentication keychain. This must be configured on the main router.

TIP: We recommend that you specify loose authentication checking if you are transitioning from nonauthenticated sessions to authenticated sessions.

```
[edit]
user@host> set routing-options static route ipv4 bfd-liveness-detection
  authentication loose-check
```

Figure 35 on page 2333 shows the sample network.

Figure 35: Customer Routes Connected to a Service Provider



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device B

```
set interfaces ge-1/2/0 unit 0 description B->D
set interfaces ge-1/2/0 unit 0 family inet address 172.16.1.1/24
```

```
set interfaces lo0 unit 57 family inet address 10.0.0.1/32
set interfaces lo0 unit 57 family inet address 10.0.0.2/32
set routing-options static route 192.168.47.0/24 next-hop 172.16.1.2
set routing-options static route 192.168.47.0/24 bfd-liveness-detection minimum-interval
  1000
set routing-options static route 192.168.47.0/24 bfd-liveness-detection authentication
  key-chain bfd-kc4
set routing-options static route 192.168.47.0/24 bfd-liveness-detection authentication
  algorithm keyed-sha-1
set security authentication-key-chains key-chain bfd-kc4 key 5 secret
  "$9$JhZHmn6Ap0In/9ApOcSs24oaZikPfT3wY24ZG.mz36AtOIEyMWxSrlKvM-dbs2a
  DkP5Ft0IQFclev7N"
set security authentication-key-chains key-chain bfd-kc4 key 5 start-time
  "2011-1-1.12:00:00 -0800"
```

Device D

```
set interfaces ge-1/2/0 unit 1 description D->B
set interfaces ge-1/2/0 unit 1 family inet address 172.16.1.2/24
set interfaces lo0 unit 2 family inet address 192.168.47.5/32
set interfaces lo0 unit 2 family inet address 192.168.47.6/32
set routing-options static route 0.0.0.0/0 next-hop 172.16.1.1
set routing-options static route 0.0.0.0/0 bfd-liveness-detection minimum-interval 1000
set routing-options static route 0.0.0.0/0 bfd-liveness-detection authentication key-chain
  bfd-kc4
set routing-options static route 0.0.0.0/0 bfd-liveness-detection authentication algorithm
  keyed-sha-1
set security authentication-key-chains key-chain bfd-kc4 key 5 secret
  "$9$JhZHmn6Ap0In/9ApOcSs24oaZikPfT3wY24ZG.mz36AtOIEyMWxSrlKvM-dbs2a
  DkP5Ft0IQFclev7N"
set security authentication-key-chains key-chain bfd-kc4 key 5 start-time
  "2011-1-1.12:00:00 -0800"
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure BFD for static routes:

1. On Device B, configure the interfaces.

```
[edit interfaces]
user@B# set ge-1/2/0 unit 0 description B->D
user@B# set ge-1/2/0 unit 0 family inet address 172.16.1.1/24

user@B# set lo0 unit 57 family inet address 10.0.0.1/32
user@B# set lo0 unit 57 family inet address 10.0.0.2/32
```

2. On Device B, create a static route and set the next-hop address.

```
[edit routing-options]
user@B# set static route 192.168.47.0/24 next-hop 172.16.1.2
```

3. On Device B, configure BFD for the static route.

```
[edit routing-options]
user@B# set static route 192.168.47.0/24 bfd-liveness-detection minimum-interval
  1000
```

4. On Device B, specify the algorithm (**keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**, or **simple-password**) to use for BFD authentication on the static route.

   ```
   [edit routing-options]
   user@B# set static route 192.168.47.0/24 bfd-liveness-detection authentication
     algorithm keyed-sha-1
   ```

   NOTE: Nonstop active routing (NSR) is not supported with the meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.

5. On Device B, specify the keychain to be used to associate BFD sessions on the specified route with the unique security authentication keychain attributes.

   This should match the keychain name configured at the **[edit security authentication key-chains]** hierarchy level.

   ```
   [edit routing-options]
   user@B# set static route 192.168.47.0/24 bfd-liveness-detection authentication
     key-chain bfd-kc4
   ```

6. On Device B, specify the unique security authentication information for BFD sessions:

   - The matching keychain name as specified in Step 5.
   - At least one key, a unique integer between **0** and **63**. Creating multiple keys allows multiple clients to use the BFD session.
   - The secret data used to allow access to the session.
   - The time at which the authentication key becomes active, in the format *yyyy-mm-dd.hh:mm:ss*.

   ```
   [edit security authentication-key-chains key-chain bfd-kc4]
   user@B# set key 5 secret
     "$9$JhZHmn6Ap0In/9ApOcSs24oaZikPfT3wY24ZG.mz36AtOIEyMWxSrlKvM-dbs2a
     DkP5Ft0IQFclev7N"
   user@B# set key 5 start-time "2011-1-1.12:00:00 -0800"
   ```

7. If you are done configuring Device B, commit the configuration.

   ```
   [edit]
   user@B# commit
   ```

8. Repeat the configuration on Device D.

   The algorithm and keychain must be configured on both ends of the BFD session, and they must match. Any mismatch in configuration prevents the BFD session from being created.

Results

Confirm your configuration by issuing the **show interfaces**, **show routing-options**, and **show security** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Device B

```
user@B# show interfaces
ge-1/2/0 {
  unit 0 {
    description B->D;
    family inet {
      address 172.16.1.1/24;
    }
  }
}
lo0 {
  unit 57 {
    family inet {
      address 10.0.0.1/32;
      address 10.0.0.2/32;
    }
  }
}

user@B# show routing-options
static {
  route 192.168.47.0/24 {
    next-hop 172.16.1.2;
    bfd-liveness-detection {
      minimum-interval 1000;
      authentication {
        key-chain bfd-kc4;
        algorithm keyed-sha-1;
      }
    }
  }
}

user@B# show security
authentication-key-chains {
  key-chain bfd-kc4 {
    key 5 {
      secret
        "$9$JhZHmn6Ap0In/9ApOcSs24oaZikPfT3wY24ZG.mz36AtOIEyMWxSrlKvM-dbs2a
        DkP5Ft0IQFclev7N"; ## SECRET-DATA
      start-time "2011-1-1.12:00:00 -0800";
    }
  }
}
```


Verification

Confirm that the configuration is working properly.

- Verifying That BFD Sessions Are Up on page 2337
- Viewing Details About the BFD Session on page 2337
- Viewing Extensive BFD Session Information on page 2337

Verifying That BFD Sessions Are Up

Purpose Verify that the BFD sessions are up.

Action From operational mode, enter the **show bfd session** command.

```
user@B> show bfd session
                                                  Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
172.16.1.2               Up        ge-1/2/0.0     3.000     1.000        3

1 sessions, 1 clients
Cumulative transmit rate 1.0 pps, cumulative receive rate 1.0 pps
```

Meaning The command output shows that the BFD session is up.

Viewing Details About the BFD Session

Purpose View details about the BFD sessions and make sure that authentication is configured.

Action From operational mode, enter the **show bfd session detail** command.

```
user@B> show bfd session detail
                                                  Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
172.16.1.2               Up        ge-1/2/0.0     3.000     1.000        3
 Client Static, TX interval 1.000, RX interval 1.000, Authenticate
 Session up time 00:53:58
 Local diagnostic NbrSignal, remote diagnostic None
 Remote state Up, version 1
 Logical system 9, routing table index 22

1 sessions, 1 clients
Cumulative transmit rate 1.0 pps, cumulative receive rate 1.0 pps
```

Meaning In the command output, **Authenticate** is displayed to indicate that BFD authentication is configured.

Viewing Extensive BFD Session Information

Purpose View more detailed information about the BFD sessions.

Action From operational mode, enter the **show bfd session extensive** command.

```
user@B> show bfd session extensive
Address                  State     Interface      Time     Interval  Multiplier
172.16.1.2               Up        ge-1/2/0.0     3.000     1.000        3
 Client Static, TX interval 1.000, RX interval 1.000, Authenticate
```



```
       keychain bfd-kc4, algo keyed-sha-1, mode strict
 Session up time 01:39:45
 Local diagnostic NbrSignal, remote diagnostic None
 Remote state Up, version 1
 Logical system 9, routing table index 22
 Min async interval 1.000, min slow interval 1.000
 Adaptive async TX interval 1.000, RX interval 1.000
 Local min TX interval 1.000, minimum RX interval 1.000, multiplier 3
 Remote min TX interval 1.000, min RX interval 1.000, multiplier 3
 Local discriminator 3, remote discriminator 4
 Echo mode disabled/inactive
 Authentication enabled/active, keychain bfd-kc4, algo keyed-sha-1, mode strict

1 sessions, 1 clients
Cumulative transmit rate 1.0 pps, cumulative receive rate 1.0 pps
```

Meaning In the command output, **Authenticate** is displayed to indicate that BFD authentication is configured. The output for the **extensive** command provides the keychain name, the authentication algorithm, and the mode for each client in the session.

Related Documentation

- Examples: Configuring BFD for Static Routes on page 2315

Configuration Statements

active

Syntax (active | passive);

Hierarchy Level
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit routing-options (aggregate | generate | static) (defaults | route)],
[edit routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Determine whether static, aggregate, or generated routes are removed from the routing and forwarding tables when they become inactive. Static routes are only removed from the routing table if the next hop becomes unreachable. This can occur if the local or neighbor interface goes down. Routes that have been configured to remain continually installed in the routing and forwarding tables are marked with **reject** next hops when they are inactive.

- **active**—Remove a route from the routing and forwarding tables when it becomes inactive.
- **passive**—Have a route remain continually installed in the routing and forwarding tables even when it becomes inactive.

Include the **active** statement when configuring an individual route in the **route** portion of the **static** statement to override a **passive** option specified in the **defaults** portion of the statement.

Default **active**

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Examples: Configuring Static Routes*
- *Example: Summarizing Routes Through Route Aggregation*
- *Example: Conditionally Generating Static Routes*

aggregate (Routing)

Syntax

```
aggregate {
  defaults {
    ... aggregate-options ...
  }
  route destination-prefix {
    policy policy-name;
    ... aggregate-options ...
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name*],
[edit logical-systems *logical-system-name* routing-options],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name*],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name*],
[edit routing-options],
[edit routing-options rib *routing-table-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure aggregate routes.

Options

aggregate-options—Additional information about aggregate routes that is included with the route when it is installed in the routing table. Specify zero or more of the following options in ***aggregate-options***. Each option is explained separately.

- **(active | passive);**
- **as-path <*as-path*> <origin (egp | igp | incomplete)> <atomic-aggregate> <aggregator *as-number ip-address*>**;
- **(brief | full)**;
- **community [*community-ids*]**;
- **discard**;
- **(metric | metric2 | metric3 | metric4) *value* <type *type*>**;
- **(preference | preference2 | color | color2) *preference* <type *type*>**;
- **tag *string***;

defaults—Specify global aggregate route options. These options only set default attributes inherited by all newly created aggregate routes. These are treated as global defaults and apply to all the aggregate routes you configure in the **aggregate** statement. This part of the **aggregate** statement is optional.

route *destination-prefix*—Configure a nondefault aggregate route:

- **default**—For the default route to the destination. This is equivalent to specifying an IP address of **0.0.0.0/0**.
- ***destination-prefix/prefix-length***—***destination-prefix*** is the network portion of the IP address, and ***prefix-length*** is the destination prefix length.

The policy statement is explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Summarizing Routes Through Route Aggregation*

as-path (Routing Options)

Syntax

as-path <*as-path*> <aggregator *as-number ip-address*> <atomic-aggregate> <origin (egp | igp | incomplete)>;

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit routing-options (aggregate | generate | static) (defaults | route)],
[edit routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Associate BGP autonomous system (AS) path information with a static, aggregate, or generated route.

In Junos OS Release 9.1 and later, the numeric range for the AS number is extended to provide BGP support for 4-byte AS numbers as defined in RFC 4893, *BGP Support for Four-octet AS Number Space*. RFC 4893 introduces two new optional transitive BGP attributes, AS4_PATH and AS4_AGGREGATOR. These new attributes are used to propagate 4-byte AS path information across BGP speakers that do not support 4-byte AS numbers. RFC 4893 also introduces a reserved, well-known, 2-byte AS number, AS 23456. This reserved AS number is called AS_TRANS in RFC 4893. All releases of Junos OS support 2-byte AS numbers.

In Junos OS Release 9.2 and later, you can also configure a 4-byte AS number using the AS-dot notation format of two integer values joined by a period: <*16-bit high-order value in decimal*>.<*16-bit low-order value in decimal*>. For example, the 4-byte AS number of 65,546 in plain-number format is represented as 1.10 in the AS-dot notation format. You can specify a value in the range from 0.0 through 65535.65535 in AS-dot notation format.

Default

No AS path information is associated with static routes.

Options

aggregator—(Optional) Attach the BGP **aggregator** path attribute to the aggregate route. You must specify the last AS number that formed the aggregate route (encoded as two octets) for ***as-number***, followed by the IP address of the BGP system that formed the aggregate route for ***ip-address***.

as-path—(Optional) AS path to include with the route. It can include a combination of individual AS path numbers and AS sets. Enclose sets in brackets ([ ]). The first AS number in the path represents the AS immediately adjacent to the local AS. Each subsequent number represents an AS that is progressively farther from the local AS, heading toward the origin of the path. You cannot specify a regular expression for ***as-path***. You must use a complete, valid AS path.

atomic-aggregate—(Optional) Attach the BGP **atomic-aggregate** path attribute to the aggregate route. This path attribute indicates that the local system selected a less specific route instead of a more specific route.

origin egp—(Optional) BGP origin attribute that indicates that the path information originated in another AS.

origin igp—(Optional) BGP origin attribute that indicates that the path information originated within the local AS.

origin incomplete—(Optional) BGP origin attribute that indicates that the path information was learned by some other means.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Examples: Configuring Static Routes*
- *Example: Summarizing Routes Through Route Aggregation*
- *Example: Conditionally Generating Static Routes*
- *Using 4-Byte Autonomous System Numbers in BGP Networks Technology Overview*

autonomous-system

Syntax

autonomous-system *autonomous-system* <asdot-notation> <loops *number*> {
  independent-domain <no-attrset>;
}

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
asdot-notation option introduced in Junos OS Release 9.3.
asdot-notation option introduced in Junos OS Release 9.3 for EX Series switches.
no-attrset option introduced in Junos OS Release 10.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Specify the routing device's AS number.

An autonomous system (AS) is a set of routing devices that are under a single technical administration and that generally use a single interior gateway protocol (IGP) and metrics to propagate routing information within the set of routing devices. An AS appears to other ASs to have a single, coherent interior routing plan and presents a consistent picture of what destinations are reachable through it. ASs are identified by a number that is assigned by the Network Information Center (NIC) in the United States (http://www.isi.edu).

If you are using BGP on the routing device, you must configure an AS number.

The AS path attribute is modified when a route is advertised to an EBGP peer. Each time a route is advertised to an EBGP peer, the local routing device prepends its AS number to the existing path attribute, and a value of 1 is added to the AS number.

In Junos OS Release 9.1 and later, the numeric range is extended to provide BGP support for 4-byte AS numbers as defined in RFC 4893, *BGP Support for Four-octet AS Number Space*. RFC 4893 introduces two new optional transitive BGP attributes, AS4_PATH and AS4_AGGREGATOR. These new attributes are used to propagate 4-byte AS path information across BGP speakers that do not support 4-byte AS numbers. RFC 4893 also introduces a reserved, well-known, 2-byte AS number, AS 23456. This reserved AS number is called AS_TRANS in RFC 4893. All releases of Junos OS support 2-byte AS numbers.

In Junos OS Release 9.3 and later, you can also configure a 4-byte AS number using the AS-dot notation format of two integer values joined by a period: *<16-bit high-order value in decimal>.<16-bit low-order value in decimal>*. For example, the 4-byte AS number of 65,546 in plain-number format is represented as 1.10 in the AS-dot notation format.

Options

autonomous-system—AS number. Use a number assigned to you by the NIC.

Range: 1 through 4,294,967,295 (2^{32} – 1) in plain-number format for 4-byte AS numbers

In this example, the 4-byte AS number 65,546 is represented in plain-number format:

```
[edit]
routing-options {
  autonomous-system 65546;
}
```

Range: 0.0 through 65535.65535 in AS-dot notation format for 4-byte numbers

In this example, 1.10 is the AS-dot notation format for 65,546:

```
[edit]
routing-options {
  autonomous-system 1.10;
}
```

Range: 1 through 65,535 in plain-number format for 2-byte AS numbers (this is a subset of the 4-byte range)

In this example, the 2-byte AS number 60,000 is represented in plain-number format:

```
[edit]
routing-options {
  autonomous-system 60000;
}
```

asdot-notation—(Optional) Display the configured 4-byte autonomous system number in the AS-dot notation format.

Default: Even if a 4-byte AS number is configured in the AS-dot notation format, the default is to display the AS number in the plain-number format.

loops ***number***—(Optional) Specify the number of times detection of the AS number in the AS_PATH attribute causes the route to be discarded or hidden. For example, if you configure **loops 1**, the route is hidden if the AS number is detected in the path one or more times. This is the default behavior. If you configure **loops 2**, the route is hidden if the AS number is detected in the path two or more times.

Range: 1 through 10

Default: 1

NOTE: When you specify the same AS number in more than one routing instance on the local routing device, you must configure the same number of loops for the AS number in each instance. For example, if you configure a value of 3 for the **loops** statement in a VRF routing instance that uses the same AS number as that of the master instance, you must also configure a value of 3 loops for the AS number in the master instance.

Use the **independent-domain** option if the **loops** statement must be enabled only on a subset of routing instances.

The remaining statement is explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Examples: Configuring External BGP Peering on page 2639
- Examples: Configuring Internal BGP Peering on page 2662

backup-pe-group

Syntax

```
backup-pe-group group-name {
  backups [ addresses ];
  local-address address;
}
```

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options multicast]

Release Information Statement introduced in Junos OS Release 9.0.
Statement introduced in Junos OS Release 9.5 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure a backup provider edge (PE) group for ingress PE redundancy when point-to-multipoint label-switched paths (LSPs) are used for multicast distribution.

Options

backups *addresses*—Specify the address of backup PE routers for ingress PE redundancy when point-to-multipoint LSPs are used for multicast distribution.

local-address *address*—Specify the address of the local PE router for ingress PE redundancy when point-to-multipoint LSPs are used for multicast distribution.

pe-group-name—Specify the name for the group of PE routers that provide ingress PE router redundancy for point-to-multipoint LSPs.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Ingress PE Redundancy*
- *Configuring Ingress PE Router Redundancy for Point-to-Multipoint LSPs*

backups

Syntax backups [*addresses*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast backup-pe-group *group-name*],
[edit logical-systems *logical-system-name* routing-options multicast backup-pe-group *group-name*],
[edit routing-instances *routing-instance-name* routing-options multicast backup-pe-group *group-name*],
[edit routing-options multicast backup-pe-group *group-name*]

Release Information Statement introduced in Junos OS Release 9.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the address of backup PEs for ingress PE redundancy when point-to-multipoint label-switched paths (LSPs) are used for multicast distribution.

Options ***addresses***—Addresses of other PEs in the backup group.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Ingress PE Redundancy*

bandwidth (Multicast Flow Map)

Syntax bandwidth (*bps* | adaptive);

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast flow-map],
[edit logical-systems *logical-system-name* routing-options multicast flow-map],
[edit routing-instances *routing-instance-name* routing-options multicast flow-map],
[edit routing-options multicast flow-map]

Release Information Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure the bandwidth property for multicast flow maps.

Options **adaptive**—Specify that the bandwidth is measured for the flows that are matched by the flow map.

bps—Bandwidth, in bits per second, for the flow map.

Range: 0 through any amount of bandwidth

Default: 2 Mbps

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring a Multicast Flow Map*

bfd-liveness-detection (Routing Options Static Route)

Syntax

```
bfd-liveness-detection {
  authentication {
    algorithm algorithm-name;
    key-chain key-chain-name;
    loose-check;
  }
  detection-time {
    threshold milliseconds;
  }
  holddown-interval milliseconds;
  local-address ip-address;
  minimum-interval milliseconds;
  minimum-receive-interval milliseconds;
  minimum-receive-ttl number;
  multiplier number;
  neighbor address;
  no-adaptation;
  transmit-interval {
    minimum-interval milliseconds;
    threshold milliseconds;
  }
  version (1 | automatic);
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* static route *destination-prefix*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* static route *destination-prefix* qualified-next-hop (*interface-name* | *address*)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options static route *destination-prefix*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options static route *destination-prefix* qualified-next-hop (*interface-name* | *address*)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* static route *destination-prefix*],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* static route *destination-prefix* qualified-next-hop (*interface-name* | *address*)],
[edit logical-systems *logical-system-name* routing-options static route *destination-prefix*],
[edit logical-systems *logical-system-name* routing-options static route *destination-prefix* qualified-next-hop (*interface-name* | *address*)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* static route *destination-prefix*],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* static route *destination-prefix* qualified-next-hop (*interface-name* | *address*)],
[edit routing-instances *routing-instance-name* routing-options static route *destination-prefix*],
[edit routing-instances *routing-instance-name* routing-options static route *destination-prefix* qualified-next-hop (*interface-name* | *address*)],
[edit routing-options rib *routing-table-name* static route *destination-prefix*],
[edit routing-options rib *routing-table-name* static route *destination-prefix* qualified-next-hop (*interface-name* | *address*)],
[edit routing-options static route *destination-prefix*],

[edit routing-options static route *destination-prefix* qualified-next-hop (*interface-name* | *address*)]

Release Information Statement introduced before Junos OS Release 7.4.
detection-time threshold and **transmit-interval threshold** options introduced in Junos OS Release 8.2.
local-address statement introduced in Junos OS Release 8.2.
minimum-receive-ttl statement introduced in Junos OS Release 8.2.
Support for logical routers introduced in Junos OS Release 8.3.
holddown-interval statement introduced in Junos OS Release 8.5.
no-adaptation statement introduced in Junos OS Release 9.0.
Support for IPv6 static routes introduced in Junos OS Release 9.1.
authentication algorithm, **authentication key-chain**, and **authentication loose-check** statements introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure bidirectional failure detection timers and authentication criteria for static routes.

Options

authentication algorithm *algorithm-name* —Configure the algorithm used to authenticate the specified BFD session: **simple-password**, **keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, or **meticulous-keyed-sha-1**.

authentication key-chain *key-chain-name*—Associate a security key with the specified BFD session using the name of the security keychain. The name you specify must match one of the keychains configured in the **authentication-key-chains key-chain** statement at the **[edit security]** hierarchy level.

authentication loose-check—(Optional) Configure loose authentication checking on the BFD session. Use only for transitional periods when authentication may not be configured at both ends of the BFD session.

detection-time threshold *milliseconds*—Configure a threshold for the adaptation of the BFD session detection time. When the detection time adapts to a value equal to or greater than the threshold, a single trap and a single system log message are sent.

holddown-interval *milliseconds*—Configure an interval specifying how long a BFD session must remain up before a state change notification is sent. If the BFD session goes down and then comes back up during the hold-down interval, the timer is restarted.

Range: 0 through 255,000

Default: 0

local-address *ip-address*—Enable a multihop BFD session and configure the source address for the BFD session.

minimum-interval *milliseconds*—Configure the minimum interval after which the local routing device transmits a hello packet and then expects to receive a reply from the neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum transmit and receive intervals separately using the **transmit-interval minimum-interval** and **minimum-receive-interval** statements.

Range: 1 through 255,000

minimum-receive-interval *milliseconds*—Configure the minimum interval after which the routing device expects to receive a reply from a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum receive interval using the **minimum-interval** statement at the **[edit routing-options static route** ***destination-prefix*** **bfd-liveness-detection]** hierarchy level.

Range: 1 through 255,000

minimum-receive-ttl *number*—Configure the time to live (TTL) for the multihop BFD session.

Range: 1 through 255

Default: 255

multiplier *number*—Configure number of hello packets not received by the neighbor that causes the originating interface to be declared down.

Range: 1 through 255

Default: 3

neighbor *address*—Configure a next-hop address for the BFD session for a next hop specified as an interface name.

no-adaptation—Specify for BFD sessions not to adapt to changing network conditions. We recommend that you not disable BFD adaptation unless it is preferable not to have BFD adaptation enabled in your network.

transmit-interval threshold *milliseconds*—Configure the threshold for the adaptation of the BFD session transmit interval. When the transmit interval adapts to a value greater than the threshold, a single trap and a single system message are sent. The interval threshold must be greater than the minimum transmit interval.

Range: 0 through 4,294,967,295

transmit-interval minimum-interval *milliseconds*—Configure the minimum interval at which the routing device transmits hello packets to a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum transmit interval using the **minimum-interval** statement at the **[edit routing-options static route *destination-prefix* bfd-liveness-detection]** hierarchy level.

Range: 1 through 255,000

version—Configure the BFD version to detect: **1** (BFD version 1) or **automatic** (autodetect the BFD version).

Default: **automatic**

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BFD for Static Routes on page 2319
- Example: Configuring BFD Authentication for Static Routes on page 2332

bgp-orf-cisco-mode

Syntax bgp-orf-cisco-mode;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp outbound-route-filter],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* outbound-route-filter],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp outbound-route-filter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* outbound-route-filter,
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options outbound-route-filter],
[edit logical-systems *logical-system-name* routing-options outbound-route-filter],
[edit protocols bgp outbound-route-filter],
[edit protocols bgp group *group-name* outbound-route-filter],
[edit protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit routing-instances *routing-instance-name* protocols bgp outbound-route-filter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* outbound-route-filter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit routing-instances *routing-instance-name* routing-options outbound-route-filter],
[edit routing-options outbound-route-filter]

Release Information Statement introduced in Junos OS Release 9.2.
Statement introduced in Junos OS Release 9.2 for EX Series switches.
Support for the BGP group and neighbor hierarchy levels introduced in Junos OS Release 9.2.
Support for the BGP group and neighbor hierarchy levels introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Enable interoperability with routing devices that use the vendor-specific outbound route filter compatibility code of 130 and code type of 128.

NOTE: **To enable interoperability for all BGP peers configured on the routing device, include the statement at the [edit routing-options outbound-route-filter] hierarchy level.**

Default Disabled

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BGP Prefix-Based Outbound Route Filtering on page 2807

bmp

Syntax

```
bmp {
  memory limit bytes;
  station-address (ip-address | name);
  station-port port-number;
  statistics-timeout seconds;
}
```

Hierarchy Level [edit routing-options]

Release Information Statement introduced in Junos OS Release 9.5.
Statement introduced in Junos OS Release 9.5 for EX Series switches.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure the BGP Monitoring Protocol (BMP), which enables the routing device to collect data from the BGP **Adjacency-RIB-In** routing tables and periodically send that data to a monitoring station.

Options **memory-limit *bytes***—(Optional) Specify a threshold at which to stop collecting BMP data if the limit is exceeded.

Default: 10 MB

Range: 1,048,576 through 52,428,800

station-address (*ip-address* | *name*)—Specify the IP address or a valid URL for the monitoring where BMP data should be sent.

station-port *port-number*—Specify the port number of the monitoring station to use when sending BMP data.

statistics-timeout *seconds*—(Optional) Specify how often to send BMP data to the monitoring station.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring the BGP Monitoring Protocol*

brief

Syntax (brief | full);

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options (aggregate | generate) (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options (aggregate | generate) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options (aggregate | generate) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)],
[edit routing-options (aggregate | generate) (defaults | route)],
[edit routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure all AS numbers from all contributing paths to be included in the aggregate or generated route's path.

- **brief**—Include only the longest common leading sequences from the contributing AS paths. If this results in AS numbers being omitted from the aggregate route, the BGP **ATOMIC_ATTRIBUTE** path attribute is included with the aggregate route.
- **full**—Include all AS numbers from all contributing paths in the aggregate or generated route's path. Include this option when configuring an individual route in the **route** portion of the **generate** statement to override a **retain** option specified in the **defaults** portion of the statement.

Default full

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Summarizing Routes Through Route Aggregation*
- *Example: Conditionally Generating Static Routes*
- aggregate on page 2342
- generate on page 2372

centralized

Syntax centralized;

Hierarchy Level [edit protocols lacp ppm]

Release Information Statement introduced in Junos OS Release 10.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Disable distributed periodic packet management (PPM) processing for Link Aggregation Control Protocol (LACP) packets and run all PPM processing for LACP packets on the Routing Engine.

This statement disables distributed PPM processing for only LACP packets. You can disable distributed PPM processing for all packets that use PPM and run all PPM processing on the Routing Engine by configuring the **no-delegate-processing** statement in the **[edit routing-options ppm]** hierarchy.

BEST PRACTICE: **We generally recommend that you disable distributed PPM only if Juniper Networks Customer Service advises you to do so. You should disable distributed PPM only if you have a compelling reason to disable it.**

Default Distributed PPM processing is enabled for all packets that use PPM.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Distributed Periodic Packet Management on an EX Series Switch (CLI Procedure)*
- *Configuring Aggregated Ethernet LACP (CLI Procedure)*
- Configuring Distributed Periodic Packet Management on page 2312
- Configuring Link Aggregation on page 2019

community (Routing Options)

Syntax community ([*community-ids*] | no-advertise | no-export | no-export-subconfed | none);

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit routing-options (aggregate | generate | static) (defaults | route)],
[edit routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Associate BGP community information with a static, aggregate, or generated route.

Default No BGP community information is associated with static routes.

Options ***community-ids***—One or more community identifiers. The ***community-ids*** format varies according to the type of attribute that you use.

The BGP community attribute format is ***as-number:community-value***:

- ***as-number***—AS number of the community member. It can be a value from 1 through 65,535. The AS number can be a decimal or hexadecimal value.
- ***community-value***—Identifier of the community member. It can be a number from 0 through 65,535.

For more information about BGP community attributes, see the "Configuring the Extended Communities Attribute" section in the *Routing Policy Feature Guide for Routing Devices*.

For specifying the BGP community attribute only, you also can specify ***community-ids*** as one of the following well-known community names defined in RFC 1997:

- **no-advertise**—Routes containing this community name are not advertised to other BGP peers.
- **no-export**—Routes containing this community name are not advertised outside a BGP confederation boundary.
- **no-export-subconfed**—Routes containing this community name are not advertised to external BGP peers, including peers in other members' ASs inside a BGP confederation.

NOTE: Extended community attributes are not supported at the **[edit routing-options]** hierarchy level. You must configure extended communities at the **[edit policy-options]** hierarchy level. For information about configuring extended communities, see the *Routing Policy Feature Guide for Routing Devices*.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Examples: Configuring Static Routes*
- *Example: Summarizing Routes Through Route Aggregation*
- *Example: Conditionally Generating Static Routes*
- aggregate on page 2342
- generate on page 2372
- *static*

confederation

Syntax confederation *confederation-autonomous-system* members [*autonomous-systems*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-options],
[edit routing-options]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Specify the routing device's confederation AS number.

If you administer multiple ASs that contain a very large number of BGP systems, you can group them into one or more *confederations*. Each confederation is identified by its own AS number, which is called a *confederation AS number*. To external ASs, a confederation appears to be a single AS. Thus, the internal topology of the ASs making up the confederation is hidden.

The BGP path attributes **NEXT_HOP**, **LOCAL_PREF**, and **MULTI_EXIT_DISC**, which normally are restricted to a single AS, are allowed to be propagated throughout the ASs that are members of the same confederation.

Because each confederation is treated as if it were a single AS, you can apply the same routing policy to all the ASs that make up the confederation.

Grouping ASs into confederations reduces the number of BGP connections required to interconnect ASs.

If you are using BGP, you can enable the local routing device to participate as a member of an AS confederation. To do this, include the **confederation** statement.

Specify the AS confederation identifier, along with the peer AS numbers that are members of the confederation.

Note that peer adjacencies do not form if two BGP neighbors disagree about whether an adjacency falls within a particular confederation.

Options ***autonomous-systems***—AS numbers of the confederation members.

Range: 1 through 65,535

confederation-autonomous-system—Confederation AS number. Use one of the numbers assigned to you by the NIC.

Range: 1 through 65,535

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BGP Confederations on page 2945

description (Routing Instances)

Syntax description *text*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name*],
[edit routing-instances *routing-instance-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Provide a text description for the routing instance. If the text includes one or more spaces, enclose it in quotation marks (" "). Any descriptive text you include is displayed in the output of the **show route instance detail** command and has no effect on the operation of the routing instance.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Routing Instances on PE Routers in VPNs*
- show route instance on page 2544

discard

Syntax discard;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options (aggregate | generate) (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options (aggregate | generate) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options (aggregate | generate) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)],
[edit routing-options (aggregate | generate) (defaults | route)],
[edit routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Do not forward packets addressed to this destination. Instead, drop the packets, do not send ICMP unreachable messages to the packets' originators, and install a reject route for this destination into the routing table.

To propagate static routes into the routing protocols, include the **discard** statement when you define the route, along with a routing policy.

NOTE: In other vendors' software, a common way to propagate static routes into routing protocols is to configure the routes so that the next-hop routing device is the loopback address (commonly, 127.0.0.1). However, configuring static routes in this way (by including a statement such as **route** ***address/mask-length*** **next-hop 127.0.0.1**) does not propagate the static routes, because the forwarding table ignores static routes whose next-hop routing device is the loopback address.

Default When an aggregate route becomes active, it is installed in the routing table with a reject next hop, which means that ICMP unreachable messages are sent.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Summarizing Routes Through Route Aggregation*
- *Example: Conditionally Generating Static Routes*

- aggregate on page 2342
- generate on page 2372

export (Routing Options)

Syntax export [*policy-name*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options forwarding-table],
[edit logical-systems *logical-system-name* routing-options forwarding-table],
[edit routing-instances *routing-instance-name* routing-options forwarding-table],
[edit routing-options forwarding-table]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Apply one or more policies to routes being exported from the routing table into the forwarding table.

In the **export** statement, list the name of the routing policy to be evaluated when routes are being exported from the routing table into the forwarding table. Only active routes are exported from the routing table.

You can reference the same routing policy one or more times in the same or a different **export** statement.

You can apply export policies to routes being exported from the routing table into the forwarding table for the following features:

- Per-packet load balancing
- Class of service (CoS)

Options ***policy-name***—Name of one or more policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Load Balancing BGP Traffic on page 2858
- *Routing Policy Feature Guide for Routing Devices*
- *How a Routing Policy Is Evaluated*

export-rib

Syntax export-rib *routing-table-name*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib-groups *group-name*],
[edit logical-systems *logical-system-name* routing-options rib-groups *group-name*],
[edit routing-instances *routing-instance-name* routing-options rib-groups *group-name*],
[edit routing-options rib-groups *group-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Specify the name of the routing table from which Junos OS should export routing information.

Options ***routing-table-name***—Routing table group name.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Exporting Specific Routes from One Routing Table Into Another Routing Table*
- import-rib on page 2375
- *passive*

fate-sharing

Syntax

```
fate-sharing {
  group group-name {
    cost value;
    from address <to address>;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit routing-options],
[edit routing-instances *routing-instance-name* routing-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Specify a backup path in case the primary path becomes unusable.

You specify one or more objects with common characteristics within a group. All objects are treated as /32 host addresses. The objects can be a LAN interface, a router ID, or a point-to-point link. Sequence is insignificant.

Changing the fate-sharing database does not affect existing established LSPs until the next CSPF reoptimization. The fate-sharing database does affect fast-reroute detour path computations.

Options

cost ***value***—Cost assigned to the group.

Range: 1 through 65,535

Default: 1

from ***address***—Address of the router or address of the LAN/NBMA interface. For example, an Ethernet network with four hosts in the same fate-sharing group would require you to list all four of the separate **from** addresses in the group.

group ***group-name***—Each fate-sharing group must have a name, which can have a maximum of 32 characters, including letters, numbers, periods (.), and hyphens (-). You can define up to 512 groups.

to ***address***—(Optional) Address of egress router. For point-to-point link objects, you must specify both a **from** and a **to** address.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Ingress Router for MPLS-Signaled LSPs*
- *Junos OS MPLS Applications Library for Routing Devices*

flow

Syntax

```
flow {
  route name {
    match {
      match-conditions;
    }
    term-order (legacy | standard);
    then {
      actions;
    }
  }
  firewall-install-disable;
  term-order (legacy | standard);
  validation {
    traceoptions {
      file filename <files number> <size size> <world-readable | no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
  }
}
```

Hierarchy Level

[edit routing-options],
[edit logical-systems *logical-system-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
term-order statement introduced in Junos OS Release 10.0
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure a flow route.

Default

legacy

Options

actions—An action to take if conditions match.

match-conditions—Match packets to these conditions.

route *name*—Name of the flow route.

standard—Specify to use version 7 or later of the flow-specification algorithm.

term-order (legacy | standard)—Specify the version of the flow-specification algorithm.

- **legacy**—Use version 6 of the flow-specification algorithm.
- **standard**—Use version 7 of the flow-specification algorithm.

then—Actions to take on matching packets.

The remaining statements are explained separately.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Flow Routes*

flow-map

Syntax

```
flow-map flow-map-name {
  bandwidth (bps | adaptive);
  forwarding-cache {
    timeout (never non-discard-entry-only | minutes);
  }
  policy [ policy-names ];
  redundant-sources [ addresses ];
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances routing-instance-name
  routing-options multicast],
[edit logical-systems logical-system-name routing-options multicast],
[edit routing-instances routing-instance-name routing-options multicast],
[edit routing-options multicast]
```

Release Information
Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description
Configure multicast flow maps.

Options
flow-map-name—Name of the flow-map.

The remaining statements are explained separately.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring a Multicast Flow Map*

forwarding-cache (Flow Maps)

Syntax

```
forwarding-cache {
   timeout (minutes | never non-discard-entry-only );
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast flow-map *flow-map-name*],
[edit logical-systems *logical-system-name* routing-options multicast flow-map *flow-map-name*],
[edit routing-instances *routing-instance-name* routing-options multicast flow-map *flow-map-name*],
[edit routing-options multicast flow-map *flow-map-name*]

Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure multicast forwarding cache properties for the flow map.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

forwarding-cache (Multicast)

Syntax

```
forwarding-cache {
  allow-maximum;
  family (inet | inet6) {
    threshold {
      log-warning value;
      suppress value <reuse value>;
    }
  }
  threshold {
    log-warning value;
    suppress value <reuse value>;
  }
  timeout minutes;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options multicast]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure multicast forwarding cache properties. These properties include threshold suppression and reuse limits, the threshold at which a warning message is logged, and timeout values.

Specify a value for the threshold at which to suppress new multicast forwarding cache entries and an optional reuse value for the threshold at which the router begins to create new multicast forwarding cache entries. The range for both is from 1 through 200,000. If configured, the reuse value should be less than the suppression threshold value. The suppression value is mandatory. If you do not specify the optional reuse value, then the number of multicast forwarding cache entries is limited to the suppression value. A new entry is created as soon as the number of multicast forwarding cache entries falls below the suppression value.

You can configure the thresholds globally for the multicast forwarding cache or individually for the IPv4 and IPv6 multicast forwarding caches. Configuring the **threshold** statement globally for the multicast forwarding cache or including the **family** statement to configure the thresholds for the IPv4 and IPv6 multicast forwarding caches are mutually exclusive.

Default

By default, there are no limits on the number of multicast forwarding cache entries.

Options

family (inet | inet6)—(Optional) Apply the configured thresholds to either IPv4 or IPv6 multicast forwarding cache entries.

Default: By default, the configured thresholds are applied to both IPv4 and IPv6 multicast forwarding cache entries.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring the Multicast Forwarding Cache*

forwarding-table

Syntax

```
forwarding-table {
  export [ policy--names ];
  (indirect-next-hop | no-indirect-next-hop);
}
```

Hierarchy Level [edit logical-systems *logical-system-name* routing-options],
[edit routing-options]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure information about the routing device's forwarding table.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring Per-Packet Load Balancing on page 2310

generate

Syntax

```
generate {
  defaults {
    generate-options;
  }
  route destination-prefix {
    policy policy-name;
    generate-options;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name*],
[edit routing-options],
[edit routing-options rib *routing-table-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure generated routes, which are used as routes of last resort.

Options

defaults—(Optional) Specify global generated route options. These options only set default attributes inherited by all newly created generated routes. These are treated as global defaults and apply to all the generated routes you configure in the **generate** statement.

generate-options—Additional information about generated routes, which is included with the route when it is installed in the routing table. Specify zero or more of the following options in ***generate-options***. Each option is explained separately.

- **(active | passive);**
- **as-path <*as-path*> <origin (egp | igp | incomplete)> <atomic-aggregate> <aggregator *as-number in-address*>;**
- **(brief | full);**
- **community [*community-ids*];**
- **discard;**
- **(metric | metric2 | metric3 | metric4) *value* <type *type*>;**
- **(preference | preference2 | color | color2) *preference* <type *type*>;**
- **tag *string*;**

route *destination-prefix*—Configure a non-default generated route:

- **default**—For the default route to the destination. This is equivalent to specifying an IP address of **0.0.0.0/0**.

- ***destination-prefix/prefix-length***—*/**destination-prefix*** is the network portion of the IP address, and ***prefix-length*** is the destination prefix length.

The policy statement is explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Conditionally Generating Static Routes*

import (Routing Options)

Syntax import [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options resolution rib],
[edit logical-systems *logical-system-name* routing-options resolution rib],
[edit routing-instances *routing-instance-name* routing-options resolution rib],
[edit routing-options resolution rib]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify one or more import policies to use for route resolution.

Options ***policy-names***—Name of one or more import policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Route Resolution on PE Routers*

import-policy

Syntax import-policy [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib-groups *group-name*],
[edit logical-systems *logical-system-name* routing-options rib-groups *group-name*],
[edit routing-instances *routing-instance-name* routing-options rib-groups *group-name*],
[edit routing-options rib-groups *group-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Apply one or more policies to routes imported into the routing table group. The **import-policy** statement complements the **import-rib** statement and cannot be used unless you first specify the routing tables to which routes are being imported.

NOTE: On EX Series switches, only dynamically learned routes can be imported from one routing table group to another.

Options *policy-names*—Name of one or more policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Exporting Specific Routes from One Routing Table Into Another Routing Table*
- export-rib on page 2365
- *passive*

import-rib

Syntax import-rib [*routing-table-names*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib-groups *group-name*],
[edit logical-systems *logical-system-name* routing-options rib-groups *group-name*],
[edit routing-instances *routing-instance-name* routing-options rib-groups *group-name*],
[edit routing-options rib-groups *group-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify the name of the routing table into which Junos OS should import routing information. The first routing table name you enter is the primary routing table. Any additional names you enter identify secondary routing tables. When a protocol imports routes, it imports them into the primary and any secondary routing tables. If the primary route is deleted, the secondary route also is deleted. For IPv4 import routing tables, the primary routing table must be **inet.0** or **routing-instance-name.inet.0**. For IPv6 import routing tables, the primary routing table must be **inet6.0**.

In Junos OS Release 9.5 and later, you can configure an IPv4 import routing table that includes both IPv4 and IPv6 routing tables. Including both types of routing tables permits you, for example, to populate an IPv6 routing table with IPv6 addresses that are compatible with IPv4. In releases prior to Junos OS Release 9.5, you could configure an import routing table with only either IPv4 or IPv6 routing tables.

NOTE: On EX Series switches, only dynamically learned routes can be imported from one routing table group to another.

Options *routing-table-names*—Name of one or more routing tables.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Exporting Specific Routes from One Routing Table Into Another Routing Table*
- export-rib on page 2365
- *passive*

indirect-next-hop

Syntax (indirect-next-hop | no-indirect-next-hop);

Hierarchy Level [edit logical-systems *logical-system-name* routing-options forwarding-table],
[edit routing-options forwarding-table]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Enable indirectly connected next hops for route convergence. This statement is implemented on the Packet Forward Engine to speed up forwarding information base (FIB) updates. Configuring this statement significantly speeds convergence times. The only downside of configuring this statement is that some additional FIB memory overhead is required. Unless routes have an extremely high number of next hops, this increased memory usage should not be noticeable.

NOTE:

- When virtual private LAN service (VPLS) is configured on the routing device, the **indirect-next-hop** statement is configurable at the **[edit routing-options forwarding-table]** hierarchy level. However, this configuration is not applicable to indirect nexthops specific to VPLS routing instances.
- By default, the Junos Trio Modular Port Concentrator (MPC) chipset on MX Series routers is enabled with indirectly connected next hops, and this cannot be disabled using the **no-indirect-next-hop** statement.

Default Disabled.

Options **indirect-next-hop**—Enable indirectly connected next hops.

no-indirect-next-hop—Explicitly disable indirect next hops.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Optimizing Route Reconvergence by Enabling Indirect Next Hops on the Packet Forwarding Engine*

install (Routing Options)

Syntax (install | no-install);

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options static (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit logical-systems *logical-system-name* routing-options static (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options static (defaults | route)],
[edit routing-options rib *routing-table-name* static (defaults | route)]
[edit routing-options static (defaults | route)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure whether Junos OS installs all static routes into the forwarding table. Even if you configure a route so it is not installed in the forwarding table, the route is still eligible to be exported from the routing table to other protocols.

Options **install**—Explicitly install all static routes into the forwarding table. Include this statement when configuring an individual route in the **route** portion of the **static** statement to override a **no-install** option specified in the **defaults** portion of the statement.

no-install—Do not install the route into the forwarding table, even if it is the route with the lowest preference.

Default: install

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Examples: Configuring Static Routes*
- *static*

instance-type

Syntax instance-type virtual-router

Hierarchy Level [edit routing-instances]

Release Information Statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify the type of routing instance.

Options **virtual-router**—Virtual router routing instance.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Using Virtual Routing Instances to Route Among VLANs on EX Series Switches*
- *Configuring Virtual Routing Instances (CLI Procedure)*
- Configuring Virtual Router Routing Instances on page 2313

interface (Multicast Static Routes)

Syntax

```
interface interface-names {
  disable;
  maximum-bandwidth bps;
  no-qos-adjust;
  reverse-oif-mapping {
    no-qos-adjust;
  }
  subscriber-leave-timer seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options multicast]

Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Enable multicast traffic on an interface.

By default, multicast packets are forwarded by enabling Protocol Independent Multicast (PIM) on an interface. PIM adds multicast routes into the routing table.

You can also configure multicast packets to be forwarded over a static route, such as a static route associated with an LSP next hop. Multicast packets are accepted on an interface and forwarded over a static route in the forwarding table. This is useful when you want to enable multicast traffic on a specific interface without configuring PIM on the interface.

You cannot enable multicast traffic on an interface and configure PIM on the same interface simultaneously.

Static routes must be configured before you can enable multicast on an interface. Configuring the **interface** statement alone does not install any routes into the routing table. This feature relies on the static route configuration.

Options

interface-names—Name of one or more interfaces on which to enable multicast traffic.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Defining Interface Bandwidth Maximums*
- *Example: Configuring Multicast with Subscriber VLANs*

interface (Routing Instances)

Syntax interface *interface-name*;

Hierarchy Level [edit routing-instances]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description For virtual router routing instances, configure an interface.

NOTE:

- You must configure only interfaces from the Node devices assigned to the network Node group. If you try to configure interfaces from the Node devices assigned to server Node groups, the configuration does not commit.
- You can configure an interface for one routing instance only.

Options *interface-name*—Name of an interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Virtual Router Routing Instances on page 2313

interface (Routing Options)

Syntax

```
interface interface-names {
  maximum-bandwidth bps;
  no-qos-adjust;
  reverse-oif-mapping {
    no-qos-adjust;
  }
  subscriber-leave-timer seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options multicast]

Release Information

Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Enable multicast traffic on an interface.

TIP: You cannot enable multicast traffic on an interface by using the **routing-options multicast interface** statement and configure PIM on the interface.

Options

interface-name—Names of the physical or logical interface.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Defining Interface Bandwidth Maximums*
- *Example: Configuring Multicast with Subscriber VLANs*

interface-routes

Syntax

```
interface-routes {
  family (inet | inet6) {
    export {
      lan;
      point-to-point;
    }
  }
  rib-group group-name;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

NOTE: On EX Series switches, only dynamically learned routes can be imported from one routing table group to another.

Description

Associate a routing table group with the routing device's interfaces, and specify routing table groups into which interface routes are imported.

By default, IPv4 interface routes (also called direct routes) are imported into routing table **inet.0,** and IPv6 interface routes are imported into routing table **inet6.0**. If you are configuring alternate routing tables for use by some routing protocols, it might be necessary to import the interface routes into the alternate routing tables. To define the routing tables into which interface routes are imported, you create a routing table group and associate it with the routing device's interfaces.

To create the routing table groups, include the **passive** statement at the **[edit routing-options]** hierarchy level.

If you have configured a routing table, configure the OSPF primary instance at the **[edit protocols ospf]** hierarchy level with the statements needed for your network so that routes are installed in **inet.0** and in the forwarding table. Make sure to include the routing table group.

To export local routes, include the **export** statement.

To export LAN routes, include the **lan** option. To export point-to-point routes, include the **point-to-point** option.

Only local routes on point-to-point interfaces configured with a destination address are exportable.

Options **inet**—Specify the IPv4 address family.

inet6—Specify the IPv6 address family.

lan—Export LAN routes.

point-to-point—Export point-to-point routes.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Importing Direct and Static Routes Into a Routing Instance*
- *Example: Configuring Multiple Routing Instances of OSPF*
- *passive*

local-address (Routing Options)

Syntax local-address *address*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast backup-pe-group *group-name*],
[edit logical-systems *logical-system-name* routing-options multicast backup-pe-group *group-name*],
[edit routing-instances *routing-instance-name* routing-options multicast backup-pe-group *group-name*],
[edit routing-options multicast backup-pe-group *group-name*]

Release Information Statement introduced in Junos OS Release 9.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the address of the local PE for ingress PE redundancy when point-to-multipoint LSPs are used for multicast distribution.

Options ***address***—Address of local PEs in the backup group.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Ingress PE Redundancy*

martians

Syntax

```
martians {
  destination-prefix match-type <allow>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name*],
[edit logical-systems *logical-system-name* routing-options],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name*],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name*],
[edit routing-options],
[edit routing-options rib *routing-table-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure martian addresses.

Options

allow—(Optional) Explicitly allow a subset of a range of addresses that has been disallowed. The **allow** option is the only supported action.

destination-prefix—Destination route you are configuring:

- ***destination-prefix/prefix-length***—***destination-prefix*** is the network portion of the IP address, and ***prefix-length*** is the destination prefix length.
- **default**—Default route to use when routing packets do not match a network or host in the routing table. This is equivalent to specifying the IP address **0.0.0.0/0**.

match-type—Criteria that the destination must match:

- **exact**—Exactly match the route's mask length.
- **longer**—The route's mask length is greater than the specified mask length.
- **orlonger**—The route's mask length is equal to or greater than the specified mask length.
- **through *destination-prefix***—The route matches the first prefix, the route matches the second prefix for the number of bits in the route, and the number of bits in the route is less than or equal to the number of bits in the second prefix.
- **upto *prefix-length***—The route's mask length falls between the two destination prefix lengths, inclusive.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Martian Addresses*

maximum-bandwidth (Routing Options)

Syntax maximum-bandwidth *bps*;

Hierarchy Level
[edit dynamic-profiles *profile-name* routing-instances *instance-name* routing-options multicast interface *interface-name*],
[edit dynamic-profiles *profile-name* routing-options multicast interface *interface-name*]
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast interface *interface-name*],
[edit logical-systems *logical-system-name* routing-options multicast interface *interface-name*],
[edit routing-instances *routing-instance-name* routing-options multicast interface *interface-name*],
[edit routing-options multicast interface *interface-name*]

Release Information
Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
dynamic-profiles hierarchy level added in Junos OS Release 11.2.

Description Configure the multicast bandwidth for the interface.

Options *bps*—Bandwidth rate, in bits per second, for the multicast interface.

Range: 0 through any amount of bandwidth

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Defining Interface Bandwidth Maximums*

maximum-paths

Syntax maximum-paths *path-limit* <log-interval *seconds*> <log-only | threshold *value*>;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-options]

Release Information Statement introduced in Junos OS Release 8.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure a limit for the number of routes installed in a routing table based upon the route path.

NOTE: The **maximum-paths** statement is similar to the **maximum-prefixes** statement. The **maximum-prefixes** statement limits the number of unique destinations in a routing instance. For example, suppose a routing instance has the following routes:

```
OSPF 10.10.10.0/24
ISIS 10.10.10.0/24
```

These are two routes, but only one destination (prefix). The **maximum-paths** limit applies the total number of routes (two). The **maximum-prefixes** limit applies to the total number of unique prefixes (one).

Options **log-interval** ***seconds***—(Optional) Minimum time interval (in seconds) between log messages.

Range: 5 through 86,400

log-only—(Optional) Sets the route limit as an advisory limit. An advisory limit triggers only a warning, and additional routes are not rejected.

path-limit—Maximum number of routes. If this limit is reached, a warning is triggered and additional routes are rejected.

Range: 1 through 4,294,967,295 ($2^{32} - 1$)

Default: No default

threshold ***value***—(Optional) Percentage of the maximum number of routes that starts triggering a warning. You can configure a percentage of the ***path-limit*** value that starts triggering the warnings.

Range: 1 through 100

NOTE: When the number of routes reaches the **threshold** value, routes are still installed into the routing table while warning messages are sent. When the number of routes reaches the ***path-limit*** value, then additional routes are rejected.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Limiting the Number of Paths and Prefixes Accepted from CE Routers in Layer 3 VPNs*

maximum-prefixes

Syntax maximum-prefixes *prefix-limit* <log-interval *seconds*> <log-only | threshold *percentage*>;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-options]

Release Information Statement introduced in Junos OS Release 8.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure a limit for the number of routes installed in a routing table based upon the route prefix.

Using a prefix limit, you can curtail the number of prefixes received from a CE router in a VPN. Prefix limits apply only to dynamic routing protocols and are not applicable to static or interface routes.

NOTE: The **maximum-prefixes** statement is similar to the **maximum-paths** statement. The **maximum-prefixes** statement limits the number of unique destinations in a routing instance. For example, suppose a routing instance has the following routes:

```
OSPF 10.10.10.0/24
ISIS 10.10.10.0/24
```

These are two routes, but only one destination (prefix). The **maximum-paths** limit applies the total number of routes (two). The **maximum-prefixes** limit applies to the total number of unique prefixes (one).

Options **log-interval *seconds***—(Optional) Minimum time interval (in seconds) between log messages.

Range: 5 through 86,400

log-only—(Optional) Sets the prefix limit as an advisory limit. An advisory limit triggers only a warning, and additional routes are not rejected.

prefix-limit—Maximum number of route prefixes. If this limit is reached, a warning is triggered and any additional routes are rejected.

Range: 1 through 4,294,967,295

Default: No default

threshold *value*—(Optional) Percentage of the maximum number of prefixes that starts triggering a warning. You can configure a percentage of the ***prefix-limit*** value that starts triggering the warnings.

Range: 1 through 100

NOTE: When the number of routes reaches the **threshold** value, routes are still installed into the routing table while warning messages are sent. When the number of routes reaches the ***prefix-limit*** value, then additional routes are rejected.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Limiting the Number of Paths and Prefixes Accepted from CE Routers in Layer 3 VPNs*

med-igp-update-interval

Syntax med-igp-update-interval *minutes*;

Hierarchy Level [edit routing-options]

Release Information
Statement introduced in Junos OS Release 9.0
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure a timer for how long to delay updates for the multiple exit discriminator (MED) path attribute for BGP groups and peers configured with the **metric-out igp *offset* delay-med-update** statement. The timer delays MED updates for the interval configured unless the MED is lower than the previously advertised attribute or another attribute associated with the route has changed or if the BGP peer is responding to a refresh route request.

Options *minutes*—Interval to delay MED updates.

Range: 10 through 600

Default: 10 minutes

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Associating the MED Path Attribute with the IGP Metric and Delaying MED Updates on page 2730
- metric-out on page 3073

metric (Aggregate, Generated, or Static Route)

Syntax (metric | metric2 | metric3 | metric4) *metric* <type *type*>;

Hierarchy Level [edit logical-systems *logical-system-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit routing-options (aggregate | generate | static) (defaults | route)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Specify the metric value for an aggregate, generated, or static route. You can specify up to four metric values, starting with **metric** (for the first metric value) and continuing with **metric2**, **metric3**, and **metric4**.

Options *metric*—Metric value.

Range: 0 through 4,294,967,295 ($2^{32} – 1$)

type ***type***—(Optional) Type of route.

When routes are exported to OSPF, type 1 routes are advertised in type 1 externals, and routes of any other type are advertised in type 2 externals. Note that if a qualified-next-hop metric value is configured, this value overrides the route metric.

Range: 1 through 16

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Summarizing Static Routes Through Route Aggregation*
- *Example: Conditionally Generating Static Routes*
- aggregate on page 2342
- generate on page 2372
- *static*

multicast (Routing Options)

Syntax

```
multicast {
  forwarding-cache {
    threshold suppress value <reuse value>;
  }
  interface interface-name {
    enable;
  }
  scope scope-name {
    interface [ interface-names ];
    prefix destination-prefix;
  }
  ssm-groups {
    address;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure generic multicast properties.

NOTE: You cannot apply a scoping policy to a specific routing instance. All scoping policies are applied to all routing instances. However, you can apply the scope statement to a specific routing instance.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Examples: Configuring Administrative Scoping*
- Example: Configuring Source-Specific Multicast Groups with Any-Source Override on page 4103
- *Examples: Configuring the Multicast Forwarding Cache*
- *Multicast Protocols Feature Guide for Routing Devices*
- (indirect-next-hop on page 2376 | no-indirect-next-hop)

no-qos-adjust

Syntax no-qos-adjust;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast interface *interface-name* reverse-oif-mapping],
[edit logical-systems *logical-system-name* routing-options multicast interface *interface-name*],
[edit logical-systems *logical-system-name* routing-options multicast interface *interface-name* reverse-oif-mapping],
[edit routing-instances *routing-instance-name* routing-options multicast interface *interface-name*],
[edit routing-instances *routing-instance-name* routing-options multicast interface *interface-name* reverse-oif-mapping],
[edit routing-options multicast interface *interface-name*],
[edit routing-options multicast interface *interface-name* reverse-oif-mapping]

Release Information Statement introduced in Junos OS Release 9.5.
Statement introduced in Junos OS Release 9.5 for EX Series switches.
Statement added to **[edit routing-instances *routing-instance-name* routing-options multicast interface *interface-name*]**, **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast interface *interface-name*]**, and **[edit routing-options multicast interface *interface-name*]** hierarchy levels in Junos OS Release 9.6.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Disable hierarchical bandwidth adjustment for all subscriber interfaces that are identified by their MLD or IGMP request from a specific multicast interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Multicast with Subscriber VLANs*

options (Routing Options)

Syntax

```
options {
  syslog (level level | upto level level);
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name*
  routing-options],
[edit logical-systems *logical-system-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure the types of system logging messages sent about the routing protocols process to the system message logging file. These messages are also displayed on the system console. You can log messages at a particular level, or up to and including a particular level.

Options

level *level*—Severity of the message. It can be one or more of the following levels, in order of decreasing urgency:

- **alert**—Conditions that should be corrected immediately, such as a corrupted system database.
- **critical**—Critical conditions, such as hard drive errors.
- **debug**—Software debugging messages.
- **emergency**—Panic or other conditions that cause the system to become unusable.
- **error**—Standard error conditions.
- **info**—Informational messages.
- **notice**—Conditions that are not error conditions, but might warrant special handling.
- **warning**—System warning messages.

upto level *level*—Log all messages up to a particular level.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **syslog** in the *Junos OS Administration Library for Routing Devices*

pim-to-igmp-proxy

Syntax

```
pim-to-igmp-proxy {
  upstream-interface [ interface-names ];
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options multicast]

Release Information

Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure the rendezvous point (RP) routing device that resides between a customer edge-facing Protocol Independent Multicast (PIM) domain and a core-facing PIM domain to translate PIM join or prune messages into corresponding Internet Group Management Protocol (IGMP) report or leave messages. The routing device then transmits the report or leave messages by proxying them to one or two upstream interfaces that you configure on the RP routing device. Including the **pim-to-igmp-proxy** statement enables you to use IGMP to forward IPv4 multicast traffic across the PIM sparse mode domains.

The remaining statement is explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring PIM-to-IGMP Message Translation*

policy (Aggregate and Generated Routes)

Syntax policy *policy-name*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options (aggregate | generate) (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options (aggregate | generate) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options (aggregate | generate) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)],
[edit routing-options (aggregate | generate) (defaults | route)],
[edit routing-options rib *routing-table-name* (aggregate | generate) (defaults | route)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Associate a routing policy when configuring an aggregate or generated route's destination prefix in the **routes** part of the **aggregate** or **generate** statement. This provides the equivalent of an import routing policy filter for the destination prefix. That is, each potential contributor to an aggregate route, along with any aggregate options, is passed through the policy filter. The policy then can accept or reject the route as a contributor to the aggregate route.

If the contributor is accepted, the policy can modify the default preferences. The contributor with the numerically smallest prefix becomes the most preferred, or *primary*, contributor. A rejected contributor still can contribute to a less specific aggregate route. If you do not specify a policy filter, all candidate routes contribute to an aggregate route.

The following algorithm is used to compare two generated contributing routes in order to determine which one is the primary or preferred contributor:

1. Compare the protocol's **preference** of the contributing routes. The lower the preference, the better the route. This is similar to the comparison that is done while determining the best route for the routing table.
2. Compare the protocol's **preference2** of the contributing routes. The lower **preference2** value is better. If only one route has **preference2**, then this route is preferred.
3. The preference values are the same. Proceed with a numerical comparison of the prefixes' values.
   a. The primary contributor is the numerically smallest prefix value.
   b. If the two prefixes are numerically equal, the primary contributor is the route that has the smallest prefix length value.

At this point, the two routes are the same. The primary contributor does not change. An additional next hop is available for the existing primary contributor.

A rejected contributor still can contribute to less specific generated route. If you do not specify a policy filter, all candidate routes contribute to a generated route.

Options *policy-name*—Name of a routing policy.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Summarizing Routes Through Route Aggregation*
- *Example: Conditionally Generating Static Routes*
- aggregate on page 2342
- generate on page 2372

policy (Flow Maps)

Syntax policy [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast flow-map *flow-map-name*],
[edit logical-systems *logical-system-name* routing-options multicast flow-map *flow-map-name*],
[edit routing-instances *routing-instance-name* routing-options multicast flow-map *flow-map-name*],
[edit routing-options multicast flow-map *flow-map-name*]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure a flow map policy.

Options *policy-names*—Name of one or more policies for flow mapping.

Required Privilege Level routing—To view this statement in the configuration.

policy-options

Syntax

```
policy-options
  application-maps application-map-name {
    application application-name {
      code-points [ aliases ] [ bit-patterns ];
    }
  }
  policy-statement policy-name {
    term term-name {
      from {
        family family-name;
        match-conditions;
        policy subroutine-policy-name;
        prefix-list prefix-list-name;
        prefix-list-filter prefix-list-name match-type <actions>;
        route-filter destination-prefix match-type <actions>;
        source-address-filter source-prefix match-type <actions>;
      }
      to {
        match-conditions;
        policy subroutine-policy-name;
      }
      then actions;
    }
  }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 12.1 for the EX Series.

Description Configure options such as application maps for DCBX application protocol exchange and policy statements.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

policy-statement

Syntax

```
policy-statement policy-name {
  term term-name {
    from {
      family family-name;
      match-conditions;
      policy subroutine-policy-name;
      prefix-list prefix-list-name;
      prefix-list-filter prefix-list-name match-type <actions>;
      route-filter destination-prefix match-type <actions>;
      source-address-filter source-prefix match-type <actions>;
    }
    to {
      match-conditions;
      policy subroutine-policy-name;
    }
    then actions;
  }
}
```

Hierarchy Level

[edit dynamic policy-options],
[edit logical-systems *logical-system-name* policy-options],
[edit policy-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for configuration in the dynamic database introduced in Junos OS Release 9.5.
Support for configuration in the dynamic database introduced in Junos OS Release 9.5 for EX Series switches.
inet-mdt option introduced in Junos OS Release 10.0R2.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
route-target option introduced in Junos OS Release 12.2.

Description

Define a routing policy, including subroutine policies.

A *term* is a named structure in which match conditions and actions are defined. Routing policies are made up of one or more terms. Each routing policy term is identified by a term name. The name can contain letters, numbers, and hyphens (-) and can be up to 255 characters long. To include spaces in the name, enclose the entire name in double quotation marks.

Each term contains a set of match conditions and a set of actions:

- Match conditions are criteria that a route must match before the actions can be applied. If a route matches all criteria, one or more actions are applied to the route.
- Actions specify whether to accept or reject the route, control how a series of policies are evaluated, and manipulate the characteristics associated with a route.

Generally, a router compares a route against the match conditions of each term in a routing policy, starting with the first and moving through the terms in the order in which they are defined, until a match is made and an explicitly configured or default action of

accept or **reject** is taken. If none of the terms in the policy match the route, the router compares the route against the next policy, and so on, until either an action is taken or the default policy is evaluated.

If none of the match conditions of each term evaluates to true, the final action is executed. The final action is defined in an unnamed term. Additionally, you can define a default action (either **accept** or **reject**) that overrides any action intrinsic to the protocol.

The order of match conditions in a term is not relevant, because a route must match all match conditions in a term for an action to be taken.

To list the routing policies under the **[edit policy-options]** hierarchy level by **policy-statement** ***policy-name*** in alphabetical order, enter the **show policy-options** configuration command.

Options ***actions***—(Optional) One or more actions to take if the conditions match. The actions are described in *Configuring Flow Control Actions*.

family ***family-name***—(Optional) Specify an address family protocol. Specify **inet** for IPv4. Specify **inet6** for 128-bit IPv6, and to enable interpretation of IPv6 router filter addresses. For IS-IS traffic, specify **iso**. For IPv4 multicast VPN traffic, specify **inet-mvpn**. For IPv6 multicast VPN traffic, specify **inet6-mvpn**. For multicast-distribution-tree (MDT) IPv4 traffic, specify **inet-mdt**. For BGP route target VPN traffic, specify**route-target**.

NOTE: When family is not specified, the routing device or routing instance uses the address family or families carried by BGP. If multiprotocol BGP (MP-BGP) is enabled, the policy defaults to the protocol family or families carried in the network layer reachability information (NLRI) as configured in the family statement for BGP. If MP-BGP is not enabled, the policy uses the default BGP address family unicast IPv4.

from—(Optional) Match a route based on its source address.

match-conditions—(Optional in **from** statement; required in **to** statement) One or more conditions to use to make a match. The qualifiers are described in *Routing Policy Match Conditions*.

policy ***subroutine-policy-name***—Use another policy as a match condition within this policy. The name identifying the subroutine policy can contain letters, numbers, and hyphens (-) and can be up to 255 characters long. To include spaces in the name, enclose it in quotation marks (“ ”). Policy names cannot take the form **__.*-internal__**, as this form is reserved. For information about how to configure subroutines, see *Understanding Policy Subroutines in Routing Policy Match Conditions*.

policy-name—Name that identifies the policy. The name can contain letters, numbers, and hyphens (-) and can be up to 255 characters long. To include spaces in the name, enclose it in quotation marks (“ ”).

prefix-list ***prefix-list-name*** —Name of a list of IPv4 or IPv6 prefixes.

prefix-list-filter ***prefix-list-name***—Name of a prefix list to evaluate using qualifiers; ***match-type*** is the type of match (see *Configuring Prefix List Filters*), and ***actions*** is the action to take if the prefixes match.

route-filter ***destination-prefix match-type <actions>***—(Optional) List of routes on which to perform an immediate match; ***destination-prefix*** is the IPv4 or IPv6 route prefix to match, ***match-type*** is the type of match (see *Configuring Route Lists*), and ***actions*** is the action to take if the ***destination-prefix*** matches.

source-address-filter ***source-prefix match-type <actions>***—(Optional) Unicast source addresses in multiprotocol BGP (MBGP) and Multicast Source Discovery Protocol (MSDP) environments on which to perform an immediate match. ***source-prefix*** is the IPv4 or IPv6 route prefix to match, ***match-type*** is the type of match (see *Configuring Route Lists*), and ***actions*** is the action to take if the ***source-prefix*** matches.

term ***term-name***—Name that identifies the term. The term name must be unique in the policy. It can contain letters, numbers, and hyphens (-) and can be up to 64 characters long. To include spaces in the name, enclose the entire name in quotation marks (" "). A policy statement can include multiple terms. We recommend that you name all terms. However, you do have the option to include an unnamed term which must be the final term in the policy. To configure an unnamed term, omit the **term** statement when defining match conditions and actions.

to—(Optional) Match a route based on its destination address or the protocols into which the route is being advertised.

then—(Optional) Actions to take on matching routes. The actions are described in *Configuring Flow Control Actions* and *Configuring Actions That Manipulate Route Characteristics*.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *dynamic-db*

ppm

Syntax

```
ppm {
  no-delegate-processing;
}
```

Hierarchy Level [edit logical-systems *logical-system-name* routing-options],
[edit routing-options]

Release Information Statement introduced in Junos OS Release 9.4.
Statement introduced in Junos OS Release 10.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description (M120, M320, MX Series, T Series, TX Matrix routers, M7i and M10i routers with Enhanced CFEB [CFEB-E], EX Series switches, and QFX Series only) Disable distributed periodic packet management (PPM) to the Packet Forwarding Engine (on routers), to access ports (on EX3200 and EX4200 switches, and QFX Series), or to line cards (on EX6200 and EX8200 switches).

After you disable PPM, PPM processing continues to run on the Routing Engine.

In Junos OS Release 8.2, PPM was moved from the Routing Engine to the Packet Forwarding Engine, access ports, or line cards. The **no-delegate-processing** statement disables the default behavior and restores the legacy behavior.

Default Distributed PPM processing is enabled for all protocols that use PPM.

Options **no-delegate-processing**—Disable PPM to the Packet Forwarding Engine, access ports, or line cards. Distributed PPM is enabled by default.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Distributed Periodic Packet Management on an EX Series Switch (CLI Procedure)*
- Configuring Distributed Periodic Packet Management on page 2312

ppm (Ethernet Switching)

Syntax

```
ppm {
  centralized;
}
```

Hierarchy Level [edit protocols lacp]

Release Information Statement introduced in Junos OS Release 10.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.1 for T Series devices.

Description Configure PPM processing options for Link Aggregation Control Protocol (LACP) packets.

This command configures the PPM processing options for LACP packets only. You can disable distributed PPM processing for all packets that use PPM and run all PPM processing on the Routing Engine by configuring the **no-delegate-processing** configuration statement in the **[edit routing-options ppm]** statement hierarchy.

Default Distributed PPM processing is enabled for all packets that use PPM.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Distributed Periodic Packet Management on an EX Series Switch (CLI Procedure)*
- Configuring Distributed Periodic Packet Management on page 2312

preference (Routing Options)

Syntax (preference | preference2 | color | color2) *preference* <type *type*>;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit routing-options (aggregate | generate | static) (defaults | route)],
[edit routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Preference value for a static, aggregate, or generated route. You also can specify a secondary preference value (**preference2**), as well as colors, which are even finer-grained preference values (**color** and **color2**).

If the Junos OS routing table contains a dynamic route to a destination that has a better (lower) preference value than the static, aggregate, or generated route, the dynamic route is chosen as the active route and is installed in the forwarding table.

Options *preference*—Preference value. A lower number indicates a more preferred route.

Range: 0 through 4,294,967,295 ($2^{32} – 1$)

Default: 5 (for static routes), 130 (for aggregate and generated routes)

type *type*—(Optional) Type of route.

Range: 1 through 16

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Examples: Configuring Static Routes*
- *Example: Summarizing Routes Through Route Aggregation*
- *Example: Conditionally Generating Static Routes*
- aggregate on page 2342
- generate on page 2372
- *static*

prefix

Syntax prefix *destination-prefix*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast scope *scope-name*],
[edit logical-systems *logical-system-name* routing-options multicast scope *scope-name*],
[edit routing-instances *routing-instance-name* routing-options multicast scope *scope-name*],
[edit routing-options multicast scope *scope-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure the prefix for multicast scopes.

Options ***destination-prefix***—Address range for the multicast scope.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Examples: Configuring Administrative Scoping*
- *Example: Creating a Named Scope for Multicast Scoping*
- *multicast*

protocols

Syntax

```
protocols {
  bgp {
    ... bgp-configuration ...
  }
  isis {
    ... isis-configuration ...
  }
  ldp {
    ... ldp-configuration ...
  }
  msdp {
    ... msdp-configuration ...
  }
  mstp {
    ... mstp-configuration ...
  }
  ospf {
    domain-id domain-id;
    domain-vpn-tag number;
    route-type-community (iana | vendor);
    ... ospf-configuration ...
  }
  ospf3 {
    domain-id domain-id;
    domain-vpn-tag number;
    route-type-community (iana | vendor);
    ... ospf3-configuration ...
  }
  pim {
    ... pim-configuration ...
  }
  rip {
    ... rip-configuration ...
  }
  ripng {
    ... ripng-configuration ...
  }
  rstp {
    rstp-configuration;
  }
  vstp {
    vstp configuration;
  }
  vpls {
    vpls configuration;
  }
}
```

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name*],
[edit routing-instances *routing-instance-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Support for RIPng introduced in Junos OS Release 9.0.
Statement introduced in Junos OS Release 11.1 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify the protocol for a routing instance. You can configure multiple instances of many protocol types. Not all protocols are supported on the switches. See the switch CLI.

Options

bgp—Specify BGP as the protocol for a routing instance.

isis—Specify IS-IS as the protocol for a routing instance.

ldp—Specify LDP as the protocol for a routing instance.

l2vpn—Specify Layer 2 VPN as the protocol for a routing instance.

msdp—Specify the Multicast Source Discovery Protocol (MSDP) for a routing instance.

mstp—Specify the Multiple Spanning Tree Protocol (MSTP) for a virtual switch routing instance.

ospf—Specify OSPF as the protocol for a routing instance.

ospf3—Specify OSPF version 3 (OSPFv3) as the protocol for a routing instance.

NOTE: OSPFv3 supports the no-forwarding, virtual-router, and vrf routing instance types only.

pim—Specify the Protocol Independent Multicast (PIM) protocol for a routing instance.

rip—Specify RIP as the protocol for a routing instance.

ripng—Specify RIP next generation (RIPng) as the protocol for a routing instance.

rstp—Specify the Rapid Spanning Tree Protocol (RSTP) for a virtual switch routing instance.

vstp—Specify the VLAN Spanning Tree Protocol (VSTP) for a virtual switch routing instance.

vpls—Specify VPLS as the protocol for a routing instance.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Multiple Routing Instances of OSPF*

qualified-next-hop (Static Routes)

Syntax

```
qualified-next-hop (address | interface-name) {
  bfd-liveness-detection {
    authentication {
      algorithm (keyed-md5 | keyed-sha-1 | meticulous-keyed-md5 | meticulous-keyed-sha-1 |
        simple-password);
      key-chain key-chain-name;
      loose-check;
    }
    detection-time {
      threshold milliseconds;
    }
    holddown-interval milliseconds;
    minimum-interval milliseconds;
    minimum-receive-interval milliseconds;
    multiplier number;
    no-adaptation;
    transmit-interval {
      minimum-interval milliseconds;
      threshold milliseconds;
    }
    version (1 | automatic);
  }
  interface interface-name;
  metric metric;
  preference preference;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options static route *destination-prefix*],
[edit logical-systems *logical-system-name* routing-options rib inet6.0 static route *destination-prefix*],
[edit logical-systems *logical-system-name* routing-options static route *destination-prefix*],
[edit routing-instances *routing-instance-name* routing-options static route *destination-prefix*],
[edit routing-options rib inet6.0 static route *destination-prefix*],
[edit routing-options static route *destination-prefix*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure a static route with multiple possible next hops, each of which can have its own preference value, IGP metric that is used when the route is exported into an IGP, and Bidirectional Forwarding Detection (BFD) settings. If multiple links are operational, the one with the most preferred next hop is used. The most preferred next hop is the one with the lowest preference value.

Options

address—IPv4, IPv6, or ISO network address of the next hop.

interface-name—Name of the interface on which to configure an independent metric or preference for a static route. To configure an unnumbered interface as the next-hop interface for a static route, specify **qualified-next-hop *interface-name***, where ***interface-name*** is the name of the IPv4 or IPv6 unnumbered interface.

NOTE: For an Ethernet interface to be configured as the qualified next hop for a static route, it must be an unnumbered interface.

To configure an Ethernet interface as an unnumbered interface, configure the **unnumbered-address *<interface-name>*** statement at the **[edit interfaces *<interface-name>* unit *<logical-unit-number>* family *<family-name>*]** hierarchy level as described in *Configuring an Unnumbered Interface*.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Static Route Preferences and Qualified Next Hops*
- Example: Enabling BFD on Qualified Next Hops in Static Routes on page 2325

readvertise

Syntax (readvertise | no-readvertise);

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options static (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit logical-systems *logical-system-name* routing-options static (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options static (defaults | route)],
[edit routing-options rib *routing-table-name* static (defaults | route)],
[edit routing-options static (defaults | route)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure whether static routes are eligible to be readvertised by routing protocols:

Default Static routes are eligible to be readvertised (that is, exported from the routing table into dynamic routing protocols) if a policy to do so is configured. To mark an IPv4 static route as being ineligible for readvertisement, include the **no-readvertise** statement.

Options **readvertise**—Readvertise static routes. Include the **readvertise** statement when configuring an individual route in the **route** portion of the **static** statement to override a **no-readvertise** option specified in the **defaults** portion of the statement.

no-readvertise—Mark a static route as being ineligible for readvertisement. Include the **no-readvertise** option when configuring the route.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Controlling Static Routes in Routing and Forwarding Tables*
- *static*

redundant-sources

Syntax redundant-sources [*addresses*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast flow-map *flow-map-name*],
[edit logical-systems *logical-system-name* routing-options multicast flow-map *flow-map-name*],
[edit routing-instances *routing-instance-name* routing-options multicast flow-map *flow-map-name*],
[edit routing-options multicast flow-map *flow-map-name*]

Release Information Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure a list of redundant sources for multicast flows defined by a flow map.

Options ***addresses***—List of IPv4 or IPv6 addresses for use as redundant (backup) sources for multicast flows defined by a flow map.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring a Multicast Flow Map*

resolution

Syntax

```
resolution {
  rib routing-table-name {
    import [ policy-names ];
    resolution-ribs [ routing-table-names ];
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure the router to perform custom route resolution on protocol next hops of routes in a certain routing table. The protocol next hop is used to determine the forwarding next-hop.

For example, you might want to direct **inet.2** route resolution to use topology routing tables **:red.inet.0** and **:blue.inet.0** for protocol next-hop IP address lookups. Or you might want to direct bgp.l3vpn.0 to use the information in inet.0 to resolve routes, thus overriding the default behavior, which is to use inet.3.

You can specify up to two routing tables in the resolution-ribs statement. The route resolution scheme first checks the first-listed routing table for the protocol next-hop address. If the address is found, it uses this entry. If it is not found, the resolution scheme checks second-listed routing table. Hence, only one routing table is used for each protocol nexthop address. For example, if you configure **resolution rib bgp.l3vpn.0 resolution-ribs [inet.0 inet.3]**, inet.0 is checked first and then inet.3 is checked.

NOTE: Customizing route resolution might cause the routing protocol process (rpd) to consume more memory resources than it ordinarily would. When you customize route resolution, we recommend that you check the memory resources by running the **show system processes** and the **show task memory** commands. For more information, see *Routing Protocol Process Memory FAQs*.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Route Resolution on PE Routers*
- *Example: Configuring Route Resolution on Route Reflectors*
- *Example: Configuring Multitopology Routing Based on a Multicast Source*

resolution-ribs

Syntax resolution-ribs [*routing-table-names*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options resolution rib],
[edit logical-systems *logical-system-name* routing-options resolution rib],
[edit routing-instances *routing-instance-name* routing-options resolution rib],
[edit routing-options resolution rib]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify one or more routing tables to use for route resolution.

This statement enables you to override the default routing tables that Junos OS uses for route resolution. For example, suppose that the resolution routing table is **inet.3**, but you want to allow fallback resolution through **inet.0**. One example use case is overriding the **bgp.rtarget.0** (**family route-target**) routing table resolution from using only **inet.3** to using both **inet.3** and **inet.0**.

Options ***routing-table-names***—Name of one or more routing tables.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Route Resolution on PE Routers*
- *Example: Configuring Multitopology Routing Based on a Multicast Source*

resolve

Syntax resolve;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options static (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit logical-systems *logical-system-name* routing-options static (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options static (defaults | route)],
[edit routing-options rib *routing-table-name* static (defaults | route)],
[edit routing-options static (defaults | route)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Statically configure routes to be resolved to a next hop that is not directly connected. The route is resolved through the **inet.0** and **inet.3** routing tables.

Default Static routes can point only to a directly connected next hop.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *static*

retain

Syntax (no-retain | retain);

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options static (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit logical-systems *logical-system-name* routing-options static (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* static (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options static (defaults | route)],
[edit routing-options rib *routing-table-name* static (defaults | route)],
[edit routing-options static (defaults | route)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure statically configured routes to be deleted from or retained in the forwarding table when the routing protocol process shuts down normally:

Default Statically configured routes are deleted from the forwarding table when the routing protocol process shuts down normally. Doing this greatly reduces the time required to restart a system that has a large number of routes in its routing table.

Options **no-retain**—Delete statically configured routes from the forwarding table when the routing protocol process shuts down normally. To explicitly specify that routes be deleted from the forwarding table, include the **no-retain** statement. Include this statement when configuring an individual route in the **route** portion of the **static** statement to override a **retain** option specified in the **defaults** portion of the statement.

retain—Have a static route remain in the forwarding table when the routing protocol process shuts down normally. Doing this greatly reduces the time required to restart a system that has a large number of routes in its routing table.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Examples: Configuring Static Routes*
- *static*

reverse-oif-mapping

Syntax

```
reverse-oif-mapping {
  no-qos-adjust;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast interface *interface-name*],
[edit logical-systems *logical-system-name* routing-options multicast interface *interface-name*],
[edit routing-instances *routing-instance-name* routing-options multicast interface *interface-name*],
[edit routing-options multicast interface *interface-name*]

Release Information

Statement introduced in Junos OS Release 9.2.
Statement introduced in Junos OS Release 9.2 for EX Series switches.
The **no-qos-adjust** statement added in Junos OS Release 9.5.
The **no-qos-adjust** statement introduced in Junos OS Release 9.5 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Enable the routing device to identify a subscriber VLAN or interface based on an IGMP or MLD request it receives over the multicast VLAN.

The remaining statement is explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Multicast with Subscriber VLANs*

rpf-check-policy (Routing Options RPF)

Syntax rpf-check-policy [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options multicast]

Release Information Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Apply policies for disabling RPF checks on arriving multicast packets. The policies must be correctly configured.

Options ***policy-names***—Name of one or more multicast RPF check policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring RPF Policies*

rib (General)

Syntax

```
rib routing-table-name {
  aggregate {
    defaults {
      ... aggregate-options ...
    }
    route destination-prefix {
      policy policy-name;
      ... aggregate-options ...
    }
    generate {
      defaults {
        generate-options;
      }
      route destination-prefix {
        policy policy-name;
        generate-options;
      }
    }
    martians {
      destination-prefix match-type <allow>;
    }
  }
  static {
    defaults {
      static-options;
    }
    rib-group group-name;
    route destination-prefix {
      next-hop;
      static-options;
    }
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Create a routing table.

Explicitly creating a routing table with ***routing-table-name*** is optional if you are not adding any static, martian, aggregate, or generated routes to the routing table and if you also are creating a routing table group.

NOTE: The IPv4 multicast routing table (**inet.1**) and the IPv6 multicast routing table (**inet6.1**) are not supported for this statement.

Default

If you do not specify a routing table name with the ***routing-table-name*** option, the software uses the default routing tables, which are **inet.0** for unicast routes and **inet.1** for the multicast cache.

Options

routing-table-name—Name of the routing table, in the following format: ***protocol*** [***.identifier***].

In a routing instance, the routing table name must include the routing instance name. For example, if the routing instance name is **link0**, the routing table name might be **link0.inet6.0**.

- ***protocol*** is the protocol family. It can be **inet6** for the IPv6 family, **inet** for the IPv4 family, **iso** for the ISO protocol family, or ***instance-name*.iso.0** for an ISO routing instance.
- ***identifier*** is a positive integer that specifies the instance of the routing table.

Default: inet.0

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Creating Routing Tables*
- *passive*

rib (Route Resolution)

Syntax

```
rib routing-table-name {
  import [ policy-names ];
  resolution-ribs [ routing-table-names ];
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options resolution],
[edit logical-systems *logical-system-name* routing-options resolution],
[edit routing-instances *routing-instance-name* routing-options resolution],
[edit routing-options resolution]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Specify a routing table name for route resolution.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Route Resolution on PE Routers*

rib-group (Routing Options)

Syntax rib-group *group-name*;

Hierarchy Level
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options interface-routes],
[edit logical-systems *logical-system-name* routing-options interface-routes],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* static],
[edit logical-systems *logical-system-name* routing-options static],
[edit routing-instances *routing-instance-name* routing-options interface-routes],
[edit routing-options interface-routes],
[edit routing-options rib *routing-table-name* static],
[edit routing-options static]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure which routing table groups interface routes are imported into.

Options ***group-name***—Name of the routing table group. The name must start with a letter and can include letters, numbers, and hyphens. It generally does not make sense to specify more than a single routing table group.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Importing Direct and Static Routes Into a Routing Instance*
- *Example: Exporting Specific Routes from One Routing Table Into Another Routing Table*
- interface-routes on page 2382
- rib-groups on page 2422

rib-groups

Syntax

```
rib-groups {
  group-name {
    export-rib group-name;
    import-policy [ policy-names ];
    import-rib [ group-names ];
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options],
[edit routing-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Group one or more routing tables to form a routing table group. A routing protocol can import routes into all the routing tables in the group and can export routes from a single routing table.

Each routing table group must contain one or more routing tables that Junos OS uses when importing routes (specified in the **import-rib** statement) and optionally can contain one routing table group that Junos OS uses when exporting routes to the routing protocols (specified in the **export-rib** statement).

The first routing table you specify is the *primary routing table*, and any additional routing tables are the *secondary routing tables*.

The primary routing table determines the address family of the routing table group. To configure an IP version 4 (IPv4) routing table group, specify **inet.0** as the primary routing table. To configure an IP version 6 (IPv6) routing table group, specify **inet6.0** as the primary routing table. If you configure an IPv6 routing table group, the primary and all secondary routing tables must be IPv6 routing tables (**inet6.*x***).

In Junos OS Release 9.5 and later, you can include both IPv4 and IPv6 routing tables in an IPv4 import routing table group using the **import-rib** statement. In releases prior to Junos OS Release 9.5, you can only include either IPv4 or IPv6 routing tables in the same **import-rib** statement. The ability to configure an import routing table group with both IPv4 and IPv6 routing tables enables you, for example, to populate the **inet6.3** routing table with IPv6 addresses that are compatible with IPv4. Specify **inet.0** as the primary routing table, and specify **inet6.3** as a secondary routing table.

NOTE: On EX Series switches, only dynamically learned routes can be imported from one routing table group to another.

NOTE: If you configure an import routing table group that includes both IPv4 and IPv6 routing tables, any corresponding export routing table group must include only IPv4 routing tables.

If you have configured a routing table, configure the OSPF primary instance at the **[edit protocols ospf]** hierarchy level with the statements needed for your network so that routes are installed in **inet.0** and in the forwarding table. Make sure to include the routing table group. For more information, see *Example: Configuring Multiple Routing Instances of OSPF*.

After specifying the routing table from which to import routes, you can apply one or more policies to control which routes are installed in the routing table group. To apply a policy to routes being imported into the routing table group, include the **import-policy** statement.

Options *group-name*—Name of the routing table group. The name must start with a letter and can include letters, numbers, and hyphens.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Exporting Specific Routes from One Routing Table Into Another Routing Table*
- rib-group on page 2421

route-record

Syntax route-record;

Hierarchy Level [edit logical-systems *logical-system-name* routing-options],
[edit routing-options]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Export the AS path and routing information to the traffic sampling process.

Before you can perform flow aggregation, the routing protocol process must export the AS path and routing information to the sampling process.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Enabling Flow Aggregation*
- *Junos OS Services Interfaces Library for Routing Devices*

router-id

Syntax

router-id *address*;

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Specify the routing device's IP address.

The router identifier is used by BGP and OSPF to identify the routing device from which a packet originated. The router identifier usually is the IP address of the local routing device. If you do not configure a router identifier, the IP address of the first interface to come online is used. This is usually the loopback interface. Otherwise, the first hardware interface with an IP address is used.

NOTE: **We strongly recommend that you configure the router identifier under the [edit routing-options] hierarchy level to avoid unpredictable behavior if the interface address on a loopback interface changes.**

For more information about the router identifier in OSPF, see "Example: Configuring an OSPF Router Identifier" on page 3380.

Options

address—IP address of the routing device.

Default: Address of the first interface encountered by Junos OS

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Examples: Configuring External BGP Peering on page 2639
- Examples: Configuring Internal BGP Peering on page 2662

routing-instances

Syntax

```
routing-instances routing-instance-name {
    description;
    instance-type virtual-router;
    interface interface-name;
    protocols;
    routing-options
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description (QFabric switches only) Configure a virtual router routing instance.

Options *routing-instance-name*—Name of this routing instance.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Virtual Router Routing Instances on page 2313

routing-options

Syntax routing-options { ... }

Hierarchy Level [edit],
[edit routing-instances *routing-instance-name*]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure protocol-independent routing properties.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Overview of Routing Options on page 2303
- Understanding Distributed Periodic Packet Management on page 2304
- Example: Configuring SSM Maps for Different Groups to Different Sources on page 4106

scope

Syntax

```
scope scope-name {
   interface [ interface-names ];
   prefix destination-prefix;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options multicast]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure multicast scoping.

Options

scope-name—Name of the multicast scope.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Creating a Named Scope for Multicast Scoping*

scope-policy

Syntax scope-policy [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-options multicast]

NOTE: You can configure a scope policy at these two hierarchy levels only. You cannot apply a scope policy to a specific routing instance, because all scoping policies are applied to all routing instances. However, you can apply the **scope** statement to a specific routing instance at the **[edit routing-instances *routing-instance-name* routing-options multicast]** or **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast]** hierarchy level.

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Apply policies for scoping. The policy must be correctly configured at the **edit policy-options policy-statement** hierarchy level.

Options *policy-names*—Name of one or more multicast scope policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- scope on page 2426
- *Example: Using a Scope Policy for Multicast Scoping*

source-routing

Syntax

```
source-routing {
  (ip | ipv6)
}
```

Hierarchy Level [edit routing-options]

Release Information Statement for IPv6 introduced in Junos OS Release 8.2.
Statement for IPv4 introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Enable source routing.

Source routing allows a sender of a packet to partially or completely specify the route the packet takes through the network. In contrast, in non-source routing protocols, routers in the network determine the path based on the packet's destination.

NOTE: We recommend that you not use source routing. Instead, we recommend that you use policy-based routing or filter-based forwarding to route packets based on source addresses.

Default Disabled

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Filter-Based Forwarding on the Source Address*

static (Routes)

Syntax

```
static {
  defaults {
    static-options;
  }
  rib-group group-name;
  route destination-prefix {
    next-hop address;
    next-hop options;
    qualified-next-hop address {
      metric metric;
      preference preference;
    }
    static-options;
  }
}
```

Hierarchy Level

[edit routing-options],
[edit routing-options rib *routing-table-name*]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure static routes to be installed in the routing table. You can specify any number of routes within a single **static** statement, and you can specify any number of **static** options in the configuration.

Options

defaults—Specify global static route options. These options only set default attributes inherited by all newly created static routes. These are treated as global defaults and apply to all the static routes you configure in the **static** statement. This part of the **static** statement is optional.

route *destination-prefix*—Destination of the static route.

- **defaults**—For the default route to the destination. This is equivalent to specifying an IP address of **0.0.0.0/0**.
- ***destination-prefix/prefix-length*—*destination-prefix*** is the network portion of the IP address, and ***prefix-length*** is the destination prefix length.
- **next-hop *address***—Reach the next-hop routing device by specifying an IP address, an interface name, or an ISO network entity title (NET).
- ***nsap-prefix*—*nsap-prefix*** is the network service access point (NSAP) address for ISO.

next-hop options—Additional information for how to manage forwarding of packets to the next hop.

- **discard**—Do not forward packets addressed to this destination. Instead, drop the packets, do not send ICMP unreachable messages to the packets' originators, and install a reject route for this destination into the routing table.

- ***iso-net***—Reach the next-hop routing device by specifying an ISO NSAP.
- **next-table** ***routing-table-name***—Name of the next routing table to the destination.
- **receive**—Install a receive route for this destination into the routing table.
- **reject**—Do not forward packets addressed to this destination. Instead, drop the packets, send ICMP unreachable messages to the packets' originators, and install a reject route for this destination into the routing table.

static-options—(Optional under **route**) Additional information about static routes, which is included with the route when it is installed in the routing table.

You can specify one or more of the following in ***static-options***. Each of the options is explained separately.

- **(active | passive)**;
- **(install | no-install)**;
- **(metric | metric2 | metric3 | metric4)** ***value*** **<type** ***type*****>**;
- **(preference | preference2 | color | color2)** ***preference*** **<type** ***type*****>**;
- **(resolve | no-resolve)**;
- **(no-retain | retain)**;

The remaining statements are explained separately.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring Static Routing on page 2310

subscriber-leave-timer

Syntax subscriber-leave-timer *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast interface *interface-name*],
[edit logical-systems *logical-system-name* routing-options multicast interface *interface-name*],
[edit routing-instances *routing-instance-name* routing-options multicast interface *interface-name*],
[edit routing-options multicast interface *interface-name*]

Release Information Statement introduced in Junos OS Release 9.2.
Statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Length of time before the multicast VLAN updates QoS data (for example, available bandwidth) for subscriber interfaces after it receives an IGMP leave message.

Options ***seconds***—Length of time before the multicast VLAN updates QoS data (for example, available bandwidth) for subscriber interfaces after it receives an IGMP leave message. Specifying a value of 0 results in an immediate update. This is the same as if the statement were not configured.

Range: 0 through 30

Default: 0 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Multicast with Subscriber VLANs*

tag (Routing Options)

Syntax

tag *metric* type *number*;

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options (aggregate | generate | static) (defaults | route)],
[edit logical-systems *logical-system-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options aggregate | generate | static) (defaults | route)],
[edit routing-instances *routing-instance-name* routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)],
[edit routing-options (aggregate | generate | static) (defaults | route)],
[edit routing-options rib *routing-table-name* (aggregate | generate | static) (defaults | route)]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Associate a tag with a static, aggregate, or generated route.

Default

No tag strings are associated with routes.

Options

metric—Tag metric.

Range: 0 through 4,294,967,295

type *number*—Tag type.

Range: 1 through 16

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Examples: Configuring Static Routes*
- *Example: Summarizing Routes Through Route Aggregation*
- *Example: Conditionally Generating Static Routes*
- aggregate on page 2342
- generate on page 2372
- *static*

threshold (Multicast Forwarding Cache)

Syntax

```
threshold {
  log-warning value;
  suppress value <reuse value>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast forwarding-cache],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast forwarding-cache family (inet | inet6)],
[edit logical-systems *logical-system-name* routing-options multicast forwarding-cache],
[edit logical-systems *logical-system-name* routing-options multicast forwarding-cache family (inet | inet6)],
[edit routing-instances *routing-instance-name* routing-options multicast forwarding-cache],
[edit routing-instances *routing-instance-name* routing-options multicast forwarding-cache (inet | inet6)],
[edit routing-options multicast forwarding-cache],
[edit routing-options multicast forwarding-cache family (inet | inet6)]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure the global suppression, reuse, and warning log message thresholds for multicast forwarding cache limits. You can configure the thresholds globally for the multicast forwarding cache or individually for the IPv4 and IPv6 multicast forwarding caches. Configuring the **threshold** statement globally for the multicast forwarding cache or including the **family** statement to configure the thresholds for the IPv4 and IPv6 multicast forwarding caches are mutually exclusive.

To confirm the configured threshold values, use the **show multicast forwarding-cache statistics** command.

Options

reuse *value*—(Optional) Value at which to begin creating new multicast forwarding cache entries. If configured, this number should be less than the **suppress** value.

Range: 1 through 200,000

suppress *value*—Value at which to begin suppressing new multicast forwarding cache entries. This value is mandatory. This number should be greater than the **reuse** value.

Range: 1 through 200,000

The remaining statement is explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Examples: Configuring the Multicast Forwarding Cache*

timeout (Flow Maps)

Syntax timeout (never non-discard-entry-only | *minutes*);

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast flow-map *flow-map-name*],
[edit logical-systems *logical-system-name* routing-options multicast flow-map *flow-map-name*],
[edit routing-instances *routing-instance-name* routing-options multicast flow-map *flow-map-name*],
[edit routing-options multicast flow-map *flow-map-name*]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure the timeout value for multicast forwarding cache entries associated with the flow map.

Options *minutes*—Length of time that the forwarding cache entry remains active.

Range: 1 through 720

never non-discard-entry-only—Specify that the forwarding cache entry always remain active. If you omit the **non-discard-entry-only** option, all multicast forwarding entries, including those in forwarding and pruned states, are kept forever. If you include the **non-discard-entry-only** option, entries with forwarding states are kept forever, and entries with pruned states time out.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

timeout (Multicast)

Syntax timeout *minutes* <family (inet | inet6)>;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast forwarding-cache],
[edit logical-systems *logical-system-name* routing-options multicast forwarding-cache],
[edit routing-instances *routing-instance-name* routing-options multicast forwarding-cache],
[edit routing-options multicast forwarding-cache]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure the timeout value for multicast forwarding cache entries.

Options *minutes*—Length of time that the forwarding cache limit remains active.

Range: 1 through 720

family (inet | inet6)—(Optional) Apply the configured timeout to either IPv4 or IPv6 multicast forwarding cache entries. Configuring the **timeout** statement globally for the multicast forwarding cache or including the **family** statement to configure the timeout value for the IPv4 and IPv6 multicast forwarding caches are mutually exclusive.

Default: By default, the configured timeout applies to both IPv4 and IPv6 multicast forwarding cache entries.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring the Multicast Forwarding Cache*

traceoptions (Routing Options)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options],
[edit routing-options flow],
[edit routing-options multicast]

Release Information

Statement introduced before Junos OS Release 7.4.
nsr-synchronization flag for BGP, IS-IS, LDP, and OSPF added in Junos OS Release 8.4.
nsr-synchronization and **nsr-packet** flags for BFD sessions added in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
nsr-synchronization flag for RIP and RIPng added in Junos OS Release 9.0.
nsr-synchronization flag for Layer 2 VPNs and VPLS added in Junos OS Release 9.1.
nsr-synchronization flag for PIM added in Junos OS Release 9.3.
nsr-synchronization flag for MPLS added in Junos OS Release 10.1.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
nsr-synchronization flag for MSDP added in Junos OS Release 12.1.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Define tracing operations that track all routing protocol functionality in the routing device.

To specify more than one tracing operation, include multiple **flag** statements.

Default

If you do not include this statement, no global tracing operations are performed.

Options

Values:

disable—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *filename*—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. We recommend that you place global routing protocol tracing output in the file **routing-log**.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. Note that if you specify a maximum number of files, you also must specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 10 files

flag ***flag***—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements. These are the global routing protocol tracing options:

- **all**—All tracing operations
- **condition-manager**—Condition-manager events
- **config-internal**—Configuration internals
- **general**—All normal operations and routing table changes (a combination of the **normal** and **route** trace operations)
- **graceful-restart**—Graceful restart operations
- **normal**—All normal operations
- **nsr-packet**—Detailed trace information for BFD nonstop active routing only
- **nsr-synchronization**—Tracing operations for nonstop active routing
- **nsr-synchronization-detail**—(MPLS only) Tracing operations for nonstop active routing in detail
- **parse**—Configuration parsing
- **policy**—Routing policy operations and actions
- **regex-parse**—Regular-expression parsing
- **route**—Routing table changes
- **state**—State transitions
- **task**—Interface transactions and processing
- **timer**—Timer usage

no-world-readable—(Optional) Prevent any user from reading the log file.

size ***size***—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*****.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*****.0** is renamed ***trace-file*****.1** and ***trace-file*** is renamed ***trace-file*****.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. Note that if you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

Syntax: ***x*****k** to specify KB, ***x*****m** to specify MB, or ***x*****g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 128 KB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation

- *Example: Tracing Global Routing Protocol Operations*
- *Tracing Nonstop Active Routing Synchronization Events*

upstream-interface

Syntax upstream-interface [*interface-names*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast pim-to-igmp-proxy],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast pim-to-mld-proxy],
[edit logical-systems *logical-system-name* routing-options multicast pim-to-igmp-proxy],
[edit logical-systems *logical-system-name* routing-options multicast pim-to-mld-proxy],
[edit routing-instances *routing-instance-name* routing-options multicast pim-to-igmp-proxy],
[edit routing-instances *routing-instance-name* routing-options multicast pim-to-mld-proxy],
[edit routing-options multicast pim-to-igmp-proxy],
[edit routing-options multicast pim-to-mld-proxy]

Release Information Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure at least one, but not more than two, upstream interfaces on the rendezvous point (RP) routing device that resides between a customer edge–facing Protocol Independent Multicast (PIM) domain and a core-facing PIM domain. The RP routing device translates PIM join or prune messages into corresponding IGMP report or leave messages (if you include the **pim-to-igmp-proxy** statement), or into corresponding MLD report or leave messages (if you include the **pim-to-mld-proxy** statement). The routing device then proxies the IGMP or MLD report or leave messages to one or both upstream interfaces to forward IPv4 multicast traffic (for IGMP) or IPv6 multicast traffic (for MLD) across the PIM domains.

Options ***interface-names***—Names of one or two upstream interfaces to which the RP routing device proxies IGMP or MLD report or leave messages for transmission of multicast traffic across PIM domains. You can specify a maximum of two upstream interfaces on the RP routing device. To configure a set of two upstream interfaces, specify the full interface names, including all physical and logical address components, within square brackets ([ ]).

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring PIM-to-IGMP Message Translation*
- *Configuring PIM-to-MLD Message Translation*

CHAPTER 29

Administration

Routine Monitoring

Monitoring Routing Information

Purpose Use the monitoring functionality to view the **inet.0** routing table on the routing device.

Action To view the routing table, enter the following commands in the CLI interface:

- **show route terse**
- **show route detail**

Meaning Table 203 on page 2441 describes the different filters, their functions, and the associated actions.

Table 204 on page 2442 summarizes key output fields in the routing information display.

Table 203: Filtering Route Messages

Field	Function	Your Action
Destination Address	Specifies the destination address of the route.	Enter the destination address.
Next hop address	Specifies the network layer address of the directly reachable neighboring system (if applicable) and the interface used to reach it.	Enter the next hop address.
Best route	Specifies only the best route available.	Select the view details of the best route.
Inactive routes	Specifies the inactive routes.	Select the view details of inactive routes.
Exact route	Specifies the exact route.	Select the view details of the exact route.

Table 203: Filtering Route Messages *(continued)*

Field	Function	Your Action
Hidden routes	Specifies the hidden routes.	Select the view details of hidden routes.
Search	Applies the specified filter and displays the matching messages.	To apply the filter and display messages, click **Search**.

Table 204: Summary of Key Routing Information Output Fields

Field	Values	Additional Information
Static Route Addresses	The list of static route addresses.	
Protocol	Protocol from which the route was learned: **Static**, **Direct**, **Local**.	
Preference	The preference is the individual preference value for the route.	The route preference is used as one of the route selection criteria.
Next-Hop	Network layer address of the directly reachable neighboring system (if applicable) and the interface used to reach it.	If a next hop is listed as **Discard**, all traffic with that destination address is discarded rather than routed. This value generally means that the route is a static route for which the **discard** attribute has been set. If a next hop is listed as **Reject**, all traffic with that destination address is rejected. This value generally means that the address is unreachable. For example, if the address is a configured interface address and the interface is unavailable, traffic bound for that address is rejected. If a next hop is listed as **Local**, the destination is an address on the host (either the loopback address or Ethernet management port 0 address, for example).
Age	How long the route has been active.	
State	Flags for this route.	There are many possible flags.

Related Documentation

- Configuring Static Routing on page 2310

Verifying That Virtual Router Routing Instances Are Working

Purpose After creating a virtual router routing instance, verify that it has been set up properly.

Action

1. Use the **show route instance** command to list all the routing instances and their properties:

   `user@switch>` **show route instance**


```
Instance              Type
         Primary RIB                                  Active/holddown/hidden
master                forwarding
         inet.0                                         4/0/1

__juniper_private1__ forwarding
         __juniper_private1__.inet.0                    1/0/3

__juniper_private2__ forwarding
         __juniper_private2__.inet.0                    0/0/1

__juniper_private3__ forwarding
         __juniper_private3__.inet.0                    1/0/2

__juniper_private4__ forwarding
         __juniper_private4__.inet.0                    4/0/2

__master.anon__       forwarding

r1                  virtual-router

r2                  virtual-router
```

2. Use the **show route forwarding-table** command to view the forwarding table information for each routing instance:

```
user@switch> show route forwarding-table
Routing table: r1---qfabric.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct  1628     1
0.0.0.0/32         perm     0                    dscd  1626     1
224.0.0.0/4        perm     0                    mdsc  1627     1
224.0.0.1/32       perm     0 224.0.0.1          mcst  1623     1
255.255.255.255/32 perm     0                    bcst  1624     1
```

Meaning The output displays the routing table information and confirms that the virtual router routing instances have been created and the links are up.

Related Documentation

- Configuring Virtual Router Routing Instances on page 2313

Operational Commands

- clear ipv6 neighbors
- show as-path
- show as-path domain
- show as-path summary
- show ipv6 neighbors
- show ipv6 router-advertisement
- show route
- show route active-path
- show route all

- show route aspath-regex
- show route best
- show route brief
- show route community
- show route community-name
- show route damping
- show route detail
- show route exact
- show route export
- show route extensive
- show route flow validation
- show route forwarding-table
- show route inactive-path
- show route inactive-prefix
- show route instance
- show route label
- show route label-switched-path
- show route martians
- show route next-hop
- show route no-community
- show route protocol
- show route range
- show route receive-protocol
- show route resolution
- show route snooping
- show route source-gateway
- show route summary
- show route table
- show route terse

clear ipv6 neighbors

Syntax clear ipv6 neighbors
<all | host *hostname*>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.3 for EX Series switches.
Command introduced in Junos OS Release 12.2 for the QFX Series.

Description Clear IPv6 neighbor cache information.

Options **none**—Clear all IPv6 neighbor cache information.

all—(Optional) Clear all IPv6 neighbor cache information.

host ***hostname***—(Optional) Clear the information for the specified IPv6 neighbors.

Required Privilege Level view

Related Documentation

- show ipv6 neighbors on page 2454

List of Sample Output clear ipv6 neighbors on page 2445

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear ipv6 neighbors

```
user@host> clear ipv6 neighbors
```

show as-path

Syntax

show as-path
<brief | detail>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show as-path
<brief | detail>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display the distribution of autonomous system (AS) paths that the local routing device is using (usually through the routing table). Use this command to debug problems for AS paths and to understand how AS paths have been manipulated through a policy (through the **as-path-prepend** action) or through aggregation.

AS paths are stored in a hash table. A hash table is one method for fast lookup. Each entry in the table is called a bucket. Junos OS computes a hash value that indicates in which bucket the AS path is stored. The AS paths are dispersed among the hash buckets so that a manageable number of AS paths is stored in each bucket. Only unique AS paths are stored. Duplicate AS paths increase a reference count, but do not increase the number of AS paths stored in the hash table.

Options

none—Display basic information about AS paths that the local routing device is using (same as brief).

brief | detail—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- show as-path summary on page 2452

List of Sample Output

show as-path on page 2447
show as-path detail on page 2448

Output Fields

Table 205 on page 2446 lists the output fields for the **show as-path** command. Output fields are listed in the approximate order in which they appear.

Table 205: show as-path Output Fields

Field Name	Field Description	Level of Output
Total AS paths	Total number of AS paths.	**brief** none
Bucket	Bucket number.	All levels

Table 205: show as-path Output Fields *(continued)*

Field Name	Field Description	Level of Output
Count	Number of AS path entries in this bucket.	All levels
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **?**—Incomplete; typically, the AS path was aggregated. • **Atomic**—Route is an aggregate of several route prefixes. • **Aggregator**—Routing device has summarized a range of prefixes.	All levels
domain	Number of independent AS domains. The AS paths of an independent AS domain are not shared with the AS paths and AS path attributes of other domains, including the master routing instance domain.	**detail**
neighbor as	AS peer address.	**detail**
length	Length of the AS path.	**detail**
segments	Length of the AS segment descriptor.	**detail**
references	Path reference count.	**detail**

Sample Output

show as-path

```
user@host> show as-path
Total AS paths: 30382
  Bucket 0    Count: 36
    I
    14203 2914 174 31752 I
    14203 2914 701 21512 I
    14203 2914 1239 26632 I
    14203 2914 1239 29704 I
    14203 2914 4323 10248 I
    14203 2914 4766 23560 I
    14203 2914 6395 32776 I
    14203 2914 7911 11272 I
    14203 2914 12180 18440 I
    14203 2914 17408 17416 I
    14203 2914 701 702 24586 I
    14203 2914 1239 4657 9226 I
    14203 2914 1239 7132 16394 I
    14203 2914 1299 8308 34826 I
    14203 2914 3320 5603 28682 I
    14203 2914 3491 1680 33802 I
    14203 2914 3549 7908 27658 I
    14203 2914 3549 20804 30730 I
    14203 2914 7018 2687 9226 I
    14203 2914 174 9318 9318 23564 I
```

```
    14203 2914 701 3786 3786 23564 I
    14203 2914 701 4761 4795 9228 I
    14203 2914 1239 7132 5673 18444 I
    14203 2914 3491 20485 24588 24588 I
    14203 2914 5511 2200 1945 2060 I
    14203 2914 7911 14325 14325 14348 I
    14203 2914 701 4637 9230 9230 9230 I
    14203 2914 6395 14 14 14 14 I
    14203 2914 9299 6163 6163 6163 6163 9232 I
    14203 2914 3356 3356 3356 3356 3356 11955 21522 I
    14203 2914 9837 9837 9219 I Aggregator: 9219 202.27.91.253
    14203 2914 174 30209 30222 30222 30222 ?
    14203 2914 1299 5377 I (Atomic) Aggregator: 5377 193.219.192.22
    14203 2914 4323 36097 I (Atomic) Aggregator: 36097 216.69.252.254
    14203 2914 209 2516 17676 23813 I (Atomic) Aggregator: 23813 219.127.233.66
  Bucket 1    Count: 28
    14203 2914 35847 I
    14203 2914 174 19465 I
    14203 2914 174 35849 I
    14203 2914 2828 32777 I
    14203 2914 4323 14345 I
    14203 2914 4323 29705 I
    14203 2914 6395 32777 I

...
```

show as-path detail

```
user@host> show as-path detail
Total AS paths: 30410
  Bucket 0    Count: 36
    AS path: I
      domain 0, length 0, segments 0, references 54
    AS path: 14203 2914 174 31752 I
      domain 1, neighbor as: 14203, length 4, segments 1, references 2
    AS path: 14203 2914 701 21512 I
      domain 1, neighbor as: 14203, length 4, segments 1, references 2
    AS path: 14203 2914 1239 26632 I
      domain 1, neighbor as: 14203, length 4, segments 1, references 2
    AS path: 14203 2914 1239 29704 I
      domain 1, neighbor as: 14203, length 4, segments 1, references 2
    AS path: 14203 2914 4323 10248 I
      domain 1, neighbor as: 14203, length 4, segments 1, references 2
    AS path: 14203 2914 4766 23560 I
      domain 1, neighbor as: 14203, length 4, segments 1, references 2
    AS path: 14203 2914 6395 32776 I
      domain 1, neighbor as: 14203, length 4, segments 1, references 3
    AS path: 14203 2914 7911 11272 I
      domain 1, neighbor as: 14203, length 4, segments 1, references 2
    AS path: 14203 2914 12180 18440 I
      domain 1, neighbor as: 14203, length 4, segments 1, references 3
    AS path: 14203 2914 17408 17416 I
      domain 1, neighbor as: 14203, length 4, segments 1, references 3
    AS path: 14203 2914 701 702 24586 I
      domain 1, neighbor as: 14203, length 5, segments 1, references 3
    AS path: 14203 2914 1239 4657 9226 I
      domain 1, neighbor as: 14203, length 5, segments 1, references 7
    AS path: 14203 2914 1239 7132 16394 I
      domain 1, neighbor as: 14203, length 5, segments 1, references 2
    AS path: 14203 2914 1299 8308 34826 I
      domain 1, neighbor as: 14203, length 5, segments 1, references 2
```



```
    AS path: 14203 2914 3320 5603 28682 I
      domain 1, neighbor as: 14203, length 5, segments 1, references 2
    AS path: 14203 2914 3491 1680 33802 I
      domain 1, neighbor as: 14203, length 5, segments 1, references 2
    AS path: 14203 2914 3549 7908 27658 I
      domain 1, neighbor as: 14203, length 5, segments 1, references 2
    AS path: 14203 2914 3549 20804 30730 I
      domain 1, neighbor as: 14203, length 5, segments 1, references 2
    AS path: 14203 2914 7018 2687 9226 I
      domain 1, neighbor as: 14203, length 5, segments 1, references 3
    AS path: 14203 2914 174 9318 9318 23564 I
      domain 1, neighbor as: 14203, length 6, segments 1, references 2
    AS path: 14203 2914 701 3786 3786 23564 I
      domain 1, neighbor as: 14203, length 6, segments 1, references 2
    AS path: 14203 2914 701 4761 4795 9228 I
      domain 1, neighbor as: 14203, length 6, segments 1, references 14
    AS path: 14203 2914 1239 7132 5673 18444 I
      domain 1, neighbor as: 14203, length 6, segments 1, references 2
    AS path: 14203 2914 3491 20485 24588 24588 I
      domain 1, neighbor as: 14203, length 6, segments 1, references 4
    AS path: 14203 2914 5511 2200 1945 2060 I
      domain 1, neighbor as: 14203, length 6, segments 1, references 2
    AS path: 14203 2914 7911 14325 14325 14348 I
      domain 1, neighbor as: 14203, length 6, segments 1, references 2
    AS path: 14203 2914 701 4637 9230 9230 9230 I
      domain 1, neighbor as: 14203, length 7, segments 1, references 3
    AS path: 14203 2914 6395 14 14 14 14 I
      domain 1, neighbor as: 14203, length 7, segments 1, references 10
...
```

show as-path domain

Syntax

show as-path domain
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show as-path domain

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display autonomous system (AS) path domain information.

Options

none—(Optional) Display AS path domain information for all routing instances.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show as-path domain on page 2451

Output Fields

Table 206 on page 2450 lists the output fields for the **show as-path domain** command. Output fields are listed in the approximate order in which they appear

Table 206: show as-path domain Output Fields

Field Name	Field Description
Domain	Number of independent AS domains. The AS paths of an independent AS domain are not shared with the AS paths and AS path attributes of other domains, including the master routing instance domain.
Primary	Primary AS number.
References	Path reference count.
***Number* Paths**	Number of known AS paths.
Flags	Information about the AS path: • **ASLoop**—Path contains an AS loop. • **Atomic**—Path includes the ATOMIC_AGGREGATE path attribute. • **Local**—Path was created by local aggregation. • **Master**—Path was created by the master routing instance.
Local AS	AS number of the local routing device.
Loops	How many times this AS number can appear in an AS path.

Sample Output

show as-path domain

```
user@host> show as-path domain
Domain: 1        Primary: 10458
    References:          3 Paths:      30383
    Flags: Master
    Local AS: 10458  Loops: 1
```

show as-path summary

Syntax

show as-path summary
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show as-path summary

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display autonomous system (AS) path summary information.

AS paths are stored in a hash table. A hash table is one method for fast lookup. Each entry in the table is called a bucket. Junos OS computes a hash value that indicates in which bucket the AS path is stored. The AS paths are dispersed among the hash buckets so that a manageable number of AS paths is stored in each bucket. Only unique AS paths are stored. Duplicate AS paths increase a reference count, but do not increase the number of AS paths stored in the hash table.

Options

none—(Optional) Display AS path summary information for all routing instances.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- show as-path on page 2446

List of Sample Output

show as-path summary on page 2453

Output Fields

Table 207 on page 2452 lists the output fields for the **show as-path summary** command. Output fields are listed in the approximate order in which they appear.

Table 207: show as-path summary Output Fields

Field Name	Field Description
AS Paths	Number of AS paths.
Buckets	Number of hash buckets in use.
Max	Maximum number of AS path entries per bucket.
Min	Minimum number of AS path entries per bucket.
Avg	Average number of AS path entries per bucket.
Std deviation	Standard deviation of AS path entries per bucket.

Sample Output

show as-path summary

```
user@host> show as-path summary
AS Paths  Buckets      Max     Min     Avg   Std deviation
   30425     1024       95      12      29        6.481419
```

show ipv6 neighbors

Syntax show ipv6 neighbors

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.3 for EX Series switches.
Command introduced in Junos OS Release 12.2 for the QFX Series.

Description Display information about the IPv6 neighbor cache.

Options This command has no options.

Required Privilege Level view

Related Documentation

- clear ipv6 neighbors on page 2445

List of Sample Output show ipv6 neighbors on page 2454

Output Fields Table 208 on page 2454 describes the output fields for the **show ipv6 neighbors** command. Output fields are listed in the approximate order in which they appear.

Table 208: show ipv6 neighbors Output Fields

Field Name	Field Description
IPv6 Address	Name of the IPv6 interface.
Linklayer Address	Link-layer address.
State	State of the link: **up**, **down**, **incomplete**, **reachable**, **stale**, or **unreachable**.
Exp	Number of seconds until the entry expires.
Rtr	Whether the neighbor is a routing device: **yes** or **no**.
Secure	Whether this entry was created using the Secure Neighbor Discovery (SEND) protocol: **yes** or **no**.
Interface	Name of the interface.

Sample Output

show ipv6 neighbors

```
user@host> show ipv6 neighbors
IPv6 Address                Linklayer Address  State       Exp Rtr Secure
Interface
2001:db8:0:1:2a0:a514:0:24c  00:05:85:8f:c8:bd  stale       546 yes no
fe-1/2/0.1
```



```
fe80::2a0:a514:0:24c         00:05:85:8f:c8:bd  stale       258 yes no
fe-1/2/0.1
fe80::2a0:a514:0:64c         00:05:85:8f:c8:bd  stale       111 yes no
fe-1/2/1.5
fe80::2a0:a514:0:a4c         00:05:85:8f:c8:bd  stale       327 yes no
fe-1/2/2.9
```

show ipv6 router-advertisement

Syntax

show ipv6 router-advertisement
<conflicts>
<interface *interface*>
<logical-system (all | *logical-system-name*)>
<prefix *prefix/prefix length*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.2 for the QFX Series.

Description

Display information about IPv6 router advertisements, including statistics about messages sent and received on interfaces, and information received from advertisements from other routers.

Options

none—Display all IPv6 router advertisement information for all interfaces.

conflicts—(Optional) Display only the IPv6 router advertisement information that is conflicting.

interface *interface*—(Optional) Display IPv6 router advertisement information for the specified interface.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

prefix *prefix/prefix length*—(Optional) Display IPv6 router advertisement information for the specified prefix.

Additional Information

The display identifies conflicting information by enclosing the value the router is advertising in brackets.

Required Privilege Level

view

Related Documentation

- *clear ipv6 router-advertisement*

List of Sample Output

show ipv6 router-advertisement on page 2457
show ipv6 router-advertisement conflicts on page 2458
show ipv6 router-advertisement prefix on page 2458

Output Fields

Table 209 on page 2456 describes the output fields for the **show ipv6 router-advertisement** command. Output fields are listed in the approximate order in which they appear.

Table 209: show ipv6 router-advertisement Output Fields

Field Name	Field Description
Interface	Name of the interface.
Advertisements sent	Number of router advertisements sent and the elapsed time since they were sent.

Table 209: show ipv6 router-advertisement Output Fields *(continued)*

Field Name	Field Description
Solicits received	Number of solicitation messages received.
Advertisements received	Number of router advertisements received.
Advertisements from	Names of interfaces from which router advertisements have been received and the elapsed time since the last one was received.
Managed	Managed address configuration flag: **0** (stateless) or **1** (stateful).
Other configuration	Other stateful configuration flag: **0** (stateless) or **1** (stateful).
Reachable time	Time that a node identifies a neighbor as reachable after receiving a reachability confirmation, in milliseconds.
Default lifetime	Default lifetime, in seconds: from 0 seconds to 18.2 hours. A setting of 0 indicates that the router is not a default router.
Retransmit timer	Time between retransmitted Neighbor Solicitation messages, in milliseconds.
Current hop limit	Configured current hop limit.
Prefix	Name and length of the prefix.
Valid lifetime	How long the prefix remains valid for onlink determination.
Preferred lifetime	How long the prefix generated by stateless autoconfiguration remains preferred.
On link	Onlink flag: **0** (not onlink) or **1** (onlink).
Autonomous	Autonomous address configuration flag: **0** (not autonomous) or **1** (autonomous).

Sample Output

show ipv6 router-advertisement

```
user@host> show ipv6 router-advertisement
Interface: fe-0/1/1.0
  Advertisements sent: 0
  Solicits received: 0
  Advertisements received: 0
Interface: fxp0.0
  Advertisements sent: 0
  Solicits received: 0
  Advertisements received: 1
  Advertisement from fe80::2d0:b7ff:fe1e:7b0e, heard 00:00:13 ago
    Managed: 0
    Other configuration: 0 [1]
      Reachable time: 0 ms
      Default lifetime: 1800 sec
```

```
      Retransmit timer: 0 ms
      Current hop limit: 64
```

show ipv6 router-advertisement conflicts

```
user@host> show ipv6 router-advertisement conflicts
Interface: fxp0.0
  Advertisement from fe80::2d0:b7ff:fe1e:7b0e, heard 00:01:08 ago
    Other configuration: 0 [1]
```

show ipv6 router-advertisement prefix

```
user@host> show ipv6 router-advertisement prefix 8040::/16
Interface: fe-0/1/3.0
  Advertisements sent: 3, last sent 00:04:11 ago
  Solicits received: 0
  Advertisements received: 3
  Advertisement from fe80::290:69ff:fe9a:5403, heard 00:00:05 ago
    Managed: 0
    Other configuration: 0
    Reachable time: 0 ms
    Default lifetime: 180 sec [1800 sec]
    Retransmit timer: 0 ms
    Current hop limit: 64
    Prefix: 8040:1::/64
      Valid lifetime: 2592000 sec
      Preferred lifetime: 604800 sec
      On link: 1
      Autonomous: 1
```

show route

Syntax

show route
<all>
<*destination-prefix*>
<logical-system (all | *logical-system-name*)>
<private>

Syntax (EX Series Switches)

show route
<all>
<*destination-prefix*>
<private>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Option **private** introduced in Junos OS Release 9.5.
Option **private** introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display the active entries in the routing tables.

Options

none—Display brief information about all active entries in the routing tables.

all—(Optional) Display information about all routing tables, including private, or internal, routing tables.

destination-prefix—(Optional) Display active entries for the specified address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

private—(Optional) Display information only about all private, or internal, routing tables.

Required Privilege Level

view

Related Documentation

- Example: Configuring RIP on page 3637
- *Example: Configuring RIPng*
- *Example: Configuring IS-IS*
- Examples: Configuring Internal BGP Peering on page 2662
- Examples: Configuring External BGP Peering on page 2639
- Examples: Configuring OSPF Routing Policy on page 3492

List of Sample Output

show route on page 2462
show route on page 2462
show route destination-prefix on page 2463
show route extensive on page 2463

Output Fields Table 210 on page 2460 describes the output fields for the **show route** command. Output fields are listed in the approximate order in which they appear.

Table 210: show route Output Fields

Field Name	Field Description
routing-table-name	Name of the routing table (for example, inet.0).
***number* destinations**	Number of destinations for which there are routes in the routing table.
***number* routes**	Number of routes in the routing table and total number of routes in the following states: • **active** (routes that are active). • **holddown** (routes that are in the pending state before being declared inactive). A holddown route was once the active route and is no longer the active route. The route is in the holddown state because a protocol still has interest in the route, meaning that the interest bit is set. A protocol might have its interest bit set on the previously active route because the protocol is still advertising the route. The route will be deleted after all protocols withdraw their advertisement of the route and remove their interest bit. A persistent holddown state often means that the interested protocol is not releasing its interest bit properly. However, if you have configured advertisement of multiple routes (with the **add-path** or advertise-inactive statement), the holddown bit is most likely set because BGP is advertising the route as an active route. In this case, you can ignore the holddown state because nothing is wrong. • **hidden** (routes that are not used because of a routing policy).

destination-prefix	Route destination (for example:10.0.0.1/24). Sometimes the route information is presented in another format, such as:
	• ***MPLS-label*** (for example, 80001).
	• ***interface-name*** (for example, ge-1/0/2).
	• ***neighbor-address*:*control-word-status*:*encapsulation type*:*vc-id*:*source*** (Layer 2 circuit only. For example, 10.1.1.195:NoCtrlWord:1:1:Local/96):
	  ◦ ***neighbor-address***—Address of the neighbor.
	  ◦ ***control-word-status***—Whether the use of the control word has been negotiated for this virtual circuit: **NoCtrlWord** or **CtrlWord**.
	  ◦ ***encapsulation type***—Type of encapsulation, represented by a number: (1) Frame Relay DLCI, (2) ATM AAL5 VCC transport, (3) ATM transparent cell transport, (4) Ethernet, (5) VLAN Ethernet, (6) HDLC, (7) PPP, (8) ATM VCC cell transport, (10) ATM VPC cell transport.
	  ◦ ***vc-id***—Virtual circuit identifier.
	  ◦ ***source***—Source of the advertisement: **Local** or **Remote**.

[*protocol*, *preference*]	Protocol from which the route was learned and the preference value for the route. • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the **LocalPref** value for Route 1 is 100, the **Preference2** value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.

Table 210: show route Output Fields *(continued)*

Field Name	Field Description
weeks:days hours:minutes:seconds	How long the route been known (for example, **2w4d 13:11:14**, or 2 weeks, 4 days, 13 hours, 11 minutes, and 14 seconds).
metric	Cost value of the indicated route. For routes within an AS, the cost is determined by the IGP and the individual protocol metrics. For external routes, destinations, or routing domains, the cost is determined by a preference value.
localpref	Local preference value included in the route.
from	Interface from which the route was received.
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the local AS number associated with the AS path if more than one AS number is configured on the routing device, or if AS path prepending is configured. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.
validation-state	(BGP-learned routes) Validation status of the route: • **Invalid**—Indicates that the prefix is found, but either the corresponding AS received from the EBGP peer is not the AS that appears in the database, or the prefix length in the BGP update message is longer than the maximum length permitted in the database. • **Unknown**—Indicates that the prefix is not among the prefixes or prefix ranges in the database. • **Valid**—Indicates that the prefix and autonomous system pair are found in the database.
to	Next hop to the destination. An angle bracket (>) indicates that the route is the selected route. If the destination is **Discard**, traffic is dropped.

Table 210: show route Output Fields *(continued)*

Field Name	Field Description
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the interface that is actually used is followed by the word **Selected**. This field can also contain the following information: • **Weight**—Value used to distinguish primary, secondary, and fast reroute backup routes. Weight information is available when MPLS label-switched path (LSP) link protection, node-link protection, or fast reroute is enabled, or when the standby state is enabled for secondary paths. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible. • **Balance**—Balance coefficient indicating how traffic of unequal cost is distributed among next hops when a routing device is performing unequal-cost load balancing. This information is available when you enable BGP multipath load balancing. • ***lsp-path-name***—Name of the LSP used to reach the next hop. • ***label-action***—MPLS label and operation occurring at the next hop. The operation can be **pop** (where a label is removed from the top of the stack), **push** (where another label is added to the label stack), or **swap** (where a label is replaced by another label). For VPNs, expect to see multiple **push** operations, corresponding to the inner and outer labels required for VPN routes (in the case of a direct PE-to-PE connection, the VPN route would have the inner label push only).

Sample Output

show route

```
user@host> show route
inet.0: 11 destinations, 12 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1:65500:1:10.0.0.20/240
                   *[MVPN/70] 19:53:41, metric2 1
                      Indirect
1:65500:1:10.0.0.40/240
                   *[BGP/170] 19:53:29, localpref 100, from 10.0.0.30
                      AS path: I
                    > to 10.0.24.4 via lt-0/3/0.24, label-switched-path toD
                    [BGP/170] 19:53:26, localpref 100, from 10.0.0.33
                      AS path: I
                    > to 10.0.24.4 via lt-0/3/0.24, label-switched-path toD
1:65500:1:10.0.0.60/240
                   *[BGP/170] 19:53:29, localpref 100, from 10.0.0.30
                      AS path: I
                    > to 10.0.28.8 via lt-0/3/0.28, label-switched-path toF
                    [BGP/170] 19:53:25, localpref 100, from 10.0.0.33
                      AS path: I
                    > to 10.0.28.8 via lt-0/3/0.28, label-switched-path toF
```

show route

The following sample output shows a VPN route with composite next hops enabled. The first **Push** operation corresponds to the outer label. The second **Push** operation corresponds to the inner label.

```
user@host> show route 70.0.0.0

13979:665001.inet.0: 871 destinations, 3556 routes (871 active, 0 holddown, 0
hidden)
```

```
+ = Active Route, - = Last Active, * = Both

70.0.0.0/24        @[BGP/170] 00:28:32, localpref 100, from 10.9.9.160
                      AS path: 13980 ?
                    > to 10.100.0.42 via ae2.0, Push 16, Push 300368(top)
                    [BGP/170] 00:28:28, localpref 100, from 10.9.9.169
                      AS path: 13980 ?
                    > to 10.100.0.42 via ae2.0, Push 126016, Push 300368(top)
                   #[Multipath/255] 00:28:28, metric2 102
                    > to 10.100.0.42 via ae2.0, Push 16, Push 300368(top)
                      to 10.100.0.42 via ae2.0, Push 16, Push 300368(top)
```

show route destination-prefix

```
user@host> show route 172.16.0.0/12

inet.0: 10 destinations, 10 routes (9 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.0.0/12      *[Static/5] 2w4d 12:54:27
                    > to 192.168.167.254 via fxp0.0
```

show route extensive

```
user@host> show route extensive
v1.mvpn.0: 5 destinations, 8 routes (5 active, 1 holddown, 0 hidden)
1:65500:1:10.0.0.40/240 (1 entry, 1 announced)
    *BGP   Preference: 170/-101
          PMSI: Flags 0x0: Label[0:0:0]: PIM-SM: Sender 10.0.0.40 Group 225.1.1.1

           Next hop type: Indirect
           Address: 0x92455b8
           Next-hop reference count: 2
           Source: 10.0.0.30
           Protocol next hop: 10.0.0.40
           Indirect next hop: 2 no-forward
           State: <Active Int Ext>
                     Local AS: 65500 Peer AS: 65500
           Age: 3  Metric2: 1
           Task: BGP_65500.10.0.0.30+179
           Announcement bits (2): 0-PIM.v1 1-mvpn global task
           AS path: I (Originator) Cluster list:  10.0.0.30
           AS path:  Originator ID: 10.0.0.40
           Communities: target:65520:100
           Import Accepted
           Localpref: 100
           Router ID: 10.0.0.30
           Primary Routing Table bgp.mvpn.0
           Indirect next hops: 1
                Protocol next hop: 10.0.0.40 Metric: 1
                Indirect next hop: 2 no-forward
                Indirect path forwarding next hops: 1
                      Next hop type: Router
                      Next hop: 10.0.24.4 via lt-0/3/0.24 weight 0x1
                10.0.0.40/32 Originating RIB: inet.3
                      Metric: 1                        Node path count: 1
                      Forwarding nexthops: 1
                         Nexthop: 10.0.24.4 via lt-0/3/0.24
```

show route active-path

Syntax

show route active-path
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route active-path
<brief | detail | extensive | terse>

Release Information

Command introduced in Junos OS Release 8.0.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display all active routes for destinations. An active route is a route that is selected as the best path. Inactive routes are not displayed.

Options

none—Display all active routes.

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route active-path on page 2464
show route active-path brief on page 2465
show route active-path detail on page 2465
show route active-path extensive on page 2466
show route active-path terse on page 2468

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route active-path

```
user@host> show route active-path

inet.0: 7 destinations, 7 routes (6 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.70.19/32    *[Direct/0] 21:33:52
                    > via lo0.0
10.255.71.50/32    *[IS-IS/15] 00:18:13, metric 10
                    > to 100.1.2.1 via so-2/1/3.0
100.1.2.0/24       *[Direct/0] 00:18:36
                    > via so-2/1/3.0
100.1.2.2/32       *[Local/0] 00:18:41
                      Local via so-2/1/3.0
192.168.64.0/21    *[Direct/0] 21:33:52
```

```
                          > via fxp0.0
192.168.70.19/32    *[Local/0] 21:33:52
                          Local via fxp0.0
```

show route active-path brief

The output for the **show route active-path brief** command is identical to that for the **show route active-path** command. For sample output, see show route active-path on page 2464.

show route active-path detail

```
user@host> show route active-path detail

inet.0: 7 destinations, 7 routes (6 active, 0 holddown, 1 hidden)

10.255.70.19/32 (1 entry, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:   200
                Age: 21:37:10
                Task: IF
                Announcement bits (3): 2-IS-IS 5-Resolve tree 2 6-Resolve tree 3

                AS path: I

10.255.71.50/32 (1 entry, 1 announced)
        *IS-IS  Preference: 15
                Level: 1
                Next hop type: Router, Next hop index: 397
                Next-hop reference count: 4
                Next hop: 100.1.2.1 via so-2/1/3.0, selected
                State: <Active Int>
                Local AS:   200
                Age: 21:31      Metric: 10
                Task: IS-IS
                Announcement bits (4): 0-KRT 2-IS-IS 5-Resolve tree 2 6-Resolve
tree 3
                AS path: I

100.1.2.0/24 (1 entry, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via so-2/1/3.0, selected
                State: <Active Int>
                Local AS:   200
                Age: 21:54
                Task: IF
                Announcement bits (3): 2-IS-IS 5-Resolve tree 2 6-Resolve tree 3

                AS path: I

100.1.2.2/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 11
                Interface: so-2/1/3.0
                State: <Active NoReadvrt Int>
```

```
                Local AS:   200
                Age: 21:59
                Task: IF
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I

192.168.64.0/21 (1 entry, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via fxp0.0, selected
                State: <Active Int>
                Local AS:   200
                Age: 21:37:10
                Task: IF
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I

192.168.70.19/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 11
                Interface: fxp0.0
                State: <Active NoReadvrt Int>
                Local AS:   200
                Age: 21:37:10
                Task: IF
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I
```

show route active-path extensive

user@host> **show route active-path extensive**

```
inet.0: 7 destinations, 7 routes (6 active, 0 holddown, 1 hidden)
10.255.70.19/32 (1 entry, 1 announced)
TSI:
IS-IS level 1, LSP fragment 0
IS-IS level 2, LSP fragment 0
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:   200
                Age: 21:39:47
                Task: IF
                Announcement bits (3): 2-IS-IS 5-Resolve tree 2 6-Resolve tree 3

                AS path: I

10.255.71.50/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.255.71.50/32 -> {100.1.2.1}
IS-IS level 2, LSP fragment 0
        *IS-IS  Preference: 15
                Level: 1
                Next hop type: Router, Next hop index: 397
                Next-hop reference count: 4
                Next hop: 100.1.2.1 via so-2/1/3.0, selected
                State: <Active Int>
```

```
                Local AS:   200
                Age: 24:08      Metric: 10
                Task: IS-IS
                Announcement bits (4): 0-KRT 2-IS-IS 5-Resolve tree 2 6-Resolve
tree 3
                AS path: I

100.1.2.0/24 (1 entry, 1 announced)
TSI:
IS-IS level 1, LSP fragment 0
IS-IS level 2, LSP fragment 0
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via so-2/1/3.0, selected
                State: <Active Int>
                Local AS:   200
                Age: 24:31
                Task: IF
                Announcement bits (3): 2-IS-IS 5-Resolve tree 2 6-Resolve tree 3

                AS path: I

100.1.2.2/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 11
                Interface: so-2/1/3.0
                State: <Active NoReadvrt Int>
                Local AS:   200
                Age: 24:36
                Task: IF
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I

192.168.64.0/21 (1 entry, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via fxp0.0, selected
                State: <Active Int>
                Local AS:   200
                Age: 21:39:47
                Task: IF
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I

192.168.70.19/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 11
                Interface: fxp0.0
                State: <Active NoReadvrt Int>
                Local AS:   200
                Age: 21:39:47
                Task: IF
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I
```

show route active-path terse

user@host> **show route active-path terse**

```
inet.0: 7 destinations, 7 routes (6 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.255.70.19/32    D   0                       >lo0.0
* 10.255.71.50/32    I  15         10            >100.1.2.1
* 100.1.2.0/24       D   0                       >so-2/1/3.0
* 100.1.2.2/32       L   0                        Local
* 192.168.64.0/21    D   0                       >fxp0.0
* 192.168.70.19/32   L   0                        Local
```

show route all

Syntax

show route all
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route all

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display information about all routes in all routing tables, including private, or internal, tables.

Options

none—Display information about all routes in all routing tables, including private, or internal, tables.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route all on page 2469

Output Fields

In Junos OS Release 9.5 and later, only the output fields for the **show route all** command display all routing tables, including private, or hidden, routing tables. The output field table of the show route command does not display entries for private, or hidden, routing tables in Junos OS Release 9.5 and later.

Sample Output

show route all

The following example displays a snippet of output from the **show route** command and then displays the same snippet of output from the **show route all** command:

```
user@host> show route
mpls.0: 7 destinations, 7 routes (5 active, 0 holddown, 2 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
0                  *[MPLS/0] 2d 02:24:39, metric 1
                      Receive
1                  *[MPLS/0] 2d 02:24:39, metric 1
                      Receive
2                  *[MPLS/0] 2d 02:24:39, metric 1
                      Receive
800017             *[VPLS/7] 1d 14:00:16
                    > via vt-3/2/0.32769, Pop
800018             *[VPLS/7] 1d 14:00:26
                    > via vt-3/2/0.32772, Pop

user@host> show route all
mpls.0: 7 destinations, 7 routes (5 active, 0 holddown, 2 hidden)
Restart Complete
```



```
+ = Active Route, - = Last Active, * = Both
0                  *[MPLS/0] 2d 02:19:12, metric 1
                      Receive
1                  *[MPLS/0] 2d 02:19:12, metric 1
                      Receive
2                  *[MPLS/0] 2d 02:19:12, metric 1
                      Receive
800017             *[VPLS/7] 1d 13:54:49
                    > via vt-3/2/0.32769, Pop
800018             *[VPLS/7] 1d 13:54:59
                    > via vt-3/2/0.32772, Pop
vt-3/2/0.32769      [VPLS/7] 1d 13:54:49
                      Unusable
vt-3/2/0.32772      [VPLS/7] 1d 13:54:59
                      Unusable
```

show route aspath-regex

Syntax

show route aspath-regex *regular-expression*
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route aspath-regex *regular-expression*

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the entries in the routing table that match the specified autonomous system (AS) path regular expression.

Options

regular-expression—Regular expression that matches an entire AS path.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Additional Information

You can specify a regular expression as:

- An individual AS number
- A period wildcard used in place of an AS number
- An AS path regular expression that is enclosed in parentheses

You also can include the operators described in the table of AS path regular expression operators in the *Junos Policy Framework Configuration Guide*. The following list summarizes these operators:

- **{*m*,*n*}**—At least *m* and at most *n* repetitions of the AS path term.
- **{*m*}**—Exactly *m* repetitions of the AS path term.
- **{*m*,}**—*m* or more repetitions of the AS path term.
- ***—Zero or more repetitions of an AS path term.
- **+**—One or more repetitions of an AS path term.
- **?**—Zero or one repetition of an AS path term.
- ***aspath_term* | *aspath_term***—Match one of the two AS path terms.

  When you specify more than one AS number or path term, or when you include an operator in the regular expression, enclose the entire regular expression in quotation marks. For example, to match any path that contains AS number 234, specify the following command:

  ```
  show route aspath-regex ".* 234 .*"
  ```

Required Privilege Level

view

Related Documentation

- *Example: Using AS Path Regular Expressions*

List of Sample Output

show route aspath-regex (Matching a Specific AS Number) on page 2472
show route aspath-regex (Matching Any Path with Two AS Numbers) on page 2472

Output Fields

For information about output fields, see the output field table for the show route command.

Sample Output

show route aspath-regex (Matching a Specific AS Number)

```
user@host> show route aspath-regex 65477
inet.0: 46411 destinations, 46411 routes (46409 active, 0 holddown, 2 hidden)
+ = Active Route, - = Last Active, * = Both

111.222.1.0/25     *[BGP/170] 00:08:48, localpref 100, from 111.222.2.24
                   AS Path: [65477] ({65488 65535}) IGP
                     to 111.222.18.225 via fpa0.0(111.222.18.233)
111.222.1.128/25   *[IS-IS/15] 09:15:37, metric 37, tag 1
                     to 111.222.18.225 via fpa0.0(111.222.18.233)
                    [BGP/170] 00:08:48, localpref 100, from 111.222.2.24
                   AS Path: [65477] ({65488 65535}) IGP
                     to 111.222.18.225 via fpa0.0(111.222.18.233)
...
```

show route aspath-regex (Matching Any Path with Two AS Numbers)

```
user@host> show route aspath-regex ?.* 234 3561 .*?

inet.0: 46351 destinations, 46351 routes (46349 active, 0 holddown, 2 hidden)
+ = Active Route, - = Last Active, * = Both

9.20.0.0/17        *[BGP/170] 01:35:00, localpref 100, from 131.103.20.49
                   AS Path: [666] 234 3561 2685 2686 Incomplete
                     to 192.156.169.1 via 192.156.169.14(so-0/0/0)
12.10.231.0/24     *[BGP/170] 01:35:00, localpref 100, from 131.103.20.49
                   AS Path: [666] 234 3561 5696 7369 IGP
                     to 192.156.169.1 via 192.156.169.14(so-0/0/0)
24.64.32.0/19      *[BGP/170] 01:34:59, localpref 100, from 131.103.20.49
                   AS Path: [666] 234 3561 6327 IGP
                     to 192.156.169.1 via 192.156.169.14(so-0/0/0)
...
```

show route best

Syntax

show route best *destination-prefix*
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route best *destination-prefix*
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the route in the routing table that is the best route to the specified address or range of addresses. The best route is the longest matching route.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

destination-prefix—Address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route best on page 2473
show route best detail on page 2474
show route best extensive on page 2475
show route best terse on page 2475

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route best

```
user@host> show route best 10.255.70.103
inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
10.255.70.103/32    *[OSPF/10] 1d 13:19:20, metric 2
                     > to 10.31.1.6 via ge-3/1/0.0
                       via so-0/3/0.0

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
10.255.70.103/32    *[RSVP/7] 1d 13:20:13, metric 2
                     > via so-0/3/0.0, label-switched-path green-r1-r3

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
```

```
+ = Active Route, - = Last Active, * = Both
10.0.0.0/8         *[Direct/0] 2d 01:43:34
                    > via fxp2.0
                    [Direct/0] 2d 01:43:34
                    > via fxp1.0
```

show route best detail

```
user@host> show route best 10.255.70.103 detail
inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete
10.255.70.103/32 (1 entry, 1 announced)
        *OSPF   Preference: 10
                Next-hop reference count: 9
                Next hop: 10.31.1.6 via ge-3/1/0.0, selected
                Next hop: via so-0/3/0.0
                State: <Active Int>
                Local AS:    69
                Age: 1d 13:20:06        Metric: 2
                Area: 0.0.0.0
                Task: OSPF
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete
10.255.70.103/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
                Next-hop reference count: 5
                Next hop: via so-0/3/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 100016
                State: <Active Int>
                Local AS:    69
                Age: 1d 13:20:59        Metric: 2
                Task: RSVP
                Announcement bits (1): 1-Resolve tree 2
                AS path: I

private1__inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
10.0.0.0/8 (2 entries, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via fxp2.0, selected
                State: <Active Int>
                Age: 2d 1:44:20
                Task: IF
                AS path: I
         Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via fxp1.0, selected
                State: <NotBest Int>
                Inactive reason: No difference
                Age: 2d 1:44:20
                Task: IF
                AS path: I
```


show route best extensive

The output for the **show route best extensive** command is identical to that for the **show route best detail** command. For sample output, see show route best detail on page 2474.

show route best terse

```
user@host> show route best 10.255.70.103 terse
inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.255.70.103/32   O  10          2            >10.31.1.6
                                                  so-0/3/0.0

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.255.70.103/32   R   7          2            >so-0/3/0.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.0.0.0/8         D   0                       >fxp2.0
                     D   0                       >fxp1.0
```


show route brief

Syntax

show route brief
<*destination-prefix*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route brief
<*destination-prefix*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display brief information about the active entries in the routing tables.

Options

none—Display all active entries in the routing table.

destination-prefix—(Optional) Display active entries for the specified address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route brief on page 2476

Output Fields

For information about output fields, see the Output Field table of the show route command.

Sample Output

show route brief

```
user@host> show route brief
inet.0: 10 destinations, 10 routes (9 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0          *[Static/5] 1w5d 20:30:29
                      Discard
10.255.245.51/32   *[Direct/0] 2w4d 13:11:14
                    > via lo0.0
172.16.0.0/12      *[Static/5] 2w4d 13:11:14
                    > to 192.168.167.254 via fxp0.0
192.168.0.0/18     *[Static/5] 1w5d 20:30:29
                    > to 192.168.167.254 via fxp0.0
192.168.40.0/22    *[Static/5] 2w4d 13:11:14
                    > to 192.168.167.254 via fxp0.0
192.168.64.0/18    *[Static/5] 2w4d 13:11:14
                    > to 192.168.167.254 via fxp0.0
192.168.164.0/22   *[Direct/0] 2w4d 13:11:14
                    > via fxp0.0
192.168.164.51/32  *[Local/0] 2w4d 13:11:14
                      Local via fxp0.0
207.17.136.192/32  *[Static/5] 2w4d 13:11:14
```

```
                    > to 192.168.167.254 via fxp0.0
green.inet.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
100.101.0.0/16     *[Direct/0] 1w5d 20:30:28
                    > via fe-0/0/3.0
100.101.2.3/32     *[Local/0] 1w5d 20:30:28
                      Local via fe-0/0/3.0
224.0.0.5/32       *[OSPF/10] 1w5d 20:30:29, metric 1
                      MultiRecv
```

show route community

Syntax

show route community *as-number:community-value*
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route community *as-number:community-value*
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the route entries in each routing table that are members of a Border Gateway Protocol (BGP) community.

Options

as-number:community-value—One or more community identifiers. ***as-number*** is the AS number, and ***community-value*** is the community identifier. When you specify more than one community identifier, enclose the identifiers in double quotation marks. Community identifiers can include wildcards.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Additional Information

Specifying the community option displays all routes matching the community found within the routing table. The community option does not limit the output to only the routes being advertised to the neighbor after any egress routing policy.

Required Privilege Level

view

Related Documentation

- show route detail on page 2487

List of Sample Output

show route community on page 2478

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route community

```
user@host> show route community 234:80
inet.0: 46511 destinations, 46511 routes (46509 active, 0 holddown, 2 hidden)
+ = Active Route, - = Last Active, * = Both

4.0.0.0/8          *[BGP/170] 03:33:07, localpref 100, from 131.103.20.49
                   AS Path: {666} 234 2548 1 IGP
                     to 192.156.169.1 via 192.156.169.14(so-0/0/0)
6.0.0.0/8          *[BGP/170] 03:33:07, localpref 100, from 131.103.20.49
```

```
                   AS Path: {666} 234 2548 568 721 Incomplete
                     to 192.156.169.1 via 192.156.169.14(so-0/0/0)
9.2.0.0/16         *[BGP/170] 03:33:06, localpref 100, from 131.103.20.49
                   AS Path: {666} 234 2548 1673 1675 1747 IGP
                     to 192.156.169.1 via 192.156.169.14(so-0/0/0)
```

show route community-name

Syntax

show route community-name *community-name*
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route community-name *community-name*
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the route entries in each routing table that are members of a Border Gateway Protocol (BGP) community, specified by a community name.

Options

community-name—Name of the community.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route community-name on page 2480

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route community-name

```
user@host> show route community-name red-com
inet.0: 17 destinations, 17 routes (16 active, 0 holddown, 1 hidden)

inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

instance1.inet.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

red.inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.245.212/32  *[BGP/170] 00:04:40, localpref 100, from 10.255.245.204
                      AS path: 300 I
                    > to 100.1.2.2 via ge-1/1/0.0, label-switched-path to_fix
20.20.20.20/32     *[BGP/170] 00:04:40, localpref 100, from 10.255.245.204
                      AS path: I
                    > to 100.1.2.2 via ge-1/1/0.0, label-switched-path to_fix
100.1.4.0/24       *[BGP/170] 00:04:40, localpref 100, from 10.255.245.204
                      AS path: I
                    > to 100.1.2.2 via ge-1/1/0.0, label-switched-path to_fix
```

```
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

bgp.l3vpn.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.245.204:10:10.255.245.212/32
                   *[BGP/170] 00:06:40, localpref 100, from 10.255.245.204
                      AS path: 300 I
                    > to 100.1.2.2 via ge-1/1/0.0, label-switched-path to_fix
10.255.245.204:10:20.20.20.20/32
                   *[BGP/170] 00:36:02, localpref 100, from 10.255.245.204
                      AS path: I
                    > to 100.1.2.2 via ge-1/1/0.0, label-switched-path to_fix
10.255.245.204:10:100.1.4.0/24
                   *[BGP/170] 00:36:02, localpref 100, from 10.255.245.204
                      AS path: I
                    > to 100.1.2.2 via ge-1/1/0.0, label-switched-path to_fix

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

instance1.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```


show route damping

Syntax

show route damping (decayed | history | suppressed)
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and QFX Series)

show route damping (decayed | history | suppressed)
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display the BGP routes for which updates might have been reduced because of route flap damping.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to brief.

decayed—Display route damping entries that might no longer be valid, but are not suppressed.

history—Display entries that have already been withdrawn, but have been logged.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

suppressed—Display entries that have been suppressed and are no longer being installed into the forwarding table or exported by routing protocols.

Required Privilege Level

view

Related Documentation

- clear bgp damping on page 3130
- show policy damping on page 3163

List of Sample Output

show route damping decayed detail on page 2485
show route damping history on page 2486
show route damping history detail on page 2486

Output Fields

Table 211 on page 2482 lists the output fields for the **show route damping** command. Output fields are listed in the approximate order in which they appear.

Table 211: show route damping Output Fields

Field Name	Field Description	Level of Output
routing-table-name	Name of the routing table—for example, **inet.0**.	All levels
destinations	Number of destinations for which there are routes in the routing table.	All levels

Table 211: show route damping Output Fields *(continued)*

Field Name	Field Description	Level of Output
number **routes**	Number of routes in the routing table and total number of routes in the following states: • **active** • **holddown** (routes that are in a pending state before being declared inactive) • **hidden** (the routes are not used because of a routing policy)	All levels
destination-prefix **(entry, announced)**	Destination prefix. The **entry** value is the number of routes for this destination, and the **announced** value is the number of routes being announced for this destination.	**detail extensive**
[*protocol***,** *preference***]**	Protocol from which the route was learned and the preference value for the route. • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the LocalPref value for Route 1 is 100, the Preference2 value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.	All levels
Next-hop reference count	Number of references made to the next hop.	**detail extensive**
Source	IP address of the route source.	**detail extensive**
Next hop	Network layer address of the directly reachable neighboring system.	**detail extensive**
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the interface that is actually used is followed by the word **Selected**.	**detail extensive**
Protocol next hop	Network layer address of the remote routing device that advertised the prefix. This address is used to derive a forwarding next hop.	**detail extensive**
Indirect next hop	Index designation used to specify the mapping between protocol next hops, tags, kernel export policy, and the forwarding next hops.	**detail extensive**
State	Flags for this route. For a description of possible values for this field, see the output field table for the show route detail command.	**detail extensive**
Local AS	AS number of the local routing device.	**detail extensive**
Peer AS	AS number of the peer routing device.	**detail extensive**

Table 211: show route damping Output Fields *(continued)*

Field Name	Field Description	Level of Output
Age	How long the route has been known.	**detail extensive**
Metric	Metric for the route.	**detail extensive**
Task	Name of the protocol that has added the route.	**detail extensive**
Announcement bits	List of protocols that announce this route. ***n*-Resolve inet** indicates that the route is used for route resolution for next hops found in the routing table. ***n*** is an index used by Juniper Networks customer support only.	**detail extensive**
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the local AS number associated with the AS path if more than one AS number is configured on the routing device or if AS path prepending is configured. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.	All levels
to	Next hop to the destination. An angle bracket (>) indicates that the route is the selected route.	**brief** none
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the interface that is actually used is followed by the word **Selected**.	**brief** none
Communities	Community path attribute for the route. See the output field table for the show route detail command.	**detail extensive**
Localpref	Local preference value included in the route.	All levels
Router ID	BGP router ID as advertised by the neighbor in the open message.	**detail extensive**
Merit (last update/now)	Last updated and current figure-of-merit value.	**detail extensive**

Table 211: show route damping Output Fields *(continued)*

Field Name	Field Description	Level of Output
damping-parameters	Name that identifies the damping parameters used, which is defined in the damping statement at the **[edit policy-options]** hierarchy level.	**detail extensive**
Last update	Time of most recent change in path attributes.	**detail extensive**
First update	Time of first change in path attributes, which started the route damping process.	**detail extensive**
Flaps	Number of times the route has gone up or down or its path attributes have changed.	**detail extensive**
Suppressed	(**suppressed** keyword only) This route is currently suppressed. A suppressed route does not appear in the forwarding table and routing protocols do not export it.	All levels
Reusable in	(**suppressed** keyword only) Time when a suppressed route will again be available.	All levels
Preference will be	(**suppressed** keyword only) Preference value that will be applied to the route when it is again active.	All levels

Sample Output

show route damping decayed detail

```
user@host> show route damping decayed detail
inet.0: 173319 destinations, 1533668 routes (172625 active, 4 holddown, 108083
hidden)
10.0.111.0/24 (7 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next-hop reference count: 151973
                Source: 172.23.2.129
                Next hop: via so-1/2/0.0
                Next hop: via so-5/1/0.0, selected
                Next hop: via so-6/0/0.0
                Protocol next hop: 172.23.2.129
                Indirect next hop: 89a1a00 264185
                State: <Active Ext>
                Local AS: 65000 Peer AS:   65490
                Age: 3:28       Metric2: 0
                Task: BGP_65490.172.23.2.129+179
                Announcement bits (6): 0-KRT 1-RT 4-KRT 5-BGP.0.0.0.0+179

         6-Resolve tree 2 7-Resolve tree 3
                AS path: 65490 65520 65525 65525 65525 65525 I ()
                Communities: 65501:390 65501:2000 65501:3000 65504:701
                Localpref: 100
                Router ID: 172.23.2.129
                Merit (last update/now): 1934/1790
                damping-parameters: damping-high
                Last update:       00:03:28 First update:       00:06:40
                Flaps: 2
```


show route damping history

```
user@host> show route damping history
inet.0: 173320 destinations, 1533529 routes (172624 active, 6 holddown, 108122
hidden)
+ = Active Route, - = Last Active, * = Both

10.108.0.0/15       [BGP ] 2d 22:47:58, localpref 100
                      AS path: 65220 65501 65502 I
                    > to 192.168.60.85 via so-3/1/0.0
```

show route damping history detail

```
user@host> show route damping history detail
inet.0: 173319 destinations, 1533435 routes (172627 active, 2 holddown, 108105
hidden)
10.108.0.0/15 (3 entries, 1 announced)
         BGP                  /-101
                Next-hop reference count: 69058
                Source: 192.168.60.85
                Next hop: 192.168.60.85 via so-3/1/0.0, selected
                State: <Hidden Ext>
                Inactive reason: Unusable path
                Local AS: 65000 Peer AS:  65220
                Age: 2d 22:48:10
                Task: BGP_65220.192.168.60.85+179
                AS path: 65220 65501 65502 I ()
                Communities: 65501:390 65501:2000 65501:3000 65504:3561
                Localpref: 100
                Router ID: 192.168.80.25
                Merit (last update/now): 1000/932
                damping-parameters: set-normal
                Last update:       00:01:05 First update:       00:01:05
                Flaps: 1
```

show route detail

Syntax

show route detail
<*destination-prefix*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route detail
<*destination-prefix*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description

Display detailed information about the active entries in the routing tables.

Options

none—Display all active entries in the routing table on all systems.

destination-prefix—(Optional) Display active entries for the specified address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route detail on page 2496
show route detail (with BGP Multipath) on page 2501
show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs) on page 2502

Output Fields

Table 212 on page 2487 describes the output fields for the **show route detail** command. Output fields are listed in the approximate order in which they appear.

Table 212: show route detail Output Fields

Field Name	Field Description
routing-table-name	Name of the routing table (for example, inet.0).
number destinations	Number of destinations for which there are routes in the routing table.
number routes	Number of routes in the routing table and total number of routes in the following states: • **active** (routes that are active) • **holddown** (routes that are in the pending state before being declared inactive) • **hidden** (routes that are not used because of a routing policy)

Table 212: show route detail Output Fields *(continued)*

Field Name	Field Description

route-destination **(entry, announced)**	Route destination (for example:10.0.0.1/24). The **entry** value is the number of routes for this destination, and the **announced** value is the number of routes being announced for this destination. Sometimes the route destination is presented in another format, such as:
	• ***MPLS-label*** (for example, 80001).
	• ***interface-name*** (for example, ge-1/0/2).
	• ***neighbor-address***:***control-word-status***:***encapsulation type***:***vc-id***:***source*** (Layer 2 circuit only; for example, 10.1.1.195:NoCtrlWord:1:1:Local/96).
	  ◦ ***neighbor-address***—Address of the neighbor.
	  ◦ ***control-word-status***—Whether the use of the control word has been negotiated for this virtual circuit: **NoCtrlWord** or **CtrlWord**.
	  ◦ ***encapsulation type***—Type of encapsulation, represented by a number: (1) Frame Relay DLCI, (2) ATM AAL5 VCC transport, (3) ATM transparent cell transport, (4) Ethernet, (5) VLAN Ethernet, (6) HDLC, (7) PPP, (8) ATM VCC cell transport, (10) ATM VPC cell transport.
	  ◦ ***vc-id***—Virtual circuit identifier.
	  ◦ ***source***—Source of the advertisement: **Local** or **Remote**.

label stacking	(Next-to-the-last-hop routing device for MPLS only) Depth of the MPLS label stack, where the label-popping operation is needed to remove one or more labels from the top of the stack. A pair of routes is displayed, because the pop operation is performed only when the stack depth is two or more labels. • **S=0 route** indicates that a packet with an incoming label stack depth of 2 or more exits this routing device with one fewer label (the label-popping operation is performed). • If there is no **S=** information, the route is a normal MPLS route, which has a stack depth of 1 (the label-popping operation is not performed).
[*protocol*, *preference*]	Protocol from which the route was learned and the preference value for the route. • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the **LocalPref** value for Route 1 is 100, the **Preference2** value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.
Level	(IS-IS only). In IS-IS, a single AS can be divided into smaller groups called areas. Routing between areas is organized hierarchically, allowing a domain to be administratively divided into smaller areas. This organization is accomplished by configuring Level 1 and Level 2 intermediate systems. Level 1 systems route within an area. When the destination is outside an area, they route toward a Level 2 system. Level 2 intermediate systems route between areas and toward other ASs.
Route Distinguisher	IP subnet augmented with a 64-bit prefix.
PMSI	Provider multicast service interface (MVPN routing table).
Next-hop type	Type of next hop. For a description of possible values for this field, see Table 213 on page 2491.

Table 212: show route detail Output Fields *(continued)*

Field Name	Field Description
Next-hop reference count	Number of references made to the next hop.
Flood nexthop branches exceed maximum message	Indicates that the number of flood next-hop branches exceeded the system limit of 32 branches, and only a subset of the flood next-hop branches were installed in the kernel.
Source	IP address of the route source.
Next hop	Network layer address of the directly reachable neighboring system.
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the name of the interface that is actually used is followed by the word **Selected**. This field can also contain the following information: • Weight—Value used to distinguish primary, secondary, and fast reroute backup routes. Weight information is available when MPLS label-switched path (LSP) link protection, node-link protection, or fast reroute is enabled, or when the standby state is enabled for secondary paths. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible. • Balance—Balance coefficient indicating how traffic of unequal cost is distributed among next hops when a routing device is performing unequal-cost load balancing. This information is available when you enable BGP multipath load balancing.
Label-switched-path *lsp-path-name*	Name of the LSP used to reach the next hop.
Label operation	MPLS label and operation occurring at this routing device. The operation can be **pop** (where a label is removed from the top of the stack), **push** (where another label is added to the label stack), or **swap** (where a label is replaced by another label).
Interface	(Local only) Local interface name.
Protocol next hop	Network layer address of the remote routing device that advertised the prefix. This address is used to derive a forwarding next hop.
Indirect next hop	Index designation used to specify the mapping between protocol next hops, tags, kernel export policy, and the forwarding next hops.
State	State of the route (a route can be in more than one state). See Table 214 on page 2493.
Local AS	AS number of the local routing device.
Age	How long the route has been known.
AIGP	Accumulated interior gateway protocol (AIGP) BGP attribute.
Metric*n*	Cost value of the indicated route. For routes within an AS, the cost is determined by IGP and the individual protocol metrics. For external routes, destinations, or routing domains, the cost is determined by a preference value.

Table 212: show route detail Output Fields *(continued)*

Field Name	Field Description
MED-plus-IGP	Metric value for BGP path selection to which the IGP cost to the next-hop destination has been added.
TTL-Action	For MPLS LSPs, state of the TTL propagation attribute. Can be enabled or disabled for all RSVP-signaled and LDP-signaled LSPs or for specific VRF routing instances. For sample output, see show route table.
Task	Name of the protocol that has added the route.
Announcement bits	List of protocols that announce this route. ***n*-Resolve inet** indicates that the route is used for route resolution for next hops found in the routing table. ***n*** is an index used by Juniper Networks customer support only.
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **Recorded**—The AS path is recorded by the sample process (sampled). • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the number that precedes the AS path. This number represents the number of ASs present in the AS path, when calculated as defined in RFC 4271. This value is used in the AS-path merge process, as defined in RFC 4893. • **[ ]**—If more than one AS number is configured on the routing device, or if AS path prepending is configured, brackets enclose the local AS number associated with the AS path. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.
validation-state	(BGP-learned routes) Validation status of the route: • **Invalid**—Indicates that the prefix is found, but either the corresponding AS received from the EBGP peer is not the AS that appears in the database, or the prefix length in the BGP update message is longer than the maximum length permitted in the database. • **Unknown**—Indicates that the prefix is not among the prefixes or prefix ranges in the database. • **Unverified**—Indicates that the origin of the prefix is not verified against the database. This is because the database got populated and the validation is not called for in the BGP import policy, although origin validation is enabled, or the origin validation is not enabled for the BGP peers. • **Valid**—Indicates that the prefix and autonomous system pair are found in the database.
FECs bound to route	Point-to-multipoint root address, multicast source address, and multicast group address when multipoint LDP (M-LDP) inband signaling is configured.

Table 212: show route detail Output Fields *(continued)*

Field Name	Field Description
VC Label	MPLS label assigned to the Layer 2 circuit virtual connection.
MTU	Maximum transmission unit (MTU) of the Layer 2 circuit.
VLAN ID	VLAN identifier of the Layer 2 circuit.
Prefixes bound to route	Forwarding equivalent class (FEC) bound to this route. Applicable only to routes installed by LDP.
Communities	Community path attribute for the route. See Table 215 on page 2495 for all possible values for this field.
Layer2-info: encaps	Layer 2 encapsulation (for example, VPLS).
control flags	Control flags: **none** or **Site Down**.
mtu	Maximum transmission unit (MTU) information.
Label-Base, range	First label in a block of labels and label block size. A remote PE routing device uses this first label when sending traffic toward the advertising PE routing device.
status vector	Layer 2 VPN and VPLS network layer reachability information (NLRI).
Accepted Multipath	Current active path when BGP multipath is configured.
Accepted MultipathContrib	Path currently contributing to BGP multipath.
Localpref	Local preference value included in the route.
Router ID	BGP router ID as advertised by the neighbor in the open message.
Primary Routing Table	In a routing table group, the name of the primary routing table in which the route resides.
Secondary Tables	In a routing table group, the name of one or more secondary tables in which the route resides.

Table 213 on page 2491 describes all possible values for the Next-hop Types output field.

Table 213: Next-hop Types Output Field Values

Next-Hop Type	Description
Broadcast (bcast)	Broadcast next hop.
Deny	Deny next hop.
Discard	Discard next hop.

Table 213: Next-hop Types Output Field Values *(continued)*

Next-Hop Type	Description
Flood	Flood next hop. Consists of components called branches, up to a maximum of 32 branches. Each flood next-hop branch sends a copy of the traffic to the forwarding interface. Used by point-to-multipoint RSVP, point-to-multipoint LDP, point-to-multipoint CCC, and multicast.
Hold	Next hop is waiting to be resolved into a unicast or multicast type.
Indexed (idxd)	Indexed next hop.
Indirect (indr)	Used with applications that have a protocol next hop address that is remote. You are likely to see this next-hop type for internal BGP (IBGP) routes when the BGP next hop is a BGP neighbor that is not directly connected.
Interface	Used for a network address assigned to an interface. Unlike the router next hop, the interface next hop does not reference any specific node on the network.
Local (locl)	Local address on an interface. This next-hop type causes packets with this destination address to be received locally.
Multicast (mcst)	Wire multicast next hop (limited to the LAN).
Multicast discard (mdsc)	Multicast discard.
Multicast group (mgrp)	Multicast group member.
Receive (recv)	Receive.
Reject (rjct)	Discard. An ICMP unreachable message was sent.
Resolve (rslv)	Resolving next hop.
Routed multicast (mcrt)	Regular multicast next hop.
Router	A specific node or set of nodes to which the routing device forwards packets that match the route prefix. To qualify as next-hop type router, the route must meet the following criteria: • Must not be a direct or local subnet for the routing device. • Must have a next hop that is directly connected to the routing device.
Table	Routing table next hop.

Table 213: Next-hop Types Output Field Values *(continued)*

Next-Hop Type	Description
Unicast (ucst)	Unicast.
Unilist (ulst)	List of unicast next hops. A packet sent to this next hop goes to any next hop in the list.

Table 214 on page 2493 describes all possible values for the State output field. A route can be in more than one state (for example, **<Active NoReadvrt Int Ext>**).

Table 214: State Output Field Values

Value	Description
Accounting	Route needs accounting.
Active	Route is active.
Always Compare MED	Path with a lower multiple exit discriminator (MED) is available.
AS path	Shorter AS path is available.
Cisco Non-deterministic MED selection	Cisco nondeterministic MED is enabled, and a path with a lower MED is available.
Clone	Route is a clone.
Cluster list length	Length of cluster list sent by the route reflector.
Delete	Route has been deleted.
Ex	Exterior route.
Ext	BGP route received from an external BGP neighbor.
FlashAll	Forces all protocols to be notified of a change to any route, active or inactive, for a prefix. When not set, protocols are informed of a prefix only when the active route changes.
Hidden	Route not used because of routing policy.
IfCheck	Route needs forwarding RPF check.
IGP metric	Path through next hop with lower IGP metric is available.
Inactive reason	Flags for this route, which was not selected as best for a particular destination.
Initial	Route being added.

Table 214: State Output Field Values *(continued)*

Value	Description
Int	Interior route.
Int Ext	BGP route received from an internal BGP peer or a BGP confederation peer.
Interior > Exterior > Exterior via Interior	Direct, static, IGP, or EBGP path is available.
Local Preference	Path with a higher local preference value is available.
Martian	Route is a martian (ignored because it is obviously invalid).
MartianOK	Route exempt from martian filtering.
Next hop address	Path with lower metric next hop is available.
No difference	Path from neighbor with lower IP address is available.
NoReadvrt	Route not to be advertised.
NotBest	Route not chosen because it does not have the lowest MED.
Not Best in its group	Incoming BGP AS is not the best of a group (only one AS can be the best).
NotInstall	Route not to be installed in the forwarding table.
Number of gateways	Path with a greater number of next hops is available.
Origin	Path with a lower origin code is available.
Pending	Route pending because of a hold-down configured on another route.
Release	Route scheduled for release.
RIB preference	Route from a higher-numbered routing table is available.
Route Distinguisher	64-bit prefix added to IP subnets to make them unique.
Route Metric or MED comparison	Route with a lower metric or MED is available.
Route Preference	Route with lower preference value is available
Router ID	Path through a neighbor with lower ID is available.
Secondary	Route not a primary route.

Table 214: State Output Field Values *(continued)*

Value	Description
Unusable path	Path is not usable because of one of the following conditions: • The route is damped. • The route is rejected by an import policy. • The route is unresolved.
Update source	Last tiebreaker is the lowest IP address value.

Table 215 on page 2495 describes the possible values for the Communities output field.

Table 215: Communities Output Field Values

Value	Description
area-number	4 bytes, encoding a 32-bit area number. For AS-external routes, the value is **0**. A nonzero value identifies the route as internal to the OSPF domain, and as within the identified area. Area numbers are relative to a particular OSPF domain.
bandwidth: ***local AS number:link-bandwidth-number***	Link-bandwidth community value used for unequal-cost load balancing. When BGP has several candidate paths available for multipath purposes, it does not perform unequal-cost load balancing according to the link-bandwidth community unless all candidate paths have this attribute.
domain-id	Unique configurable number that identifies the OSPF domain.
domain-id-vendor	Unique configurable number that further identifies the OSPF domain.
link-bandwidth-number	Link-bandwidth number: from **0** through **4,294,967,295** (bytes per second).
local AS number	Local AS number: from **1** through **65,535**.
options	1 byte. Currently this is only used if the route type is **5** or **7**. Setting the least significant bit in the field indicates that the route carries a type 2 metric.
origin	(Used with VPNs) Identifies where the route came from.
ospf-route-type	1 byte, encoded as **1** or **2** for intra-area routes (depending on whether the route came from a type 1 or a type 2 LSA); **3** for summary routes; **5** for external routes (area number must be**0**); **7** for NSSA routes; or **129** for sham link endpoint addresses.
route-type-vendor	Displays the area number, OSPF route type, and option of the route. This is configured using the BGP extended community attribute **0x8000**. The format is ***area-number:ospf-route-type:options***.
rte-type	Displays the area number, OSPF route type, and option of the route. This is configured using the BGP extended community attribute **0x0306**. The format is ***area-number:ospf-route-type:options***.
target	Defines which VPN the route participates in; **target** has the format ***32-bit IP address:16-bit number***. For example, 10.19.0.0:100.

Table 215: Communities Output Field Values *(continued)*

Value	Description
unknown IANA	Incoming IANA codes with a value between **0x1** and **0x7fff**. This code of the BGP extended community attribute is accepted, but it is not recognized.
unknown OSPF vendor community	Incoming IANA codes with a value above **0x8000**. This code of the BGP extended community attribute is accepted, but it is not recognized.

Sample Output

show route detail

```
user@host> show route detail

inet.0: 22 destinations, 23 routes (21 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 29
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 1:31:43
                Task: RT
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

10.31.1.0/30 (2 entries, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 2
                Next hop: via so-0/3/0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:30:17
                Task: IF
                Announcement bits (1): 3-Resolve tree 2
                AS path: I
         OSPF   Preference: 10
                Next-hop reference count: 1
                Next hop: via so-0/3/0.0, selected
                State: <Int>
                Inactive reason: Route Preference
                Local AS:    69
                Age: 1:30:17    Metric: 1
                Area: 0.0.0.0
                Task: OSPF
                AS path: I

10.31.1.1/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 7
                Interface: so-0/3/0.0
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:30:20
                Task: IF
```



```
                Announcement bits (1): 3-Resolve tree 2
                AS path: I

...

10.31.2.0/30 (1 entry, 1 announced)
        *OSPF   Preference: 10
                Next-hop reference count: 9
                Next hop: via so-0/3/0.0
                Next hop: 10.31.1.6 via ge-3/1/0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:29:56    Metric: 2
                Area: 0.0.0.0
                Task: OSPF
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

...

224.0.0.2/32 (1 entry, 1 announced)
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:45
                Task: PIM Recv
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

...

224.0.0.22/32 (1 entry, 1 announced)
        *IGMP   Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:43
                Task: IGMP
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

10.255.70.103/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
                Next-hop reference count: 6
                Next hop: 10.31.1.6 via ge-3/1/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 100096
                State: <Active Int>
                Local AS:    69
                Age: 1:25:49    Metric: 2
                Task: RSVP
                Announcement bits (2): 1-Resolve tree 1 2-Resolve tree 2
                AS path: I

10.255.71.238/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
```

```
                Next-hop reference count: 6
                Next hop: via so-0/3/0.0 weight 0x1, selected
                Label-switched-path green-r1-r2
                State: <Active Int>
                Local AS:    69
                Age: 1:25:49    Metric: 1
                Task: RSVP
                Announcement bits (2): 1-Resolve tree 1 2-Resolve tree 2
                AS path: I

private__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

47.0005.80ff.f800.0000.0108.0001.0102.5507.1052/152 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:31:44
                Task: IF
                AS path: I

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
0   (1 entry, 1 announced)
        *MPLS   Preference: 0
                Next hop type: Receive
                Next-hop reference count: 6
                State: <Active Int>
                Local AS:    69
                Age: 1:31:45    Metric: 1
                Task: MPLS
                Announcement bits (1): 0-KRT
                AS path: I

...

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

  299840 (1 entry, 1 announced)
  TSI:
  KRT in-kernel 299840 /52 -> {indirect(1048575)}
          *RSVP   Preference: 7/2
                  Next hop type: Flood
                  Address: 0x9174a30
                  Next-hop reference count: 4
                  Next hop type: Router, Next hop index: 798
                  Address: 0x9174c28
                  Next-hop reference count: 2
                  Next hop: 8.0.0.2 via lt-1/2/0.9 weight 0x1
                  Label-switched-path R2-to-R4-2p2mp
                  Label operation: Pop
                  Next hop type: Router, Next hop index: 1048574
                  Address: 0x92544f0
                  Next-hop reference count: 2
                  Next hop: 7.0.0.2 via lt-1/2/0.7 weight 0x1
                  Label-switched-path R2-to-R200-p2mp
                  Label operation: Pop
                  Next hop: 6.0.0.2 via lt-1/2/0.5 weight 0x8001
```



```
                 Label operation: Pop
                 State: <Active Int>
                 Age: 1:29       Metric: 1
                 Task: RSVP
                 Announcement bits (1): 0-KRT
                 AS path: I...

800010 (1 entry, 1 announced)
        *VPLS   Preference: 7
                Next-hop reference count: 2
                Next hop: via vt-3/2/0.32769, selected
                Label operation: Pop
                State: <Active Int>
                Age: 1:29:30
                Task: Common L2 VC
                Announcement bits (1): 0-KRT
                AS path: I

vt-3/2/0.32769 (1 entry, 1 announced)
        *VPLS   Preference: 7
                Next-hop reference count: 2
                Next hop: 10.31.1.6 via ge-3/1/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 800012, Push 100096(top)
                Protocol next hop: 10.255.70.103
                Push 800012
                Indirect next hop: 87272e4 1048574
                State: <Active Int>
                Age: 1:29:30    Metric2: 2
                Task: Common L2 VC
                Announcement bits (2): 0-KRT 1-Common L2 VC
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0

inet6.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

abcd::10:255:71:52/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:31:44
                Task: IF
                AS path: I

fe80::280:42ff:fe10:f179/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:44
                Task: IF
                AS path: I

ff02::2/128 (1 entry, 1 announced)
        *PIM    Preference: 0
```

```
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:45
                Task: PIM Recv6
                Announcement bits (1): 0-KRT
                AS path: I

ff02::d/128 (1 entry, 1 announced)
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:45
                Task: PIM Recv6
                Announcement bits (1): 0-KRT
                AS path: I

ff02::16/128 (1 entry, 1 announced)
        *MLD    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:43
                Task: MLD
                Announcement bits (1): 0-KRT
                AS path: I

private.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

fe80::280:42ff:fe10:f179/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.16385, selected
                State: <Active NoReadvrt Int>
                Age: 1:31:44
                Task: IF
                AS path: I

green.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)

10.255.70.103:1:3:1/96 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 10.255.70.103:1
                Next-hop reference count: 7
                Source: 10.255.70.103
                Protocol next hop: 10.255.70.103
                Indirect next hop: 2 no-forward
                State: <Secondary Active Int Ext>
                Local AS:    69 Peer AS:    69
                Age: 1:25:49    Metric2: 1
                AIGP 210
                Task: BGP_69.10.255.70.103+179
                Announcement bits (1): 0-green-l2vpn
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0
                Label-base: 800008, range: 8
                Localpref: 100
                Router ID: 10.255.70.103
```



```
                    Primary Routing Table bgp.l2vpn.0

10.255.71.52:1:1:1/96 (1 entry, 1 announced)
        *L2VPN  Preference: 170/-1
                Next-hop reference count: 5
                Protocol next hop: 10.255.71.52
                Indirect next hop: 0 -
                State: <Active Int Ext>
                Age: 1:31:40    Metric2: 1
                Task: green-l2vpn
                Announcement bits (1): 1-BGP.0.0.0.0+179
                AS path: I
                Communities: Layer2-info: encaps:VPLS, control flags:Site-Down,
                mtu: 0
                Label-base: 800016, range: 8, status-vector: 0x9F

10.255.71.52:1:5:1/96 (1 entry, 1 announced)
        *L2VPN  Preference: 170/-101
                Next-hop reference count: 5
                Protocol next hop: 10.255.71.52
                Indirect next hop: 0 -
                State: <Active Int Ext>
                Age: 1:31:40    Metric2: 1
                Task: green-l2vpn
                Announcement bits (1): 1-BGP.0.0.0.0+179
                AS path: I
                Communities: Layer2-info: encaps:VPLS, control flags:, mtu: 0
                Label-base: 800008, range: 8, status-vector: 0x9F

...

l2circuit.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
10.245.255.63:CtrlWord:4:3:Local/96 (1 entry, 1 announced)
        *L2CKT  Preference: 7
                Next hop: via so-1/1/2.0 weight 1, selected
                Label-switched-path my-lsp
                Label operation: Push 100000[0]
                Protocol next hop: 10.245.255.63 Indirect next hop: 86af000 296
                State: <Active Int>
                Local AS:    99
                Age: 10:21
                Task: l2 circuit
                Announcement bits (1): 0-LDP
                AS path: I
                VC Label 100000, MTU 1500, VLAN ID 512
```

show route detail (with BGP Multipath)

user@host> **show route detail**

```
10.1.1.8/30 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 262142
                Address: 0x901a010
                Next-hop reference count: 2
                Source: 10.1.1.2
                Next hop: 10.1.1.2 via ge-0/3/0.1, selected
                Next hop: 10.1.1.6 via ge-0/3/0.5
                State: <Active Ext>
                Local AS:     1 Peer AS:     2
                Age: 5:04:43
```

```
                      Validation State: unverified
                       Task: BGP_2.10.1.1.2+59955
                       Announcement bits (1): 0-KRT
                       AS path: 2 I
                       Accepted Multipath
                       Localpref: 100
                       Router ID: 1.1.1.2
                BGP    Preference: 170/-101
                       Next hop type: Router, Next hop index: 678
                       Address: 0x8f97520
                       Next-hop reference count: 9
                       Source: 10.1.1.6
                       Next hop: 10.1.1.6 via ge-0/3/0.5, selected
                       State: <NotBest Ext>
                       Inactive reason: Not Best in its group - Active preferred
                       Local AS:     1 Peer AS:     2
                       Age: 5:04:43
                    Validation State: unverified
                       Task: BGP_2.10.1.1.6+58198
                       AS path: 2 I
                       Accepted MultipathContrib
                       Localpref: 100
                       Router ID: 1.1.1.3
```

show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs)

```
user@host> show route label 299872 detail
mpls.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
299872 (1 entry, 1 announced)
        *LDP    Preference: 9
                Next hop type: Flood
                Next-hop reference count: 3
                Address: 0x9097d90
                Next hop: via vt-0/1/0.1
                Next-hop index: 661
                Label operation: Pop
                Address: 0x9172130
                Next hop: via so-0/0/3.0
                Next-hop index: 654
                Label operation: Swap 299872
                State: **Active Int>
                Local AS:  1001
                Age: 8:20       Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
               FECs bound to route: P2MP root-addr 10.255.72.166, grp 232.1.1.1,
 src 192.168.142.2
```

show route exact

Syntax

show route exact *destination-prefix*
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route exact *destination-prefix*
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display only the routes that exactly match the specified address or range of addresses.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

destination-prefix—Address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route exact on page 2503
show route exact detail on page 2503
show route exact extensive on page 2504
show route exact terse on page 2504

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route exact

```
user@host> show route exact 207.17.136.0/24

inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
207.17.136.0/24    *[Static/5] 2d 03:30:22
                    > to 192.168.71.254 via fxp0.0
```

show route exact detail

```
user@host> show route exact 207.17.136.0/24 detail

inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete
207.17.136.0/24 (1 entry, 1 announced)
        *Static Preference: 5
```



```
                Next-hop reference count: 29
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2d 3:30:26
                Task: RT
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I
```

show route exact extensive

```
user@host> show route exact 207.17.136.0/24 extensive
inet.0: 22 destinations, 23 routes (21 active, 0 holddown, 1 hidden)
207.17.136.0/24 (1 entry, 1 announced)
TSI:
KRT in-kernel 207.17.136.0/24 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 29
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 1:25:18
                Task: RT
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I
```

show route exact terse

```
user@host> show route exact 207.17.136.0/24 terse

inet.0: 22 destinations, 23 routes (21 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both
A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 207.17.136.0/24    S   5                       >192.168.71.254
```


show route export

Syntax

show route export
<brief | detail>
<instance <*instance-name*> | *routing-table-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route export
<brief | detail>
<instance <*instance-name*> | *routing-table-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display policy-based route export information. Policy-based export simplifies the process of exchanging route information between routing instances.

Options

none—(Same as **brief**.) Display standard information about policy-based export for all instances and routing tables on all systems.

brief | detail—(Optional) Display the specified level of output.

instance <*instance-name*>—(Optional) Display a particular routing instance for which policy-based export is currently enabled.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

routing-table-name—(Optional) Display information about policy-based export for all routing tables whose name begins with this string (for example, inet.0 and inet6.0 are both displayed when you run the **show route export inet** command).

Required Privilege Level

view

List of Sample Output

show route export on page 2506
show route export detail on page 2506
show route export instance detail on page 2506

Output Fields

Table 216 on page 2505 lists the output fields for the **show route export** command. Output fields are listed in the approximate order in which they appear.

Table 216: show route export Output Fields

Field Name	Field Description	Level of Output
Table or *table-name*	Name of the routing tables that either import or export routes.	All levels
Routes	Number of routes exported from this table into other tables. If a particular route is exported to different tables, the counter will only increment by one.	**brief** none
Export	Whether the table is currently exporting routes to other tables: **Y** or **N** (Yes or No).	**brief** none

Table 216: show route export Output Fields *(continued)*

Field Name	Field Description	Level of Output
Import	Tables currently importing routes from the originator table. (Not displayed for tables that are not exporting any routes.)	**detail**
Flags	(**instance** keyword only) Flags for this feature on this instance: • **config auto-policy**—The policy was deduced from the configured IGP export policies. • **cleanup**—Configuration information for this instance is no longer valid. • **config**—The instance was explicitly configured.	**detail**
Options	(**instance** keyword only) Configured option displays the type of routing tables the feature handles: • **unicast**—Indicates *instance*.inet.0. • **multicast**—Indicates *instance*.inet.2. • **unicast multicast**—Indicates *instance*.inet.0 and *instance*.inet.2.	**detail**
Import policy	(**instance** keyword only) Policy that **route export** uses to construct the import-export matrix. Not displayed if the instance type is **vrf**.	**detail**
Instance	(**instance** keyword only) Name of the routing instance.	**detail**
Type	(**instance** keyword only) Type of routing instance: **forwarding**, **non-forwarding**, or **vrf**.	**detail**

Sample Output

show route export

```
user@host> show route export
Table                            Export          Routes
inet.0                           N                    0
black.inet.0                     Y                    3
red.inet.0                       Y                    4
```

show route export detail

```
user@host>  show route export detail
inet.0                                         Routes:        0
black.inet.0                                   Routes:        3
  Import: [ inet.0 ]
red.inet.0                                     Routes:        4
  Import: [ inet.0 ]
```

show route export instance detail

```
user@host>  show route export instance detail
Instance: master                        Type: forwarding
  Flags: <config auto-policy> Options: <unicast multicast>
  Import policy: [ (ospf-master-from-red || isis-master-from-black) ]
Instance: black                         Type: non-forwarding
Instance: red                           Type: non-forwarding
```


show route extensive

Syntax

show route extensive
<*destination-prefix*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route extensive
<*destination-prefix*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display extensive information about the active entries in the routing tables.

Options

none—Display all active entries in the routing table.

destination-prefix—(Optional) Display active entries for the specified address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route extensive on page 2514
show route extensive (Access Route) on page 2520
show route extensive (BGP PIC Edge) on page 2521
show route extensive (FRR and LFA) on page 2521
show route extensive (Route Reflector) on page 2522
show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs) on page 2522

Output Fields

Table 217 on page 2508 describes the output fields for the **show route extensive** command. Output fields are listed in the approximate order in which they appear.

Table 217: show route extensive Output Fields

Field Name	Field Description
routing-table-name	Name of the routing table (for example, inet.0).
number destinations	Number of destinations for which there are routes in the routing table.
number routes	Number of routes in the routing table and total number of routes in the following states: • **active** (routes that are active). • **holddown** (routes that are in the pending state before being declared inactive). • **hidden** (routes that are not used because of a routing policy).

Table 217: show route extensive Output Fields *(continued)*

Field Name	Field Description

***route-destination* (entry, announced)**	Route destination (for example: 10.0.0.1/24). The **entry** value is the number of route for this destination, and the **announced** value is the number of routes being announced for this destination. Sometimes the route destination is presented in another format, such as:
	• ***MPLS-label*** (for example, 80001).
	• ***interface-name*** (for example, ge-1/0/2).
	• ***neighbor-address*:*control-word-status*:*encapsulation type*:*vc-id*:*source*** (Layer 2 circuit only; for example, 10.1.1.195:NoCtrlWord:1:1:Local/96).
	  ◦ ***neighbor-address***—Address of the neighbor.
	  ◦ ***control-word-status***—Whether the use of the control word has been negotiated for this virtual circuit: **NoCtrlWord** or **CtrlWord**.
	  ◦ ***encapsulation type***—Type of encapsulation, represented by a number: (1) Frame Relay DLCI, (2) ATM AAL5 VCC transport, (3) ATM transparent cell transport, (4) Ethernet, (5) VLAN Ethernet, (6) HDLC, (7) PPP, (8) ATM VCC cell transport, (10) ATM VPC cell transport.
	  ◦ ***vc-id***—Virtual circuit identifier.
	  ◦ ***source***—Source of the advertisement: **Local** or **Remote**.

TSI	Protocol header information.
label stacking	(Next-to-the-last-hop routing device for MPLS only) Depth of the MPLS label stack, where the label-popping operation is needed to remove one or more labels from the top of the stack. A pair of routes is displayed, because the pop operation is performed only when the stack depth is two or more labels. • **S=0 route** indicates that a packet with an incoming label stack depth of two or more exits this router with one fewer label (the label-popping operation is performed). • If there is no **S=** information, the route is a normal MPLS route, which has a stack depth of 1 (the label-popping operation is not performed).
[*protocol*, *preference*]	Protocol from which the route was learned and the preference value for the route. • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the **LocalPref** value for Route 1 is 100, the **Preference2** value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.
Level	(IS-IS only). In IS-IS, a single autonomous system (AS) can be divided into smaller groups called areas. Routing between areas is organized hierarchically, allowing a domain to be administratively divided into smaller areas. This organization is accomplished by configuring Level 1 and Level 2 intermediate systems. Level 1 systems route within an area. When the destination is outside an area, they route toward a Level 2 system. Level 2 intermediate systems route between areas and toward other ASs.
Route Distinguisher	IP subnet augmented with a 64-bit prefix.

Table 217: show route extensive Output Fields *(continued)*

Field Name	Field Description
Next-hop type	Type of next hop. For a description of possible values for this field, see the Output Field table in the show route detail command.
Next-hop reference count	Number of references made to the next hop.
Flood nexthop branches exceed maximum message	Indicates that the number of flood next-hop branches exceeded the system limit of 32 branches, and only a subset of the flood next-hop branches were installed in the kernel.
Source	IP address of the route source.
Next hop	Network layer address of the directly reachable neighboring system.
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the name of the interface that is actually used is followed by the word **Selected**. This field can also contain the following information: • Weight—Value used to distinguish primary, secondary, and fast reroute backup routes. Weight information is available when MPLS label-switched path (LSP) link protection, node-link protection, or fast reroute is enabled, or when the standby state is enabled for secondary paths. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible. • Balance—Balance coefficient indicating how traffic of unequal cost is distributed among next hops when a routing device is performing unequal-cost load balancing. This information is available when you enable BGP multipath load balancing.
Label-switched-path *lsp-path-name*	Name of the LSP used to reach the next hop.
Label operation	MPLS label and operation occurring at this routing device. The operation can be **pop** (where a label is removed from the top of the stack), **push** (where another label is added to the label stack), or **swap** (where a label is replaced by another label).
Offset	Whether the metric has been increased or decreased by an offset value.
Interface	(Local only) Local interface name.
Protocol next hop	Network layer address of the remote routing device that advertised the prefix. This address is used to recursively derive a forwarding next hop.
label-operation	MPLS label and operation occurring at this routing device. The operation can be **pop** (where a label is removed from the top of the stack), **push** (where another label is added to the label stack), or **swap** (where a label is replaced by another label).

Table 217: show route extensive Output Fields *(continued)*

Field Name	Field Description
Indirect next hops	When present, a list of nodes that are used to resolve the path to the next-hop destination, in the order that they are resolved. When BGP PIC Edge is enabled, the output lines that contain **Indirect next hop: weight** follow next hops that the software can use to repair paths where a link failure occurs. The next-hop weight has one of the following values: • 0x1 indicates active next hops. • 0x4000 indicates passive next hops.
State	State of the route (a route can be in more than one state). See the Output Field table in the show route detail command.
Session ID	The BFD session ID number that represents the protection using MPLS fast reroute (FRR) and loop-free alternate (LFA).
Weight	Weight for the backup path. If the weight of an indirect next hop is larger than zero, the weight value is shown. For sample output, see show route table.

Table 217: show route extensive Output Fields *(continued)*

Field Name	Field Description
Inactive reason	If the route is inactive, the reason for its current state is indicated. Typical reasons include: • **Active preferred**—Currently active route was selected over this route. • **Always compare MED**—Path with a lower multiple exit discriminator (MED) is available. • **AS path**—Shorter AS path is available. • **Cisco Non-deterministic MED selection**—Cisco nondeterministic MED is enabled and a path with a lower MED is available. • **Cluster list length**—Path with a shorter cluster list length is available. • **Forwarding use only**—Path is only available for forwarding purposes. • **IGP metric**—Path through the next hop with a lower IGP metric is available. • **IGP metric type**—Path with a lower OSPF link-state advertisement type is available. • **Interior > Exterior > Exterior via Interior**—Direct, static, IGP, or EBGP path is available. • **Local preference**—Path with a higher local preference value is available. • **Next hop address**—Path with a lower metric next hop is available. • **No difference**—Path from a neighbor with a lower IP address is available. • **Not Best in its group**—Occurs when multiple peers of the same external AS advertise the same prefix and are grouped together in the selection process. When this reason is displayed, an additional reason is provided (typically one of the other reasons listed). • **Number of gateways**—Path with a higher number of next hops is available. • **Origin**—Path with a lower origin code is available. • **OSPF version**—Path does not support the indicated OSPF version. • **RIB preference**—Route from a higher-numbered routing table is available. • **Route destinguisher**—64-bit prefix added to IP subnets to make them unique. • **Route metric or MED comparison**—Route with a lower metric or MED is available. • **Route preference**—Route with a lower preference value is available. • **Router ID**—Path through a neighbor with a lower ID is available. • **Unusable path**—Path is not usable because of one of the following conditions: the route is damped, the route is rejected by an import policy, or the route is unresolved. • **Update source**—Last tiebreaker is the lowest IP address value.
Local AS	Autonomous system (AS) number of the local routing device.
Age	How long the route has been known.
AIGP	Accumulated interior gateway protocol (AIGP) BGP attribute.
Metric	Cost value of the indicated route. For routes within an AS, the cost is determined by IGP and the individual protocol metrics. For external routes, destinations, or routing domains, the cost is determined by a preference value.
MED-plus-IGP	Metric value for BGP path selection to which the IGP cost to the next-hop destination has been added.
TTL-Action	For MPLS LSPs, state of the TTL propagation attribute. Can be enabled or disabled for all RSVP-signaled and LDP-signaled LSPs or for specific VRF routing instances. For sample output, see show route table.

Table 217: show route extensive Output Fields *(continued)*

Field Name	Field Description
Task	Name of the protocol that has added the route.
Announcement bits	List of protocols that announce this route. ***n*-Resolve inet** indicates that the route is used for route resolution for next hops found in the routing table. ***n*** is an index used by Juniper Networks customer support only.
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **Recorded**—The AS path is recorded by the sample process (sampled). • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the local AS number associated with the AS path if more than one AS number is configured on the routing device, or if AS path prepending is configured. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.
FECs bound to route	Point-to-multipoint root address, multicast source address, and multicast group address when multipoint LDP (M-LDP) inband signaling is configured.
AS path: I <Originator>	(For route reflected output only) Originator ID attribute set by the route reflector.
VC Label	MPLS label assigned to the Layer 2 circuit virtual connection.
MTU	Maximum transmission unit (MTU) of the Layer 2 circuit.
VLAN ID	VLAN identifier of the Layer 2 circuit.
Cluster list	(For route reflected output only) Cluster ID sent by the route reflector.
Originator ID	(For route reflected output only) Address of router that originally sent the route to the route reflector.
Prefixes bound to route	Forwarding equivalent class (FEC) bound to this route. Applicable only to routes installed by LDP.
Communities	Community path attribute for the route. See the Output Field table in the show route detail command for all possible values for this field.
Layer2-info: encaps	Layer 2 encapsulation (for example, VPLS).

Table 217: show route extensive Output Fields *(continued)*

Field Name	Field Description
control flags	Control flags: **none** or Site Down.
mtu	Maximum transmission unit (MTU) information.
Label-Base, range	First label in a block of labels and label block size. A remote PE routing device uses this first label when sending traffic toward the advertising PE routing device.
status vector	Layer 2 VPN and VPLS network layer reachability information (NLRI).
Localpref	Local preference value included in the route.
Router ID	BGP router ID as advertised by the neighbor in the open message.
Primary Routing Table	In a routing table group, the name of the primary routing table in which the route resides.
Secondary Tables	In a routing table group, the name of one or more secondary tables in which the route resides.
Originating RIB	Name of the routing table whose active route was used to determine the forwarding next-hop entry in the resolution database. For example, in the case of inet.0 resolving through inet.0 and inet.3, this field indicates which routing table, inet.0 or inet.3, provided the best path for a particular prefix.
Node path count	Number of nodes in the path.
Forwarding nexthops	Number of forwarding next hops. The forwarding next hop is the network layer address of the directly reachable neighboring system (if applicable) and the interface used to reach it.

Sample Output

show route extensive

```
user@host> show route extensive
inet.0: 22 destinations, 23 routes (21 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.10.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 29
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 1:34:06
                Task: RT
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

10.31.1.0/30 (2 entries, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 2
                Next hop: via so-0/3/0.0, selected
                State: <Active Int>
```

```
                Local AS:    69
                Age: 1:32:40
                Task: IF
                Announcement bits (1): 3-Resolve tree 2
                AS path: I
         OSPF   Preference: 10
                Next-hop reference count: 1
                Next hop: via so-0/3/0.0, selected
                State: <Int>
                Inactive reason: Route Preference
                Local AS:    69
                Age: 1:32:40    Metric: 1
                Area: 0.0.0.0
                Task: OSPF
                AS path: I

10.31.1.1/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 7
                Interface: so-0/3/0.0
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:32:43
                Task: IF
                Announcement bits (1): 3-Resolve tree 2
                AS path: I

...

10.31.2.0/30 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.31.2.0/30 -> {10.31.1.6}
        *OSPF   Preference: 10
                Next-hop reference count: 9
                Next hop: via so-0/3/0.0
                Next hop: 10.31.1.6 via ge-3/1/0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:32:19    Metric: 2
                Area: 0.0.0.0
                Task: OSPF
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

...

224.0.0.2/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 224.0.0.2/32 -> {}
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:34:08
                Task: PIM Recv
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

...
```

```
224.0.0.22/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 224.0.0.22/32 -> {}
        *IGMP   Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:34:06
                Task: IGMP
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

10.255.70.103/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
                Next-hop reference count: 6
                Next hop: 10.31.1.6 via ge-3/1/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 100096
                State: <Active Int>
                Local AS:    69
                Age: 1:28:12    Metric: 2
                Task: RSVP
                Announcement bits (2): 1-Resolve tree 1 2-Resolve tree 2
                AS path: I

10.255.71.238/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
                Next-hop reference count: 6
                Next hop: via so-0/3/0.0 weight 0x1, selected
                Label-switched-path green-r1-r2
                State: <Active Int>
                Local AS:    69
                Age: 1:28:12    Metric: 1
                Task: RSVP
                Announcement bits (2): 1-Resolve tree 1 2-Resolve tree 2
                AS path: I

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

...

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

47.0005.80ff.f800.0000.0108.0001.0102.5507.1052/152 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:34:07
                Task: IF
                AS path: I

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

0   (1 entry, 1 announced)
```



```
TSI:
KRT in-kernel 0      /36 -> {}
        *MPLS   Preference: 0
                Next hop type: Receive
                Next-hop reference count: 6
                State: <Active Int>
                Local AS:    69
                Age: 1:34:08    Metric: 1
                Task: MPLS
                Announcement bits (1): 0-KRT
                AS path: I

...

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
299776 (1 entry, 1 announced)
TSI:
KRT in-kernel 299776 /52 -> {Flood}
        *RSVP   Preference: 7
                Next hop type: Flood
                Next-hop reference count: 130
                Flood nexthop branches exceed maximum
                Address: 0x8ea65d0
...

800010 (1 entry, 1 announced)

TSI:
KRT in-kernel 800010 /36 -> {vt-3/2/0.32769}
        *VPLS   Preference: 7
                Next-hop reference count: 2
                Next hop: via vt-3/2/0.32769, selected
                Label operation: Pop
                State: <Active Int>
                Age: 1:31:53
                Task: Common L2 VC
                Announcement bits (1): 0-KRT
                AS path: I

vt-3/2/0.32769 (1 entry, 1 announced)
TSI:
KRT in-kernel vt-3/2/0.32769.0      /16 -> {indirect(1048574)}
        *VPLS   Preference: 7
                Next-hop reference count: 2
                Next hop: 10.31.1.6 via ge-3/1/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 800012, Push 100096(top)
                Protocol next hop: 10.255.70.103
                Push 800012
                Indirect next hop: 87272e4 1048574
                State: <Active Int>
                Age: 1:31:53    Metric2: 2
                Task: Common L2 VC
                Announcement bits (2): 0-KRT 1-Common L2 VC
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0
                Indirect next hops: 1
                        Protocol next hop: 10.255.70.103 Metric: 2
                        Push 800012
                        Indirect next hop: 87272e4 1048574
```

```
                        Indirect path forwarding next hops: 1
                                Next hop: 10.31.1.6 via ge-3/1/0.0 weight 0x1
                        10.255.70.103/32 Originating RIB: inet.3
                          Metric: 2                        Node path count: 1
                          Forwarding nexthops: 1
                                Nexthop: 10.31.1.6 via ge-3/1/0.0

inet6.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

abcd::10:255:71:52/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:34:07
                Task: IF
                AS path: I

fe80::280:42ff:fe10:f179/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:34:07
                Task: IF
                AS path: I

ff02::2/128 (1 entry, 1 announced)
TSI:
KRT in-kernel ff02::2/128 -> {}
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:34:08
                Task: PIM Recv6
                Announcement bits (1): 0-KRT
                AS path: I

ff02::d/128 (1 entry, 1 announced)
TSI:
KRT in-kernel ff02::d/128 -> {}
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:34:08
                Task: PIM Recv6
                Announcement bits (1): 0-KRT
                AS path: I

ff02::16/128 (1 entry, 1 announced)
TSI:
KRT in-kernel ff02::16/128 -> {}
        *MLD    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
```



```
                Local AS:    69
                Age: 1:34:06
                Task: MLD
                Announcement bits (1): 0-KRT
                AS path: I

private.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

fe80::280:42ff:fe10:f179/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.16385, selected
                State: <Active NoReadvrt Int>
                Age: 1:34:07
                Task: IF
                AS path: I

green.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)

10.255.70.103:1:3:1/96 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 10.255.70.103:1
                Next-hop reference count: 7
                Source: 10.255.70.103
                Protocol next hop: 10.255.70.103
                Indirect next hop: 2 no-forward
                State: <Secondary Active Int Ext>
                Local AS:    69 Peer AS:    69
                Age: 1:28:12    Metric2: 1
                Task: BGP_69.10.255.70.103+179
                Announcement bits (1): 0-green-l2vpn
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0
                Label-base: 800008, range: 8
                Localpref: 100
                Router ID: 10.255.70.103
                Primary Routing Table bgp.l2vpn.0

10.255.71.52:1:1:1/96 (1 entry, 1 announced)
TSI:
Page 0 idx 0 Type 1 val 8699540
        *L2VPN  Preference: 170/-1
                Next-hop reference count: 5
                Protocol next hop: 10.255.71.52
                Indirect next hop: 0 -
                State: <Active Int Ext>
                Age: 1:34:03    Metric2: 1
                Task: green-l2vpn
                Announcement bits (1): 1-BGP.0.0.0.0+179
                AS path: I
                Communities: Layer2-info: encaps:VPLS, control flags:Site-Down,
                mtu: 0
                Label-base: 800016, range: 8, status-vector: 0x9F

10.255.71.52:1:5:1/96 (1 entry, 1 announced)
TSI:
Page 0 idx 0 Type 1 val 8699528
        *L2VPN  Preference: 170/-101
                Next-hop reference count: 5
```

```
                Protocol next hop: 10.255.71.52
                Indirect next hop: 0 -
                State: <Active Int Ext>
                Age: 1:34:03    Metric2: 1
                Task: green-l2vpn
                Announcement bits (1): 1-BGP.0.0.0.0+179
                AS path: I
                Communities: Layer2-info: encaps:VPLS, control flags:, mtu: 0
                Label-base: 800008, range: 8, status-vector: 0x9F

...

l2circuit.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

TSI:

10.245.255.63:CtrlWord:4:3:Local/96 (1 entry, 1 announced)
        *L2CKT  Preference: 7
                Next hop: via so-1/1/2.0 weight 1, selected
                Label-switched-path my-lsp
                Label operation: Push 100000[0]
                Protocol next hop: 10.245.255.63 Indirect next hop: 86af000 296
                State: <Active Int>
                Local AS:    99
                Age: 10:21
                Task: l2 circuit
                Announcement bits (1): 0-LDP
                AS path: I
                VC Label 100000, MTU 1500, VLAN ID 512


55.0.0.0/24 (1 entry, 1 announced)
TSI:
KRT queued (pending) add
  55.0.0.0/24 -> {Push 300112}
        *BGP    Preference: 170/-101
                Next hop type: Router
                Address: 0x925c208
                Next-hop reference count: 2
                Source: 10.0.0.9
                Next hop: 10.0.0.9 via ge-1/2/0.15, selected
                Label operation: Push 300112
                Label TTL action: prop-ttl
                State: <Active Ext>
                Local AS:  7019 Peer AS: 13979
                Age: 1w0d 23:06:56
                AIGP: 25
                Task: BGP_13979.10.0.0.9+56732
                Announcement bits (1): 0-KRT
                AS path: 13979 7018 I
                Accepted
                Route Label: 300112
                Localpref: 100
                Router ID: 10.9.9.1
```

show route extensive (Access Route)

```
user@host> show route 13.160.0.102 extensive
inet.0: 39256 destinations, 39258 routes (39255 active, 0 holddown, 1 hidden)
13.160.0.102/32 (1 entry, 1 announced)
TSI:
```



```
KRT in-kernel 13.160.0.102/32 -> {13.160.0.2}
OSPF area : 0.0.0.0, LSA ID : 13.160.0.102, LSA type : Extern
        *Access Preference: 13
                Next-hop reference count: 78472
                Next hop: 13.160.0.2 via fe-0/0/0.0, selected
                State: <Active Int>
       Age: 12
                Task: RPD Unix Domain Server./var/run/rpd_serv.local
                Announcement bits (2): 0-KRT 1-OSPFv2
                AS path: I
```

show route extensive (BGP PIC Edge)

```
user@host> show route 1.1.1.6 extensive
ed.inet.0: 6 destinations, 9 routes (6 active, 0 holddown, 0 hidden)
  1.1.1.6/32 (3 entries, 2 announced)
          State: <CalcForwarding>
  TSI:
  KRT in-kernel 1.1.1.6/32 -> {indirect(1048574), indirect(1048577)}
  Page 0 idx 0 Type 1 val 9219e30
      Nexthop: Self
      AS path: [2] 3 I
      Communities: target:2:1
  Path 1.1.1.6 from 1.1.1.4 Vector len 4.  Val: 0
..
          #Multipath Preference: 255
                  Next hop type: Indirect
                  Address: 0x93f4010
                  Next-hop reference count: 2
..
                  Protocol next hop: 1.1.1.4
                  Push 299824
                  Indirect next hop: 944c000 1048574 INH Session ID: 0x3
                  Indirect next hop: weight 0x1
                  Protocol next hop: 1.1.1.5
                  Push 299824
                  Indirect next hop: 944c1d8 1048577 INH Session ID: 0x4
                  Indirect next hop: weight 0x4000
                  State: <ForwardingOnly Int Ext)>
                  Inactive reason: Forwarding use only
                  Age: 25         Metric2: 15
                  Validation State: unverified
                  Task: RT
                  Announcement bits (1): 0-KRT
                  AS path: 3 I
                  Communities: target:2:1
```

show route extensive (FRR and LFA)

```
user@host> show route 20:31:2:0 extensive
inet.0: 46 destinations, 49 routes (45 active, 0 holddown, 1 hidden)
20.31.2.0/24 (2 entries, 1 announced)
        State: FlashAll
TSI:
KRT in-kernel 20.31.2.0/24 -> {Push 299776, Push 299792}
        *RSVP   Preference: 7/1
                Next hop type: Router, Next hop index: 1048574
                Address: 0xbbbc010
                Next-hop reference count: 5
                Next hop: 10.31.1.2 via ge-2/1/8.0 weight 0x1, selected
                Label-switched-path europa-d-to-europa-e
```

```
                Label operation: Push 299776
                Label TTL action: prop-ttl
                Session Id: 0x201
                Next hop: 10.31.2.2 via ge-2/1/4.0 weight 0x4001
                Label-switched-path europa-d-to-europa-e
                Label operation: Push 299792
                Label TTL action: prop-ttl
                Session Id: 0x202
                State: Active Int
                Local AS:   100
                Age: 5:31  Metric: 2
                Task: RSVP
                Announcement bits (1): 0-KRT
                AS path: I
         OSPF   Preference: 10
                Next hop type: Router, Next hop index: 615
                Address: 0xb9d78c4
                Next-hop reference count: 7
                Next hop: 10.31.1.2 via ge-2/1/8.0, selected
                Session Id: 0x201
                State: Int
                Inactive reason: Route Preference
                Local AS:   100
                Age: 5:35  Metric: 3
                Area: 0.0.0.0
                Task: OSPF
                AS path: I
```

show route extensive (Route Reflector)

```
user@host> show route extensive
1.0.0.0/8 (1 entry, 1 announced)

TSI:
KRT in-kernel 1.0.0.0/8 -> {indirect(40)}
        *BGP    Preference: 170/-101
                Source: 192.168.4.214
                Protocol next hop: 207.17.136.192 Indirect next hop: 84ac908 40
                State: <Active Int Ext>
                Local AS: 10458 Peer AS: 10458
                Age: 3:09       Metric: 0       Metric2: 0
                Task: BGP_10458.192.168.4.214+1033
                Announcement bits (2): 0-KRT 4-Resolve inet.0
                AS path: 3944 7777 I <Originator>
                Cluster list:  1.1.1.1
                Originator ID: 10.255.245.88
                Communities: 7777:7777
                Localpref: 100
                Router ID: 4.4.4.4
                Indirect next hops: 1
                        Protocol next hop: 207.17.136.192 Metric: 0
                        Indirect next hop: 84ac908 40
                        Indirect path forwarding next hops: 0
                                Next hop type: Discard
```

show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs)

```
user@host> show route label 299872 detail
mpls.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
299872 (1 entry, 1 announced)
        *LDP    Preference: 9
```



```
                Next hop type: Flood
                Next-hop reference count: 3
                Address: 0x9097d90
                Next hop: via vt-0/1/0.1
                Next-hop index: 661
                Label operation: Pop
                Address: 0x9172130
                Next hop: via so-0/0/3.0
                Next-hop index: 654
                Label operation: Swap 299872
                State: **Active Int>
                Local AS:  1001
                Age: 8:20       Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
               FECs bound to route: P2MP root-addr 10.255.72.166, grp 232.1.1.1,
src 192.168.142.2
```

show route flow validation

Syntax

show route flow validation
<brief | detail>
<*ip-prefix*>
<table *table-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route flow validation
<brief | detail>
<*ip-prefix*>
<table *table-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display flow route information.

Options

none—Display flow route information.

brief | detail—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to brief.

ip-prefix—(Optional) IP address for the flow route.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

table *table-name*—(Optional) Display flow route information for all routing tables whose name begins with this string (for example, inet.0 and inet6.0 are both displayed when you run the **show route flow validation inet** command).

Required Privilege Level

view

List of Sample Output

show route flow validation on page 2525

Output Fields

Table 218 on page 2524 lists the output fields for the **show route flow validation** command. Output fields are listed in the approximate order in which they appear.

Table 218: show route flow validation Output Fields

Field Name	Field Description	Level of Output
routing-table-name	Name of the routing table (for example, inet.0).	All levels
prefix	Route address.	All levels
Active unicast route	Active route in the routing table.	All levels
Dependent flow destinations	Number of flows for which there are routes in the routing table.	All levels

Table 218: show route flow validation Output Fields *(continued)*

Field Name	Field Description	Level of Output
Origin	Source of the route flow.	All levels
Neighbor AS	Autonomous system identifier of the neighbor.	All levels
Flow destination	Number of entries and number of destinations that match the route flow.	All levels
Unicast best match	Destination that is the best match for the route flow.	All levels
Flags	Information about the route flow.	All levels

Sample Output

show route flow validation

```
user@host> show route flow validation
inet.0:
10.0.5.0/24Active unicast route
Dependent flow destinations: 1
Origin: 192.168.224.218, Neighbor AS: 65001
Flow destination (3 entries, 1 match origin)
Unicast best match: 10.0.5.0/24
Flags: SubtreeApex Consistent
```


show route forwarding-table

Syntax

show route forwarding-table
<detail | extensive | summary>
<all>
<ccc *interface-name*>
<destination *destination-prefix*>
<family *family* | matching *matching*>
<interface-name *interface-name*>
<label *name*>
<matching *matching*>
<multicast>
<table (default | *logical-system-name/routing-instance-name* | *routing-instance-name*)>
<vlan (all | *vlan-name*)>
<vpn *vpn*>

Syntax (MX Series Routers)

show route forwarding-table
<detail | extensive | summary>
<all>
<bridge-domain (all | *domain-name*)>
<ccc *interface-name*>
<destination *destination-prefix*>
<family *family* | matching *matching*>
<interface-name *interface-name*>
<label *name*>
<learning-vlan-id *learning-vlan-id*>
<matching *matching*>
<multicast>
<table (default | *logical-system-name/routing-instance-name* | *routing-instance-name*)>
<vlan (all | *vlan-name*)>
<vpn *vpn*>

Syntax (TX Matrix and TX Matrix Plus Routers)

show route forwarding-table
<detail | extensive | summary>
<all>
<ccc *interface-name*>
<destination *destination-prefix*>
<family *family* | matching *matching*>
<interface-name *interface-name*>
<matching *matching*>
<label *name*>
<lcc *number*>
<multicast>
<table *routing-instance-name*>
<vpn *vpn*>

Release Information

Command introduced before Junos OS Release 7.4.
Option **bridge-domain** introduced in Junos OS Release 7.5
Option **learning-vlan-id** introduced in Junos OS Release 8.4
Options **all** and **vlan** introduced in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description Display the Routing Engine's forwarding table, including the network-layer prefixes and their next hops. This command is used to help verify that the routing protocol process has relayed the correction information to the forwarding table. The Routing Engine constructs and maintains one or more routing tables. From the routing tables, the Routing Engine derives a table of active routes, called the forwarding table.

NOTE: The Routing Engine copies the forwarding table to the Packet Forwarding Engine, the part of the router that is responsible for forwarding packets. To display the entries in the Packet Forwarding Engine's forwarding table, use the show pfe route command.

Options **none**—Display the routes in the forwarding tables. By default, the **show route forwarding-table** command does not display information about private, or internal, forwarding tables.

detail | extensive | summary—(Optional) Display the specified level of output.

all—(Optional) Display routing table entries for all forwarding tables, including private, or internal, tables.

bridge-domain (all | *bridge-domain-name*)—(MX Series routers only) (Optional) Display route entries for all bridge domains or the specified bridge domain.

ccc *interface-name*—(Optional) Display route entries for the specified circuit cross-connect interface.

destination *destination-prefix*—(Optional) Destination prefix.

family *family*—(Optional) Display routing table entries for the specified family: **fibre-channel**, **fmembers**, **inet**, **inet6**, **iso**, **mpls**, **tnp**, **unix**, **vpls**, or **vlan-classification**.

interface-name *interface-name*—(Optional) Display routing table entries for the specified interface.

label *name*—(Optional) Display route entries for the specified label.

lcc *number*—(TX Matrix and TX matrix Plus routers only) (Optional) On a routing matrix composed of a TX Matrix router and T640 routers, display information for the specified T640 router (or line-card chassis) connected to the TX Matrix router. On a routing matrix composed of the TX Matrix Plus router and T1600 or T4000 routers, display information for the specified router (line-card chassis) connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.

- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

learning-vlan-id ***learning-vlan-id***—(MX Series routers only) (Optional) Display learned information for all VLANs or for the specified VLAN.

matching ***matching***—(Optional) Display routing table entries matching the specified prefix or prefix length.

multicast—(Optional) Display routing table entries for multicast routes.

table (default | ***logical-system-name/routing-instance-name*** **|** ***routing-instance-name*****)**—(Optional) Display route entries for all the routing tables in the main routing instance or for the specified routing instance. If your device supports logical systems, you can also display route entries for the specified logical system and routing instance. To view the routing instances on your device, use the show route instance command.

vlan (all | ***vlan-name*****)**—(Optional) Display information for all VLANs or for the specified VLAN.

vpn ***vpn***—(Optional) Display routing table entries for a specified VPN.

Required Privilege Level

view

List of Sample Output

show route forwarding-table on page 2531
show route forwarding-table detail on page 2532
show route forwarding-table destination extensive (Weights and Balances) on page 2532
show route forwarding-table extensive on page 2533
show route forwarding-table extensive (RPF) on page 2534
show route forwarding-table family mpls on page 2535
show route forwarding-table family vpls on page 2535
show route forwarding-table family vpls extensive on page 2535
show route forwarding-table table default on page 2537
show route forwarding-table table logical-system-name/routing-instance-name on page 2537
show route forwarding-table vpn on page 2538

Output Fields

Table 219 on page 2529 lists the output fields for the **show route forwarding-table** command. Output fields are listed in the approximate order in which they appear. Field names might be abbreviated (as shown in parentheses) when no level of output is specified, or when the **detail** keyword is used instead of the **extensive** keyword.

Table 219: show route forwarding-table Output Fields

Field Name	Field Description	Level of Output
Logical system	Name of the logical system. This field is displayed if you specify the **table *logical-system-name/routing-instance-name*** option on a device that is configured for and supports logical systems.	All levels
Routing table	Name of the routing table (for example, inet, inet6, mpls).	All levels
Address family	Address family (for example, **IP**, **IPv6**, **ISO**, **MPLS**, and **VPLS**).	All levels
Destination	Destination of the route.	**detail extensive**
Route Type (Type)	How the route was placed into the forwarding table. When the **detail** keyword is used, the route type might be abbreviated (as shown in parentheses): • **cloned** (**clon**)—(TCP or multicast only) Cloned route. • **destination** (**dest**)—Remote addresses directly reachable through an interface. • **destination down** (**iddn**)—Destination route for which the interface is unreachable. • **interface cloned** (**ifcl**)—Cloned route for which the interface is unreachable. • **route down** (**ifdn**)—Interface route for which the interface is unreachable. • **ignore** (**ignr**)—Ignore this route. • **interface** (**intf**)—Installed as a result of configuring an interface. • **permanent** (**perm**)—Routes installed by the kernel when the routing table is initialized. • **user**—Routes installed by the routing protocol process or as a result of the configuration.	All levels
Route Reference (RtRef)	Number of routes to reference.	**detail extensive**
Flags	Route type flags: • **none**—No flags are enabled. • **accounting**—Route has accounting enabled. • **cached**—Cache route. • **incoming-iface *interface-number***—Check against incoming interface. • **prefix load balance**—Load balancing is enabled for this prefix. • **rt nh decoupled**—Route has been decoupled from the next hop to the destination. • **sent to PFE**—Route has been sent to the Packet Forwarding Engine. • **static**—Static route.	**extensive**
Next hop	IP address of the next hop to the destination.	**detail extensive**

Table 219: show route forwarding-table Output Fields *(continued)*

Field Name	Field Description	Level of Output
Next hop Type (Type)	Next-hop type. When the **detail** keyword is used, the next-hop type might be abbreviated (as indicated in parentheses): • **broadcast (bcst)**—Broadcast. • **deny**—Deny. • **discard (dscd)** —Discard. • **hold**—Next hop is waiting to be resolved into a unicast or multicast type. • **indexed (idxd)**—Indexed next hop. • **indirect (indr)**—Indirect next hop. • **local (locl)**—Local address on an interface. • **routed multicast (mcrt)**—Regular multicast next hop. • **multicast (mcst)**—Wire multicast next hop (limited to the LAN). • **multicast discard (mdsc)**—Multicast discard. • **multicast group (mgrp)**—Multicast group member. • **receive (recv)**—Receive. • **reject (rjct)**—Discard. An ICMP unreachable message was sent. • **resolve (rslv)**—Resolving the next hop. • **unicast (ucst)**—Unicast. • **unilist (ulst)**—List of unicast next hops. A packet sent to this next hop goes to any next hop in the list.	**detail extensive**
Index	Software index of the next hop that is used to route the traffic for a given prefix.	**detail extensive** none
Route interface-index	Logical interface index from which the route is learned. For example, for interface routes, this is the logical interface index of the route itself. For static routes, this field is zero. For routes learned through routing protocols, this is the logical interface index from which the route is learned.	**extensive**
Reference (NhRef)	Number of routes that refer to this next hop.	**detail extensive** none
Next-hop interface (Netif)	Interface used to reach the next hop.	**detail extensive** none
Weight	Value used to distinguish primary, secondary, and fast reroute backup routes. Weight information is available when MPLS label-switched path (LSP) link protection, node-link protection, or fast reroute is enabled, or when the standby state is enabled for secondary paths. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible (see the **Balance** field description).	**extensive**
Balance	Balance coefficient indicating how traffic of unequal cost is distributed among next hops when a router is performing unequal-cost load balancing. This information is available when you enable BGP multipath load balancing.	**extensive**
RPF interface	List of interfaces from which the prefix can be accepted. Reverse path forwarding (RPF) information is displayed only when **rpf-check** is configured on the interface.	**extensive**

Sample Output

show route forwarding-table

```
user@host> show route forwarding-table
Routing table: default.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    46     4
0.0.0.0/32         perm     0                    dscd    44     1
1.1.1.0/24         ifdn     0                    rslv   608     1 ge-2/0/1.0
1.1.1.0/32         iddn     0 1.1.1.0            recv   606     1 ge-2/0/1.0
1.1.1.1/32         user     0                    rjct    46     4
1.1.1.1/32         intf     0 1.1.1.1            locl   607     2
1.1.1.1/32         iddn     0 1.1.1.1            locl   607     2
1.1.1.255/32       iddn     0 ff:ff:ff:ff:ff:ff  bcst   605     1 ge-2/0/1.0
10.0.0.0/24        intf     0                    rslv   616     1 ge-2/0/0.0
10.0.0.0/32        dest     0 10.0.0.0           recv   614     1 ge-2/0/0.0
10.0.0.1/32        intf     0 10.0.0.1           locl   615     2
10.0.0.1/32        dest     0 10.0.0.1           locl   615     2
10.0.0.255/32      dest     0 10.0.0.255         bcst   613     1 ge-2/0/0.0
10.1.1.0/24        ifdn     0                    rslv   612     1 ge-2/0/1.0
10.1.1.0/32        iddn     0 10.1.1.0           recv   610     1 ge-2/0/1.0
10.1.1.1/32        user     0                    rjct    46     4
10.1.1.1/32        intf     0 10.1.1.1           locl   611     2
10.1.1.1/32        iddn     0 10.1.1.1           locl   611     2
10.1.1.255/32      iddn     0 ff:ff:ff:ff:ff:ff  bcst   609     1 ge-2/0/1.0
10.206.0.0/16      user     0 10.209.63.254      ucst   419    20 fxp0.0
10.209.0.0/16      user     1 0:12:1e:ca:98:0    ucst   419    20 fxp0.0
10.209.0.0/18      intf     0                    rslv   418     1 fxp0.0
10.209.0.0/32      dest     0 10.209.0.0         recv   416     1 fxp0.0
10.209.2.131/32    intf     0 10.209.2.131       locl   417     2
10.209.2.131/32    dest     0 10.209.2.131       locl   417     2
10.209.17.55/32    dest     0 0:30:48:5b:78:d2   ucst   435     1 fxp0.0
10.209.63.42/32    dest     0 0:23:7d:58:92:ca   ucst   434     1 fxp0.0
10.209.63.254/32   dest     0 0:12:1e:ca:98:0    ucst   419    20 fxp0.0
10.209.63.255/32   dest     0 10.209.63.255      bcst   415     1 fxp0.0
10.227.0.0/16      user     0 10.209.63.254      ucst   419    20 fxp0.0

...

Routing table: iso
ISO:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                   rjct    27      1
47.0005.80ff.f800.0000.0108.0003.0102.5524.5220.00
intf      0                    locl     28      1

Routing table: inet6
Internet6:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                   rjct     6      1
ff00::/8           perm     0                   mdsc     4      1
ff02::1/128        perm     0 ff02::1           mcst     3      1

Routing table: ccc
MPLS:
Interface.Label    Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct 16      1
100004(top)fe-0/0/1.0
```

show route forwarding-table detail

```
user@host> show route forwarding-table detail
Routing table: inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            user     2 0:90:69:8e:b1:1b   ucst   132     4 fxp0.0
default            perm     0                    rjct    14     1
10.1.1.0/24        intf     0 ff.3.0.21          ucst   322     1 so-5/3/0.0
10.1.1.0/32        dest     0 10.1.1.0           recv   324     1 so-5/3/0.0
10.1.1.1/32        intf     0 10.1.1.1           locl   321     1
10.1.1.255/32      dest     0 10.1.1.255         bcst   323     1 so-5/3/0.0
10.21.21.0/24      intf     0 ff.3.0.21          ucst   326     1 so-5/3/0.0
10.21.21.0/32      dest     0 10.21.21.0         recv   328     1 so-5/3/0.0
10.21.21.1/32      intf     0 10.21.21.1         locl   325     1
10.21.21.255/32    dest     0 10.21.21.255       bcst   327     1 so-5/3/0.0
127.0.0.1/32       intf     0 127.0.0.1          locl   320     1
172.17.28.19/32    clon     1 192.168.4.254      ucst   132     4 fxp0.0
172.17.28.44/32    clon     1 192.168.4.254      ucst   132     4 fxp0.0

...

Routing table: private1__.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    46     1
10.0.0.0/8         intf     0                    rslv   136     1 fxp1.0
10.0.0.0/32        dest     0 10.0.0.0           recv   134     1 fxp1.0
10.0.0.4/32        intf     0 10.0.0.4           locl   135     2
10.0.0.4/32        dest     0 10.0.0.4           locl   135     2

...

Routing table: iso
ISO:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    38     1

Routing table: inet6
Internet6:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    22     1
ff00::/8           perm     0                    mdsc    21     1
ff02::1/128        perm     0 ff02::1            mcst    17     1

...

Routing table: mpls
MPLS:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct 28      1
```

show route forwarding-table destination extensive (Weights and Balances)

```
user@host> show route forwarding-table destination 3.4.2.1 extensive
Routing table: inet [Index 0]
Internet:

Destination:  3.4.2.1/32
  Route type: user
  Route reference: 0                   Route interface-index: 0
```



```
  Flags: sent to PFE
  Next-hop type: unilist             Index: 262143   Reference: 1
  Nexthop: 4.4.4.4
  Next-hop type: unicast             Index: 335      Reference: 2
  Next-hop interface: so-1/1/0.0     Weight: 22      Balance: 3
  Nexthop: 145.12.1.2
  Next-hop type: unicast             Index: 337      Reference: 2
  Next-hop interface: so-0/1/2.0     Weight: 33      Balance: 33
```

show route forwarding-table extensive

```
user@host> show route forwarding-table extensive
Routing table: inet [Index 0]
Internet:

Destination:  default
  Route type: user
  Route reference: 2                 Route interface-index: 0
  Flags: sent to PFE
  Nexthop: 0:90:69:8e:b1:1b
  Next-hop type: unicast             Index: 132      Reference: 4
  Next-hop interface: fxp0.0

Destination:  default
  Route type: permanent
  Route reference: 0                 Route interface-index: 0
  Flags: none
  Next-hop type: reject              Index: 14       Reference: 1

Destination:  127.0.0.1/32
  Route type: interface
  Route reference: 0                 Route interface-index: 0
  Flags: sent to PFE
  Nexthop: 127.0.0.1
  Next-hop type: local               Index: 320      Reference: 1

...

Routing table: private1__.inet [Index 1]
Internet:

Destination:  default
  Route type: permanent
  Route reference: 0                 Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: reject              Index: 46       Reference: 1

Destination:  10.0.0.0/8
  Route type: interface
  Route reference: 0                 Route interface-index: 3
  Flags: sent to PFE
  Next-hop type: resolve             Index: 136      Reference: 1
  Next-hop interface: fxp1.0

...

Routing table: iso [Index 0]
ISO:

Destination:  default
  Route type: permanent
```

```
  Route reference: 0                   Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: reject                Index: 38       Reference: 1

Routing table: inet6 [Index 0]
Internet6:

Destination:  default
  Route type: permanent
  Route reference: 0                   Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: reject                Index: 22       Reference: 1

Destination:  ff00::/8
  Route type: permanent
  Route reference: 0                   Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: multicast discard     Index: 21       Reference: 1

...

Routing table: private1__.inet6 [Index 1]
Internet6:

Destination:  default
  Route type: permanent
  Route reference: 0                   Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: reject                Index: 54       Reference: 1

Destination:  fe80::2a0:a5ff:fe3d:375/128
  Route type: interface
  Route reference: 0                   Route interface-index: 0
  Flags: sent to PFE
  Nexthop: fe80::2a0:a5ff:fe3d:375
  Next-hop type: local                 Index: 75       Reference: 1

...
```

show route forwarding-table extensive (RPF)

The next example is based on the following configuration, which enables an RPF check on all routes that are learned from this interface, including the interface route:

```
so-1/1/0 {
    unit 0 {
        family inet {
            rpf-check;
            address 15.95.1.2/30;
        }
    }
}
```

```
user@host> show route forwarding-table extensive
Routing table: inet [Index 0]
Internet:
...
...
Destination:  15.95.1.3/32
  Route type: destination
  Route reference: 0                   Route interface-index: 67
```



```
  Flags: sent to PFE
  Nexthop: 15.95.1.3
  Next-hop type: broadcast             Index: 328      Reference: 1
  Next-hop interface: so-1/1/0.0
  RPF interface: so-1/1/0.0
```

show route forwarding-table family mpls

```
user@host> show route forwarding-table family mpls
Routing table: mpls
MPLS:
Destination        Type RtRef Next hop          Type Index NhRef Netif
default            perm     0                   rjct    19     1
0                  user     0                   recv    18     3
1                  user     0                   recv    18     3
2                  user     0                   recv    18     3
100000             user     0 10.31.1.6         swap  100001     fe-1/1/0.0
800002             user     0                   Pop              vt-0/3/0.32770

vt-0/3/0.32770 (VPLS)
                   user     0                   indr   351     4
                                                Push 800000, Push 100002(top)
so-0/0/0.0
```

show route forwarding-table family vpls

```
user@host> show route forwarding-table family vpls
Routing table: green.vpls
VPLS:
Destination        Type RtRef Next hop          Type Index NhRef Netif
default            dynm     0                   flood   353     1
default            perm     0                   rjct    298     1
fe-0/1/0.0         dynm     0                   flood   355     1
00:90:69:0c:20:1f/48             <<<<<Remote CE

                   dynm     0                   indr   351     4
                                                Push 800000, Push 100002(top)
so-0/0/0.0
00:90:69:85:b0:1f/48             <<<<<<Local CE

                   dynm     0                   ucst   354     2 fe-0/1/0.0
```

show route forwarding-table family vpls extensive

```
user@host> show route forwarding-table family vpls extensive
Routing table: green.vpls [Index 2]
VPLS:

Destination:  default
  Route type: dynamic
  Route reference: 0                   Route interface-index: 72
  Flags: sent to PFE
  Next-hop type: flood                 Index: 289      Reference: 1
  Next-hop type: unicast               Index: 291      Reference: 3
  Next-hop interface: fe-0/1/3.0
  Next-hop type: unicast               Index: 290      Reference: 3
  Next-hop interface: fe-0/1/2.0

Destination:  default
  Route type: permanent
  Route reference: 0                   Route interface-index: 0
  Flags: none
```

```
  Next-hop type: discard             Index: 341     Reference: 1

Destination:  fe-0/1/2.0
  Route type: dynamic
  Route reference: 0                 Route interface-index: 69
  Flags: sent to PFE
  Next-hop type: flood               Index: 293     Reference: 1
  Next-hop type: indirect            Index: 363     Reference: 4
  Next-hop type: Push 800016
  Next-hop interface: at-1/0/1.0
  Next-hop type: indirect            Index: 301     Reference: 5
  Next hop: 10.31.3.2
  Next-hop type: Push 800000
  Next-hop interface: fe-0/1/1.0
  Next-hop type: unicast             Index: 291     Reference: 3
  Next-hop interface: fe-0/1/3.0

Destination:  fe-0/1/3.0
  Route type: dynamic
  Route reference: 0                 Route interface-index: 70
  Flags: sent to PFE
  Next-hop type: flood               Index: 292     Reference: 1
  Next-hop type: indirect            Index: 363     Reference: 4
  Next-hop type: Push 800016
  Next-hop interface: at-1/0/1.0
  Next-hop type: indirect            Index: 301     Reference: 5
  Next hop: 10.31.3.2
  Next-hop type: Push 800000
  Next-hop interface: fe-0/1/1.0
  Next-hop type: unicast             Index: 290     Reference: 3
  Next-hop interface: fe-0/1/2.0

Destination:  10:00:00:01:01:01/48
  Route type: dynamic
  Route reference: 0                 Route interface-index: 70
  Flags: sent to PFE, prefix load balance
  Next-hop type: unicast             Index: 291     Reference: 3
  Next-hop interface: fe-0/1/3.0
  Route used as destination:
    Packet count:         6640    Byte count:      675786
  Route used as source
    Packet count:         6894    Byte count:      696424

Destination:  10:00:00:01:01:04/48
  Route type: dynamic
  Route reference: 0                 Route interface-index: 69
  Flags: sent to PFE, prefix load balance
  Next-hop type: unicast             Index: 290     Reference: 3
  Next-hop interface: fe-0/1/2.0
  Route used as destination:
    Packet count:           96    Byte count:        8079
  Route used as source:
    Packet count:          296    Byte count:       24955

Destination:  10:00:00:01:03:05/48
  Route type: dynamic
  Route reference: 0                 Route interface-index: 74
  Flags: sent to PFE, prefix load balance
  Next-hop type: indirect            Index: 301     Reference: 5
  Next hop: 10.31.3.2
```



```
  Next-hop type: Push 800000
  Next-hop interface: fe-0/1/1.0
```

show route forwarding-table table default

```
user@host> show route forwarding-table table default
Routing table: default.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    36     2
0.0.0.0/32         perm     0                    dscd    34     1
10.0.60.0/30       user     0 10.0.60.13         ucst   713     5 fe-0/1/3.0
10.0.60.12/30      intf     0                    rslv   688     1 fe-0/1/3.0
10.0.60.12/32      dest     0 10.0.60.12         recv   686     1 fe-0/1/3.0
10.0.60.13/32      dest     0 0:5:85:8b:bc:22    ucst   713     5 fe-0/1/3.0
10.0.60.14/32      intf     0 10.0.60.14         locl   687     2
10.0.60.14/32      dest     0 10.0.60.14         locl   687     2
10.0.60.15/32      dest     0 10.0.60.15         bcst   685     1 fe-0/1/3.0
10.0.67.12/30      user     0 10.0.60.13         ucst   713     5 fe-0/1/3.0
10.0.80.0/30       ifdn     0 ff.3.0.21          ucst   676     1 so-0/0/1.0
10.0.80.0/32       dest     0 10.0.80.0          recv   678     1 so-0/0/1.0
10.0.80.2/32       user     0                    rjct    36     2
10.0.80.2/32       intf     0 10.0.80.2          locl   675     1
10.0.80.3/32       dest     0 10.0.80.3          bcst   677     1 so-0/0/1.0
10.0.90.12/30      intf     0                    rslv   684     1 fe-0/1/0.0
10.0.90.12/32      dest     0 10.0.90.12         recv   682     1 fe-0/1/0.0
10.0.90.14/32      intf     0 10.0.90.14         locl   683     2
10.0.90.14/32      dest     0 10.0.90.14         locl   683     2
10.0.90.15/32      dest     0 10.0.90.15         bcst   681     1 fe-0/1/0.0
10.5.0.0/16        user     0 192.168.187.126    ucst   324    15 fxp0.0
10.10.0.0/16       user     0 192.168.187.126    ucst   324    15 fxp0.0
10.13.10.0/23      user     0 192.168.187.126    ucst   324    15 fxp0.0
10.84.0.0/16       user     0 192.168.187.126    ucst   324    15 fxp0.0
10.150.0.0/16      user     0 192.168.187.126    ucst   324    15 fxp0.0
10.157.64.0/19     user     0 192.168.187.126    ucst   324    15 fxp0.0
10.209.0.0/16      user     0 192.168.187.126    ucst   324    15 fxp0.0

...

Routing table: default.iso
ISO:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    60     1

Routing table: default.inet6
Internet6:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    44     1
::/128             perm     0                    dscd    42     1
ff00::/8           perm     0                    mdsc    43     1
ff02::1/128        perm     0 ff02::1            mcst    39     1

Routing table: default.mpls
MPLS:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    dscd    50     1
```

show route forwarding-table table logical-system-name/routing-instance-name

```
user@host> show route forwarding-table table R4/vpn-red
```

```
Logical system: R4
Routing table: vpn-red.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct   563     1
0.0.0.0/32         perm     0                    dscd   561     2
1.0.0.1/32         user     0                    dscd   561     2
2.0.2.0/24         intf     0                    rslv   771     1 ge-1/2/0.3
2.0.2.0/32         dest     0 2.0.2.0            recv   769     1 ge-1/2/0.3
2.0.2.1/32         intf     0 2.0.2.1            locl   770     2
2.0.2.1/32         dest     0 2.0.2.1            locl   770     2
2.0.2.2/32         dest     0 0.4.80.3.0.1b.c0.d5.e4.bd.0.1b.c0.d5.e4.bc.8.0
                                                 ucst   789     1 ge-1/2/0.3
2.0.2.255/32       dest     0 2.0.2.255          bcst   768     1 ge-1/2/0.3
224.0.0.0/4        perm     1                    mdsc   562     1
224.0.0.1/32       perm     0 224.0.0.1          mcst   558     1
255.255.255.255/32 perm     0                    bcst   559     1

Logical system: R4
Routing table: vpn-red.iso
ISO:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct   608     1

Logical system: R4
Routing table: vpn-red.inet6
Internet6:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct   708     1
::/128             perm     0                    dscd   706     1
ff00::/8           perm     0                    mdsc   707     1
ff02::1/128        perm     0 ff02::1            mcst   704     1

Logical system: R4
Routing table: vpn-red.mpls
MPLS:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    dscd   638
```

show route forwarding-table vpn

```
user@host> show route forwarding-table vpn VPN-A
      Routing table:: VPN-A.inet
Internet:
      Destination        Type RtRef Nexthop            Type Index NhRef Netif
      default            perm     0                    rjct     4     4
      10.39.10.20/30     intf     0 ff.3.0.21          ucst    40     1
      so-0/0/0.0
      10.39.10.21/32     intf     0 10.39.10.21        locl    36     1
      10.255.14.172/32   user     0                    ucst    69     2
      so-0/0/0.0
      10.255.14.175/32   user     0                    indr    81     3
                                                       Push 100004, Push
      100004(top) so-1/0/0.0
      224.0.0.0/4        perm     2                    mdsc     5     3
      224.0.0.1/32       perm     0 224.0.0.1          mcst     1     8
      224.0.0.5/32       user     1 224.0.0.5          mcst     1     8
      255.255.255.255/32 perm     0                    bcst     2     3
```


show route inactive-path

Syntax

show route inactive-path
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route inactive-path
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display routes for destinations that have no active route. An inactive route is a route that was not selected as the best path.

Options

none—Display all inactive routes.

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route inactive-path on page 2539
show route inactive-path detail on page 2540
show route inactive-path extensive on page 2541
show route inactive-path terse on page 2541

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route inactive-path

```
user@host> show route inactive-path

inet.0: 25 destinations, 26 routes (24 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

10.12.100.12/30     [OSPF/10] 03:57:28, metric 1
                    > via so-0/3/0.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.0/8          [Direct/0] 04:39:56
                    > via fxp1.0
```

```
red.inet.0: 6 destinations, 8 routes (4 active, 0 holddown, 3 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

10.12.80.0/30       [BGP/170] 04:38:17, localpref 100
                      AS path: 100 I
                    > to 10.12.80.1 via ge-6/3/2.0

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

bgp.l3vpn.0: 3 destinations, 3 routes (0 active, 0 holddown, 3 hidden)
Restart Complete

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route inactive-path detail

```
user@host> show route inactive-path detail

inet.0: 25 destinations, 26 routes (24 active, 0 holddown, 1 hidden)
Restart Complete

10.12.100.12/30 (2 entries, 1 announced)
         OSPF   Preference: 10
                Next-hop reference count: 1
                Next hop: via so-0/3/0.0, selected
                State: <Int>
                Inactive reason: Route Preference
                Local AS:     1
                Age: 3:58:24    Metric: 1
                Area: 0.0.0.0
                Task: OSPF
                AS path: I

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

10.0.0.0/8 (2 entries, 0 announced)
         Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via fxp1.0, selected
                State: <NotBest Int>
                Inactive reason: No difference
                Age: 4:40:52
                Task: IF
                AS path: I

red.inet.0: 6 destinations, 8 routes (4 active, 0 holddown, 3 hidden)
Restart Complete

10.12.80.0/30 (2 entries, 1 announced)
         BGP    Preference: 170/-101
                Next-hop reference count: 6
                Source: 10.12.80.1
```

```
Next hop: 10.12.80.1 via ge-6/3/2.0, selected
State: <Ext>
Inactive reason: Route Preference
Peer AS:   100
Age: 4:39:13
Task: BGP_100.10.12.80.1+179
AS path: 100 I
Localpref: 100
Router ID: 10.0.0.0
```

show route inactive-path extensive

The output for the **show route inactive-path extensive** command is identical to that of the **show route inactive-path detail** command. For sample output, see show route inactive-path detail on page 2540.

show route inactive-path terse

```
user@host> show route inactive-path terse

inet.0: 25 destinations, 26 routes (24 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  10.12.100.12/30    O  10          1            >so-0/3/0.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  10.0.0.0/8         D   0                        >fxp1.0

red.inet.0: 6 destinations, 8 routes (4 active, 0 holddown, 3 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  10.12.80.0/30      B 170        100             >10.12.80.1      100 I

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

bgp.l3vpn.0: 3 destinations, 3 routes (0 active, 0 holddown, 3 hidden)
Restart Complete

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route inactive-prefix

Syntax

show route inactive-prefix
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route inactive-prefix
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display inactive route destinations in each routing table.

Options

none—Display all inactive route destination.

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to brief.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route inactive-prefix on page 2542
show route inactive-prefix detail on page 2542
show route inactive-prefix extensive on page 2543
show route inactive-prefix terse on page 2543

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route inactive-prefix

```
user@host> show route inactive-prefix

inet.0: 14 destinations, 14 routes (13 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

127.0.0.1/32        [Direct/0] 00:04:54
                    > via lo0.0
```

show route inactive-prefix detail

```
user@host> show route inactive-prefix detail

inet.0: 14 destinations, 14 routes (13 active, 0 holddown, 1 hidden)
127.0.0.1/32 (1 entry, 0 announced)
         Direct Preference: 0
                Next hop type: Interface
```

```
Next-hop reference count: 1
Next hop: via lo0.0, selected
State: <Hidden Martian Int>
Age: 4:51
Task: IF
AS path: I00:04:54
    > via lo0.0
```

show route inactive-prefix extensive

The output for the **show route inactive-prefix extensive** command is identical to that of the **show route inactive-path detail** command. For sample output, see show route inactive-prefix detail on page 2542.

show route inactive-prefix terse

user@host> **show route inactive-prefix terse**

```
inet.0: 18 destinations, 18 routes (17 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  127.0.0.1/32       D   0                       >lo0.0
```

show route instance

Syntax

show route instance
<brief | detail | summary>
<*instance-name*>
<logical-system (all | *logical-system-name*)>
<operational>

Syntax (EX Series Switches and QFX Series)

show route instance
<brief | detail | summary>
<*instance-name*>
<operational>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display routing instance information.

Options

none—(Same as **brief**) Display standard information about all routing instances.

brief | detail | summary—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**. (These options are not available with the **operational** keyword.)

instance-name—(Optional) Display information for all routing instances whose name begins with this string (for example, **cust1**, **cust11**, and **cust111** are all displayed when you run the **show route instance cust1** command).

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

operational—(Optional) Display operational routing instances.

Required Privilege Level

view

Related Documentation

- Understanding Virtual Router Routing Instances on page 2304
- Configuring Virtual Router Routing Instances on page 2313
- Verifying That Virtual Router Routing Instances Are Working on page 2442

List of Sample Output

show route instance on page 2545
show route instance detail (Graceful Restart Complete) on page 2546
show route instance detail (Graceful Restart Incomplete) on page 2548
show route instance detail (VPLS Routing Instance) on page 2549
show route instance operational on page 2550
show route instance summary on page 2550

Output Fields

Table 116 on page 1375 lists the output fields for the **show route instance** command. Output fields are listed in the approximate order in which they appear.

Table 220: show route instance Output Fields

Field Name	Field Description	Level of Output
Instance or *instance-name*	Name of the routing instance.	All levels
Operational Routing Instances	(**operational** keyword only) Names of all operational routing instances.	—
Type	Type of routing instance: **forwarding**, **l2vpn**, **no-forwarding**, **vpls**, **virtual-router**, or **vrf**.	All levels
State	State of the routing instance: **active** or **inactive**.	**brief detail** none
Interfaces	Name of interfaces belonging to this routing instance.	**brief detail** none
Restart State	Status of graceful restart for this instance: **Pending** or **Complete**.	**detail**
Path selection timeout	Maximum amount of time, in seconds, remaining until graceful restart is declared complete. The default is **300**.	**detail**
Tables	Tables (and number of routes) associated with this routing instance.	**brief detail** none
Route-distinguisher	Unique route distinguisher associated with this routing instance.	**detail**
Vrf-import	VPN routing and forwarding instance import policy name.	**detail**
Vrf-export	VPN routing and forwarding instance export policy name.	**detail**
Vrf-import-target	VPN routing and forwarding instance import target community name.	**detail**
Vrf-export-target	VPN routing and forwarding instance export target community name.	**detail**
Fast-reroute-priority	Fast reroute priority setting for a VPLS routing instance: **high**, **medium**, or **low**. The default is **low**.	**detail**
Restart State	Restart state: • **Pending:***protocol-name*—List of protocols that have not yet completed graceful restart for this routing table. • **Complete**—All protocols have restarted for this routing table.	**detail**
Primary rib	Primary table for this routing instance.	**brief** none **summary**
Active/holddown/hidden	Number of active, hold-down, and hidden routes.	All levels

Sample Output

show route instance

```
user@host> show route instance
Instance             Type
         Primary RIB                                     Active/holddown/hidden
```

```
master                  forwarding
         inet.0                                     16/0/1
         iso.0                                      1/0/0
         mpls.0                                     0/0/0
         inet6.0                                    2/0/0
         l2circuit.0                                0/0/0
__juniper_private1__ forwarding
         __juniper_private1__.inet.0                12/0/0
         __juniper_private1__.inet6.0               1/0/0
```

show route instance detail (Graceful Restart Complete)

```
user@host> show route instance detail
master:
  Router ID: 10.255.14.176
  Type: forwarding        State: Active
  Restart State: Complete Path selection timeout: 300
  Tables:
    inet.0                 : 17 routes (15 active, 0 holddown, 1 hidden)
    Restart Complete
    inet.3                 : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Complete
    iso.0                  : 1 routes (1 active, 0 holddown, 0 hidden)
    Restart Complete
    mpls.0                 : 19 routes (19 active, 0 holddown, 0 hidden)
    Restart Complete
    bgp.l3vpn.0            : 10 routes (10 active, 0 holddown, 0 hidden)
    Restart Complete
    inet6.0                : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Complete
    bgp.l2vpn.0            : 1 routes (1 active, 0 holddown, 0 hidden)
    Restart Complete
BGP-INET:
  Router ID: 10.69.103.1
  Type: vrf               State: Active
  Restart State: Complete Path selection timeout: 300
  Interfaces:
    t3-0/0/0.103
  Route-distinguisher: 10.255.14.176:103
  Vrf-import: [ BGP-INET-import ]
  Vrf-export: [ BGP-INET-export ]
  Tables:
    BGP-INET.inet.0        : 4 routes (4 active, 0 holddown, 0 hidden)
    Restart Complete
BGP-L:
  Router ID: 10.69.104.1
  Type: vrf               State: Active
  Restart State: Complete Path selection timeout: 300
  Interfaces:
    t3-0/0/0.104
  Route-distinguisher: 10.255.14.176:104
  Vrf-import: [ BGP-L-import ]
  Vrf-export: [ BGP-L-export ]
  Tables:
    BGP-L.inet.0           : 4 routes (4 active, 0 holddown, 0 hidden)
    Restart Complete
    BGP-L.mpls.0           : 3 routes (3 active, 0 holddown, 0 hidden)
    Restart Complete
L2VPN:
  Router ID: 0.0.0.0
  Type: l2vpn             State: Active
```



```
    Restart State: Complete Path selection timeout: 300
    Interfaces:
      t3-0/0/0.512
    Route-distinguisher: 10.255.14.176:512
    Vrf-import: [ L2VPN-import ]
    Vrf-export: [ L2VPN-export ]
    Tables:
      L2VPN.l2vpn.0          : 2 routes (2 active, 0 holddown, 0 hidden)
      Restart Complete
  LDP:
    Router ID: 10.69.105.1
    Type: vrf               State: Active
    Restart State: Complete Path selection timeout: 300
    Interfaces:
      t3-0/0/0.105
    Route-distinguisher: 10.255.14.176:105
    Vrf-import: [ LDP-import ]
    Vrf-export: [ LDP-export ]
    Tables:
      LDP.inet.0             : 5 routes (4 active, 0 holddown, 0 hidden)
      Restart Complete
  OSPF:
    Router ID: 10.69.101.1
    Type: vrf               State: Active
    Restart State: Complete Path selection timeout: 300
    Interfaces:
      t3-0/0/0.101
    Route-distinguisher: 10.255.14.176:101
    Vrf-import: [ OSPF-import ]
    Vrf-export: [ OSPF-export ]
    Vrf-import-target: [ target:11111
    Tables:
      OSPF.inet.0            : 8 routes (7 active, 0 holddown, 0 hidden)
      Restart Complete
  RIP:
    Router ID: 10.69.102.1
    Type: vrf               State: Active
    Restart State: Complete Path selection timeout: 300
    Interfaces:
      t3-0/0/0.102
    Route-distinguisher: 10.255.14.176:102
    Vrf-import: [ RIP-import ]
    Vrf-export: [ RIP-export ]
    Tables:
      RIP.inet.0             : 6 routes (6 active, 0 holddown, 0 hidden)
      Restart Complete
  STATIC:
    Router ID: 10.69.100.1
    Type: vrf               State: Active
    Restart State: Complete Path selection timeout: 300
    Interfaces:
      t3-0/0/0.100
    Route-distinguisher: 10.255.14.176:100
    Vrf-import: [ STATIC-import ]
    Vrf-export: [ STATIC-export ]
    Tables:
      STATIC.inet.0          : 4 routes (4 active, 0 holddown, 0 hidden)
      Restart Complete
```

show route instance detail (Graceful Restart Incomplete)

```
user@host> show route instance detail
master:
  Router ID: 10.255.14.176
  Type: forwarding        State: Active
  Restart State: Pending  Path selection timeout: 300
  Tables:
    inet.0                 : 17 routes (15 active, 1 holddown, 1 hidden)
    Restart Pending: OSPF LDP
    inet.3                 : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Pending: OSPF LDP
    iso.0                  : 1 routes (1 active, 0 holddown, 0 hidden)
    Restart Complete
    mpls.0                 : 23 routes (23 active, 0 holddown, 0 hidden)
    Restart Pending: LDP VPN
    bgp.l3vpn.0            : 10 routes (10 active, 0 holddown, 0 hidden)
    Restart Pending: BGP VPN
    inet6.0                : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Complete
    bgp.l2vpn.0            : 1 routes (1 active, 0 holddown, 0 hidden)
    Restart Pending: BGP VPN
BGP-INET:
  Router ID: 10.69.103.1
  Type: vrf               State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.103
  Route-distinguisher: 10.255.14.176:103
  Vrf-import: [ BGP-INET-import ]
  Vrf-export: [ BGP-INET-export ]
  Tables:
    BGP-INET.inet.0        : 6 routes (5 active, 0 holddown, 0 hidden)
    Restart Pending: VPN
BGP-L:
  Router ID: 10.69.104.1
  Type: vrf               State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.104
  Route-distinguisher: 10.255.14.176:104
  Vrf-import: [ BGP-L-import ]
  Vrf-export: [ BGP-L-export ]
  Tables:
    BGP-L.inet.0           : 6 routes (5 active, 0 holddown, 0 hidden)
    Restart Pending: VPN
    BGP-L.mpls.0           : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Pending: VPN
L2VPN:
  Router ID: 0.0.0.0
  Type: l2vpn             State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.512
  Route-distinguisher: 10.255.14.176:512
  Vrf-import: [ L2VPN-import ]
  Vrf-export: [ L2VPN-export ]
  Tables:
    L2VPN.l2vpn.0          : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Pending: VPN L2VPN
LDP:
```



```
  Router ID: 10.69.105.1
  Type: vrf                State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.105
  Route-distinguisher: 10.255.14.176:105
  Vrf-import: [ LDP-import ]
  Vrf-export: [ LDP-export ]
  Tables:
    LDP.inet.0             : 5 routes (4 active, 1 holddown, 0 hidden)
    Restart Pending: OSPF LDP VPN
OSPF:
  Router ID: 10.69.101.1
  Type: vrf                State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.101
  Route-distinguisher: 10.255.14.176:101
  Vrf-import: [ OSPF-import ]
  Vrf-export: [ OSPF-export ]
  Tables:
    OSPF.inet.0            : 8 routes (7 active, 1 holddown, 0 hidden)
    Restart Pending: OSPF VPN
RIP:
  Router ID: 10.69.102.1
  Type: vrf                State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.102
  Route-distinguisher: 10.255.14.176:102
  Vrf-import: [ RIP-import ]
  Vrf-export: [ RIP-export ]
  Tables:
    RIP.inet.0             : 8 routes (6 active, 2 holddown, 0 hidden)
    Restart Pending: RIP VPN
STATIC:
  Router ID: 10.69.100.1
  Type: vrf                State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.100
  Route-distinguisher: 10.255.14.176:100
  Vrf-import: [ STATIC-import ]
  Vrf-export: [ STATIC-export ]
  Tables:
    STATIC.inet.0          : 4 routes (4 active, 0 holddown, 0 hidden)
    Restart Pending: VPN
```

show route instance detail (VPLS Routing Instance)

```
user@host> show route instance detail test-vpls
test-vpls:
  Router ID: 0.0.0.0
  Type: vpls               State: Active
  Interfaces:
    lsi.1048833
    lsi.1048832
    fe-0/1/0.513
  Route-distinguisher: 10.255.37.65:1
  Vrf-import: [ __vrf-import-test-vpls-internal__ ]
  Vrf-export: [ __vrf-export-test-vpls-internal__ ]
```



```
  Vrf-import-target: [ target:300:1 ]
  Vrf-export-target: [ target:300:1 ]
  Fast-reroute-priority: high
  Tables:
    test-vpls.l2vpn.0          : 3 routes (3 active, 0 holddown, 0 hidden)
```

show route instance operational

```
user@host> show route instance operational
Operational Routing Instances:

master
default
```

show route instance summary

```
user@host> show route instance summary
Instance            Type            Primary rib            Active/holddown/hidden
master              forwarding
                                    inet.0                 15/0/1
                                    iso.0                  1/0/0
                                    mpls.0                 35/0/0
                                    l3vpn.0                0/0/0
                                    inet6.0                2/0/0
                                    l2vpn.0                0/0/0
                                    l2circuit.0            0/0/0
BGP-INET            vrf
                                    BGP-INET.inet.0        5/0/0
                                    BGP-INET.iso.0         0/0/0
                                    BGP-INET.inet6.0       0/0/0
BGP-L               vrf
                                    BGP-L.inet.0           5/0/0
                                    BGP-L.iso.0            0/0/0
                                    BGP-L.mpls.0           4/0/0
                                    BGP-L.inet6.0          0/0/0
L2VPN               l2vpn
                                    L2VPN.inet.0           0/0/0
                                    L2VPN.iso.0            0/0/0
                                    L2VPN.inet6.0          0/0/0
                                    L2VPN.l2vpn.0          2/0/0
LDP                 vrf
                                    LDP.inet.0             4/0/0
                                    LDP.iso.0              0/0/0
                                    LDP.mpls.0             0/0/0
                                    LDP.inet6.0            0/0/0
                                    LDP.l2circuit.0        0/0/0
OSPF                vrf
                                    OSPF.inet.0            7/0/0
                                    OSPF.iso.0             0/0/0
                                    OSPF.inet6.0           0/0/0
RIP                 vrf
                                    RIP.inet.0             6/0/0
                                    RIP.iso.0              0/0/0
                                    RIP.inet6.0            0/0/0
STATIC              vrf
                                    STATIC.inet.0          4/0/0
                                    STATIC.iso.0           0/0/0
                                    STATIC.inet6.0         0/0/0
```


show route label

Syntax

show route label *label*
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route label *label*
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display the routes based on a specified Multiprotocol Label Switching (MPLS) label value.

Options

label—Value of the MPLS label.

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to brief.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route label on page 2551
show route label detail on page 2551
show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs) on page 2552
show route label extensive on page 2552
show route label terse on page 2552

Output Fields

For information about output fields, see the output field table for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route label

```
user@host> show route label 100016

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
100016             *[VPN/170] 03:25:41
                    > to 10.12.80.1 via ge-6/3/2.0, Pop
```

show route label detail

```
user@host> show route label 100016 detail

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
```

```
Restart Complete
100016 (1 entry, 1 announced)
        *VPN    Preference: 170
                Next-hop reference count: 2
                Source: 10.12.80.1
                Next hop: 10.12.80.1 via ge-6/3/2.0, selected
                Label operation: Pop
                State: <Active Int Ext>
                Local AS:     1
                Age: 3:23:31
                Task: BGP.0.0.0.0+179
                Announcement bits (1): 0-KRT
                AS path: 100 I
                Ref Cnt: 2
```

show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs)

```
user@host> show route label 299872 detail
mpls.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
299872 (1 entry, 1 announced)
        *LDP    Preference: 9
                Next hop type: Flood
                Next-hop reference count: 3
                Address: 0x9097d90
                Next hop: via vt-0/1/0.1
                Next-hop index: 661
                Label operation: Pop
                Address: 0x9172130
                Next hop: via so-0/0/3.0
                Next-hop index: 654
                Label operation: Swap 299872
                State: **Active Int>
                Local AS:  1001
                Age: 8:20       Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
               FECs bound to route: P2MP root-addr 10.255.72.166, grp 232.1.1.1,
 src 192.168.142.2
```

show route label extensive

The output for the show route label extensive command is identical to that of the **show route label detail** command. For sample output, see show route label detail on page 2551.

show route label terse

```
user@host> show route label 100016 terse

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 100016             V 170                       >10.12.80.1
```

show route label-switched-path

Syntax

show route label-switched-path *path-name*
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route label-switched-path *path-name*
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display the routes used in an MPLS label-switched path (LSP).

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output.

path-name—LSP tunnel name.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route label-switched-path on page 2553

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route label-switched-path

```
user@host> show route label-switched-path sf-to-ny
inet.0: 29 destinations, 29 routes (29 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32          [MPLS/7] 00:00:06, metric 0
                    > to 111.222.1.9 via s0-0/0/0, label-switched-path sf-to-ny
3.3.3.3/32         *[MPLS/7] 00:00:06, metric 0
                    > to 111.222.1.9 via s0-0/0/0, label-switched-path sf-to-ny

inet.3: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2.2.2.2/32         *[MPLS/7] 00:00:06, metric 0
                    > to 111.222.1.9 via s0-0/0/0, label-switched-path sf-to-ny
4.4.4.4/32         *[MPLS/7] 00:00:06, metric 0
                      to 111.222.1.9 via s0-0/0/0, label-switched-path abc
                    > to 111.222.1.9 via s0-0/0/0, label-switched-path xyz
                      to 111.222.1.9 via s0-0/0/0, label-switched-path sf-to-ny
111.222.1.9/32      [MPLS/7] 00:00:06, metric 0
                    > to 111.222.1.9 via s0-0/0/0, label-switched-path sf-to-ny
```

```
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

mpls.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```

show route martians

Syntax

show route martians
<logical-system (all | *logical-system-name*)>
<table *routing-table-name*>

Syntax (EX Series Switches)

show route martians
<table *routing-table-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the martian (invalid and ignored) entries associated with each routing table.

Options

none—Display standard information about route martians for all routing tables.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

table *routing-table-name*—(Optional) Display information about route martians for all routing tables whose name begins with this string (for example, **inet.0** and **inet6.0** are both displayed when you run the **show route martians table inet** command).

Required Privilege Level

view

Related Documentation

- *Example: Configuring Martian Addresses*

List of Sample Output

show route martians on page 2555

Output Fields

Table 221 on page 2555 lists the output fields for the **show route martians** command. Output fields are listed in the approximate order in which they appear

Table 221: show route martians Output Fields

Field Name	Field Description
table-name	Name of the route table in which the route martians reside.
destination-prefix	Route destination.
match value	Route match parameter.
status	Status of the route: **allowed** or **disallowed**.

Sample Output

show route martians

```
user@host> show route martians
```



```
inet.0:
             0.0.0.0/0 exact -- allowed
             0.0.0.0/8 orlonger -- disallowed
             127.0.0.0/8 orlonger -- disallowed
             192.0.0.0/24 orlonger -- disallowed
             240.0.0.0/4 orlonger -- disallowed
             224.0.0.0/4 exact -- disallowed
             224.0.0.0/24 exact -- disallowed

inet.1:
             0.0.0.0/0 exact -- allowed
             0.0.0.0/8 orlonger -- disallowed
             127.0.0.0/8 orlonger -- disallowed
             192.0.0.0/24 orlonger -- disallowed
             240.0.0.0/4 orlonger -- disallowed

inet.2:
             0.0.0.0/0 exact -- allowed
             0.0.0.0/8 orlonger -- disallowed
             127.0.0.0/8 orlonger -- disallowed
             192.0.0.0/24 orlonger -- disallowed
             240.0.0.0/4 orlonger -- disallowed
             224.0.0.0/4 exact -- disallowed
             224.0.0.0/24 exact -- disallowed

inet.3:
             0.0.0.0/0 exact -- allowed
             0.0.0.0/8 orlonger -- disallowed
             127.0.0.0/8 orlonger -- disallowed
             192.0.0.0/24 orlonger -- disallowed
             240.0.0.0/4 orlonger -- disallowed
             224.0.0.0/4 exact -- disallowed
             224.0.0.0/24 exact -- disallowed
...

inet6.0:
             ::1/128 exact -- disallowed
             ff00::/8 exact -- disallowed
             ff02::/16 exact -- disallowed

inet6.1:
             ::1/128 exact -- disallowed

inet6.2:
             ::1/128 exact -- disallowed
             ff00::/8 exact -- disallowed
             ff02::/16 exact -- disallowed

inet6.3:
             ::1/128 exact -- disallowed
             ff00::/8 exact -- disallowed
             ff02::/16 exact -- disallowed
...
```

show route next-hop

Syntax

show route next-hop *next-hop*
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route next-hop *next-hop*
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the entries in the routing table that are being sent to the specified next-hop address.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of ouput.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

next-hop—Next-hop address.

Required Privilege Level

view

List of Sample Output

show route next-hop on page 2557
show route next-hop detail on page 2558
show route next-hop extensive on page 2560
show route next-hop terse on page 2561

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route next-hop

```
user@host> show route next-hop 192.168.71.254

inet.0: 18 destinations, 18 routes (17 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

10.10.0.0/16       *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
10.209.0.0/16      *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
172.16.0.0/12      *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
192.168.0.0/16     *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
192.168.102.0/23   *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
```



```
207.17.136.0/24    *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
207.17.136.192/32  *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

red.inet.0: 4 destinations, 5 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route next-hop detail

```
user@host> show route next-hop 192.168.71.254 detail

inet.0: 18 destinations, 18 routes (17 active, 0 holddown, 1 hidden)
Restart Complete
10.10.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

10.209.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

172.16.0.0/12 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

192.168.0.0/16 (1 entry, 1 announced)
```



```
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

192.168.102.0/23 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

207.17.136.0/24 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

207.17.136.192/32 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

red.inet.0: 4 destinations, 5 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route next-hop extensive

user@host> **show route next-hop 192.168.71.254 extensive**

```
inet.0: 18 destinations, 18 routes (17 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.10.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.209.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.209.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

172.16.0.0/12 (1 entry, 1 announced)
TSI:
KRT in-kernel 172.16.0.0/12 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

192.168.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 192.168.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

192.168.102.0/23 (1 entry, 1 announced)
TSI:
KRT in-kernel 192.168.102.0/23 -> {192.168.71.254}
        *Static Preference: 5
```



```
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

207.17.136.0/24 (1 entry, 1 announced)
TSI:
KRT in-kernel 207.17.136.0/24 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

207.17.136.192/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 207.17.136.192/32 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

inet6.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

green.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

red.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route next-hop terse

user@host> **show route next-hop 192.168.71.254 terse**

```
inet.0: 25 destinations, 26 routes (24 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.10.0.0/16       S   5                       >192.168.71.254
* 10.209.0.0/16      S   5                       >192.168.71.254
* 172.16.0.0/12      S   5                       >192.168.71.254
```

```
* 192.168.0.0/16     S   5                       >192.168.71.254
* 192.168.102.0/23   S   5                       >192.168.71.254
* 207.17.136.0/24    S   5                       >192.168.71.254
* 207.17.136.192/32  S   5                       >192.168.71.254

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

red.inet.0: 4 destinations, 5 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete
private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```


show route no-community

Syntax

show route no-community
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route no-community
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the route entries in each routing table that are not associated with any community.

Options

none—(Same as **brief**) Display the route entries in each routing table that are not associated with any community.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route no-community on page 2563
show route no-community detail on page 2564
show route no-community extensive on page 2564
show route no-community terse on page 2565

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route no-community

```
user@host> show route no-community
inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.0.0/16       *[Static/5] 00:36:27
                    > to 192.168.71.254 via fxp0.0
10.209.0.0/16      *[Static/5] 00:36:27
                    > to 192.168.71.254 via fxp0.0
10.255.71.52/32    *[Direct/0] 00:36:27
                    > via lo0.0
10.255.71.63/32    *[OSPF/10] 00:04:39, metric 1
                    > to 35.1.1.2 via ge-3/1/0.0
10.255.71.64/32    *[OSPF/10] 00:00:08, metric 2
                    > to 35.1.1.2 via ge-3/1/0.0
10.255.71.240/32   *[OSPF/10] 00:05:04, metric 2
                      via so-0/1/2.0
```

```
                        > via so-0/3/2.0
10.255.71.241/32   *[OSPF/10] 00:05:14, metric 1
                        > via so-0/1/2.0
10.255.71.242/32   *[OSPF/10] 00:05:19, metric 1
                        > via so-0/3/2.0
12.1.1.0/24        *[OSPF/10] 00:05:14, metric 2
                        > via so-0/3/2.0
14.1.1.0/24        *[OSPF/10] 00:00:08, metric 3
                        > to 35.1.1.2 via ge-3/1/0.0
                          via so-0/1/2.0
                          via so-0/3/2.0
16.1.1.0/24        *[OSPF/10] 00:05:14, metric 2
                        > via so-0/1/2.0
.....
```

show route no-community detail

```
user@host> show route no-community detail

inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Age: 38:08
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.209.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Age: 38:08
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I
....
```

show route no-community extensive

```
user@host> show route no-community extensive

inet.0: 18 destinations, 18 routes (17 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.10.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:03:33
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.209.0.0/16 (1 entry, 1 announced)
TSI:
```



```
KRT in-kernel 10.209.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:03:33
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I
```

show route no-community terse

```
user@host> show route no-community terse

inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.10.0.0/16       S   5                       >192.168.71.254
* 10.209.0.0/16      S   5                       >192.168.71.254
* 10.255.71.52/32    D   0                       >lo0.0
* 10.255.71.63/32    O  10          1            >35.1.1.2
* 10.255.71.64/32    O  10          2            >35.1.1.2
* 10.255.71.240/32   O  10          2             so-0/1/2.0
                                                 >so-0/3/2.0
* 10.255.71.241/32   O  10          1            >so-0/1/2.0
* 10.255.71.242/32   O  10          1            >so-0/3/2.0
* 12.1.1.0/24        O  10          2            >so-0/3/2.0
* 14.1.1.0/24        O  10          3            >35.1.1.2
                                                  so-0/1/2.0
                                                  so-0/3/2.0
* 16.1.1.0/24        O  10          2            >so-0/1/2.0
...
```

show route protocol

Syntax

show route protocol *protocol*
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route protocol *protocol*
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
opsf2 and **ospf3** options introduced in Junos OS Release 9.2.
opsf2 and **ospf3** options introduced in Junos OS Release 9.2 for EX Series switches.
flow option introduced in Junos OS Release 10.0.
flow option introduced in Junos OS Release 10.0 for EX Series switches.

Description

Display the route entries in the routing table that were learned from a particular protocol.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

protocol—Protocol from which the route was learned:

- **access**—Access route for use by DHCP application
- **access-internal**—Access-internal route for use by DHCP application
- **aggregate**—Locally generated aggregate route
- **arp**—Route learned through the Address Resolution Protocol
- **atmvpn**—Asynchronous Transfer Mode virtual private network
- **bgp**—Border Gateway Protocol
- **ccc**—Circuit cross-connect
- **direct**—Directly connected route
- **dvmrp**—Distance Vector Multicast Routing Protocol
- **esis**—End System-to-Intermediate System
- **flow**—Locally defined flow-specification route
- **frr**—Precomputed protection route or backup route used when a link goes down
- **isis**—Intermediate System-to-Intermediate System
- **ldp**—Label Distribution Protocol
- **l2circuit**—Layer 2 circuit
- **l2vpn**—Layer 2 virtual private network

- **local**—Local address
- **mpls**—Multiprotocol Label Switching
- **msdp**—Multicast Source Discovery Protocol
- **ospf**—Open Shortest Path First versions 2 and 3
- **ospf2**—Open Shortest Path First versions 2 only
- **ospf3**—Open Shortest Path First version 3 only
- **pim**—Protocol Independent Multicast
- **rip**—Routing Information Protocol
- **ripng**—Routing Information Protocol next generation
- **rsvp**—Resource Reservation Protocol
- **rtarget**—Local route target virtual private network
- **static**—Statically defined route
- **tunnel**—Dynamic tunnel
- **vpn**—Virtual private network

NOTE: EX Series switches run a subset of these protocols. See the switch CLI for details.

Required Privilege Level view

List of Sample Output

show route protocol access on page 2568
show route protocol access-internal extensive on page 2568
show route protocol arp on page 2568
show route protocol bgp on page 2569
show route protocol bgp detail on page 2569
show route protocol bgp extensive on page 2569
show route protocol bgp terse on page 2570
show route protocol direct on page 2570
show route protocol frr on page 2571
show route protocol l2circuit detail on page 2571
show route protocol l2vpn extensive on page 2572
show route protocol ldp on page 2573
show route protocol ldp extensive on page 2573
show route protocol ospf (Layer 3 VPN) on page 2574
show route protocol ospf detail on page 2575
show route protocol rip on page 2575
show route protocol rip detail on page 2575
show route protocol ripng table inet6 on page 2576
show route protocol static detail on page 2576

Output Fields For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route protocol access

```
user@host> show route protocol access
inet.0: 30380 destinations, 30382 routes (30379 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

13.160.0.3/32      *[Access/13] 00:00:09
                    > to 13.160.0.2 via fe-0/0/0.0
13.160.0.4/32      *[Access/13] 00:00:09
                    > to 13.160.0.2 via fe-0/0/0.0
13.160.0.5/32      *[Access/13] 00:00:09
                    > to 13.160.0.2 via fe-0/0/0.0
```

show route protocol access-internal extensive

```
user@host> show route protocol access-internal 13.160.0.19 extensive
inet.0: 100020 destinations, 100022 routes (100019 active, 0 holddown, 1 hidden)
13.160.0.19/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 13.160.0.19/32 -> {13.160.0.2}
        *Access-internal Preference: 12
                Next-hop reference count: 200000
                Next hop: 13.160.0.2 via fe-0/0/0.0, selected
                State: <Active Int>
       Age: 36
                Task: RPD Unix Domain Server./var/run/rpd_serv.local
                Announcement bits (1): 0-KRT
                AS path: I
```

show route protocol arp

```
user@host> show route protocol arp
inet.0: 43 destinations, 43 routes (42 active, 0 holddown, 1 hidden)

inet.3: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

cust1.inet.0: 1033 destinations, 2043 routes (1033 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

20.20.1.3/32        [ARP/4294967293] 00:04:35, from 20.20.1.1
                      Unusable
20.20.1.4/32        [ARP/4294967293] 00:04:35, from 20.20.1.1
                      Unusable
20.20.1.5/32        [ARP/4294967293] 00:04:32, from 20.20.1.1
                      Unusable
20.20.1.6/32        [ARP/4294967293] 00:04:34, from 20.20.1.1
                      Unusable
20.20.1.7/32        [ARP/4294967293] 00:04:35, from 20.20.1.1
                      Unusable
20.20.1.8/32        [ARP/4294967293] 00:04:35, from 20.20.1.1
                      Unusable
20.20.1.9/32        [ARP/4294967293] 00:04:35, from 20.20.1.1
                      Unusable
20.20.1.10/32       [ARP/4294967293] 00:04:35, from 20.20.1.1
```



```
                        Unusable
20.20.1.11/32          [ARP/4294967293] 00:04:33, from 20.20.1.1
                        Unusable
20.20.1.12/32          [ARP/4294967293] 00:04:33, from 20.20.1.1
                        Unusable
20.20.1.13/32          [ARP/4294967293] 00:04:33, from 20.20.1.1
                        Unusable
...
```

show route protocol bgp

```
user@host> show route protocol bgp 192.168.64.0/21
inet.0: 335832 destinations, 335833 routes (335383 active, 0 holddown, 450 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.64.0/21      *[BGP/170] 6d 10:41:16, localpref 100, from 192.168.69.71
                      AS path: 10458 14203 2914 4788 4788 I
                    > to 192.168.167.254 via fxp0.0
```

show route protocol bgp detail

```
user@host> show route protocol bgp 66.117.63.0/24 detail
inet.0: 335805 destinations, 335806 routes (335356 active, 0 holddown, 450 hidden)
66.117.63.0/24  (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 1006436
                Source: 192.168.69.71
                Next hop type: Router, Next hop index: 324
                Next hop: 192.168.167.254 via fxp0.0, selected
                Protocol next hop: 192.168.69.71
                Indirect next hop: 8e166c0 342
                State: <Active Ext>
                Local AS:    69 Peer AS: 10458
                Age: 6d 10:42:42        Metric2: 0
                Task: BGP_10458.192.168.69.71+179
                Announcement bits (3): 0-KRT 2-BGP RT Background 3-Resolve tree
1
                AS path: 10458 14203 2914 4788 4788 I
                Communities: 2914:410 2914:2403 2914:3400
                Accepted
                Localpref: 100
                Router ID: 207.17.136.192
```

show route protocol bgp extensive

```
user@host> show route protocol bgp 192.168.64.0/21 extensive

inet.0: 335827 destinations, 335828 routes (335378 active, 0 holddown, 450 hidden)
192.168.64.0/21 (1 entry, 1 announced)
TSI:
KRT in-kernel 1.9.0.0/16 -> {indirect(342)}
Page 0 idx 1 Type 1 val db31a80
    Nexthop: Self
    AS path: [69] 10458 14203 2914 4788 4788 I
    Communities: 2914:410 2914:2403 2914:3400
Path 1.9.0.0 from 192.168.69.71 Vector len 4.  Val: 1
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 1006502
                Source: 192.168.69.71
                Next hop type: Router, Next hop index: 324
```

```
                        Next hop: 192.168.167.254 via fxp0.0, selected
                        Protocol next hop: 192.168.69.71
                        Indirect next hop: 8e166c0 342
                        State: <Active Ext>
                        Local AS:    69 Peer AS: 10458
                        Age: 6d 10:44:45        Metric2: 0
                        Task: BGP_10458.192.168.69.71+179
                        Announcement bits (3): 0-KRT 2-BGP RT Background 3-Resolve tree
1
                        AS path: 10458 14203 2914 4788 4788 I
                        Communities: 2914:410 2914:2403 2914:3400
                        Accepted
                        Localpref: 100
                        Router ID: 207.17.136.192
                        Indirect next hops: 1
                                Protocol next hop: 192.168.69.71
                                Indirect next hop: 8e166c0 342
                                Indirect path forwarding next hops: 1
                                        Next hop type: Router
                                        Next hop: 192.168.167.254 via fxp0.0
                                192.168.0.0/16 Originating RIB: inet.0
                                  Node path count: 1
                                  Forwarding nexthops: 1
                                        Nexthop: 192.168.167.254 via fxp0.0
```

show route protocol bgp terse

```
user@host> show route protocol bgp 192.168.64.0/21 terse

inet.0: 24 destinations, 32 routes (23 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  192.168.64.0/21    B 170        100            >100.1.3.2       10023 21 I
```

show route protocol direct

```
user@host> show route protocol direct

inet.0: 335843 destinations, 335844 routes (335394 active, 0 holddown, 450 hidden)
+ = Active Route, - = Last Active, * = Both

8.8.8.0/24         *[Direct/0] 17w0d 10:31:49
                    > via fe-1/3/1.0
10.255.165.1/32    *[Direct/0] 25w4d 04:13:18
                    > via lo0.0
30.30.30.0/24      *[Direct/0] 17w0d 23:06:26
                    > via fe-1/3/2.0
192.168.164.0/22   *[Direct/0] 25w4d 04:13:20
                    > via fxp0.0

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

47.0005.80ff.f800.0000.0108.0001.0102.5516.5001/152
                   *[Direct/0] 25w4d 04:13:21
                    > via lo0.0

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```



```
abcd::10:255:165:1/128
                   *[Direct/0] 25w4d 04:13:21
                    > via lo0.0
fe80::2a0:a5ff:fe12:ad7/128
                   *[Direct/0] 25w4d 04:13:21
                    > via lo0.0
```

show route protocol frr

user@host> **show route protocol frr**

```
inet.0: 43 destinations, 43 routes (42 active, 0 holddown, 1 hidden)

inet.3: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

cust1.inet.0: 1033 destinations, 2043 routes (1033 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

20.20.1.3/32       *[FRR/200] 00:05:38, from 20.20.1.1
                    > to 20.20.1.3 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.4/32       *[FRR/200] 00:05:38, from 20.20.1.1
                    > to 20.20.1.4 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.5/32       *[FRR/200] 00:05:35, from 20.20.1.1
                    > to 20.20.1.5 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.6/32       *[FRR/200] 00:05:37, from 20.20.1.1
                    > to 20.20.1.6 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.7/32       *[FRR/200] 00:05:38, from 20.20.1.1
                    > to 20.20.1.7 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.8/32       *[FRR/200] 00:05:38, from 20.20.1.1
                    > to 20.20.1.8 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.9/32       *[FRR/200] 00:05:38, from 20.20.1.1
                    > to 20.20.1.9 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.10/32      *[FRR/200] 00:05:38, from 20.20.1.1
...
```

show route protocol l2circuit detail

user@host> **show route protocol l2circuit detail**

```
mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
100000 (1 entry, 1 announced)
        *L2CKT  Preference: 7
                Next hop: via ge-2/0/0.0, selected
                Label operation: Pop        Offset: 4
                State: <Active Int>
                Local AS:    99
                Age: 9:52
                Task: Common L2 VC
                Announcement bits (1): 0-KRT
                AS path: I

ge-2/0/0.0 (1 entry, 1 announced)
        *L2CKT  Preference: 7
                Next hop: via so-1/1/2.0 weight 1, selected
                Label-switched-path my-lsp
```

```
                Label operation: Push 100000, Push 100000(top)[0] Offset: -4
                Protocol next hop: 10.245.255.63
                Push 100000 Offset: -4
                 Indirect next hop: 86af0c0 298
                State: <Active Int>
                Local AS:    99
                Age: 9:52
                Task: Common L2 VC
                Announcement bits (2): 0-KRT 1-Common L2 VC
                AS path: I

l2circuit.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

10.245.255.63:CtrlWord:4:3:Local/96 (1 entry, 1 announced)
        *L2CKT  Preference: 7
                Next hop: via so-1/1/2.0 weight 1, selected
                Label-switched-path my-lsp
                Label operation: Push 100000[0]
                Protocol next hop: 10.245.255.63 Indirect next hop: 86af000 296
                State: <Active Int>
                Local AS:    99
                Age: 10:21
                Task: l2 circuit
                Announcement bits (1): 0-LDP
                AS path: I
                VC Label 100000, MTU 1500, VLAN ID 512
```

show route protocol l2vpn extensive

```
user@host> show route protocol l2vpn extensive

inet.0: 14 destinations, 15 routes (13 active, 0 holddown, 1 hidden)

inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 7 destinations, 7 routes (7 active, 0 holddown, 0 hidden)
800001 (1 entry, 1 announced)
TSI:
KRT in-kernel 800001 /36 -> {so-0/0/0.0}
        *L2VPN  Preference: 7
                Next hop: via so-0/0/0.0 weight 49087 balance 97%, selected
                Label operation: Pop       Offset: 4
                State: <Active Int>
                Local AS:    69
                Age: 7:48
                Task: Common L2 VC
                Announcement bits (1): 0-KRT
                AS path: I

so-0/0/0.0 (1 entry, 1 announced)
TSI:
KRT in-kernel so-0/0/0.0.0      /16 -> {indirect(288)}
        *L2VPN  Preference: 7
                Next hop: via so-0/0/1.0, selected
                Label operation: Push 800000 Offset: -4
                Protocol next hop: 10.255.14.220
                Push 800000 Offset: -4
                 Indirect next hop: 85142a0 288
                State: <Active Int>
```



```
                Local AS:    69
                Age: 7:48
                Task: Common L2 VC
                Announcement bits (2): 0-KRT 1-Common L2 VC
                AS path: I
                Communities: target:69:1 Layer2-info: encaps:PPP,
                control flags:2, mtu: 0
```

show route protocol ldp

```
user@host> show route protocol ldp
inet.0: 12 destinations, 13 routes (12 active, 0 holddown, 0 hidden)

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.16.1/32    *[LDP/9] 1d 23:03:35, metric 1
                    > via t1-4/0/0.0, Push 100000
192.168.17.1/32    *[LDP/9] 1d 23:03:35, metric 1
                    > via t1-4/0/0.0

private1__.inet.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

mpls.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

100064             *[LDP/9] 1d 23:03:35, metric 1
                    > via t1-4/0/0.0, Pop
100064(S=0)        *[LDP/9] 1d 23:03:35, metric 1
                    > via t1-4/0/0.0, Pop
100080             *[LDP/9] 1d 23:03:35, metric 1
                    > via t1-4/0/0.0, Swap 100000
```

show route protocol ldp extensive

```
user@host> show route protocol ldp extensive
192.168.16.1/32 (1 entry, 1 announced)
        State: <FlashAll>
        *LDP    Preference: 9
                Next-hop reference count: 3
                Next hop: via t1-4/0/0.0, selected
                Label operation: Push 100000
                State: <Active Int>
                Local AS: 65500
                Age: 1d 23:03:58        Metric: 1
                Task: LDP
                Announcement bits (2): 0-Resolve tree 1 2-Resolve tree 2
                AS path: I

192.168.17.1/32 (1 entry, 1 announced)
        State: <FlashAll>
        *LDP    Preference: 9
                Next-hop reference count: 3
                Next hop: via t1-4/0/0.0, selected
                State: <Active Int>
                Local AS: 65500
                Age: 1d 23:03:58        Metric: 1
                Task: LDP
                Announcement bits (2): 0-Resolve tree 1 2-Resolve tree 2
                AS path: I
```



```
private1__.inet.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

mpls.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)

100064 (1 entry, 1 announced)
TSI:
KRT in-kernel 100064 /36 -> {t1-4/0/0.0}
        *LDP    Preference: 9
                Next-hop reference count: 2
                Next hop: via t1-4/0/0.0, selected
                State: <Active Int>
                Local AS: 65500
                Age: 1d 23:03:58        Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
                Prefixes bound to route: 192.168.17.1/32

100064(S=0) (1 entry, 1 announced)
TSI:
KRT in-kernel 100064 /40 -> {t1-4/0/0.0}
        *LDP    Preference: 9
                Next-hop reference count: 2
                Next hop: via t1-4/0/0.0, selected
                Label operation: Pop
                State: <Active Int>
                Local AS: 65500
                Age: 1d 23:03:58        Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I

100080 (1 entry, 1 announced)
TSI:
KRT in-kernel 100080 /36 -> {t1-4/0/0.0}
        *LDP    Preference: 9
                Next-hop reference count: 2
                Next hop: via t1-4/0/0.0, selected
                Label operation: Swap 100000
                State: <Active Int>
                Local AS: 65500
                Age: 1d 23:03:58        Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
                Prefixes bound to route: 192.168.16.1/32
```

show route protocol ospf (Layer 3 VPN)

```
user@host> show route protocol ospf
inet.0: 40 destinations, 40 routes (39 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

10.39.1.4/30       *[OSPF/10] 00:05:18, metric 4
                    > via t3-3/2/0.0
10.39.1.8/30        [OSPF/10] 00:05:18, metric 2
                    > via t3-3/2/0.0
10.255.14.171/32   *[OSPF/10] 00:05:18, metric 4
                    > via t3-3/2/0.0
10.255.14.179/32   *[OSPF/10] 00:05:18, metric 2
                    > via t3-3/2/0.0
```

```
224.0.0.5/32       *[OSPF/10] 20:25:55, metric 1

VPN-AB.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.39.1.16/30       [OSPF/10] 00:05:43, metric 1
                    > via so-0/2/2.0
10.255.14.173/32   *[OSPF/10] 00:05:43, metric 1
                    > via so-0/2/2.0
224.0.0.5/32       *[OSPF/10] 20:26:20, metric 1
```

show route protocol ospf detail

```
user@host> show route protocol ospf detail
VPN-AB.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.39.1.16/30 (2 entries, 0 announced)
         OSPF   Preference:  10
                Nexthop: via so-0/2/2.0, selected
                State: <Int>
                Inactive reason: Route Preference
                Age: 6:25       Metric: 1
                Area: 0.0.0.0
                Task: VPN-AB-OSPF
                AS path: I
                Communities: Route-Type:0.0.0.0:1:0

...
```

show route protocol rip

```
user@host> show route protocol rip
inet.0: 26 destinations, 27 routes (25 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

VPN-AB.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
10.255.14.177/32   *[RIP/100] 20:24:34, metric 2
                    > to 10.39.1.22 via t3-0/2/2.0
224.0.0.9/32       *[RIP/100] 00:03:59, metric 1
```

show route protocol rip detail

```
user@host> show route protocol rip detail
inet.0: 26 destinations, 27 routes (25 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

VPN-AB.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
10.255.14.177/32 (1 entry, 1 announced)
        *RIP    Preference: 100
                Nexthop: 10.39.1.22 via t3-0/2/2.0, selected
                State: <Active Int>
                Age: 20:25:02   Metric: 2
                Task: VPN-AB-RIPv2
                Announcement bits (2): 0-KRT 2-BGP.0.0.0.0+179
                AS path: I
                Route learned from 10.39.1.22 expires in 96 seconds
```

show route protocol ripng table inet6

```
user@host> show route protocol ripng table inet6
inet6.0: 4215 destinations, 4215 routes (4214 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

1111::1/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
1111::2/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
1111::3/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
1111::4/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
1111::5/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
1111::6/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
```

show route protocol static detail

```
user@host> show route protocol static detail
inet.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
10.5.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next hop type: Router, Next hop index: 324
                Address: 0x9274010
                Next-hop reference count: 27
                Next hop: 192.168.187.126 via fxp0.0, selected
                Session Id: 0x0
                State: <Active NoReadvrt Int Ext>
                Age: 7w3d 21:24:25
                Validation State: unverified
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.10.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next hop type: Router, Next hop index: 324
                Address: 0x9274010
                Next-hop reference count: 27
                Next hop: 192.168.187.126 via fxp0.0, selected
                Session Id: 0x0
                State: <Active NoReadvrt Int Ext>
                Age: 7w3d 21:24:25
                Validation State: unverified
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.13.10.0/23 (1 entry, 1 announced)
        *Static Preference: 5
                Next hop type: Router, Next hop index: 324
                Address: 0x9274010
                Next-hop reference count: 27
                Next hop: 192.168.187.126 via fxp0.0, selected
                Session Id: 0x0
                State: <Active NoReadvrt Int Ext>
                Age: 7w3d 21:24:25
                Validation State: unverified
```



```
Task: RT
Announcement bits (1): 0-KRT
AS path: I
```

show route range

Syntax

show route range
<brief | detail | extensive | terse>
<*destination-prefix*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route range
<brief | detail | extensive | terse>
<*destination-prefix*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display routing table entries using a prefix range.

Options

none—Display standard information about all routing table entries using a prefix range.

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

destination-prefix—(Optional) Destination and prefix mask for the range.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route range on page 2578
show route range destination-prefix on page 2579
show route range detail on page 2579
show route range extensive on page 2580
show route range terse on page 2581

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route range

```
user@host> show route range

inet.0: 11 destinations, 11 routes (10 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.0.0/16       *[Static/5] 00:30:01
                    > to 192.168.71.254 via fxp0.0
10.209.0.0/16      *[Static/5] 00:30:01
                    > to 192.168.71.254 via fxp0.0
10.255.71.14/32    *[Direct/0] 00:30:01
                    > via lo0.0
```

```
172.16.0.0/12      *[Static/5] 00:30:01
                    > to 192.168.71.254 via fxp0.0
192.168.0.0/16     *[Static/5] 00:30:01
                    > to 192.168.71.254 via fxp0.0
192.168.64.0/21    *[Direct/0] 00:30:01
                    > via fxp0.0
192.168.71.14/32   *[Local/0] 00:30:01
                      Local via fxp0.0
192.168.102.0/23   *[Static/5] 00:30:01
                    > to 192.168.71.254 via fxp0.0
...
```

show route range destination-prefix

```
user@host> show route range 192.168.0.0

inet.0: 11 destinations, 11 routes (10 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.0.0/16     *[Static/5] 00:31:14
                    > to 192.168.71.254 via fxp0.0
192.168.64.0/21    *[Direct/0] 00:31:14
                    > via fxp0.0
192.168.71.14/32   *[Local/0] 00:31:14
                      Local via fxp0.0
192.168.102.0/23   *[Static/5] 00:31:14
                    > to 192.168.71.254 via fxp0.0
```

show route range detail

```
user@host> show route range detail

inet.0: 11 destinations, 11 routes (10 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Age: 30:05
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.209.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Age: 30:05
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.255.71.14/32 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Age: 30:05
                Task: IF
```

```
                AS path: I

172.16.0.0/12 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Age: 30:05
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

...
```

show route range extensive

```
user@host> show route range extensive

inet.0: 11 destinations, 11 routes (10 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.10.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Age: 30:17
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.209.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.209.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Age: 30:17
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.255.71.14/32 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Age: 30:17
                Task: IF
                AS path: I

172.16.0.0/12 (1 entry, 1 announced)
TSI:
KRT in-kernel 172.16.0.0/12 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Age: 30:17
```

```
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

...
```

show route range terse

```
user@host> show route range terse

inet.0: 11 destinations, 11 routes (10 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.10.0.0/16       S   5                       >192.168.71.254
* 10.209.0.0/16      S   5                       >192.168.71.254
* 10.255.71.14/32    D   0                       >lo0.0
* 172.16.0.0/12      S   5                       >192.168.71.254
* 192.168.0.0/16     S   5                       >192.168.71.254
* 192.168.64.0/21    D   0                       >fxp0.0
* 192.168.71.14/32   L   0                        Local
* 192.168.102.0/23   S   5                       >192.168.71.254
* 207.17.136.0/24    S   5                       >192.168.71.254
* 207.17.136.192/32  S   5                       >192.168.71.254

__juniper_private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0
hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.0.0.0/8         D   0                       >fxp2.0
                     D   0                       >fxp1.0
* 10.0.0.4/32        L   0                        Local

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  47.0005.80ff.f800.0000.0108.0001.0102.5507.1014/152
*                    D   0                       >lo0.0

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  abcd::10:255:71:14/128
*                    D   0                       >lo0.0
  fe80::280:42ff:fe11:226f/128
*                    D   0                       >lo0.0

__juniper_private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0
hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  fe80::280:42ff:fe11:226f/128
*                    D   0                       >lo0.16385
```

show route receive-protocol

Syntax

show route receive-protocol *protocol neighbor-address*
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)

Syntax (EX Series Switches)

show route receive-protocol *protocol neighbor-address*
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the routing information as it was received through a particular neighbor using a particular dynamic routing protocol.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

protocol neighbor-address—Protocol transmitting the route (**bgp**, **dvmrp**, **msdp**, **pim**, **rip**, or **ripng**) and address of the neighboring router from which the route entry was received.

Additional Information

The output displays the selected routes and the attributes with which they were received, but does not show the effects of import policy on the routing attributes.

Required Privilege Level

view

List of Sample Output

show route receive-protocol bgp on page 2585
show route receive-protocol bgp extensive on page 2585
show route receive-protocol bgp table extensive on page 2585
show route receive-protocol bgp logical-system extensive on page 2586
show route receive-protocol bgp detail (Layer 2 VPN) on page 2587
show route receive-protocol bgp extensive (Layer 2 VPN) on page 2587
show route receive-protocol bgp (Layer 3 VPN) on page 2588
show route receive-protocol bgp detail (Layer 3 VPN) on page 2588
show route receive-protocol bgp extensive (Layer 3 VPN) on page 2589

Output Fields

Table 222 on page 2582 describes the output fields for the **show route receive-protocol** command. Output fields are listed in the approximate order in which they appear.

Table 222: show route receive-protocol Output Fields

Field Name	Field Description	Level of Output
routing-table-name	Name of the routing table—for example, inet.0.	All levels
number destinations	Number of destinations for which there are routes in the routing table.	All levels

Table 222: show route receive-protocol Output Fields *(continued)*

Field Name	Field Description	Level of Output
number routes	Number of routes in the routing table and total number of routes in the following states: • **active** • **holddown** (routes that are in pending state before being declared inactive) • **hidden** (routes that are not used because of a routing policy)	All levels
Prefix	Destination prefix.	none **brief**
MED	Multiple exit discriminator value included in the route.	none **brief**
destination-prefix (entry, announced)	Destination prefix. The **entry** value is the number of routes for this destination, and the **announced** value is the number of routes being announced for this destination.	**detail extensive**
Route Distinguisher	64-bit prefix added to IP subnets to make them unique.	**detail extensive**
Label-Base, range	First label in a block of labels and label block size. A remote PE routing device uses this first label when sending traffic toward the advertising PE routing device.	**detail extensive**
VPN Label	Virtual private network (VPN) label. Packets are sent between CE and PE routing devices by advertising VPN labels. VPN labels transit over either an RSVP or an LDP label-switched path (LSP) tunnel.	**detail extensive**
Next hop	Next hop to the destination. An angle bracket (>) indicates that the route is the selected route.	All levels
Localpref or Lclpref	Local preference value included in the route.	All levels

Table 222: show route receive-protocol Output Fields *(continued)*

Field Name	Field Description	Level of Output
AS path	Autonomous system (AS) path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the number that precedes the AS path. This number represents the number of ASs present in the AS path, when calculated as defined in RFC 4271. This value is used the AS-path merge process, as defined in RFC 4893. • **[ ]**—If more than one AS number is configured on the router, or if AS path prepending is configured, brackets enclose the local AS number associated with the AS path. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.	All levels
Cluster list	(For route reflected output only) Cluster ID sent by the route reflector.	**detail extensive**
Originator ID	(For route reflected output only) Address of routing device that originally sent the route to the route reflector.	**detail extensive**
Communities	Community path attribute for the route. See the Output Field table in the show route detail command for all possible values for this field.	**detail extensive**
AIGP	Accumulated interior gateway protocol (AIGP) BGP attribute.	**detail extensive**
Attrset AS	Number, local preference, and path of the AS that originated the route. These values are stored in the **Attrset** attribute at the originating routing device.	**detail extensive**
Layer2-info: encaps	Layer 2 encapsulation (for example, VPLS).	**detail extensive**
control flags	Control flags: **none** or **Site Down**.	**detail extensive**
mtu	Maximum transmission unit (MTU) of the Layer 2 circuit.	**detail extensive**

Sample Output

show route receive-protocol bgp

user@host> **show route receive-protocol bgp 10.255.245.215**

```
inet.0: 28 destinations, 33 routes (27 active, 0 holddown, 1 hidden)
Prefix                  Next hop            MED     Lclpref    AS path
10.22.1.0/24            10.255.245.215      0       100        I
10.22.2.0/24            10.255.245.215      0       100        I
```

show route receive-protocol bgp extensive

user@host> **show route receive-protocol bgp 10.255.245.63 extensive**

```
inet.0: 244 destinations, 244 routes (243 active, 0 holddown, 1 hidden)
Prefix            Next hop                MED    Lclpref AS path
1.1.1.0/24 (1 entry, 1 announced)
     Next hop: 10.0.50.3
     Localpref: 100
     AS path: I <Orginator>
     Cluster list:  10.2.3.1
     Originator ID: 10.255.245.45
165.3.0.0/16 (1 entry, 1 announced)
     Next hop: 111.222.5.254
     Localpref: 100
     AS path: I <Originator>
     Cluster list:  10.2.3.1
     Originator ID: 10.255.245.68
165.4.0.0/16 (1 entry, 1 announced)
     Next hop: 111.222.5.254
     Localpref: 100
     AS path: I <Originator>
     Cluster list:  10.2.3.1
     Originator ID: 10.255.245.45
195.1.2.0/24 (1 entry, 1 announced)
     Next hop: 111.222.5.254
     Localpref: 100
     AS path: I <Originator>
     Cluster list:  10.2.3.1
     Originator ID: 10.255.245.68
inet.2: 63 destinations, 63 routes (63 active, 0 holddown, 0 hidden)
Prefix            Next hop                MED    Lclpref AS path
inet.3: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
Prefix            Next hop                MED    Lclpref AS path
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Prefix            Next hop                MED    Lclpref AS path
mpls.0: 48 destinations, 48 routes (48 active, 0 holddown, 0 hidden)
```

show route receive-protocol bgp table extensive

user@host> **show route receive-protocol bgp 207.17.136.192 table inet.0 66.117.68.0/24 extensive**

```
inet.0: 227315 destinations, 227316 routes (227302 active, 0 holddown, 13 hidden)
* 66.117.63.0/24 (1 entry, 1 announced)
     Nexthop: 207.17.136.29
     Localpref: 100
     AS path: AS2 PA[6]: 14203 2914 3356 29748 33437 AS_TRANS
     AS path: AS4 PA[2]: 33437 393219
     AS path: Merged[6]: 14203 2914 3356 29748 33437 393219 I
     Communities: 2914:420
```

show route receive-protocol bgp logical-system extensive

```
user@host> show route receive-protocol bgp 10.0.0.9 logical-system PE4 extensive
inet.0: 12 destinations, 13 routes (12 active, 0 holddown, 0 hidden)
* 10.0.0.0/30 (1 entry, 1 announced)
     Accepted
     Route Label: 3
     Nexthop: 10.0.0.9
     AS path: 13979 I

* 10.0.0.4/30 (1 entry, 1 announced)
     Accepted
     Route Label: 3
     Nexthop: 10.0.0.9
     AS path: 13979 I

  10.0.0.8/30 (2 entries, 1 announced)
     Accepted
     Route Label: 3
     Nexthop: 10.0.0.9
     AS path: 13979 I

* 10.9.9.1/32 (1 entry, 1 announced)
     Accepted
     Route Label: 3
     Nexthop: 10.0.0.9
     AS path: 13979 I

* 10.100.1.1/32 (1 entry, 1 announced)
     Accepted
     Route Label: 3
     Nexthop: 10.0.0.9
     AS path: 13979 I

* 44.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 300096
     Nexthop: 10.0.0.9
     AS path: 13979 I
     AIGP: 203

* 55.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 300112
     Nexthop: 10.0.0.9
     AS path: 13979 7018 I
     AIGP: 25

* 66.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 300144
     Nexthop: 10.0.0.9
     AS path: 13979 7018 I

* 99.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 300160
     Nexthop: 10.0.0.9
     AS path: 13979 7018 I
```


show route receive-protocol bgp detail (Layer 2 VPN)

```
user@host> show route receive-protocol bgp 10.255.14.171 detail
inet.0: 68 destinations, 68 routes (67 active, 0 holddown, 1 hidden)
Prefix            Nexthop              MED    Lclpref AS path
inet.3: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Prefix            Nexthop              MED    Lclpref AS path
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Prefix            Nexthop              MED    Lclpref AS path
mpls.0: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
Prefix            Nexthop              MED    Lclpref AS path
frame-vpn.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0
hidden)
Prefix            Nexthop              MED    Lclpref AS path
10.255.245.35:1:5:1/96 (1 entry, 1 announced)
     Route Distinguisher: 10.255.245.35:1
     Label-base : 800000, range : 4, status-vector : 0x0
     Nexthop: 10.255.245.35
     Localpref: 100
     AS path: I
     Communities: target:65299:100 Layer2-info: encaps:FRAME RELAY,
     control flags: 0, mtu: 0
bgp.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Prefix            Nexthop              MED    Lclpref AS path
10.255.245.35:1:5:1/96 (1 entry, 0 announced)
     Route Distinguisher: 10.255.245.35:1
     Label-base : 800000, range : 4, status-vector : 0x0
     Nexthop: 10.255.245.35
     Localpref: 100
     AS path: I
     Communities: target:65299:100 Layer2-info: encaps:FRAME RELAY,
     control flags:0, mtu: 0
```

show route receive-protocol bgp extensive (Layer 2 VPN)

```
user@host> show route receive-protocol bgp 10.255.14.171 extensive
inet.0: 68 destinations, 68 routes (67 active, 0 holddown, 1 hidden)
Prefix            Nexthop              MED    Lclpref AS path
inet.3: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Prefix            Nexthop              MED    Lclpref AS path
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Prefix            Nexthop              MED    Lclpref AS path
mpls.0: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
Prefix            Nexthop              MED    Lclpref AS path
frame-vpn.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Prefix            Nexthop              MED    Lclpref AS path
10.255.245.35:1:5:1/96 (1 entry, 1 announced)
     Route Distinguisher: 10.255.245.35:1
     Label-base : 800000, range : 4, status-vector : 0x0
     Nexthop: 10.255.245.35
     Localpref: 100
     AS path: I
     Communities: target:65299:100 Layer2-info: encaps:FRAME RELAY,
     control flags:0, mtu: 0
bgp.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Prefix            Nexthop              MED    Lclpref AS path
10.255.245.35:1:5:1/96 (1 entry, 0 announced)
     Route Distinguisher: 10.255.245.35:1
     Label-base : 800000, range : 4, status-vector : 0x0
     Nexthop: 10.255.245.35
     Localpref: 100
```



```
AS path: I
Communities: target:65299:100 Layer2-info: encaps:FRAME RELAY,
control flags:0, mtu: 0
```

show route receive-protocol bgp (Layer 3 VPN)

```
user@host> show route receive-protocol bgp 10.255.14.171
      inet.0: 33 destinations, 33 routes (32 active, 0 holddown, 1 hidden)
      Prefix            Nexthop                MED    Lclpref AS path
      inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
      Prefix            Nexthop                MED    Lclpref AS path
      VPN-A.inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
      Prefix            Nexthop                MED    Lclpref AS path
      10.255.14.175/32   10.255.14.171                    100 2 I
      10.255.14.179/32   10.255.14.171           2        100 I
      VPN-B.inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
      Prefix            Nexthop                MED    Lclpref AS path
      10.255.14.175/32   10.255.14.171                    100 2 I
      10.255.14.177/32   10.255.14.171                    100 I
      iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
      Prefix            Nexthop                MED    Lclpref AS path
      mpls.0: 9 destinations, 9 routes (9 active, 0 holddown, 0 hidden)
      Prefix            Nexthop                MED    Lclpref AS path
      bgp.l3vpn.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
      Prefix            Nexthop                MED    Lclpref AS path
      10.255.14.171:300:10.255.14.177/32
                         10.255.14.171                    100 I
      10.255.14.171:100:10.255.14.179/32
                         10.255.14.171           2        100 I
      10.255.14.171:200:10.255.14.175/32
                         10.255.14.171                    100 2 I
```

show route receive-protocol bgp detail (Layer 3 VPN)

```
user@host> show route receive-protocol bgp 10.255.14.174 detail
inet.0: 16 destinations, 17 routes (15 active, 0 holddown, 1 hidden)
inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
vpna.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
* 10.49.0.0/30 (1 entry, 1 announced)
     Route Distinguisher: 10.255.14.176:2
     VPN Label: 101264
     Nexthop: 10.255.14.174
     Localpref: 100
     AS path: I
     Communities: target:200:100
     AttrSet AS: 100
         Localpref: 100
         AS path: I
* 10.255.14.172/32 (1 entry, 1 announced)
     Route Distinguisher: 10.255.14.176:2
     VPN Label: 101280
     Nexthop: 10.255.14.174
     Localpref: 100
     AS path: I
     Communities: target:200:100
     AttrSet AS: 100
         Localpref: 100
         AS path: I
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
bgp.l3vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
```

```
* 10.255.14.174:2:10.49.0.0/30 (1 entry, 0 announced)
     Route Distinguisher: 10.255.14.174:2
     VPN Label: 101264
     Nexthop: 10.255.14.174
     Localpref: 100
     AS path: I
     Communities: target:200:100
     AttrSet AS: 100
         Localpref: 100
         AS path: I
* 10.255.14.174:2:10.255.14.172/32 (1 entry, 0 announced)
     Route Distinguisher: 10.255.14.174:2
     VPN Label: 101280
     Nexthop: 10.255.14.174
     Localpref: 100
     AS path: I
     Communities: target:200:100
     AttrSet AS: 100
         Localpref: 100
         AS path: I
inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
```

show route receive-protocol bgp extensive (Layer 3 VPN)

```
user@host> show route receive-protocol bgp 10.255.245.63 extensive
inet.0: 244 destinations, 244 routes (243 active, 0 holddown, 1 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     1.1.1.0/24 (1 entry, 1 announced)
          Nexthop: 10.0.50.3
          Localpref: 100
          AS path: I <Originator>
          Cluster list:  10.2.3.1
          Originator ID: 10.255.245.45
     165.3.0.0/16 (1 entry, 1 announced)
          Nexthop: 111.222.5.254
          Localpref: 100
          AS path: I <Originator>
          Cluster list:  10.2.3.1
          Originator ID: 10.255.245.68
     165.4.0.0/16 (1 entry, 1 announced)
          Nexthop: 111.222.5.254
          Localpref: 100
          AS path: I <Originator>
          Cluster list:  10.2.3.1
          Originator ID: 10.255.245.45
     195.1.2.0/24 (1 entry, 1 announced)
          Nexthop: 111.222.5.254
          Localpref: 100
          AS path: I <Originator>
          Cluster list:  10.2.3.1
          Originator ID: 10.255.245.68
     inet.2: 63 destinations, 63 routes (63 active, 0 holddown, 0 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     inet.3: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     mpls.0: 48 destinations, 48 routes (48 active, 0 holddown, 0 hidden)
```


show route resolution

Syntax

show route resolution
<brief | detail | extensive | summary>
<index *index*>
<logical-system (all | *logical-system-name*)>
<*prefix*>
<table *routing-table-name*>
<unresolved>

Syntax (EX Series Switches)

show route resolution
<brief | detail | extensive | summary>
<index *index*>
<*prefix*>
<table *routing-table-name*>
<unresolved>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the entries in the next-hop resolution database. This database provides for recursive resolution of next hops through other prefixes in the routing table.

Options

none—Display standard information about all entries in the next-hop resolution database.

brief | detail | extensive | summary—(Optional) Display the specified level of output.

index *index*—(Optional) Show the index of the resolution tree.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

prefix network/destination-prefix—(Optional) Display database entries for the specified address.

table *routing-table-name*—(Optional) Display information about a particular routing table (for example, **inet.0**) where policy-based export is currently enabled.

unresolved—(Optional) Display routes that could not be resolved.

Required Privilege Level

view

Related Documentation

- *Example: Configuring Route Resolution on PE Routers*

List of Sample Output

show route resolution detail on page 2591
show route resolution summary on page 2592
show route resolution unresolved on page 2592

Output Fields Table 223 on page 2591 describes the output fields for the **show route resolution** command. Output fields are listed in the approximate order in which they appear.

Table 223: show route resolution Output Fields

Field Name	Field Description
routing-table-name	Name of the routing table whose prefixes are resolved using the entries in the route resolution database. For routing table groups, this is the name of the primary routing table whose prefixes are resolved using the entries in the route resolution database.
Tree index	Tree index identifier.
Nodes	Number of nodes in the tree.
Reference count	Number of references made to the next hop.
Contributing routing tables	Routing tables used for next-hop resolution.
Originating RIB	Name of the routing table whose active route was used to determine the forwarding next-hop entry in the resolution database. For example, in the case of **inet.0** resolving through **inet.0** and **inet.3**, this field indicates which routing table, **inet.0** or **inet.3**, provided the best path for a particular prefix.
Metric	Metric associated with the forwarding next hop.
Node path count	Number of nodes in the path.
Forwarding next hops	Number of forwarding next hops. The forwarding next hop is the network layer address of the directly reachable neighboring system (if applicable) and the interface used to reach it.

Sample Output

show route resolution detail

```
user@host> show route resolution detail
Tree Index: 1, Nodes 0, Reference Count 1
Contributing routing tables: inet.3
Tree Index: 2, Nodes 23, Reference Count 1
Contributing routing tables: inet.0 inet.3
10.10.0.0/16 Originating RIB: inet.0
  Node path count: 1
  Forwarding nexthops: 1
10.31.1.0/30 Originating RIB: inet.0
  Node path count: 1
  Forwarding nexthops: 1
10.31.1.1/32 Originating RIB: inet.0
  Node path count: 1
  Forwarding nexthops: 0
10.31.1.4/30 Originating RIB: inet.0
  Node path count: 1
  Forwarding nexthops: 1
10.31.1.5/32 Originating RIB: inet.0
```



```
  Node path count: 1
  Forwarding nexthops: 0
10.31.2.0/30 Originating RIB: inet.0
  Metric: 2 Node path count: 1
  Forwarding nexthops: 2
10.31.11.0/24 Originating RIB: inet.0
  Node path count: 1
  Forwarding nexthops: 1
```

show route resolution summary

```
user@host> show route resolution summary
Tree Index: 1, Nodes 24, Reference Count 1
 Contributing routing tables: :voice.inet.0 :voice.inet.3
 Tree Index: 2, Nodes 2, Reference Count 1
 Contributing routing tables: inet.3
 Tree Index: 3, Nodes 43, Reference Count 1
 Contributing routing tables: inet.0 inet.3
```

show route resolution unresolved

```
user@host> show route resolution unresolved
Tree Index 1
vt-3/2/0.32769.0      /16
        Protocol Nexthop: 10.255.71.238 Push 800000
        Indirect nexthop: 0 -
vt-3/2/0.32772.0      /16
        Protocol Nexthop: 10.255.70.103 Push 800008
        Indirect nexthop: 0 -
Tree Index 2
```


show route snooping

Syntax

show route snooping
<brief | detail | extensive | terse>
<all>
<best *address/prefix*>
<exact *address*>
<range *prefix-range*>
<summary>
<table *table-name*>

Release Information

Command introduced in Junos OS Release 8.5.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the entries in the routing table that were learned from snooping.

Options

none—Display the entries in the routing table that were learned from snooping.

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

all—(Optional) Display all entries, including hidden entries.

best ***address/prefix***—(Optional) Display the longest match for the provided address and optional prefix.

exact ***address/prefix***—(Optional) Display exact matches for the provided address and optional prefix.

range ***prefix-range***—(Optional) Display information for the provided address range.

summary—(Optional) Display route snooping summary statisitics.

table ***table-name***—(Optional) Display information for the named table.

Required Privilege Level

view

List of Sample Output

show route snooping detail on page 2593

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route snooping detail

```
user@host> show route snooping detail
__+domainAll__.inet.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
 224.0.0.2/32 (1 entry, 1 announced)
        *IGMP   Preference: 0
                Next hop type: MultiRecv
                Next-hop reference count: 4
                State: <Active NoReadvrt Int>
```

```
                Age: 2:24
                Task: IGMP
                Announcement bits (1): 0-KRT
                AS path: I

224.0.0.22/32 (1 entry, 1 announced)
        *IGMP   Preference: 0
                Next hop type: MultiRecv
                Next-hop reference count: 4
                State: <Active NoReadvrt Int>
                Age: 2:24
                Task: IGMP
                Announcement bits (1): 0-KRT
                AS path: I

__+domainAll__.inet.1: 36 destinations, 36 routes (36 active, 0 holddown, 0 hidden)

224.0.0.0.0.0.0.0/24 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4), Next hop index: 1048584
                Next-hop reference count: 4
                State: <Active Int>
                Age: 2:24
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

225.0.0.2.11.11.11.100.3.9.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:13
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

225.0.0.3.11.11.11.100.3.9.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:15
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

225.0.0.4.11.11.11.100.3.9.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:17
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

225.0.0.5.11.11.11.100.3.9.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
```



```
                State: <Active Int>
                Age: 1:58
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

225.0.0.6.11.11.11.100.3.9.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:14
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

225.0.0.7.11.11.11.100.3.9.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:12
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

225.0.0.9.11.11.11.100.3.9.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:13
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

225.0.0.10.11.11.11.100.3.9.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:15
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

226.0.0.1.11.11.11.100.3.10.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:09
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

226.0.0.2.11.11.11.100.3.10.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
```

```
                Age: 8
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

226.0.0.4.11.11.11.100.3.10.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:10
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

226.0.0.8.11.11.11.100.3.10.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:12
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

226.0.0.10.11.11.11.100.3.10.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 1:56
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

227.0.0.1.11.11.11.100.3.11.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:10
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

227.0.0.2.11.11.11.100.3.11.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:13
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

227.0.0.3.11.11.11.100.3.11.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:16
```



```
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

227.0.0.4.11.11.11.100.3.11.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:15
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

227.0.0.5.11.11.11.100.3.11.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 1:57
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

227.0.0.7.11.11.11.100.3.11.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 1:57
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

227.0.0.8.11.11.11.100.3.11.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:10
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

227.0.0.10.11.11.11.100.3.11.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:15
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

228.0.0.1.11.11.11.100.3.12.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:09
                Task: MC
```

```
                Announcement bits (1): 0-KRT
                AS path: I

228.0.0.2.11.11.11.100.3.12.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:18
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

228.0.0.7.11.11.11.100.3.12.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:11
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

228.0.0.8.11.11.11.100.3.12.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:17
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

228.0.0.9.11.11.11.100.3.12.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 8
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

228.0.0.10.11.11.11.100.3.12.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:12
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

229.0.0.3.11.11.11.100.3.13.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:09
                Task: MC
                Announcement bits (1): 0-KRT
```



```
                AS path: I

229.0.0.4.11.11.11.100.3.13.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:12
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

229.0.0.5.11.11.11.100.3.13.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 9
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

229.0.0.6.11.11.11.100.3.13.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:15
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

229.0.0.7.11.11.11.100.3.13.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:15
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

229.0.0.8.11.11.11.100.3.13.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:15
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I

229.0.0.9.11.11.11.100.3.13.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:14
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I
```



```
229.0.0.10.11.11.11.100.3.13.0.0/80 (1 entry, 1 announced)
        *Multicast Preference: 180
                Next hop type: Multicast (IPv4)
                Next-hop reference count: 113
                State: <Active Int>
                Age: 2:13
                Task: MC
                Announcement bits (1): 0-KRT
                AS path: I
```

show route source-gateway

Syntax show route source-gateway *address*
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches) show route source-gateway *address*
<brief | detail | extensive | terse>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description Display the entries in the routing table that were learned from a particular address. The **Source** field in the **show route detail** command output lists the source for each route, if known.

Options **brief | detail | extensive | terse**—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

address—IP address of the system.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level view

List of Sample Output show route source-gateway on page 2601
show route source-gateway detail on page 2602
show route source-gateway extensive on page 2604

Output Fields For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route source-gateway

user@host> show route source-gateway 10.255.70.103

```
inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 7 destinations, 7 routes (5 active, 0 holddown, 2 hidden)
Restart Complete
```

```
inet6.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

green.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

10.255.70.103:1:3:1/96
                   *[BGP/170] 12:12:24, localpref 100, from 10.255.70.103
                      AS path: I
                    > via so-0/3/0.0, label-switched-path green-r1-r3

red.l2vpn.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

10.255.70.103:2:3:1/96
                   *[BGP/170] 12:12:24, localpref 0, from 10.255.70.103
                      AS path: I
                    > via so-0/3/0.0, label-switched-path green-r1-r3

bgp.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

10.255.70.103:1:3:1/96
                   *[BGP/170] 12:12:24, localpref 100, from 10.255.70.103
                      AS path: I
                    > via so-0/3/0.0, label-switched-path green-r1-r3

10.255.70.103:2:3:1/96
                   *[BGP/170] 12:12:24, localpref 0, from 10.255.70.103
                      AS path: I
                    > via so-0/3/0.0, label-switched-path green-r1-r3
```

show route source-gateway detail

```
user@host> show route source-gateway 10.255.70.103 detail
inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 7 destinations, 7 routes (5 active, 0 holddown, 2 hidden)
Restart Complete

inet6.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
Restart Complete
green.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)

Restart Complete
10.255.70.103:1:3:1/96 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
```



```
                Route Distinguisher: 10.255.70.103:1
                Next-hop reference count: 7
                Source: 10.255.70.103
                Protocol next hop: 10.255.70.103
                Indirect next hop: 2 no-forward
                State: <Secondary Active Int Ext>
                Local AS:    69 Peer AS:    69
                Age: 12:14:00   Metric2: 1
                Task: BGP_69.10.255.70.103+179
                Announcement bits (1): 0-green-l2vpn
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0
                Label-base: 800008, range: 8
                Localpref: 100
                Router ID: 10.255.70.103
                Primary Routing Table bgp.l2vpn.0

red.l2vpn.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
Restart Complete

10.255.70.103:2:3:1/96 (1 entry, 1 announced)
        *BGP    Preference: 170/-1
                Route Distinguisher: 10.255.70.103:2
                Next-hop reference count: 7
                Source: 10.255.70.103
                Protocol next hop: 10.255.70.103
                Indirect next hop: 2 no-forward
                State: <Secondary Active Int Ext>
                Local AS:    69 Peer AS:    69
                Age: 12:14:00   Metric2: 1
                Task: BGP_69.10.255.70.103+179
                Announcement bits (1): 0-red-l2vpn
                AS path: I
                Communities: target:11111:2 Layer2-info: encaps:VPLS,
                control flags:Site-Down, mtu: 0
                Label-base: 800016, range: 8
                Localpref: 0
                Router ID: 10.255.70.103
                Primary Routing Table bgp.l2vpn.0

bgp.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

10.255.70.103:1:3:1/96 (1 entry, 0 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 10.255.70.103:1
                Next-hop reference count: 7
                Source: 10.255.70.103
                Protocol next hop: 10.255.70.103
                Indirect next hop: 2 no-forward
                State: <Active Int Ext>
                Local AS:    69 Peer AS:    69
                Age: 12:14:00   Metric2: 1
                Task: BGP_69.10.255.70.103+179
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS, control
flags:, mtu: 0
                Label-base: 800008, range: 8
                Localpref: 100
                Router ID: 10.255.70.103
```

```
                Secondary Tables: green.l2vpn.0
10.255.70.103:2:3:1/96 (1 entry, 0 announced)
        *BGP    Preference: 170/-1
                Route Distinguisher: 10.255.70.103:2
                Next-hop reference count: 7
                Source: 10.255.70.103
                Protocol next hop: 10.255.70.103
                Indirect next hop: 2 no-forward
                State: <Active Int Ext>
                Local AS:    69 Peer AS:    69
                Age: 12:14:00   Metric2: 1
                Task: BGP_69.10.255.70.103+179
                AS path: I
                Communities: target:11111:2 Layer2-info: encaps:VPLS,
                control flags:Site-Down,
                mtu: 0
                Label-base: 800016, range: 8
                Localpref: 0
                Router ID: 10.255.70.103
                Secondary Tables: red.l2vpn.0
```

show route source-gateway extensive

```
user@host> show route source-gateway 10.255.70.103 extensive
inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 7 destinations, 7 routes (5 active, 0 holddown, 2 hidden)
Restart Complete

inet6.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
Restart Complete

green.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete
10.255.70.103:1:3:1/96 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 10.255.70.103:1
                Next-hop reference count: 7
                Source: 10.255.70.103
                Protocol next hop: 10.255.70.103
                Indirect next hop: 2 no-forward
                State: <Secondary Active Int Ext>
                Local AS:    69 Peer AS:    69
                Age: 12:15:24   Metric2: 1
                Task: BGP_69.10.255.70.103+179
                Announcement bits (1): 0-green-l2vpn
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0
                Label-base: 800008, range: 8
                Localpref: 100
                Router ID: 10.255.70.103
```



```
                Primary Routing Table bgp.l2vpn.0

red.l2vpn.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
Restart Complete

10.255.70.103:2:3:1/96 (1 entry, 1 announced)
        *BGP    Preference: 170/-1
                Route Distinguisher: 10.255.70.103:2
                Next-hop reference count: 7
                Source: 10.255.70.103
                Protocol next hop: 10.255.70.103
                Indirect next hop: 2 no-forward
                State: <Secondary Active Int Ext>
                Local AS:    69 Peer AS:    69
                Age: 12:15:24   Metric2: 1
                Task: BGP_69.10.255.70.103+179
                Announcement bits (1): 0-red-l2vpn
                AS path: I
                Communities: target:11111:2 Layer2-info: encaps:VPLS,
                control flags:Site-Down, mtu: 0
                Label-base: 800016, range: 8
                Localpref: 0
                Router ID: 10.255.70.103
                Primary Routing Table bgp.l2vpn.0

bgp.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

10.255.70.103:1:3:1/96 (1 entry, 0 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 10.255.70.103:1
                Next-hop reference count: 7
                Source: 10.255.70.103
                Protocol next hop: 10.255.70.103
                Indirect next hop: 2 no-forward
                State: <Active Int Ext>
                Local AS:    69 Peer AS:    69
                Age: 12:15:24   Metric2: 1
                Task: BGP_69.10.255.70.103+179
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0
                Label-base: 800008, range: 8
                Localpref: 100
                Router ID: 10.255.70.103
                Secondary Tables: green.l2vpn.0
                Indirect next hops: 1
                        Protocol next hop: 10.255.70.103 Metric: 2
                        Indirect next hop: 2 no-forward
                        Indirect path forwarding next hops: 1
                Next hop:        via so-0/3/0.0 weight 0x1
                        10.255.70.103/32 Originating RIB: inet.3
                          Metric: 2                       Node path count: 1
                          Forwarding nexthops: 1
                                Nexthop: via so-0/3/0.0

10.255.70.103:2:3:1/96 (1 entry, 0 announced)
        *BGP    Preference: 170/-1
                Route Distinguisher: 10.255.70.103:2
                Next-hop reference count: 7
                Source: 10.255.70.103
```

```
Protocol next hop: 10.255.70.103
Indirect next hop: 2 no-forward
State: <Active Int Ext>
Local AS:    69 Peer AS:    69
Age: 12:15:24   Metric2: 1
Task: BGP_69.10.255.70.103+179
AS path: I
Communities: target:11111:2 Layer2-info: encaps:VPLS,
control flags:Site-Down,
mtu: 0
Label-base: 800016, range: 8
Localpref: 0
Router ID: 10.255.70.103
Secondary Tables: red.l2vpn.0
Indirect next hops: 1
        Protocol next hop: 10.255.70.103 Metric: 2
        Indirect next hop: 2 no-forward
        Indirect path forwarding next hops: 1
Next hop:        via so-0/3/0.0 weight 0x1
        10.255.70.103/32 Originating RIB: inet.3
          Metric: 2                       Node path count: 1
          Forwarding nexthops: 1
                Nexthop: via so-0/3/0.0
```


show route summary

Syntax show route summary
<logical-system (all | *logical-system-name*)>
<table *routing-table-name*>

Syntax (EX Series Switches) show route summary

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description Display summary statistics about the entries in the routing table.

CPU utilization might increase while the device learns routes. We recommend that you use the **show route summary** command after the device learns and enters the routes into the routing table. Depending on the size of your network, this might take several minutes. If you receive a "timeout communicating with routing daemon" error when using the **show route summary** command, wait several minutes before attempting to use the command again. This is not a critical system error, but you might experience a delay in using the command-line interface (CLI).

Options **none**—Display summary statistics about the entries in the routing table.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

table *routing-table-name*—(Optional) Display summary statistics for all routing tables whose name begins with this string (for example, **inet.0** and **inet6.0** are both displayed when you run the **show route summary table inet** command). If you only want to display statistics for a specific routing table, make sure to enter the exact name of that routing table.

Required Privilege Level view

List of Sample Output
show route summary on page 2608
show route summary table on page 2609
show route summary table (with Route Limits Configured for the Routing Table) on page 2609

Output Fields Table 224 on page 2607 lists the output fields for the **show route summary** command. Output fields are listed in the approximate order in which they appear.

Table 224: show route summary Output Fields

Field Name	Field Description
Router ID	Address of the local routing device.
routing-table-name	Name of the routing table (for example, **inet.0**).

Table 224: show route summary Output Fields *(continued)*

Field Name	Field Description
destinations	Number of destinations for which there are routes in the routing table.
routes	Number of routes in the routing table: • **active**—Number of routes that are active. • **holddown**—Number of routes that are in the hold-down state before being declared inactive. • **hidden**—Number of routes that are not used because of routing policy.
Limit/Threshold	Displays the configured route limits for the routing table set with the maximum-prefixes and the maximum-paths statements. If you do not configure route limits for the routing table, the show output does not display this information. • **destinations**—The first number represents the maximum number of route prefixes installed in the routing table. The second number represents the number of route prefixes that trigger a warning message. • **routes**—The first number represents the maximum number of routes. The second number represents the number of routes that trigger a warning message.
Direct	Routes on the directly connected network.
Local	Local routes.
protocol-name	Name of the protocol from which the route was learned. For example, **OSPF**, **RSVP**, and **Static**.

Sample Output

show route summary

```
user@host> show route summary
Autonomous system number: 69
Router ID: 10.255.71.52
Maximum-ECMP: 32
inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete
              Direct:      6 routes,      5 active
               Local:      4 routes,      4 active
                OSPF:      5 routes,      4 active
              Static:      7 routes,      7 active
                IGMP:      1 routes,      1 active
                 PIM:      2 routes,      2 active

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete
                RSVP:      2 routes,      2 active

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete
              Direct:      1 routes,      1 active
```

```
mpls.0: 7 destinations, 7 routes (5 active, 0 holddown, 2 hidden)
Restart Complete
                MPLS:      3 routes,      3 active
                VPLS:      4 routes,      2 active

inet6.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
Restart Complete
              Direct:      2 routes,      2 active
                 PIM:      2 routes,      2 active
                 MLD:      1 routes,      1 active

green.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete
                 BGP:      2 routes,      2 active
               L2VPN:      2 routes,      2 active

red.l2vpn.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
Restart Complete
                 BGP:      2 routes,      2 active
               L2VPN:      1 routes,      1 active

bgp.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete
                 BGP:      4 routes,      4 active
```

show route summary table

```
user@host> show route summary table inet
Router ID: 192.168.0.1

inet.0: 32 destinations, 34 routes (31 active, 0 holddown, 1 hidden)
              Direct:      6 routes,      5 active
               Local:      9 routes,      9 active
                OSPF:      3 routes,      1 active
              Static:     13 routes,     13 active
                IGMP:      1 routes,      1 active
                 PIM:      2 routes,      2 active

inet.1: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
           Multicast:      1 routes,      1 active

inet6.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
               Local:      1 routes,      1 active
                 PIM:      2 routes,      2 active

inet6.1: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
           Multicast:      1 routes,      1 active
```

show route summary table (with Route Limits Configured for the Routing Table)

```
user@host> show route summary table VPN-A.inet.0
Autonomous system number: 100
Router ID: 10.255.182.142

VPN-A.inet.0: 13 destinations, 14 routes (13 active, 0 holddown, 0 hidden)
Limit/Threshold: 2000/200 destinations 20/12 routes
              Direct:      2 routes,      2 active
               Local:      1 routes,      1 active
                OSPF:      4 routes,      3 active
                 BGP:      4 routes,      4 active
```



```
IGMP:       1 routes,       1 active
 PIM:       2 routes,       2 active
```

show route table

Syntax

show route table *routing-table-name*
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route table *routing-table-name*
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the route entries in a particular routing table.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

routing-table-name—Display route entries for all routing tables whose name begins with this string (for example, inet.0 and inet6.0 are both displayed when you run the **show route table inet** command).

Required Privilege Level

view

Related Documentation

• show route summary on page 2607

List of Sample Output

show route table inetflow detail on page 2620

Output Fields For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route table bgp.l2.vpn

```
user@host> show route table bgp.l2.vpn
bgp.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.24.1:1:4:1/96
                   *[BGP/170] 01:08:58, localpref 100, from 192.168.24.1
                      AS path: I
                    > to 10.0.16.2 via fe-0/0/1.0, label-switched-path am
```

show route table bgp.l3vpn.0

```
user@host> show route table bgp.l3vpn.0
      bgp.l3vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
      + = Active Route, - = Last Active, * = Both

      10.255.71.15:100:10.255.71.17/32
                         *[BGP/170] 00:03:59, MED 1, localpref 100, from
      10.255.71.15
                            AS path: I
                          > via so-2/1/0.0, Push 100020, Push 100011(top)
      10.255.71.15:200:10.255.71.18/32
                         *[BGP/170] 00:03:59, MED 1, localpref 100, from
      10.255.71.15
                            AS path: I
                          > via so-2/1/0.0, Push 100021, Push 100011(top)
```

show route table bgp.l3vpn.0 detail

```
user@host> show route table bgp.l3vpn.0 detail
bgp.l3vpn.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)

10.255.245.12:1:4.0.0.0/8 (1 entry, 1 announced)
  *BGP    Preference: 170/-101
          Route Distinguisher: 10.255.245.12:1
          Source: 10.255.245.12
          Next hop: 192.168.208.66 via fe-0/0/0.0, selected
          Label operation: Push 182449
          Protocol next hop: 10.255.245.12
          Push 182449
          Indirect next hop: 863a630 297
          State: <Active Int Ext>
          Local AS:     35 Peer AS:    35
          Age: 12:19      Metric2: 1
          Task: BGP_35.10.255.245.12+179
          Announcement bits (1): 0-BGP.0.0.0.0+179
          AS path: 30 10458 14203 2914 3356 I (Atomic) Aggregator: 3356 4.68.0.11

          Communities: 2914:420 target:11111:1 origin:56:78
          VPN Label: 182449
          Localpref: 100
```



```
          Router ID: 10.255.245.12

10.255.245.12:1:4.17.225.0/24 (1 entry, 1 announced)
  *BGP   Preference: 170/-101
         Route Distinguisher: 10.255.245.12:1
         Source: 10.255.245.12
         Next hop: 192.168.208.66 via fe-0/0/0.0, selected
         Label operation: Push 182465
         Protocol next hop: 10.255.245.12
         Push 182465
         Indirect next hop: 863a8f0 305
         State: <Active Int Ext>
         Local AS:    35 Peer AS:    35
         Age: 12:19      Metric2: 1
         Task: BGP_35.10.255.245.12+179
         Announcement bits (1): 0-BGP.0.0.0.0+179
AS path: 30 10458 14203 2914 11853 11853 11853 6496 6496 6496 6496 6496 6496 I
                Communities: 2914:410 target:12:34 target:11111:1 origin:12:34
                VPN Label: 182465
                Localpref: 100
                Router ID: 10.255.245.12

10.255.245.12:1:4.17.226.0/23 (1 entry, 1 announced)
  *BGP   Preference: 170/-101
         Route Distinguisher: 10.255.245.12:1
         Source: 10.255.245.12
         Next hop: 192.168.208.66 via fe-0/0/0.0, selected
         Label operation: Push 182465
         Protocol next hop: 10.255.245.12
         Push 182465
         Indirect next hop: 86bd210 330
         State: <Active Int Ext>
         Local AS:    35 Peer AS:    35
         Age: 12:19      Metric2: 1
         Task: BGP_35.10.255.245.12+179
         Announcement bits (1): 0-BGP.0.0.0.0+179
         AS path: 30 10458 14203 2914 11853 11853 11853 6496 6496 6496 6496 6496

         6496 I
         Communities: 2914:410 target:12:34 target:11111:1 origin:12:34
         VPN Label: 182465
         Localpref: 100
         Router ID: 10.255.245.12

10.255.245.12:1:4.17.251.0/24 (1 entry, 1 announced)
  *BGP   Preference: 170/-101
         Route Distinguisher: 10.255.245.12:1
         Source: 10.255.245.12
         Next hop: 192.168.208.66 via fe-0/0/0.0, selected
         Label operation: Push 182465
         Protocol next hop: 10.255.245.12
         Push 182465
         Indirect next hop: 86bd210 330
         State: <Active Int Ext>
         Local AS:    35 Peer AS:    35
         Age: 12:19      Metric2: 1
         Task: BGP_35.10.255.245.12+179
         Announcement bits (1): 0-BGP.0.0.0.0+179
         AS path: 30 10458 14203 2914 11853 11853 11853 6496 6496 6496 6496 6496

         6496 I
```

```
         Communities: 2914:410 target:12:34 target:11111:1 origin:12:34
         VPN Label: 182465
         Localpref: 100
```

show route table bgp.rtarget.0 (When Proxy BGP Route Target Filtering Is Configured)

```
user@host> show route table bgp.rtarget.o
bgp.rtarget.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

100:100:100/96
                   *[RTarget/5] 00:03:14
                      Type Proxy
                        for 10.255.165.103
                        for 10.255.166.124
                      Local
```

show route table inet.0

```
user@host> show route table inet.0
inet.0: 12 destinations, 12 routes (11 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0          *[Static/5] 00:51:57
                    > to 111.222.5.254 via fxp0.0
1.0.0.1/32         *[Direct/0] 00:51:58
                    > via at-5/3/0.0
1.0.0.2/32         *[Local/0] 00:51:58
                     Local
12.12.12.21/32     *[Local/0] 00:51:57
                     Reject
13.13.13.13/32     *[Direct/0] 00:51:58
                    > via t3-5/2/1.0
13.13.13.14/32     *[Local/0] 00:51:58
                     Local
13.13.13.21/32     *[Local/0] 00:51:58
                     Local
13.13.13.22/32     *[Direct/0] 00:33:59
                    > via t3-5/2/0.0
127.0.0.1/32        [Direct/0] 00:51:58
                    > via lo0.0
111.222.5.0/24     *[Direct/0] 00:51:58
                    > via fxp0.0
111.222.5.81/32    *[Local/0] 00:51:58
                     Local
```

show route table inet6.0

```
user@host> show route table inet6.0
inet6.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Route, * = Both

fec0:0:0:3::/64 *[Direct/0] 00:01:34
>via fe-0/1/0.0

fec0:0:0:3::/128 *[Local/0] 00:01:34
>Local

fec0:0:0:4::/64 *[Static/5] 00:01:34
>to fec0:0:0:3::ffff via fe-0/1/0.0
```

show route table inet6.3

```
user@router> show route table inet6.3
inet6.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

::10.255.245.195/128
                   *[LDP/9] 00:00:22, metric 1
                    > via so-1/0/0.0
::10.255.245.196/128
                   *[LDP/9] 00:00:08, metric 1
                    > via so-1/0/0.0, Push 100008
```

show route table inetflow detail

```
user@host> show route table inetflow detail
inetflow.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
10.12.44.1,*/48 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Next-hop reference count: 2
                State: <Active Ext>
                Local AS: 65002 Peer AS: 65000
                Age: 4
                Task: BGP_65000.10.12.99.5+3792
                Announcement bits (1): 0-Flow
                AS path: 65000 I
                Communities: traffic-rate:0:0
                Validation state: Accept, Originator: 10.12.99.5
                Via: 10.12.44.0/24, Active
                Localpref: 100
                Router ID: 10.255.71.161

10.12.56.1,*/48 (1 entry, 1 announced)
        *Flow   Preference: 5
                Next-hop reference count: 2
                State: <Active>
                Local AS: 65002
                Age: 6:30
                Task: RT Flow
                Announcement bits (2): 0-Flow 1-BGP.0.0.0.0+179
                AS path: I
                Communities: 1:1
```

show route table l2circuit.0

```
user@host> show route table l2circuit.0
l2circuit.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.1.1.195:NoCtrlWord:1:1:Local/96
                   *[L2CKT/7] 00:50:47
                    > via so-0/1/2.0, Push 100049
                      via so-0/1/3.0, Push 100049
10.1.1.195:NoCtrlWord:1:1:Remote/96
                   *[LDP/9] 00:50:14
                      Discard
10.1.1.195:CtrlWord:1:2:Local/96
                   *[L2CKT/7] 00:50:47
                    > via so-0/1/2.0, Push 100049
                      via so-0/1/3.0, Push 100049
10.1.1.195:CtrlWord:1:2:Remote/96
```



```
                   *[LDP/9] 00:50:14
                      Discard
```

show route table mpls

```
user@host> show route table mpls
mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0                  *[MPLS/0] 00:13:55, metric 1
                      Receive
1                  *[MPLS/0] 00:13:55, metric 1
                      Receive
2                  *[MPLS/0] 00:13:55, metric 1
                      Receive
1024               *[VPN/0] 00:04:18
                      to table red.inet.0, Pop
```

show route table mpls extensive

```
user@host> show route table mpls extensive
100000 (1 entry, 1 announced)
TSI:
KRT in-kernel 100000 /36 -> {so-1/0/0.0}
        *LDP    Preference:   9
                Next hop:  via so-1/0/0.0, selected
                Pop
                State: <Active Int>
                Age: 29:50      Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
                Prefixes bound to route: 10.0.0.194/32
```

show route table mpls.0

```
user@host> show route table mpls.0
mpls.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0                  *[MPLS/0] 00:45:09, metric 1
                      Receive
1                  *[MPLS/0] 00:45:09, metric 1
                      Receive
2                  *[MPLS/0] 00:45:09, metric 1
                      Receive
100000             *[L2VPN/7] 00:43:04
                    > via so-0/1/0.1, Pop
100001             *[L2VPN/7] 00:43:03
                    > via so-0/1/0.2, Pop       Offset: 4
100002             *[LDP/9] 00:43:22, metric 1
                      via so-0/1/2.0, Pop
                    > via so-0/1/3.0, Pop
100002(S=0)        *[LDP/9] 00:43:22, metric 1
                      via so-0/1/2.0, Pop
                    > via so-0/1/3.0, Pop
100003             *[LDP/9] 00:43:22, metric 1
                    > via so-0/1/2.0, Swap 100002
                      via so-0/1/3.0, Swap 100002
100004             *[LDP/9] 00:43:16, metric 1
                      via so-0/1/2.0, Swap 100049
                    > via so-0/1/3.0, Swap 100049
```

```
so-0/1/0.1          *[L2VPN/7] 00:43:04
                     > via so-0/1/2.0, Push 100001, Push 100049(top)
                       via so-0/1/3.0, Push 100001, Push 100049(top)
so-0/1/0.2          *[L2VPN/7] 00:43:03
                       via so-0/1/2.0, Push 100000, Push 100049(top) Offset: -4
                     > via so-0/1/3.0, Push 100000, Push 100049(top) Offset: -4
```

show route table mpls.0 (RSVP Route—Transit LSP)

```
user@host> show route table mpls.0

mpls.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0                   *[MPLS/0] 00:37:31, metric 1
                       Receive
1                   *[MPLS/0] 00:37:31, metric 1
                       Receive
2                   *[MPLS/0] 00:37:31, metric 1
                       Receive
13                  *[MPLS/0] 00:37:31, metric 1
                       Receive
300352              *[RSVP/7/1] 00:08:00, metric 1
                     > to 8.64.0.106 via ge-1/0/1.0, label-switched-path lsp1_p2p
300352(S=0)         *[RSVP/7/1] 00:08:00, metric 1
                     > to 8.64.0.106 via ge-1/0/1.0, label-switched-path lsp1_p2p
300384              *[RSVP/7/2] 00:05:20, metric 1
                     > to 8.64.1.106 via ge-1/0/0.0, Pop
300384(S=0)         *[RSVP/7/2] 00:05:20, metric 1
                     > to 8.64.1.106 via ge-1/0/0.0, Pop
```

show route table vpls_1 detail

```
user@host> show route table vpls_1 detail
vpls_1.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

1.1.1.11:1000:1:1/96 (1 entry, 1 announced)
*L2VPN Preference: 170/-1
Receive table: vpls_1.l2vpn.0
Next-hop reference count: 2
State: <Active Int Ext>
Age: 4:29:47 Metric2: 1
Task: vpls_1-l2vpn
Announcement bits (1): 1-BGP.0.0.0.0+179
AS path: I
Communities: Layer2-info: encaps:VPLS, control flags:Site-Down
Label-base: 800000, range: 8, status-vector: 0xFF
```

show route table vpn-a

```
user@host> show route table vpn-a
vpn-a.l2vpn.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

+ = Active Route, - = Last Active, * = Both
192.168.16.1:1:1:1/96
                    *[VPN/7] 05:48:27
                      Discard
192.168.24.1:1:2:1/96
                    *[BGP/170] 00:02:53, localpref 100, from 192.168.24.1
                       AS path: I
                     > to 10.0.16.2 via fe-0/0/1.0, label-switched-path am
```

```
192.168.24.1:1:3:1/96
                   *[BGP/170] 00:02:53, localpref 100, from 192.168.24.1
                      AS path: I
                    > to 10.0.16.2 via fe-0/0/1.0, label-switched-path am
```

show route table vpn-a.mdt.0

```
user@host> show route table vpn-a.mdt.0
vpn-a.mdt.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1:1:0:10.255.14.216:232.1.1.1/144
                   *[MVPN/70] 01:23:05, metric2 1
                      Indirect
1:1:1:10.255.14.218:232.1.1.1/144
                   *[BGP/170] 00:57:49, localpref 100, from 10.255.14.218
                      AS path: I
                    > via so-0/0/0.0, label-switched-path r0e-to-r1
1:1:2:10.255.14.217:232.1.1.1/144
                   *[BGP/170] 00:57:49, localpref 100, from 10.255.14.217
                      AS path: I
> via so-0/0/1.0, label-switched-path r0-to-r2
```

show route table VPN-A detail

```
user@host> show route table VPN-A detail
VPN-AB.inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
10.255.179.9/32 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 10.255.179.13:200
                Next hop type: Indirect
                Next-hop reference count: 5
                Source: 10.255.179.13
                Next hop type: Router, Next hop index: 732
                Next hop: 10.39.1.14 via fe-0/3/0.0, selected
                Label operation: Push 299824, Push 299824(top)
                Protocol next hop: 10.255.179.13
                Push 299824
                Indirect next hop: 8f275a0 1048574
                State: (Secondary Active Int Ext)
                Local AS: 1 Peer AS: 1
                Age: 3:41:06 Metric: 1 Metric2: 1
                Task: BGP_1.10.255.179.13+64309
                Announcement bits (2): 0-KRT 1-BGP RT Background
                AS path: I
                Communities: target:1:200 rte-type:0.0.0.0:1:0
                Import Accepted
                VPN Label: 299824 TTL Action: vrf-ttl-propagate
                Localpref: 100
                Router ID: 10.255.179.13
                Primary Routing Table bgp.l3vpn.0
```

show route table VPN-AB.inet.0

```
user@host> show route table VPN-AB.inet.0
      VPN-AB.inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
      + = Active Route, - = Last Active, * = Both

      10.39.1.0/30       *[OSPF/10] 00:07:24, metric 1
                          > via so-7/3/1.0
      10.39.1.4/30       *[Direct/0] 00:08:42
                          > via so-5/1/0.0
```



```
10.39.1.6/32       *[Local/0] 00:08:46
                      Local
10.255.71.16/32    *[Static/5] 00:07:24
                     > via so-2/0/0.0
10.255.71.17/32    *[BGP/170] 00:07:24, MED 1, localpref 100, from
10.255.71.15
                       AS path: I
                     > via so-2/1/0.0, Push 100020, Push 100011(top)
10.255.71.18/32    *[BGP/170] 00:07:24, MED 1, localpref 100, from
10.255.71.15
                       AS path: I
                     > via so-2/1/0.0, Push 100021, Push 100011(top)
10.255.245.245/32  *[BGP/170] 00:08:35, localpref 100
                       AS path: 2 I
                     > to 10.39.1.5 via so-5/1/0.0
10.255.245.246/32  *[OSPF/10] 00:07:24, metric 1
                     > via so-7/3/1.0
```

show route table VPN_blue.mvpn-inet6.0

```
user@host> show route table VPN_blue.mvpn-inet6.0
vpn_blue.mvpn-inet6.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1:10.255.2.202:65535:10.255.2.202/432
                   *[BGP/170] 00:02:37, localpref 100, from 10.255.2.202
                      AS path: I
                    > via so-0/1/3.0
1:10.255.2.203:65535:10.255.2.203/432
                   *[BGP/170] 00:02:37, localpref 100, from 10.255.2.203
                      AS path: I
                    > via so-0/1/0.0
1:10.255.2.204:65535:10.255.2.204/432
                   *[MVPN/70] 00:57:23, metric2 1
                      Indirect
5:10.255.2.202:65535:128:::192.168.90.2:128:ffff::1/432
                   *[BGP/170] 00:02:37, localpref 100, from 10.255.2.202
                      AS path: I
                    > via so-0/1/3.0
6:10.255.2.203:65535:65000:128:::10.12.53.12:128:ffff::1/432
                   *[PIM/105] 00:02:37
                      Multicast (IPv6)
7:10.255.2.202:65535:65000:128:::192.168.90.2:128:ffff::1/432
                   *[MVPN/70] 00:02:37, metric2 1
                      Indirect
```

show route table VPN-A detail

```
user@host> show route table VPN-A detail
VPN-AB.inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
10.255.179.9/32 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 10.255.179.13:200
                Next hop type: Indirect
                Next-hop reference count: 5
                Source: 10.255.179.13
                Next hop type: Router, Next hop index: 732
                Next hop: 10.39.1.14 via fe-0/3/0.0, selected
                Label operation: Push 299824, Push 299824(top)
                Protocol next hop: 10.255.179.13
                Push 299824
```

```
                                Indirect next hop: 8f275a0 1048574
                                State: (Secondary Active Int Ext)
                                Local AS: 1 Peer AS: 1
                                Age: 3:41:06 Metric: 1 Metric2: 1
                                Task: BGP_1.10.255.179.13+64309
                                Announcement bits (2): 0-KRT 1-BGP RT Background
                                AS path: I
                                Communities: target:1:200 rte-type:0.0.0.0:1:0
                                Import Accepted
                                VPN Label: 299824 TTL Action: vrf-ttl-propagate
                                Localpref: 100
                                Router ID: 10.255.179.13
                                Primary Routing Table bgp.l3vpn.0
```

show route table inetflow detail

```
user@host> show route table inetflow detail
inetflow.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
10.12.44.1,*/48 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Next-hop reference count: 2
                State: <Active Ext>
                Local AS: 65002 Peer AS: 65000
                Age: 4
                Task: BGP_65000.10.12.99.5+3792
                Announcement bits (1): 0-Flow
                AS path: 65000 I
                Communities: traffic-rate:0:0
                Validation state: Accept, Originator: 10.12.99.5
                Via: 10.12.44.0/24, Active
                Localpref: 100
                Router ID: 10.255.71.161

10.12.56.1,*/48 (1 entry, 1 announced)
        *Flow   Preference: 5
                Next-hop reference count: 2
                State: <Active>
                Local AS: 65002
                Age: 6:30
                Task: RT Flow
                Announcement bits (2): 0-Flow 1-BGP.0.0.0.0+179
                AS path: I
                Communities: 1:1

user@PE1> show route table green.l2vpn.0 (VPLS Multihoming with FEC 129)
green.l2vpn.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.2:100:1.1.1.2/96 AD
                   *[VPLS/170] 1d 03:11:03, metric2 1
                         Indirect
1.1.1.4:100:1.1.1.4/96 AD
                   *[BGP/170] 1d 03:11:02, localpref 100, from 1.1.1.4
                      AS path: I, validation-state: unverified
                    >    via ge-1/2/1.5
1.1.1.2:100:1:0/96 MH
                   *[VPLS/170] 1d 03:11:03, metric2 1
                         Indirect
1.1.1.4:100:1:0/96 MH
                   *[BGP/170] 1d 03:11:02, localpref 100, from 1.1.1.4
                      AS path: I, validation-state: unverified
```



```
                    >    via ge-1/2/1.5
1.1.1.4:NoCtrlWord:5:100:100:1.1.1.2:1.1.1.4/176
                   *[VPLS/7] 1d 03:11:02, metric2 1
                    >    via ge-1/2/1.5
1.1.1.4:NoCtrlWord:5:100:100:1.1.1.4:1.1.1.2/176
                   *[LDP/9] 1d 03:11:02
                         Discard
```

user@host> **show route table red extensive**

```
red.inet.0: 364481 destinations, 714087 routes (364480 active, 48448 holddown, 1
 hidden)
22.0.0.0/32 (3 entries, 1 announced)
        State: <OnList CalcForwarding>
TSI:
KRT in-kernel 22.0.0.0/32 -> {composite(1048575)} Page 0 idx 1 Type 1 val 0x934342c

    Nexthop: Self
    AS path: [2] I
    Communities: target:2:1
Path 22.0.0.0 from 2.3.0.0 Vector len 4.  Val: 1
        @BGP    Preference: 170/-1
                Route Distinguisher: 2:1
                Next hop type: Indirect
                Address: 0x258059e4
                Next-hop reference count: 2
                Source: 2.2.0.0
                Next hop type: Router
                Next hop: 10.1.1.1 via ge-1/1/9.0, selected
                Label operation: Push 707633
                Label TTL action: prop-ttl
                Session Id: 0x17d8
                Protocol next hop: 2.2.0.0
                Push 16
                Composite next hop: 0x25805988 - INH Session ID: 0x193c
                Indirect next hop: 0x23eea900 - INH Session ID: 0x193c
                State: <Secondary Active Int Ext ProtectionPath ProtectionCand>
                Local AS:     2 Peer AS:     2
                Age: 23         Metric2: 35
                Validation State: unverified
                Task: BGP_2.2.2.0.0+34549
                AS path: I
                Communities: target:2:1
                Import Accepted
                VPN Label: 16
                Localpref: 0
                Router ID: 2.2.0.0
                Primary Routing Table bgp.l3vpn.0
                Composite next hops: 1
                        Protocol next hop: 2.2.0.0 Metric: 35
                        Push 16
                        Composite next hop: 0x25805988 - INH Session ID: 0x193c
                        Indirect next hop: 0x23eea900 - INH Session ID: 0x193c
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.1.1.1 via ge-1/1/9.0
                                Session Id: 0x17d8
                        2.2.0.0/32 Originating RIB: inet.3
                          Metric: 35                      Node path count: 1
                          Forwarding nexthops: 1
                                Nexthop: 10.1.1.1 via ge-1/1/9.0
         BGP    Preference: 170/-1
```



```
                Route Distinguisher: 2:1
                Next hop type: Indirect
                Address: 0x9347028
                Next-hop reference count: 3
                Source: 2.3.0.0
                Next hop type: Router, Next hop index: 702
                Next hop: 10.1.4.2 via ge-1/0/0.0, selected
                Label operation: Push 634278
                Label TTL action: prop-ttl
                Session Id: 0x17d9
                Protocol next hop: 2.3.0.0
                Push 16
                Composite next hop: 0x93463a0 1048575 INH Session ID: 0x17da
                Indirect next hop: 0x91e8800 1048574 INH Session ID: 0x17da
                State: <Secondary NotBest Int Ext ProtectionPath ProtectionCand>

                Inactive reason: Not Best in its group - IGP metric
                Local AS:     2 Peer AS:     2
                Age: 3:34       Metric2: 70
                Validation State: unverified
                Task: BGP_2.2.3.0.0+32805
                Announcement bits (2): 0-KRT 1-BGP_RT_Background
                AS path: I
                Communities: target:2:1
                Import Accepted
                VPN Label: 16
                Localpref: 0
                Router ID: 2.3.0.0
                Primary Routing Table bgp.l3vpn.0
                Composite next hops: 1
                        Protocol next hop: 2.3.0.0 Metric: 70
                        Push 16
                        Composite next hop: 0x93463a0 1048575 INH Session ID:
0x17da
                        Indirect next hop: 0x91e8800 1048574 INH Session ID:
0x17da
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.1.4.2 via ge-1/0/0.0
                                Session Id: 0x17d9
                        2.3.0.0/32 Originating RIB: inet.3
                          Metric: 70                      Node path count: 1
                          Forwarding nexthops: 1
                                Nexthop: 10.1.4.2 via ge-1/0/0.0
        #Multipath Preference: 255
                Next hop type: Indirect
                Address: 0x24afca30
                Next-hop reference count: 1
                Next hop type: Router
                Next hop: 10.1.1.1 via ge-1/1/9.0, selected
                Label operation: Push 707633
                Label TTL action: prop-ttl
                Session Id: 0x17d8
                Next hop type: Router, Next hop index: 702
                Next hop: 10.1.4.2 via ge-1/0/0.0
                Label operation: Push 634278
                Label TTL action: prop-ttl
                Session Id: 0x17d9
                Protocol next hop: 2.2.0.0
                Push 16
                Composite next hop: 0x25805988 - INH Session ID: 0x193c
```



```
                Indirect next hop: 0x23eea900 - INH Session ID: 0x193c Weight 0x1

                 Protocol next hop: 2.3.0.0
                 Push 16
                 Composite next hop: 0x93463a0 1048575 INH Session ID: 0x17da
                Indirect next hop: 0x91e8800 1048574 INH Session ID: 0x17da Weight
0x4000
                 State: <ForwardingOnly Int Ext>
                 Inactive reason: Forwarding use only
                 Age: 23         Metric2: 35
                 Validation State: unverified
                 Task: RT
                 AS path: I
                 Communities: target:2:1
```

show route terse

Syntax

show route terse
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route terse

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display a high-level summary of the routes in the routing table.

NOTE: For BGP routes, the **show route terse** command displays the local preference attribute and MED instead of the metric1 and metric2 values. This is mostly due to historical reasons.

To display the metric1 and metric2 value of a BGP route, use the show route extensive command.

Options

none—Display a high-level summary of the routes in the routing table.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route terse on page 2626

Output Fields

Table 225 on page 2624 describes the output fields for the **show route terse** command. Output fields are listed in the approximate order in which they appear.

Table 225: show route terse Output Fields

Field Name	Field Description
routing-table-name	Name of the routing table (for example, inet.0).
number destinations	Number of destinations for which there are routes in the routing table.
number routes	Number of routes in the routing table and total number of routes in the following states: • **active** (routes that are active) • **holddown** (routes that are in the pending state before being declared inactive) • **hidden** (routes that are not used because of a routing policy)

Table 225: show route terse Output Fields *(continued)*

Field Name	Field Description
route key	Key for the state of the route: • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route.
A	Active route. An asterisk (*) indicates this is the active route.
V	Validation status of the route: • **?**—Not evaluated. Indicates that the route was not learned through BGP. • **I**—Invalid. Indicates that the prefix is found, but either the corresponding AS received from the EBGP peer is not the AS that appears in the database, or the prefix length in the BGP update message is longer than the maximum length permitted in the database. • **N**—Unknown. Indicates that the prefix is not among the prefixes or prefix ranges in the database. • **V**—Valid. Indicates that the prefix and autonomous system pair are found in the database.
Destination	Destination of the route.
P	Protocol through which the route was learned: • **A**—Aggregate • **B**—BGP • **C**—CCC • **D**—Direct • **G**—GMPLS • **I**—IS-IS • **L**—L2CKT, L2VPN, LDP, Local • **K**—Kernel • **M**—MPLS, MSDP • **O**—OSPF • **P**—PIM • **R**—RIP, RIPng • **S**—Static • **T**—Tunnel
Prf	Preference value of the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the **LocalPref** value for Route 1 is 100, the **Preference2** value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.
Metric 1	First metric value in the route. For routes learned from BGP, this is the MED metric.
Metric 2	Second metric value in the route. For routes learned from BGP, this is the IGP metric.

Table 225: show route terse Output Fields *(continued)*

Field Name	Field Description
Next hop	Next hop to the destination. An angle bracket (>) indicates that the route is the selected route.
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **?**—Incomplete; typically, the AS path was aggregated.

Sample Output

show route terse

```
user@host> show route terse
inet.0: 10 destinations, 12 routes (10 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

A V Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* ? 1.0.1.1/32         O  10          1            >10.0.0.2
  ?                    B 170        100                             I
  unverified                                       >10.0.0.2
* ? 1.1.1.1/32         D   0                       >lo0.2
* V 2.2.0.2/32         B 170        110                             200 I
  valid                                            >10.0.0.2
* ? 10.0.0.0/30        D   0                       >lt-1/2/0.1
  ?                    B 170        100                             I
  unverified                                       >10.0.0.2
* ? 10.0.0.1/32        L   0                        Local
* ? 10.0.0.4/30        B 170        100                             I
  unverified                                       >10.0.0.2
* ? 10.0.0.8/30        B 170        100                             I
  unverified                                       >10.0.0.2
* I 172.16.1.1/32      B 170         90                             200 I
  invalid                                          >10.0.0.2
* N 192.168.2.3/32     B 170        100                             200 I
  unknown                                          >10.0.0.2
* ? 224.0.0.5/32       O  10          1             MultiRecv
```


CHAPTER 30

Troubleshooting

Troubleshooting Procedures

Troubleshooting Virtual Routing Instances

Direct Routes Not Leaked Between Routing Instances

Problem Direct routes are not exported (leaked) between virtual routing instances For example, consider the following scenario:

- QFX switch with two virtual routing instances:
  - Routing instance 1 connects to downstream device through interface xe-0/0/1.
  - Routing instance 2 connects to upstream device through interface xe-0/0/2.

If you enable route leaking between the routing instances (by using the **rib-group** statement, for example), the downstream device cannot connect to the upstream device because the QFX switch connects to the upstream device over a direct route and these routes are not leaked between instances.

NOTE: You can see a route to the upstream device in the routing table of the downstream device, but this route is not functional.

Indirect routes *are* leaked between routing instances, so the downstream device can connect to any upstream devices that are connected to the QFX switch over indirect routes.

Solution This is expected behavior.

Related Documentation

- Understanding Virtual Router Routing Instances on page 2304
- Configuring Virtual Router Routing Instances on page 2313
- **rib-group on page 2421**

PART 10

Border Gateway Protocol

CHAPTER 31

Overview

BGP Overview

Understanding BGP

BGP is an exterior gateway protocol (EGP) that is used to exchange routing information among routers in different autonomous systems (ASs). BGP routing information includes the complete route to each destination. BGP uses the routing information to maintain a database of network reachability information, which it exchanges with other BGP systems. BGP uses the network reachability information to construct a graph of AS connectivity, which enables BGP to remove routing loops and enforce policy decisions at the AS level.

Multiprotocol BGP (MBGP) extensions enable BGP to support IP version 6 (IPv6). MBGP defines the attributes MP_REACH_NLRI and MP_UNREACH_NLRI, which are used to carry IPv6 reachability information. Network layer reachability information (NLRI) update messages carry IPv6 address prefixes of feasible routes.

BGP allows for policy-based routing. You can use routing policies to choose among multiple paths to a destination and to control the redistribution of routing information.

BGP uses TCP as its transport protocol, using port 179 for establishing connections. Running over a reliable transport protocol eliminates the need for BGP to implement update fragmentation, retransmission, acknowledgment, and sequencing.

The Junos OS routing protocol software supports BGP version 4. This version of BGP adds support for Classless Interdomain Routing (CIDR), which eliminates the concept of network classes. Instead of assuming which bits of an address represent the network by looking at the first octet, CIDR allows you to explicitly specify the number of bits in the network address, thus providing a means to decrease the size of the routing tables. BGP version 4 also supports aggregation of routes, including the aggregation of AS paths.

This section discusses the following topics:

Autonomous Systems

An *autonomous system* (AS) is a set of routers that are under a single technical administration and normally use a single interior gateway protocol and a common set of metrics to propagate routing information within the set of routers. To other ASs, an AS appears to have a single, coherent interior routing plan and presents a consistent picture of what destinations are reachable through it.

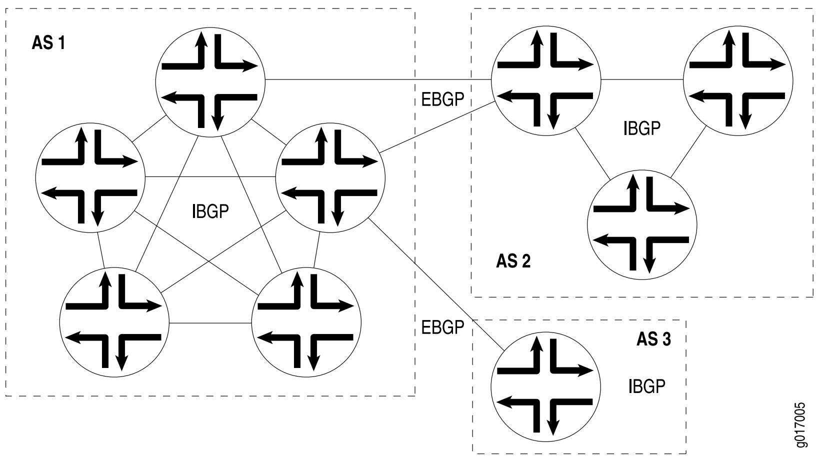
AS Paths and Attributes

The routing information that BGP systems exchange includes the complete route to each destination, as well as additional information about the route. The route to each destination is called the *AS path*, and the additional route information is included in *path attributes*. BGP uses the AS path and the path attributes to completely determine the network topology. Once BGP understands the topology, it can detect and eliminate routing loops and select among groups of routes to enforce administrative preferences and routing policy decisions.

External and Internal BGP

BGP supports two types of exchanges of routing information: exchanges among different ASs and exchanges within a single AS. When used among ASs, BGP is called *external BGP* (EBGP) and BGP sessions perform *inter-AS routing*. When used within an AS, BGP is called *internal BGP* (IBGP) and BGP sessions perform *intra-AS routing*. Figure 36 on page 2633 illustrates ASs, IBGP, and EBGP.

Figure 36: ASs, EBGP, and IBGP



A BGP system shares network reachability information with adjacent BGP systems, which are referred to as *neighbors* or *peers*.

BGP systems are arranged into *groups*. In an IBGP group, all peers in the group—called *internal peers*—are in the same AS. Internal peers can be anywhere in the local AS and do not have to be directly connected to one another. Internal groups use routes from an IGP to resolve forwarding addresses. They also propagate external routes among all other internal routers running IBGP, computing the next hop by taking the BGP next hop received with the route and resolving it using information from one of the interior gateway protocols.

In an EBGP group, the peers in the group—called *external peers*—are in different ASs and normally share a subnet. In an external group, the next hop is computed with respect to the interface that is shared between the external peer and the local router.

Multiple Instances of BGP

You can configure multiple instances of BGP at the following hierarchy levels:

- **[edit routing-instances *routing-instance-name* protocols]**
- **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols]**

Multiple instances of BGP are primarily used for Layer 3 VPN support.

IGP peers and external BGP (EBGP) peers (both nonmultihop and multihop) are all supported for routing instances. BGP peering is established over one of the interfaces configured under the **routing-instances** hierarchy.

NOTE: When a BGP neighbor sends BGP messages to the local routing device, the incoming interface on which these messages are received must be configured in the same routing instance that the BGP neighbor configuration exists in. This is true for neighbors that are a single hop away or multiple hops away.

Routes learned from the BGP peer are added to the **instance-name.inet.0** table by default. You can configure import and export policies to control the flow of information into and out of the instance routing table.

For Layer 3 VPN support, configure BGP on the provider edge (PE) router to receive routes from the customer edge (CE) router and to send the instances' routes to the CE router if necessary. You can use multiple instances of BGP to maintain separate per-site forwarding tables for keeping VPN traffic separate on the PE router.

You can configure import and export policies that allow the service provider to control and rate-limit traffic to and from the customer.

You can configure an EBGP multihop session for a VRF routing instance. Also, you can set up the EBGP peer between the PE and CE routers by using the loopback address of the CE router instead of the interface addresses.

Related Documentation

- BGP Routes Overview on page 2634
- BGP Messages Overview on page 2635

BGP Routes Overview

A BGP route is a destination, described as an IP address prefix, and information that describes the path to the destination.

The following information describes the path:

- AS path, which is a list of numbers of the ASs that a route passes through to reach the local router. The first number in the path is that of the last AS in the path—the AS closest to the local router. The last number in the path is the AS farthest from the local router, which is generally the origin of the path.
- Path attributes, which contain additional information about the AS path that is used in routing policy.

BGP peers advertise routes to each other in update messages.

BGP stores its routes in the Junos OS routing table (**inet.0**). The routing table stores the following information about BGP routes:

- Routing information learned from update messages received from peers

- Local routing information that BGP applies to routes because of local policies
- Information that BGP advertises to BGP peers in update messages

For each prefix in the routing table, the routing protocol process selects a single best path, called the active path. Unless you configure BGP to advertise multiple paths to the same destination, BGP advertises only the active path.

The BGP router that first advertises a route assigns it one of the following values to identify its origin. During route selection, the lowest origin value is preferred.

- **0**—The router originally learned the route through an IGP (OSPF, IS-IS, or a static route).
- **1**—The router originally learned the route through an EGP (most likely BGP).
- **2**—The route's origin is unknown.

Related Documentation

- Understanding BGP Path Selection on page 2827
- Example: Advertising Multiple Paths in BGP on page 2876

BGP Messages Overview

All BGP messages have the same fixed-size header, which contains a marker field that is used for both synchronization and authentication, a length field that indicates the length of the packet, and a type field that indicates the message type (for example, open, update, notification, keepalive, and so on).

This section discusses the following topics:

Open Messages

After a TCP connection is established between two BGP systems, they exchange BGP open messages to create a BGP connection between them. Once the connection is established, the two systems can exchange BGP messages and data traffic.

Open messages consist of the BGP header plus the following fields:

- Version—The current BGP version number is 4.
- Local AS number—You configure this by including the **autonomous-system** statement at the **[edit routing-options]** or **[edit logical-systems *logical-system-name* routing-options]** hierarchy level.
- Hold time—Proposed hold-time value. You configure the local hold time with the BGP **hold-time** statement.
- BGP identifier—IP address of the BGP system. This address is determined when the system starts and is the same for every local interface and every BGP peer. You can

configure the BGP identifier by including the **router-id** statement at the **[edit routing-options]** or **[edit logical-systems *logical-system-name* routing-options]** hierarchy level. By default, BGP uses the IP address of the first interface it finds in the router.

- Parameter field length and the parameter itself—These are optional fields.

Update Messages

BGP systems send update messages to exchange network reachability information. BGP systems use this information to construct a graph that describes the relationships among all known ASs.

Update messages consist of the BGP header plus the following optional fields:

- Unfeasible routes length—Length of the withdrawn routes field
- Withdrawn routes—IP address prefixes for the routes being withdrawn from service because they are no longer deemed reachable
- Total path attribute length—Length of the path attributes field; it lists the path attributes for a feasible route to a destination
- Path attributes—Properties of the routes, including the path origin, the multiple exit discriminator (MED), the originating system's preference for the route, and information about aggregation, communities, confederations, and route reflection
- Network layer reachability information (NLRI)—IP address prefixes of feasible routes being advertised in the update message

Keepalive Messages

BGP systems exchange keepalive messages to determine whether a link or host has failed or is no longer available. Keepalive messages are exchanged often enough so that the hold timer does not expire. These messages consist only of the BGP header.

Notification Messages

BGP systems send notification messages when an error condition is detected. After the message is sent, the BGP session and the TCP connection between the BGP systems are closed. Notification messages consist of the BGP header plus the error code and subcode, and data that describes the error.

Related Documentation

- Understanding BGP on page 2632
- BGP Routes Overview on page 2634

Understanding the Advertisement of Multiple Paths to a Single Destination in BGP

BGP peers advertise routes to each other in update messages. BGP stores its routes in the Junos OS routing table (**inet.0**). For each prefix in the routing table, the routing protocol process selects a single best path, called the active path. Unless you configure BGP to advertise multiple paths to the same destination, BGP advertises only the active path.

Instead of advertising only the active path to a destination, you can configure BGP to advertise multiple paths to the destination. Within an autonomous system (AS), the availability of multiple exit points to reach a destination provides the following benefits:

- Fault tolerance—Path diversity leads to reduction in restoration time after failure. For instance, a border after receiving multiple paths to the same destination can precompute a backup path and have it ready so that when the primary path becomes invalid, the border routing device can use the backup to quickly restore connectivity. Without a backup path, the restoration time depends on BGP reconvergence, which includes withdraw and advertisement messages in the network before a new best path can be learned.
- Load balancing—The availability of multiple paths to reach the same destination enables load balancing of traffic, if the routing within the AS meets certain constraints.
- Maintenance—The availability of alternate exit points allows for graceful maintenance operation of routers.

The following limitations apply to advertising multiple routes in BGP:

- Address families supported:
  - IPv4 unicast (**family inet unicast**)
  - IPv6 unicast (**family inet6 unicast**)
  - IPv4 labeled unicast (**family inet labeled-unicast**)
  - IPv6 labeled unicast (**family inet6 labeled-unicast**)
- Internal BGP (IBGP) peers only. No support on external BGP (EBGP) peers.
- Master instance only. No support for routing instances.
- Graceful restart supported, but not nonstop active routing (NSR).
- No BGP Monitoring Protocol (BMP) support.
- No support for EBGP sessions between confederations.
- Prefix policies enable you to filter routes on a router that is configured to advertise multiple paths to a destination. Prefix policies can only match prefixes. They cannot match route attributes, and they cannot change the attributes of routes.

Related Documentation

- Understanding BGP Path Selection on page 2827
- Example: Advertising Multiple Paths in BGP on page 2876

CHAPTER 32

Configuration

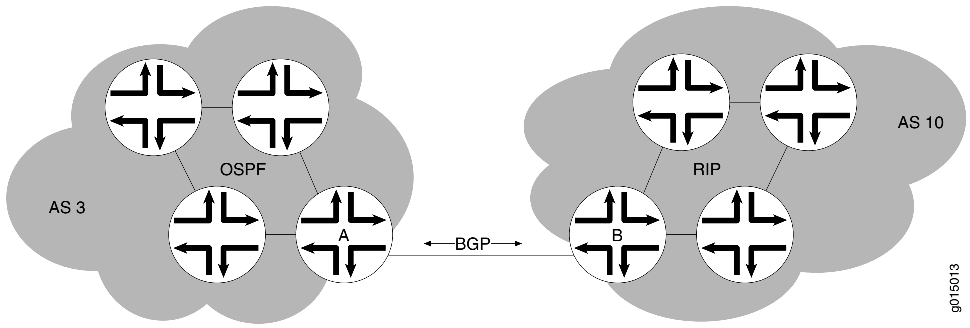
Basic BGP Configuration

Examples: Configuring External BGP Peering

Understanding External BGP Peering Sessions

To establish point-to-point connections between peer autonomous systems (ASs), you configure a BGP session on each interface of a point-to-point link. Generally, such sessions are made at network exit points with neighboring hosts outside the AS. Figure 37 on page 2640 shows an example of a BGP peering session.

Figure 37: BGP Peering Session



In Figure 37 on page 2640, Router A is a gateway router for AS 3, and Router B is a gateway router for AS 10. For traffic internal to either AS, an interior gateway protocol (IGP) is used (OSPF, for instance). To route traffic between peer ASs, a BGP session is used.

You arrange BGP routing devices into groups of peers. Different peer groups can have different group types, AS numbers, and route reflector cluster identifiers.

To define a BGP group that recognizes only the specified BGP systems as peers, statically configure all the system's peers by including one or more **neighbor** statements. The peer neighbor's address can be either an IPv6 or IPv4 address.

As the number of external BGP (EBGP) groups increases, the ability to support a large number of BGP sessions might become a scaling issue. The preferred way to configure a large number of BGP neighbors is to configure a few groups consisting of multiple neighbors per group. Supporting fewer EBGP groups generally scales better than supporting a large number of EBGP groups. This becomes more evident in the case of hundreds of EBGP groups when compared with a few EBGP groups with multiple peers in each group.

After the BGP peers are established, BGP routes are not automatically advertised by the BGP peers. At each BGP-enabled device, policy configuration is required to export the local, static, or IGP-learned routes into the BGP RIB and then advertise them as BGP routes to the other peers. BGP's advertisement policy, by default, does not advertise any non-BGP routes (such as local routes) to peers.

Example: Configuring External BGP Point-to-Point Peer Sessions

This example shows how to configure BGP point-to-point peer sessions.

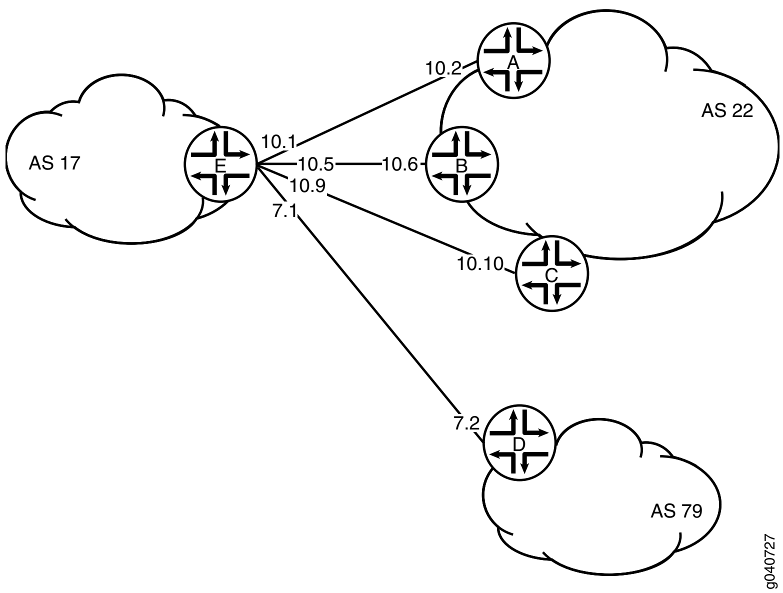
Requirements

Before you begin, if the default BGP policy is not adequate for your network, configure routing policies to filter incoming BGP routes and to advertise BGP routes.

Overview

Figure 38 on page 2641 shows a network with BGP peer sessions. In the sample network, Device E in AS 17 has BGP peer sessions to a group of peers called **external-peers**. Peers A, B, and C reside in AS 22 and have IP addresses 10.10.10.2, 10.10.10.6, and 10.10.10.10. Peer D resides in AS 79, at IP address 10.21.7.2. This example shows the configuration on Device E.

Figure 38: Typical Network with BGP Peer Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set interfaces ge-1/2/0 unit 0 description to-A
set interfaces ge-1/2/0 unit 0 family inet address 10.10.10.1/30
set interfaces ge-0/0/1 unit 5 description to-B
set interfaces ge-0/0/1 unit 5 family inet address 10.10.10.5/30
set interfaces ge-0/1/0 unit 9 description to-C
set interfaces ge-0/1/0 unit 9 family inet address 10.10.10.9/30
set interfaces ge-1/2/1 unit 21 description to-D
set interfaces ge-1/2/1 unit 21 family inet address 10.21.7.1/30
set protocols bgp group external-peers type external
set protocols bgp group external-peers peer-as 22
set protocols bgp group external-peers neighbor 10.10.10.2
set protocols bgp group external-peers neighbor 10.10.10.6
set protocols bgp group external-peers neighbor 10.10.10.10
set protocols bgp group external-peers neighbor 10.21.7.2 peer-as 79
set routing-options autonomous-system 17
```


Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. Configure the interfaces to Peers A, B, C, and D.

```
[edit interfaces]
user@E# set ge-1/2/0 unit 0 description to-A
user@E# set ge-1/2/0 unit 0 family inet address 10.10.10.1/30
user@E# set ge-0/0/1 unit 5 description to-B
user@E# set ge-0/0/1 unit 5 family inet address 10.10.10.5/30
user@E# set ge-0/1/0 unit 9 description to-C
user@E# set ge-0/1/0 unit 9 family inet address 10.10.10.9/30
user@E# set ge-1/2/1 unit 21 description to-D
user@E# set ge-1/2/1 unit 21 family inet address 10.21.7.1/30
```

2. Set the autonomous system (AS) number.

```
[edit routing-options]
user@E# set autonomous-system 17
```

3. Create the BGP group, and add the external neighbor addresses.

```
[edit protocols bgp group external-peers]
user@E# set neighbor 10.10.10.2
user@E# set neighbor 10.10.10.6
user@E# set neighbor 10.10.10.10
```

4. Specify the autonomous system (AS) number of the external AS.

```
[edit protocols bgp group external-peers]
user@E# set peer-as 22
```

5. Add Peer D, and set the AS number at the individual neighbor level.

   The neighbor configuration overrides the group configuration. So, while **peer-as 22** is set for all the other neighbors in the group, **peer-as 79** is set for neighbor 10.21.7.2.

```
[edit protocols bgp group external-peers]
user@E# set neighbor 10.21.7.2 peer-as 79
```

6. Set the peer type to external BGP (EBGP).

```
[edit protocols bgp group external-peers]
user@E# set type external
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@E# show interfaces
ge-1/2/0 {
  unit 0 {
    description to-A;
    family inet {
      address 10.10.10.1/30;
```

```
        }
      }
    }
    ge-0/0/1 {
      unit 5 {
        description to-B;
        family inet {
          address 10.10.10.5/30;
        }
      }
    }
    ge-0/1/0 {
      unit 9 {
        description to-C;
        family inet {
          address 10.10.10.9/30;
        }
      }
    }
    ge-1/2/1 {
      unit 21 {
        description to-D;
        family inet {
          address 10.21.7.1/30;
        }
      }
    }

    [edit]
    user@E# show protocols
    bgp {
      group external-peers {
        type external;
        peer-as 22;
        neighbor 10.10.10.2;
        neighbor 10.10.10.6;
        neighbor 10.10.10.10;
        neighbor 10.21.7.2 {
          peer-as 79;
        }
      }
    }

    [edit]
    user@E# show routing-options
    autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 2644
- Verifying BGP Groups on page 2646
- Verifying BGP Summary Information on page 2646

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is active for each neighbor address.

Action From operational mode, run the **show bgp neighbor** command.

```
user@E> show bgp neighbor
Peer: 10.10.10.2+179 AS 22     Local: 10.10.10.1+65406 AS 17
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.10.10.2       Local ID: 10.10.10.1       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  Local Interface: ge-1/2/0.0
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 22)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 10   Sent 6    Checked 1
  Input messages:  Total 8522   Updates 1      Refreshes 0     Octets 161922
  Output messages: Total 8433   Updates 0      Refreshes 0     Octets 160290
  Output Queue[0]: 0

Peer: 10.10.10.6+54781 AS 22   Local: 10.10.10.5+179 AS 17
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.10.10.6       Local ID: 10.10.10.1       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
  Local Interface: ge-0/0/1.5
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
```



```
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 22)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 12   Sent 6    Checked 33
  Input messages:  Total 8527   Updates 1       Refreshes 0     Octets 162057
  Output messages: Total 8430   Updates 0       Refreshes 0     Octets 160233
  Output Queue[0]: 0

Peer: 10.10.10.10+55012 AS 22  Local: 10.10.10.9+179 AS 17
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.10.10.10      Local ID: 10.10.10.1      Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 2
  BFD: disabled, down
  Local Interface: fe-0/1/0.9
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 22)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 15   Sent 6    Checked 37
  Input messages:  Total 8527   Updates 1       Refreshes 0     Octets 162057
  Output messages: Total 8429   Updates 0       Refreshes 0     Octets 160214
  Output Queue[0]: 0

Peer: 10.21.7.2+61867 AS 79    Local: 10.21.7.1+179 AS 17
  Type: External    State: Established    Flags: <ImportEval Sync>
```

```
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.21.7.2        Local ID: 10.10.10.1       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 3
  BFD: disabled, down
  Local Interface: ge-1/2/1.21
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 79)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 28   Sent 24   Checked 47
  Input messages:  Total 8521   Updates 1       Refreshes 0     Octets 161943
  Output messages: Total 8427   Updates 0       Refreshes 0     Octets 160176
  Output Queue[0]: 0
```

Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From operational mode, run the **show bgp group** command.

```
user@E> show bgp group
Group Type: External                               Local AS: 17
  Name: external-peers  Index: 0                   Flags: <>
  Holdtime: 0
  Total peers: 4        Established: 4
  10.10.10.2+179
  10.10.10.6+54781
  10.10.10.10+55012
  10.21.7.2+61867
  inet.0: 0/0/0/0

Groups: 1  Peers: 4    External: 4    Internal: 0    Down peers: 0   Flags: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 0          0          0          0          0          0
```

Verifying BGP Summary Information

Purpose Verify that the BGP configuration is correct.

Action From operational mode, run the **show bgp summary** command.

```
user@E> show bgp summary
Groups: 1 Peers: 4 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 0          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn 
State|#Active/Received/Accepted/Damped...
10.10.10.2               22       8559       8470       0       0 2d 16:12:56 
0/0/0/0              0/0/0/0
10.10.10.6               22       8566       8468       0       0 2d 16:12:12 
0/0/0/0              0/0/0/0
10.10.10.10              22       8565       8466       0       0 2d 16:11:31 
0/0/0/0              0/0/0/0
10.21.7.2                79       8560       8465       0       0 2d 16:10:58 
0/0/0/0              0/0/0/0
```

Example: Configuring External BGP on Logical Systems with IPv6 Interfaces

This example shows how to configure external BGP (EBGP) point-to-point peer sessions on logical systems with IPv6 interfaces.

- Requirements on page 2647
- Overview on page 2647
- Configuration on page 2648
- Verification on page 2657

Requirements

In this example, no special configuration beyond device initialization is required.

Overview

Junos OS supports EBGP peer sessions by means of IPv6 addresses. An IPv6 peer session can be configured when an IPv6 address is specified in the **neighbor** statement. This example uses EUI-64 to generate IPv6 addresses that are automatically applied to the interfaces. An EUI-64 address is an IPv6 address that uses the IEEE EUI-64 format for the interface identifier portion of the address (the last 64 bits).

NOTE: Alternatively, you can configure EBGP sessions using manually assigned 128-bit IPv6 addresses.

If you use 128-bit link-local addresses for the interfaces, you must include the **local-interface** statement. This statement is valid only for 128-bit IPv6 link-local addresses and is mandatory for configuring an IPv6 EBGP link-local peer session.

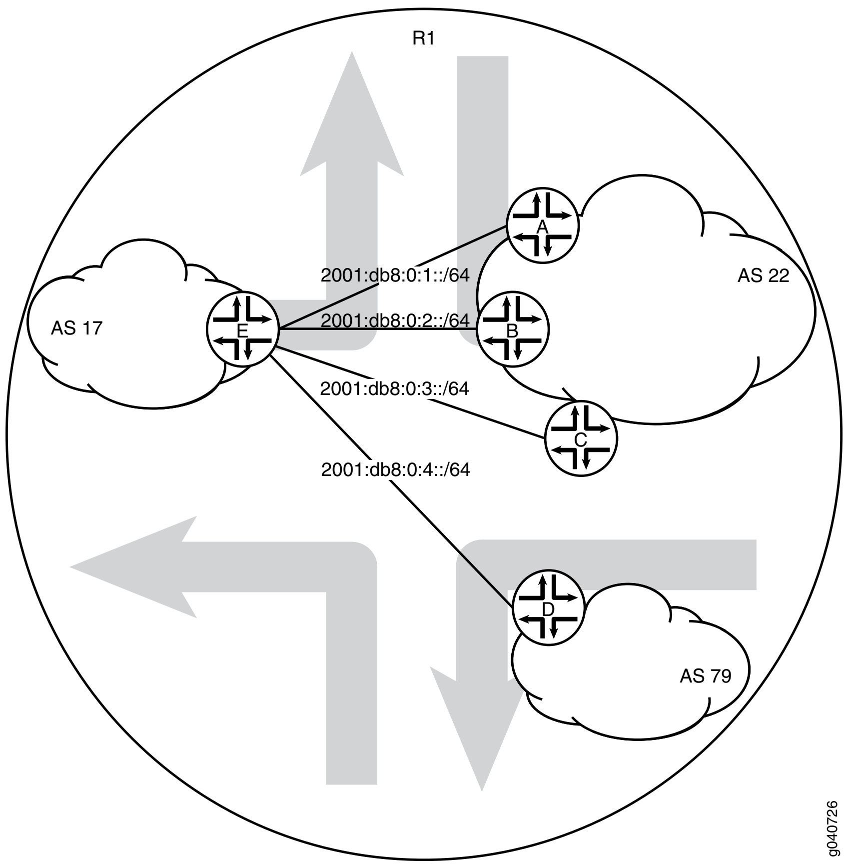
Configuring EBGP peering using link-local addresses is only applicable for directly connected interfaces. There is no support for multihop peering.

After your interfaces are up, you can use the **show interfaces terse** command to view the EUI-64-generated IPv6 addresses on the interfaces. You must use these generated addresses in the BGP **neighbor** statements. This example demonstrates the full end-to-end procedure.

In this example, Frame Relay interface encapsulation is applied to the logical tunnel (**lt**) interfaces. This is a requirement because only Frame Relay encapsulation is supported when IPv6 addresses are configured on the **lt** interfaces.

Figure 39 on page 2648 shows a network with BGP peer sessions. In the sample network, Router R1 has five logical systems configured. Device E in autonomous system (AS) 17 has BGP peer sessions to a group of peers called **external-peers**. Peers A, B, and C reside in AS 22. This example shows the step-by-step configuration on Logical System A and Logical System E.

Figure 39: Typical Network with BGP Peer Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device A

```
set logical-systems A interfaces lt-0/1/0 unit 1 description to-E
set logical-systems A interfaces lt-0/1/0 unit 1 encapsulation frame-relay
set logical-systems A interfaces lt-0/1/0 unit 1 dlci 1
```

```
set logical-systems A interfaces lt-0/1/0 unit 1 peer-unit 25
set logical-systems A interfaces lt-0/1/0 unit 1 family inet6 address 2001:db8:0:1::/64
   eui-64
set logical-systems A interfaces lo0 unit 1 family inet6 address 2001:db8::1/128
set logical-systems A protocols bgp group external-peers type external
set logical-systems A protocols bgp group external-peers peer-as 17
set logical-systems A protocols bgp group external-peers neighbor
   2001:db8:0:1:2a0:a502:0:19da
set logical-systems A routing-options router-id 1.1.1.1
set logical-systems A routing-options autonomous-system 22
```

Device B

```
set logical-systems B interfaces lt-0/1/0 unit 6 description to-E
set logical-systems B interfaces lt-0/1/0 unit 6 encapsulation frame-relay
set logical-systems B interfaces lt-0/1/0 unit 6 dlci 6
set logical-systems B interfaces lt-0/1/0 unit 6 peer-unit 5
set logical-systems B interfaces lt-0/1/0 unit 6 family inet6 address 2001:db8:0:2::/64
   eui-64
set logical-systems B interfaces lo0 unit 2 family inet6 address 2001:db8::2/128
set logical-systems B protocols bgp group external-peers type external
set logical-systems B protocols bgp group external-peers peer-as 17
set logical-systems B protocols bgp group external-peers neighbor
   2001:db8:0:2:2a0:a502:0:5da
set logical-systems B routing-options router-id 2.2.2.2
set logical-systems B routing-options autonomous-system 22
```

Device C

```
set logical-systems C interfaces lt-0/1/0 unit 10 description to-E
set logical-systems C interfaces lt-0/1/0 unit 10 encapsulation frame-relay
set logical-systems C interfaces lt-0/1/0 unit 10 dlci 10
set logical-systems C interfaces lt-0/1/0 unit 10 peer-unit 9
set logical-systems C interfaces lt-0/1/0 unit 10 family inet6 address 2001:db8:0:3::/64
   eui-64
set logical-systems C interfaces lo0 unit 3 family inet6 address 2001:db8::3/128
set logical-systems C protocols bgp group external-peers type external
set logical-systems C protocols bgp group external-peers peer-as 17
set logical-systems C protocols bgp group external-peers neighbor
   2001:db8:0:3:2a0:a502:0:9da
set logical-systems C routing-options router-id 3.3.3.3
set logical-systems C routing-options autonomous-system 22
```

Device D

```
set logical-systems D interfaces lt-0/1/0 unit 7 description to-E
set logical-systems D interfaces lt-0/1/0 unit 7 encapsulation frame-relay
set logical-systems D interfaces lt-0/1/0 unit 7 dlci 7
set logical-systems D interfaces lt-0/1/0 unit 7 peer-unit 21
set logical-systems D interfaces lt-0/1/0 unit 7 family inet6 address 2001:db8:0:4::/64
   eui-64
set logical-systems D interfaces lo0 unit 4 family inet6 address 2001:db8::4/128
set logical-systems D protocols bgp group external-peers type external
set logical-systems D protocols bgp group external-peers peer-as 17
set logical-systems D protocols bgp group external-peers neighbor
   2001:db8:0:4:2a0:a502:0:15da
set logical-systems D routing-options router-id 4.4.4.4
set logical-systems D routing-options autonomous-system 79
```

Device E

```
set logical-systems E interfaces lt-0/1/0 unit 5 description to-B
set logical-systems E interfaces lt-0/1/0 unit 5 encapsulation frame-relay
```



```
set logical-systems E interfaces lt-0/1/0 unit 5 dlci 6
set logical-systems E interfaces lt-0/1/0 unit 5 peer-unit 6
set logical-systems E interfaces lt-0/1/0 unit 5 family inet6 address 2001:db8:0:2::/64
  eui-64
set logical-systems E interfaces lt-0/1/0 unit 9 description to-C
set logical-systems E interfaces lt-0/1/0 unit 9 encapsulation frame-relay
set logical-systems E interfaces lt-0/1/0 unit 9 dlci 10
set logical-systems E interfaces lt-0/1/0 unit 9 peer-unit 10
set logical-systems E interfaces lt-0/1/0 unit 9 family inet6 address 2001:db8:0:3::/64
  eui-64
set logical-systems E interfaces lt-0/1/0 unit 21 description to-D
set logical-systems E interfaces lt-0/1/0 unit 21 encapsulation frame-relay
set logical-systems E interfaces lt-0/1/0 unit 21 dlci 7
set logical-systems E interfaces lt-0/1/0 unit 21 peer-unit 7
set logical-systems E interfaces lt-0/1/0 unit 21 family inet6 address 2001:db8:0:4::/64
  eui-64
set logical-systems E interfaces lt-0/1/0 unit 25 description to-A
set logical-systems E interfaces lt-0/1/0 unit 25 encapsulation frame-relay
set logical-systems E interfaces lt-0/1/0 unit 25 dlci 1
set logical-systems E interfaces lt-0/1/0 unit 25 peer-unit 1
set logical-systems E interfaces lt-0/1/0 unit 25 family inet6 address 2001:db8:0:1::/64
  eui-64
set logical-systems E interfaces lo0 unit 5 family inet6 address 2001:db8::5/128
set logical-systems E protocols bgp group external-peers type external
set logical-systems E protocols bgp group external-peers peer-as 22
set logical-systems E protocols bgp group external-peers neighbor
  2001:db8:0:1:2a0:a502:0:1da
set logical-systems E protocols bgp group external-peers neighbor
  2001:db8:0:2:2a0:a502:0:6da
set logical-systems E protocols bgp group external-peers neighbor
  2001:db8:0:3:2a0:a502:0:ada
set logical-systems E protocols bgp group external-peers neighbor
  2001:db8:0:4:2a0:a502:0:7da peer-as 79
set logical-systems E routing-options router-id 5.5.5.5
set logical-systems E routing-options autonomous-system 17
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. Run the **show interfaces terse** command to verify that the physical router has a logical tunnel (**lt**) interface.

```
user@R1> show interfaces terse
Interface               Admin Link Proto    Local                 Remote
...
lt-0/1/0                up    up
...
```

2. On Logical System A, configure the interface encapsulation, peer-unit number, and DLCI to reach Logical System E.

```
user@R1> set cli logical-system A
Logical system: A
[edit]
```



```
user@R1:A> edit
Entering configuration mode
[edit]
user@R1:A# edit interfaces
[edit interfaces]
user@R1:A# set lt-0/1/0 unit 1 encapsulation frame-relay
user@R1:A# set lt-0/1/0 unit 1 dlci 1
user@R1:A# set lt-0/1/0 unit 1 peer-unit 25
```

3. On Logical System A, configure the network address for the link to Peer E, and configure a loopback interface.

```
[edit interfaces]
user@R1:A# set lt-0/1/0 unit 1 description to-E
user@R1:A# set lt-0/1/0 unit 1 family inet6 address 2001:db8:0:1::/64 eui-64
user@R1:A# set lo0 unit 1 family inet6 address 2001:db8::1/128
```

4. On Logical System E, configure the interface encapsulation, peer-unit number, and DLCI to reach Logical System A.

```
user@R1> set cli logical-system E
Logical system: E
[edit]
user@R1:E> edit
Entering configuration mode
[edit]
user@R1:E# edit interfaces
[edit interfaces]
user@R1:E# set lt-0/1/0 unit 25 encapsulation frame-relay
user@R1:E# set lt-0/1/0 unit 25 dlci 1
user@R1:E# set lt-0/1/0 unit 25 peer-unit 1
```

5. On Logical System E, configure the network address for the link to Peer A, and configure a loopback interface.

```
[edit interfaces]
user@R1:E# set lt-0/1/0 unit 25 description to-A
user@R1:E# set lt-0/1/0 unit 25 family inet6 address 2001:db8:0:1::/64 eui-64
user@R1:E# set lo0 unit 5 family inet6 address 2001:db8::5/128
```

6. Run the **show interfaces terse** command to see the IPv6 addresses that are generated by EUI-64.

   The 2001 addresses are used in this example in the BGP **neighbor** statements.

   NOTE: The fe80 addresses are link-local addresses and are not used in this example.

```
user@R1:A> show interfaces terse
Interface               Admin Link Proto    Local                 Remote
Logical system: A

betsy@tp8:A> show interfaces terse
Interface               Admin Link Proto    Local                 Remote
lt-0/1/0
lt-0/1/0.1              up    up   inet6    2001:db8:0:1:2a0:a502:0:1da/64
```



```
                                          fe80::2a0:a502:0:1da/64
lo0
lo0.1                   up    up   inet6    2001:db8::1
                                          fe80::2a0:a50f:fc56:1da

user@R1:E> show interfaces terse
Interface               Admin Link Proto    Local                 Remote
lt-0/1/0
lt-0/1/0.25             up    up   inet6    2001:db8:0:1:2a0:a502:0:19da/64

                                          fe80::2a0:a502:0:19da/64
lo0
lo0.5                   up    up   inet6    2001:db8::5
                                          fe80::2a0:a50f:fc56:1da
```

7. Repeat the interface configuration on the other logical systems.

Configuring the External BGP Sessions

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. On Logical System A, create the BGP group, and add the external neighbor address.

   [edit protocols bgp group external-peers]
   user@R1:A# **set neighbor 2001:db8:0:1:2a0:a502:0:19da**

2. On Logical System E, create the BGP group, and add the external neighbor address.

   [edit protocols bgp group external-peers]
   user@R1:E# **set neighbor 2001:db8:0:1:2a0:a502:0:1da**

3. On Logical System A, specify the autonomous system (AS) number of the external AS.

   [edit protocols bgp group external-peers]
   user@R1:A# **set peer-as 17**

4. On Logical System E, specify the autonomous system (AS) number of the external AS.

   [edit protocols bgp group external-peers]
   user@R1:E# **set peer-as 22**

5. On Logical System A, set the peer type to EBGP.

   [edit protocols bgp group external-peers]
   user@R1:A# **set type external**

6. On Logical System E, set the peer type to EBGP.

   [edit protocols bgp group external-peers]
   user@R1:E# **set type external**

7. On Logical System A, set the autonomous system (AS) number and router ID.

   [edit routing-options]
   user@R1:A# **set router-id 1.1.1.1**
   user@R1:A# **set autonomous-system 22**

8. On Logical System E, set the AS number and router ID.

```
[edit routing-options]
user@R1:E# set router-id 5.5.5.5
user@R1:E# set autonomous-system 17
```

9. Repeat these steps for Peers A, B, C, and D.

Results From configuration mode, confirm your configuration by entering the **show logical-systems** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@R1# show logical-systems
A {
  interfaces {
    lt-0/1/0 {
      unit 1 {
        description to-E;
        encapsulation frame-relay;
        dlci 1;
        peer-unit 25;
        family inet6 {
          address 2001:db8:0:1::/64 {
            eui-64;
          }
        }
      }
    }
    lo0 {
      unit 1 {
        family inet6 {
          address 2001:db8::1/128;
        }
      }
    }
  }
  protocols {
    bgp {
      group external-peers {
        type external;
        peer-as 17;
        neighbor 2001:db8:0:1:2a0:a502:0:19da;
      }
    }
    routing-options {
      router-id 1.1.1.1;
      autonomous-system 22;
    }
  }
  B {
    interfaces {
      lt-0/1/0 {
        unit 6 {
          description to-E;
          encapsulation frame-relay;
```

```
            dlci 6;
            peer-unit 5;
            family inet6 {
                address 2001:db8:0:2::/64 {
                    eui-64;
                }
            }
        }
    }
    lo0 {
        unit 2 {
            family inet6 {
                address 2001:db8::2/128;
            }
        }
    }
}
protocols {
    bgp {
        group external-peers {
            type external;
            peer-as 17;
            neighbor 2001:db8:0:2:2a0:a502:0:5da;
        }
    }
    routing-options {
        router-id 2.2.2.2;
        autonomous-system 22;
    }
}
C {
    interfaces {
        lt-0/1/0 {
            unit 10 {
                description to-E;
                encapsulation frame-relay;
                dlci 10;
                peer-unit 9;
                family inet6 {
                    address 2001:db8:0:3::/64 {
                        eui-64;
                    }
                }
            }
        }
        lo0 {
            unit 3 {
                family inet6 {
                    address 2001:db8::3/128;
                }
            }
        }
    }
    protocols {
        bgp {
            group external-peers {
```



```
                type external;
                peer-as 17;
                neighbor 2001:db8:0:3:2a0:a502:0:9da;
            }
        }
    }
    routing-options {
        router-id 3.3.3.3;
        autonomous-system 22;
    }
}
D {
    interfaces {
        lt-0/1/0 {
            unit 7 {
                description to-E;
                encapsulation frame-relay;
                dlci 7;
                peer-unit 21;
                family inet6 {
                    address 2001:db8:0:4::/64 {
                        eui-64;
                    }
                }
            }
        }
        lo0 {
            unit 4 {
                family inet6 {
                    address 2001:db8::4/128;
                }
            }
        }
    }
    protocols {
        bgp {
            group external-peers {
                type external;
                peer-as 17;
                neighbor 2001:db8:0:4:2a0:a502:0:15da;
            }
        }
        routing-options {
            router-id 4.4.4.4;
            autonomous-system 79;
        }
    }
    E {
        interfaces {
            lt-0/1/0 {
                unit 5 {
                    description to-B;
                    encapsulation frame-relay;
                    dlci 6;
                    peer-unit 6;
                    family inet6 {
```

```
                address 2001:db8:0:2::/64 {
                    eui-64;
                }
            }
        }
        unit 9 {
            description to-C;
            encapsulation frame-relay;
            dlci 10;
            peer-unit 10;
            family inet6 {
                address 2001:db8:0:3::/64 {
                    eui-64;
                }
            }
        }
        unit 21 {
            description to-D;
            encapsulation frame-relay;
            dlci 7;
            peer-unit 7;
            family inet6 {
                address 2001:db8:0:4::/64 {
                    eui-64;
                }
            }
        }
        unit 25 {
            description to-A;
            encapsulation frame-relay;
            dlci 1;
            peer-unit 1;
            family inet6 {
                address 2001:db8:0:1::/64 {
                    eui-64;
                }
            }
        }
    }
    lo0 {
        unit 5 {
            family inet6 {
                address 2001:db8::5/128;
            }
        }
    }
}
protocols {
    bgp {
        group external-peers {
            type external;
            peer-as 22;
            neighbor 2001:db8:0:1:2a0:a502:0:1da;
            neighbor 2001:db8:0:2:2a0:a502:0:6da;
            neighbor 2001:db8:0:3:2a0:a502:0:ada;
            neighbor 2001:db8:0:4:2a0:a502:0:7da {
```



```
                peer-as 79;
              }
            }
          }
        }
        routing-options {
          router-id 5.5.5.5;
          autonomous-system 17;
        }
      }
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 2657
- Verifying BGP Groups on page 2660
- Verifying BGP Summary Information on page 2660
- Checking the Routing Table on page 2660

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is active for each neighbor address.

Action From operational mode, run the **show bgp neighbor** command.

```
user@R1:E> show bgp neighbor
Peer: 2001:db8:0:1:2a0:a502:0:1da+54987 AS 22 Local:
2001:db8:0:1:2a0:a502:0:19da+179 AS 17
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: Open Message Error
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Error: 'Open Message Error' Sent: 20 Recv: 0
  Peer ID: 1.1.1.1         Local ID: 5.5.5.5           Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  Local Interface: lt-0/1/0.25
  NLRI for restart configured on peer: inet6-unicast
  NLRI advertised by peer: inet6-unicast
  NLRI for this session: inet6-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet6-unicast
  NLRI of received end-of-rib markers: inet6-unicast
  NLRI of all end-of-rib markers sent: inet6-unicast
  Peer supports 4 byte AS extension (peer-as 22)
  Peer does not support Addpath
  Table inet6.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
```

```
      Active prefixes:              0
      Received prefixes:            0
      Accepted prefixes:            0
      Suppressed due to damping:    0
      Advertised prefixes:          0
    Last traffic (seconds): Received 7    Sent 18   Checked 81
    Input messages:  Total 1611   Updates 1      Refreshes 0     Octets 30660
    Output messages: Total 1594   Updates 0      Refreshes 0     Octets 30356
    Output Queue[0]: 0

  Peer: 2001:db8:0:2:2a0:a502:0:6da+179 AS 22 Local:
  2001:db8:0:2:2a0:a502:0:5da+55502 AS 17
    Type: External    State: Established    Flags: <Sync>
    Last State: OpenConfirm   Last Event: RecvKeepAlive
    Last Error: Open Message Error
    Options: <Preference PeerAS Refresh>
    Holdtime: 90 Preference: 170
    Number of flaps: 0
    Error: 'Open Message Error' Sent: 26 Recv: 0
    Peer ID: 2.2.2.2         Local ID: 5.5.5.5           Active Holdtime: 90
    Keepalive Interval: 30         Peer index: 2
    BFD: disabled, down
    Local Interface: lt-0/1/0.5
    NLRI for restart configured on peer: inet6-unicast
    NLRI advertised by peer: inet6-unicast
    NLRI for this session: inet6-unicast
    Peer supports Refresh capability (2)
    Stale routes from peer are kept for: 300
    Peer does not support Restarter functionality
    NLRI that restart is negotiated for: inet6-unicast
    NLRI of received end-of-rib markers: inet6-unicast
    NLRI of all end-of-rib markers sent: inet6-unicast
    Peer supports 4 byte AS extension (peer-as 22)
    Peer does not support Addpath
    Table inet6.0 Bit: 10000
      RIB State: BGP restart is complete
      Send state: in sync
      Active prefixes:              0
      Received prefixes:            0
      Accepted prefixes:            0
      Suppressed due to damping:    0
      Advertised prefixes:          0
    Last traffic (seconds): Received 15   Sent 8    Checked 8
    Input messages:  Total 1610   Updates 1      Refreshes 0     Octets 30601
    Output messages: Total 1645   Updates 0      Refreshes 0     Octets 32417
    Output Queue[0]: 0

  Peer: 2001:db8:0:3:2a0:a502:0:ada+55983 AS 22 Local:
  2001:db8:0:3:2a0:a502:0:9da+179 AS 17
    Type: External    State: Established    Flags: <Sync>
    Last State: OpenConfirm   Last Event: RecvKeepAlive
    Last Error: None
    Options: <Preference PeerAS Refresh>
    Holdtime: 90 Preference: 170
    Number of flaps: 0
    Peer ID: 3.3.3.3         Local ID: 5.5.5.5           Active Holdtime: 90
    Keepalive Interval: 30         Peer index: 3
    BFD: disabled, down
    Local Interface: lt-0/1/0.9
    NLRI for restart configured on peer: inet6-unicast
    NLRI advertised by peer: inet6-unicast
```



```
  NLRI for this session: inet6-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet6-unicast
  NLRI of received end-of-rib markers: inet6-unicast
  NLRI of all end-of-rib markers sent: inet6-unicast
  Peer supports 4 byte AS extension (peer-as 22)
  Peer does not support Addpath
  Table inet6.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 21   Sent 21   Checked 67
  Input messages:  Total 1610   Updates 1       Refreshes 0     Octets 30641
  Output messages: Total 1587   Updates 0       Refreshes 0     Octets 30223
  Output Queue[0]: 0

Peer: 2001:db8:0:4:2a0:a502:0:7da+49255 AS 79 Local:
2001:db8:0:4:2a0:a502:0:15da+179 AS 17
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 4.4.4.4         Local ID: 5.5.5.5           Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
  Local Interface: lt-0/1/0.21
  NLRI for restart configured on peer: inet6-unicast
  NLRI advertised by peer: inet6-unicast
  NLRI for this session: inet6-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet6-unicast
  NLRI of received end-of-rib markers: inet6-unicast
  NLRI of all end-of-rib markers sent: inet6-unicast
  Peer supports 4 byte AS extension (peer-as 79)
  Peer does not support Addpath
  Table inet6.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 6    Sent 17   Checked 25
  Input messages:  Total 1615   Updates 1       Refreshes 0     Octets 30736
  Output messages: Total 1593   Updates 0       Refreshes 0     Octets 30337
  Output Queue[0]: 0
```

Meaning IPv6 unicast network layer reachability information (NLRI) is being exchanged between the neighbors.

Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From operational mode, run the **show bgp group** command.

```
user@R1:E> show bgp group
Group Type: External                               Local AS: 17
  Name: external-peers  Index: 0                   Flags: <>
  Holdtime: 0
  Total peers: 4       Established: 4
  2001:db8:0:1:2a0:a502:0:1da+54987
  2001:db8:0:2:2a0:a502:0:6da+179
  2001:db8:0:3:2a0:a502:0:ada+55983
  2001:db8:0:4:2a0:a502:0:7da+49255
  inet6.0: 0/0/0/0

Groups: 1  Peers: 4    External: 4    Internal: 0    Down peers: 0   Flags: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet6.0                0          0          0          0          0          0
inet6.2                0          0          0          0          0          0
```

Meaning The group type is external, and the group has four peers.

Verifying BGP Summary Information

Purpose Verify that the BGP that the peer relationships are established.

Action From operational mode, run the **show bgp summary** command.

```
user@R1:E> show bgp summary
Groups: 1 Peers: 4 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet6.0                0          0          0          0          0          0
inet6.2                0          0          0          0          0          0
Peer                         AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
2001:db8:0:1:2a0:a502:0:1da          22       1617       1600       0       0
 12:07:00 Establ
  inet6.0: 0/0/0/0
2001:db8:0:2:2a0:a502:0:6da          22       1616       1651       0       0
 12:06:56 Establ
  inet6.0: 0/0/0/0
2001:db8:0:3:2a0:a502:0:ada          22       1617       1594       0       0
 12:04:32 Establ
  inet6.0: 0/0/0/0
2001:db8:0:4:2a0:a502:0:7da          79       1621       1599       0       0
 12:07:00 Establ
  inet6.0: 0/0/0/0
```

Meaning The Down peers: 0 output shows that the BGP peers are in the established state.

Checking the Routing Table

Purpose Verify that the inet6.0 routing table is populated with local and direct routes.

Action From operational mode, run the **show route** command.

```
user@R1:E> show route
inet6.0: 15 destinations, 18 routes (15 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2001:db8::5/128    *[Direct/0] 12:41:18
                    > via lo0.5
2001:db8:0:1::/64  *[Direct/0] 14:40:01
                    > via lt-0/1/0.25
2001:db8:0:1:2a0:a502:0:19da/128
                   *[Local/0] 14:40:01
                      Local via lt-0/1/0.25
2001:db8:0:2::/64  *[Direct/0] 14:40:02
                    > via lt-0/1/0.5
2001:db8:0:2:2a0:a502:0:5da/128
                   *[Local/0] 14:40:02
                      Local via lt-0/1/0.5
2001:db8:0:3::/64  *[Direct/0] 14:40:02
                    > via lt-0/1/0.9
2001:db8:0:3:2a0:a502:0:9da/128
                   *[Local/0] 14:40:02
                      Local via lt-0/1/0.9
2001:db8:0:4::/64  *[Direct/0] 14:40:01
                    > via lt-0/1/0.21
2001:db8:0:4:2a0:a502:0:15da/128
                   *[Local/0] 14:40:01
                      Local via lt-0/1/0.21
fe80::/64          *[Direct/0] 14:40:02
                    > via lt-0/1/0.5
                    [Direct/0] 14:40:02
                    > via lt-0/1/0.9
                    [Direct/0] 14:40:01
                    > via lt-0/1/0.21
                    [Direct/0] 14:40:01
                    > via lt-0/1/0.25
fe80::2a0:a502:0:5da/128
                   *[Local/0] 14:40:02
                      Local via lt-0/1/0.5
fe80::2a0:a502:0:9da/128
                   *[Local/0] 14:40:02
                      Local via lt-0/1/0.9
fe80::2a0:a502:0:15da/128
                   *[Local/0] 14:40:01
                      Local via lt-0/1/0.21
fe80::2a0:a502:0:19da/128
                   *[Local/0] 14:40:01
                      Local via lt-0/1/0.25
fe80::2a0:a50f:fc56:1da/128
                   *[Direct/0] 12:41:18
                    > via lo0.5
```

Meaning The inet6.0 routing table contains local and direct routes. To populate the routing table with other types of routes, you must configure routing policies.

Related Documentation

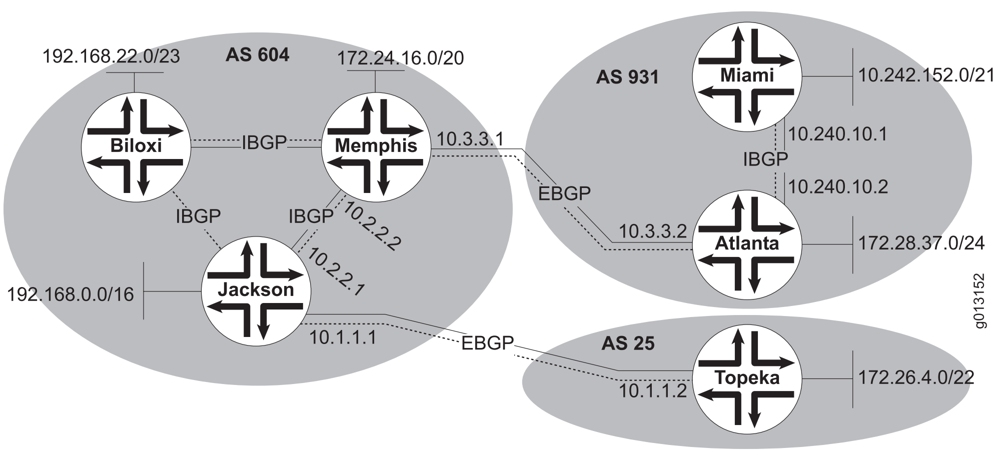
- Examples: Configuring Internal BGP Peering on page 2662
- *BGP Configuration Overview*

Examples: Configuring Internal BGP Peering

Understanding Internal BGP Peering Sessions

When two BGP-enabled devices are in the same autonomous system (AS), the BGP session is called an *internal* BGP session, or IBGP session. BGP uses the same message types on IBGP and external BGP (EBGP) sessions, but the rules for when to send each message and how to interpret each message differ slightly. For this reason, some people refer to IBGP and EBGP as two separate protocols.

Figure 40: Internal and External BGP



In Figure 40 on page 2662, Device Jackson, Device Memphis, and Device Biloxi have IBGP peer sessions with each other. Likewise, Device Miami and Device Atlanta have IBGP peer sessions between each other.

The purpose of IBGP is to provide a means by which EBGP route advertisements can be forwarded throughout the network. In theory, to accomplish this task you could redistribute all of your EBGP routes into an interior gateway protocol (IGP), such as OSPF or IS-IS. This, however, is not recommended in a production environment because of the large number of EBGP routes in the Internet and because of the way that IGPs operate. In short, with that many routes the IGP churns or crashes.

Generally, the loopback interface (lo0) is used to establish connections between IBGP peers. The loopback interface is always up as long as the device is operating. If there is a route to the loopback address, the IBGP peering session stays up. If a physical interface address is used instead and that interface goes up and down, the IBGP peering session also goes up and down. Thus the loopback interface provides fault tolerance in case the physical interface or the link goes down, if the device has link redundancy.

While IBGP neighbors do not need to be directly connected, they do need to be fully meshed. In this case, fully meshed means that each device is logically connected to every other device through neighbor peer relationships. The **neighbor** statement creates the mesh. Because of the full mesh requirement of IBGP, you must configure individual peering sessions between all IBGP devices in the AS. The full mesh need not be physical links. Rather, the configuration on each routing device must create a full mesh of peer sessions (using multiple **neighbor** statements).

NOTE: The requirement for a full mesh is waived if you configure a confederation or route reflection.

To understand the full-mesh requirement, consider that an IBGP-learned route cannot be readvertised to another IBGP peer. The reason for preventing the readvertisement of IBGP routes and requiring the full mesh is to avoid routing loops within an AS. The AS path attribute is the means by which BGP routing devices avoid loops. The path information is examined for the local AS number only when the route is received from an EBGP peer. Because the attribute is only modified across AS boundaries, this system works well. However, the fact that the attribute is only modified across AS boundaries presents an issue inside the AS. For example, suppose that routing devices A, B, and C are all in the same AS. Device A receives a route from an EBGP peer and sends the route to Device B, which installs it as the active route. The route is then sent to Device C, which installs it locally and sends it back to Device A. If Device A installs the route, a loop is formed within the AS. The routing devices are not able to detect the loop because the AS path attribute is not modified during these advertisements. Therefore, the BGP protocol designers decided that the only assurance of never forming a routing loop was to prevent an IBGP peer from advertising an IBGP-learned route within the AS. For route reachability, the IBGP peers are fully meshed.

IBGP supports multihop connections, so IBGP neighbors can be located anywhere within the AS and often do not share a link. A recursive route lookup resolves the loopback peering address to an IP forwarding next hop. The lookup service is provided by static routes or an IGP, such as OSPF.

Example: Configuring Internal BGP Peer Sessions

This example shows how to configure internal BGP peer sessions.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

In this example, you configure internal BGP (IBGP) peer sessions. The loopback interface (lo0) is used to establish connections between IBGP peers. The loopback interface is always up as long as the device is operating. If there is a route to the loopback address, the IBGP peer session stays up. If a physical interface address is used instead and that interface goes up and down, the IBGP peer session also goes up and down. Thus, if the device has link redundancy, the loopback interface provides fault tolerance in case the physical interface or one of the links goes down.

When a device peers with a remote device's loopback interface address, the local device expects BGP update messages to come from (be sourced by) the remote device's loopback interface address. The **local-address** statement enables you to specify the source information in BGP update messages. If you omit the **local-address** statement, the expected source of BGP update messages is based on the device's source address selection rules, which normally results in the egress interface address being the expected source of update messages. When this happens, the peer session is not established because a mismatch exists between the expected source address (the egress interface of the peer) and the actual source (the loopback interface of the peer). To make sure that the expected source address matches the actual source address, specify the loopback interface address in the **local-address** statement.

Because IBGP supports multihop connections, IBGP neighbors can be located anywhere within the autonomous system (AS) and often do not share a link. A recursive route lookup resolves the loopback peer address to an IP forwarding next hop. In this example, this service is provided by OSPF. Although interior gateway protocol (IGP) neighbors do not need to be directly connected, they do need to be fully meshed. In this case, fully meshed means that each device is logically connected to every other device through neighbor peer relationships. The **neighbor** statement creates the mesh.

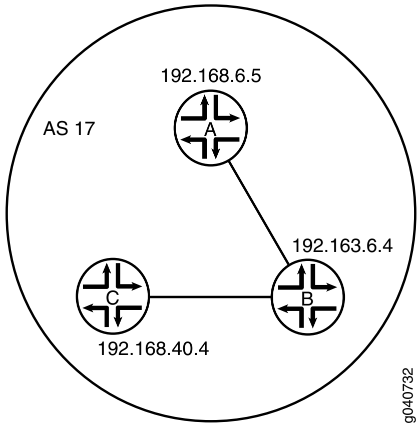
NOTE: The requirement for a full mesh is waived if you configure a confederation or route reflection.

After the BGP peers are established, BGP routes are not automatically advertised by the BGP peers. At each BGP-enabled device, policy configuration is required to export the local, static, or IGP-learned routes into the BGP routing information base (RIB) and then advertise them as BGP routes to the other peers. BGP's advertisement policy, by default, does not advertise any non-BGP routes (such as local routes) to peers.

In the sample network, the devices in AS 17 are fully meshed in the group **internal-peers**. The devices have loopback addresses 192.168.6.5, 192.163.6.4, and 192.168.40.4.

Figure 41 on page 2665 shows a typical network with internal peer sessions.

Figure 41: Typical Network with IBGP Sessions



Configuration

- Configuring Device A on page 2666
- Configuring Device B on page 2668
- Configuring Device C on page 2670

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device A

```
set interfaces ge-0/1/0 unit 1 description to-B
set interfaces ge-0/1/0 unit 1 family inet address 10.10.10.1/30
set interfaces lo0 unit 1 family inet address 192.168.6.5/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers description “connections to B and C”
set protocols bgp group internal-peers local-address 192.168.6.5
set protocols bgp group internal-peers export send-direct
set protocols bgp group internal-peers neighbor 192.163.6.4
set protocols bgp group internal-peers neighbor 192.168.40.4
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface ge-0/1/0.1
set policy-options policy-statement send-direct term 2 from protocol direct
set policy-options policy-statement send-direct term 2 then accept
set routing-options router-id 192.168.6.5
set routing-options autonomous-system 17
```

Device B

```
set interfaces ge-0/1/0 unit 2 description to-A
set interfaces ge-0/1/0 unit 2 family inet address 10.10.10.2/30
set interfaces ge-0/1/1 unit 5 description to-C
set interfaces ge-0/1/1 unit 5 family inet address 10.10.10.5/30
set interfaces lo0 unit 2 family inet address 192.163.6.4/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers description “connections to A and C”
set protocols bgp group internal-peers local-address 192.163.6.4
set protocols bgp group internal-peers export send-direct
set protocols bgp group internal-peers neighbor 192.168.40.4
set protocols bgp group internal-peers neighbor 192.168.6.5
```

```
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface ge-0/1/0.2
set protocols ospf area 0.0.0.0 interface ge-0/1/1.5
set policy-options policy-statement send-direct term 2 from protocol direct
set policy-options policy-statement send-direct term 2 then accept
set routing-options router-id 192.163.6.4
set routing-options autonomous-system 17
```

Device C

```
set interfaces ge-0/1/0 unit 6 description to-B
set interfaces ge-0/1/0 unit 6 family inet address 10.10.10.6/30
set interfaces lo0 unit 3 family inet address 192.168.40.4/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers description "connections to A and B"
set protocols bgp group internal-peers local-address 192.168.40.4
set protocols bgp group internal-peers export send-direct
set protocols bgp group internal-peers neighbor 192.163.6.4
set protocols bgp group internal-peers neighbor 192.168.6.5
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface ge-0/1/0.6
set policy-options policy-statement send-direct term 2 from protocol direct
set policy-options policy-statement send-direct term 2 then accept
set routing-options router-id 192.168.40.4
set routing-options autonomous-system 17
```

Configuring Device A

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure internal BGP peer sessions on Device A:

1. Configure the interfaces.

```
[edit interfaces ge-0/1/0 unit 1]
user@A# set description to-B
user@A# set family inet address 10.10.10.1/30

[edit interfaces]
user@A# set lo0 unit 1 family inet address 192.168.6.5/32
```

2. Configure BGP.

   The **neighbor** statements are included for both Device B and Device C, even though Device A is not directly connected to Device C.

```
[edit protocols bgp group internal-peers]
user@A# set type internal
user@A# set description "connections to B and C"
user@A# set local-address 192.168.6.5
user@A# set export send-direct
user@A# set neighbor 192.163.6.4
user@A# set neighbor 192.168.40.4
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
```



```
user@A# set interface lo0.1 passive
user@A# set interface ge-0/1/0.1
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

   ```
   [edit policy-options policy-statement send-direct term 2]
   user@A# set from protocol direct
   user@A# set then accept
   ```

5. Configure the router ID and the AS number.

   ```
   [edit routing-options]
   user@A# set router-id 192.168.6.5
   user@A# set autonomous-system 17
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@A# show interfaces
ge-0/1/0 {
  unit 1 {
    description to-B;
    family inet {
      address 10.10.10.1/30;
    }
  }
}
lo0 {
  unit 1 {
    family inet {
      address 192.168.6.5/32;
    }
  }
}
```

```
user@A# show policy-options
policy-statement send-direct {
  term 2 {
    from protocol direct;
    then accept;
  }
}
```

```
user@A# show protocols
bgp {
  group internal-peers {
    type internal;
    description "connections to B and C";
    local-address 192.168.6.5;
    export send-direct;
    neighbor 192.163.6.4;
    neighbor 192.168.40.4;
```

```
    }
  }
  ospf {
    area 0.0.0.0 {
      interface lo0.1 {
        passive;
      }
      interface ge-0/1/0.1;
    }
  }
```

```
user@A# show routing-options
router-id 192.168.6.5;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device B

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode*.

To configure internal BGP peer sessions on Device B:

1. Configure the interfaces.

   ```
   [edit interfaces ge-0/1/0 unit 2]
   user@B# set description to-A
   user@B# set family inet address 10.10.10.2/30

   [edit interfaces ge-0/1/1]
   user@B# set unit 5 description to-C
   user@B# set unit 5 family inet address 10.10.10.5/30

   [edit interfaces]
   user@B# set lo0 unit 2 family inet address 192.163.6.4/32
   ```

2. Configure BGP.

   The **neighbor** statements are included for both Device B and Device C, even though Device A is not directly connected to Device C.

   ```
   [edit protocols bgp group internal-peers]
   user@B# set type internal
   user@B# set description “connections to A and C”
   user@B# set local-address 192.163.6.4
   user@B# set export send-direct
   user@B# set neighbor 192.168.40.4
   user@B# set neighbor 192.168.6.5
   ```

3. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@B# set interface lo0.2 passive
   user@B# set interface ge-0/1/0.2
   user@B# set interface ge-0/1/1.5
   ```


4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

   ```
   [edit policy-options policy-statement send-direct term 2]
   user@B# set from protocol direct
   user@B# set then accept
   ```

5. Configure the router ID and the AS number.

   ```
   [edit routing-options]
   user@B# set router-id 192.163.6.4
   user@B# set autonomous-system 17
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@B# show interfaces
ge-0/1/0 {
  unit 2 {
    description to-A;
    family inet {
      address 10.10.10.2/30;
    }
  }
}
ge-0/1/1 {
  unit 5 {
    description to-C;
    family inet {
      address 10.10.10.5/30;
    }
  }
}
lo0 {
  unit 2 {
    family inet {
      address 192.163.6.4/32;
    }
  }
}
```

```
user@B# show policy-options
policy-statement send-direct {
  term 2 {
    from protocol direct;
    then accept;
  }
}
```

```
user@B# show protocols
bgp {
  group internal-peers {
    type internal;
```

```
        description "connections to A and C";
        local-address 192.163.6.4;
        export send-direct;
        neighbor 192.168.40.4;
        neighbor 192.168.6.5;
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.2 {
            passive;
        }
        interface ge-0/1/0.2;
        interface ge-0/1/1.5;
    }
}
```

```
user@B# show routing-options
router-id 192.163.6.4;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device C

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure internal BGP peer sessions on Device C:

1. Configure the interfaces.

   ```
   [edit interfaces ge-0/1/0 unit 6]
   user@C# set description to-B
   user@C# set family inet address 10.10.10.6/30

   [edit interfaces]
   user@C# set lo0 unit 3 family inet address 192.168.40.4/32
   ```

2. Configure BGP.

   The **neighbor** statements are included for both Device B and Device C, even though Device A is not directly connected to Device C.

   ```
   [edit protocols bgp group internal-peers]
   user@C# set type internal
   user@C# set description "connections to A and B"
   user@C# set local-address 192.168.40.4
   user@C# set export send-direct
   user@C# set neighbor 192.163.6.4
   user@C# set neighbor 192.168.6.5
   ```

3. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@C# set interface lo0.3 passive
   user@C# set interface ge-0/1/0.6
   ```


4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

   ```
   [edit policy-options policy-statement send-direct term 2]
   user@C# set from protocol direct
   user@C# set then accept
   ```

5. Configure the router ID and the AS number.

   ```
   [edit routing-options]
   user@C# set router-id 192.168.40.4
   user@C# set autonomous-system 17
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@C# show interfaces
ge-0/1/0 {
   unit 6 {
      description to-B;
      family inet {
         address 10.10.10.6/30;
      }
   }
}
lo0 {
   unit 3 {
      family inet {
         address 192.168.40.4/32;
      }
   }
}
```

```
user@C# show policy-options
policy-statement send-direct {
   term 2 {
      from protocol direct;
      then accept;
   }
}
```

```
user@C# show protocols
bgp {
   group internal-peers {
      type internal;
      description “connections to A and B”;
      local-address 192.168.40.4;
      export send-direct;
      neighbor 192.163.6.4;
      neighbor 192.168.6.5;
   }
}
ospf {
```

```
    area 0.0.0.0 {
      interface lo0.3 {
        passive;
      }
      interface ge-0/1/0.6;
    }
  }
```

```
user@C# show routing-options
router-id 192.168.40.4;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 2672
- Verifying BGP Groups on page 2673
- Verifying BGP Summary Information on page 2674
- Verifying That BGP Routes Are Installed in the Routing Table on page 2674

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is active for each neighbor address.

Action From operational mode, enter the **show bgp neighbor** command.

```
user@A> show bgp neighbor
Peer: 192.163.6.4+179 AS 17    Local: 192.168.6.5+58852 AS 17
  Type: Internal    State: Established    Flags: Sync
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-direct ]
  Options: Preference LocalAddress Refresh
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.163.6.4     Local ID: 192.168.6.5      Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
```



```
    Active prefixes:              0
    Received prefixes:            3
    Accepted prefixes:            3
    Suppressed due to damping:    0
    Advertised prefixes:          2
  Last traffic (seconds): Received 25   Sent 19   Checked 67
  Input messages:  Total 2420   Updates 4       Refreshes 0     Octets 46055
  Output messages: Total 2411   Updates 2       Refreshes 0     Octets 45921
  Output Queue[0]: 0

Peer: 192.168.40.4+179 AS 17   Local: 192.168.6.5+56466 AS 17
  Type: Internal    State: Established    Flags: Sync
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-direct ]
  Options: Preference LocalAddress Refresh
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.168.40.4    Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            2
    Accepted prefixes:            2
    Suppressed due to damping:    0
    Advertised prefixes:          2
  Last traffic (seconds): Received 7    Sent 21   Checked 24
  Input messages:  Total 2412   Updates 2       Refreshes 0     Octets 45867
  Output messages: Total 2409   Updates 2       Refreshes 0     Octets 45883
  Output Queue[0]: 0
```

Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From operational mode, enter the **show bgp group** command.

```
user@A> show bgp group
Group Type: Internal    AS: 17                        Local AS: 17
  Name: internal-peers  Index: 0                      Flags: <Export Eval>
  Export: [ send-direct ]
  Holdtime: 0
  Total peers: 2        Established: 2
  192.163.6.4+179
  192.168.40.4+179
```

```
  inet.0: 0/5/5/0

Groups: 1  Peers: 2    External: 0    Internal: 2    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 5          0          0          0          0          0
```

Verifying BGP Summary Information

Purpose Verify that the BGP configuration is correct.

Action From operational mode, enter the **show bgp summary** command.

```
user@A> show bgp summary
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 5          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.163.6.4              17       2441       2432       0       0    18:18:52
0/3/3/0              0/0/0/0
192.168.40.4             17       2432       2430       0       0    18:18:48
0/2/2/0              0/0/0/0
```

Verifying That BGP Routes Are Installed in the Routing Table

Purpose Verify that the export policy configuration is causing the BGP routes to be installed in the routing tables of the peers.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@A> show route protocol bgp
inet.0: 7 destinations, 12 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.0/30       [BGP/170] 07:09:57, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via ge-0/1/0.1
10.10.10.4/30       [BGP/170] 07:09:57, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via ge-0/1/0.1
                    [BGP/170] 07:07:12, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via ge-0/1/0.1
192.163.6.4/32      [BGP/170] 07:09:57, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via ge-0/1/0.1
192.168.40.4/32     [BGP/170] 07:07:12, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via ge-0/1/0.1
```

Example: Configuring Internal BGP Peering Sessions on Logical Systems

This example shows how to configure internal BGP peer sessions on logical systems.

- Requirements on page 2675
- Overview on page 2675

- Configuration on page 2675
- Verification on page 2682

Requirements

In this example, no special configuration beyond device initialization is required.

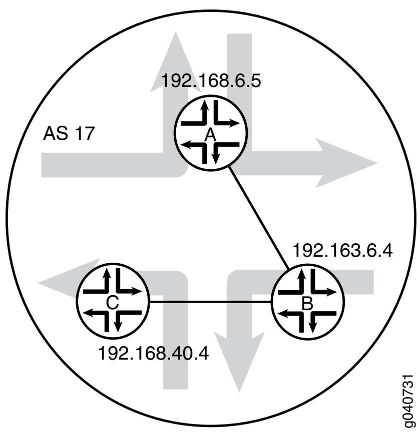
Overview

In this example, you configure internal BGP (IBGP) peering sessions.

In the sample network, the devices in AS 17 are fully meshed in the group **internal-peers**. The devices have loopback addresses 192.168.6.5, 192.163.6.4, and 192.168.40.4.

Figure 42 on page 2675 shows a typical network with internal peer sessions.

Figure 42: Typical Network with IBGP Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set logical-systems A interfaces lt-0/1/0 unit 1 description to-B
set logical-systems A interfaces lt-0/1/0 unit 1 encapsulation ethernet
set logical-systems A interfaces lt-0/1/0 unit 1 peer-unit 2
set logical-systems A interfaces lt-0/1/0 unit 1 family inet address 10.10.10.1/30
set logical-systems A interfaces lo0 unit 1 family inet address 192.168.6.5/32
set logical-systems A protocols bgp group internal-peers type internal
set logical-systems A protocols bgp group internal-peers local-address 192.168.6.5
set logical-systems A protocols bgp group internal-peers export send-direct
set logical-systems A protocols bgp group internal-peers neighbor 192.163.6.4
set logical-systems A protocols bgp group internal-peers neighbor 192.168.40.4
set logical-systems A protocols ospf area 0.0.0.0 interface lo0.1 passive
set logical-systems A protocols ospf area 0.0.0.0 interface lt-0/1/0.1
set logical-systems A policy-options policy-statement send-direct term 2 from protocol
  direct
set logical-systems A policy-options policy-statement send-direct term 2 then accept
set logical-systems A routing-options router-id 192.168.6.5
```

```
set logical-systems A routing-options autonomous-system 17
set logical-systems B interfaces lt-0/1/0 unit 2 description to-A
set logical-systems B interfaces lt-0/1/0 unit 2 encapsulation ethernet
set logical-systems B interfaces lt-0/1/0 unit 2 peer-unit 1
set logical-systems B interfaces lt-0/1/0 unit 2 family inet address 10.10.10.2/30
set logical-systems B interfaces lt-0/1/0 unit 5 description to-C
set logical-systems B interfaces lt-0/1/0 unit 5 encapsulation ethernet
set logical-systems B interfaces lt-0/1/0 unit 5 peer-unit 6
set logical-systems B interfaces lt-0/1/0 unit 5 family inet address 10.10.10.5/30
set logical-systems B interfaces lo0 unit 2 family inet address 192.163.6.4/32
set logical-systems B protocols bgp group internal-peers type internal
set logical-systems B protocols bgp group internal-peers local-address 192.163.6.4
set logical-systems B protocols bgp group internal-peers export send-direct
set logical-systems B protocols bgp group internal-peers neighbor 192.168.40.4
set logical-systems B protocols bgp group internal-peers neighbor 192.168.6.5
set logical-systems B protocols ospf area 0.0.0.0 interface lo0.2 passive
set logical-systems B protocols ospf area 0.0.0.0 interface lt-0/1/0.2
set logical-systems B protocols ospf area 0.0.0.0 interface lt-0/1/0.5
set logical-systems B policy-options policy-statement send-direct term 2 from protocol
   direct
set logical-systems B policy-options policy-statement send-direct term 2 then accept
set logical-systems B routing-options router-id 192.163.6.4
set logical-systems B routing-options autonomous-system 17
set logical-systems C interfaces lt-0/1/0 unit 6 description to-B
set logical-systems C interfaces lt-0/1/0 unit 6 encapsulation ethernet
set logical-systems C interfaces lt-0/1/0 unit 6 peer-unit 5
set logical-systems C interfaces lt-0/1/0 unit 6 family inet address 10.10.10.6/30
set logical-systems C interfaces lo0 unit 3 family inet address 192.168.40.4/32
set logical-systems C protocols bgp group internal-peers type internal
set logical-systems C protocols bgp group internal-peers local-address 192.168.40.4
set logical-systems C protocols bgp group internal-peers export send-direct
set logical-systems C protocols bgp group internal-peers neighbor 192.163.6.4
set logical-systems C protocols bgp group internal-peers neighbor 192.168.6.5
set logical-systems C protocols ospf area 0.0.0.0 interface lo0.3 passive
set logical-systems C protocols ospf area 0.0.0.0 interface lt-0/1/0.6
set logical-systems C policy-options policy-statement send-direct term 2 from protocol
   direct
set logical-systems C policy-options policy-statement send-direct term 2 then accept
set logical-systems C routing-options router-id 192.168.40.4
set logical-systems C routing-options autonomous-system 17
```

Device A

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure internal BGP peer sessions on Device A:

1. Configure the interfaces.

```
[edit logical-systems A interfaces lt-0/1/0 unit 1]
user@R1# set description to-B
user@R1# set encapsulation ethernet
user@R1# set peer-unit 2
user@R1# set family inet address 10.10.10.1/30
```

```
user@R1# set family inet address 192.168.6.5/32
user@R1# up
user@R1# up
[edit logical-systems A interfaces]
user@R1# set lo0 unit 1 family inet address 192.168.6.5/32
user@R1# exit
[edit]
user@R1# edit logical-systems B interfaces lt-0/1/0
[edit logical-systems B interfaces lt-0/1/0]
user@R1# set unit 2 description to-A
user@R1# set unit 2 encapsulation ethernet
user@R1# set unit 2 peer-unit 1
user@R1# set unit 2 family inet address 10.10.10.2/30
user@R1# set unit 5 description to-C
user@R1# set unit 5 encapsulation ethernet
user@R1# set unit 5 peer-unit 6
user@R1# set family inet address 10.10.10.5/30
user@R1# up
[edit logical-systems B interfaces]
user@R1# set lo0 unit 2 family inet address 192.163.6.4/32
user@R1# exit
[edit]
user@R1# edit logical-systems C interfaces lt-0/1/0 unit 6
[edit logical-systems C interfaces lt-0/1/0 unit 6]
set description to-B
set encapsulation ethernet
set peer-unit 5
set family inet address 10.10.10.6/30
user@R1# up
user@R1# up
[edit logical-systems C interfaces]
set lo0 unit 3 family inet address 192.168.40.4/32
```

2. Configure BGP.

   On Logical System A, the **neighbor** statements are included for both Device B and Device C, even though Logical System A is not directly connected to Device C.

```
[edit logical-systems A protocols bgp group internal-peers]
user@R1# set type internal
user@R1# set local-address 192.168.6.5
user@R1# set export send-direct
user@R1# set neighbor 192.163.6.4
user@R1# set neighbor 192.168.40.4

[edit logical-systems B protocols bgp group internal-peers]
user@R1# set type internal
user@R1# set local-address 192.163.6.4
user@R1# set export send-direct
user@R1# set neighbor 192.168.40.4
user@R1# set neighbor 192.168.6.5

[edit logical-systems C protocols bgp group internal-peers]
user@R1# set type internal
user@R1# set local-address 192.168.40.4
user@R1# set export send-direct
```



```
user@R1# set neighbor 192.163.6.4
user@R1# set neighbor 192.168.6.5
```

3. Configure OSPF.

```
[edit logical-systems A protocols ospf area 0.0.0.0]
user@R1# set interface lo0.1 passive
user@R1# set interface lt-0/1/0.1

[edit logical-systems A protocols ospf area 0.0.0.0]
user@R1# set interface lo0.2 passive
user@R1# set interface lt-0/1/0.2
user@R1# set interface lt-0/1/0.5

[edit logical-systems A protocols ospf area 0.0.0.0]
user@R1# set interface lo0.3 passive
user@R1# set interface lt-0/1/0.6
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit logical-systems A policy-options policy-statement send-direct term 2]
user@R1# set from protocol direct
user@R1# set then accept

[edit logical-systems B policy-options policy-statement send-direct term 2]
user@R1# set from protocol direct
user@R1# set then accept

[edit logical-systems C policy-options policy-statement send-direct term 2]
user@R1# set from protocol direct
user@R1# set then accept
```

5. Configure the router ID and the autonomous system (AS) number.

```
[edit logical-systems A routing-options]
user@R1# set router-id 192.168.6.5
user@R1# set autonomous-system 17

[edit logical-systems B routing-options]
user@R1# set router-id 192.163.6.4
user@R1# set autonomous-system 17

[edit logical-systems C routing-options]
user@R1# set router-id 192.168.40.4
user@R1# set autonomous-system 17
```

Results From configuration mode, confirm your configuration by entering the **show logical-systems** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R1# show logical-systems
A {
```



```
  interfaces {
    lt-0/1/0 {
      unit 1 {
        description to-B;
        encapsulation ethernet;
        peer-unit 2;
        family inet {
          address 10.10.10.1/30;
        }
      }
    }
    lo0 {
      unit 1 {
        family inet {
          address 192.168.6.5/32;
        }
      }
    }
  }
  protocols {
    bgp {
      group internal-peers {
        type internal;
        local-address 192.168.6.5;
        export send-direct;
        neighbor 192.163.6.4;
        neighbor 192.168.40.4;
      }
    }
    ospf {
      area 0.0.0.0 {
        interface lo0.1 {
          passive;
        }
        interface lt-0/1/0.1;
      }
    }
  }
  policy-options {
    policy-statement send-direct {
      term 2 {
        from protocol direct;
        then accept;
      }
    }
  }
  routing-options {
    router-id 192.168.6.5;
    autonomous-system 17;
  }
}
B {
  interfaces {
    lt-0/1/0 {
      unit 2 {
        description to-A;
```

```
                encapsulation ethernet;
                peer-unit 1;
                family inet {
                    address 10.10.10.2/30;
                }
            }
            unit 5 {
                description to-C;
                encapsulation ethernet;
                peer-unit 6;
                family inet {
                    address 10.10.10.5/30;
                }
            }
        }
        lo0 {
            unit 2 {
                family inet {
                    address 192.163.6.4/32;
                }
            }
        }
    }
    protocols {
        bgp {
            group internal-peers {
                type internal;
                local-address 192.163.6.4;
                export send-direct;
                neighbor 192.168.40.4;
                neighbor 192.168.6.5;
            }
        }
        ospf {
            area 0.0.0.0 {
                interface lo0.2 {
                    passive;
                }
                interface lt-0/1/0.2;
                interface lt-0/1/0.5;
            }
        }
    }
    policy-options {
        policy-statement send-direct {
            term 2 {
                from protocol direct;
                then accept;
            }
        }
    }
    routing-options {
        router-id 192.163.6.4;
        autonomous-system 17;
    }
}
```



```
C {
  interfaces {
    lt-0/1/0 {
      unit 6 {
        description to-B;
        encapsulation ethernet;
        peer-unit 5;
        family inet {
          address 10.10.10.6/30;
        }
      }
    }
    lo0 {
      unit 3 {
        family inet {
          address 192.168.40.4/32;
        }
      }
    }
  }
  protocols {
    bgp {
      group internal-peers {
        type internal;
        local-address 192.168.40.4;
        export send-direct;
        neighbor 192.163.6.4;
        neighbor 192.168.6.5;
      }
    }
    ospf {
      area 0.0.0.0 {
        interface lo0.3 {
          passive;
        }
        interface lt-0/1/0.6;
      }
    }
  }
  policy-options {
    policy-statement send-direct {
      term 2 {
        from protocol direct;
        then accept;
      }
    }
  }
  routing-options {
    router-id 192.168.40.4;
    autonomous-system 17;
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 2682
- Verifying BGP Groups on page 2683
- Verifying BGP Summary Information on page 2683
- Verifying That BGP Routes Are Installed in the Routing Table on page 2684

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is active for each neighbor address.

Action From the operational mode, enter the **show bgp neighbor** command.

```
user@R1> show bgp neighbor logical-system A
Peer: 192.163.6.4+179 AS 17    Local: 192.168.6.5+58852 AS 17
  Type: Internal    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-direct ]
  Options: <Preference LocalAddress Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.163.6.4     Local ID: 192.168.6.5      Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            3
    Accepted prefixes:            3
    Suppressed due to damping:    0
    Advertised prefixes:          2
  Last traffic (seconds): Received 16   Sent 1    Checked 63
  Input messages:  Total 15713  Updates 4       Refreshes 0     Octets 298622
  Output messages: Total 15690  Updates 2       Refreshes 0     Octets 298222
  Output Queue[0]: 0

Peer: 192.168.40.4+179 AS 17   Local: 192.168.6.5+56466 AS 17
  Type: Internal    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
```



```
  Export: [ send-direct ]
  Options: <Preference LocalAddress Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.168.40.4    Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            2
    Accepted prefixes:            2
    Suppressed due to damping:    0
    Advertised prefixes:          2
  Last traffic (seconds): Received 15   Sent 22   Checked 68
  Input messages:  Total 15688  Updates 2       Refreshes 0     Octets 298111
  Output messages: Total 15688  Updates 2       Refreshes 0     Octets 298184
  Output Queue[0]: 0
```

Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From the operational mode, enter the **show bgp group** command.

```
user@A> show bgp group logical-system A
Group Type: Internal    AS: 17                     Local AS: 17
  Name: internal-peers  Index: 0                   Flags: <Export Eval>
  Export: [ send-direct ]
  Holdtime: 0
  Total peers: 2       Established: 2
  192.163.6.4+179
  192.168.40.4+179
  inet.0: 0/5/5/0

Groups: 1  Peers: 2    External: 0    Internal: 2    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 5          0          0          0          0          0
```

Verifying BGP Summary Information

Purpose Verify that the BGP configuration is correct.

Action From the operational mode, enter the **show bgp summary** command.

```
user@A> show bgp summary logical-system A
```

```
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 5          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.163.6.4              17      15723      15700       0       0 4d 22:13:15
0/3/3/0              0/0/0/0
192.168.40.4             17      15698      15699       0       0 4d 22:13:11
0/2/2/0              0/0/0/0
```

Verifying That BGP Routes Are Installed in the Routing Table

Purpose Verify that the export policy configuration is working.

Action From the operational mode, enter the **show route protocol bgp** command.

```
user@A> show route protocol bgp logical-system A
inet.0: 7 destinations, 12 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.0/30       [BGP/170] 4d 11:05:55, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via lt-0/1/0.1
10.10.10.4/30       [BGP/170] 4d 11:05:55, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via lt-0/1/0.1
                    [BGP/170] 4d 11:03:10, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via lt-0/1/0.1
192.163.6.4/32      [BGP/170] 4d 11:05:55, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via lt-0/1/0.1
192.168.40.4/32     [BGP/170] 4d 11:03:10, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via lt-0/1/0.1
```

Related Documentation

- Examples: Configuring External BGP Peering on page 2639

Configuring BGP Monitoring Protocol Version 3

BGP Monitoring Protocol (BMP) allows the Junos OS to send the BGP route information from the router to a monitoring application on a separate device. The monitoring application is called the BMP monitoring station or BMP station. To deploy BMP in your network, you need to configure BMP on each router and you also need to configure at least one BMP station. This procedure describes how to configure BMP on a router.

You can specify these settings for all BMP stations by configuring the statements described here at the **[edit routing-options bmp]** hierarchy level. You can also configure settings for specific BMP stations by configuring these statements at the **[edit routing-options bmp station *station-name*]** hierarchy level.

The following procedure describes how to configure BMP version 3 on the router:

1. Specify the name or address for the BMP monitoring station by configuring the **station-address** statement. You can specify one or the other but not both. The address must be a valid IPv4 or IPv6 address.

   station-address (*station-address* | *station-name*);

2. Specify the authentication algorithm used to encrypt authentication between the BMP-enabled router and the BMP station using the **authentication-algorithm** statement.

   authentication-algorithm *algorithm*;

   You can specify one of the following types of authentication algorithms:

   - **aes-128-cmac-96**—Cipher-based message authentication code (AES128, 96 bits).
   - **hmac-sha-1-96**—Hash-based message authentication code (SHA1, 96 bits).
   - **md5**—Message digest 5.

3. Specify an MD5 authentication key (password) using the **authentication-key** statement.

   authentication-key *key*;

4. Specify the authentication key chain using the **authentication-key-chain** statement.

   authentication-key-chain *key-chain*;

   The authentication key chain itself needs to be configured at the **[edit security authentication-key-chains key-chain]** hierarchy level. For a detailed example, see "Example: Configuring Route Authentication for BGP" on page 2953.

5. Specify how to handle a BMP station flap by configuring the **hold-down** statement. A flap is when the TCP session unexpectedly switches from established to non-established. The BMP station can be prevented from attempting to reconnect to the device for a specified period of time.

```
hold-down {
  seconds;
  flaps number;
  period seconds;
}
```

You can specify the following options for the **hold-down** statement:

- ***seconds***—Specify the time in seconds to wait before allowing the BMP station to reconnect to the device.
- **flaps** ***number***—Specify the number of BMP station flaps allowed before terminating the connection to the BMP station and triggering the hold down timer.
- **period** ***seconds***—Specify the time in seconds between BMP station flaps before terminating the connection to the BMP station and triggering the hold down timer.

6. (Optional) Specify an initiation message to be sent to the BMP station using the **initiation-message** statement. This statement allows you to provide some information to the BMP station system administrator (for example, a contact phone number).

   initiation-message *text*;

7. Specify the connection mode for the connection between the BMP-enabled router and the BMP station using the **connection-mode** statement. The connection mode can be **active** or **passive**:

   - **active**—BMP initiates the connection to the BMP station. If you configure active mode, you must also configure a station port using the station-port statement. However, you must not configure a local port (active mode).
   - **passive**—BMP does not initiate a connection the BMP station. However, it does listen for a connection request from active BMP stations and will connect if a station is available. If you configure passive mode, you must not configure a station port. However, you must configure a local port using the local-port statement (passive mode).

   connection-mode (active | passive);

8. Specify the port number for the BMP monitoring station by configuring the **station-port** statement. See also connection-mode.

   station-port *port*;

9. Specify the listening port for the BMP station connection using the **local-port** statement. See also connection-mode.

   If you change the local port, the BMP station connection flaps when you commit the configuration.

   local-port

10. (Optional) Specify the IPv4 or IPv6 address for the BMP connection on the device using the **local-address** statement. For both active and passive connections, configure a loopback local address. This provides a consistent local endpoint, is useful for debugging, and assures greater reliability for the BMP connection since it is not tied to a single router interface.

    For passive mode, specifying a local address is required. It also provides some security against a malicious BMP connection. For active mode, we also recommend configuring a local address to help ensure reliability.

    If you change the local address, the BMP station connection flaps when you commit the configuration.

    local-address *address*;

11. BMP monitoring is enabled by default. You can explicitly enable BMP monitoring or disable it. You can also selectively enable or disable BMP monitoring at various hierarchy levels (for example, **[edit protocols bgp group *group-name*]** or **[edit protocols bgp group *group-name* neighbor *address*]**). If you disable BMP monitoring, withdrawal messages are sent for any previously advertised routes. These are followed by a down message. If you enable BMP monitoring, an up message is sent first and then the route advertisements follow.

    ```
    monitor (enable | disable);
    ```

12. Specify the dispatch priority for BMP by configuring the **priority** statement. The dispatch priority controls the frequency with which the device is able to forward BMP messages to BMP stations. You can configure the dispatch priority as either **high**, **medium**, or **low**.

    ```
    priority (high | medium | low);
    ```

13. Specify whether BMP should send pre-policy route monitoring messages, post-policy route monitoring messages, both types of messages, or none at all. The pre-policy can be configured to exclude routes that are non-feasible for the decision process (for example, a route loop) by including the **non-feasible** option for the **pre-policy** statement. This represents the view of the BGP routes before running the import policy.

    The post-policy can be configured to exclude routes that are not eligible for the decision process (for example, protocol nexthop not resolved) by including the **exclude-non-eligible** option for the **post-policy** statement. This represents the view of the BGP routes after running the import policy. If the import policy has rejected the BGP route, the route does not exist in the post policy view.

    You can explicitly disable route monitoring by specifying the **none** option for the **route-monitoring** statement. This is the default behavior.

    ```
    route-monitoring {
      none;
      post-policy {
        exclude-non-eligble;
      }
      pre-policy {
        exclude-non-feasible;
      }
    }
    ```

14. Configure how often statistics messages are sent to the BMP monitoring station by specifying the number of seconds between message transmissions using **statistics-timeout** statement. If you configure a value of 0, no statistics messages are sent.

    ```
    statistics-timeout seconds;
    ```

Related Documentation

- Example: Configuring Route Authentication for BGP on page 2953

BGP Path Attribute Configuration

Example: Configuring BGP Local Preference

Understanding the BGP Local Preference

Internal BGP (IBGP) sessions use a metric called the *local preference*, which is carried in IBGP update packets in the path attribute LOCAL_PREF. When an autonomous system (AS) has multiple routes to another AS, the local preference indicates the degree of preference for one route over the other routes. The route with the highest local preference value is preferred.

The LOCAL_PREF path attribute is always advertised to IBGP peers and to neighboring confederations. It is never advertised to external BGP (EBGP) peers. The default behavior is to not modify the LOCAL_PREF path attribute if it is present.

The LOCAL_PREF path attribute applies at export time only, when the routes are exported from the routing table into BGP.

If a BGP route is received without a LOCAL_PREF attribute, the route is stored in the routing table and advertised by BGP as if it were received with a LOCAL_PREF value of 100. A non-BGP route that is advertised by BGP is advertised with a LOCAL_PREF value of 100 by default.

Example: Configuring the Local Preference Value for BGP Routes

This example shows how to configure local preference in internal BGP (IBGP) peer sessions.

Requirements

No special configuration beyond device initialization is required before you configure this example.

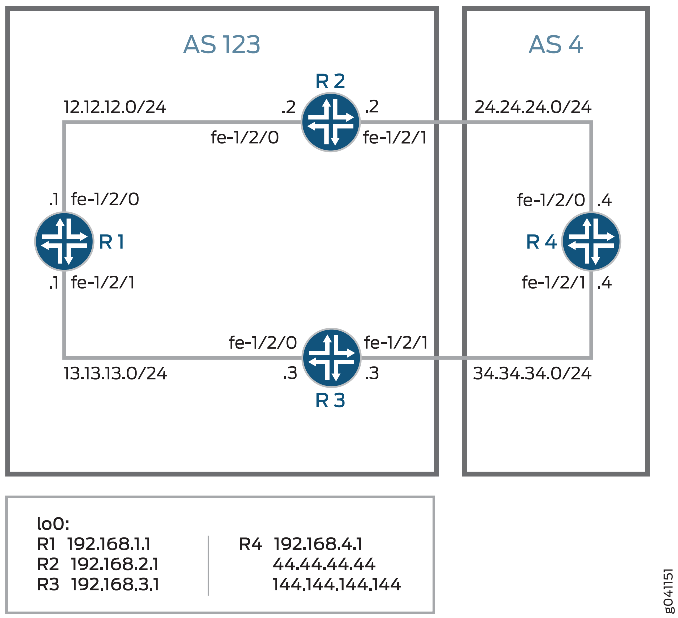
Overview

To change the local preference metric advertised in the path attribute, you must include the local-preference statement, specifying a value from 0 through 4,294,967,295 ($2^{32} - 1$).

There are several reasons you might want to prefer one path over another. For example, compared to other paths, one path might be less expensive to use, might have higher bandwidth, or might be more stable.

Figure 43 on page 2689 shows a typical network with internal peer sessions and multiple exit points to a neighboring AS.

Figure 43: Typical Network with IBGP Sessions and Multiple Exit Points



To reach Device R4, Device R1 can take a path through either Device R2 or Device R3. By default, the local preference is 100 for either route. When the local preferences are equal, Junos OS has rules for breaking the tie and choosing a path. (See “Understanding BGP Path Selection” on page 2827.) In this example, the active route is through Device R2 because the router ID of Device R2 is lower than the router ID of Device R3. The following example shows how to override the default behavior with an explicit setting for the local preference. The example configures a local preference of 300 on Device R3, thereby making Device R3 the preferred path to reach Device R4.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 12.12.12.1/24
set interfaces fe-1/2/1 unit 2 family inet address 13.13.13.1/24
```

```
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.1.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group internal neighbor 192.168.3.1
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.1.1
```

Device R2

```
set interfaces fe-1/2/0 unit 3 family inet address 12.12.12.2/24
set interfaces fe-1/2/1 unit 4 family inet address 24.24.24.2/24
set interfaces lo0 unit 2 family inet address 192.168.2.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.2.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.3.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 24.24.24.4
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.3
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.2.1
```

Device R3

```
set interfaces fe-1/2/0 unit 5 family inet address 13.13.13.3/24
set interfaces fe-1/2/1 unit 6 family inet address 34.34.34.3/24
set interfaces lo0 unit 3 family inet address 192.168.3.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.3.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 34.34.34.4
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.5
set protocols ospf area 0.0.0.0 interface fe-1/2/1.6
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.3.1
```

Device R4

```
set interfaces fe-1/2/0 unit 7 family inet address 24.24.24.4/24
```

```
set interfaces fe-1/2/1 unit 8 family inet address 34.34.34.4/24
set interfaces lo0 unit 4 family inet address 192.168.4.1/32
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 123
set protocols bgp group external neighbor 34.34.34.3
set protocols bgp group external neighbor 24.24.24.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 4
set routing-options router-id 192.168.4.1
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 1]
   user@R1# set family inet address 12.12.12.1/24
   ```

   ```
   [edit interfaces fe-1/2/1 unit 2]
   user@R1# set family inet address 13.13.13.1/24
   ```

   ```
   [edit interfaces lo0 unit 1]
   user@R1# set family inet address 192.168.1.1/32
   ```

2. Configure BGP.

   ```
   [edit protocols bgp group internal]
   user@R1# set type internal
   user@R1# set local-address 192.168.1.1
   user@R1# set export send-direct
   user@R1# set neighbor 192.168.2.1
   user@R1# set neighbor 192.168.3.1
   ```

3. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@R1# set interface lo0.1 passive
   user@R1# set interface fe-1/2/0.1
   user@R1# set interface fe-1/2/1.2
   ```

4. Configure a policy that accepts direct routes.

   NOTE: Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

   ```
   [edit policy-options policy-statement send-direct term 1]
   user@R1# set from protocol direct
   ```

user@R1# **set then accept**

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R1# set autonomous-system 123
user@R1# set router-id 192.168.1.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
  unit 1 {
    family inet {
      address 12.12.12.1/24;
    }
  }
}
fe-1/2/1 {
  unit 2 {
    family inet {
      address 13.13.13.1/24;
    }
  }
}
lo0 {
  unit 1 {
    family inet {
      address 192.168.1.1/32;
    }
  }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
  }
}
```

```
user@R1# show protocols
bgp {
  group internal {
    type internal;
    local-address 192.168.1.1;
    export send-direct;
    neighbor 192.168.2.1;
    neighbor 192.168.3.1;
  }
}
ospf {
  area 0.0.0.0 {
```



```
      interface lo0.1 {
         passive;
      }
      interface fe-1/2/0.1;
      interface fe-1/2/1.2;
   }
}
```

```
user@R1# show routing-options
autonomous-system 123;
router-id 192.168.1.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 3]
   user@R2# set family inet address 12.12.12.21/24

   [edit interfaces fe-1/2/1 unit 4]
   user@R2# set family inet address 24.24.24.2/24

   [edit interfaces lo0 unit 2]
   user@R2# set family inet address 192.168.2.1/32
   ```

2. Configure BGP.

   ```
   [edit protocols bgp group internal]
   user@R2# set type internal
   user@R2# set local-address 192.168.2.1
   user@R2# set export send-direct
   user@R2# set neighbor 192.168.1.1
   user@R2# set neighbor 192.168.3.1

   [edit protocols bgp group external]
   user@R2# set type external
   user@R2# set export send-direct
   user@R2# set peer-as 4
   user@R2# set neighbor 24.24.24.4
   ```

3. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@R2# set interface lo0.2 passive
   user@R2# set interface fe-1/2/0.3
   user@R2# set interface fe-1/2/1.4
   ```

4. Configure a policy that accepts direct routes.

NOTE: Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R2# set from protocol direct
user@R2# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R2# set autonomous-system 123
user@R2# set router-id 192.168.2.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
  unit 3 {
    family inet {
      address 12.12.12.2/24;
    }
  }
}
fe-1/2/1 {
  unit 4 {
    family inet {
      address 24.24.24.2/24;
    }
  }
}
lo0 {
  unit 2 {
    family inet {
      address 192.168.2.1/32;
    }
  }
}
```

```
user@R2# show policy-options
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
  }
}
```

```
user@R2# show protocols
bgp {
  group internal {
    type internal;
```



```
      local-address 192.168.2.1;
      export send-direct;
      neighbor 192.168.1.1;
      neighbor 192.168.3.1;
    }
    group external {
      type external;
      export send-direct;
      peer-as 4;
      neighbor 24.24.24.4;
    }
  }
  ospf {
    area 0.0.0.0 {
      interface lo0.2 {
        passive;
      }
      interface fe-1/2/0.3;
      interface fe-1/2/1.4;
    }
  }
```

```
user@R2# show routing-options
autonomous-system 123;
router-id 192.168.2.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R3

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R3:

1. Configure the interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 5]
   user@R3# set family inet address 13.13.13.3/24
   ```

   ```
   [edit interfaces fe-1/2/1 unit 6]
   user@R3# set family inet address 34.34.34.3/24
   ```

   ```
   [edit interfaces lo0 unit 3]
   user@R3# set family inet address 192.168.3.1/32
   ```

2. Configure BGP.

   ```
   [edit protocols bgp group internal]
   user@R3# set type internal
   user@R3# set local-address 192.168.3.1
   user@R3# set export send-direct
   user@R3# set neighbor 192.168.1.1
   user@R3# set neighbor 192.168.2.1
   ```

```
[edit protocols bgp group external]
user@R3# set type external
user@R3# set export send-direct
user@R3# set peer-as 4
user@R3# set neighbor 34.34.34.4
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R3# set interface lo0.3 passive
user@R3# set interface fe-1/2/0.5
user@R3# set interface fe-1/2/1.6
```

4. Configure a policy that accepts direct routes.

NOTE: Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R3# set from protocol direct
user@R3# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R3# set autonomous-system 123
user@R3# set router-id 192.168.3.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show interfaces
fe-1/2/0 {
  unit 5 {
    family inet {
      address 13.13.13.3/24;
    }
  }
}
fe-1/2/1 {
  unit 6 {
    family inet {
      address 34.34.34.3/24;
    }
  }
}
lo0 {
  unit 3 {
    family inet {
      address 192.168.3.1/32;
    }
  }
```



```
}
user@R3# show policy-options
policy-statement send-direct {
    term 1 {
        from protocol direct;
        then accept;
    }
}
user@R3# show protocols
bgp {
    group internal {
        type internal;
        local-address 192.168.3.1;
        export send-direct;
        neighbor 192.168.1.1;
        neighbor 192.168.2.1;
    }
    group external {
        type external;
        export send-direct;
        peer-as 4;
        neighbor 34.34.34.4;
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.3 {
            passive;
        }
        interface fe-1/2/0.5;
        interface fe-1/2/1.6;
    }
}
user@R3# show routing-options
autonomous-system 123;
router-id 192.168.3.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R4

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R4:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 7]
user@R4# set family inet address 24.24.24.4/24

[edit interfaces fe-1/2/1 unit 8]
user@R4# set family inet address 34.34.34.4/24
```

```
[edit interfaces lo0 unit 4]
user@R4# set family inet address 192.168.4.1/32
```

2. Configure BGP.

```
[edit protocols bgp group external]
user@R4# set type external
user@R4# set export send-direct
user@R4# set peer-as 123
user@R4# set neighbor 34.34.34.3
user@R4# set neighbor 24.24.24.2
```

3. Configure a policy that accepts direct routes.

NOTE: Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R4# set from protocol direct
user@R4# set then accept
```

4. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R4# set autonomous-system 4
user@R4# set router-id 192.168.4.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R4# show interfaces
fe-1/2/0 {
  unit 7 {
    family inet {
      address 24.24.24.4/24;
    }
  }
}
fe-1/2/1 {
  unit 8 {
    family inet {
      address 34.34.34.4/24;
    }
  }
}
lo0 {
  unit 4 {
    family inet {
      address 192.168.4.1/32;
    }
  }
}
```



```
user@R4# show policy-options
policy-statement send-direct {
    term 1 {
        from protocol direct;
        then accept;
    }
}
```

```
user@R4# show protocols
bgp {
    group external {
        type external;
        export send-direct;
        peer-as 123;
        neighbor 34.34.34.3;
        neighbor 24.24.24.2;
    }
}
```

```
user@R4# show routing-options
autonomous-system 4;
router-id 192.168.4.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the Active Path From Device R1 to Device R4 on page 2699
- Altering the Local Preference to Change the Path Selection on page 2700
- Rechecking the Active Path From Device R1 to Device R4 on page 2700

Checking the Active Path From Device R1 to Device R4

Purpose Verify that the active path from Device R1 to Device R4 goes through Device R2.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R1> show route protocol bgp
inet.0: 11 destinations, 18 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

12.12.12.0/24      [BGP/170] 00:11:48, localpref 100, from 192.168.2.1
                     AS path: I
                   > to 12.12.12.2 via fe-1/2/0.1
13.13.13.0/24      [BGP/170] 00:11:48, localpref 100, from 192.168.3.1
                     AS path: I
                   > to 13.13.13.3 via fe-1/2/1.2
24.24.24.0/24      [BGP/170] 00:11:48, localpref 100, from 192.168.2.1
                     AS path: I
                   > to 12.12.12.2 via fe-1/2/0.1
34.34.34.0/24      [BGP/170] 00:11:48, localpref 100, from 192.168.3.1
                     AS path: I
                   > to 13.13.13.3 via fe-1/2/1.2
192.168.2.1/32     [BGP/170] 00:11:48, localpref 100, from 192.168.2.1
                     AS path: I
                   > to 12.12.12.2 via fe-1/2/0.1
```



```
192.168.3.1/32      [BGP/170] 00:11:48, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
192.168.4.1/32     *[BGP/170] 00:05:14, localpref 100, from 192.168.2.1
                      AS path: 4 I
                    > to 12.12.12.2 via fe-1/2/0.1
                    [BGP/170] 00:05:14, localpref 100, from 192.168.3.1
                      AS path: 4 I
                    > to 13.13.13.3 via fe-1/2/1.2
```

Meaning The asterisk (*) shows that the preferred path is through Device R2. In the default configuration, Device R2 has a lower router ID than Device R3. The router ID is controlling the path selection.

Altering the Local Preference to Change the Path Selection

Purpose Change the path so that it goes through Device R3.

Action From configuration mode, enter the **set local-preference 300** command.

```
[edit protocols bgp group internal]
user@R3# set local-preference 300
user@R3# commit
```

Rechecking the Active Path From Device R1 to Device R4

Purpose Verify that the active path from Device R1 to Device R4 goes through Device R3.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R1> show route protocol bgp
inet.0: 11 destinations, 17 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

12.12.12.0/24       [BGP/170] 00:16:48, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
13.13.13.0/24       [BGP/170] 00:00:22, localpref 300, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
24.24.24.0/24       [BGP/170] 00:16:48, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
34.34.34.0/24       [BGP/170] 00:00:22, localpref 300, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
192.168.2.1/32      [BGP/170] 00:16:48, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
192.168.3.1/32      [BGP/170] 00:00:22, localpref 300, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
192.168.4.1/32     *[BGP/170] 00:00:21, localpref 300, from 192.168.3.1
                      AS path: 4 I
                    > to 13.13.13.3 via fe-1/2/1.2
```


Meaning The asterisk (*) shows that the preferred path is through Device R3. In the altered configuration, Device R3 has a higher local preference than Device R2. The local preference is controlling the path selection.

Related Documentation

- Examples: Configuring Internal BGP Peering on page 2662
- *BGP Configuration Overview*

Examples: Configuring BGP MED

Understanding the MED Attribute

The BGP multiple exit discriminator (MED, or MULTI_EXIT_DISC) is a non-transitive attribute, meaning that it is not propagated throughout the Internet, but only to adjacent autonomous systems (ASs). The MED attribute is optional, meaning that it is not always sent with the BGP updates. The purpose of MED is to influence how other ASs enter your AS to reach a certain prefix.

The MED attribute has a value that is referred to as a *metric*. If all other factors in determining an exit point are equal, the exit point with the lowest metric is preferred.

If a MED is received over an external BGP link, it is propagated over internal links to other BGP-enabled devices within the AS.

BGP update messages include a MED metric if the route was learned from BGP and already had a MED metric associated with it, or if you configure the MED metric in the configuration file.

A MED metric is advertised with a route according to the following general rules:

- A more specific metric overrides a less specific metric. That is, a group-specific metric overrides a global BGP metric, and a peer-specific metric overrides a global BGP or group-specific metric.
- A metric defined with a routing policy overrides a metric defined with the **metric-out** statement.
- If any metric is defined, it overrides a metric received in a route.
- If the received route does not have an associated MED metric, and if you do not explicitly configure a metric value, no metric is advertised. When you do not explicitly configure a metric value, the MED value is equivalent to zero (0) when advertising an active route.

Because the AS path rather than the number of hops between hosts is the primary criterion for BGP route selection, an AS with multiple connections to a peer AS can have multiple equivalent AS paths. When the routing table contains two routes to the same host in a neighboring AS, an MED metric assigned to each route can determine which to include in the forwarding table. The MED metric you assign can force traffic through a particular exit point in an AS.

Figure 44 on page 2702 illustrates how MED metrics are used to determine route selection.

Figure 44: Default MED Example

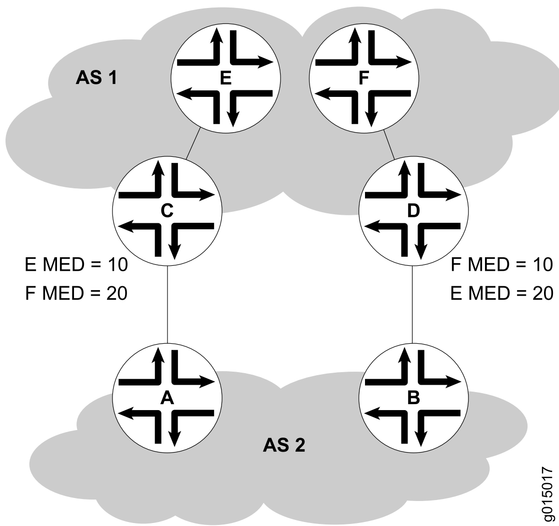


Figure 44 on page 2702 shows AS 1 and AS 2 connected by two separate BGP links to Routers C and D. Host E in AS 1 is located nearer to Router C. Host F, also in AS 1, is located nearer to Router D. Because the AS paths are equivalent, two routes exist for each host, one through Router C and one through Router D. To force all traffic destined for Host E through Router C, the network administrator for AS 1 assigns an MED metric for each router to Host E at its exit point. An MED metric of 10 is assigned to the route to Host E through Router C, and an MED metric of 20 is assigned to the route to Host E through Router D. BGP routers in AS 2 then select the route with the lower MED metric for the forwarding table.

By default, only the MEDs of routes that have the same peer ASs are compared. However, you can configure the routing table path selection options listed in Table 226 on page 2703 to compare MEDs in different ways. The MED options are not mutually exclusive and can be configured in combination or independently. For the MED options to take effect, you must configure them uniformly all through your network. The MED option or options you configure determine the route selected. Thus we recommend that you carefully evaluate your network for preferred routes before configuring the MED options.

Table 226: MED Options for Routing Table Path Selection

Option (Name)	Function	Use
Always comparing MEDs (**always-compare-med**)	Ensures that the MEDs for paths from peers in different ASs are always compared in the route selection process.	Useful when all enterprises participating in a network agree on a uniform policy for setting MEDs. For example, in a network shared by two ISPs, both must agree that a certain path is the better path to configure the MED values correctly.
Adding IGP cost to MED (**med-plus-igp**)	Before comparing MED values for path selection, adds to the MED the cost of the IGP route to the BGP next-hop destination. This option replaces the MED value for the router, but does not affect the IGP metric comparison. As a result, when multiple routes have the same value after the MED-plus-IPG comparison, and route selection continues, the IGP route metric is also compared, even though it was added to the MED value and compared earlier in the selection process.	Useful when the downstream AS requires the complete cost of a certain route that is received across multiple ASs.
Applying Cisco IOS nondeterministic behavior (**cisco-non-deterministic**)	Specifies the nondeterministic behavior of the Cisco IOS software: • The active path is always first. All nonactive but eligible paths follow the active path and are maintained in the order in which they were received. Ineligible paths remain at the end of the list. • When a new path is added to the routing table, path comparisons are made among all routes, including those paths that must never be selected because they lose the MED tie-breaking rule.	We recommend that you do not configure this option, because the nondeterministic behavior sometimes prevents the system from properly comparing the MEDs between paths.

Example: Configuring the MED Attribute Directly

This example shows how to configure a multiple exit discriminator (MED) metric to advertise in BGP update messages.

- Requirements on page 2703
- Overview on page 2704
- Configuration on page 2705
- Verification on page 2715

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

To directly configure a MED metric to advertise in BGP update messages, include the **metric-out** statement:

metric-out (*metric* | minimum-igp *offset* | igp delay-med-update | *offset*);

metric is the primary metric on all routes sent to peers. It can be a value in the range from 0 through 4,294,967,295 ($2^{32} – 1$).

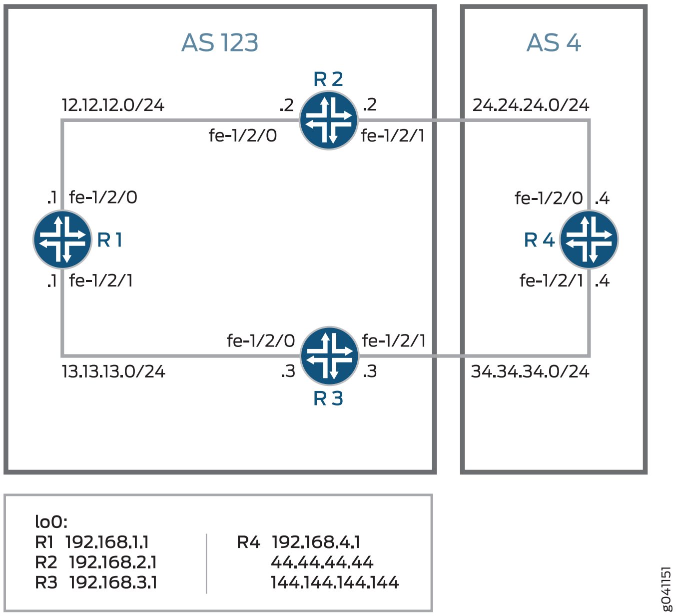
The following optional settings are also supported:

- **minimum-igp**—Sets the metric to the minimum metric value calculated in the interior gateway protocol (IGP) to get to the BGP next hop. If a newly calculated metric is greater than the minimum metric value, the metric value remains unchanged. If a newly calculated metric is lower, the metric value is lowered to that value.
- **igp**—Sets the metric to the most recent metric value calculated in the IGP to get to the BGP next hop.
- **delay-med-update**—Delays sending MED updates when the MED value increases. Include the **delay-med-update** statement when you configure the **igp** statement. The default interval to delay sending updates, unless the MED is lower or another attribute associated with the route has changed is 10 minutes. Include the **med-igp-update-interval** ***minutes*** statement at the **[edit routing-options]** hierarchy level to modify the default interval.
- ***offset***—Specifies a value for ***offset*** to increase or decrease the metric that is used from the metric value calculated in the IGP. The metric value is offset by the value specified. The metric calculated in the IGP (by specifying either **igp** or **igp-minimum**) is increased if the ***offset*** value is positive. The metric calculated in the IGP (by specifying either **igp** or **igp-minimum**) is decreased if the ***offset*** value is negative.

  offset can be a value in the range from $–2^{31}$ through $2^{31} – 1$. Note that the adjusted metric can never go below 0 or above $2^{32} – 1$.

Figure 45 on page 2705 shows a typical network with internal peer sessions and multiple exit points to a neighboring autonomous system (AS).

Figure 45: Typical Network with IBGP Sessions and Multiple Exit Points



Device R4 has multiple loopback interfaces configured to simulate advertised prefixes. The extra loopback interface addresses are 44.44.44.44/32 and 144.144.144.144/32. This example shows how to configure Device R4 to advertise a MED value of 30 to Device R3 and a MED value of 20 to Device R2. This causes all of the devices in AS 123 to prefer the path through Device R2 to reach AS 4.

Configuration

- Configuring Device R1 on page 2707
- Configuring Device R2 on page 2709
- Configuring Device R3 on page 2711
- Configuring Device R4 on page 2713

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 12.12.12.1/24
set interfaces fe-1/2/1 unit 2 family inet address 13.13.13.1/24
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.1.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group internal neighbor 192.168.3.1
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
```

```
set routing-options autonomous-system 123
set routing-options router-id 192.168.1.1
```

Device R2

```
set interfaces fe-1/2/0 unit 3 family inet address 12.12.12.2/24
set interfaces fe-1/2/1 unit 4 family inet address 24.24.24.2/24
set interfaces lo0 unit 2 family inet address 192.168.2.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.2.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.3.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 24.24.24.4
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.3
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.2.1
```

Device R3

```
set interfaces fe-1/2/0 unit 5 family inet address 13.13.13.3/24
set interfaces fe-1/2/1 unit 6 family inet address 34.34.34.3/24
set interfaces lo0 unit 3 family inet address 192.168.3.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.3.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 34.34.34.4
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.5
set protocols ospf area 0.0.0.0 interface fe-1/2/1.6
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.3.1
```

Device R4

```
set interfaces fe-1/2/0 unit 7 family inet address 24.24.24.4/24
set interfaces fe-1/2/1 unit 8 family inet address 34.34.34.4/24
set interfaces lo0 unit 4 family inet address 192.168.4.1/32
set interfaces lo0 unit 4 family inet address 44.44.44.44/32
set interfaces lo0 unit 4 family inet address 144.144.144.144/32
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 123
set protocols bgp group external neighbor 34.34.34.3 metric-out 30
set protocols bgp group external neighbor 24.24.24.2 metric-out 20
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
```



```
set routing-options autonomous-system 4
set routing-options router-id 192.168.4.1
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 1]
   user@R1# set family inet address 12.12.12.1/24

   [edit interfaces fe-1/2/1 unit 2]
   user@R1# set family inet address 13.13.13.1/24

   [edit interfaces lo0 unit 1]
   user@R1# set family inet address 192.168.1.1/32
   ```

2. Configure BGP.

   ```
   [edit protocols bgp group internal]
   user@R1# set type internal
   user@R1# set local-address 192.168.1.1
   user@R1# set export send-direct
   user@R1# set neighbor 192.168.2.1
   user@R1# set neighbor 192.168.3.1
   ```

3. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@R1# set interface lo0.1 passive
   user@R1# set interface fe-1/2/0.1
   user@R1# set interface fe-1/2/1.2
   ```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

   ```
   [edit policy-options policy-statement send-direct term 1]
   user@R1# set from protocol direct
   user@R1# set then accept
   ```

5. Configure the router ID and autonomous system (AS) number.

   ```
   [edit routing-options]
   user@R1# set autonomous-system 123
   user@R1# set router-id 192.168.1.1
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.


```
user@R1# show interfaces
fe-1/2/0 {
    unit 1 {
        family inet {
            address 12.12.12.1/24;
        }
    }
}
fe-1/2/1 {
    unit 2 {
        family inet {
            address 13.13.13.1/24;
        }
    }
}
lo0 {
    unit 1 {
        family inet {
            address 192.168.1.1/32;
        }
    }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
    term 1 {
        from protocol direct;
        then accept;
    }
}
```

```
user@R1# show protocols
bgp {
    group internal {
        type internal;
        local-address 192.168.1.1;
        export send-direct;
        neighbor 192.168.2.1;
        neighbor 192.168.3.1;
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.1 {
            passive;
        }
        interface fe-1/2/0.1;
        interface fe-1/2/1.2;
    }
}
```

```
user@R1# show routing-options
autonomous-system 123;
router-id 192.168.1.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 3]
   user@R2# set family inet address 12.12.12.21/24

   [edit interfaces fe-1/2/1 unit 4]
   user@R2# set family inet address 24.24.24.2/24

   [edit interfaces lo0 unit 2]
   user@R2# set family inet address 192.168.2.1/32
   ```

2. Configure BGP.

   ```
   [edit protocols bgp group internal]
   user@R2# set type internal
   user@R2# set local-address 192.168.2.1
   user@R2# set export send-direct
   user@R2# set neighbor 192.168.1.1
   user@R2# set neighbor 192.168.3.1

   [edit protocols bgp group external]
   user@R2# set type external
   user@R2# set export send-direct
   user@R2# set peer-as 4
   user@R2# set neighbor 24.24.24.4
   ```

3. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@R2# set interface lo0.2 passive
   user@R2# set interface fe-1/2/0.3
   user@R2# set interface fe-1/2/1.4
   ```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

   ```
   [edit policy-options policy-statement send-direct term 1]
   user@R2# set from protocol direct
   user@R2# set then accept
   ```

5. Configure the router ID and autonomous system (AS) number.

   ```
   [edit routing-options]
   user@R2# set autonomous-system 123
   user@R2# set router-id 192.168.2.1
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
  unit 3 {
    family inet {
      address 12.12.12.2/24;
    }
  }
}
fe-1/2/1 {
  unit 4 {
    family inet {
      address 24.24.24.2/24;
    }
  }
}
lo0 {
  unit 2 {
    family inet {
      address 192.168.2.1/32;
    }
  }
}
```

```
user@R2# show policy-options
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
  }
}
```

```
user@R2# show protocols
bgp {
  group internal {
    type internal;
    local-address 192.168.2.1;
    export send-direct;
    neighbor 192.168.1.1;
    neighbor 192.168.3.1;
  }
  group external {
    type external;
    export send-direct;
    peer-as 4;
    neighbor 24.24.24.4;
  }
}
ospf {
  area 0.0.0.0 {
    interface lo0.2 {
      passive;
```



```
        }
        interface fe-1/2/0.3;
        interface fe-1/2/1.4;
    }
}
```

```
user@R2# show routing-options
autonomous-system 123;
router-id 192.168.2.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R3

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R3:

1. Configure the interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 5]
   user@R3# set family inet address 13.13.13.3/24

   [edit interfaces fe-1/2/1 unit 6]
   user@R3# set family inet address 34.34.34.3/24

   [edit interfaces lo0 unit 3]
   user@R3# set family inet address 192.168.3.1/32
   ```

2. Configure BGP.

   ```
   [edit protocols bgp group internal]
   user@R3# set type internal
   user@R3# set local-address 192.168.3.1
   user@R3# set export send-direct
   user@R3# set neighbor 192.168.1.1
   user@R3# set neighbor 192.168.2.1

   [edit protocols bgp group external]
   user@R3# set type external
   user@R3# set export send-direct
   user@R3# set peer-as 4
   user@R3# set neighbor 34.34.34.4
   ```

3. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@R3# set interface lo0.3 passive
   user@R3# set interface fe-1/2/0.5
   user@R3# set interface fe-1/2/1.6
   ```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R3# set from protocol direct
user@R3# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R3# set autonomous-system 123
user@R3# set router-id 192.168.3.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show interfaces
fe-1/2/0 {
  unit 5 {
    family inet {
      address 13.13.13.3/24;
    }
  }
}
fe-1/2/1 {
  unit 6 {
    family inet {
      address 34.34.34.3/24;
    }
  }
}
lo0 {
  unit 3 {
    family inet {
      address 192.168.3.1/32;
    }
  }
}
```

```
user@R3# show policy-options
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
  }
}
```

```
user@R3# show protocols
bgp {
  group internal {
    type internal;
    local-address 192.168.3.1;
    export send-direct;
    neighbor 192.168.1.1;
    neighbor 192.168.2.1;
  }
  group external {
```



```
      type external;
      export send-direct;
      peer-as 4;
      neighbor 34.34.34.4;
    }
  }
  ospf {
    area 0.0.0.0 {
      interface lo0.3 {
        passive;
      }
      interface fe-1/2/0.5;
      interface fe-1/2/1.6;
    }
  }
```

```
user@R3# show routing-options
autonomous-system 123;
router-id 192.168.3.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R4

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R4:

1. Configure the interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 7]
   user@R4# set family inet address 24.24.24.4/24
   ```

   ```
   [edit interfaces fe-1/2/1 unit 8]
   user@R4# set family inet address 34.34.34.4/24
   ```

   ```
   [edit interfaces lo0 unit 4]
   user@R4# set family inet address 192.168.4.1/32
   user@R4# set family inet address 44.44.44.44/32
   user@R4# set family inet address 144.144.144.144/32
   ```

   Device R4 has multiple loopback interface addresses to simulate advertised prefixes.

2. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

   ```
   [edit policy-options policy-statement send-direct term 1]
   user@R4# set from protocol direct
   user@R4# set then accept
   ```

3. Configure BGP.

   ```
   [edit protocols bgp group external]
   user@R4# set type external
   ```

```
user@R4# set export send-direct
user@R4# set peer-as 123
```

4. Configure a MED value of 30 for neighbor Device R3, and a MED value of 20 for neighbor Device R2.

```
[edit protocols bgp group external]
user@R4# set neighbor 34.34.34.3 metric-out 30
user@R4# set neighbor 24.24.24.2 metric-out 20
```

   This configuration causes autonomous system (AS) 123 (of which Device R1, Device R2, and Device R3 are members) to prefer the path through Device R2 to reach AS 4.

5. Configure the router ID and AS number.

```
[edit routing-options]
user@R4# set autonomous-system 4
user@R4# set router-id 192.168.4.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R4# show interfaces
fe-1/2/0 {
  unit 7 {
    family inet {
      address 24.24.24.4/24;
    }
  }
}
fe-1/2/1 {
  unit 8 {
    family inet {
      address 34.34.34.4/24;
    }
  }
}
lo0 {
  unit 4 {
    family inet {
      address 192.168.4.1/32;
      address 44.44.44.44/32;
      address 144.144.144.144/32;
    }
  }
}
```

```
user@R4# show policy-options
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
  }
}
```



```
user@R4# show protocols
bgp {
    group external {
        type external;
        export send-direct;
        peer-as 123;
        neighbor 34.34.34.3 {
            metric-out 30;
        }
        neighbor 24.24.24.2 {
            metric-out 20;
        }
    }
}
```

```
user@R4# show routing-options
autonomous-system 4;
router-id 192.168.4.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the Active Path From Device R1 to Device R4 on page 2715
- Verifying That Device R4 Is Sending Its Routes Correctly on page 2716

Checking the Active Path From Device R1 to Device R4

Purpose Verify that the active path goes through Device R2.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R1> show route protocol bgp
inet.0: 13 destinations, 19 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

12.12.12.0/24       [BGP/170] 3d 22:52:38, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
13.13.13.0/24       [BGP/170] 3d 03:15:16, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
24.24.24.0/24       [BGP/170] 3d 22:52:38, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
34.34.34.0/24       [BGP/170] 3d 03:15:16, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
44.44.44.44/32     *[BGP/170] 01:41:11, MED 20, localpref 100, from 192.168.2.1
                      AS path: 4 I
                    > to 12.12.12.2 via fe-1/2/0.1
144.144.144.144/32 *[BGP/170] 00:08:13, MED 20, localpref 100, from 192.168.2.1
                      AS path: 4 I
                    > to 12.12.12.2 via fe-1/2/0.1
192.168.2.1/32      [BGP/170] 3d 22:52:38, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
```



```
192.168.3.1/32       [BGP/170] 3d 03:15:16, localpref 100, from 192.168.3.1
                       AS path: I
                     > to 13.13.13.3 via fe-1/2/1.2
192.168.4.1/32      *[BGP/170] 01:41:11, MED 20, localpref 100, from 192.168.2.1
                       AS path: 4 I
                     > to 12.12.12.2 via fe-1/2/0.1
```

Meaning The asterisk (*) shows that the preferred path is through Device R2. The reason for the path selection is listed as MED 20.

Verifying That Device R4 Is Sending Its Routes Correctly

Purpose Make sure that Device R4 is sending update messages with a value of 20 to Device R2 and a value of 30 to Device R3.

Action From operational mode, enter the **show route advertising-protocol bgp 24.24.24.2** command.

```
user@R4> show route advertising-protocol bgp 24.24.24.2
inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 24.24.24.0/24           Self                 20                 I
* 34.34.34.0/24           Self                 20                 I
* 44.44.44.44/32          Self                 20                 I
* 144.144.144.144/32      Self                 20                 I
* 192.168.4.1/32          Self                 20                 I

user@R4> show route advertising-protocol bgp 34.34.34.3
inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 24.24.24.0/24           Self                 30                 I
* 34.34.34.0/24           Self                 30                 I
* 44.44.44.44/32          Self                 30                 I
* 144.144.144.144/32      Self                 30                 I
* 192.168.4.1/32          Self                 30                 I
```

Meaning The MED column shows that Device R4 is sending the correct MED values to its two external BGP (EBGP) neighbors.

Example: Configuring the MED Using Route Filters

This example shows how to configure a policy that uses route filters to modify the multiple exit discriminator (MED) metric to advertise in BGP update messages.

- Requirements on page 2716
- Overview on page 2717
- Configuration on page 2717
- Verification on page 2728

Requirements

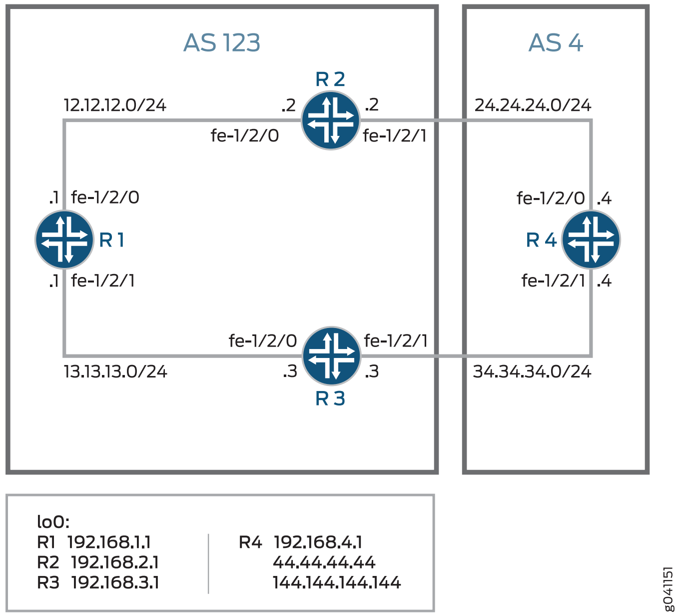
No special configuration beyond device initialization is required before you configure this example.

Overview

To configure a route-filter policy that modifies the advertised MED metric in BGP update messages, include the **metric** statement in the policy action.

Figure 46 on page 2717 shows a typical network with internal peer sessions and multiple exit points to a neighboring autonomous system (AS).

Figure 46: Typical Network with IBGP Sessions and Multiple Exit Points



Device R4 has multiple loopback interfaces configured to simulate advertised prefixes. The extra loopback interface addresses are 44.44.44.44/32 and 144.144.144.144/32. This example shows how to configure Device R4 to advertise a MED value of 30 to Device R3 for all routes except 144.144.144.144. For 144.144.144.144, a MED value of 10 is advertised to Device 3. A MED value of 20 is advertised to Device R2, regardless of the route prefix.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 12.12.12.1/24
set interfaces fe-1/2/1 unit 2 family inet address 13.13.13.1/24
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.1.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group internal neighbor 192.168.3.1
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.2
```

```
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.1.1
```

Device R2

```
set interfaces fe-1/2/0 unit 3 family inet address 12.12.12.2/24
set interfaces fe-1/2/1 unit 4 family inet address 24.24.24.2/24
set interfaces lo0 unit 2 family inet address 192.168.2.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.2.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.3.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 24.24.24.4
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.3
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.2.1
```

Device R3

```
set interfaces fe-1/2/0 unit 5 family inet address 13.13.13.3/24
set interfaces fe-1/2/1 unit 6 family inet address 34.34.34.3/24
set interfaces lo0 unit 3 family inet address 192.168.3.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.3.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 34.34.34.4
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.5
set protocols ospf area 0.0.0.0 interface fe-1/2/1.6
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.3.1
```

Device R4

```
set interfaces fe-1/2/0 unit 7 family inet address 24.24.24.4/24
set interfaces fe-1/2/1 unit 8 family inet address 34.34.34.4/24
set interfaces lo0 unit 4 family inet address 192.168.4.1/32
set interfaces lo0 unit 4 family inet address 44.44.44.44/32
set interfaces lo0 unit 4 family inet address 144.144.144.144/32
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 123
set protocols bgp group external neighbor 34.34.34.3 export med-10
set protocols bgp group external neighbor 34.34.34.3 export med-30
```



```
set protocols bgp group external neighbor 24.24.24.2 metric-out 20
set policy-options policy-statement med-10 from route-filter 144.144.144.144/32 exact
set policy-options policy-statement med-10 then metric 10
set policy-options policy-statement med-10 then accept
set policy-options policy-statement med-30 from route-filter 0.0.0.0/0 longer
set policy-options policy-statement med-30 then metric 30
set policy-options policy-statement med-30 then accept
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 4
set routing-options router-id 192.168.4.1
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the device interfaces.

```
[edit interfaces fe-1/2/0 unit 1]
user@R1# set family inet address 12.12.12.1/24

[edit interfaces fe-1/2/1 unit 2]
user@R1# set family inet address 13.13.13.1/24

[edit interfaces lo0 unit 1]
user@R1# set family inet address 192.168.1.1/32
```

2. Configure BGP.

```
[edit protocols bgp group internal]
user@R1# set type internal
user@R1# set local-address 192.168.1.1
user@R1# set export send-direct
user@R1# set neighbor 192.168.2.1
user@R1# set neighbor 192.168.3.1
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface lo0.1 passive
user@R1# set interface fe-1/2/0.1
user@R1# set interface fe-1/2/1.2
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R1# set from protocol direct
user@R1# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
```

```
user@R1# set autonomous-system 123
user@R1# set router-id 192.168.1.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
  unit 1 {
    family inet {
      address 12.12.12.1/24;
    }
  }
}
fe-1/2/1 {
  unit 2 {
    family inet {
      address 13.13.13.1/24;
    }
  }
}
lo0 {
  unit 1 {
    family inet {
      address 192.168.1.1/32;
    }
  }
}
```

```
user@R1# show protocols
bgp {
  group internal {
    type internal;
    local-address 192.168.1.1;
    export send-direct;
    neighbor 192.168.2.1;
    neighbor 192.168.3.1;
  }
}
ospf {
  area 0.0.0.0 {
    interface lo0.1 {
      passive;
    }
    interface fe-1/2/0.1;
    interface fe-1/2/1.2;
  }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
```



```
    }
  }
```

```
user@R1# show routing-options
autonomous-system 123;
router-id 192.168.1.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the device interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 3]
   user@R2# set family inet address 12.12.12.21/24

   [edit interfaces fe-1/2/1 unit 4]
   user@R2# set family inet address 24.24.24.2/24

   [edit interfaces lo0 unit 2]
   user@R2# set family inet address 192.168.2.1/32
   ```

2. Configure BGP.

   ```
   [edit protocols bgp group internal]
   user@R2# set type internal
   user@R2# set local-address 192.168.2.1
   user@R2# set export send-direct
   user@R2# set neighbor 192.168.1.1
   user@R2# set neighbor 192.168.3.1

   [edit protocols bgp group external]
   user@R2# set type external
   user@R2# set export send-direct
   user@R2# set peer-as 4
   user@R2# set neighbor 24.24.24.4
   ```

3. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@R2# set interface lo0.2 passive
   user@R2# set interface fe-1/2/0.3
   user@R2# set interface fe-1/2/1.4
   ```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

   ```
   [edit policy-options policy-statement send-direct term 1]
   user@R2# set from protocol direct
   user@R2# set then accept
   ```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R2# set autonomous-system 123
user@R2# set router-id 192.168.2.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
  unit 3 {
    family inet {
      address 12.12.12.2/24;
    }
  }
}
fe-1/2/1 {
  unit 4 {
    family inet {
      address 24.24.24.2/24;
    }
  }
}
lo0 {
  unit 2 {
    family inet {
      address 192.168.2.1/32;
    }
  }
}
```

```
user@R2# show protocols
bgp {
  group internal {
    type internal;
    local-address 192.168.2.1;
    export send-direct;
    neighbor 192.168.1.1;
    neighbor 192.168.3.1;
  }
  group external {
    type external;
    export send-direct;
    peer-as 4;
    neighbor 24.24.24.4;
  }
}
ospf {
  area 0.0.0.0 {
    interface lo0.2 {
      passive;
    }
    interface fe-1/2/0.3;
```



```
        interface fe-1/2/1.4;
    }
}
user@R2# show policy-options
policy-statement send-direct {
    term 1 {
        from protocol direct;
        then accept;
    }
}
user@R2# show routing-options
autonomous-system 123;
router-id 192.168.2.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R3

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R3:

1. Configure the device interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 5]
   user@R3# set family inet address 13.13.13.3/24

   [edit interfaces fe-1/2/1 unit 6]
   user@R3# set family inet address 34.34.34.3/24

   [edit interfaces lo0 unit 3]
   user@R3# set family inet address 192.168.3.1/32
   ```

2. Configure BGP.

   ```
   [edit protocols bgp group internal]
   user@R3# set type internal
   user@R3# set local-address 192.168.3.1
   user@R3# set export send-direct
   user@R3# set neighbor 192.168.1.1
   user@R3# set neighbor 192.168.2.1

   [edit protocols bgp group external]
   user@R3# set type external
   user@R3# set export send-direct
   user@R3# set peer-as 4
   user@R3# set neighbor 34.34.34.4
   ```

3. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@R3# set interface lo0.3 passive
   user@R3# set interface fe-1/2/0.5
   ```



```
user@R3# set interface fe-1/2/1.6
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R3# set from protocol direct
user@R3# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R3# set autonomous-system 123
user@R3# set router-id 192.168.3.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show interfaces
fe-1/2/0 {
   unit 5 {
      family inet {
         address 13.13.13.3/24;
      }
   }
}
fe-1/2/1 {
   unit 6 {
      family inet {
         address 34.34.34.3/24;
      }
   }
}
lo0 {
   unit 3 {
      family inet {
         address 192.168.3.1/32;
      }
   }
}
```

```
user@R3# show protocols
bgp {
   group internal {
      type internal;
      local-address 192.168.3.1;
      export send-direct;
      neighbor 192.168.1.1;
      neighbor 192.168.2.1;
   }
   group external {
      type external;
      export send-direct;
```

```
      peer-as 4;
      neighbor 34.34.34.4;
    }
  }
  ospf {
    area 0.0.0.0 {
      interface lo0.3 {
        passive;
      }
      interface fe-1/2/0.5;
      interface fe-1/2/1.6;
    }
  }
```

```
user@R3# show policy-options
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
  }
}
```

```
user@R3# show routing-options
autonomous-system 123;
router-id 192.168.3.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R4

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R4:

1. Configure the device interfaces.

```
[edit interfaces fe-1/2/0 unit 7]
user@R4# set family inet address 24.24.24.4/24

[edit interfaces fe-1/2/1 unit 8]
user@R4# set family inet address 34.34.34.4/24

[edit interfaces lo0 unit 4]
user@R4# set family inet address 192.168.4.1/32
user@R4# set family inet address 44.44.44.44/32
user@R4# set family inet address 144.144.144.144/32
```

   Device R4 has multiple loopback interface addresses to simulate advertised prefixes.

2. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
```

```
user@R4# set from protocol direct
user@R4# set then accept
```

3. Configure BGP.

```
[edit protocols bgp group external]
user@R4# set type external
user@R4# set export send-direct
user@R4# set peer-as 123
```

4. Configure the two MED policies.

```
[edit policy-options]
set policy-statement med-10 from route-filter 144.144.144.144/32 exact
set policy-statement med-10 then metric 10
set policy-statement med-10 then accept

set policy-statement med-30 from route-filter 0.0.0.0/0 longer
set policy-statement med-30 then metric 30
set policy-statement med-30 then accept
```

5. Configure the two EBGP neighbors, applying the two MED policies to Device R3, and a MED value of 20 to Device R2.

```
[edit protocols bgp group external]
user@R4# set neighbor 34.34.34.3 export med-10
user@R4# set neighbor 34.34.34.3 export med-30
user@R4# set neighbor 24.24.24.2 metric-out 20
```

6. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R4# set autonomous-system 4
user@R4# set router-id 192.168.4.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R4# show interfaces
fe-1/2/0 {
  unit 7 {
    family inet {
      address 24.24.24.4/24;
    }
  }
}
fe-1/2/1 {
  unit 8 {
    family inet {
      address 34.34.34.4/24;
    }
  }
}
lo0 {
  unit 4 {
```

```
        family inet {
            address 192.168.4.1/32;
            address 44.44.44.44/32;
            address 144.144.144.144/32;
        }
    }
}
```

user@R4# **show protocols**

```
bgp {
    group external {
        type external;
        export send-direct;
        peer-as 123;
        neighbor 24.24.24.2 {
            metric-out 20;
        }
        neighbor 34.34.34.3 {
            export [ med-10 med-30 ];
        }
    }
}
```

user@R4# **show policy-options**

```
policy-statement med-10 {
    from {
        route-filter 144.144.144.144/32 exact;
    }
    then {
        metric 10;
        accept;
    }
}
policy-statement med-30 {
    from {
        route-filter 0.0.0.0/0 longer;
    }
    then {
        metric 30;
        accept;
    }
}
policy-statement send-direct {
    term 1 {
        from protocol direct;
        then accept;
    }
}
```

user@R4# **show routing-options**

```
autonomous-system 4;
router-id 192.168.4.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the Active Path from Device R1 to Device R4 on page 2728
- Verifying That Device R4 Is Sending Its Routes Correctly on page 2728

Checking the Active Path from Device R1 to Device R4

Purpose Verify that the active path goes through Device R2.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R1> show route protocol bgp
inet.0: 13 destinations, 19 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

12.12.12.0/24       [BGP/170] 4d 01:13:32, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
13.13.13.0/24       [BGP/170] 3d 05:36:10, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
24.24.24.0/24       [BGP/170] 4d 01:13:32, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
34.34.34.0/24       [BGP/170] 3d 05:36:10, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
44.44.44.44/32     *[BGP/170] 00:06:03, MED 20, localpref 100, from 192.168.2.1
                      AS path: 4 I
                    > to 12.12.12.2 via fe-1/2/0.1
144.144.144.144/32 *[BGP/170] 00:06:03, MED 10, localpref 100, from 192.168.3.1
                      AS path: 4 I
                    > to 13.13.13.3 via fe-1/2/1.2
192.168.2.1/32      [BGP/170] 4d 01:13:32, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
192.168.3.1/32      [BGP/170] 3d 05:36:10, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
192.168.4.1/32     *[BGP/170] 00:06:03, MED 20, localpref 100, from 192.168.2.1
                      AS path: 4 I
                    > to 12.12.12.2 via fe-1/2/0.1
```

Meaning The output shows that the preferred path to the routes advertised by Device R4 is through Device R2 for all routes except 144.144.144.144/32. For 144.144.144.144/32, the preferred path is through Device R3.

Verifying That Device R4 Is Sending Its Routes Correctly

Purpose Make sure that Device R4 is sending update messages with a value of 20 to Device R2 and a value of 30 to Device R3.

Action From operational mode, enter the **show route advertising-protocol bgp** command.

```
user@R4> show route advertising-protocol bgp 24.24.24.2
```



```
inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 24.24.24.0/24           Self                 20                 I
* 34.34.34.0/24           Self                 20                 I
* 44.44.44.44/32          Self                 20                 I
* 144.144.144.144/32      Self                 20                 I
* 192.168.4.1/32          Self                 20                 I

user@R4> show route advertising-protocol bgp 34.34.34.3
inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 24.24.24.0/24           Self                 30                 I
* 34.34.34.0/24           Self                 30                 I
* 44.44.44.44/32          Self                 30                 I
* 144.144.144.144/32      Self                 10                 I
* 192.168.4.1/32          Self                 30                 I
```

Meaning The MED column shows that Device R4 is sending the correct MED values to its two EBGP neighbors.

Example: Configuring the MED Using Communities

Set the multiple exit discriminator (MED) metric to 20 for all routes from a particular community.

```
[edit]
routing-options {
  router-id 10.0.0.1;
  autonomous-system 23;
}
policy-options {
  policy-statement from-otago {
    from community otago;
    then metric 20;
  }
  community otago members [56:2379 23:46944];
}
protocols {
  bgp {
    import from-otago;
    group 23 {
      type external;
      peer-as 56;
      neighbor 192.168.0.1 {
        traceoptions {
          file bgp-log-peer;
          flag packets;
        }
        log-updown;
      }
    }
  }
}
```


Example: Associating the MED Path Attribute with the IGP Metric and Delaying MED Updates

This example shows how to associate the multiple exit discriminator (MED) path attribute with the interior gateway protocol (IGP) metric, and configure a timer to delay update of the MED attribute.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

BGP can be configured to advertise the MED attribute for a route based on the IGP distance of its internal BGP (IBGP) route next-hop. The IGP metric enables internal routing to follow the shortest path according to the administrative setup. In some deployments, it might be ideal to communicate IGP shortest-path knowledge to external BGP (EBGP) peers in a neighboring autonomous system (AS). This allows those EBGP peers to forward traffic into your AS using the shortest paths possible.

Routes learned from an EBGP peer usually have a next hop on a directly connected interface, and thus the IGP value is equal to zero. Zero is the value advertised. The IGP metric is a nonzero value when a BGP peer sends third-party next hops that require the local system to perform next-hop resolution—IBGP configurations, configurations within confederation peers, or EBGP configurations that include the **multihop** command. In these scenarios, it might make sense to associate the MED value with the IGP metric by including the **metric-out minimum-igp** or **metric-out igp** option.

The drawback of associating the MED with the IGP metric is the risk of excessive route advertisements when there are IGP instabilities in the network. Configuring a delay for the MED update provides a mechanism to reduce route advertisements in such scenarios. The delay works by slowing down MED updates when the IGP metric for the next hop changes. The approach uses a timer to periodically advertise MED updates. When the timer expires, the MED attribute for routes with **metric-out igp delay-updates** configured is updated to the current IGP metric of the next hop. The BGP-enabled device sends out advertisements for routes for which the MED attribute has changed.

The **delay-updates** option identifies the BGP groups (or peers) for which the MED updates must be suppressed. The time for advertising MED updates is set to 10 minutes by default. You can increase the interval up to 600 minutes by including the **med-igp-update-interval** statement in the **routing-options** configuration.

NOTE: If you have nonstop active routing (NSR) enabled and a switchover occurs, the delayed MED updates might be advertised as soon as the switchover occurs.

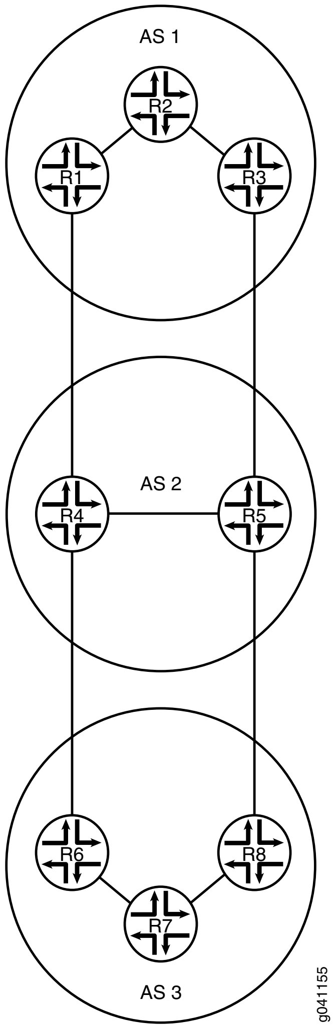
When you configure the **metric-out igp** option, the IGP metric directly tracks the IGP cost to the IBGP peer. When the IGP cost goes down, so does the advertised MED value. Conversely, when the IGP cost goes up, the MED value goes up as well.

When you configure the **metric-out minimum-igp** option, the advertised MED value changes only when the IGP cost to the IBGP peer goes down. An increase in the IGP cost does not affect the MED value. The router monitors and remembers the lowest IGP cost until the routing process (rpd) is restarted. The BGP peer sends an update only if the MED is lower than the previously advertised value or another attribute associated with the route has changed, or if the BGP peer is responding to a refresh route request.

This example uses the **metric** statement in the OSPF configuration to demonstrate that when the IGP metric changes, the MED also changes after the configured delay interval. The OSPF metric can range from 1 through 65,535.

Figure 47 on page 2732 shows the sample topology.

Figure 47: Topology for Delaying the MED Update



In this example, the MED value advertised by Device R1 is associated with the IGP running in AS 1. The MED value advertised by Device R1 impacts the decisions of the neighboring AS (AS 2) when AS 2 is forwarding traffic into AS 1.

Configuration

- Configuring Device R1 on page 2736

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 2 description R1->R2
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.1/30
set interfaces fe-1/2/1 unit 7 description R1->R4
set interfaces fe-1/2/1 unit 7 family inet address 172.16.0.1/30
set interfaces lo0 unit 1 family inet address 192.168.0.1/32
set protocols bgp group internal type internal
```

```
set protocols bgp group internal local-address 192.168.0.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.2
set protocols bgp group internal neighbor 192.168.0.3
set protocols bgp group external type external
set protocols bgp group external metric-out igp delay-med-update
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 2
set protocols bgp group external neighbor 172.16.0.2
set protocols ospf area 0.0.0.0 interface fe-1/2/0.2 metric 600
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options med-igp-update-interval 12
set routing-options router-id 192.168.0.1
set routing-options autonomous-system 1
```

Device R2

```
set interfaces fe-1/2/0 unit 1 description R2->R1
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 4 description R2->R3
set interfaces fe-1/2/1 unit 4 family inet address 10.0.2.2/30
set interfaces lo0 unit 2 family inet address 192.168.0.2/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.2
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.1
set protocols bgp group internal neighbor 192.168.0.3
set protocols ospf area 0.0.0.0 interface fe-1/2/0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.2
set routing-options autonomous-system 1
```

Device R3

```
set interfaces fe-1/2/0 unit 3 description R3->R2
set interfaces fe-1/2/0 unit 3 family inet address 10.0.2.1/30
set interfaces fe-1/2/1 unit 5 description R3->R5
set interfaces fe-1/2/1 unit 5 family inet address 172.16.0.5/30
set interfaces lo0 unit 3 family inet address 192.168.0.3/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.3
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.1
set protocols bgp group internal neighbor 192.168.0.2
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 2
set protocols bgp group external neighbor 172.16.0.6
set protocols ospf area 0.0.0.0 interface fe-1/2/0.3
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.3
set routing-options autonomous-system 1
```

Device R4

```
set interfaces fe-1/2/0 unit 8 description R4->R1
set interfaces fe-1/2/0 unit 8 family inet address 172.16.0.2/30
set interfaces fe-1/2/1 unit 9 description R4->R5
set interfaces fe-1/2/1 unit 9 family inet address 10.0.4.1/30
set interfaces fe-1/2/2 unit 13 description R4->R6
set interfaces fe-1/2/2 unit 13 family inet address 172.16.0.9/30
set interfaces lo0 unit 4 family inet address 192.168.0.4/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.4
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.5
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external neighbor 172.16.0.10 peer-as 3
set protocols bgp group external neighbor 172.16.0.1 peer-as 1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.9
set protocols ospf area 0.0.0.0 interface lo0.4 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.4
set routing-options autonomous-system 2
```

Device R5

```
set interfaces fe-1/2/0 unit 6 description R5->R3
set interfaces fe-1/2/0 unit 6 family inet address 172.16.0.6/30
set interfaces fe-1/2/1 unit 10 description R5->R4
set interfaces fe-1/2/1 unit 10 family inet address 10.0.4.2/30
set interfaces fe-1/2/2 unit 11 description R5->R8
set interfaces fe-1/2/2 unit 11 family inet address 172.16.0.13/30
set interfaces lo0 unit 5 family inet address 192.168.0.5/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.5
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.4
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external neighbor 172.16.0.5 peer-as 1
set protocols bgp group external neighbor 172.16.0.14 peer-as 3
set protocols ospf area 0.0.0.0 interface fe-1/2/1.10
set protocols ospf area 0.0.0.0 interface lo0.5 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.5
set routing-options autonomous-system 2
```

Device R6

```
set interfaces fe-1/2/0 unit 14 description R6->R4
set interfaces fe-1/2/0 unit 14 family inet address 172.16.0.10/30
set interfaces fe-1/2/1 unit 15 description R6->R7
set interfaces fe-1/2/1 unit 15 family inet address 10.0.6.1/30
set interfaces lo0 unit 6 family inet address 192.168.0.6/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.6
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.7
set protocols bgp group internal neighbor 192.168.0.8
set protocols bgp group external type external
```



```
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 2
set protocols bgp group external neighbor 172.16.0.9 peer-as 2
set protocols ospf area 0.0.0.0 interface fe-1/2/1.15
set protocols ospf area 0.0.0.0 interface lo0.6 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.6
set routing-options autonomous-system 3
```

Device R7

```
set interfaces fe-1/2/0 unit 16 description R7->R6
set interfaces fe-1/2/0 unit 16 family inet address 10.0.6.2/30
set interfaces fe-1/2/1 unit 17 description R7->R8
set interfaces fe-1/2/1 unit 17 family inet address 10.0.7.2/30
set interfaces lo0 unit 7 family inet address 192.168.0.7/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.7
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.6
set protocols bgp group internal neighbor 192.168.0.8
set protocols ospf area 0.0.0.0 interface fe-1/2/0.16
set protocols ospf area 0.0.0.0 interface fe-1/2/1.17
set protocols ospf area 0.0.0.0 interface lo0.7 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.7
set routing-options autonomous-system 3
```

Device R8

```
set interfaces fe-1/2/0 unit 12 description R8->R5
set interfaces fe-1/2/0 unit 12 family inet address 172.16.0.14/30
set interfaces fe-1/2/1 unit 18 description R8->R7
set interfaces fe-1/2/1 unit 18 family inet address 10.0.7.1/30
set interfaces lo0 unit 8 family inet address 192.168.0.8/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.8
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.6
set protocols bgp group internal neighbor 192.168.0.7
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 2
set protocols bgp group external neighbor 172.16.0.13 peer-as 2
set protocols ospf area 0.0.0.0 interface fe-1/2/1.18
set protocols ospf area 0.0.0.0 interface lo0.8 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.8
set routing-options autonomous-system 3
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 2]
user@R1# set description R1->R2
user@R1# set family inet address 10.0.0.1/30

[edit interfaces fe-1/2/1 unit 7]
user@R1# set description R1->R4
user@R1# set family inet address 172.16.0.1/30

[edit interfaces lo0 unit 1]
user@R1# set family inet address 192.168.0.1/32
```

2. Configure IBGP.

```
[edit protocols bgp group internal]
user@R1# set type internal
user@R1# set local-address 192.168.0.1
user@R1# set export send-direct
user@R1# set neighbor 192.168.0.2
user@R1# set neighbor 192.168.0.3
```

3. Configure EBGP.

```
[edit protocols bgp group external]
user@R1# set type external
user@R1# set export send-direct
user@R1# set peer-as 2
user@R1# set neighbor 172.16.0.2
```

4. Associate the MED value with the IGP metric.

```
[edit protocols bgp group external]
user@R1# set metric-out igp delay-med-update
```

   The default for the MED update is 10 minutes when you include the **delay-med-update** option. When you exclude the **delay-med-update** option, the MED update occurs immediately after the IGP metric changes.

5. (Optional) Configure the update interval for the MED update.

```
[edit routing-options]
user@R1# set med-igp-update-interval 12
```

   You can configure the interval from 10 minutes through 600 minutes.

6. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface fe-1/2/0.2 metric 600
user@R1# set interface lo0.1 passive
```

The **metric** statement is used here to demonstrate what happens when the IGP metric changes.

7. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

   ```
   [edit policy-options policy-statement send-direct term 1]
   user@R1# set from protocol direct
   user@R1# set then accept
   ```

8. Configure the router ID and autonomous system (AS) number.

   ```
   [edit routing-options]
   user@R1# set router-id 192.168.0.1
   user@R1# set autonomous-system 1
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 2 {
      description R1->R2;
      family inet {
         address 10.0.0.1/30;
      }
   }
}
fe-1/2/1 {
   unit 7 {
      description R1->R4;
      family inet {
         address 172.16.0.1/30;
      }
   }
}
lo0 {
   unit 1 {
      family inet {
         address 192.168.0.1/32;
      }
   }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R1# show protocols
```

```
bgp {
  group internal {
    type internal;
    local-address 192.168.0.1;
    export send-direct;
    neighbor 192.168.0.2;
    neighbor 192.168.0.3;
  }
  group external {
    type external;
    metric-out igp delay-med-update;
    export send-direct;
    peer-as 2;
    neighbor 172.16.0.2;
  }
}
ospf {
  area 0.0.0.0 {
    interface fe-1/2/0.2 {
      metric 600;
    }
    interface lo0.1 {
      passive;
    }
  }
}
```

```
user@R1# show routing-options
med-igp-update-interval 12;
router-id 192.168.0.1;
autonomous-system 1;
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat the configuration steps on the other devices in the topology, as needed for your network.

Verification

Confirm that the configuration is working properly.

- Checking the BGP Advertisements on page 2738
- Verifying That the MED Value Changes When the OSPF Metric Changes on page 2739
- Testing the minimum-igp Setting on page 2739

Checking the BGP Advertisements

Purpose Verify that Device R1 is advertising to Device R4 a BGP MED value that reflects the IGP metric.

Action From operational mode, enter the **show route advertising-protocol bgp** command.

```
user@R1> show route advertising-protocol bgp 172.16.0.2
inet.0: 19 destinations, 33 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30             Self                 0                  I
* 172.16.0.0/30           Self                 0                  I
```

```
* 172.16.0.4/30          Self                 601                 I
* 192.168.0.1/32         Self                 0                   I
```

Meaning The 601 value in the MED column shows that the MED value has been updated to reflect the configured OSPF metric.

Verifying That the MED Value Changes When the OSPF Metric Changes

Purpose Make sure that when you raise the OSPF metric to 700, the MED value is updated to reflect this change.

Action From configuration mode, enter the **set protocols ospf area 0 interface fe-1/2/0.2 metric 700** command.

```
user@R1# set protocols ospf area 0 interface fe-1/2/0.2 metric 700
user@R1# commit
```

After waiting 12 minutes (the configured delay period), enter the **show route advertising-protocol bgp** command from operational mode.

```
user@R1> show route advertising-protocol bgp 172.16.0.2
inet.0: 19 destinations, 33 routes (19 active, 0 holddown, 0 hidden)
  Prefix                 Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30            Self                 0                  I
* 172.16.0.0/30          Self                 0                  I
* 172.16.0.4/30          Self                 701                I
* 192.168.0.1/32         Self                 0                  I
```

Meaning The 701 value in the MED column shows that the MED value has been updated to reflect the configured OSPF metric.

Testing the minimum-igp Setting

Purpose Change the configuration to use the **minimum-igp** statement instead of the **igp** statement. When you increase the OSPF metric, the MED value remains unchanged, but when you decrease the OSPF metric, the MED value reflects the new OSPF metric.

Action From configuration mode, delete the **igp** statement, add the **minimum-igp** statement, and increase the OSPF metric.

```
user@R1# delete protocols bgp group external metric-out igp
user@R1# set protocols bgp group external metric-out minimum-igp
user@R1# set protocols ospf area 0 interface fe-1/2/0.2 metric 800
user@R1# commit
```

From operational mode, enter the **show route advertising-protocol bgp** command to make sure that the MED value does not change.

```
user@R1> show route advertising-protocol bgp 172.16.0.2
inet.0: 19 destinations, 33 routes (19 active, 0 holddown, 0 hidden)
  Prefix                 Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30            Self                 0                  I
* 172.16.0.0/30          Self                 0                  I
* 172.16.0.4/30          Self                 701                I
* 192.168.0.1/32         Self                 0                  I
```


From configuration mode, decrease the OSPF metric.

```
user@R1# set protocols ospf area 0 interface fe-1/2/0.2 metric 20
user@R1# commit
```

From operational mode, enter the **show route advertising-protocol bgp** command to make sure that the MED value does change.

```
user@R1> show route advertising-protocol bgp 172.16.0.2
inet.0: 19 destinations, 33 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30             Self                 0                  I
* 172.16.0.0/30           Self                 0                  I
* 172.16.0.4/30           Self                 21                 I
* 192.168.0.1/32          Self                 0                  I
```

Meaning When the **minimum-igp** statement is configured, the MED value changes only when a shorter path is available.

Related Documentation

- Examples: Configuring External BGP Peering on page 2639
- *BGP Configuration Overview*

Examples: Configuring BGP Local AS

Understanding the BGP Local AS Attribute

When an Internet service provider (ISP) acquires a network that belongs to a different autonomous system (AS), there is no seamless method for moving the BGP peers of the acquired network to the AS of the acquiring ISP. The process of configuring the BGP peers with the new AS number can be time-consuming and cumbersome. Sometimes customers do not want to or are not immediately able to modify their peer arrangements or configuration. During this kind of transition period, it can be useful to configure BGP-enabled devices in the new AS to use the former AS number in BGP updates. This former AS number is called a *local AS*.

Using a local AS number permits the routing devices in an acquired network to appear to belong to the former AS.

For example, ISP A, with an AS of 200, acquires ISP B, with an AS of 250. ISP B has a customer, ISP C, that does not want to change its configuration. After ISP B becomes part of ISP A, a local AS number of 250 is configured for use in EBGP peer sessions with ISP C. Consequently, the local AS number of 250 is either prepended before or used instead of the global AS number of 200 in the AS path used to export routes to direct external peers in ISP C.

If the route is received from an internal BGP (IBGP) peer, the AS path includes the local AS number prepended before the global AS number.

The local AS number is used instead of the global AS number if the route is an external route, such as a static route or an interior gateway protocol (IGP) route that is imported into BGP. If the route is external and you want the global AS number to be included in the AS path, you can apply a routing policy that uses **as-path-expand** or **as-path-prepend**. Use the **as-path-expand** policy action to place the global AS number behind the local AS number. Use the **as-path-prepend** policy action to place the global AS number in front of the local AS number.

For example:

```
user@R2# show policy-options
policy-statement prepend-global {
   term 1 {
      from protocol static;
      then {
         as-path-prepend 200; # or use as-path-expand
         accept;
      }
   }
}
user@R2# show protocols bgp
group ext {
   export prepend-global;
   type external;
   local-as 250;
   neighbor 10.0.0.1 {
      peer-as 100;
   }
   neighbor 10.1.0.2 {
      peer-as 300;
   }
}
user@R2# show routing-options
static {
   route 1.1.1.1/32 next-hop 10.0.0.1;
}
autonomous-system 200;
```

```
user@R3# run show route 1.1.1.1 protocol bgp
inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32          *[BGP/170] 00:05:11, localpref 100
                       AS path: 200 250 I, validation-state: unverified
                     > to 10.1.0.1 via lt-1/2/0.4
```

In a Layer 3 VPN scenario, in which a provider edge (PE) device uses external BGP (EBGP) to peer with a customer edge (CE) device, the **local-as** statement behaves differently than in the non-VPN scenario. In the VPN scenario, the global AS number defined in the master instance is prepended to the AS path by default. To override this behavior, you can configure the **no-prepend-global-as** in the routing-instance BGP configuration on the PE device, as shown here:

```
user@R2# show routing-instances
```

```
red {
   instance-type vrf;
   interface fe-1/2/0.2;
   route-distinguisher 2:1;
   vrf-target target:2:1;
   protocols {
      bgp {
         group toR1 {
            type external;
            peer-as 1;
            local-as 200 no-prepend-global-as;
            neighbor 10.1.1.1;
         }
      }
   }
}
```

The Junos operating system (Junos OS) implementation of the local AS attribute supports the following options:

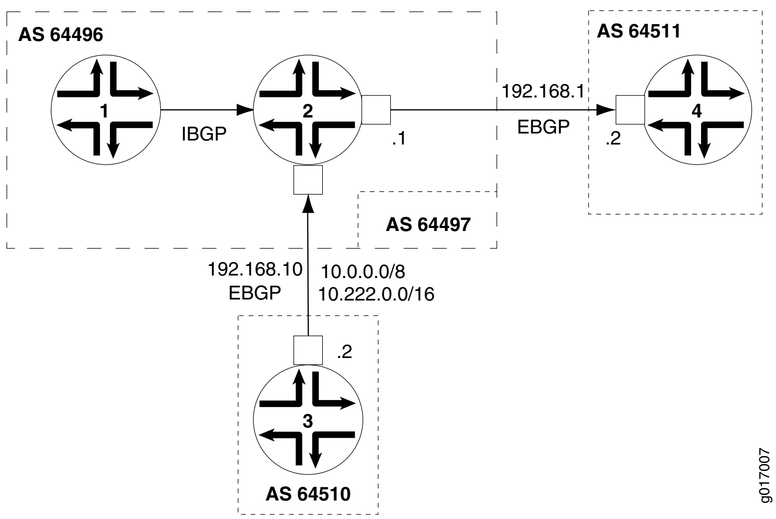
- **Local AS with private option**—When you use the **private** option, the local AS is used during the establishment of the BGP session with an EBGP neighbor but is hidden in the AS path sent to other EBGP peers. Only the global AS is included in the AS path sent to external peers.

  The **private** option is useful for establishing local peering with routing devices that remain configured with their former AS or with a specific customer that has not yet modified its peer arrangements. The local AS is used to establish the BGP session with the EBGP neighbor but is hidden in the AS path sent to external peers in another AS.

  Include the **private** option so that the local AS is not prepended before the global AS in the AS path sent to external peers. When you specify the **private** option, the local AS is prepended only in the AS path sent to the EBGP neighbor.

  For example, in Figure 48 on page 2743, Router 1 and Router 2 are in AS 64496, Router 4 is in AS 64511, and Router 3 is in AS 64510. Router 2 formerly belonged to AS 64497, which has merged with another network and now belongs to AS 64496. Because Router 3 still peers with Router 2 using its former AS (64497), Router 2 needs to be configured with a local AS of 64497 in order to maintain peering with Router 3. Configuring a local AS of 64497 permits Router 2 to add AS 64497 when advertising routes to Router 3. Router 3 sees an AS path of 64497 64496 for the prefix 10/8.

  Figure 48: Local AS Configuration

  To prevent Router 2 from adding the local AS number in its announcements to other peers, use the **local-as 64497 private** statement. This statement configures Router 2 to not include local AS 64497 when announcing routes to Router 1 and to Router 4. In this case, Router 4 sees an AS path of 64496 64510 for the prefix 10.222/16.

- **Local AS with alias option**—In Junos OS Release 9.5 and later, you can configure a local AS as an alias. During the establishment of the BGP open session, the AS used in the open message alternates between the local AS and the global AS. If the local AS is used to connect with the EBGP neighbor, then only the local AS is prepended to the AS path when the BGP peer session is established. If the global AS is used to connect with the EBGP neighbor, then only the global AS is prepended to the AS path when the BGP peer session is established. The use of the **alias** option also means that the local AS is not prepended to the AS path for any routes learned from that EBGP neighbor. Therefore, the local AS remains hidden from other external peers.

Configuring a local AS with the **alias** option is especially useful when you are migrating the routing devices in an acquired network to the new AS. During the migration process, some routing devices might be configured with the new AS while others remain configured with the former AS. For example, it is good practice to start by first migrating to the new AS any routing devices that function as route reflectors. However, as you migrate the route reflector clients incrementally, each route reflector has to peer with routing devices configured with the former AS, as well as peer with routing devices configured with the new AS. To establish local peer sessions, it can be useful for the BGP peers in the network to use both the local AS and the global AS. At the same time, you want to hide this local AS from external peers and use only the global AS in the AS path when exporting routes to another AS. In this kind of situation, configure the **alias** option.

Include the **alias** option to configure the local AS as an alias to the global AS configured at the **[edit routing-options]** hierarchy level. When you configure a local AS as an alias, during the establishment of the BGP open session, the AS used in the open message alternates between the local AS and the global AS. The local AS is prepended to the AS path only when the peer session with an EBGP neighbor is established using that local AS. The local AS is hidden in the AS path sent to any other external peers. Only the global AS is prepended to the AS path when the BGP session is established using the global AS.

NOTE: **The private and alias options are mutually exclusive. You cannot configure both options with the same local-as statement.**

- **Local AS with option not to prepend the global AS**—In Junos OS Release 9.6 and later, you can configure a local AS with the option not to prepend the global AS. Only the local AS is included in the AS path sent to external peers.

  Use the **no-prepend-global-as** option when you want to strip the global AS number from outbound BGP updates in a virtual private network (VPN) scenario. This option is useful in aVPN scenario in which you want to hide the global AS from the VPN.

  Include the **no-prepend-global-as** option to have the global AS configured at the **[edit routing-options]** hierarchy level removed from the AS path sent to external peers. When you use this option, only the local AS is included in the AS path for the routes sent to a customer edge (CE) device.

- **Number of loops option**—The local AS feature also supports specifying the number of times that detection of the AS number in the AS_PATH attribute causes the route to be discarded or hidden. For example, if you configure **loops 1**, the route is hidden if the AS number is detected in the path one or more times. This is the default behavior. If you configure **loops 2**, the route is hidden if the AS number is detected in the path two or more times.

  For the **loops *number*** statement, you can configure 1 through 10.

NOTE: If you configure the local AS values for any BGP group, the detection of routing loops is performed using both the AS and the local AS values for all BGP groups.

If the local AS for the EBGP or IBGP peer is the same as the current AS, do not use the **local-as** statement to specify the local AS number.

When you configure the local AS within a VRF, this impacts the AS path loop-detection mechanism. All of the **local-as** statements configured on the device are part of a single AS domain. The AS path loop-detection mechanism is based on looking for a matching AS present in the domain.

Example: Configuring a Local AS for EBGP Sessions

This example shows how to configure a local autonomous system (AS) for a BGP peer so that both the global AS and the local AS are used in BGP inbound and outbound updates.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

Use the **local-as** statement when ISPs merge and want to preserve a customer's configuration, particularly the AS with which the customer is configured to establish a peer relationship. The **local-as** statement simulates the AS number already in place in customer routers, even if the ISP's router has moved to a different AS.

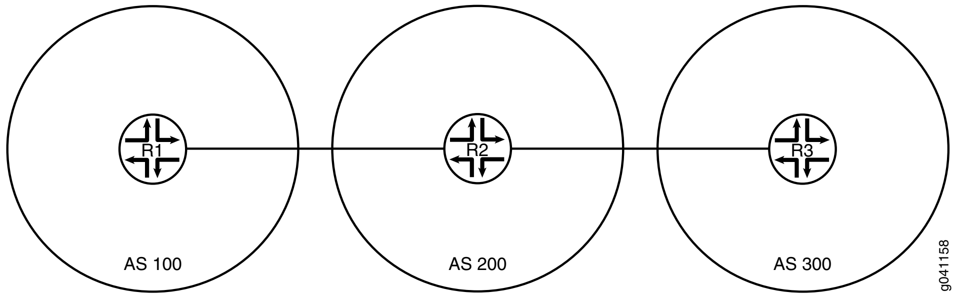
This example shows how to use the **local-as** statement to configure a local AS. The **local-as** statement is supported for BGP at the global, group, and neighbor hierarchy levels.

When you configure the **local-as** statement, you must specify an AS number. You can specify a number from 1 through 4,294,967,295 in plain-number format. In Junos OS Release 9.1 and later, the range for AS numbers is extended to provide BGP support for 4-byte AS numbers as defined in RFC 4893, *BGP Support for Four-octet AS Number Space*. In Junos OS Release 9.3 and later, you can also configure a 4-byte AS number using the AS-dot notation format of two integer values joined by a period: *<16-bit high-order value in decimal>*.*<16-bit low-order value in decimal>*. For example, the 4-byte AS number of 65,546 in plain-number format is represented as 1.10 in the AS-dot notation format. You can specify a value from 0.0 through 65535.65535 in AS-dot notation format. Junos

OS continues to support 2-byte AS numbers. The 2-byte AS number range is 1 through 65,535 (this is a subset of the 4-byte range).

Figure 49 on page 2746 shows the sample topology.

Figure 49: Topology for Configuring the Local AS



In this example, Device R2 formerly belonged to AS 250 and now is in AS 200. Device R1 and Device R3 are configured to peer with AS 250 instead of with the new AS number (AS 200). Device R2 has the new AS number configured with the **autonomous-system 200** statement. To enable the peering sessions to work, the **local-as 250** statement is added in the BGP configuration. Because **local-as 250** is configured, Device R2 includes both the global AS (200) and the local AS (250) in its BGP inbound and outbound updates.

Configuration

- Configuring Device R1 on page 2747
- Configuring Device R2 on page 2749
- Configuring Device R3 on page 2751

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set interfaces lo0 unit 1 family inet address 192.168.0.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext peer-as 250
set protocols bgp group ext neighbor 10.0.0.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 10.1.0.0/30 next-hop 10.0.0.2
set routing-options autonomous-system 100
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 3 family inet address 10.1.0.1/30
set interfaces lo0 unit 2 family inet address 192.168.0.2/32
set protocols bgp group ext type external
```

```
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext local-as 250
set protocols bgp group ext neighbor 10.0.0.1 peer-as 100
set protocols bgp group ext neighbor 10.1.0.2 peer-as 300
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options autonomous-system 200
```

Device R3

```
set interfaces fe-1/2/0 unit 4 family inet address 10.1.0.2/30
set interfaces lo0 unit 3 family inet address 192.168.0.3/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext peer-as 250
set protocols bgp group ext neighbor 10.1.0.1
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 10.0.0.0/30 next-hop 10.1.0.1
set routing-options autonomous-system 300
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces]
user@R1# set fe-1/2/0 unit 1 family inet address 10.0.0.1/30

user@R1# set lo0 unit 1 family inet address 192.168.0.1/32
```

2. Configure external BGP (EBGP).

```
[edit protocols bgp group ext]
user@R1# set type external
user@R1# set export send-direct
user@R1# set export send-static
user@R1# set peer-as 250
user@R1# set neighbor 10.0.0.2
```

3. Configure the routing policy.

```
[edit policy-options]
user@R1# set policy-statement send-direct term 1 from protocol direct
user@R1# set policy-statement send-direct term 1 then accept
user@R1# set policy-statement send-static term 1 from protocol static
user@R1# set policy-statement send-static term 1 then accept
```

4. Configure a static route to the remote network between Device R2 and Device R3.

```
[edit routing-options]
user@R1# set static route 10.1.0.0/30 next-hop 10.0.0.2
```

5. Configure the global AS number.

```
[edit routing-options]
user@R1# set autonomous-system 100
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
  unit 1 {
    family inet {
      address 10.0.0.1/30;
    }
  }
}
lo0 {
  unit 1 {
    family inet {
      address 192.168.0.1/32;
    }
  }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
  }
}
policy-statement send-static {
  term 1 {
    from protocol static;
    then accept;
  }
}
```

```
user@R1# show protocols
bgp {
  group ext {
    type external;
    export [ send-direct send-static ];
    peer-as 250;
    neighbor 10.0.0.2;
  }
}
```

```
user@R1# show routing-options
static {
```



```
    route 10.1.0.0/30 next-hop 10.0.0.2;
  }
  autonomous-system 100;
```

When you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@R2# set fe-1/2/0 unit 2 family inet address 10.0.0.2/30

   user@R2# set fe-1/2/1 unit 3 family inet address 10.1.0.1/30

   user@R2# set lo0 unit 2 family inet address 192.168.0.2/32
   ```

2. Configure EBGP.

   ```
   [edit protocols bgp group ext]
   user@R2# set type external
   user@R2# set export send-direct
   user@R2# set export send-static
   user@R2# set neighbor 10.0.0.1 peer-as 100
   user@R2# set neighbor 10.1.0.2 peer-as 300
   ```

3. Configure the local autonomous system (AS) number.

   ```
   [edit protocols bgp group ext]
   user@R2# set local-as 250
   ```

4. Configure the global AS number.

   ```
   [edit routing-options]
   user@R2# set autonomous-system 200
   ```

5. Configure the routing policy.

   ```
   [edit policy-options]
   user@R2# set policy-statement send-direct term 1 from protocol direct
   user@R2# set policy-statement send-direct term 1 then accept
   user@R2# set policy-statement send-static term 1 from protocol static
   user@R2# set policy-statement send-static term 1 then accept
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
  unit 2 {
```

```
      family inet {
        address 10.0.0.2/30;
      }
    }
  }
  fe-1/2/1 {
    unit 3 {
      family inet {
        address 10.1.0.1/30;
      }
    }
  }
  lo0 {
    unit 2 {
      family inet {
        address 192.168.0.2/32;
      }
    }
  }
```

```
user@R2# show policy-options
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
  }
}
policy-statement send-static {
  term 1 {
    from protocol static;
    then accept;
  }
}
```

```
user@R2# show protocols
bgp {
  group ext {
    type external;
    export [ send-direct send-static ];
    local-as 250;
    neighbor 10.0.0.1 {
      peer-as 100;
    }
    neighbor 10.1.0.2 {
      peer-as 300;
    }
  }
}
```

```
user@R2# show routing-options
autonomous-system 200;
```

When you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R3

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R3:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@R3# set fe-1/2/0 unit 4 family inet address 10.1.0.2/30

   user@R3# set lo0 unit 3 family inet address 192.168.0.3/32
   ```

2. Configure EBGP.

   ```
   [edit protocols bgp group ext]
   user@R3# set type external
   user@R3# set export send-direct
   user@R3# set export send-static
   user@R3# set peer-as 250
   user@R3# set neighbor 10.1.0.1
   ```

3. Configure the global autonomous system (AS) number.

   ```
   [edit routing-options]
   user@R3# set autonomous-system 300
   ```

4. Configure a static route to the remote network between Device R1 and Device R2.

   ```
   [edit routing-options]
   user@R3# set static route 10.0.0.0/30 next-hop 10.1.0.1
   ```

5. Configure the routing policy.

   ```
   [edit policy-options]
   user@R3# set policy-statement send-direct term 1 from protocol direct
   user@R3# set policy-statement send-direct term 1 then accept
   user@R3# set policy-statement send-static term 1 from protocol static
   user@R3# set policy-statement send-static term 1 then accept
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show interfaces
fe-1/2/0 {
  unit 4 {
    family inet {
      address 10.1.0.2/30;
    }
  }
}
lo0 {
  unit 3 {
```

```
        family inet {
            address 192.168.0.3/32;
        }
    }
}
```

```
user@R3# show policy-options
policy-statement send-direct {
    term 1 {
        from protocol direct;
        then accept;
    }
}
policy-statement send-static {
    term 1 {
        from protocol static;
        then accept;
    }
}
```

```
user@R3# show protocols
bgp {
    group ext {
        type external;
        export [ send-direct send-static ];
        peer-as 250;
        neighbor 10.1.0.1;
    }
}
```

```
user@R3# show routing-options
static {
    route 10.0.0.0/30 next-hop 10.1.0.1;
}
autonomous-system 300;
```

When you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the Local and Global AS Settings on page 2752
- Checking the BGP Peering Sessions on page 2754
- Verifying the BGP AS Paths on page 2754

Checking the Local and Global AS Settings

Purpose Make sure that Device R2 has the local and global AS settings configured.

Action From operational mode, enter the **show bgp neighbors** command.

```
user@R2> show bgp neighbors
Peer: 10.0.0.1+179 AS 100      Local: 10.0.0.2+61036 AS 250
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
```



```
    Export: [ send-direct send-static ]
    Options: <Preference PeerAS LocalAS Refresh>
    Holdtime: 90 Preference: 170 Local AS: 250 Local System AS: 200
    Number of flaps: 0
    Peer ID: 192.168.0.1     Local ID: 192.168.0.2      Active Holdtime: 90
    Keepalive Interval: 30         Peer index: 0
    BFD: disabled, down
    Local Interface: fe-1/2/0.2
    NLRI for restart configured on peer: inet-unicast
    NLRI advertised by peer: inet-unicast
    NLRI for this session: inet-unicast
    Peer supports Refresh capability (2)
    Stale routes from peer are kept for: 300
    Peer does not support Restarter functionality
    NLRI that restart is negotiated for: inet-unicast
    NLRI of received end-of-rib markers: inet-unicast
    NLRI of all end-of-rib markers sent: inet-unicast
    Peer supports 4 byte AS extension (peer-as 100)
    Peer does not support Addpath
    Table inet.0 Bit: 10000
      RIB State: BGP restart is complete
      Send state: in sync
      Active prefixes:              1
      Received prefixes:            3
      Accepted prefixes:            2
      Suppressed due to damping:    0
      Advertised prefixes:          4
    Last traffic (seconds): Received 6    Sent 14   Checked 47
    Input messages:  Total 258    Updates 3      Refreshes 0     Octets 4969
    Output messages: Total 258    Updates 2      Refreshes 0     Octets 5037
    Output Queue[0]: 0

  Peer: 10.1.0.2+179 AS 300      Local: 10.1.0.1+52296 AS 250
    Type: External    State: Established    Flags: <Sync>
    Last State: OpenConfirm   Last Event: RecvKeepAlive
    Last Error: None
    Export: [ send-direct send-static ]
    Options: <Preference PeerAS LocalAS Refresh>
    Holdtime: 90 Preference: 170 Local AS: 250 Local System AS: 200
    Number of flaps: 0
    Peer ID: 192.168.0.3     Local ID: 192.168.0.2      Active Holdtime: 90
    Keepalive Interval: 30         Peer index: 1
    BFD: disabled, down
    Local Interface: fe-1/2/1.3
    NLRI for restart configured on peer: inet-unicast
    NLRI advertised by peer: inet-unicast
    NLRI for this session: inet-unicast
    Peer supports Refresh capability (2)
    Stale routes from peer are kept for: 300
    Peer does not support Restarter functionality
    NLRI that restart is negotiated for: inet-unicast
    NLRI of received end-of-rib markers: inet-unicast
    NLRI of all end-of-rib markers sent: inet-unicast
    Peer supports 4 byte AS extension (peer-as 300)
    Peer does not support Addpath
    Table inet.0 Bit: 10000
      RIB State: BGP restart is complete
      Send state: in sync
      Active prefixes:              1
      Received prefixes:            3
      Accepted prefixes:            2
```



```
    Suppressed due to damping:    0
    Advertised prefixes:          4
  Last traffic (seconds): Received 19   Sent 26   Checked 9
  Input messages:  Total 256    Updates 3       Refreshes 0     Octets 4931
  Output messages: Total 256    Updates 2       Refreshes 0     Octets 4999
  Output Queue[0]: 0
```

Meaning The Local AS: 250 and Local System AS: 200 output shows that Device R2 has the expected settings. Additionally, the output shows that the options list includes LocalAS.

Checking the BGP Peering Sessions

Purpose Ensure that the sessions are established and that the local AS number 250 is displayed.

Action From operational mode, enter the **show bgp summary** command.

```
user@R1> show bgp summary
Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 4          2          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.0.0.2                250        232        233       0       4     1:42:37
2/4/4/0              0/0/0/0
```

```
user@R3> show bgp summary
Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 4          2          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.1.0.1                250        235        236       0       4     1:44:25
2/4/4/0              0/0/0/0
```

Meaning Device R1 and Device R3 appear to be peering with a device in AS 250, even though Device R2 is actually in AS 200.

Verifying the BGP AS Paths

Purpose Make sure that the routes are in the routing tables and that the AS paths show the local AS number 250.

Action From configuration mode, enter the **set route protocol bgp** command.

```
user@R1> show route protocol bgp
inet.0: 6 destinations, 8 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.0/30         [BGP/170] 01:46:44, localpref 100
                      AS path: 250 I
                    > to 10.0.0.2 via fe-1/2/0.1
10.1.0.0/30         [BGP/170] 01:46:44, localpref 100
                      AS path: 250 I
                    > to 10.0.0.2 via fe-1/2/0.1
192.168.0.2/32     *[BGP/170] 01:46:44, localpref 100
                      AS path: 250 I
                    > to 10.0.0.2 via fe-1/2/0.1
```



```
192.168.0.3/32      *[BGP/170] 01:46:40, localpref 100
                       AS path: 250 300 I
                     > to 10.0.0.2 via fe-1/2/0.1
```

`user@R3>` **show route protocol bgp**

```
inet.0: 6 destinations, 8 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.0/30          [BGP/170] 01:47:10, localpref 100
                       AS path: 250 I
                     > to 10.1.0.1 via fe-1/2/0.4
10.1.0.0/30          [BGP/170] 01:47:10, localpref 100
                       AS path: 250 I
                     > to 10.1.0.1 via fe-1/2/0.4
192.168.0.1/32      *[BGP/170] 01:47:10, localpref 100
                       AS path: 250 100 I
                     > to 10.1.0.1 via fe-1/2/0.4
192.168.0.2/32      *[BGP/170] 01:47:10, localpref 100
                       AS path: 250 I
                     > to 10.1.0.1 via fe-1/2/0.4
```

Meaning The output shows that Device R1 and Device R3 appear to have routes with AS paths that include AS 250, even though Device R2 is actually in AS 200.

Example: Configuring a Private Local AS for EBGP Sessions

This example shows how to configure a private local autonomous system (AS) number. The local AS is considered to be private because it is advertised to peers that use the local AS number for peering, but is hidden in the announcements to peers that can use the global AS number for peering.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

Use the **local-as** statement when ISPs merge and want to preserve a customer's configuration, particularly the AS with which the customer is configured to establish a peer relationship. The **local-as** statement simulates the AS number already in place in customer routers, even if the ISP's router has moved to a different AS.

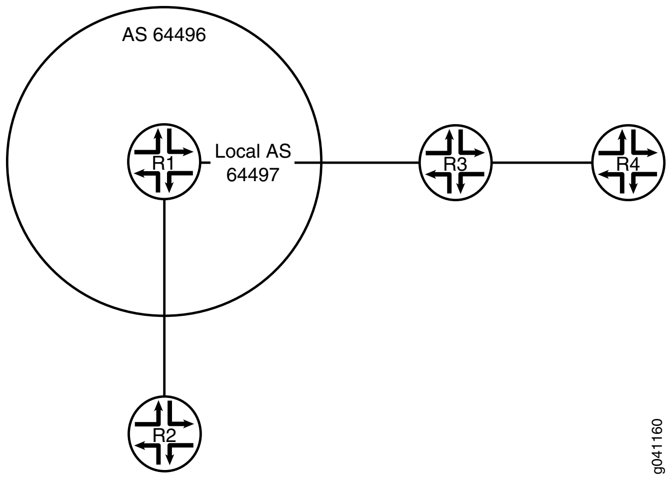
When you use the **private** option, the local AS is used during the establishment of the BGP session with an external BGP (EBGP) neighbor, but is hidden in the AS path sent to other EBGP peers. Only the global AS is included in the AS path sent to external peers.

The **private** option is useful for establishing local peering with routing devices that remain configured with their former AS or with a specific customer that has not yet modified its peer arrangements. The local AS is used to establish the BGP session with the EBGP neighbor, but is hidden in the AS path sent to external peers in another AS.

Include the **private** option so that the local AS is not prepended before the global AS in the AS path sent to external peers. When you specify the **private** option, the local AS is prepended only in the AS path sent to the EBGP neighbor.

Figure 50 on page 2756 shows the sample topology.

Figure 50: Topology for Configuring a Private Local AS



Device R1 is in AS 64496. Device R2 is in AS 64510. Device R3 is in AS 64511. Device R4 is in AS 64512. Device R1 formerly belonged to AS 64497, which has merged with another network and now belongs to AS 64496. Because Device R3 still peers with Device R1, using its former AS, 64497, Device R1 needs to be configured with a local AS of 64497 in order to maintain peering with Device R3. Configuring a local AS of 64497 permits Device R1 to add AS 64497 when advertising routes to Device R3. Device R3 sees an AS path of 64497 64496 for the prefix 10.1.1.2/32, which is Device R2's loopback interface. Device R4, which is behind Device R3, sees an AS path of 64511 64497 64496 64510 to Device R2’s loopback interface. To prevent Device R1 from adding the local AS number in its announcements to other peers, this example includes the **local-as 64497 private** statement. The **private** option configures Device R1 to not include the local AS 64497 when announcing routes to Device R2. Device R2 sees an AS path of 64496 64511 to Device R3 and an AS path of 64496 64511 64512 to Device R4. The **private** option in Device R1's configuration causes the AS number 64497 to be missing from the AS paths that Device R1 readvertises to Device R2.

Device R2 is hiding the private local AS from all the routers, except Device R3. The **private** option applies to the routes that Device R1 receives (learns) from Device R3 and that Device R1, in turn, readvertises to other routers. When these routes learned from Device R3 are readavertised by Device R1 to Device R2, the private local AS is missing from the AS path advertised to Device R2.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network

configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 3 family inet address 192.168.1.1/24
set interfaces fe-1/2/1 unit 5 family inet address 192.168.10.1/24
set interfaces lo0 unit 2 family inet address 10.1.1.1/32
set protocols bgp group external-AS64511 type external
set protocols bgp group external-AS64511 peer-as 64511
set protocols bgp group external-AS64511 local-as 64497
set protocols bgp group external-AS64511 local-as private
set protocols bgp group external-AS64511 neighbor 192.168.1.2
set protocols bgp group external-AS64510 type external
set protocols bgp group external-AS64510 peer-as 64510
set protocols bgp group external-AS64510 neighbor 192.168.10.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 64496
```

Device R2

```
set interfaces fe-1/2/0 unit 6 family inet address 192.168.10.2/24
set interfaces lo0 unit 3 family inet address 10.1.1.2/32
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 64496
set protocols bgp group external neighbor 192.168.10.1
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 64510
```

Device R3

```
set interfaces fe-1/2/0 unit 4 family inet address 192.168.1.2/24
set interfaces fe-1/2/1 unit 7 family inet address 192.168.5.1/24
set interfaces lo0 unit 4 family inet address 10.1.1.3/32
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external neighbor 192.168.1.1 peer-as 64497
set protocols bgp group external neighbor 192.168.5.2 peer-as 64512
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 64511
```

Device R4

```
set interfaces fe-1/2/0 unit 8 family inet address 192.168.5.2/24
set interfaces lo0 unit 5 family inet address 10.1.1.4/32
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 64511
set protocols bgp group external neighbor 192.168.5.1
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 64512
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 3]
   user@R1# set family inet address 192.168.1.1/24

   [edit interfaces fe-1/2/1 unit 5]
   user@R1# set family inet address 192.168.10.1/24

   [edit interfaces lo0 unit 2]
   user@R1# set family inet address 10.1.1.1/32
   ```

2. Configure the EBGP peering session with Device R2.

   ```
   [edit protocols bgp group external-AS64510]
   user@R1# set type external
   user@R1# set peer-as 64510
   user@R1# set neighbor 192.168.10.2
   ```

3. Configure the EBGP peering session with Device R3.

   ```
   [edit protocols bgp group external-AS64511]
   user@R1# set type external
   user@R1# set peer-as 64511
   user@R1# set local-as 64497
   user@R1# set local-as private
   user@R1# set neighbor 192.168.1.2
   ```

4. Configure the routing policy.

   ```
   [edit policy-options policy-statement send-direct term 1]
   user@R1# set from protocol direct
   user@R1# set then accept
   ```

5. Configure the global autonomous system (AS) number.

   ```
   [edit routing-options]
   user@R1# set autonomous-system 64496
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
  unit 3 {
    family inet {
      address 192.168.1.1/24;
    }
```



```
    }
}
fe-1/2/1 {
    unit 5 {
        family inet {
            address 192.168.10.1/24;
        }
    }
}
lo0 {
    unit 2 {
        family inet {
            address 10.1.1.1/32;
        }
    }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
    term 1 {
        from protocol direct;
        then accept;
    }
}
```

```
user@R1# show protocols
bgp {
    group external-AS64511 {
        type external;
        peer-as 64511;
        local-as 64497 private;
        neighbor 192.168.1.2;
    }
    group external-AS64510 {
        type external;
        peer-as 64510;
        neighbor 192.168.10.2;
    }
}
```

```
user@R1# show routing-options
autonomous-system 64496;
```

If you are done configuring the device, enter **commit** from configuration mode.

Repeat the configuration as needed for the other devices in the topology.

Verification

Confirm that the configuration is working properly.

- Checking Device R2's AS Paths on page 2760
- Checking Device R3's AS Paths on page 2760

Checking Device R2's AS Paths

Purpose Make sure that Device R2 does not have AS 64497 in its AS paths to Device R3 and Device R4.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R2> show route protocol bgp
inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.1.1.3/32        *[BGP/170] 01:33:11, localpref 100
                      AS path: 64496 64511 I
                    > to 192.168.10.1 via fe-1/2/0.6
10.1.1.4/32        *[BGP/170] 01:33:11, localpref 100
                      AS path: 64496 64511 64512 I
                    > to 192.168.10.1 via fe-1/2/0.6
192.168.5.0/24     *[BGP/170] 01:49:15, localpref 100
                      AS path: 64496 64511 I
                    > to 192.168.10.1 via fe-1/2/0.6
```

Meaning Device R2's AS paths do not include AS 64497.

Checking Device R3's AS Paths

Purpose Make sure that Device R3 does not have AS 64497 in its AS path to Device R4.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R3> show route protocol bgp
inet.0: 7 destinations, 8 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.1.1.2/32        *[BGP/170] 01:35:11, localpref 100
                      AS path: 64497 64496 64510 I
                    > to 192.168.1.1 via fe-1/2/0.4
10.1.1.4/32        *[BGP/170] 01:35:11, localpref 100
                      AS path: 64512 I
                    > to 192.168.5.2 via fe-1/2/1.7
192.168.5.0/24      [BGP/170] 01:51:15, localpref 100
                      AS path: 64512 I
                    > to 192.168.5.2 via fe-1/2/1.7
```

Meaning Device R3's route to Device R2 (prefix 10.1.1.2) includes both the local and the global AS configured on Device R1 (64497 and 64496, respectively).

Related Documentation

- Examples: Configuring External BGP Peering on page 2639
- *BGP Configuration Overview*

Example: Configuring the Accumulated IGP Attribute for BGP

- Understanding the Accumulated IGP Attribute for BGP on page 2761
- Example: Configuring the Accumulated IGP Attribute for BGP on page 2761

Understanding the Accumulated IGP Attribute for BGP

The interior gateway protocols (IGPs) are designed to handle routing within a single domain or an autonomous system (AS). Each link is assigned a particular value called a metric. The distance between the two nodes is calculated as a sum of all the metric values of links along the path. The IGP selects the shortest path between two nodes based on distance.

BGP is designed to provide routing over a large number of independent ASs with limited or no coordination among respective administrations. BGP does not use metrics in the path selection decisions.

The accumulated IGP (AIGP) metric attribute for BGP enables deployment in which a single administration can run several contiguous BGP ASs. Such deployments allow BGP to make routing decisions based on the IGP metric. In such networks, it is possible for BGP to select paths based on metrics as is done by IGPs. In this case, BGP chooses the shortest path between two nodes, even though the nodes might be in two different ASs.

The AIGP attribute is particularly useful in networks that use tunneling to deliver a packet to its BGP next hop. The Juniper Networks® Junos® operating system (Junos OS) currently supports the AIGP attribute for two BGP address families, **family inet labeled-unicast** and **family inet6 labeled-unicast**.

AIGP impacts the BGP best-route decision process. The AIGP attribute preference rule is applied after the local-preference rule. The AIGP distance is compared to break a tie. The BGP best-route decision process also impacts the way the interior cost rule is applied if the resolving next hop has an AIGP attribute. Without AIGP enabled, the interior cost of a route is based on the calculation of the metric to the next hop for the route. With AIGP enabled, the resolving AIGP distance is added to the interior cost.

The AIGP attribute is an optional non-transitive BGP path attribute and is specified in Internet draft draft-ietf-idr-aigp-06, *The Accumulated IGP Metric Attribute for BGP*.

Example: Configuring the Accumulated IGP Attribute for BGP

This example shows how to configure the accumulated IGP (AIGP) metric attribute for BGP.

Requirements

This example uses the following hardware and software components:

- Seven BGP-speaking devices.
- Junos OS Release 12.1 or later.

Overview

The AIGP attribute enables deployments in which a single administration can run several contiguous BGP autonomous systems (ASs). Such deployments allow BGP to make routing decisions based on the IGP metric. With AIGP enabled, BGP can select paths based on IGP metrics. This enables BGP to choose the shortest path between two nodes, even though the nodes might be in different ASs. The AIGP attribute is particularly useful in networks that use tunneling to deliver a packet to its BGP next hop. This example shows AIGP configured with MPLS label-switched paths.

To enable AIGP, you include the **aigp** statement in the BGP configuration on a protocol family basis. Configuring AIGP on a particular family enables sending and receiving of the AIGP attribute on that family. By default, AIGP is disabled. An AIGP-disabled neighbor does not send an AIGP attribute and silently discards a received AIGP attribute.

Junos OS supports AIGP for **family inet labeled-unicast** and **family inet6 labeled-unicast**. The **aigp** statement can be configured for a given family at the global BGP, group, or neighbor level.

By default, the value of the AIGP attribute for a local prefix is zero. An AIGP-enabled neighbor can originate an AIGP attribute for a given prefix by export policy, using the **aigp-originate** policy action. The value of the AIGP attribute reflects the IGP distance to the prefix. Alternatively, you can specify a value, by using the **aigp-originate distance *distance*** policy action. The configurable range is 0 through 4,294,967,295. Only one node needs to originate an AIGP attribute. The AIGP attribute is retained and readvertised if the neighbors are AIGP enabled with the **aigp** statement in the BGP configuration.

The policy action to originate the AIGP attribute has the following requirements:

- Neighbor must be AIGP enabled.
- Policy must be applied as an export policy.
- Prefix must have no current AIGP attribute.
- Prefix must export with next-hop self.
- Prefix must reside within the AIGP domain. Typically, a loopback IP address is the prefix to originate.

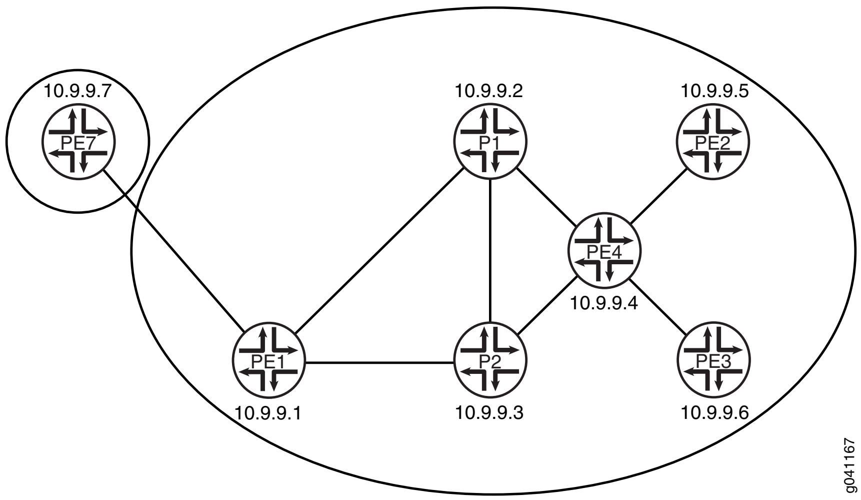
The policy is ignored if these requirements are not met.

Topology Diagram

Figure 51 on page 2763 shows the topology used in this example. OSPF is used as the interior gateway protocol (IGP). Internal BGP (IBGP) is configured between Device PE1 and Device PE4. External BGP (EBGP) is configured between Device PE7 and Device PE1, between Device PE4 and Device PE3, and between Device PE4 and Device PE2. Devices PE4, PE2, and PE3 are configured for multihop. Device PE4 selects a path based on the AIGP value and then readvertises the AIGP value based on the AIGP and policy configuration. Device PE1 readvertises the AIGP value to Device PE7, which is in another administrative domain. Every device has two loopback interface addresses: 10.9.9.x is used for BGP peering and the router ID, and 10.100.1.x is used for the BGP next hop.

The network between Device PE1 and PE3 has IBGP peering and multiple OSPF areas. The external link to Device PE7 is configured to show that the AIGP attribute is readvertised to a neighbor outside of the administrative domain, if that neighbor is AIGP enabled.

Figure 51: Advertisement of Multiple Paths in BGP



For origination of an AIGP attribute, the BGP next hop is required to be itself. If the BGP next hop remains unchanged, the received AIGP attribute is readvertised, as is, to another AIGP neighbor. If the next hop changes, the received AIGP attribute is readvertised with an increased value to another AIGP neighbor. The increase in value reflects the IGP distance to the previous BGP next hop. To demonstrate, this example uses loopback interface addresses for Device PE4's EBGP peering sessions with Device PE2 and Device PE3. Multihop is enabled on these sessions so that a recursive lookup is performed to determine the point-to-point interface. Because the next hop changes, the IGP distance is added to the AIGP distance.

Configuration

- Configuring Device P1 on page 2769
- Configuring Device P2 on page 2772
- Configuring Device PE4 on page 2775
- Configuring Device PE1 on page 2780
- Configuring Device PE2 on page 2784
- Configuring Device PE3 on page 2788
- Configuring Device PE7 on page 2791

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device P1

```
set interfaces fe-1/2/0 unit 1 description P1-to-PE1
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.2/30
set interfaces fe-1/2/0 unit 1 family mpls
set interfaces fe-1/2/1 unit 4 description P1-to-P2
```

```
set interfaces fe-1/2/1 unit 4 family inet address 10.0.0.29/30
set interfaces fe-1/2/1 unit 4 family mpls
set interfaces fe-1/2/2 unit 8 description P1-to-PE4
set interfaces fe-1/2/2 unit 8 family inet address 10.0.0.17/30
set interfaces fe-1/2/2 unit 8 family mpls
set interfaces lo0 unit 3 family inet address 10.9.9.2/32
set interfaces lo0 unit 3 family inet address 10.100.1.2/32
set protocols rsvp interface fe-1/2/0.1
set protocols rsvp interface fe-1/2/2.8
set protocols rsvp interface fe-1/2/1.4
set protocols mpls label-switched-path P1-to-P2 to 10.9.9.3
set protocols mpls label-switched-path P1-to-PE1 to 10.9.9.1
set protocols mpls label-switched-path P1-to-PE4 to 10.9.9.4
set protocols mpls interface fe-1/2/0.1
set protocols mpls interface fe-1/2/2.8
set protocols mpls interface fe-1/2/1.4
set protocols bgp group internal type internal
set protocols bgp group internal local-address 10.9.9.2
set protocols bgp group internal family inet labeled-unicast aigp
set protocols bgp group internal neighbor 10.9.9.1
set protocols bgp group internal neighbor 10.9.9.3
set protocols bgp group internal neighbor 10.9.9.4
set protocols ospf area 0.0.0.1 interface fe-1/2/0.1 metric 1
set protocols ospf area 0.0.0.1 interface fe-1/2/1.4 metric 1
set protocols ospf area 0.0.0.0 interface fe-1/2/2.8 metric 1
set protocols ospf area 0.0.0.0 interface 10.9.9.2 passive
set protocols ospf area 0.0.0.0 interface 10.9.9.2 metric 1
set protocols ospf area 0.0.0.0 interface 10.100.1.2 passive
set protocols ospf area 0.0.0.0 interface 10.100.1.2 metric 1
set routing-options router-id 10.9.9.2
set routing-options autonomous-system 13979
```

Device P2

```
set interfaces fe-1/2/0 unit 3 description P2-to-PE1
set interfaces fe-1/2/0 unit 3 family inet address 10.0.0.6/30
set interfaces fe-1/2/0 unit 3 family mpls
set interfaces fe-1/2/1 unit 5 description P2-to-P1
set interfaces fe-1/2/1 unit 5 family inet address 10.0.0.30/30
set interfaces fe-1/2/1 unit 5 family mpls
set interfaces fe-1/2/2 unit 6 description P2-to-PE4
set interfaces fe-1/2/2 unit 6 family inet address 10.0.0.13/30
set interfaces fe-1/2/2 unit 6 family mpls
set interfaces lo0 unit 5 family inet address 10.9.9.3/32
set interfaces lo0 unit 5 family inet address 10.100.1.3/32
set protocols rsvp interface fe-1/2/1.5
set protocols rsvp interface fe-1/2/2.6
set protocols rsvp interface fe-1/2/0.3
set protocols mpls label-switched-path P2-to-PE1 to 10.9.9.1
set protocols mpls label-switched-path P2-to-P1 to 10.9.9.2
set protocols mpls label-switched-path P2-to-PE4 to 10.9.9.4
set protocols mpls interface fe-1/2/1.5
set protocols mpls interface fe-1/2/2.6
set protocols mpls interface fe-1/2/0.3
set protocols bgp group internal type internal
set protocols bgp group internal local-address 10.9.9.3
set protocols bgp group internal family inet labeled-unicast aigp
set protocols bgp group internal neighbor 10.9.9.1
```

```
set protocols bgp group internal neighbor 10.9.9.2
set protocols bgp group internal neighbor 10.9.9.4
set protocols ospf area 0.0.0.0 interface fe-1/2/2.6 metric 1
set protocols ospf area 0.0.0.0 interface 10.9.9.3 passive
set protocols ospf area 0.0.0.0 interface 10.9.9.3 metric 1
set protocols ospf area 0.0.0.0 interface 10.100.1.3 passive
set protocols ospf area 0.0.0.0 interface 10.100.1.3 metric 1
set routing-options router-id 10.9.9.3
set routing-options autonomous-system 13979
```

Device PE4

```
set interfaces fe-1/2/0 unit 7 description PE4-to-P2
set interfaces fe-1/2/0 unit 7 family inet address 10.0.0.14/30
set interfaces fe-1/2/0 unit 7 family mpls
set interfaces fe-1/2/1 unit 9 description PE4-to-P1
set interfaces fe-1/2/1 unit 9 family inet address 10.0.0.18/30
set interfaces fe-1/2/1 unit 9 family mpls
set interfaces fe-1/2/2 unit 10 description PE4-to-PE2
set interfaces fe-1/2/2 unit 10 family inet address 10.0.0.21/30
set interfaces fe-1/2/2 unit 10 family mpls
set interfaces fe-1/0/2 unit 12 description PE4-to-PE3
set interfaces fe-1/0/2 unit 12 family inet address 10.0.0.25/30
set interfaces fe-1/0/2 unit 12 family mpls
set interfaces lo0 unit 7 family inet address 10.9.9.4/32
set interfaces lo0 unit 7 family inet address 10.100.1.4/32
set protocols rsvp interface fe-1/2/0.7
set protocols rsvp interface fe-1/2/1.9
set protocols rsvp interface fe-1/2/2.10
set protocols rsvp interface fe-1/0/2.12
set protocols mpls label-switched-path PE4-to-PE2 to 10.9.9.5
set protocols mpls label-switched-path PE4-to-PE3 to 10.9.9.6
set protocols mpls label-switched-path PE4-to-P1 to 10.9.9.2
set protocols mpls label-switched-path PE4-to-P2 to 10.9.9.3
set protocols mpls interface fe-1/2/0.7
set protocols mpls interface fe-1/2/1.9
set protocols mpls interface fe-1/2/2.10
set protocols mpls interface fe-1/0/2.12
set protocols bgp export next-hop
set protocols bgp export aigp
set protocols bgp group internal type internal
set protocols bgp group internal local-address 10.9.9.4
set protocols bgp group internal family inet labeled-unicast aigp
set protocols bgp group internal neighbor 10.9.9.1
set protocols bgp group internal neighbor 10.9.9.3
set protocols bgp group internal neighbor 10.9.9.2
set protocols bgp group external type external
set protocols bgp group external multihop ttl 2
set protocols bgp group external local-address 10.9.9.4
set protocols bgp group external family inet labeled-unicast aigp
set protocols bgp group external peer-as 7018
set protocols bgp group external neighbor 10.9.9.5
set protocols bgp group external neighbor 10.9.9.6
set protocols ospf area 0.0.0.0 interface fe-1/2/1.9 metric 1
set protocols ospf area 0.0.0.0 interface fe-1/2/0.7 metric 1
set protocols ospf area 0.0.0.0 interface 10.9.9.4 passive
set protocols ospf area 0.0.0.0 interface 10.9.9.4 metric 1
set protocols ospf area 0.0.0.0 interface 10.100.1.4 passive
```

```
set protocols ospf area 0.0.0.0 interface 10.100.1.4 metric 1
set protocols ospf area 0.0.0.2 interface fe-1/2/2.10 metric 1
set protocols ospf area 0.0.0.3 interface fe-1/0/2.12 metric 1
set policy-options policy-statement aigp term 10 from protocol static
set policy-options policy-statement aigp term 10 from route-filter 44.0.0.0/24 exact
set policy-options policy-statement aigp term 10 then aigp-originate distance 200
set policy-options policy-statement aigp term 10 then next-hop 10.100.1.4
set policy-options policy-statement aigp term 10 then accept
set policy-options policy-statement next-hop term 10 from protocol bgp
set policy-options policy-statement next-hop term 10 then next-hop 10.100.1.4
set policy-options policy-statement next-hop term 10 then accept
set policy-options policy-statement next-hop term 20 from protocol direct
set policy-options policy-statement next-hop term 20 from route-filter 10.9.9.4/32 exact
set policy-options policy-statement next-hop term 20 from route-filter 10.100.1.4/32
  exact
set policy-options policy-statement next-hop term 20 then next-hop 10.100.1.4
set policy-options policy-statement next-hop term 20 then accept
set routing-options static route 44.0.0.0/24 discard
set routing-options router-id 10.9.9.4
set routing-options autonomous-system 13979
```

Device PE1

```
set interfaces fe-1/2/0 unit 0 description PE1-to-P1
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces fe-1/2/0 unit 0 family mpls
set interfaces fe-1/2/1 unit 2 description PE1-to-P2
set interfaces fe-1/2/1 unit 2 family inet address 10.0.0.5/30
set interfaces fe-1/2/1 unit 2 family mpls
set interfaces fe-1/2/2 unit 14 description PE1-to-PE7
set interfaces fe-1/2/2 unit 14 family inet address 10.0.0.9/30
set interfaces lo0 unit 1 family inet address 10.9.9.1/32
set interfaces lo0 unit 1 family inet address 10.100.1.1/32
set protocols rsvp interface fe-1/2/0.0
set protocols rsvp interface fe-1/2/1.2
set protocols rsvp interface fe-1/2/2.14
set protocols mpls label-switched-path PE1-to-P1 to 10.9.9.2
set protocols mpls label-switched-path PE1-to-P2 to 10.9.9.3
set protocols mpls interface fe-1/2/0.0
set protocols mpls interface fe-1/2/1.2
set protocols mpls interface fe-1/2/2.14
set protocols bgp group internal type internal
set protocols bgp group internal local-address 10.9.9.1
set protocols bgp group internal family inet labeled-unicast aigp
set protocols bgp group internal export SET_EXPORT_ROUTES
set protocols bgp group internal vpn-apply-export
set protocols bgp group internal neighbor 10.9.9.4
set protocols bgp group internal neighbor 10.9.9.2
set protocols bgp group internal neighbor 10.9.9.3
set protocols bgp group external type external
set protocols bgp group external family inet labeled-unicast aigp
set protocols bgp group external export SET_EXPORT_ROUTES
set protocols bgp group external peer-as 7019
set protocols bgp group external neighbor 10.0.0.10
set protocols ospf area 0.0.0.1 interface fe-1/2/0.0 metric 1
set protocols ospf area 0.0.0.1 interface fe-1/2/1.2 metric 1
set protocols ospf area 0.0.0.1 interface 10.9.9.1 passive
set protocols ospf area 0.0.0.1 interface 10.9.9.1 metric 1
```



```
set protocols ospf area 0.0.0.1 interface 10.100.1.1 passive
set protocols ospf area 0.0.0.1 interface 10.100.1.1 metric 1
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol direct
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol bgp
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then next-hop
  10.100.1.1
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then accept
set routing-options router-id 10.9.9.1
set routing-options autonomous-system 13979
```

Device PE2

```
set interfaces fe-1/2/0 unit 11 description PE2-to-PE4
set interfaces fe-1/2/0 unit 11 family inet address 10.0.0.22/30
set interfaces fe-1/2/0 unit 11 family mpls
set interfaces lo0 unit 9 family inet address 10.9.9.5/32 primary
set interfaces lo0 unit 9 family inet address 10.100.1.5/32
set protocols rsvp interface fe-1/2/0.11
set protocols mpls label-switched-path PE2-to-PE4 to 10.9.9.4
set protocols mpls interface fe-1/2/0.11
set protocols bgp group external type external
set protocols bgp group external multihop ttl 2
set protocols bgp group external local-address 10.9.9.5
set protocols bgp group external family inet labeled-unicast aigp
set protocols bgp group external export next-hop
set protocols bgp group external export aigp
set protocols bgp group external export SET_EXPORT_ROUTES
set protocols bgp group external vpn-apply-export
set protocols bgp group external peer-as 13979
set protocols bgp group external neighbor 10.9.9.4
set protocols ospf area 0.0.0.2 interface 10.9.9.5 passive
set protocols ospf area 0.0.0.2 interface 10.9.9.5 metric 1
set protocols ospf area 0.0.0.2 interface 10.100.1.5 passive
set protocols ospf area 0.0.0.2 interface 10.100.1.5 metric 1
set protocols ospf area 0.0.0.2 interface fe-1/2/0.11 metric 1
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol direct
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol static
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol bgp
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then next-hop
  10.100.1.5
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then accept
set policy-options policy-statement aigp term 10 from route-filter 55.0.0.0/24 exact
set policy-options policy-statement aigp term 10 then aigp-originate distance 20
set policy-options policy-statement aigp term 10 then next-hop 10.100.1.5
set policy-options policy-statement aigp term 10 then accept
set policy-options policy-statement aigp term 20 from route-filter 99.0.0.0/24 exact
set policy-options policy-statement aigp term 20 then aigp-originate distance 30
set policy-options policy-statement aigp term 20 then next-hop 10.100.1.5
set policy-options policy-statement aigp term 20 then accept
set policy-options policy-statement next-hop term 10 from protocol bgp
set policy-options policy-statement next-hop term 10 then next-hop 10.100.1.5
set policy-options policy-statement next-hop term 10 then accept
set policy-options policy-statement next-hop term 20 from protocol direct
set policy-options policy-statement next-hop term 20 from route-filter 10.9.9.5/32 exact
set policy-options policy-statement next-hop term 20 from route-filter 10.100.1.5/32
  exact
set policy-options policy-statement next-hop term 20 then next-hop 10.100.1.5
set policy-options policy-statement next-hop term 20 then accept
```



```
set routing-options static route 99.0.0.0/24 discard
set routing-options static route 55.0.0.0/24 discard
set routing-options router-id 10.9.9.5
set routing-options autonomous-system 7018
```

Device PE3

```
set interfaces fe-1/2/0 unit 13 description PE3-to-PE4
set interfaces fe-1/2/0 unit 13 family inet address 10.0.0.26/30
set interfaces fe-1/2/0 unit 13 family mpls
set interfaces lo0 unit 11 family inet address 10.9.9.6/32
set interfaces lo0 unit 11 family inet address 10.100.1.6/32
set protocols rsvp interface fe-1/2/0.13
set protocols mpls label-switched-path PE3-to-PE4 to 10.9.9.4
set protocols mpls interface fe-1/2/0.13
set protocols bgp group external type external
set protocols bgp group external multihop ttl 2
set protocols bgp group external local-address 10.9.9.6
set protocols bgp group external family inet labeled-unicast aigp
set protocols bgp group external export next-hop
set protocols bgp group external export SET_EXPORT_ROUTES
set protocols bgp group external vpn-apply-export
set protocols bgp group external peer-as 13979
set protocols bgp group external neighbor 10.9.9.4
set protocols ospf area 0.0.0.3 interface 10.9.9.6 passive
set protocols ospf area 0.0.0.3 interface 10.9.9.6 metric 1
set protocols ospf area 0.0.0.3 interface 10.100.1.6 passive
set protocols ospf area 0.0.0.3 interface 10.100.1.6 metric 1
set protocols ospf area 0.0.0.3 interface fe-1/2/0.13 metric 1
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol direct
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol static
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol bgp
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then next-hop
  10.100.1.6
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then accept
set policy-options policy-statement next-hop term 10 from protocol bgp
set policy-options policy-statement next-hop term 10 then next-hop 10.100.1.6
set policy-options policy-statement next-hop term 10 then accept
set policy-options policy-statement next-hop term 20 from protocol direct
set policy-options policy-statement next-hop term 20 from route-filter 10.9.9.6/32 exact
set policy-options policy-statement next-hop term 20 from route-filter 10.100.1.6/32
  exact
set policy-options policy-statement next-hop term 20 then next-hop 10.100.1.6
set policy-options policy-statement next-hop term 20 then accept
set routing-options router-id 10.9.9.6
set routing-options autonomous-system 7018
```

Device PE7

```
set interfaces fe-1/2/0 unit 15 description PE7-to-PE1
set interfaces fe-1/2/0 unit 15 family inet address 10.0.0.10/30
set interfaces lo0 unit 13 family inet address 10.9.9.7/32
set interfaces lo0 unit 13 family inet address 10.100.1.7/32
set protocols bgp group external type external
set protocols bgp group external family inet labeled-unicast aigp
set protocols bgp group external export SET_EXPORT_ROUTES
set protocols bgp group external peer-as 13979
set protocols bgp group external neighbor 10.0.0.9
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol direct
```



```
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol bgp
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then next-hop
  10.100.1.7
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then accept
set routing-options router-id 10.9.9.7
set routing-options autonomous-system 7019
```

Configuring Device P1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device P1:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@P1# set fe-1/2/0 unit 1 description P1-to-PE1
   user@P1# set fe-1/2/0 unit 1 family inet address 10.0.0.2/30
   user@P1# set fe-1/2/0 unit 1 family mpls
   user@P1# set fe-1/2/1 unit 4 description P1-to-P2
   user@P1# set fe-1/2/1 unit 4 family inet address 10.0.0.29/30
   user@P1# set fe-1/2/1 unit 4 family mpls
   user@P1# set fe-1/2/2 unit 8 description P1-to-PE4
   user@P1# set fe-1/2/2 unit 8 family inet address 10.0.0.17/30
   user@P1# set fe-1/2/2 unit 8 family mpls
   user@P1# set lo0 unit 3 family inet address 10.9.9.2/32
   user@P1# set lo0 unit 3 family inet address 10.100.1.2/32
   ```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

   ```
   [edit protocols]
   user@P1# set rsvp interface fe-1/2/0.1
   user@P1# set rsvp interface fe-1/2/2.8
   user@P1# set rsvp interface fe-1/2/1.4
   user@P1# set mpls label-switched-path P1-to-P2 to 10.9.9.3
   user@P1# set mpls label-switched-path P1-to-PE1 to 10.9.9.1
   user@P1# set mpls label-switched-path P1-to-PE4 to 10.9.9.4
   user@P1# set mpls interface fe-1/2/0.1
   user@P1# set mpls interface fe-1/2/2.8
   user@P1# set mpls interface fe-1/2/1.4
   ```

3. Configure BGP.

   ```
   [edit protocols bgp group internal]
   user@P1# set type internal
   user@P1# set local-address 10.9.9.2
   user@P1# set neighbor 10.9.9.1
   user@P1# set neighbor 10.9.9.3
   user@P1# set neighbor 10.9.9.4
   ```

4. Enable AIGP.

   ```
   [edit protocols bgp group internal]
   user@P1# set family inet labeled-unicast aigp
   ```


5. Configure an IGP, such as OSPF, RIP, or IS-IS.

```
[edit protocols ospf]
user@P1# set area 0.0.0.1 interface fe-1/2/0.1 metric 1
user@P1# set area 0.0.0.1 interface fe-1/2/1.4 metric 1
user@P1# set area 0.0.0.0 interface fe-1/2/2.8 metric 1
user@P1# set area 0.0.0.0 interface 10.9.9.2 passive
user@P1# set area 0.0.0.0 interface 10.9.9.2 metric 1
user@P1# set area 0.0.0.0 interface 10.100.1.2 passive
user@P1# set area 0.0.0.0 interface 10.100.1.2 metric 1
```

6. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@P1# set router-id 10.9.9.2
user@P1# set autonomous-system 13979
```

7. If you are done configuring the device, commit the configuration.

```
user@P1# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@P1# show interfaces
fe-1/2/0 {
   unit 1 {
      description P1-to-PE1;
      family inet {
         address 10.0.0.2/30;
      }
      family mpls;
   }
}
fe-1/2/1 {
   unit 4 {
      description P1-to-P2;
      family inet {
         address 10.0.0.29/30;
      }
      family mpls;
   }
}
fe-1/2/2 {
   unit 8 {
      description P1-to-PE4;
      family inet {
         address 10.0.0.17/30;
      }
      family mpls;
   }
}
lo0 {
   unit 3 {
      family inet {
```



```
            address 10.9.9.2/32;
            address 10.100.1.2/32;
        }
    }
}
```

user@P1# **show protocols**

```
rsvp {
    interface fe-1/2/0.1;
    interface fe-1/2/2.8;
    interface fe-1/2/1.4;
}
mpls {
    label-switched-path P1-to-P2 {
        to 10.9.9.3;
    }
    label-switched-path P1-to-PE1 {
        to 10.9.9.1;
    }
    label-switched-path P1-to-PE4 {
        to 10.9.9.4;
    }
    interface fe-1/2/0.1;
    interface fe-1/2/2.8;
    interface fe-1/2/1.4;
}
bgp {
    group internal {
        type internal;
        local-address 10.9.9.2;
        family inet {
            labeled-unicast {
                aigp;
            }
        }
        neighbor 10.9.9.1;
        neighbor 10.9.9.3;
        neighbor 10.9.9.4;
    }
}
ospf {
    area 0.0.0.1 {
        interface fe-1/2/0.1 {
            metric 1;
        }
        interface fe-1/2/1.4 {
            metric 1;
        }
    }
    area 0.0.0.0 {
        interface fe-1/2/2.8 {
            metric 1;
        }
        interface 10.9.9.2 {
            passive;
            metric 1;
```

```
        }
        interface 10.100.1.2 {
            passive;
            metric 1;
        }
    }
}
```

```
user@P1# show routing-options
router-id 10.9.9.2;
autonomous-system 13979;
```

Configuring Device P2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device P2:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@P2# set fe-1/2/0 unit 3 description P2-to-PE1
   user@P2# set fe-1/2/0 unit 3 family inet address 10.0.0.6/30
   user@P2# set fe-1/2/0 unit 3 family mpls
   user@P2# set fe-1/2/1 unit 5 description P2-to-P1
   user@P2# set fe-1/2/1 unit 5 family inet address 10.0.0.30/30
   user@P2# set fe-1/2/1 unit 5 family mpls
   user@P2# set fe-1/2/2 unit 6 description P2-to-PE4
   user@P2# set fe-1/2/2 unit 6 family inet address 10.0.0.13/30
   user@P2# set fe-1/2/2 unit 6 family mpls
   user@P2# set lo0 unit 5 family inet address 10.9.9.3/32
   user@P2# set lo0 unit 5 family inet address 10.100.1.3/32
   ```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

   ```
   [edit protocols]
   user@P2# set rsvp interface fe-1/2/1.5
   user@P2# set rsvp interface fe-1/2/2.6
   user@P2# set rsvp interface fe-1/2/0.3
   user@P2# set mpls label-switched-path P2-to-PE1 to 10.9.9.1
   user@P2# set mpls label-switched-path P2-to-P1 to 10.9.9.2
   user@P2# set mpls label-switched-path P2-to-PE4 to 10.9.9.4
   user@P2# set mpls interface fe-1/2/1.5
   user@P2# set mpls interface fe-1/2/2.6
   user@P2# set mpls interface fe-1/2/0.3
   ```

3. Configure BGP.

   ```
   [edit protocols bgp group internal]
   user@P2# set type internal
   user@P2# set local-address 10.9.9.3
   user@P2# set neighbor 10.9.9.1
   user@P2# set neighbor 10.9.9.2
   user@P2# set neighbor 10.9.9.4
   ```


4. Enable AIGP.

```
[edit protocols bgp group internal]
user@P2# set family inet labeled-unicast aigp
```

5. Configure an IGP, such as OSPF, RIP, or IS-IS.

```
[edit protocols ospf]
user@P2# set area 0.0.0.0 interface fe-1/2/2.6 metric 1
user@P2# set area 0.0.0.0 interface 10.9.9.3 passive
user@P2# set area 0.0.0.0 interface 10.9.9.3 metric 1
user@P2# set area 0.0.0.0 interface 10.100.1.3 passive
user@P2# set area 0.0.0.0 interface 10.100.1.3 metric 1
```

6. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@P2# set router-id 10.9.9.3
user@P2# set autonomous-system 13979
```

7. If you are done configuring the device, commit the configuration.

```
user@P2# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@P2# show interfaces
fe-1/2/0 {
  unit 3 {
    description P2-to-PE1;
    family inet {
      address 10.0.0.6/30;
    }
    family mpls;
  }
}
fe-1/2/1 {
  unit 5 {
    description P2-to-P1;
    family inet {
      address 10.0.0.30/30;
    }
    family mpls;
  }
}
fe-1/2/2 {
  unit 6 {
    description P2-to-PE4;
    family inet {
      address 10.0.0.13/30;
    }
    family mpls;
  }
}
lo0 {
```

```
    unit 5 {
        family inet {
            address 10.9.9.3/32;
            address 10.100.1.3/32;
        }
    }
}
```

user@P2# **show protocols**

```
rsvp {
    interface fe-1/2/1.5;
    interface fe-1/2/2.6;
    interface fe-1/2/0.3;
}
mpls {
    label-switched-path P2-to-PE1 {
        to 10.9.9.1;
    }
    label-switched-path P2-to-P1 {
        to 10.9.9.2;
    }
    label-switched-path P2-to-PE4 {
        to 10.9.9.4;
    }
    interface fe-1/2/1.5;
    interface fe-1/2/2.6;
    interface fe-1/2/0.3;
}
bgp {
    group internal {
        type internal;
        local-address 10.9.9.3;
        family inet {
            labeled-unicast {
                aigp;
            }
        }
        neighbor 10.9.9.1;
        neighbor 10.9.9.2;
        neighbor 10.9.9.4;
    }
}
ospf {
    area 0.0.0.0 {
        interface fe-1/2/2.6 {
            metric 1;
        }
        interface 10.9.9.3 {
            passive;
            metric 1;
        }
        interface 10.100.1.3 {
            passive;
            metric 1;
        }
    }
```



```
}
user@P2# show routing-options
router-id 10.9.9.3;
autonomous-system 13979;
```

Configuring Device PE4

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE4:

1. Configure the interfaces.

```
[edit interfaces]
user@PE4# set fe-1/2/0 unit 7 description PE4-to-P2
user@PE4# set fe-1/2/0 unit 7 family inet address 10.0.0.14/30
user@PE4# set fe-1/2/0 unit 7 family mpls
user@PE4# set fe-1/2/1 unit 9 description PE4-to-P1
user@PE4# set fe-1/2/1 unit 9 family inet address 10.0.0.18/30
user@PE4# set fe-1/2/1 unit 9 family mpls
user@PE4# set fe-1/2/2 unit 10 description PE4-to-PE2
user@PE4# set fe-1/2/2 unit 10 family inet address 10.0.0.21/30
user@PE4# set fe-1/2/2 unit 10 family mpls
user@PE4# set fe-1/0/2 unit 12 description PE4-to-PE3
user@PE4# set fe-1/0/2 unit 12 family inet address 10.0.0.25/30
user@PE4# set fe-1/0/2 unit 12 family mpls
user@PE4# set lo0 unit 7 family inet address 10.9.9.4/32
user@PE4# set lo0 unit 7 family inet address 10.100.1.4/32
```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

```
[edit protocols]
user@PE4# set rsvp interface fe-1/2/0.7
user@PE4# set rsvp interface fe-1/2/1.9
user@PE4# set rsvp interface fe-1/2/2.10
user@PE4# set rsvp interface fe-1/0/2.12
user@PE4# set mpls label-switched-path PE4-to-PE2 to 10.9.9.5
user@PE4# set mpls label-switched-path PE4-to-PE3 to 10.9.9.6
user@PE4# set mpls label-switched-path PE4-to-P1 to 10.9.9.2
user@PE4# set mpls label-switched-path PE4-to-P2 to 10.9.9.3
user@PE4# set mpls interface fe-1/2/0.7
user@PE4# set mpls interface fe-1/2/1.9
user@PE4# set mpls interface fe-1/2/2.10
user@PE4# set mpls interface fe-1/0/2.12
```

3. Configure BGP.

```
[edit protocols bgp]
user@PE4# set export next-hop
user@PE4# set export aigp
user@PE4# set group internal type internal
user@PE4# set group internal local-address 10.9.9.4
user@PE4# set group internal neighbor 10.9.9.1
user@PE4# set group internal neighbor 10.9.9.3
```

```
user@PE4# set group internal neighbor 10.9.9.2
user@PE4# set group external type external
user@PE4# set group external multihop ttl 2
user@PE4# set group external local-address 10.9.9.4
user@PE4# set group external peer-as 7018
user@PE4# set group external neighbor 10.9.9.5
user@PE4# set group external neighbor 10.9.9.6
```

4. Enable AIGP.

```
[edit protocols bgp]
user@PE4# set group external family inet labeled-unicast aigp
user@PE4# set group internal family inet labeled-unicast aigp
```

5. Originate a prefix, and configure an AIGP distance.

   By default, a prefix is originated using the current IGP distance. Optionally, you can configure a distance for the AIGP attribute, using the **distance** option, as shown here.

```
[edit policy-options policy-statement aigp term 10]
user@PE4# set from protocol static
user@PE4# set from route-filter 44.0.0.0/24 exact
user@PE4# set then aigp-originate distance 200
user@PE4# set then next-hop 10.100.1.4
user@PE4# set then accept
```

6. Enable the policies.

```
[edit policy-options policy-statement next-hop]
user@PE4# set term 10 from protocol bgp
user@PE4# set term 10 then next-hop 10.100.1.4
user@PE4# set term 10 then accept
user@PE4# set term 20 from protocol direct
user@PE4# set term 20 from route-filter 10.9.9.4/32 exact
user@PE4# set term 20 from route-filter 10.100.1.4/32 exact
user@PE4# set term 20 then next-hop 10.100.1.4
user@PE4# set term 20 then accept
```

7. Configure a static route.

```
[edit routing-options]
user@PE4# set static route 44.0.0.0/24 discard
```

8. Configure an IGP, such as OSPF, RIP, or IS-IS.

```
[edit protocols ospf]
user@PE4# set area 0.0.0.0 interface fe-1/2/1.9 metric 1
user@PE4# set area 0.0.0.0 interface fe-1/2/0.7 metric 1
user@PE4# set area 0.0.0.0 interface 10.9.9.4 passive
user@PE4# set area 0.0.0.0 interface 10.9.9.4 metric 1
user@PE4# set area 0.0.0.0 interface 10.100.1.4 passive
user@PE4# set area 0.0.0.0 interface 10.100.1.4 metric 1
user@PE4# set area 0.0.0.2 interface fe-1/2/2.10 metric 1
user@PE4# set area 0.0.0.3 interface fe-1/0/2.12 metric 1
```

9. Configure the router ID and the autonomous system number.

```
[edit routing-options]
```



```
user@PE4# set router-id 10.9.9.4
user@PE4# set autonomous-system 13979
```

10. If you are done configuring the device, commit the configuration.

```
user@PE4# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE4# show interfaces
fe-1/0/2 {
  unit 12 {
    description PE4-to-PE3;
    family inet {
      address 10.0.0.25/30;
    }
    family mpls;
  }
}
fe-1/2/0 {
  unit 7 {
    description PE4-to-P2;
    family inet {
      address 10.0.0.14/30;
    }
    family mpls;
  }
}
fe-1/2/1 {
  unit 9 {
    description PE4-to-P1;
    family inet {
      address 10.0.0.18/30;
    }
    family mpls;
  }
}
fe-1/2/2 {
  unit 10 {
    description PE4-to-PE2;
    family inet {
      address 10.0.0.21/30;
    }
    family mpls;
  }
}
lo0 {
  unit 7 {
    family inet {
      address 10.9.9.4/32;
      address 10.100.1.4/32;
    }
```

```
  }
}
```

user@PE4# **show policy-options**

```
policy-statement aigp {
  term 10 {
    from {
      protocol static;
      route-filter 44.0.0.0/24 exact;
    }
    then {
      aigp-originate distance 200;
      next-hop 10.100.1.4;
      accept;
    }
  }
}
policy-statement next-hop {
  term 10 {
    from protocol bgp;
    then {
      next-hop 10.100.1.4;
      accept;
    }
  }
  term 20 {
    from {
      protocol direct;
      route-filter 10.9.9.4/32 exact;
      route-filter 10.100.1.4/32 exact;
    }
    then {
      next-hop 10.100.1.4;
      accept;
    }
  }
}
```

user@PE4# **show protocols**

```
rsvp {
  interface fe-1/2/0.7;
  interface fe-1/2/1.9;
  interface fe-1/2/2.10;
  interface fe-1/0/2.12;
}
mpls {
  label-switched-path PE4-to-PE2 {
    to 10.9.9.5;
  }
  label-switched-path PE4-to-PE3 {
    to 10.9.9.6;
  }
  label-switched-path PE4-to-P1 {
    to 10.9.9.2;
  }
  label-switched-path PE4-to-P2 {
    to 10.9.9.3;
```

```
  }
  interface fe-1/2/0.7;
  interface fe-1/2/1.9;
  interface fe-1/2/2.10;
  interface fe-1/0/2.12;
}
bgp {
  export [ next-hop aigp ];
  group internal {
    type internal;
    local-address 10.9.9.4;
    family inet {
      labeled-unicast {
        aigp;
      }
    }
    neighbor 10.9.9.1;
    neighbor 10.9.9.3;
    neighbor 10.9.9.2;
  }
  group external {
    type external;
    multihop {
      ttl 2;
    }
    local-address 10.9.9.4;
    family inet {
      labeled-unicast {
        aigp;
      }
    }
    peer-as 7018;
    neighbor 10.9.9.5;
    neighbor 10.9.9.6;
  }
}
ospf {
  area 0.0.0.0 {
    interface fe-1/2/1.9 {
      metric 1;
    }
    interface fe-1/2/0.7 {
      metric 1;
    }
    interface 10.9.9.4 {
      passive;
      metric 1;
    }
    interface 10.100.1.4 {
      passive;
      metric 1;
    }
  }
  area 0.0.0.2 {
    interface fe-1/2/2.10 {
      metric 1;
```

```
        }
      }
      area 0.0.0.3 {
        interface fe-1/0/2.12 {
          metric 1;
        }
      }
    }
```

```
user@PE4# show routing-options
static {
  route 44.0.0.0/24 discard;
}
router-id 10.9.9.4;
autonomous-system 13979;
```

Configuring Device PE1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE1:

1. Configure the interfaces.

```
[edit interfaces]
user@PE1# set fe-1/2/0 unit 0 description PE1-to-P1
user@PE1# set fe-1/2/0 unit 0 family inet address 10.0.0.1/30
user@PE1# set fe-1/2/0 unit 0 family mpls
user@PE1# set fe-1/2/1 unit 2 description PE1-to-P2
user@PE1# set fe-1/2/1 unit 2 family inet address 10.0.0.5/30
user@PE1# set fe-1/2/1 unit 2 family mpls
user@PE1# set fe-1/2/2 unit 14 description PE1-to-PE7
user@PE1# set fe-1/2/2 unit 14 family inet address 10.0.0.9/30
user@PE1# set lo0 unit 1 family inet address 10.9.9.1/32
user@PE1# set lo0 unit 1 family inet address 10.100.1.1/32
```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

```
[edit protocols]
user@PE1# set rsvp interface fe-1/2/0.0
user@PE1# set rsvp interface fe-1/2/1.2
user@PE1# set rsvp interface fe-1/2/2.14
user@PE1# set mpls label-switched-path PE1-to-P1 to 10.9.9.2
user@PE1# set mpls label-switched-path PE1-to-P2 to 10.9.9.3
user@PE1# set mpls interface fe-1/2/0.0
user@PE1# set mpls interface fe-1/2/1.2
user@PE1# set mpls interface fe-1/2/2.14
```

3. Configure BGP.

```
[edit protocols bgp]
user@PE1# set group internal type internal
user@PE1# set group internal local-address 10.9.9.1
user@PE1# set group internal export SET_EXPORT_ROUTES
user@PE1# set group internal vpn-apply-export
```



```
user@PE1# set group internal neighbor 10.9.9.4
user@PE1# set group internal neighbor 10.9.9.2
user@PE1# set group internal neighbor 10.9.9.3
user@PE1# set group external type external
user@PE1# set group external export SET_EXPORT_ROUTES
user@PE1# set group external peer-as 7019
user@PE1# set group external neighbor 10.0.0.10
```

4. Enable AIGP.

```
[edit protocols bgp]
user@PE1# set group internal family inet labeled-unicast aigp
user@PE1# set group external family inet labeled-unicast aigp
```

5. Enable the policies.

```
[edit policy-options policy-statement SET_EXPORT_ROUTES term 10]
user@PE1# set from protocol direct
user@PE1# set from protocol bgp
user@PE1# set then next-hop 10.100.1.1
user@PE1# set then accept
```

6. Configure an IGP, such as OSPF, RIP, or IS-IS.

```
[edit protocols ospf area 0.0.0.1]
user@PE1# set interface fe-1/2/0.0 metric 1
user@PE1# set interface fe-1/2/1.2 metric 1
user@PE1# set interface 10.9.9.1 passive
user@PE1# set interface 10.9.9.1 metric 1
user@PE1# set interface 10.100.1.1 passive
user@PE1# set interface 10.100.1.1 metric 1
```

7. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@PE1# set router-id 10.9.9.1
user@PE1# set autonomous-system 13979
```

8. If you are done configuring the device, commit the configuration.

```
user@PE1# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE1# show interfaces
fe-1/2/0 {
  unit 0 {
    description PE1-to-P1;
    family inet {
      address 10.0.0.1/30;
    }
    family mpls;
  }
}
fe-1/2/1 {
```

```
   unit 2 {
      description PE1-to-P2;
      family inet {
         address 10.0.0.5/30;
      }
      family mpls;
   }
}
fe-1/2/2 {
   unit 14 {
      description PE1-to-PE7;
      family inet {
         address 10.0.0.9/30;
      }
   }
}
lo0 {
   unit 1 {
      family inet {
         address 10.9.9.1/32;
         address 10.100.1.1/32;
      }
   }
}
```

```
user@PE1# show policy-options
policy-statement SET_EXPORT_ROUTES {
   term 10 {
      from protocol [ direct bgp ];
      then {
         next-hop 10.100.1.1;
         accept;
      }
   }
}
```

```
user@PE1# show protocols
rsvp {
   interface fe-1/2/0.0;
   interface fe-1/2/1.2;
   interface fe-1/2/2.14;
}
mpls {
   label-switched-path PE1-to-P1 {
      to 10.9.9.2;
   }
   label-switched-path PE1-to-P2 {
      to 10.9.9.3;
   }
   interface fe-1/2/0.0;
   interface fe-1/2/1.2;
   interface fe-1/2/2.14;
}
bgp {
   group internal {
      type internal;
      local-address 10.9.9.1;
```

```
    family inet {
      labeled-unicast {
        aigp;
      }
    }
    export SET_EXPORT_ROUTES;
    vpn-apply-export;
    neighbor 10.9.9.4;
    neighbor 10.9.9.2;
    neighbor 10.9.9.3;
  }
  group external {
    type external;
    family inet {
      labeled-unicast {
        aigp;
      }
    }
    export SET_EXPORT_ROUTES;
    peer-as 7019;
    neighbor 10.0.0.10;
  }
}
ospf {
  area 0.0.0.1 {
    interface fe-1/2/0.0 {
      metric 1;
    }
    interface fe-1/2/1.2 {
      metric 1;
    }
    interface 10.9.9.1 {
      passive;
      metric 1;
    }
    interface 10.100.1.1 {
      passive;
      metric 1;
    }
  }
}
```

```
user@PE1# show routing-options
router-id 10.9.9.1;
autonomous-system 13979;
```

Configuring Device PE2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE2:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@PE2# set fe-1/2/0 unit 11 description PE2-to-PE4
   user@PE2# set fe-1/2/0 unit 11 family inet address 10.0.0.22/30
   user@PE2# set fe-1/2/0 unit 11 family mpls
   user@PE2# set lo0 unit 9 family inet address 10.9.9.5/32 primary
   user@PE2# set lo0 unit 9 family inet address 10.100.1.5/32
   ```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

   ```
   [edit protocols]
   user@PE2# set rsvp interface fe-1/2/0.11
   user@PE2# set mpls label-switched-path PE2-to-PE4 to 10.9.9.4
   user@PE2# set mpls interface fe-1/2/0.11
   ```

3. Configure BGP.

   ```
   [edit protocols bgp]
   user@PE2# set group external type external
   user@PE2# set group external multihop ttl 2
   user@PE2# set group external local-address 10.9.9.5
   user@PE2# set group external export next-hop
   user@PE2# set group external export aigp
   user@PE2# set group external export SET_EXPORT_ROUTES
   user@PE2# set group external vpn-apply-export
   user@PE2# set group external peer-as 13979
   user@PE2# set group external neighbor 10.9.9.4
   ```

4. Enable AIGP.

   ```
   [edit protocols bgp]
   user@PE2# set group external family inet labeled-unicast aigp
   ```

5. Originate a prefix, and configure an AIGP distance.

   By default, a prefix is originated using the current IGP distance. Optionally, you can configure a distance for the AIGP attribute, using the **distance** option, as shown here.

   ```
   [edit policy-options policy-statement aigp]
   user@PE2# set term 10 from route-filter 55.0.0.0/24 exact
   user@PE2# set term 10 then aigp-originate distance 20
   user@PE2# set term 10 then next-hop 10.100.1.5
   user@PE2# set term 10 then accept
   user@PE2# set term 20 from route-filter 99.0.0.0/24 exact
   user@PE2# set term 20 then aigp-originate distance 30
   user@PE2# set term 20 then next-hop 10.100.1.5
   user@PE2# set term 20 then accept
   ```

6. Enable the policies.

   [edit policy-options]
   user@PE2# **set policy-statement SET_EXPORT_ROUTES term 10 from protocol direct**
   user@PE2# **set policy-statement SET_EXPORT_ROUTES term 10 from protocol static**
   user@PE2# **set policy-statement SET_EXPORT_ROUTES term 10 from protocol bgp**
   user@PE2# **set policy-statement SET_EXPORT_ROUTES term 10 then next-hop 10.100.1.5**
   user@PE2# **set policy-statement SET_EXPORT_ROUTES term 10 then accept**
   user@PE2# **set policy-statement next-hop term 10 from protocol bgp**
   user@PE2# **set policy-statement next-hop term 10 then next-hop 10.100.1.5**
   user@PE2# **set policy-statement next-hop term 10 then accept**
   user@PE2# **set policy-statement next-hop term 20 from protocol direct**
   user@PE2# **set policy-statement next-hop term 20 from route-filter 10.9.9.5/32 exact**
   user@PE2# **set policy-statement next-hop term 20 from route-filter 10.100.1.5/32 exact**
   user@PE2# **set policy-statement next-hop term 20 then next-hop 10.100.1.5**
   user@PE2# **set policy-statement next-hop term 20 then accept**

7. Enable some static routes.

   [edit routing-options]
   user@PE2# **set static route 99.0.0.0/24 discard**
   user@PE2# **set static route 55.0.0.0/24 discard**

8. Configure an IGP, such as OSPF, RIP, or IS-IS.

   [edit protocols ospf area 0.0.0.2]
   user@PE2# **set interface 10.9.9.5 passive**
   user@PE2# **set interface 10.9.9.5 metric 1**
   user@PE2# **set interface 10.100.1.5 passive**
   user@PE2# **set interface 10.100.1.5 metric 1**
   user@PE2# **set interface fe-1/2/0.11 metric 1**

9. Configure the router ID and the autonomous system number.

   [edit routing-options]
   user@PE2# **set router-id 10.9.9.5**
   user@PE2# **set autonomous-system 7018**

10. If you are done configuring the device, commit the configuration.

    user@PE2# **commit**

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE2# show interfaces
fe-1/2/0 {
    unit 11 {
        description PE2-to-PE4;
```

```
        family inet {
            address 10.0.0.22/30;
        }
        family mpls;
    }
}
lo0 {
    unit 9 {
        family inet {
            address 10.9.9.5/32 {
                primary;
            }
            address 10.100.1.5/32;
        }
    }
}
```

user@PE2# **show policy-options**

```
policy-statement SET_EXPORT_ROUTES {
    term 10 {
        from protocol [ direct static bgp ];
        then {
            next-hop 10.100.1.5;
            accept;
        }
    }
}
policy-statement aigp {
    term 10 {
        from {
            route-filter 55.0.0.0/24 exact;
        }
        then {
            aigp-originate distance 20;
            next-hop 10.100.1.5;
            accept;
        }
    }
    term 20 {
        from {
            route-filter 99.0.0.0/24 exact;
        }
        then {
            aigp-originate distance 30;
            next-hop 10.100.1.5;
            accept;
        }
    }
}
policy-statement next-hop {
    term 10 {
        from protocol bgp;
        then {
            next-hop 10.100.1.5;
            accept;
        }
```



```
    }
    term 20 {
        from {
            protocol direct;
            route-filter 10.9.9.5/32 exact;
            route-filter 10.100.1.5/32 exact;
        }
        then {
            next-hop 10.100.1.5;
            accept;
        }
    }
}
```

```
user@PE2# show protocols
rsvp {
    interface fe-1/2/0.11;
}
mpls {
    label-switched-path PE2-to-PE4 {
        to 10.9.9.4;
    }
    interface fe-1/2/0.11;
}
bgp {
    group external {
        type external;
        multihop {
            ttl 2;
        }
        local-address 10.9.9.5;
        family inet {
            labeled-unicast {
                aigp;
            }
        }
        export [ next-hop aigp SET_EXPORT_ROUTES ];
        vpn-apply-export;
        peer-as 13979;
        neighbor 10.9.9.4;
    }
}
ospf {
    area 0.0.0.2 {
        interface 10.9.9.5 {
            passive;
            metric 1;
        }
        interface 10.100.1.5 {
            passive;
            metric 1;
        }
        interface fe-1/2/0.11 {
            metric 1;
        }
    }
```

```
}
user@PE2# show routing-options
static {
    route 99.0.0.0/24 discard;
    route 55.0.0.0/24 discard;
}
router-id 10.9.9.5;
autonomous-system 7018;
```

Configuring Device PE3

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE3:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@PE3# set fe-1/2/0 unit 13 description PE3-to-PE4
   user@PE3# set fe-1/2/0 unit 13 family inet address 10.0.0.26/30
   user@PE3# set fe-1/2/0 unit 13 family mpls
   user@PE3# set lo0 unit 11 family inet address 10.9.9.6/32
   user@PE3# set lo0 unit 11 family inet address 10.100.1.6/32
   ```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

   ```
   [edit protocols]
   user@PE3# set rsvp interface fe-1/2/0.13
   user@PE3# set mpls label-switched-path PE3-to-PE4 to 10.9.9.4
   user@PE3# set mpls interface fe-1/2/0.13
   ```

3. Configure BGP.

   ```
   [edit protocols bgp group external]
   user@PE3# set type external
   user@PE3# set multihop ttl 2
   user@PE3# set local-address 10.9.9.6
   user@PE3# set export next-hop
   user@PE3# set export SET_EXPORT_ROUTES
   user@PE3# set vpn-apply-export
   user@PE3# set peer-as 13979
   user@PE3# set neighbor 10.9.9.4
   ```

4. Enable AIGP.

   ```
   [edit protocols bgp group external]
   user@PE3# set family inet labeled-unicast aigp
   ```

5. Enable the policies.

   ```
   [edit policy-options]
   user@PE3# set policy-statement SET_EXPORT_ROUTES term 10 from protocol
     direct
   user@PE3# set policy-statement SET_EXPORT_ROUTES term 10 from protocol
     static
   ```



```
user@PE3# set policy-statement SET_EXPORT_ROUTES term 10 from protocol
  bgp
user@PE3# set policy-statement SET_EXPORT_ROUTES term 10 then next-hop
  10.100.1.6
user@PE3# set policy-statement SET_EXPORT_ROUTES term 10 then accept
user@PE3# set policy-statement next-hop term 10 from protocol bgp
user@PE3# set policy-statement next-hop term 10 then next-hop 10.100.1.6
user@PE3# set policy-statement next-hop term 10 then accept
user@PE3# set policy-statement next-hop term 20 from protocol direct
user@PE3# set policy-statement next-hop term 20 from route-filter 10.9.9.6/32
  exact
user@PE3# set policy-statement next-hop term 20 from route-filter 10.100.1.6/32
  exact
user@PE3# set policy-statement next-hop term 20 then next-hop 10.100.1.6
user@PE3# set policy-statement next-hop term 20 then accept
```

6. Configure an IGP, such as OSPF, RIP, or IS-IS.

```
[edit protocols ospf area 0.0.0.3]
user@PE3# set interface 10.9.9.6 passive
user@PE3# set interface 10.9.9.6 metric 1
user@PE3# set interface 10.100.1.6 passive
user@PE3# set interface 10.100.1.6 metric 1
user@PE3# set interface fe-1/2/0.13 metric 1
```

7. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@PE3# set router-id 10.9.9.6
user@PE3# set autonomous-system 7018
```

8. If you are done configuring the device, commit the configuration.

```
user@PE3# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE3# show interfaces
fe-1/2/0 {
  unit 13 {
    description PE3-to-PE4;
    family inet {
      address 10.0.0.26/30;
    }
    family mpls;
  }
}
lo0 {
  unit 11 {
    family inet {
      address 10.9.9.6/32;
      address 10.100.1.6/32;
    }
```

```
  }
}
user@PE3# show policy-options
policy-statement SET_EXPORT_ROUTES {
  term 10 {
    from protocol [ direct static bgp ];
    then {
      next-hop 10.100.1.6;
      accept;
    }
  }
}
policy-statement next-hop {
  term 10 {
    from protocol bgp;
    then {
      next-hop 10.100.1.6;
      accept;
    }
  }
  term 20 {
    from {
      protocol direct;
      route-filter 10.9.9.6/32 exact;
      route-filter 10.100.1.6/32 exact;
    }
    then {
      next-hop 10.100.1.6;
      accept;
    }
  }
}
user@PE3# show protocols
rsvp {
  interface fe-1/2/0.13;
}
mpls {
  label-switched-path PE3-to-PE4 {
    to 10.9.9.4;
  }
  interface fe-1/2/0.13;
}
bgp {
  group external {
    type external;
    multihop {
      ttl 2;
    }
    local-address 10.9.9.6;
    family inet {
      labeled-unicast {
        aigp;
      }
    }
    export [ next-hop SET_EXPORT_ROUTES ];
```



```
      vpn-apply-export;
      peer-as 13979;
      neighbor 10.9.9.4;
    }
  }
  ospf {
    area 0.0.0.3 {
      interface 10.9.9.6 {
        passive;
        metric 1;
      }
      interface 10.100.1.6 {
        passive;
        metric 1;
      }
      interface fe-1/2/0.13 {
        metric 1;
      }
    }
  }
```

```
user@PE3# show routing-options
router-id 10.9.9.6;
autonomous-system 7018;
```

Configuring Device PE7

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE7:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@PE7# set fe-1/2/0 unit 15 description PE7-to-PE1
   user@PE7# set fe-1/2/0 unit 15 family inet address 10.0.0.10/30
   user@PE7# set lo0 unit 13 family inet address 10.9.9.7/32
   user@PE7# set lo0 unit 13 family inet address 10.100.1.7/32
   ```

2. Configure BGP.

   ```
   [edit protocols bgp group external]
   user@PE7# set type external
   user@PE7# set export SET_EXPORT_ROUTES
   user@PE7# set peer-as 13979
   user@PE7# set neighbor 10.0.0.9
   ```

3. Enable AIGP.

   ```
   [edit protocols bgp group external]
   user@PE7# set family inet labeled-unicast aigp
   ```

4. Configure the routing policy.

   ```
   [edit policy-options policy-statement SET_EXPORT_ROUTES term 10]
   user@PE7# set from protocol direct
   ```

```
user@PE7# set from protocol bgp
user@PE7# set then next-hop 10.100.1.7
user@PE7# set then accept
```

5. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@PE7# set router-id 10.9.9.7
user@PE7# set autonomous-system 7019
```

6. If you are done configuring the device, commit the configuration.

```
user@PE7# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE7# show interfaces
interfaces {
  fe-1/2/0 {
    unit 15 {
      description PE7-to-PE1;
      family inet {
        address 10.0.0.10/30;
      }
    }
  }
  lo0 {
    unit 13 {
      family inet {
        address 10.9.9.7/32;
        address 10.100.1.7/32;
      }
    }
  }
}
```

```
user@PE7# show policy-options
policy-statement SET_EXPORT_ROUTES {
  term 10 {
    from protocol [ direct bgp ];
    then {
      next-hop 10.100.1.7;
      accept;
    }
  }
}
```

```
user@PE7# show protocols
bgp {
  group external {
    type external;
    family inet {
      labeled-unicast {
        aigp;
```



```
            }
        }
        export SET_EXPORT_ROUTES;
        peer-as 13979;
        neighbor 10.0.0.9;
    }
}
```

```
user@PE7# show routing-options
router-id 10.9.9.7;
autonomous-system 7019;
```

Verification

Confirm that the configuration is working properly.

Verifying That Device PE4 Is Receiving the AIGP Attribute from Its EBGP Neighbor PE2

Purpose Make sure that the AIGP policy on Device PE2 is working.

Action

```
user@PE4> show route receive-protocol bgp 10.9.9.5 extensive
* 55.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 299888
     Nexthop: 10.100.1.5
     AS path: 7018 I
     AIGP: 20

* 99.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 299888
     Nexthop: 10.100.1.5
     AS path: 7018 I
     AIGP: 30
```

Meaning On Device PE2, the **aigp-originate** statement is configured with a distance of 20 (**aigp-originate distance 20**). This statement is applied to route 55.0.0.0/24. Likewise, the **aigp-originate distance 30** statement is applied to route 99.0.0.0/24. Thus, when Device PE4 receives these routes, the AIGP attribute is attached with the configured metrics.

Checking the IGP Metric

Purpose From Device PE4, check the IGP metric to the BGP next hop 10.100.1.5.

Action

```
user@PE4> show route 10.100.1.5
inet.0: 30 destinations, 40 routes (30 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.100.1.5/32      *[OSPF/10] 05:35:50, metric 2
                    > to 10.0.0.22 via fe-1/2/2.10
                    [BGP/170] 03:45:07, localpref 100, from 10.9.9.5
                      AS path: 7018 I
                    > to 10.0.0.22 via fe-1/2/2.10
```

Meaning The IGP metric for this route is 2.

Verifying That Device PE4 Adds the IGP Metric to the AIGP Attribute

Purpose Make sure that Device PE4 adds the IGP metric to the AIGP attribute when it readvertises routes to its IBGP neighbor, Device PE1.

Action

```
user@PE4> show route advertising-protocol bgp 10.9.9.1 extensive

* 55.0.0.0/24 (1 entry, 1 announced)
 BGP group internal type Internal
     Route Label: 300544
     Nexthop: 10.100.1.4
     Flags: Nexthop Change
     Localpref: 100
     AS path: [13979] 7018 I
     AIGP: 22

* 99.0.0.0/24 (1 entry, 1 announced)
 BGP group internal type Internal
     Route Label: 300544
     Nexthop: 10.100.1.4
     Flags: Nexthop Change
     Localpref: 100
     AS path: [13979] 7018 I
     AIGP: 32
```

Meaning The IGP metric is added to the AIGP metric (20 + 2 = 22 and 30 + 2 = 32), because the next hop is changed for these routes.

Verifying That Device PE7 Is Receiving the AIGP Attribute from Its EBGP Neighbor PE1

Purpose Make sure that the AIGP policy on Device PE1 is working.

Action

```
user@PE7> show route receive-protocol bgp 10.0.0.9 extensive
* 44.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 300096
     Nexthop: 10.0.0.9
     AS path: 13979 I
     AIGP: 203

* 55.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 300112
     Nexthop: 10.0.0.9
     AS path: 13979 7018 I
     AIGP: 25

* 99.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 300112
     Nexthop: 10.0.0.9
     AS path: 13979 7018 I
     AIGP: 35
```

Meaning The 44.0.0.0/24 route is originated at Device PE4. The 55.0.0.0/24 and 99.0.0.0/24 routes are originated at Device PE2. The IGP distances are added to the configured AIGP distances.

Verifying the Resolving AIGP Metric

Purpose Confirm that if the prefix is resolved through recursion and the recursive next hops have AIGP metrics, the prefix has the sum of the AIGP values that are on the recursive BGP next hops.

Action

1. Add a static route to 66.0.0.0/24.

   ```
   [edit routing-options]
   user@PE2# set static route 66.0.0.0/24 discard
   ```

2. Delete the existing terms in the **aigp** policy statement on Device PE2.

   ```
   [edit policy-options policy-statement aigp]
   user@PE2# delete term 10
   user@PE2# delete term 20
   ```

3. Configure a recursive route lookup for the route to 66.0.0.0.

   The policy shows the AIGP metric for prefix 66.0.0.0/24 (none) and its recursive next hop. Prefix 66.0.0.0/24 is resolved by 55.0.0.1. Prefix 66.0.0.0/24 does not have its own AIGP metric being originated, but its recursive next hop, 55.0.0.1, has an AIGP value.

   ```
   [edit policy-options policy-statement aigp]
   user@PE2# set term 10 from route-filter 55.0.0.1/24 exact
   user@PE2# set term 10 then aigp-originate distance 20
   user@PE2# set term 10 then next-hop 10.100.1.5
   user@PE2# set term 10 then accept
   user@PE2# set term 20 from route-filter 66.0.0.0/24 exact
   user@PE2# set term 20 then next-hop 55.0.0.1
   ```

user@PE2# **set term 20 then accept**

4. On Device PE4, run the **show route 55.0.0.0 extensive** command.

   The value of Metric2 is the IGP metric to the BGP next hop. When Device PE4 readvertises these routes to its IBGP peer, Device PE1, the AIGP metric is the sum of AIGP + its Resolving AIGP metric + Metric2.

   Prefix 55.0.0.0 shows its own IGP metric 20, as defined and advertised by Device PE2. It does not show a resolving AIGP value because it does not have a recursive BGP next hop. The value of Metric2 is 2.

```
user@PE4> show route 55.0.0.0 extensive
inet.0: 31 destinations, 41 routes (31 active, 0 holddown, 0 hidden)
55.0.0.0/24 (1 entry, 1 announced)
TSI:
KRT in-kernel 55.0.0.0/24 -> {indirect(262151)}
Page 0 idx 0 Type 1 val 928d1b8
    Flags: Nexthop Change
    Nexthop: 10.100.1.4
    Localpref: 100
    AS path: [13979] 7018 I
    Communities:
    AIGP: 22
Path 55.0.0.0 from 10.9.9.5 Vector len 4.  Val: 0
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Address: 0x925da38
                Next-hop reference count: 4
                Source: 10.9.9.5
                Next hop type: Router, Next hop index: 1004
                Next hop: 10.0.0.22 via fe-1/2/2.10, selected
                Label operation: Push 299888
                Label TTL action: prop-ttl
                Protocol next hop: 10.100.1.5
                Push 299888
                Indirect next hop: 93514d8 262151
                State: <Active Ext>
                Local AS: 13979 Peer AS:  7018
                Age: 22:03:26   Metric2: 2
                AIGP: 20
                Task: BGP_7018.10.9.9.5+58560
                Announcement bits (3): 3-KRT 4-BGP_RT_Background 5-Resolve
tree 1
                AS path: 7018 I
                Accepted
                Route Label: 299888
                Localpref: 100
                Router ID: 10.9.9.5
                Indirect next hops: 1
                        Protocol next hop: 10.100.1.5 Metric: 2
                        Push 299888
                        Indirect next hop: 93514d8 262151
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.0.0.22 via fe-1/2/2.10
                        10.100.1.5/32 Originating RIB: inet.0
                          Metric: 2                       Node path count: 1
                          Forwarding nexthops: 1
                                Nexthop: 10.0.0.22 via fe-1/2/2.10
```


5. On Device PE4, run the **show route 66.0.0.0 extensive** command.

   Prefix 66.0.0.0/24 shows the Resolving AIGP, which is the sum of its own AIGP metric and its recursive BGP next hop:

   66.0.0.1 = 0, 55.0.0.1 = 20, 0+20 = 20

```
user@PE4> show route 66.0.0.0 extensive
inet.0: 31 destinations, 41 routes (31 active, 0 holddown, 0 hidden)
66.0.0.0/24 (1 entry, 1 announced)
TSI:
KRT in-kernel 66.0.0.0/24 -> {indirect(262162)}
Page 0 idx 0 Type 1 val 928cefc
    Flags: Nexthop Change
    Nexthop: 10.100.1.4
    Localpref: 100
    AS path: [13979] 7018 I
    Communities:
Path 66.0.0.0 from 10.9.9.5 Vector len 4.  Val: 0
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Address: 0x925d4e0
                Next-hop reference count: 4
                Source: 10.9.9.5
                Next hop type: Router, Next hop index: 1006
                Next hop: 10.0.0.22 via fe-1/2/2.10, selected
                Label operation: Push 299888, Push 299888(top)
                Label TTL action: prop-ttl, prop-ttl(top)
                Protocol next hop: 55.0.0.1
                Push 299888
                Indirect next hop: 9353e88 262162
                State: <Active Ext>
                Local AS: 13979 Peer AS:  7018
                Age: 31:42      Metric2: 2
                Resolving-AIGP: 20
                Task: BGP_7018.10.9.9.5+58560
                Announcement bits (3): 3-KRT 4-BGP_RT_Background 5-Resolve
tree 1
                AS path: 7018 I
                Accepted
                Route Label: 299888
                Localpref: 100
                Router ID: 10.9.9.5
                Indirect next hops: 1
                        Protocol next hop: 55.0.0.1 Metric: 2 AIGP: 20
                        Push 299888
                        Indirect next hop: 9353e88 262162
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.0.0.22 via fe-1/2/2.10
                        55.0.0.0/24 Originating RIB: inet.0
                          Metric: 2                       Node path count: 1
                          Indirect nexthops: 1
                                Protocol Nexthop: 10.100.1.5 Metric: 2 Push
299888
                                Indirect nexthop: 93514d8 262151
                                Indirect path forwarding nexthops: 1
                                        Nexthop: 10.0.0.22 via fe-1/2/2.10
                                10.100.1.5/32 Originating RIB: inet.0
                                  Metric: 2                            Node
 path count: 1
```

```
                    Forwarding nexthops: 1
                        Nexthop: 10.0.0.22 via fe-1/2/2.10
```

Verifying the Presence of AIGP Attributes in BGP Updates

Purpose If the AIGP attribute is not enabled under BGP (or the **group** or **neighbor** hierarchies), the AIGP attribute is silently discarded. Enable **traceoptions** and include the **packets** flag in the **detail** option in the configuration to confirm the presence of the AIGP attribute in transmitted or received BGP updates. This is useful when debugging AIGP issues.

Action

1. Configure Device PE2 and Device PE4 for **traceoptions**.

   ```
   user@host> show protocols bgp
     traceoptions {
       file bgp size 1m files 5;
       flag packets detail;
     }
   ```

2. Check the **traceoptions** file on Device PE2.

   The following sample shows Device PE2 advertising prefix 99.0.0.0/24 to Device PE4 (10.9.9.4) with an AIGP metric of 20:

   ```
   user@PE2> show log bgp
   Mar 22 09:27:18.982150 BGP SEND 10.9.9.5+49652 -> 10.9.9.4+179
   Mar 22 09:27:18.982178 BGP SEND message type 2 (Update) length 70
   Mar 22 09:27:18.982198 BGP SEND Update PDU length 70
   Mar 22 09:27:18.982248 BGP SEND flags 0x40 code Origin(1): IGP
   Mar 22 09:27:18.982273 BGP SEND flags 0x40 code ASPath(2) length 6: 7018
   Mar 22 09:27:18.982295 BGP SEND flags 0x80 code AIGP(26): AIGP: 20
   Mar 22 09:27:18.982316 BGP SEND flags 0x90 code MP_reach(14): AFI/SAFI 1/4
   Mar 22 09:27:18.982341 BGP SEND         nhop 10.100.1.5 len 4
   Mar 22 09:27:18.982372 BGP SEND      99.0.0.0/24 (label 301664)
   Mar 22 09:27:33.665412 bgp_send: sending 19 bytes to abcd::10:255:170:84
   (External AS 13979)
   ```

3. Verify that the route was received on Device PE4 using the **show route receive-protocol** command.

   AIGP is not enabled on Device PE4, so the AIGP attribute is silently discarded for prefix 99.0.0.0/24 and does not appear in the following output:

   ```
   user@PE4> show route receive-protocol bgp 10.9.9.5 extensive | find 55.0.0.0
   * 99.0.0.0/24 (2 entries, 1 announced)
        Accepted
        Route Label: 301728
        Nexthop: 10.100.1.5
        AS path: 7018 I
   ```

4. Check the **traceoptions** file on Device PE4.

   The following output from the **traceoptions** log shows that the 99.0.0.0/24 prefix was received with the AIGP attribute attached:

   ```
   user@PE4> show log bgp
   Mar 22 09:41:39.650295 BGP RECV 10.9.9.5+64690 -> 10.9.9.4+179
   Mar 22 09:41:39.650331 BGP RECV message type 2 (Update) length 70
   Mar 22 09:41:39.650350 BGP RECV Update PDU length 70
   Mar 22 09:41:39.650370 BGP RECV flags 0x40 code Origin(1): IGP
   Mar 22 09:41:39.650394 BGP RECV flags 0x40 code ASPath(2) length 6: 7018
   ```



```
Mar 22 09:41:39.650415 BGP RECV flags 0x80 code AIGP(26): AIGP: 20
Mar 22 09:41:39.650436 BGP RECV flags 0x90 code MP_reach(14): AFI/SAFI 1/4
Mar 22 09:41:39.650459 BGP RECV         nhop 10.100.1.5 len 4
Mar 22 09:41:39.650495 BGP RECV      99.0.0.0/24 (label 301728)
Mar 22 09:41:39.650574 bgp_rcv_nlri: 99.0.0.0/24
Mar 22 09:41:39.650607 bgp_rcv_nlri: 99.0.0.0/24 belongs to meshgroup
Mar 22 09:41:39.650629 bgp_rcv_nlri: 99.0.0.0/24 qualified bnp->ribact 0x0
l2afcb 0x0
```

Meaning Performing this verification helps with AIGP troubleshooting and debugging issues. It enables you to verify which devices in your network send and receive AIGP attributes.

Related Documentation

- Understanding BGP Path Selection on page 2827
- Examples: Configuring Internal BGP Peering on page 2662

BGP Policy Configuration

Example: Configuring BGP Interactions with IGPs

Understanding Routing Policies

Each routing policy is identified by a policy name. The name can contain letters, numbers, and hyphens (-) and can be up to 255 characters long. To include spaces in the name, enclose the entire name in double quotation marks. Each routing policy name must be unique within a configuration.

Once a policy is created and named, it must be applied before it is active. You apply routing policies using the **import** and **export** statements at the **protocols>*protocol-name*** level in the configuration hierarchy.

In the **import** statement, you list the name of the routing policy to be evaluated when routes are imported into the routing table from the routing protocol.

In the **export** statement, you list the name of the routing policy to be evaluated when routes are being exported from the routing table into a dynamic routing protocol. Only active routes are exported from the routing table.

To specify more than one policy and create a policy chain, you list the policies using a space as a separator. If multiple policies are specified, the policies are evaluated in the order in which they are specified. As soon as an accept or reject action is executed, the policy chain evaluation ends.

Example: Injecting OSPF Routes into the BGP Routing Table

This example shows how to create a policy that injects OSPF routes into the BGP routing table.

Requirements

Before you begin:

- Configure network interfaces.
- Configure external peer sessions. See “Example: Configuring External BGP Point-to-Point Peer Sessions” on page 2640.
- Configure interior gateway protocol (IGP) sessions between peers.

Overview

In this example, you create a routing policy called **injectpolicy1** and a routing term called **injectterm1**. The policy injects OSPF routes into the BGP routing table.

Configuration

Configuring the Routing Policy

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set policy-options policy-statement injectpolicy1 term injectterm1 from protocol ospf
set policy-options policy-statement injectpolicy1 term injectterm1 from area 0.0.0.1
set policy-options policy-statement injectpolicy1 term injectterm1 then accept
set protocols bgp export injectpolicy1
```


Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To inject OSPF routes into a BGP routing table:

1. Create the policy term.

   ```
   [edit policy-options policy-statement injectpolicy1]
   user@host# set term injectterm1
   ```

2. Specify OSPF as a match condition.

   ```
   [edit policy-options policy-statement injectpolicy1 term injectterm1]
   user@host# set from protocol ospf
   ```

3. Specify the routes from an OSPF area as a match condition.

   ```
   [edit policy-options policy-statement injectpolicy1 term injectterm1]
   user@host# set from area 0.0.0.1
   ```

4. Specify that the route is to be accepted if the previous conditions are matched.

   ```
   [edit policy-options policy-statement injectpolicy1 term injectterm1]
   user@host# set then accept
   ```

5. Apply the routing policy to BGP.

   ```
   [edit]
   user@host# set protocols bgp export injectpolicy1
   ```

Results

Confirm your configuration by entering the **show policy-options** and **show protocols bgp** commands from configuration mode. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show policy-options
policy-statement injectpolicy1 {
  term injectterm1 {
    from {
      protocol ospf;
      area 0.0.0.1;
    }
    then accept;
  }
}
```

```
user@host# show protocols bgp
export injectpolicy1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Tracing for the Routing Policy

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set policy-options policy-statement injectpolicy1 term injectterm1 then trace
set routing-options traceoptions file ospf-bgp-policy-log
set routing-options traceoptions file size 5m
set routing-options traceoptions file files 5
set routing-options traceoptions flag policy
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Include a trace action in the policy.

   ```
   [edit policy-options policy-statement injectpolicy1 term injectterm1]
   user@host# then trace
   ```

2. Configure the tracing file for the output.

   ```
   [edit routing-options traceoptions]
   user@host# set file ospf-bgp-policy-log
   user@host# set file size 5m
   user@host# set file files 5
   user@host# set flag policy
   ```

Results

Confirm your configuration by entering the **show policy-options** and **show routing-options** commands from configuration mode. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show policy-options
policy-statement injectpolicy1 {
  term injectterm1 {
    then {
      trace;
    }
  }
}
```

```
user@host# show routing-options
traceoptions {
  file ospf-bgp-policy-log size 5m files 5;
  flag policy;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying That the Expected BGP Routes Are Present

Purpose

Verify the effect of the export policy.

Action

From operational mode, enter the **show route** command.

Troubleshooting

Using the show log Command to Examine the Actions of the Routing Policy

Problem The routing table contains unexpected routes, or routes are missing from the routing table.

Solution If you configure policy tracing as shown in this example, you can run the **show log ospf-bgp-policy-log** command to diagnose problems with the routing policy. The **show log ospf-bgp-policy-log** command displays information about the routes that the **injectpolicy1** policy term analyzes and acts upon.

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

Example: Configuring BGP Route Advertisement

Understanding Route Advertisement

All routing protocols use the Junos OS routing table to store the routes that they learn and to determine which routes they should advertise in their protocol packets. Routing policy allows you to control which routes the routing protocols store in and retrieve from the routing table. For information about routing policy, see the *Routing Policy Feature Guide for Routing Devices*.

When configuring BGP routing policy, you can perform the following tasks:

Applying Routing Policy

You define routing policy at the **[edit policy-options]** hierarchy level. To apply policies you have defined for BGP, include the **import** and **export** statements within the BGP configuration.

You can apply policies as follows:

- BGP global **import** and **export** statements—Include these statements at the **[edit protocols bgp]** hierarchy level (for routing instances, include these statements at the **[edit routing-instances *routing-instance-name* protocols bgp]** hierarchy level).

- Group **import** and **export** statements—Include these statements at the **[edit protocols bgp group *group-name*]** hierarchy level (for routing instances, include these statements at the **[edit routing-instances *routing-instance-name* protocols bgp group *group-name*]** hierarchy level).
- Peer **import** and **export** statements—Include these statements at the **[edit protocols bgp group *group-name* neighbor *address*]** hierarchy level (for routing instances, include these statements at the **[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]** hierarchy level).

A peer-level **import** or **export** statement overrides a group **import** or **export** statement. A group-level **import** or **export** statement overrides a global BGP **import** or **export** statement.

To apply policies, see the following sections:

- Applying Policies to Routes Being Imported into the Routing Table from BGP on page 2804
- Applying Policies to Routes Being Exported from the Routing Table into BGP on page 2804

Applying Policies to Routes Being Imported into the Routing Table from BGP

To apply policy to routes being imported into the routing table from BGP, include the **import** statement, listing the names of one or more policies to be evaluated:

import [*policy-names*];

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

If you specify more than one policy, they are evaluated in the order specified, from first to last, and the first matching filter is applied to the route. If no match is found, BGP places into the routing table only those routes that were learned from BGP routing devices.

Applying Policies to Routes Being Exported from the Routing Table into BGP

To apply policy to routes being exported from the routing table into BGP, include the **export** statement, listing the names of one or more policies to be evaluated:

export [*policy-names*];

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

If you specify more than one policy, they are evaluated in the order specified, from first to last, and the first matching filter is applied to the route. If no routes match the filters, the routing table exports into BGP only the routes that it learned from BGP.

Setting BGP to Advertise Inactive Routes

By default, BGP stores the route information it receives from update messages in the Junos OS routing table, and the routing table exports only active routes into BGP, which BGP then advertises to its peers. To have the routing table export to BGP the best route learned by BGP even if Junos OS did not select it to be an active route, include the **advertise-inactive** statement:

advertise-inactive;

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

Configuring BGP to Advertise the Best External Route to Internal Peers

In general, deployed BGP implementations do not advertise the external route with the highest local preference value to internal peers unless it is the best route. Although this behavior was required by an earlier version of the BGP version 4 specification, RFC 1771, it was typically not followed in order to minimize the amount of advertised information and to prevent routing loops. However, there are scenarios in which advertising the best external route is beneficial, in particular, situations that can result in IBGP route oscillation.

In Junos OS Release 9.3 and later, you can configure BGP to advertise the best external route into an internal BGP (IBGP) mesh group, a route reflector cluster, or an autonomous system (AS) confederation, even when the best route is an internal route.

NOTE: In order to configure the **advertise-external** statement on a route reflector, you must disable intracluster reflection with the **no-client-reflect** statement.

When a routing device is configured as a route reflector for a cluster, a route advertised by the route reflector is considered internal if it is received from an internal peer with the same cluster identifier or if both peers have no cluster identifier configured. A route received from an internal peer that belongs to another cluster, that is, with a different cluster identifier, is considered external.

In a confederation, when advertising a route to a confederation border router, any route from a different confederation sub-AS is considered external.

You can also configure BGP to advertise the external route only if the route selection process reaches the point where the multiple exit discriminator (MED) metric is evaluated. As a result, an external route with an AS path worse (that is, longer) than that of the active path is not advertised.

Junos OS also provides support for configuring a BGP export policy that matches on the state of an advertised route. You can match on either active or inactive routes. For more information, see the *Routing Policy Feature Guide for Routing Devices*.

To configure BGP to advertise the best external path to internal peers, include the **advertise-external** statement:

```
advertise-external;
```

NOTE: The **advertise-external** statement is supported at both the group and neighbor level. If you configure the statement at the neighbor level, you must configure it for all neighbors in a group. Otherwise, the group is automatically split into different groups.

For a complete list of hierarchy levels at which you can configure this statement, see the statement summary section for this statement.

To configure BGP to advertise the best external path only if the route selection process reaches the point where the MED value is evaluated, include the **conditional** statement:

```
advertise-external {
  conditional;
}
```

Configuring How Often BGP Exchanges Routes with the Routing Table

BGP stores the route information it receives from update messages in the routing table, and the routing table exports active routes from the routing table into BGP. BGP then advertises the exported routes to its peers. By default, the exchange of route information between BGP and the routing table occurs immediately after the routes are received. This immediate exchange of route information might cause instabilities in the network reachability information. To guard against this, you can delay the time between when BGP and the routing table exchange route information.

To configure how often BGP and the routing table exchange route information, include the **out-delay** statement:

out-delay *seconds*;

By default, the routing table retains some of the route information learned from BGP. To have the routing table retain all or none of this information, include the **keep** statement:

keep (all | none);

For a list of hierarchy levels at which you can include these statements, see the statement summary sections for these statements.

The routing table can retain the route information learned from BGP in one of the following ways:

- Default (omit the **keep** statement)—Keep all route information that was learned from BGP, except for routes whose AS path is looped and whose loop includes the local AS.
- **keep all**—Keep all route information that was learned from BGP.
- **keep none**—Discard routes that were received from a peer and that were rejected by import policy or other sanity checking, such as AS path or next hop. When you configure **keep none** for the BGP session and the inbound policy changes, Junos OS forces readvertisement of the full set of routes advertised by the peer.

In an AS path healing situation, routes with looped paths theoretically could become usable during a soft reconfiguration when the AS path loop limit is changed. However, there is a significant memory usage difference between the default and **keep all**.

Consider the following scenarios:

- A peer readvertises routes back to the peer from which it learned them.

  This can happen in the following cases:

  - Another vendor's routing device advertises the routes back to the sending peer.

  - The Junos OS peer's default behavior of not readvertising routes back to the sending peer is overridden by configuring **advertise-peer-as**.

- A provider edge (PE) routing device discards any VPN route that does not have any of the expected route targets.

When **keep all** is configured, the behavior of discarding routes received in the above scenarios is overridden.

Disabling Suppression of Route Advertisements

Junos OS does not advertise the routes learned from one EBGP peer back to the same external BGP (EBGP) peer. In addition, the software does not advertise those routes back to any EBGP peers that are in the same AS as the originating peer, regardless of the routing instance. You can modify this behavior by including the **advertise-peer-as** statement in the configuration. To disable the default advertisement suppression, include the **advertise-peer-as** statement:

```
advertise-peer-as;
```

NOTE: The route suppression default behavior is disabled if the **as-override** statement is included in the configuration.

If you include the **advertise-peer-as** statement in the configuration, BGP advertises the route regardless of this check.

To restore the default behavior, include the **no-advertise-peer-as** statement in the configuration:

```
no-advertise-peer-as;
```

If you include both the **as-override** and **no-advertise-peer-as** statements in the configuration, the **no-advertise-peer-as** statement is ignored. You can include these statements at multiple hierarchy levels.

For a list of hierarchy levels at which you can include these statements, see the statement summary section for these statements.

Example: Configuring BGP Prefix-Based Outbound Route Filtering

This example shows how to configure a Juniper Networks router to accept route filters from remote peers and perform outbound route filtering using the received filters.

Requirements

Before you begin:

- Configure the router interfaces.
- Configure an interior gateway protocol (IGP).

Overview

You can configure a BGP peer to accept route filters from remote peers and perform outbound route filtering using the received filters. By filtering out unwanted updates, the sending peer saves resources needed to generate and transmit updates, and the receiving peer saves resources needed to process updates. This feature can be useful, for example, in a virtual private network (VPN) in which subsets of customer edge (CE) devices are not capable of processing all the routes in the VPN. The CE devices can use prefix-based outbound route filtering to communicate to the provider edge (PE) routing device to transmit only a subset of routes, such as routes to the main data centers only.

The maximum number of prefix-based outbound route filters that a BGP peer can accept is 5000. If a remote peer sends more than 5000 outbound route filters to a peer address, the additional filters are discarded, and a system log message is generated.

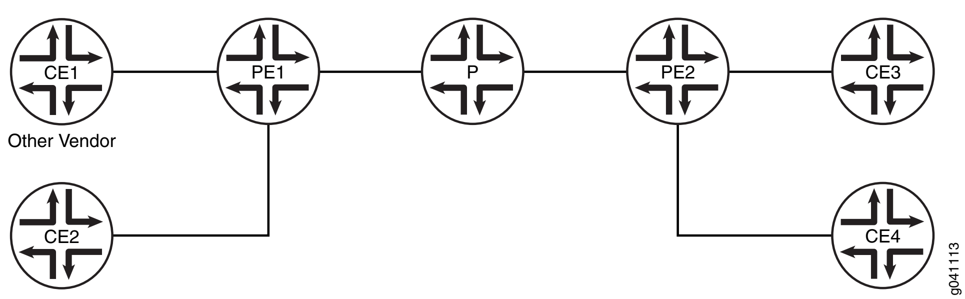
You can configure interoperability for the routing device as a whole or for specific BGP groups or peers only.

Topology

In the sample network, Device CE1 is a router from another vendor. The configuration shown in this example is on Juniper Networks Router PE1.

Figure 52 on page 2808 shows the sample network.

Figure 52: BGP Prefix-Based Outbound Route Filtering



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

PE1

```
set protocols bgp group cisco-peers type external
set protocols bgp group cisco-peers description “to CE1”
set protocols bgp group cisco-peers local-address 192.168.165.58
```



```
set protocols bgp group cisco-peers peer-as 35
set protocols bgp group cisco-peers outbound-route-filter bgp-orf-cisco-mode
set protocols bgp group cisco-peers outbound-route-filter prefix-based accept inet
set protocols bgp group cisco-peers neighbor 192.168.165.56
set routing-options autonomous-system 65500
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router PE1 to accept route filters from Device CE1 and perform outbound route filtering using the received filters:

1. Configure the local autonomous system.

   ```
   [edit routing-options]
   user@PE1# set autonomous-system 65500
   ```

2. Configure external peering with Device CE1.

   ```
   [edit protocols bgp group cisco-peers]
   user@PE1# set type external
   user@PE1# set description “to CE1”
   user@PE1# set local-address 192.168.165.58
   user@PE1# set peer-as 35
   user@PE1# set neighbor 192.168.165.56
   ```

3. Configure Router PE1 to accept IPv4 route filters from Device CE1 and perform outbound route filtering using the received filters.

   ```
   [edit protocols bgp group cisco-peers]
   user@PE1# set outbound-route-filter prefix-based accept inet
   ```

4. (Optional) Enable interoperability with routing devices that use the vendor-specific compatibility code of 130 for outbound route filters and the code type of 128.

   The IANA standard code is 3, and the standard code type is 64.

   ```
   [edit protocols bgp group cisco-peers]
   user@PE1# set outbound-route-filter bgp-orf-cisco-mode
   ```

Results

From configuration mode, confirm your configuration by entering the **show protocols** and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE1# show protocols
group cisco-peers {
  type external;
  description “to CE1”;
  local-address 192.168.165.58;
  peer-as 35;
  outbound-route-filter {
    bgp-orf-cisco-mode;
    prefix-based {
      accept {
        inet;
      }
```

```
      }
    }
    neighbor 192.168.165.56;
  }
```

user@PE1# **show routing-options**
autonomous-system 65500;

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying the Outbound Route Filter

Purpose Display information about the prefix-based outbound route filter received from Device CE1.

Action From operational mode, enter the **show bgp neighbor orf detail** command.

```
user@PE1> show bgp neighbor orf 192.168.165.56 detail
   Peer: 192.168.165.56 Type: External
   Group: cisco-peers

   inet-unicast
    Filter updates recv:          4 Immediate:         0
    Filter: prefix-based            receive
            Updates recv:          4
      Received filter entries:
        seq 10 2.2.0.0/16 deny minlen 0 maxlen 0
        seq 20 3.3.0.0/16 deny minlen 24 maxlen 0
        seq 30 4.4.0.0/16 deny minlen 0 maxlen 28
        seq 40 5.5.0.0/16 deny minlen 24 maxlen 28
```

Verifying the BGP Neighbor Mode

Purpose Verify that the **bgp-orf-cisco-mode** setting is enabled for the peer by making sure that the **ORFCiscoMode** option is displayed in the **show bgp neighbor** command output.

Action From operational mode, enter the **show bgp neighbor** command.

```
user@PE1> show bgp neighbor
Peer: 192.168.165.56 AS 35       Local: 192.168.165.58 AS 65500
  Type: External    State: Active         Flags: <>
  Last State: Idle          Last Event: Start
  Last Error: None
  Export: [ adv_stat ]
  Options: <Preference LocalAddress AddressFamily PeerAS Refresh>
  Options: <ORF ORFCiscoMode>
  Address families configured: inet-unicast
  Local Address: 192.168.165.58 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Trace options: detail open detail refresh
  Trace file: /var/log/orf size 5242880 files 20
```


Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*
- *Example: Configuring BGP to Advertise the Best External Route to Internal Peers*
- *Example: Setting BGP to Advertise Inactive Routes*

Example: Configuring EBGP Multihop

Understanding BGP Multihop

When external BGP (EBGP) peers are not directly connected to each other, they must cross one or more non-BGP routers to reach each other. Configuring multihop EBGP enables the peers to pass through the other routers to form peer relationships and exchange update messages. This type of configuration is typically used when a Juniper Networks routing device needs to run EBGP with a third-party router that does not allow direct connection of the two EBGP peers. EBGP multihop enables a neighbor connection between two EBGP peers that do not have a direct connection.

Example: Configuring EBGP Multihop Sessions

This example shows how to configure an external BGP (EBGP) peer that is more than one hop away from the local router. This type of session is called a *multihop* BGP session.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

The configuration to enable multihop EBGP sessions requires connectivity between the two EBGP peers. This example uses static routes to provide connectivity between the devices.

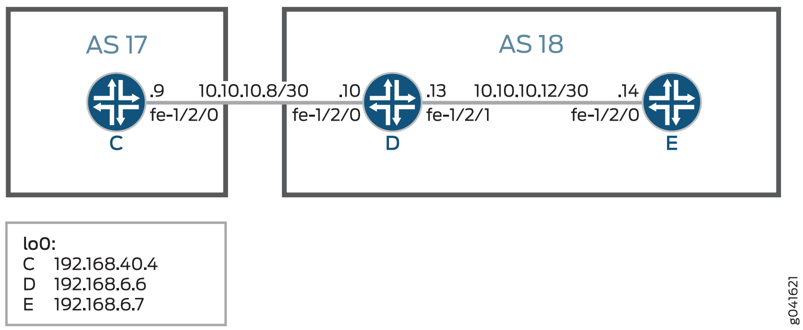
Unlike directly connected EBGP sessions in which physical address are typically used in the **neighbor** statements, you must use loopback interface addresses for multihop EBGP by specifying the loopback interface address of the indirectly connected peer. In this way, EBGP multihop is similar to internal BGP (IBGP).

Finally, you must add the multihop statement. Optionally, you can set a maximum time-to-live (TTL) value with the **ttl** statement. The TTL is carried in the IP header of BGP packets. If you do not specify a TTL value, the system's default maximum TTL value is used. The default TTL value is 64 for multihop EBGP sessions. Another option is to retain the BGP next-hop value for route advertisements by including the **no-nexthop-change** statement.

Figure 53 on page 2812 shows a typical EBGP multihop network.

Device C and Device E have an established EBGP session. Device D is not a BGP-enabled device. All of the devices have connectivity via static routes.

Figure 53: Typical Network with EBGP Multihop Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device C

```
set interfaces fe-1/2/0 unit 9 description to-D
set interfaces fe-1/2/0 unit 9 family inet address 10.10.10.9/30
set interfaces lo0 unit 3 family inet address 192.168.40.4/32
set protocols bgp group external-peers type external
set protocols bgp group external-peers multihop ttl 2
set protocols bgp group external-peers local-address 192.168.40.4
set protocols bgp group external-peers export send-static
set protocols bgp group external-peers peer-as 18
set protocols bgp group external-peers neighbor 192.168.6.7
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 10.10.10.14/32 next-hop 10.10.10.10
set routing-options static route 192.168.6.7/32 next-hop 10.10.10.10
set routing-options router-id 192.168.40.4
set routing-options autonomous-system 17
```

Device D

```
set interfaces fe-1/2/0 unit 10 description to-C
set interfaces fe-1/2/0 unit 10 family inet address 10.10.10.10/30
set interfaces fe-1/2/1 unit 13 description to-E
set interfaces fe-1/2/1 unit 13 family inet address 10.10.10.13/30
set interfaces lo0 unit 4 family inet address 192.168.6.6/32
set routing-options static route 192.168.40.4/32 next-hop 10.10.10.9
set routing-options static route 192.168.6.7/32 next-hop 10.10.10.14
set routing-options router-id 192.168.6.6
```

Device E

```
set interfaces fe-1/2/0 unit 14 description to-D
```

```
set interfaces fe-1/2/0 unit 14 family inet address 10.10.10.14/30
set interfaces lo0 unit 5 family inet address 192.168.6.7/32
set protocols bgp group external-peers multihop ttl 2
set protocols bgp group external-peers local-address 192.168.6.7
set protocols bgp group external-peers export send-static
set protocols bgp group external-peers peer-as 17
set protocols bgp group external-peers neighbor 192.168.40.4
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 10.10.10.8/30 next-hop 10.10.10.13
set routing-options static route 192.168.40.4/32 next-hop 10.10.10.13
set routing-options router-id 192.168.6.7
set routing-options autonomous-system 18
```

Device C

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device C:

1. Configure the interface to the directly connected device (to-D), and configure the loopback interface.

   ```
   [edit interfaces fe-1/2/0 unit 9]
   user@C# set description to-D
   user@C# set family inet address 10.10.10.9/30

   [edit interfaces lo0 unit 3]
   user@C# set family inet address 192.168.40.4/32
   ```

2. Configure an EBGP session with Device E.

   The **neighbor** statement points to the loopback interface on Device E.

   ```
   [edit protocols bgp group external-peers]
   user@C# set type external
   user@C# set local-address 192.168.40.4
   user@C# set export send-static
   user@C# set peer-as 18
   user@C# set neighbor 192.168.6.7
   ```

3. Configure the multihop statement to enable Device C and Device E to become EBGP peers.

   Because the peers are two hops away from each other, the example uses the **ttl 2** statement.

   ```
   [edit protocols bgp group external-peers]
   user@C# set multihop ttl 2
   ```

4. Configure connectivity to Device E, using static routes.

   You must configure a route to both the loopback interface address and to the address on the physical interface.

   ```
   [edit routing-options]
   ```

```
user@C# set static route 10.10.10.14/32 next-hop 10.10.10.10
user@C# set static route 192.168.6.7/32 next-hop 10.10.10.10
```

5. Configure the local router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@C# set router-id 192.168.40.4
user@C# set autonomous-system 17
```

6. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-static term 1]
user@C# set from protocol static
user@C# set then accept
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@C# show interfaces
fe-1/2/0 {
  unit 9 {
    description to-D;
    family inet {
      address 10.10.10.9/30;
    }
  }
}
lo0 {
  unit 3 {
    family inet {
      address 192.168.40.4/32;
    }
  }
}
```

```
user@C# show protocols
bgp {
  group external-peers {
    type external;
    multihop {
      ttl 2;
    }
    local-address 192.168.40.4;
    export send-static;
    peer-as 18;
    neighbor 192.168.6.7;
  }
}
```

```
user@C# show policy-options
policy-statement send-static {
  term 1 {
```



```
        from protocol static;
        then accept;
    }
}
user@C# show routing-options
static {
    route 10.10.10.14/32 next-hop 10.10.10.10;
    route 192.168.6.7/32 next-hop 10.10.10.10;
}
router-id 192.168.40.4;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.
Repeat these steps for all BFD sessions in the topology.

Configuring Device D

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device D:

1. Set the CLI to Device D.

   ```
   user@host> set cli logical-system D
   ```

2. Configure the interfaces to the directly connected devices, and configure a loopback interface.

   ```
   [edit interfaces fe-1/2/0 unit 10]
   user@D# set description to-C
   user@D# set family inet address 10.10.10.10/30

   [edit interfaces fe-1/2/1 unit 13]
   user@D# set description to-E
   user@D# set family inet address 10.10.10.13/30

   [edit interfaces lo0 unit 4]
   user@D# set family inet address 192.168.6.6/32
   ```

3. Configure connectivity to the other devices using static routes to the loopback interface addresses.

   On Device D, you do not need static routes to the physical addresses because Device D is directly connected to Device C and Device E.

   ```
   [edit routing-options]
   user@D# set static route 192.168.40.4/32 next-hop 10.10.10.9
   user@D# set static route 192.168.6.7/32 next-hop 10.10.10.14
   ```

4. Configure the local router ID.

   ```
   [edit routing-options]
   user@D# set router-id 192.168.6.6
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces** and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@D# show interfaces
fe-1/2/0 {
   unit 10 {
      description to-C;
      family inet {
         address 10.10.10.10/30;
      }
   }
}
fe-1/2/1 {
   unit 13 {
      description to-E;
      family inet {
         address 10.10.10.13/30;
      }
   }
}
lo0 {
   unit 4 {
      family inet {
         address 192.168.6.6/32;
      }
   }
}
```

```
user@D# show protocols
```

```
user@D# show routing-options
static {
   route 192.168.40.4/32 next-hop 10.10.10.9;
   route 192.168.6.7/32 next-hop 10.10.10.14;
}
router-id 192.168.6.6;
```

If you are done configuring the device, enter **commit** from configuration mode.
Repeat these steps for all BFD sessions in the topology.

Configuring Device E

Step-by-Step Procedure The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device E:

1. Set the CLI to Device E.

   ```
   user@host> set cli logical-system E
   ```

2. Configure the interface to the directly connected device (to-D), and configure the loopback interface.

   ```
   [edit interfaces fe-1/2/0 unit 14]
   ```



```
user@E# set description to-D
user@E# set family inet address 10.10.10.14/30

[edit interfaces lo0 unit 5]
user@E# set family inet address 192.168.6.7/32
```

3. Configure an EBGP session with Device E.

   The **neighbor** statement points to the loopback interface on Device C.

   ```
   [edit protocols bgp group external-peers]
   user@E# set local-address 192.168.6.7
   user@E# set export send-static
   user@E# set peer-as 17
   user@E# set neighbor 192.168.40.4
   ```

4. Configure the **multihop** statement to enable Device C and Device E to become EBGP peers.

   Because the peers are two hops away from each other, the example uses the **ttl 2** statement.

   ```
   [edit protocols bgp group external-peers]
   user@E# set multihop ttl 2
   ```

5. Configure connectivity to Device E, using static routes.

   You must configure a route to both the loopback interface address and to the address on the physical interface.

   ```
   [edit routing-options]
   user@E# set static route 10.10.10.8/30 next-hop 10.10.10.13
   user@E# set static route 192.168.40.4/32 next-hop 10.10.10.13
   ```

6. Configure the local router ID and the autonomous system (AS) number.

   ```
   [edit routing-options]
   user@E# set router-id 192.168.6.7
   user@E# set autonomous-system 18
   ```

7. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

   ```
   [edit policy-options policy-statement send-static term 1]
   user@E# set from protocol static
   user@E# set then accept
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@E# show interfaces
fe-1/2/0 {
  unit 14 {
    description to-D;
    family inet {
```

```
            address 10.10.10.14/30;
        }
    }
}
lo0 {
    unit 5 {
        family inet {
            address 192.168.6.7/32;
        }
    }
}
```

```
user@E# show protocols
bgp {
    group external-peers {
        multihop {
            ttl 2;
        }
        local-address 192.168.6.7;
        export send-static;
        peer-as 17;
        neighbor 192.168.40.4;
    }
}
```

```
user@E# show policy-options
policy-statement send-static {
    term 1 {
        from protocol static;
        then accept;
    }
}
```

```
user@E# show routing-options
static {
    route 10.10.10.8/30 next-hop 10.10.10.13;
    route 192.168.40.4/32 next-hop 10.10.10.13;
}
router-id 192.168.6.7;
autonomous-system 18;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying Connectivity on page 2818
- Verifying That BGP Sessions Are Established on page 2819
- Viewing Advertised Routes on page 2819

Verifying Connectivity

Purpose Make sure that Device C can ping Device E, specifying the loopback interface address as the source of the ping request.

The loopback interface address is the source address that BGP will use.

Action From operational mode, enter the **ping 10.10.10.14 source 192.168.40.4** command from Device C, and enter the **ping 10.10.10.9 source 192.168.6.7** command from Device E.

```
user@C> ping 10.10.10.14 source 192.168.40.4

PING 10.10.10.14 (10.10.10.14): 56 data bytes
64 bytes from 10.10.10.14: icmp_seq=0 ttl=63 time=1.262 ms
64 bytes from 10.10.10.14: icmp_seq=1 ttl=63 time=1.202 ms
^C
--- 10.10.10.14 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.202/1.232/1.262/0.030 ms
```

```
user@E> ping 10.10.10.9 source 192.168.6.7

PING 10.10.10.9 (10.10.10.9): 56 data bytes
64 bytes from 10.10.10.9: icmp_seq=0 ttl=63 time=1.255 ms
64 bytes from 10.10.10.9: icmp_seq=1 ttl=63 time=1.158 ms
^C
--- 10.10.10.9 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.158/1.206/1.255/0.049 ms
```

Meaning The static routes are working if the pings work.

Verifying That BGP Sessions Are Established

Purpose Verify that the BGP sessions are up.

Action From operational mode, enter the show bgp summary command.

```
user@C> show bgp summary

Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 2          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.168.6.7              18        147        147       0       1     1:04:27
0/2/2/0              0/0/0/0
```

```
user@E> show bgp summary

Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 2          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.168.40.4             17        202        202       0       1     1:02:18
0/2/2/0              0/0/0/0
```

Meaning The output shows that both devices have one peer each. No peers are down.

Viewing Advertised Routes

Purpose Check to make sure that routes are being advertised by BGP.

Action From operational mode, enter the **show route advertising-protocol bgp *neighbor*** command.

```
user@C> show route advertising-protocol bgp 192.168.6.7

inet.0: 5 destinations, 7 routes (5 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.10.10.14/32          Self                                    I
* 192.168.6.7/32          Self                                    I

user@E> show route advertising-protocol bgp 192.168.40.4

inet.0: 5 destinations, 7 routes (5 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.10.10.8/30           Self                                    I
* 192.168.40.4/32         Self                                    I
```

Meaning The **send-static** routing policy is exporting the static routes from the routing table into BGP. BGP is advertising these routes between the peers because the BGP peer session is established.

Related Documentation

- Examples: Configuring External BGP Peering on page 2639
- *BGP Configuration Overview*

Example: Configuring BGP Route Preference (Administrative Distance)

Understanding Route Preference Values

The Junos OS routing protocol process assigns a default preference value (also known as an *administrative distance*) to each route that the routing table receives. The default value depends on the source of the route. The preference value is a value from 0 through 4,294,967,295 ($2^{32} – 1$), with a lower value indicating a more preferred route. Table 227 on page 2820 lists the default preference values.

Table 227: Default Route Preference Values

How Route Is Learned	Default Preference	Statement to Modify Default Preference
Directly connected network	0	–
System routes	4	–
Static and Static LSPs	5	*static*
RSVP-signaled LSPs	7	RSVP **preference** as described in the *Junos OS MPLS Applications Library for Routing Devices*
LDP-signaled LSPs	9	LDP **preference**, as described in the *Junos OS MPLS Applications Library for Routing Devices*

Table 227: Default Route Preference Values *(continued)*

How Route Is Learned	Default Preference	Statement to Modify Default Preference
OSPF internal route	10	OSPF preference
IS-IS Level 1 internal route	15	IS-IS preference
IS-IS Level 2 internal route	18	IS-IS preference
Redirects	30	–
Kernel	40	–
SNMP	50	–
Router discovery	55	–
RIP	100	RIP preference
RIPng	100	RIPng *preference*
PIM	105	*Multicast Protocols Feature Guide for Routing Devices*
DVMRP	110	*Multicast Protocols Feature Guide for Routing Devices*
Aggregate	130	aggregate
OSPF AS external routes	150	OSPF external-preference
IS-IS Level 1 external route	160	IS-IS external-preference
IS-IS Level 2 external route	165	IS-IS external-preference
BGP	170	BGP preference, export, import
MSDP	175	*Multicast Protocols Feature Guide for Routing Devices*

In general, the narrower the scope of the statement, the higher precedence its preference value is given, but the smaller the set of routes it affects. To modify the default preference value for routes learned by routing protocols, you generally apply routing policy when configuring the individual routing protocols. You also can modify some preferences with other configuration statements, which are indicated in the table.

Example: Configuring the Preference Value for BGP Routes

This example shows how to specify the preference for routes learned from BGP. Routing information can be learned from multiple sources. To break ties among equally specific routes learned from multiple sources, each source has a preference value. Routes that are learned through explicit administrative action, such as static routes, are preferred over routes learned from a routing protocol, such as BGP or OSPF. This concept is called *administrative distance* by some vendors.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

Routing information can be learned from multiple sources, such as through static configuration, BGP, or an interior gateway protocol (IGP). When Junos OS determines a route's preference to become the active route, it selects the route with the lowest preference as the active route and installs this route into the forwarding table. By default, the routing software assigns a preference of 170 to routes that originated from BGP. Of all the routing protocols, BGP has the highest default preference value, which means that routes learned by BGP are the least likely to become the active route.

Some vendors have a preference (distance) of 20 for external BGP (EBGP) and a distance of 200 for internal BGP (IGBP). Junos OS uses the same value (170) for both EBGP and IBGP. However, this difference between vendors has no operational impact because Junos OS always prefers EBGP routes over IBGP routes.

Another area in which vendors differ is in regard to IGP distance compared to BGP distance. For example, some vendors assign a distance of 110 to OSPF routes. This is higher than the EBGP distance of 20 , and results in the selection of an EBGP route over an equivalent OSPF route. In the same scenario, Junos OS chooses the OSPF route, because of the default preference 10 for an internal OSPF route and 150 for an external OSPF route, which are both lower than the 170 preference assigned to all BGP routes.

In a multivendor environment, you might want to change the preference value for BGP routes so that Junos OS chooses an EBGP route instead of an OSPF route. To accomplish this goal, one option is to include the preference statement in the EBGP configuration. To modify the default BGP preference value, include the **preferece** statement, specifying a value from 0 through 4,294,967,295 ($2^{32} – 1$).

TIP: Another way to achieve multivendor compatibility is to include the advertise-inactive statement in the EBGP configuration. This causes the routing table to export to BGP the best route learned by BGP even if Junos OS did not select it to be an active route. By default, BGP stores the route information it receives from update messages in the Junos OS routing table, and the routing table exports only active routes into BGP, which BGP then advertises to its peers. The **advertise-inactive** statement causes Junos OS to advertise the best BGP route that is inactive because of IGP preference. When you use the **advertise-inactive** statement, the Junos OS device uses the OSPF route for forwarding, and the other vendor's device uses the EBGP route for forwarding. However, from the perspective of an EBGP peer in a neighboring AS, both vendors' devices appear to behave the same way.

Topology

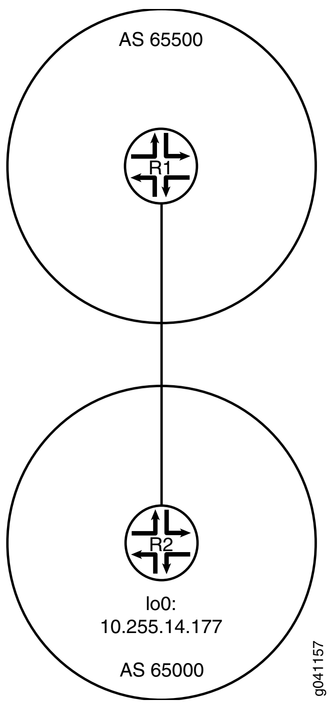
In the sample network, Device R1 and Device R2 have EBGP routes to each other and also OSPF routes to each other.

This example shows the routing tables in the following cases:

- Accept the default preference values of 170 for BGP and 10 for OSPF.
- Change the BGP preference to 8.

Figure 54 on page 2823 shows the sample network.

Figure 54: BGP Preference Value Topology



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 4 family inet address 1.12.0.1/30
set interfaces lo0 unit 2 family inet address 10.255.71.24/32
set protocols bgp export send-direct
set protocols bgp group ext type external
```

```
set protocols bgp group ext preference 8
set protocols bgp group ext peer-as 65000
set protocols bgp group ext neighbor 1.12.0.2
set protocols ospf area 0.0.0.0 interface fe-1/2/0.4
set protocols ospf area 0.0.0.0 interface 10.255.71.24
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 65500
```

Device R2

```
set interfaces fe-1/2/0 unit 6 family inet address 1.12.0.2/30
set interfaces lo0 unit 3 family inet address 10.255.14.177/32
set protocols bgp export send-direct
set protocols bgp group ext type external
set protocols bgp group ext peer-as 65500
set protocols bgp group ext neighbor 1.12.0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/0.6
set protocols ospf area 0.0.0.0 interface 10.255.14.177
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 65000
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces]
user@R1# set fe-1/2/0 unit 4 family inet address 1.12.0.1/30
user@R1# set lo0 unit 2 family inet address 10.255.71.24/32
```

2. Configure the local autonomous system.

```
[edit routing-options]
user@R1# set autonomous-system 65500
```

3. Configure the external peering with Device R2.

```
[edit protocols bgp]
user@R1# set export send-direct
user@R1# set group ext type external
user@R1# set group ext preference 8
user@R1# set group ext peer-as 65000
user@R1# set group ext neighbor 1.12.0.2
```

4. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface fe-1/2/0.4
user@R1# set interface 10.255.71.24
```

5. Configure the routing policy.

```
[edit policy-options policy-statement send-direct term 1]
user@R1# set from protocol direct
user@R1# set then accept
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 4 {
      family inet {
         address 1.12.0.1/30;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 10.255.71.24/32;
      }
   }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R1# show protocols
protocols {
   bgp {
      export send-direct;
      group ext {
         type external;
         preference 8;
         peer-as 65000;
         neighbor 1.12.0.2;
      }
   }
   ospf {
      area 0.0.0.0 {
         interface fe-1/2/0.4;
         interface 10.255.71.24;
      }
   }
}
```

```
user@R1# show routing-options
autonomous-system 65500;
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat these steps on Device R2.

Verification

Confirm that the configuration is working properly.

Verifying the Preference

Purpose Make sure that the routing tables on Device R1 and Device R2 reflect the fact that Device R1 is using the configured EBGP preference of 8, and Device R2 is using the default EBGP preference of 170.

Action From operational mode, enter the **show route** command.

```
user@R1> show route
inet.0: 5 destinations, 7 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.12.0.0/30        *[Direct/0] 3d 07:03:01
                    > via fe-1/2/0.4
                    [BGP/8] 01:04:49, localpref 100
                      AS path: 65000 I
                    > to 1.12.0.2 via fe-1/2/0.4
1.12.0.1/32        *[Local/0] 3d 07:03:01
                      Local via fe-1/2/0.4
10.255.14.177/32   *[BGP/8] 01:04:49, localpref 100
                      AS path: 65000 I
                    > to 1.12.0.2 via fe-1/2/0.4
                    [OSPF/10] 3d 07:02:16, metric 1
                    > to 1.12.0.2 via fe-1/2/0.4
10.255.71.24/32    *[Direct/0] 3d 07:03:01
                    > via lo0.2
224.0.0.5/32       *[OSPF/10] 5d 03:42:16, metric 1
                      MultiRecv
```

```
user@R2> show route
inet.0: 5 destinations, 7 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.12.0.0/30        *[Direct/0] 3d 07:03:30
                    > via fe-1/2/0.6
                    [BGP/170] 00:45:36, localpref 100
                      AS path: 65500 I
                    > to 1.12.0.1 via fe-1/2/0.6
1.12.0.2/32        *[Local/0] 3d 07:03:30
                      Local via fe-1/2/0.6
10.255.14.177/32   *[Direct/0] 3d 07:03:30
                    > via lo0.3
10.255.71.24/32    *[OSPF/10] 3d 07:02:45, metric 1
                    > to 1.12.0.1 via fe-1/2/0.6
                    [BGP/170] 00:45:36, localpref 100
                      AS path: 65500 I
                    > to 1.12.0.1 via fe-1/2/0.6
224.0.0.5/32       *[OSPF/10] 5d 03:42:45, metric 1
                      MultiRecv
```

Meaning The output shows that on Device R1, the active path to Device R2's loopback interface (10.255.14.177/32) is a BGP route. The output also shows that on Device R2, the active path to Device R1's loopback interface (10.255.71.24/32) is an OSPF route.

Related Documentation

- *Route Preferences Overview*
- Understanding External BGP Peering Sessions on page 2639

- *BGP Configuration Overview*

Example: Configuring BGP Path Selection

Understanding BGP Path Selection

For each prefix in the routing table, the routing protocol process selects a single best path. After the best path is selected, the route is installed in the routing table. The best path becomes the active route if the same prefix is not learned by a protocol with a lower (more preferred) global preference value, also known as the administrative distance. The algorithm for determining the active route is as follows:

1. Verify that the next hop can be resolved.
2. Choose the path with the lowest preference value (routing protocol process preference).

   Routes that are not eligible to be used for forwarding (for example, because they were rejected by routing policy or because a next hop is inaccessible) have a preference of –1 and are never chosen.
3. Prefer the path with higher local preference.

   For non-BGP paths, choose the path with the lowest **preference2** value.
4. If the accumulated interior gateway protocol (AIGP) attribute is enabled, prefer the path with the lower AIGP attribute.
5. Prefer the path with the shortest autonomous system (AS) path value (skipped if the **as-path-ignore** statement is configured).

   A confederation segment (sequence or set) has a path length of 0. An AS set has a path length of 1.
6. Prefer the route with the lower origin code.

   Routes learned from an IGP have a lower origin code than those learned from an exterior gateway protocol (EGP), and both have lower origin codes than incomplete routes (routes whose origin is unknown).
7. Prefer the path with the lowest multiple exit discriminator (MED) metric.

   Depending on whether nondeterministic routing table path selection behavior is configured, there are two possible cases:

   - If nondeterministic routing table path selection behavior is not configured (that is, if the **path-selection cisco-nondeterministic** statement is not included in the BGP configuration), for paths with the same neighboring AS numbers at the front of the AS path, prefer the path with the lowest MED metric. To always compare MEDs whether or not the peer ASs of the compared routes are the same, include the **path-selection always-compare-med** statement.

- If nondeterministic routing table path selection behavior is configured (that is, the **path-selection cisco-nondeterministic** statement is included in the BGP configuration), prefer the path with the lowest MED metric.

Confederations are not considered when determining neighboring ASs. A missing MED metric is treated as if a MED were present but zero.

NOTE: MED comparison works for single path selection within an AS (when the route does not include an AS path), though this usage Is uncommon.

By default, only the MEDs of routes that have the same peer autonomous systems (ASs) are compared. You can configure routing table path selection options to obtain different behaviors.

8. Prefer strictly internal paths, which include IGP routes and locally generated routes (static, direct, local, and so forth).
9. Prefer strictly external BGP (EBGP) paths over external paths learned through internal BGP (IBGP) sessions.
10. Prefer the path whose next hop is resolved through the IGP route with the lowest metric.

NOTE: A path is considered a BGP equal-cost path (and will be used for forwarding) if a tie-break is performed after the previous step. All paths with the same neighboring AS, learned by a multipath-enabled BGP neighbor, are considered.

BGP multipath does not apply to paths that share the same MED-plus-IGP cost yet differ in IGP cost. Multipath path selection is based on the IGP cost metric, even if two paths have the same MED-plus-IGP cost.

11. If both paths are external, prefer the currently active path to minimize route-flapping. This rule is not used if any one of the following conditions is true:
    - **path-selection external-router-id** is configured.
    - Both peers have the same router ID.
    - Either peer is a confederation peer.
    - Neither path is the current active path.
12. Prefer a primary route over a secondary route. A primary route is one that belongs to the routing table. A secondary route is one that is added to the routing table through an export policy.
13. Prefer the path from the peer with the lowest router ID. For any path with an originator ID attribute, substitute the originator ID for the router ID during router ID comparison.

14. Prefer the path with the shortest cluster list length. The length is 0 for no list.
15. Prefer the path from the peer with the lowest peer IP address.

Routing Table Path Selection

The shortest AS path step of the algorithm, by default, evaluates the length of the AS path and determines the active path. You can configure an option that enables Junos OS to skip this step of the algorithm by including the **as-path-ignore** option.

NOTE: **The as-path-ignore option is not supported for routing instances.**

To configure routing table path selection behavior, include the **path-selection** statement:

```
path-selection {
  (always-compare-med | cisco-non-deterministic | external-router-id);
  as-path-ignore;
  med-plus-igp {
    igp-multiplier number;
    med-multiplier number;
  }
}
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

Routing table path selection can be configured in one of the following ways:

- Emulate the Cisco IOS default behavior (**cisco-non-deterministic**). This mode evaluates routes in the order that they are received and does not group them according to their neighboring AS. With **cisco-non-deterministic** mode, the active path is always first. All inactive, but eligible, paths follow the active path and are maintained in the order in which they were received, with the most recent path first. Ineligible paths remain at the end of the list.

  As an example, suppose you have three path advertisements for the 192.168.1.0 /24 route:

  - Path 1—learned through EBGP; AS Path of 65010; MED of 200
  - Path 2—learned through IBGP; AS Path of 65020; MED of 150; IGP cost of 5
  - Path 3—learned through IBGP; AS Path of 65010; MED of 100; IGP cost of 10

  These advertisements are received in quick succession, within a second, in the order listed. Path 3 is received most recently, so the routing device compares it against path 2, the next most recent advertisement. The cost to the IBGP peer is better for path 2, so the routing device eliminates path 3 from contention. When comparing paths 1 and 2, the routing device prefers path 1 because it is received from an EBGP peer. This allows the routing device to install path 1 as the active path for the route.

NOTE: We do not recommend using this configuration option in your network. It is provided solely for interoperability to allow all routing devices in the network to make consistent route selections.

- Always comparing MEDs whether or not the peer ASs of the compared routes are the same (**always-compare-med**).
- Override the rule that If both paths are external, the currently active path is preferred (**external-router-id**). Continue with the next step (Step 12) in the path-selection process.
- Adding the IGP cost to the next-hop destination to the MED value before comparing MED values for path selection (**med-plus-igp**).

  BGP multipath does not apply to paths that share the same MED-plus-IGP cost, yet differ in IGP cost. Multipath path selection is based on the IGP cost metric, even if two paths have the same MED-plus-IGP cost.

Effects of Advertising Multiple Paths to a Destination

BGP advertises only the active path, unless you configure BGP to advertise multiple paths to a destination.

Suppose a routing device has in its routing table four paths to a destination and is configured to advertise up to three paths (**add-path send path-count 3**). The three paths are chosen based on path selection criteria. That is, the three best paths are chosen in path-selection order. The best path is the active path. This path is removed from consideration and a new best path is chosen. This process is repeated until the specified number of paths is reached.

Example: Ignoring the AS Path Attribute When Selecting the Best Path

If multiple BGP routes to the same destination exist, BGP selects the best path based on the route attributes of the paths. One of the route attributes that affects the best-path decision is the length of the AS paths of each route. Routes with shorter AS paths are preferred over those with longer AS paths. Although not typically practical, some scenarios might require that the AS path length be ignored in the route selection process. This example shows how to configure a routing device to ignore the AS path attribute.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

On externally connected routing devices, the purpose of skipping the AS path comparison might be to force an external BGP (EBGP) versus internal BGP (IBGP) decision to remove traffic from your network as soon as possible. On internally connected routing devices, you might want your IBGP-only routers to default to the local externally connected gateway. The local IBGP-only (internal) routers skip the AS path comparison and move down the decision tree to use the closest interior gateway protocol (IGP) gateway (lowest IGP metric). Doing this might be an effective way to force these routers to use a LAN connection instead of their WAN connection.

CAUTION: When you include the **as-path-ignore** statement on a routing device in your network, you might need to include it on all other BGP-enabled devices in your network to prevent routing loops and convergence issues. This is especially true for IBGP path comparisons.

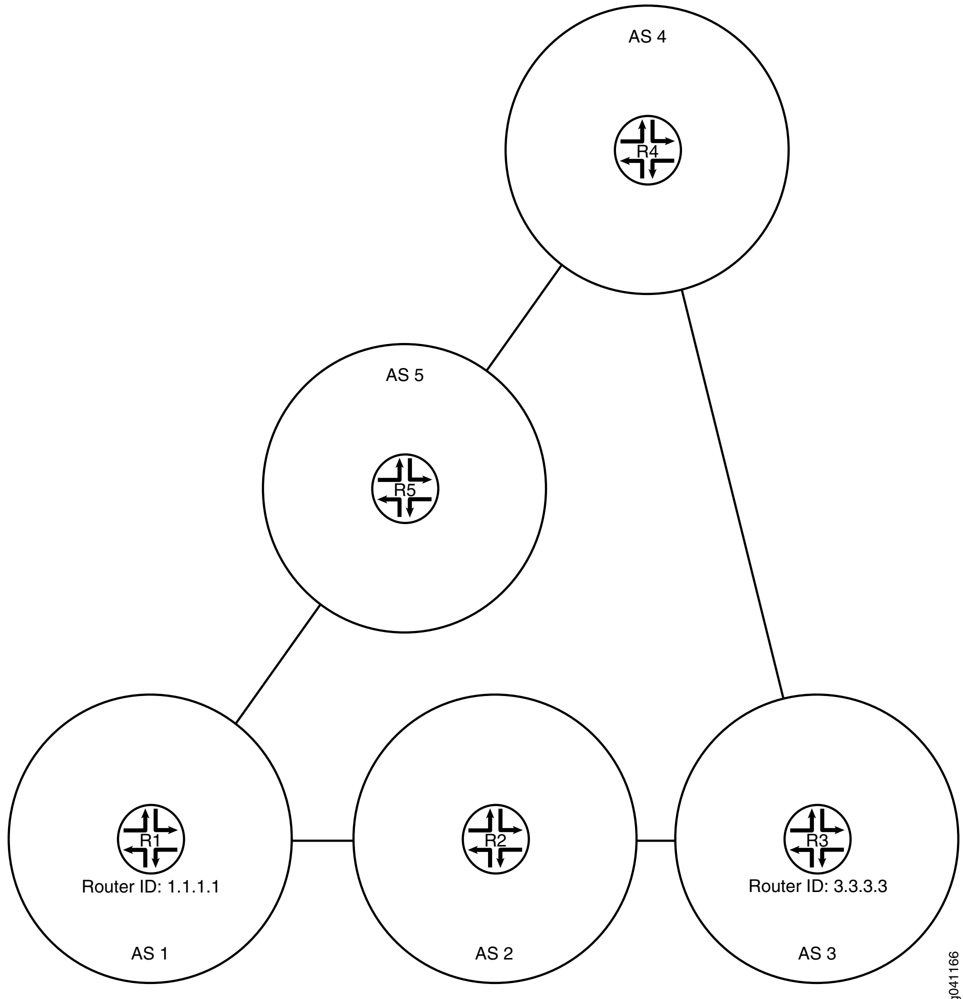
In this example, Device R2 is learning about the loopback interface address on Device R4 (4.4.4.4/32) from Device R1 and Device R3. Device R1 is advertising 4.4.4.4/32 with an AS-path of 1 5 4, and Device R3 is advertising 4.4.4.4/32 with an AS-path of 3 4. Device R2 selects the path for 4.4.4.4/32 from Device R3 as the best path because the AS path is shorter than the AS path from Device R1.

This example modifies the BGP configuration on Device R2 so that the AS-path length is not used in the best-path selection.

Device R1 has a lower router ID (1.1.1.1) than Device R3 (1.1.1.1). If all other path selection criteria are equal (or, as in this case, ignored), the route learned from Device R1 is used. Because the AS-path attribute is being ignored, the best path is toward Device R1 because of its lower router ID value.

Figure 55 on page 2832 shows the sample topology.

Figure 55: Topology for Ignoring the AS-Path Lengh



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 192.168.10.1/24
set interfaces fe-1/2/1 unit 10 family inet address 192.168.50.2/24
set interfaces lo0 unit 1 family inet address 1.1.1.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext export send-local
set protocols bgp group ext neighbor 192.168.10.2 peer-as 2
set protocols bgp group ext neighbor 192.168.50.1 peer-as 5
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-local term 1 from protocol local
```

```
set policy-options policy-statement send-local term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.20.0/24 next-hop 192.168.10.2
set routing-options static route 192.168.30.0/24 next-hop 192.168.10.2
set routing-options static route 192.168.40.0/24 next-hop 192.168.50.1
set routing-options router-id 1.1.1.1
set routing-options autonomous-system 1
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 192.168.10.2/24
set interfaces fe-1/2/1 unit 3 family inet address 192.168.20.2/24
set interfaces lo0 unit 2 family inet address 2.2.2.2/32
set protocols bgp path-selection as-path-ignore
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext export send-local
set protocols bgp group ext neighbor 192.168.10.1 peer-as 1
set protocols bgp group ext neighbor 192.168.20.1 peer-as 3
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-local term 1 from protocol local
set policy-options policy-statement send-local term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.50.0/24 next-hop 192.168.10.1
set routing-options static route 192.168.40.0/24 next-hop 192.168.10.1
set routing-options static route 192.168.30.0/24 next-hop 192.168.20.1
set routing-options router-id 2.2.2.2
set routing-options autonomous-system 2
```

Device R3

```
set interfaces fe-1/2/0 unit 4 family inet address 192.168.20.1/24
set interfaces fe-1/2/1 unit 5 family inet address 192.168.30.1/24
set interfaces lo0 unit 3 family inet address 1.1.1.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext export send-local
set protocols bgp group ext neighbor 192.168.20.2 peer-as 2
set protocols bgp group ext neighbor 192.168.30.2 peer-as 4
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-local term 1 from protocol local
set policy-options policy-statement send-local term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.10.0/24 next-hop 192.168.20.2
set routing-options static route 192.168.50.0/24 next-hop 192.168.20.2
set routing-options static route 192.168.40.0/24 next-hop 192.168.30.2
set routing-options router-id 3.3.3.3
set routing-options autonomous-system 3
```

Device R4

```
set interfaces fe-1/2/0 unit 6 family inet address 192.168.30.2/24
set interfaces fe-1/2/1 unit 7 family inet address 192.168.40.1/24
set interfaces lo0 unit 4 family inet address 4.4.4.4/32
```

```
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext export send-local
set protocols bgp group ext neighbor 192.168.30.1 peer-as 3
set protocols bgp group ext neighbor 192.168.40.2 peer-as 5
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-local term 1 from protocol local
set policy-options policy-statement send-local term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.10.0/24 next-hop 192.168.40.2
set routing-options static route 192.168.50.0/24 next-hop 192.168.40.2
set routing-options static route 192.168.40.0/24 next-hop 192.168.30.1
set routing-options router-id 4.4.4.4
set routing-options autonomous-system 4
```

Device R5

```
set interfaces fe-1/2/0 unit 8 family inet address 192.168.40.2/24
set interfaces fe-1/2/1 unit 9 family inet address 192.168.50.1/24
set interfaces lo0 unit 5 family inet address 5.5.5.5/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext export send-local
set protocols bgp group ext neighbor 192.168.40.1 peer-as 4
set protocols bgp group ext neighbor 192.168.50.2 peer-as 1
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-local term 1 from protocol local
set policy-options policy-statement send-local term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.10.0/24 next-hop 192.168.50.2
set routing-options static route 192.168.20.0/24 next-hop 192.168.50.2
set routing-options static route 192.168.30.0/24 next-hop 192.168.40.1
set routing-options router-id 5.5.5.5
set routing-options autonomous-system 5
```

Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@R2# set fe-1/2/0 unit 2 family inet address 192.168.10.2/24
   user@R2# set fe-1/2/1 unit 3 family inet address 192.168.20.2/24
   user@R2# set lo0 unit 2 family inet address 2.2.2.2/32
   ```

2. Configure EBGP.

   ```
   [edit protocols bgp group ext]
   ```



```
user@R2# set type external
user@R2# set export send-direct
user@R2# set export send-static
user@R2# set export send-local
user@R2# set neighbor 192.168.10.1 peer-as 1
user@R2# set neighbor 192.168.20.1 peer-as 3
```

3. Configure the autonomous system (AS) path attribute to be ignored in the Junos OS path selection algorithm.

```
[edit protocols bgp]
user@R2# set path-selection as-path-ignore
```

4. Configure the routing policy.

```
[edit policy-options]
user@R2# set policy-statement send-direct term 1 from protocol direct
user@R2# set policy-statement send-direct term 1 then accept
user@R2# set policy-statement send-local term 1 from protocol local
user@R2# set policy-statement send-local term 1 then accept
user@R2# set policy-statement send-static term 1 from protocol static
user@R2# set policy-statement send-static term 1 then accept
```

5. Configure some static routes.

```
[edit routing-options static]
user@R2# set route 192.168.50.0/24 next-hop 192.168.10.1
user@R2# set route 192.168.40.0/24 next-hop 192.168.10.1
user@R2# set route 192.168.30.0/24 next-hop 192.168.20.1
```

6. Configure the autonomous system (AS) number and the router ID.

```
[edit routing-options]
user@R2# set router-id 2.2.2.2
user@R2# set autonomous-system 2
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
  unit 2 {
    family inet {
      address 192.168.10.2/24;
    }
  }
}
fe-1/2/1 {
  unit 3 {
    family inet {
      address 192.168.20.2/24;
    }
  }
}
lo0 {
  unit 2 {
```

```
        family inet {
            address 2.2.2.2/32;
        }
    }
}
```

```
user@R2# show policy-options
policy-statement send-direct {
    term 1 {
        from protocol direct;
        then accept;
    }
}
policy-statement send-local {
    term 1 {
        from protocol local;
        then accept;
    }
}
policy-statement send-static {
    term 1 {
        from protocol static;
        then accept;
    }
}
```

```
user@R2# show protocols
bgp {
    path-selection as-path-ignore;
    group ext {
        type external;
        export [ send-direct send-static send-local ];
        neighbor 192.168.10.1 {
            peer-as 1;
        }
        neighbor 192.168.20.1 {
            peer-as 3;
        }
    }
}
```

```
user@R21# show routing-options
static {
    route 192.168.50.0/24 next-hop 192.168.10.1;
    route 192.168.40.0/24 next-hop 192.168.10.1;
    route 192.168.30.0/24 next-hop 192.168.20.1;
}
router-id 2.2.2.2;
autonomous-system 2;
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat the configuration on the other devices in the network, changing the interface names and IP addresses, as needed.

Verification

Confirm that the configuration is working properly.

- Checking the Neighbor Status on page 2837

Checking the Neighbor Status

Purpose Make sure that from Device R2, the active path to get to AS 4 is through AS 1 and AS 5, not through AS 3.

NOTE: To verify the functionality of the **as-path-ignore** statement, you might need to run the **restart routing** command to force reevaluation of the active path. This is because for BGP, if both paths are external, the Junos OS behavior is to prefer the currently active path. This behavior helps to minimize route-flapping. Use caution when restarting the routing protocol process in a production network.

Action From operational mode, enter the **restart routing** command.

```
user@R2> restart routing
Routing protocols process started, pid 49396
```

From operational mode, enter the **show route 4.4.4.4 protocol bgp** command.

```
user@R2> show route 4.4.4.4 protocol bgp
inet.0: 12 destinations, 25 routes (12 active, 0 holddown, 4 hidden)
+ = Active Route, - = Last Active, * = Both

4.4.4.4/32         *[BGP/170] 00:00:12, localpref 100
                      AS path: 1 5 4 I
                    > to 192.168.10.1 via fe-1/2/0.2
                    [BGP/170] 00:00:08, localpref 100
                      AS path: 3 4 I
                    > to 192.168.20.1 via fe-1/2/1.3
```

Meaning The asterisk (*) is next to the path learned from R1, meaning that this is the active path. The AS path for the active path is 1 5 4, which is longer than the AS path (3 4) for the nonactive path learned from Router R3.

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

Example: Removing Private AS Numbers

- Understanding Private AS Number Removal from AS Paths on page 2838
- Example: Removing Private AS Numbers from AS Paths on page 2839

Understanding Private AS Number Removal from AS Paths

By default, when BGP advertises AS paths to remote systems, it includes all AS numbers, including private AS numbers. You can configure the software so that it removes private AS numbers from AS paths. Doing this is useful when any of the following circumstances are true:

- A remote AS for which you provide connectivity is multihomed, but only to the local AS.
- The remote AS does not have an officially allocated AS number.
- It is not appropriate to make the remote AS a confederation member AS of the local AS.

Most companies acquire their own AS number. Some companies also use private AS numbers to connect to their public AS network. These companies might use a different private AS number for each region in which their company does business. In any implementation, announcing a private AS number to the Internet must be avoided. Service providers can use the remove-private statement to prevent advertising private AS numbers to the Internet.

In an enterprise scenario, suppose that you have multiple AS numbers in your company, some of which are private AS numbers, and one with a public AS number. The one with a public AS number has a direct connection to the service provider. In the AS that connects directly to the service provider, you can use the **remove-private** statement to filter out any private AS numbers in the advertisements that are sent to the service provider.

CAUTION: **Changing configuration statements that affect BGP peers, such as enabling or disabling remove-private or renaming a BGP group, resets the BGP sessions. Changes that affect BGP peers should only be made when resetting a BGP session is acceptable.**

The AS numbers are stripped from the AS path starting at the left end of the AS path (the end where AS paths have been most recently added). The routing device stops searching for private ASs when it finds the first nonprivate AS or a peer's private AS. If the AS path contains the AS number of the external BGP (EBGP) neighbor, BGP does not remove the private AS number.

NOTE: **As of Junos OS 10.0R2 and later, if there is a need to send prefixes to an EBGP peer that has an AS number that matches an AS number in the AS path, consider using the as-override statement instead of the remove-private statement.**

The operation takes place after any confederation member ASs have already been removed from the AS path, if applicable.

The software is preconfigured with knowledge of the set of AS numbers that is considered private, a range that is defined in the Internet Assigned Numbers Authority (IANA) assigned numbers document. The set of AS numbers reserved as private are in the range from 64,512 through 65,534, inclusive.

Example: Removing Private AS Numbers from AS Paths

This example demonstrates the removal of a private AS number from the advertised AS path to avoid announcing the private AS number to the Internet.

Requirements

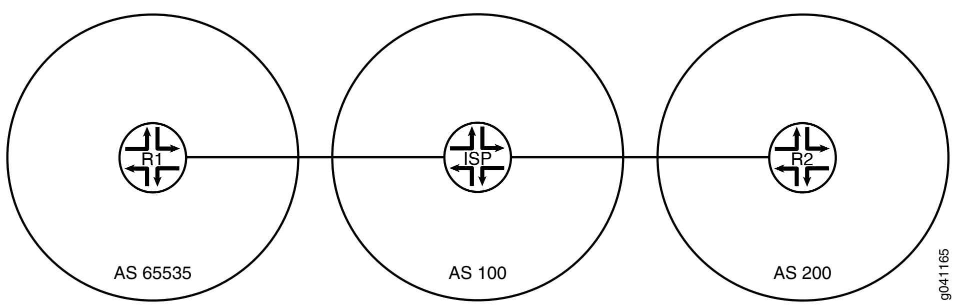
No special configuration beyond device initialization is required before you configure this example.

Overview

Service providers and enterprise networks use the remove-private statement to prevent advertising private AS numbers to the Internet. The **remove-private** statement works in the outbound direction. You configure the **remove-private** statement on a device that has a public AS number and that is connected to one or more devices that have private AS numbers. Generally, you would not configure this statement on a device that has a private AS number.

Figure 56 on page 2839 shows the sample topology.

Figure 56: Topology for Removing a Private AS from the Advertised AS Path



In this example, Device R1 is connected to its service provider using private AS number 65535. The example shows the **remove-private** statement configured on Device ISP to prevent Device R1's private AS number from being announced to Device R2. Device R2 sees only the AS number of the service provider.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network

configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 192.168.10.1/24
set interfaces lo0 unit 1 family inet address 10.10.10.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext peer-as 100
set protocols bgp group ext neighbor 192.168.10.10
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.20.0/24 next-hop 192.168.10.10
set routing-options autonomous-system 65535
```

Device ISP

```
set interfaces fe-1/2/0 unit 2 family inet address 192.168.10.10/24
set interfaces fe-1/2/1 unit 3 family inet address 192.168.20.20/24
set interfaces lo0 unit 2 family inet address 10.10.0.1/32
set protocols bgp group ext type external
set protocols bgp group ext neighbor 192.168.10.1 peer-as 65535
set protocols bgp group ext neighbor 192.168.20.1 remove-private
set protocols bgp group ext neighbor 192.168.20.1 peer-as 200
set routing-options autonomous-system 100
```

Device R2

```
set interfaces fe-1/2/0 unit 4 family inet address 192.168.20.1/24
set interfaces lo0 unit 3 family inet address 10.10.20.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext peer-as 100
set protocols bgp group ext neighbor 192.168.20.20
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.10.0/24 next-hop 192.168.20.20
set routing-options autonomous-system 200
```

Device ISP

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device ISP:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@ISP# set fe-1/2/0 unit 2 family inet address 192.168.10.10/24
   user@ISP# set fe-1/2/1 unit 3 family inet address 192.168.20.20/24
   user@ISP# set lo0 unit 2 family inet address 10.10.0.1/32
   ```

2. Configure EBGP.


```
[edit protocols bgp group ext]
user@ISP# set type external
user@ISP# set neighbor 192.168.10.1 peer-as 65535
user@ISP# set neighbor 192.168.20.1 peer-as 200
```

3. For the neighbor in autonomous system (AS) 200 (Device R2), remove private AS numbers from the advertised AS paths.

```
[edit protocols bgp group ext]
user@ISP# set neighbor 192.168.20.1 remove-private
```

4. Configure the AS number.

```
[edit routing-options]
user@ISP# set autonomous-system 100
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@ISP# show interfaces
fe-1/2/0 {
  unit 2 {
    family inet {
      address 192.168.10.10/24;
    }
  }
}
fe-1/2/1 {
  unit 3 {
    family inet {
      address 192.168.20.20/24;
    }
  }
}
lo0 {
  unit 2 {
    family inet {
      address 10.10.0.1/32;
    }
  }
}
```

```
user@ISP# show protocols
bgp {
  group ext {
    type external;
    neighbor 192.168.10.1 {
      peer-as 65535;
    }
    neighbor 192.168.20.1 {
      remove-private;
      peer-as 200;
    }
  }
}
```



```
user@ISP# show routing-options
autonomous-system 100;
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat the configuration on Device R1 and Device R2, changing the interface names and IP address, as needed, and adding the routing policy configuration.

Verification

Confirm that the configuration is working properly.

- Checking the Neighbor Status on page 2842
- Checking the Routing Tables on page 2843
- Checking the AS Path When the remove-private Statement Is Deactivated on page 2843

Checking the Neighbor Status

Purpose Make sure that Device ISP has the **remove-private** setting enabled in its neighbor session with Device R2.

Action From operational mode, enter the **show bgp neighbor 192.168.20.1** command.

```
user@ISP> show bgp neighbor 192.168.20.1
Peer: 192.168.20.1+179 AS 200  Local: 192.168.20.20+60216 AS 100
  Type: External    State: Established    Flags: <ImportEval Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference RemovePrivateAS PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.10.20.1      Local ID: 10.10.0.1        Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  Local Interface: fe-1/2/1.3
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 200)
  Peer does not support Addpath
  Table inet.0 Bit: 10001
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              1
    Received prefixes:            3
    Accepted prefixes:            2
    Suppressed due to damping:    0
    Advertised prefixes:          1
  Last traffic (seconds): Received 10   Sent 16   Checked 55
  Input messages:  Total 54     Updates 3       Refreshes 0     Octets 1091
  Output messages: Total 54     Updates 1       Refreshes 0     Octets 1118
  Output Queue[0]: 0
```


Meaning The **RemovePrivateAS** option shows that Device ISP has the expected setting.

Checking the Routing Tables

Purpose Make sure that the devices have the expected routes and AS paths.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R1> show route protocol bgp
inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.20.1/32      *[BGP/170] 00:28:57, localpref 100
                      AS path: 100 200 I
                    > to 192.168.10.10 via fe-1/2/0.1
```

```
user@ISP> show route protocol bgp

inet.0: 7 destinations, 11 routes (7 active, 0 holddown, 2 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.1/32      *[BGP/170] 00:29:40, localpref 100
                      AS path: 65535 I
                    > to 192.168.10.1 via fe-1/2/0.2
10.10.20.1/32      *[BGP/170] 00:29:36, localpref 100
                      AS path: 200 I
                    > to 192.168.20.1 via fe-1/2/1.3
192.168.10.0/24     [BGP/170] 00:29:40, localpref 100
                      AS path: 65535 I
                    > to 192.168.10.1 via fe-1/2/0.2
192.168.20.0/24     [BGP/170] 00:29:36, localpref 100
                      AS path: 200 I
                    > to 192.168.20.1 via fe-1/2/1.3
```

```
user@R2> show route protocol bgp
inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.1/32      *[BGP/170] 00:29:53, localpref 100
                      AS path: 100 I
                    > to 192.168.20.20 via fe-1/2/0.4
```

Meaning Device ISP has the private AS number 65535 in its AS path to Device R1. However, Device ISP does not advertise this private AS number to Device R2. This is shown in the routing table of Device R2. Device R2's path to Device R1 contains only the AS number for Device ISP.

Checking the AS Path When the remove-private Statement Is Deactivated

Purpose Verify that without the **remove-private** statement, the private AS number appears in Device R2's routing table.

Action From configuration mode on Device ISP, enter the **deactivate remove-private** command and then recheck the routing table on Device R2.

[protocols bgp group ext neighbor 192.168.20.1]

```
user@ISP# deactivate remove-private
user@ISP# commit
```

```
user@R2> show route protocol bgp
inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.1/32      *[BGP/170] 00:00:54, localpref 100
                      AS path: 100 65535 I
                    > to 192.168.20.20 via fe-1/2/0.4
```

Meaning Private AS number 65535 appears in Device R2's AS path to Device R1.

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

BGP BFD Configuration

- Example: Configuring BFD for BGP on page 2844
- Example: Configuring BFD Authentication for BGP on page 2853

Example: Configuring BFD for BGP

- Understanding BFD for BGP on page 2844
- Example: Configuring BFD on Internal BGP Peer Sessions on page 2845

Understanding BFD for BGP

The Bidirectional Forwarding Detection (BFD) protocol is a simple hello mechanism that detects failures in a network. Hello packets are sent at a specified, regular interval. A neighbor failure is detected when the routing device stops receiving a reply after a specified interval. BFD works with a wide variety of network environments and topologies. The failure detection timers for BFD have shorter time limits than default failure detection mechanisms for BGP, so they provide faster detection.

The BFD failure detection timers are adaptive and can be adjusted to be faster or slower. The lower the BFD failure detection timer value, the faster the failure detection and vice versa. For example, the timers can adapt to a higher value if the adjacency fails (that is, the timer detects failures more slowly). Or a neighbor can negotiate a higher value for a timer than the configured value. The timers adapt to a higher value when a BFD session flap occurs more than three times in a span of 15 seconds. A back-off algorithm increases the receive (Rx) interval by two if the local BFD instance is the reason for the session flap. The transmission (Tx) interval is increased by two if the remote BFD instance is the reason for the session flap. You can use the **clear bfd adaptation** command to return BFD interval timers to their configured values. The **clear bfd adaptation** command is hitless, meaning that the command does not affect traffic flow on the routing device.

In Junos OS Release 8.3 and later, BFD is supported on internal BGP (IBGP) and multihop external BGP (EBGP) sessions as well as on single-hop EBGP sessions. In Junos OS Release 9.1 through Junos OS Release 11.1, BFD supports IPv6 interfaces in static routes only. In Junos OS Release 11.2 and later, BFD supports IPv6 interfaces with BGP.

Example: Configuring BFD on Internal BGP Peer Sessions

This example shows how to configure internal BGP (IBGP) peer sessions with the Bidirectional Forwarding Detection (BFD) protocol to detect failures in a network.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

The minimum configuration to enable BFD on IBGP sessions is to include the bfd-liveness-detection **minimum-interval** statement in the BGP configuration of all neighbors participating in the BFD session. The **minimum-interval** statement specifies the minimum transmit and receive intervals for failure detection. Specifically, this value represents the minimum interval after which the local routing device transmits hello packets as well as the minimum interval that the routing device expects to receive a reply from a neighbor with which it has established a BFD session. You can configure a value from 1 through 255,000 milliseconds.

Optionally, you can specify the minimum transmit and receive intervals separately using the **transmit-interval minimum-interval** and **minimum-receive-interval** statements. For information about these and other optional BFD configuration statements, see bfd-liveness-detection.

NOTE: BFD is an intensive protocol that consumes system resources. Specifying a minimum interval for BFD less than 100 ms for Routing Engine-based sessions and less than 10 ms for distributed BFD sessions can cause undesired BFD flapping.

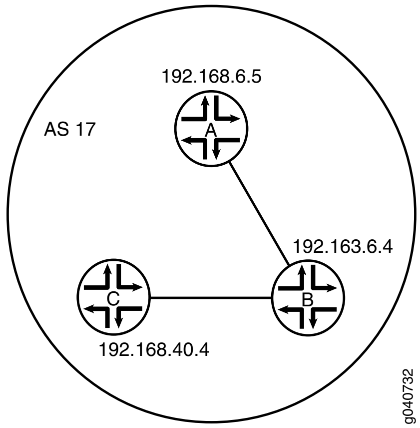
Depending on your network environment, these additional recommendations might apply:

- For large-scale network deployments with a large number of BFD sessions, specify a minimum interval of 300 ms for Routing Engine-based sessions and 100 ms for distributed BFD sessions.
- For very large-scale network deployments with a large number of BFD sessions, contact Juniper Networks customer support for more information.
- For BFD sessions to remain up during a Routing Engine switchover event when nonstop active routing (NSR) is configured, specify a minimum interval of 2500 ms for Routing Engine-based sessions. For distributed BFD sessions with NSR configured, the minimum interval recommendations are unchanged and depend only on your network deployment.

BFD is supported on the default routing instance (the main router), routing instances, and logical systems. This example shows BFD on logical systems.

Figure 57 on page 2846 shows a typical network with internal peer sessions.

Figure 57: Typical Network with IBGP Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device A

```
set logical-systems A interfaces lt-1/2/0 unit 1 description to-B
set logical-systems A interfaces lt-1/2/0 unit 1 encapsulation ethernet
set logical-systems A interfaces lt-1/2/0 unit 1 peer-unit 2
set logical-systems A interfaces lt-1/2/0 unit 1 family inet address 10.10.10.1/30
set logical-systems A interfaces lo0 unit 1 family inet address 192.168.6.5/32
set logical-systems A protocols bgp group internal-peers type internal
set logical-systems A protocols bgp group internal-peers traceoptions file bgp-bfd
set logical-systems A protocols bgp group internal-peers traceoptions flag bfd detail
set logical-systems A protocols bgp group internal-peers local-address 192.168.6.5
set logical-systems A protocols bgp group internal-peers export send-direct
set logical-systems A protocols bgp group internal-peers bfd-liveness-detection
  minimum-interval 1000
set logical-systems A protocols bgp group internal-peers neighbor 192.163.6.4
set logical-systems A protocols bgp group internal-peers neighbor 192.168.40.4
set logical-systems A protocols ospf area 0.0.0.0 interface lo0.1 passive
set logical-systems A protocols ospf area 0.0.0.0 interface lt-1/2/0.1
set logical-systems A policy-options policy-statement send-direct term 2 from protocol
  direct
set logical-systems A policy-options policy-statement send-direct term 2 then accept
set logical-systems A routing-options router-id 192.168.6.5
set logical-systems A routing-options autonomous-system 17
```

Device B

```
set logical-systems B interfaces lt-1/2/0 unit 2 description to-A
set logical-systems B interfaces lt-1/2/0 unit 2 encapsulation ethernet
set logical-systems B interfaces lt-1/2/0 unit 2 peer-unit 1
set logical-systems B interfaces lt-1/2/0 unit 2 family inet address 10.10.10.2/30
set logical-systems B interfaces lt-1/2/0 unit 5 description to-C
```

```
set logical-systems B interfaces lt-1/2/0 unit 5 encapsulation ethernet
set logical-systems B interfaces lt-1/2/0 unit 5 peer-unit 6
set logical-systems B interfaces lt-1/2/0 unit 5 family inet address 10.10.10.5/30
set logical-systems B interfaces lo0 unit 2 family inet address 192.163.6.4/32
set logical-systems B protocols bgp group internal-peers type internal
set logical-systems B protocols bgp group internal-peers local-address 192.163.6.4
set logical-systems B protocols bgp group internal-peers export send-direct
set logical-systems B protocols bgp group internal-peers bfd-liveness-detection
  minimum-interval 1000
set logical-systems B protocols bgp group internal-peers neighbor 192.168.40.4
set logical-systems B protocols bgp group internal-peers neighbor 192.168.6.5
set logical-systems B protocols ospf area 0.0.0.0 interface lo0.2 passive
set logical-systems B protocols ospf area 0.0.0.0 interface lt-1/2/0.2
set logical-systems B protocols ospf area 0.0.0.0 interface lt-1/2/0.5
set logical-systems B policy-options policy-statement send-direct term 2 from protocol
  direct
set logical-systems B policy-options policy-statement send-direct term 2 then accept
set logical-systems B routing-options router-id 192.163.6.4
set logical-systems B routing-options autonomous-system 17
```

Device C

```
set logical-systems C interfaces lt-1/2/0 unit 6 description to-B
set logical-systems C interfaces lt-1/2/0 unit 6 encapsulation ethernet
set logical-systems C interfaces lt-1/2/0 unit 6 peer-unit 5
set logical-systems C interfaces lt-1/2/0 unit 6 family inet address 10.10.10.6/30
set logical-systems C interfaces lo0 unit 3 family inet address 192.168.40.4/32
set logical-systems C protocols bgp group internal-peers type internal
set logical-systems C protocols bgp group internal-peers local-address 192.168.40.4
set logical-systems C protocols bgp group internal-peers export send-direct
set logical-systems C protocols bgp group internal-peers bfd-liveness-detection
  minimum-interval 1000
set logical-systems C protocols bgp group internal-peers neighbor 192.163.6.4
set logical-systems C protocols bgp group internal-peers neighbor 192.168.6.5
set logical-systems C protocols ospf area 0.0.0.0 interface lo0.3 passive
set logical-systems C protocols ospf area 0.0.0.0 interface lt-1/2/0.6
set logical-systems C policy-options policy-statement send-direct term 2 from protocol
  direct
set logical-systems C policy-options policy-statement send-direct term 2 then accept
set logical-systems C routing-options router-id 192.168.40.4
set logical-systems C routing-options autonomous-system 17
```

Configuring Device A

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device A:

1. Set the CLI to Logical System A.

   ```
   user@host> set cli logical-system A
   ```

2. Configure the interfaces.

   ```
   [edit interfaces lt-1/2/0 unit 1]
   user@host:A# set description to-B
   user@host:A# set encapsulation ethernet
   ```

```
user@host:A# set peer-unit 2
user@host:A# set family inet address 10.10.10.1/30

[edit interfaces lo0 unit 1]
user@host:A# set family inet address 192.168.6.5/32
```

3. Configure BGP.

   The **neighbor** statements are included for both Device B and Device C, even though Device A is not directly connected to Device C.

```
[edit protocols bgp group internal-peers]
user@host:A# set type internal
user@host:A# set local-address 192.168.6.5
user@host:A# set export send-direct
user@host:A# set neighbor 192.163.6.4
user@host:A# set neighbor 192.168.40.4
```

4. Configure BFD.

```
[edit protocols bgp group internal-peers]
user@host:A# set bfd-liveness-detection minimum-interval 1000
```

   You must configure the same minimum interval on the connecting peer.

5. (Optional) Configure BFD tracing.

```
[edit protocols bgp group internal-peers]
user@host:A# set traceoptions file bgp-bfd
user@host:A# set traceoptions flag bfd detail
```

6. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@host:A# set interface lo0.1 passive
user@host:A# set interface lt-1/2/0.1
```

7. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 2]
user@host:A# set from protocol direct
user@host:A# set then accept
```

8. Configure the router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@host:A# set router-id 192.168.6.5
user@host:A# set autonomous-system 17
```

9. If you are done configuring the device, enter **commit** from configuration mode. Repeat these steps to configure Device B and Device C.

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.


```
user@host:A# show interfaces
lt-1/2/0 {
  unit 1 {
    description to-B;
    encapsulation ethernet;
    peer-unit 2;
    family inet {
      address 10.10.10.1/30;
    }
  }
}
lo0 {
  unit 1 {
    family inet {
      address 192.168.6.5/32;
    }
  }
}
```

```
user@host:A# show policy-options
policy-statement send-direct {
  term 2 {
    from protocol direct;
    then accept;
  }
}
```

```
user@host:A# show protocols
bgp {
  group internal-peers {
    type internal;
    traceoptions {
      file bgp-bfd;
      flag bfd detail;
    }
    local-address 192.168.6.5;
    export send-direct;
    bfd-liveness-detection {
      minimum-interval 1000;
    }
    neighbor 192.163.6.4;
    neighbor 192.168.40.4;
  }
}
ospf {
  area 0.0.0.0 {
    interface lo0.1 {
      passive;
    }
    interface lt-1/2/0.1;
  }
}
```

```
user@host:A# show routing-options
router-id 192.168.6.5;
autonomous-system 17;
```


Verification

Confirm that the configuration is working properly.

- Verifying That BFD Is Enabled on page 2850
- Verifying That BFD Sessions Are Up on page 2850
- Viewing Detailed BFD Events on page 2851
- Viewing Detailed BFD Events After Deactivating and Reactivating a Loopback Interface on page 2852

Verifying That BFD Is Enabled

Purpose Verify that BFD is enabled between the IBGP peers.

Action From operational mode, enter the **show bgp neighbor** command. You can use the **| match bfd** filter to narrow the output.

```
user@host:A> show bgp neighbor | match bfd
Options: <BfdEnabled>
  BFD: enabled, up
  Trace file: /var/log/A/bgp-bfd size 131072 files 10
  Options: <BfdEnabled>
  BFD: enabled, up
  Trace file: /var/log/A/bgp-bfd size 131072 files 10
```

Meaning The output shows that Logical System A has two neighbors with BFD enabled. When BFD is not enabled, the output displays **BFD: disabled, down**, and the **<BfdEnabled>** option is absent. If BFD is enabled and the session is down, the output displays **BFD: enabled, down**. The output also shows that BFD-related events are being written to a log file because trace operations are configured.

Verifying That BFD Sessions Are Up

Purpose Verify that the BFD sessions are up, and view details about the BFD sessions.

Action From operational mode, enter the **show bfd session extensive** command.

```
user@host:A> show bfd session extensive
                                                  Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
192.163.6.4              Up                       3.000     1.000        3
 Client BGP, TX interval 1.000, RX interval 1.000
 Session up time 00:54:40
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 Logical system 12, routing table index 25
 Min async interval 1.000, min slow interval 1.000
 Adaptive async TX interval 1.000, RX interval 1.000
 Local min TX interval 1.000, minimum RX interval 1.000, multiplier 3
 Remote min TX interval 1.000, min RX interval 1.000, multiplier 3
 Local discriminator 10, remote discriminator 9
 Echo mode disabled/inactive
 Multi-hop route table 25, local-address 192.168.6.5

                                                  Detect   Transmit
```



```
Address                  State     Interface      Time     Interval  Multiplier
192.168.40.4             Up                       3.000     1.000       3
 Client BGP, TX interval 1.000, RX interval 1.000
 Session up time 00:48:03
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 Logical system 12, routing table index 25
 Min async interval 1.000, min slow interval 1.000
 Adaptive async TX interval 1.000, RX interval 1.000
 Local min TX interval 1.000, minimum RX interval 1.000, multiplier 3
 Remote min TX interval 1.000, min RX interval 1.000, multiplier 3
 Local discriminator 14, remote discriminator 13
 Echo mode disabled/inactive
 Multi-hop route table 25, local-address 192.168.6.5

2 sessions, 2 clients
Cumulative transmit rate 2.0 pps, cumulative receive rate 2.0 pps
```

Meaning The **TX interval 1.000, RX interval 1.000** output represents the setting configured with the **minimum-interval** statement. All of the other output represents the default settings for BFD. To modify the default settings, include the optional statements under the bfd-liveness-detection statement.

Viewing Detailed BFD Events

Purpose View the contents of the BFD trace file to assist in troubleshooting, if needed.

Action From operational mode, enter the **file show /var/log/A/bgp-bfd** command.

```
user@host:A> file show /var/log/A/bgp-bfd
Aug 15 17:07:25 trace_on: Tracing to "/var/log/A/bgp-bfd" started
Aug 15 17:07:26.492190 bgp_peer_init: BGP peer 192.163.6.4 (Internal AS 17) local
 address 192.168.6.5 not found.  Leaving peer idled
Aug 15 17:07:26.493176 bgp_peer_init: BGP peer 192.168.40.4 (Internal AS 17) local
 address 192.168.6.5 not found.  Leaving peer idled
Aug 15 17:07:32.597979 task_connect: task BGP_17.192.163.6.4+179 addr
192.163.6.4+179: No route to host
Aug 15 17:07:32.599623 bgp_connect_start: connect 192.163.6.4 (Internal AS 17):
No route to host
Aug 15 17:07:36.869394 task_connect: task BGP_17.192.168.40.4+179 addr
192.168.40.4+179: No route to host
Aug 15 17:07:36.870624 bgp_connect_start: connect 192.168.40.4 (Internal AS 17):
 No route to host
Aug 15 17:08:04.599220 task_connect: task BGP_17.192.163.6.4+179 addr
192.163.6.4+179: No route to host
Aug 15 17:08:04.601135 bgp_connect_start: connect 192.163.6.4 (Internal AS 17):
No route to host
Aug 15 17:08:08.869717 task_connect: task BGP_17.192.168.40.4+179 addr
192.168.40.4+179: No route to host
Aug 15 17:08:08.869934 bgp_connect_start: connect 192.168.40.4 (Internal AS 17):
 No route to host
Aug 15 17:08:36.603544 advertising receiving-speaker only capabilty to neighbor
192.163.6.4 (Internal AS 17)
Aug 15 17:08:36.606726 bgp_read_message: 192.163.6.4 (Internal AS 17): 0 bytes
buffered
Aug 15 17:08:36.609119 Initiated BFD session to peer 192.163.6.4 (Internal AS
17): address=192.163.6.4 ifindex=0 ifname=(none) txivl=1000 rxivl=1000 mult=3
ver=255
Aug 15 17:08:36.734033 advertising receiving-speaker only capabilty to neighbor
```

```
192.168.40.4 (Internal AS 17)
Aug 15 17:08:36.738436 Initiated BFD session to peer 192.168.40.4 (Internal AS
17): address=192.168.40.4 ifindex=0 ifname=(none) txivl=1000 rxivl=1000 mult=3
ver=255
Aug 15 17:08:40.537552 BFD session to peer 192.163.6.4 (Internal AS 17) up
Aug 15 17:08:40.694410 BFD session to peer 192.168.40.4 (Internal AS 17) up
```

Meaning Before the routes are established, the **No route to host** message appears in the output. After the routes are established, the last two lines show that both BFD sessions come up.

Viewing Detailed BFD Events After Deactivating and Reactivating a Loopback Interface

Purpose Check to see what happens after bringing down a router or switch and then bringing it back up. To simulate bringing down a router or switch, deactivate the loopback interface on Logical System B.

Action

1. From configuration mode, enter the **deactivate logical-systems B interfaces lo0 unit 2 family inet** command.

   ```
   user@host:A# deactivate logical-systems B interfaces lo0 unit 2 family inet
   user@host:A# commit
   ```

2. From operational mode, enter the **file show /var/log/A/bgp-bfd** command.

   ```
   user@host:A> file show /var/log/A/bgp-bfd
   ...
   Aug 15 17:20:55.995648 bgp_read_v4_message:9747: NOTIFICATION received from
   192.163.6.4 (Internal AS 17): code 6 (Cease) subcode 6 (Other Configuration
   Change)
   Aug 15 17:20:56.004508 Terminated BFD session to peer 192.163.6.4 (Internal
   AS 17)
   Aug 15 17:21:28.007755 task_connect: task BGP_17.192.163.6.4+179 addr
   192.163.6.4+179: No route to host
   Aug 15 17:21:28.008597 bgp_connect_start: connect 192.163.6.4 (Internal AS
   17): No route to host
   ```

3. From configuration mode, enter the **activate logical-systems B interfaces lo0 unit 2 family inet** command.

   ```
   user@host:A# activate logical-systems B interfaces lo0 unit 2 family inet
   user@host:A# commit
   ```

4. From operational mode, enter the **file show /var/log/A/bgp-bfd** command.

   ```
   user@host:A> file show /var/log/A/bgp-bfd
   ...
   Aug 15 17:25:53.623743 advertising receiving-speaker only capabilty to neighbor
    192.163.6.4 (Internal AS 17)
   Aug 15 17:25:53.631314 Initiated BFD session to peer 192.163.6.4 (Internal AS
    17): address=192.163.6.4 ifindex=0 ifname=(none) txivl=1000 rxivl=1000 mult=3
    ver=255
   Aug 15 17:25:57.570932 BFD session to peer 192.163.6.4 (Internal AS 17) up
   ```

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

Example: Configuring BFD Authentication for BGP

Understanding BFD Authentication for BGP

Bidirectional Forwarding Detection protocol (BFD) enables rapid detection of communication failures between adjacent systems. By default, authentication for BFD sessions is disabled. However, when you run BFD over Network Layer protocols, the risk of service attacks can be significant. We strongly recommend using authentication if you are running BFD over multiple hops or through insecure tunnels. Beginning with Junos OS Release 9.6, Junos OS supports authentication for BFD sessions running over BGP. BFD authentication is not supported on MPLS OAM sessions. BFD authentication is only supported in the Canada and United States version of the Junos OS image and is not available in the export version.

You authenticate BFD sessions by specifying an authentication algorithm and keychain, and then associating that configuration information with a security authentication keychain using the keychain name.

The following sections describe the supported authentication algorithms, security keychains, and level of authentication that can be configured:

BFD Authentication Algorithms

Junos OS supports the following algorithms for BFD authentication:

- **simple-password**—Plain-text password. One to 16 bytes of plain text are used to authenticate the BFD session. One or more passwords can be configured. This method is the least secure and should be used only when BFD sessions are not subject to packet interception.
- **keyed-md5**—Keyed Message Digest 5 hash algorithm for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed MD5 uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than or equal to the last sequence number received. Although more secure than a simple password, this method is vulnerable to replay attacks. Increasing the rate at which the sequence number is updated can reduce this risk.
- **meticulous-keyed-md5**—Meticulous keyed Message Digest 5 hash algorithm. This method works in the same manner as keyed MD5, but the sequence number is updated with every packet. Although more secure than keyed MD5 and simple passwords, this method might take additional time to authenticate the session.

- **keyed-sha-1**—Keyed Secure Hash Algorithm I for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed SHA uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. The key is not carried within the packets. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than the last sequence number received.
- **meticulous-keyed-sha-1**—Meticulous keyed Secure Hash Algorithm I. This method works in the same manner as keyed SHA, but the sequence number is updated with every packet. Although more secure than keyed SHA and simple passwords, this method might take additional time to authenticate the session.

NOTE: Nonstop active routing (NSR) is not supported with meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.

Security Authentication Keychains

The security authentication keychain defines the authentication attributes used for authentication key updates. When the security authentication keychain is configured and associated with a protocol through the keychain name, authentication key updates can occur without interrupting routing and signaling protocols.

The authentication keychain contains one or more keychains. Each keychain contains one or more keys. Each key holds the secret data and the time at which the key becomes valid. The algorithm and keychain must be configured on both ends of the BFD session, and they must match. Any mismatch in configuration prevents the BFD session from being created.

BFD allows multiple clients per session, and each client can have its own keychain and algorithm defined. To avoid confusion, we recommend specifying only one security authentication keychain.

Strict Versus Loose Authentication

By default, strict authentication is enabled and authentication is checked at both ends of each BFD session. Optionally, to smooth migration from nonauthenticated sessions to authenticated sessions, you can configure *loose checking*. When loose checking is configured, packets are accepted without authentication being checked at each end of the session. This feature is intended for transitional periods only.

Example: Configuring BFD Authentication for BGP

Beginning with Junos OS Release 9.6, you can configure authentication for BFD sessions running over BGP. Only three steps are needed to configure authentication on a BFD session:

1. Specify the BFD authentication algorithm for the BGP protocol.
2. Associate the authentication keychain with the BGP protocol.

3. Configure the related security authentication keychain.

The following sections provide instructions for configuring and viewing BFD authentication on BGP:

- Configuring BFD Authentication Parameters on page 2855
- Viewing Authentication Information for BFD Sessions on page 2856

Configuring BFD Authentication Parameters

BFD authentication can be configured for the entire BGP protocol, or a specific BGP group, neighbor, or routing instance.

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure BFD authentication:

1. Specify the algorithm (**keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**, or **simple-password**) to use.

   ```
   [edit]
   user@host# set protocols bgp bfd-liveness-detection authentication algorithm
     keyed-sha-1
   user@host# set protocols bgp group bgp-gr1 bfd-liveness-detection authentication
     algorithm keyed-sha-1
   user@host# set protocols bgp group bgp-gr1 neighbor 10.10.10.7 bfd-liveness-detection
     authentication algorithm keyed-sha-1
   ```

   NOTE: Nonstop active routing is not supported with meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.

2. Specify the keychain to be used to associate BFD sessions on BGP with the unique security authentication keychain attributes.

   The keychain name you specify must match a keychain name configured at the **[edit security authentication key-chains]** hierarchy level.

   ```
   [edit]
   user@host# set protocols bgp bfd-liveness-detection authentication keychain bfd-bgp
   user@host# set protocols bgp group bgp-gr1 bfd-liveness-detection authentication
     keychain bfd-bgp
   user@host# set protocols bgp group bgp-gr1 neighbor 10.10.10.7 bfd-liveness-detection
     authentication keychain bfd-bgp
   ```

   NOTE: The algorithm and keychain must be configured on both ends of the BFD session, and they must match. Any mismatch in configuration prevents the BFD session from being created.

3. Specify the unique security authentication information for BFD sessions:
   - The matching keychain name as specified in Step 2.
   - At least one key, a unique integer between **0** and **63**. Creating multiple keys allows multiple clients to use the BFD session.
   - The secret data used to allow access to the session.
   - The time at which the authentication key becomes active, in the format *yyyy-mm-dd.hh:mm:ss*.

   ```
   [edit security]
   user@host# set authentication-key-chains key-chain bfd-bgp key 53 secret
     $9$ggaJDmPQ6/tJgF/AtREVsyPsnCtUHm start-time 2009-06-14.10:00:00
   ```
4. (Optional) Specify loose authentication checking if you are transitioning from nonauthenticated sessions to authenticated sessions.

   ```
   [edit]
   user@host# set protocols bgp bfd-liveness-detection authentication loose-check
   user@host# set protocols bgp group bgp-gr1 bfd-liveness-detection authentication
     loose-check
   user@host# set protocols bgp group bgp-gr1 neighbor 10.10.10.7 bfd-liveness-detection
     authentication loose-check
   ```
5. (Optional) View your configuration using the **show bfd session detail** or **show bfd session extensive** command.
6. Repeat these steps to configure the other end of the BFD session.

NOTE: BFD authentication is only supported in the Canada and United States version of the Junos OS image and is not available in the export version.

Viewing Authentication Information for BFD Sessions

You can view the existing BFD authentication configuration using the **show bfd session detail** and **show bfd session extensive** commands.

The following example shows BFD authentication configured for the **bgp-gr1** BGP group. It specifies the keyed SHA-1 authentication algorithm and a keychain name of **bfd-bgp**. The authentication keychain is configured with two keys. Key **1** contains the secret data "**9ggaJDmPQ6/tJgF/AtREVsyPsnCtUHm**" and a start time of June 1, 2009, at 9:46:02 AM PST. Key **2** contains the secret data "**9a5jiKW9l.reP38ny.TszF2/9**" and a start time of June 1, 2009, at 3:29:20 PM PST.

```
[edit protocols bgp]
group bgp-gr1 {
  bfd-liveness-detection {
    authentication {
      algorithm keyed-sha-1;
      key-chain bfd-bgp;
    }
  }
}
```

```
[edit security]
authentication key-chains {
  key-chain bfd-bgp {
    key 1 {
      secret "$9$ggaJDmPQ6/tJgF/AtREVsyPsnCtUHm";
      start-time "2009-6-1.09:46:02 -0700";
    }
    key 2 {
      secret "$9$a5jiKW9l.reP38ny.TszF2/9";
      start-time "2009-6-1.15:29:20 -0700";
    }
  }
}
```

If you commit these updates to your configuration, you see output similar to the following. In the output for the **show bfd session detail** command, **Authenticate** is displayed to indicate that BFD authentication is configured. For more information about the configuration, use the **show bfd session extensive** command. The output for this command provides the keychain name, the authentication algorithm and mode for each client in the session, and the overall BFD authentication configuration status, keychain name, and authentication algorithm and mode.

show bfd session detail

```
user@host# show bfd session detail

                                                   Detect   Transmit
Address                  State      Interface      Time     Interval  Multiplier
50.0.0.2                 Up         ge-0/1/5.0     0.900     0.300       3
 Client BGP, TX interval 0.300, RX interval 0.300, Authenticate
 Session up time 3d 00:34
 Local diagnostic None, remote diagnostic NbrSignal
 Remote state Up, version 1
 Replicated
```

show bfd session extensive

```
user@host# show bfd session extensive
                                                   Detect   Transmit
Address                  State      Interface      Time     Interval  Multiplier
50.0.0.2                 Up         ge-0/1/5.0     0.900     0.300       3
 Client BGP, TX interval 0.300, RX interval 0.300, Authenticate
        keychain bfd-bgp, algo keyed-sha-1, mode strict
 Session up time 00:04:42
 Local diagnostic None, remote diagnostic NbrSignal
 Remote state Up, version 1
 Replicated
 Min async interval 0.300, min slow interval 1.000
 Adaptive async TX interval 0.300, RX interval 0.300
 Local min TX interval 0.300, minimum RX interval 0.300, multiplier 3
 Remote min TX interval 0.300, min RX interval 0.300, multiplier 3
 Local discriminator 2, remote discriminator 2
 Echo mode disabled/inactive
 Authentication enabled/active, keychain bfd-bgp, algo keyed-sha-1, mode strict
```

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

BGP Load Balancing Configuration

Examples: Configuring BGP Multipath

Understanding BGP Multipath

The Junos OS BGP multipath feature supports the following applications:

- Load balancing across multiple links between two routing devices belonging to different autonomous systems (ASs)
- Load balancing across a common subnet or multiple subnets to different routing devices belonging to the same peer AS
- Load balancing across multiple links between two routing devices belonging to different external confederation peers
- Load balancing across a common subnet or multiple subnets to different routing devices belonging to external confederation peers

In a common scenario for load balancing, a customer is multihomed to multiple routers in a point of presence (POP). The default behavior is to send all traffic across only one of the available links. Load balancing causes traffic to use two or more of the links.

BGP multipath does not apply to paths that share the same MED-plus-IGP cost, yet differ in IGP cost. Multipath path selection is based on the IGP cost metric, even if two paths have the same MED-plus-IGP cost.

Example: Load Balancing BGP Traffic

This example shows how to configure BGP to select multiple equal-cost external BGP (EBGP) or internal BGP (IBGP) paths as active paths.

Requirements

Before you begin:

- Configure the device interfaces.
- Configure an interior gateway protocol (IGP).
- Configure BGP.
- Configure a routing policy that exports routes (such as direct routes or IGP routes) from the routing table into BGP.

Overview

The following steps show how to configure per-packet load balancing:

1. Define a load-balancing routing policy by including one or more **policy-statement** statements at the **[edit policy-options]** hierarchy level, defining an action of **load-balance per-packet**:

   ```
   policy-statement policy-name {
     from {
       match-conditions;
       route-filter destination-prefix match-type <actions>;
       prefix-list name;
     }
     then {
       load-balance per-packet;
     }
   }
   ```

2. Apply the policy to routes exported from the routing table to the forwarding table. To do this, include the **forwarding-table** and **export** statements:

   ```
   forwarding-table {
     export policy-name;
   }
   ```

   You cannot apply the export policy to VRF routing instances.

3. Specify all next hops of that route, if more than one exists, when allocating a label corresponding to a route that is being advertised.

4. Configure the forwarding-options hash key for MPLS to include the IP payload.

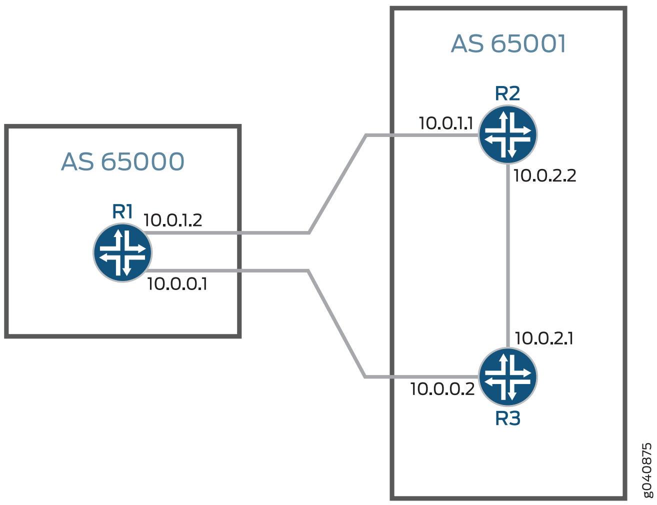
NOTE: On some platforms, you can increase the number of paths that are load balanced by using the chassis maximum-ecmp statement. With this statement, you can change the maximum number of equal-cost load-balanced paths to 32 or 64.

In this example, Device R1 is in AS 65000 and is connected to both Device R2 and Device R3, which are in AS 65001. This example shows the configuration on Device R1.

Topology

Figure 58 on page 2860 shows the topology used in this example.

Figure 58: BGP Load Balancing



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols bgp group external type external
set protocols bgp group external peer-as 65001
set protocols bgp group external multipath
set protocols bgp group external neighbor 10.0.1.1
set protocols bgp group external neighbor 10.0.0.2
set policy-options policy-statement loadbal from route-filter 10.0.0.0/16 orlonger
set policy-options policy-statement loadbal then load-balance per-packet
set routing-options forwarding-table export loadbal
set routing-options autonomous-system 65000
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. Configure the BGP group.

```
[edit protocols bgp group external]
user@R1# set type external
user@R1# set peer-as 65001
user@R1# set neighbor 10.0.1.1
user@R1# set neighbor 10.0.0.2
```

2. Enable the BGP group to use multiple paths.

NOTE: To disable the default check requiring that paths accepted by BGP multipath must have the same neighboring autonomous system (AS), include the **multiple-as** option.

```
[edit protocols bgp group external]
user@R1# set multipath
```

3. Configure the load-balancing policy.

```
[edit policy-options policy-statement loadbal]
user@R1# set from route-filter 10.0.0.0/16 orlonger
user@R1# set then load-balance per-packet
```

4. Apply the load-balancing policy.

```
[edit routing-options]
user@R1# set forwarding-table export loadbal
```

5. Configure the local autonomous system (AS) number.

```
[edit routing-options]
user@R1# set autonomous-system 65000
```

Results From configuration mode, confirm your configuration by entering the **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@R1# show protocols
bgp {
  group external {
    type external;
    peer-as 65001;
    multipath;
    neighbor 10.0.1.1;
    neighbor 10.0.0.2;
  }
}

[edit]
user@R1# show policy-options
policy-statement loadbal {
  from {
    route-filter 10.0.0.0/16 orlonger;
  }
  then {
    load-balance per-packet;
  }
}

[edit]
user@R1# show routing-options
autonomous-system 65000;
forwarding-table {
```

```
    export loadbal;
  }
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly:

- Verifying Routes on page 2862
- Verifying Forwarding on page 2863

Verifying Routes

Purpose Verify that routes are learned from both routers in the neighboring AS.

Action From operational mode, run the **show route** command.

```
user@R1> show route 10.0.2.0
inet.0: 12 destinations, 15 routes (12 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.2.0/30        *[BGP/170] 03:12:32, localpref 100
                      AS path: 65001 I
                      to 10.0.1.1 via ge-1/2/0.0
                    > to 10.0.0.2 via ge-1/2/1.0
                    [BGP/170] 03:12:32, localpref 100
                      AS path: 65001 I
                    > to 10.0.1.1 via ge-1/2/0.0

user@R1> show route 10.0.2.0 detail
inet.0: 12 destinations, 15 routes (12 active, 0 holddown, 0 hidden)
10.0.2.0/30 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 262142
                Next-hop reference count: 3
                Source: 10.0.0.2
                Next hop: 10.0.1.1 via ge-1/2/0.0
                Next hop: 10.0.0.2 via ge-1/2/1.0, selected
                State: <Active Ext>
                Local AS: 65000 Peer AS: 65001
                Age: 3:18:30
                Task: BGP_65001.10.0.0.2+55402
                Announcement bits (1): 2-KRT
                AS path: 65001 I
                Accepted Multipath
                Localpref: 100
                Router ID: 192.168.2.1
         BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 602
                Next-hop reference count: 5
                Source: 10.0.1.1
                Next hop: 10.0.1.1 via ge-1/2/0.0, selected
                State: <NotBest Ext>
                Inactive reason: Not Best in its group - Active preferred
                Local AS: 65000 Peer AS: 65001
                Age: 3:18:30
                Task: BGP_65001.10.0.1.1+53135
                AS path: 65001 I
```



```
Accepted
Localpref: 100
Router ID: 192.168.3.1
```

Meaning The active path, denoted with an asterisk (*), has two next hops: 10.0.1.1 and 10.0.0.2 to the 10.0.2.0 destination. The 10.0.1.1 next hop is copied from the inactive path to the active path.

NOTE: The **show route detail** command output designates one gateway as **selected**. This output is potentially confusing in the context of load balancing. The selected gateway is used for many purposes in addition to deciding which gateway to install into the kernel when Junos OS is not performing per-packet load-balancing. For instance, the **ping mpls** command uses the selected gateway when sending packets. Multicast protocols use the selected gateway in some cases to determine the upstream interface. Therefore, even when Junos OS is performing per-packet load-balancing by way of a forwarding-table policy, the selected gateway information is still required for other purposes. It is useful to display the selected gateway for troubleshooting purposes. Additionally, it is possible to use forwarding-table policy to override what is installed into the kernel (for example, by using the **install-nexthop** action). In this case, the next-hop gateway installed in the forwarding table might be a subset of the total gateways displayed in the **show route** command.

Verifying Forwarding

Purpose Verify that both next hops are installed in the forwarding table.

Action From operational mode, run the **show route forwarding-table** command.

```
user@R1> show route forwarding-table destination 10.0.2.0
Routing table: default.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
10.0.2.0/30        user     0                    ulst 262142     2
                              10.0.1.1           ucst    602     5 ge-1/2/0.0
                              10.0.0.2           ucst    522     6 ge-1/2/1.0
```

Example: Configuring Single-Hop EBGP Peers to Accept Remote Next Hops

This example shows how to configure a single-hop external BGP (EBGP) peer to accept a remote next hop with which it does not share a common subnet.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

In some situations, it is necessary to configure a single-hop EBGP peer to accept a remote next hop with which it does not share a common subnet. The default behavior is for any next-hop address received from a single-hop EBGP peer that is not recognized as sharing a common subnet to be discarded. The ability to have a single-hop EBGP peer accept a remote next hop to which it is not directly connected also prevents you from having to configure the single-hop EBGP neighbor as a multihop session. When you configure a multihop session in this situation, all next-hop routes learned through this EBGP peer are labeled indirect even when they do share a common subnet. This situation breaks multipath functionality for routes that are recursively resolved over routes that include these next-hop addresses. Configuring the accept-remote-nexthop statement allows a single-hop EBGP peer to accept a remote next hop, which restores multipath functionality for routes that are resolved over these next-hop addresses. You can configure this statement at the global, group, and neighbor hierarchy levels for BGP. The statement is also supported on logical systems and the VPN routing and forwarding (VRF) routing instance type. Both the remote next-hop and the EBGP peer must support BGP route refresh as defined in RFC 2918, *Route Refresh Capability in BGP-4*. If the remote peer does not support BGP route refresh, the session is reset.

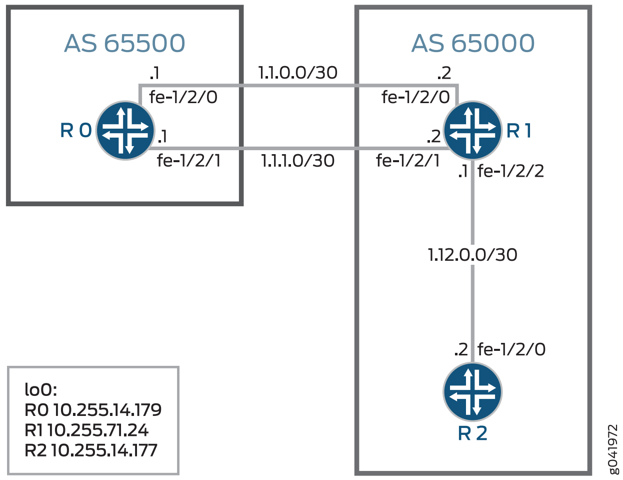
NOTE: **You cannot configure both the multihop and accept-remote-nexthop statements for the same EBGP peer.**

When you enable a single-hop EBGP peer to accept a remote next hop, you must also configure an import routing policy on the EBGP peer that specifies the remote next-hop address.

This example includes an import routing policy, **agg_route**, that enables a single-hop external BGP peer (Device R1) to accept the remote next-hop 1.1.10.10 for the route to the 1.1.230.0/23 network. At the **[edit protocols bgp]** hierarchy level, the example includes the **import agg_route** statement to apply the policy to the external BGP peer and includes the **accept-remote-nexthop** statement to enable the single-hop EBGP peer to accept the remote next hop.

Figure 59 on page 2865 shows the sample topology.

Figure 59: Topology for Accepting a Remote Next Hop



Configuration

- Device R0 on page 2866
- Configuring Device R1 on page 2868
- Configuring Device R2 on page 2871

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R0

```
set interfaces fe-1/2/0 unit 1 family inet address 1.1.0.1/30
set interfaces fe-1/2/1 unit 2 family inet address 1.1.1.1/30
set interfaces lo0 unit 1 family inet address 10.255.14.179/32
set protocols bgp group ext type external
set protocols bgp group ext export test_route
set protocols bgp group ext export agg_route
set protocols bgp group ext peer-as 65000
set protocols bgp group ext multipath
set protocols bgp group ext neighbor 1.1.0.2
set protocols bgp group ext neighbor 1.1.1.2
set policy-options policy-statement agg_route term 1 from protocol static
set policy-options policy-statement agg_route term 1 from route-filter 1.1.230.0/23 exact
set policy-options policy-statement agg_route term 1 then accept
set policy-options policy-statement test_route term 1 from protocol static
set policy-options policy-statement test_route term 1 from route-filter 1.1.10.10/32 exact
set policy-options policy-statement test_route term 1 then accept
set routing-options static route 1.1.10.10/32 reject
set routing-options static route 1.1.230.0/23 reject
set routing-options autonomous-system 65500
```

Device R1

```
set interfaces fe-1/2/0 unit 3 family inet address 1.1.0.2/30
set interfaces fe-1/2/1 unit 4 family inet address 1.12.0.1/30
set interfaces fe-1/2/2 unit 5 family inet address 1.1.1.2/30
set interfaces lo0 unit 2 family inet address 10.255.71.24/32
set protocols bgp accept-remote-nexthop
```

```
set protocols bgp group ext type external
set protocols bgp group ext import agg_route
set protocols bgp group ext peer-as 65500
set protocols bgp group ext multipath
set protocols bgp group ext neighbor 1.1.0.1
set protocols bgp group ext neighbor 1.1.1.1
set protocols bgp group int type internal
set protocols bgp group int local-address 10.255.71.24
set protocols bgp group int neighbor 10.255.14.177
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
set protocols ospf area 0.0.0.0 interface 10.255.71.24
set policy-options policy-statement agg_route term 1 from protocol bgp
set policy-options policy-statement agg_route term 1 from route-filter 1.1.230.0/23 exact
set policy-options policy-statement agg_route term 1 then next-hop 1.1.10.10
set policy-options policy-statement agg_route term 1 then accept
set routing-options autonomous-system 65000
```

Device R2

```
set interfaces fe-1/2/0 unit 6 family inet address 1.12.0.2/30
set interfaces lo0 unit 3 family inet address 10.255.14.177/32
set protocols bgp group int type internal
set protocols bgp group int local-address 10.255.14.177
set protocols bgp group int neighbor 10.255.71.24
set protocols ospf area 0.0.0.0 interface fe-1/2/0.6
set protocols ospf area 0.0.0.0 interface 10.255.14.177
set routing-options autonomous-system 65000
```

Device R0

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R0:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 1]
user@R0# set family inet address 1.1.0.1/30

[edit interfaces fe-1/2/1 unit 2]
user@R0# set family inet address 1.1.1.1/30

[edit interfaces lo0 unit 1]
user@R0# set family inet address 10.255.14.179/32
```

2. Configure EBGP.

```
[edit protocols bgp group ext]
user@R0# set type external
user@R0# set peer-as 65000
user@R0# set neighbor 1.1.0.2
user@R0# set neighbor 1.1.1.2
```

3. Enable multipath BGP between Device R0 and Device R1.

```
[edit protocols bgp group ext]
user@R0# set multipath
```


4. Configure static routes to remote networks.
   These routes are not part of the topology. The purpose of these routes is to demonstrate the functionality in this example.

   ```
   [edit routing-options]
   user@R0# set static route 1.1.10.10/32 reject
   user@R0# set static route 1.1.230.0/23 reject
   ```

5. Configure routing policies that accept the static routes.

   ```
   [edit policy-options policy-statement agg_route term 1]
   user@R0# set from protocol static
   user@R0# set from route-filter 1.1.230.0/23 exact
   user@R0# set then accept

   [edit policy-options policy-statement test_route term 1]
   user@R0# set from protocol static
   user@R0# set from route-filter 1.1.10.10/32 exact
   user@R0# set then accept
   ```

6. Export the **agg_route** and **test_route** policies from the routing table into BGP.

   ```
   [edit protocols bgp group ext]
   user@R0# set export test_route
   user@R0# set export agg_route
   ```

7. Configure the autonomous system (AS) number.

   ```
   [edit routing-options]
   user@R0# set autonomous-system 65500
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R0# show interfaces
fe-1/2/0 {
   unit 1 {
      family inet {
         address 1.1.0.1/30;
      }
   }
}
fe-1/2/1 {
   unit 2 {
      family inet {
         address 1.1.1.1/30;
      }
   }
}
lo0 {
   unit 1 {
      family inet {
         address 10.255.14.179/32;
      }
   }
```

```
}
user@R0# show policy-options
policy-statement agg_route {
   term 1 {
      from {
         protocol static;
         route-filter 1.1.230.0/23 exact;
      }
      then accept;
   }
}
policy-statement test_route {
   term 1 {
      from {
         protocol static;
         route-filter 1.1.10.10/32 exact;
      }
      then accept;
   }
}
user@R0# show protocols
bgp {
   group ext {
      type external;
      export [ test_route agg_route ];
      peer-as 65000;
      multipath;
      neighbor 1.1.0.2;
      neighbor 1.1.1.2;
   }
}
user@R0# show routing-options
static {
   route 1.1.10.10/32 reject;
   route 1.1.230.0/23 reject;
}
autonomous-system 65500;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 3]
   user@R1# set family inet address 1.1.0.2/30

   [edit interfaces fe-1/2/1 unit 4]
   ```

```
user@R1# set family inet address 1.12.0.1/30

[edit interfaces fe-1/2/2 unit 5]
user@R1# set family inet address 1.1.1.2/30

[edit interfaces lo0 unit 2]
user@R1# set family inet address 10.255.71.24/32
```

2. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface fe-1/2/1.4
user@R1# set interface 10.255.71.24
```

3. Enable Device R1 to accept the remote next hop.

```
[edit protocols bgp]
user@R1# set accept-remote-nexthop
```

4. Configure IBGP.

```
[edit protocols bgp group int]
user@R1# set type internal
user@R1# set local-address 10.255.71.24
user@R1# set neighbor 10.255.14.177
```

5. Configure EBGP.

```
[edit protocols bgp group ext]
user@R1# set type external
user@R1# set peer-as 65500
user@R1# set neighbor 1.1.0.1
user@R1# set neighbor 1.1.1.1
```

6. Enable multipath BGP between Device R0 and Device R1.

```
[edit protocols bgp group ext]
user@R1# set multipath
```

7. Configure a routing policy that enables a single-hop external BGP peer (Device R1) to accept the remote next-hop 1.1.10.10 for the route to the 1.1.230.0/23 network.

```
[edit policy-options policy-statement agg_route term 1]
user@R1# set from protocol bgp
user@R1# set from route-filter 1.1.230.0/23 exact
user@R1# set then next-hop 1.1.10.10
user@R1# set then accept
```

8. Import the **agg_route** policy into the routing table on Device R1.

```
[edit protocols bgp group ext]
user@R1# set import agg_route
```

9. Configure the autonomous system (AS) number.

```
[edit routing-options]
user@R1# set autonomous-system 65000
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output

does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
  unit 3 {
    family inet {
      address 1.1.0.2/30;
    }
  }
}
fe-1/2/1 {
  unit 4 {
    family inet {
      address 1.12.0.1/30;
    }
  }
}
fe-1/2/2 {
  unit 5 {
    family inet {
      address 1.1.1.2/30;
    }
  }
}
lo0 {
  unit 2 {
    family inet {
      address 10.255.71.24/32;
    }
  }
}
```

```
user@R1# show policy-options
policy-statement agg_route {
  term 1 {
    from {
      protocol bgp;
      route-filter 1.1.230.0/23 exact;
    }
    then {
      next-hop 1.1.10.10;
      accept;
    }
  }
}
```

```
user@R1# show protocols
bgp {
  accept-remote-nexthop;
  group ext {
    type external;
    import agg_route;
    peer-as 65500;
    multipath;
    neighbor 1.1.0.1;
```



```
        neighbor 1.1.1.1;
    }
    group int {
        type internal;
        local-address 10.255.71.24;
        neighbor 10.255.14.177;
    }
}
ospf {
    area 0.0.0.0 {
        interface fe-1/2/1.4;
        interface 10.255.71.24;
    }
}
```

```
user@R1# show routing-options
autonomous-system 65000;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

   ```
   [edit interfaces fe-1/2/0 unit 6]
   user@R2# set family inet address 1.12.0.2/30

   [edit interfaces lo0 unit 3]
   user@R2# set family inet address 10.255.14.177/32
   ```

2. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@R2# set interface fe-1/2/0.6
   user@R2# set interface 10.255.14.177
   ```

3. Configure IBGP.

   ```
   [edit protocols bgp group int]
   user@R2# set type internal
   user@R2# set local-address 10.255.14.177
   user@R2# set neighbor 10.255.71.24
   ```

4. Configure the autonomous system (AS) number.

   ```
   [edit routing-options]
   user@R1# set autonomous-system 65000
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
    unit 6 {
        family inet {
            address 1.12.0.2/30;
        }
    }
}
lo0 {
    unit 3 {
        family inet {
            address 10.255.14.177/32;
        }
    }
}
```

```
user@R2# show protocols
bgp {
    group int {
        type internal;
        local-address 10.255.14.177;
        neighbor 10.255.71.24;
    }
}
ospf {
    area 0.0.0.0 {
        interface fe-1/2/0.6;
        interface 10.255.14.177;
    }
}
```

```
user@R2# show routing-options
autonomous-system 65000;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying That the Multipath Route with the Indirect Next Hop Is in the Routing Table on page 2872
- Deactivating and Reactivating the accept-remote-nexthop Statement on page 2874

Verifying That the Multipath Route with the Indirect Next Hop Is in the Routing Table

Purpose Verify that Device R1 has a route to the 1.1.230.0/23 network.

Action From operational mode, enter the **show route 1.1.230.0 extensive** command.

```
user@R1> show route 1.1.230.0 extensive
inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
Restart Complete
1.1.230.0/23 (2 entries, 1 announced)
TSI:
KRT in-kernel 1.1.230.0/23 -> {indirect(262142)}
Page 0 idx 1 Type 1 val 9168f6c
```



```
    Nexthop: 1.1.10.10
    Localpref: 100
    AS path: [65000] 65500 I
    Communities:
Path 1.1.230.0 from 1.1.0.1 Vector len 4.  Val: 1
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Address: 0x90c44d8
                Next-hop reference count: 4
                Source: 1.1.0.1
                Next hop type: Router, Next hop index: 262143
                Next hop: 1.1.0.1 via fe-1/2/0.3, selected
                Next hop: 1.1.1.1 via fe-1/2/2.5
                Protocol next hop: 1.1.10.10
                Indirect next hop: 91c0000 262142
                State: <Active Ext>
                Local AS: 65000 Peer AS: 65500
                Age: 2:55:31    Metric2: 0
                Task: BGP_65500.1.1.0.1+64631
                Announcement bits (3): 2-KRT 3-BGP_RT_Background 4-Resolve tree
1
                AS path: 65500 I
                Accepted Multipath
                Localpref: 100
                Router ID: 10.255.14.179
                Indirect next hops: 1
                        Protocol next hop: 1.1.10.10
                        Indirect next hop: 91c0000 262142
                        Indirect path forwarding next hops: 2
                                Next hop type: Router
                                Next hop: 1.1.0.1 via fe-1/2/0.3
                                Next hop: 1.1.1.1 via fe-1/2/2.5
                        1.1.10.10/32 Originating RIB: inet.0
                          Node path count: 1
                          Forwarding nexthops: 2
                                Nexthop: 1.1.0.1 via fe-1/2/0.3
                                Nexthop: 1.1.1.1 via fe-1/2/2.5
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Address: 0x90c44d8
                Next-hop reference count: 4
                Source: 1.1.1.1
                Next hop type: Router, Next hop index: 262143
                Next hop: 1.1.0.1 via fe-1/2/0.3, selected
                Next hop: 1.1.1.1 via fe-1/2/2.5
                Protocol next hop: 1.1.10.10
                Indirect next hop: 91c0000 262142
                State: <NotBest Ext>
                Inactive reason: Not Best in its group - Update source
                Local AS: 65000 Peer AS: 65500
                Age: 2:55:27    Metric2: 0
                Task: BGP_65500.1.1.1.1+53260
                AS path: 65500 I
                Accepted
                Localpref: 100
                Router ID: 10.255.14.179
                Indirect next hops: 1
                        Protocol next hop: 1.1.10.10
                        Indirect next hop: 91c0000 262142
                        Indirect path forwarding next hops: 2
                                Next hop type: Router
```

```
        Next hop: 1.1.0.1 via fe-1/2/0.3
        Next hop: 1.1.1.1 via fe-1/2/2.5
1.1.10.10/32 Originating RIB: inet.0
  Node path count: 1
  Forwarding nexthops: 2
        Nexthop: 1.1.0.1 via fe-1/2/0.3
        Nexthop: 1.1.1.1 via fe-1/2/2.5
```

Meaning The output shows that Device R1 has a route to the 1.1.230.0 network with the multipath feature enabled (**Accepted Multipath**). The output also shows that the route has an indirect next hop of 1.1.10.10.

Deactivating and Reactivating the accept-remote-nexthop Statement

Purpose Make sure that the multipath route with the indirect next hop is removed from the routing table when you deactivate the **accept-remote-nexthop** statement.

Action

1. From configuration mode, enter the **deactivate protocols bgp accept-remote-nexthop** command.

   ```
   user@R1# deactivate protocols bgp accept-remote-nexthop
   user@R1# commit
   ```

2. From operational mode, enter the **show route 1.1.230.0** command.

   ```
   user@R1> show route 1.1.230.0
   ```

3. From configuration mode, reactivate the statement by entering the **activate protocols bgp accept-remote-nexthop** command.

   ```
   user@R1# activate protocols bgp accept-remote-nexthop
   user@R1# commit
   ```

4. From operational mode, reenter the **show route 1.1.230.0** command.

   ```
   user@R1> show route 1.1.230.0

   inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
   Restart Complete
   + = Active Route, - = Last Active, * = Both

   1.1.230.0/23       *[BGP/170] 03:13:19, localpref 100
                         AS path: 65500 I
                       > to 1.1.0.1 via fe-1/2/0.3
                         to 1.1.1.1 via fe-1/2/2.5
                        [BGP/170] 03:13:15, localpref 100, from 1.1.1.1
                         AS path: 65500 I
                       > to 1.1.0.1 via fe-1/2/0.3
                         to 1.1.1.1 via fe-1/2/2.5
   ```

Meaning When the **accept-remote-nexthop** statement is deactivated, the multipath route to the 1.1.230.0 network is removed from the routing table .

Related Documentation

- *Example: Overriding the Default BGP Routing Policy on PTX Series Packet Transport Routers*
- *Example: Load Balancing BGP Traffic with Unequal Bandwidth Allocated to the Paths*

Example: Advertising Multiple BGP Paths to a Destination

Understanding the Advertisement of Multiple Paths to a Single Destination in BGP

BGP peers advertise routes to each other in update messages. BGP stores its routes in the Junos OS routing table (**inet.0**). For each prefix in the routing table, the routing protocol process selects a single best path, called the active path. Unless you configure BGP to advertise multiple paths to the same destination, BGP advertises only the active path.

Instead of advertising only the active path to a destination, you can configure BGP to advertise multiple paths to the destination. Within an autonomous system (AS), the availability of multiple exit points to reach a destination provides the following benefits:

- Fault tolerance—Path diversity leads to reduction in restoration time after failure. For instance, a border after receiving multiple paths to the same destination can precompute a backup path and have it ready so that when the primary path becomes invalid, the border routing device can use the backup to quickly restore connectivity. Without a backup path, the restoration time depends on BGP reconvergence, which includes withdraw and advertisement messages in the network before a new best path can be learned.
- Load balancing—The availability of multiple paths to reach the same destination enables load balancing of traffic, if the routing within the AS meets certain constraints.
- Maintenance—The availability of alternate exit points allows for graceful maintenance operation of routers.

The following limitations apply to advertising multiple routes in BGP:

- Address families supported:
  - IPv4 unicast (**family inet unicast**)
  - IPv6 unicast (**family inet6 unicast**)
  - IPv4 labeled unicast (**family inet labeled-unicast**)
  - IPv6 labeled unicast (**family inet6 labeled-unicast**)
- Internal BGP (IBGP) peers only. No support on external BGP (EBGP) peers.
- Master instance only. No support for routing instances.
- Graceful restart supported, but not nonstop active routing (NSR).
- No BGP Monitoring Protocol (BMP) support.

- No support for EBGP sessions between confederations.
- Prefix policies enable you to filter routes on a router that is configured to advertise multiple paths to a destination. Prefix policies can only match prefixes. They cannot match route attributes, and they cannot change the attributes of routes.

Example: Advertising Multiple Paths in BGP

In this example, BGP routers are configured to advertise multiple paths instead of advertising only the active path. Advertising multiple paths in BGP is specified in Internet draft draft-ietf-idr-add-paths-04, *Advertisement of Multiple Paths in BGP*.

Requirements

This example uses the following hardware and software components:

- Eight BGP-enabled devices.
- Five of the BGP-enabled devices do not necessarily need to be routers. For example, they can be EX Series Ethernet Switches.
- Three of the BGP-enabled devices are configured to send multiple paths or receive multiple paths (or both send and receive multiple paths). These three BGP-enabled devices must be M Series Multiservice Edge Routers, MX Series 3D Universal Edge Routers, or T Series Core Routers.
- The three routers must be running Junos OS Release 11.4 or later.

Overview

The following statements are used for configuring multiple paths to a destination:

```
[edit protocols bgp group group-name family family]
add-path {
  receive;
  send {
    path-count number;
    prefix-policy [ policy-names ];
  }
}
```

In this example, Router R5, Router R6, and Router R7 redistribute static routes into BGP. Router R1 and Router R4 are route reflectors. Router R2 and Router R3 are clients to Route Reflector R1. Router R8 is a client to Route Reflector R4.

Route reflection is optional when multiple-path advertisement is enabled in BGP.

With the **add-path send path-count 6** configuration, Router R1 is configured to send up to six paths (per destination) to Router R4.

With the **add-path receive** configuration, Router R4 is configured to receive multiple paths from Router R1.

With the **add-path send path-count 6** configuration, Router R4 is configured to send up to six paths to Router R8.

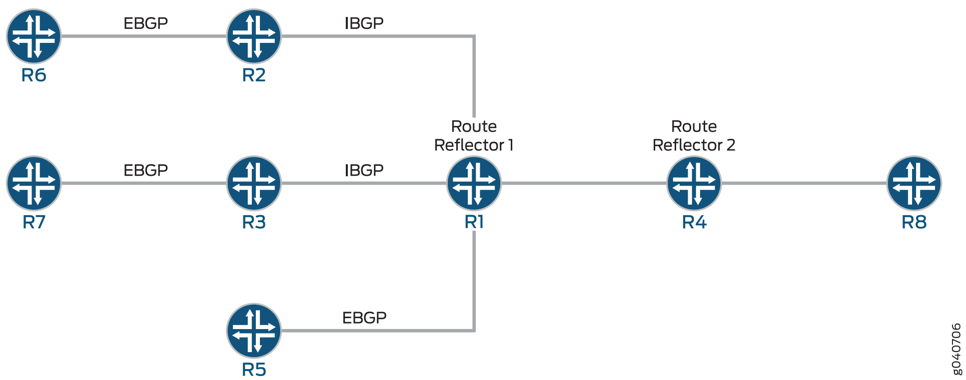
With the **add-path receive** configuration, Router R8 is configured to receive multiple paths from Router R4.

The **add-path send prefix-policy allow_199** policy configuration (along with the corresponding route filter) limits Router R4 to sending multiple paths for only the 199.1.1.1/32 route.

Topology Diagram

Figure 60 on page 2877 shows the topology used in this example.

Figure 60: Advertisement of Multiple Paths in BGP



Configuration

- Configuring Router R1 on page 2880
- Configuring Router R2 on page 2883
- Configuring Router R3 on page 2885
- Configuring Router R4 on page 2887
- Configuring Router R5 on page 2889
- Configuring Router R6 on page 2891
- Configuring Router R7 on page 2892
- Configuring Router R8 on page 2894
- Results on page 2894

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Router R1

```
set interfaces fe-0/0/0 unit 12 family inet address 10.0.12.1/24
set interfaces fe-0/0/1 unit 13 family inet address 10.0.13.1/24
set interfaces fe-1/0/0 unit 14 family inet address 10.0.14.1/24
```

```
set interfaces fe-1/2/0 unit 15 family inet address 10.0.15.1/24
set interfaces lo0 unit 10 family inet address 10.0.0.10/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.10
set protocols bgp group rr cluster 10.0.0.10
set protocols bgp group rr neighbor 10.0.0.20
set protocols bgp group rr neighbor 10.0.0.30
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.15.2 local-address 10.0.15.1
set protocols bgp group e1 neighbor 10.0.15.2 peer-as 2
set protocols bgp group rr_rr type internal
set protocols bgp group rr_rr local-address 10.0.0.10
set protocols bgp group rr_rr neighbor 10.0.0.40 family inet unicast add-path send
  path-count 6
set protocols ospf area 0.0.0.0 interface lo0.10 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.12
set protocols ospf area 0.0.0.0 interface fe-0/0/1.13
set protocols ospf area 0.0.0.0 interface fe-1/0/0.14
set protocols ospf area 0.0.0.0 interface fe-1/2/0.15
set routing-options router-id 10.0.0.10
set routing-options autonomous-system 1
```

Router R2

```
set interfaces fe-1/2/0 unit 21 family inet address 10.0.12.2/24
set interfaces fe-1/2/1 unit 26 family inet address 10.0.26.1/24
set interfaces lo0 unit 20 family inet address 10.0.0.20/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.20
set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.26.2 peer-as 2
set protocols ospf area 0.0.0.0 interface lo0.20 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.21
set protocols ospf area 0.0.0.0 interface fe-1/2/1.28
set policy-options policy-statement set_nh_self then next-hop self
set routing-options autonomous-system 1
```

Router R3

```
set interfaces fe-1/0/1 unit 31 family inet address 10.0.13.2/24
set interfaces fe-1/0/2 unit 37 family inet address 10.0.37.1/24
set interfaces lo0 unit 30 family inet address 10.0.0.30/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.30
set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.37.2 peer-as 2
set protocols ospf area 0.0.0.0 interface lo0.30 passive
set protocols ospf area 0.0.0.0 interface fe-1/0/1.31
set protocols ospf area 0.0.0.0 interface fe-1/0/2.37
set policy-options policy-statement set_nh_self then next-hop self
set routing-options autonomous-system 1
```

Router R4

```
set interfaces fe-1/2/0 unit 41 family inet address 10.0.14.2/24
set interfaces fe-1/2/1 unit 48 family inet address 10.0.48.1/24
set interfaces lo0 unit 40 family inet address 10.0.0.40/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.40
```

```
set protocols bgp group rr family inet unicast add-path receive
set protocols bgp group rr neighbor 10.0.0.10
set protocols bgp group rr_client type internal
set protocols bgp group rr_client local-address 10.0.0.40
set protocols bgp group rr_client cluster 10.0.0.40
set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  path-count 6
set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  prefix-policy allow_199
set protocols ospf area 0.0.0.0 interface fe-1/2/0.41
set protocols ospf area 0.0.0.0 interface lo0.40 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/1.48
set routing-options autonomous-system 1
set policy-options policy-statement allow_199 from route-filter 199.1.1.1/32 exact
set policy-options policy-statement allow_199 then accept
```

Router R5

```
set interfaces fe-1/2/0 unit 51 family inet address 10.0.15.2/24
set interfaces lo0 unit 50 family inet address 10.0.0.50/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.15.1 export s2b
set protocols bgp group e1 neighbor 10.0.15.1 peer-as 1
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then as-path-expand 2
set policy-options policy-statement s2b then accept
set routing-options autonomous-system 2
set routing-options static route 199.1.1.1/32 reject
set routing-options static route 198.1.1.1/32 reject
```

Router R6

```
set interfaces fe-1/2/0 unit 62 family inet address 10.0.26.2/24
set interfaces lo0 unit 60 family inet address 10.0.0.60/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.26.1 export s2b
set protocols bgp group e1 neighbor 10.0.26.1 peer-as 1
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then accept
set routing-options autonomous-system 2
set routing-options static route 199.1.1.1/32 reject
set routing-options static route 198.1.1.1/32 reject
```

Router R7

```
set interfaces fe-1/2/0 unit 73 family inet address 10.0.37.2/24
set interfaces lo0 unit 70 family inet address 10.0.0.70/32
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then accept
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.37.1 export s2b
set protocols bgp group e1 neighbor 10.0.37.1 peer-as 1
set routing-options autonomous-system 2
set routing-options static route 199.1.1.1/32 reject
```

Router R8

```
set interfaces fe-1/2/0 unit 84 family inet address 10.0.48.2/24
set interfaces lo0 unit 80 family inet address 10.0.0.80/32
set protocols bgp group rr type internal
```



```
set protocols bgp group rr local-address 10.0.0.80
set protocols bgp group rr neighbor 10.0.0.40 family inet unicast add-path receive
set protocols ospf area 0.0.0.0 interface lo0.80 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.84
set routing-options autonomous-system 1
```

Configuring Router R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router R1:

1. Configure the interfaces to Router R2, Router R3, Router R4, and Router R5, and configure the loopback (lo0) interface.

   ```
   [edit interfaces]
   user@R1# set fe-0/0/0 unit 12 family inet address 10.0.12.1/24

   user@R1# set fe-0/0/1 unit 13 family inet address 10.0.13.1/24

   user@R1# set fe-1/0/0 unit 14 family inet address 10.0.14.1/24

   user@R1# set fe-1/2/0 unit 15 family inet address 10.0.15.1/24

   user@R1#set lo0 unit 10 family inet address 10.0.0.10/32
   ```

2. Configure BGP on the interfaces, and configure IBGP route reflection.

   ```
   [edit protocols bgp]
   user@R1# set group rr type internal
   user@R1# set group rr local-address 10.0.0.10
   user@R1# set group rr cluster 10.0.0.10
   user@R1# set group rr neighbor 10.0.0.20
   user@R1# set group rr neighbor 10.0.0.30

   user@R1# set group rr_rr type internal
   user@R1# set group rr_rr local-address 10.0.0.10

   user@R1# set group e1 type external
   user@R1# set group e1 neighbor 10.0.15.2 local-address 10.0.15.1
   user@R1# set group e1 neighbor 10.0.15.2 peer-as 2
   ```

3. Configure Router R1 to send up to six paths to its neighbor, Router R4.

   The destination of the paths can be any destination that Router R1 can reach through multiple paths.

   ```
   [edit protocols bgp]
   user@R1# set group rr_rr neighbor 10.0.0.40 family inet unicast add-path send
     path-count 6
   ```

4. Configure OSPF on the interfaces.

   ```
   [edit protocols ospf]
   ```



```
user@R1# set area 0.0.0.0 interface lo0.10 passive
user@R1# set area 0.0.0.0 interface fe-0/0/0.12
user@R1# set area 0.0.0.0 interface fe-0/0/1.13
user@R1# set area 0.0.0.0 interface fe-1/0/0.14
user@R1# set area 0.0.0.0 interface fe-1/2/0.15
```

5. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@R1# set router-id 10.0.0.10
user@R1# set autonomous-system 1
```

6. If you are done configuring the device, commit the configuration.

```
user@R1# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-0/0/0 {
  unit 12 {
    family inet {
      address 10.0.12.1/24;
    }
  }
}
fe-0/0/1 {
  unit 13 {
    family inet {
      address 10.0.13.1/24;
    }
  }
}
fe-1/0/0 {
  unit 14 {
    family inet {
      address 10.0.14.1/24;
    }
  }
}
fe-1/2/0 {
  unit 15 {
    family inet {
      address 10.0.15.1/24;
    }
  }
}
lo0 {
  unit 10 {
    family inet {
      address 10.0.0.10/32;
    }
  }
```

```
}
user@R1# show protocols
bgp {
    group rr {
        type internal;
        local-address 10.0.0.10;
        cluster 10.0.0.10;
        neighbor 10.0.0.20;
        neighbor 10.0.0.30;
    }
    group e1 {
        type external;
        neighbor 10.0.15.2 {
            local-address 10.0.15.1;
            peer-as 2;
        }
    }
    group rr_rr {
        type internal;
        local-address 10.0.0.10;
        neighbor 10.0.0.40 {
            family inet {
                unicast {
                    add-path {
                        send {
                            path-count 6;
                        }
                    }
                }
            }
        }
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.10 {
            passive;
        }
        interface fe-0/0/0.12;
        interface fe-0/0/1.13;
        interface fe-1/0/0.14;
        interface fe-1/2/0.15;
    }
}
user@R1# show routing-options
router-id 10.0.0.10;
autonomous-system 1;
```

Configuring Router R2

Step-by-Step Procedure

To configure Router R2:

1. Configure the loopback (lo0) interface and the interfaces to Router R6 and Router R1.

```
[edit interfaces]
user@R2# set fe-1/2/0 unit 21 family inet address 10.0.12.2/24

user@R2# set fe-1/2/1 unit 26 family inet address 10.0.26.1/24

user@R2# set lo0 unit 20 family inet address 10.0.0.20/32
```

2. Configure BGP and OSPF on Router R2's interfaces.

```
[edit protocols]
user@R2# set bgp group rr type internal
user@R2# set bgp group rr local-address 10.0.0.20

user@R2# set bgp group e1 type external
user@R2# set bgp group e1 neighbor 10.0.26.2 peer-as 2

user@R2# set ospf area 0.0.0.0 interface lo0.20 passive
user@R2# set ospf area 0.0.0.0 interface fe-1/2/0.21
user@R2# set ospf area 0.0.0.0 interface fe-1/2/1.28
```

3. For routes sent from Router R2 to Router R1, advertise Router R2 as the next hop, because Router R1 does not have a route to Router R6's address on the 10.0.26.0/24 network.

```
[edit]
user@R2# set policy-options policy-statement set_nh_self then next-hop self

user@R2# set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
```

4. Configure the autonomous system number.

```
[edit]
user@R2# set routing-options autonomous-system 1
```

5. If you are done configuring the device, commit the configuration.

```
user@R2# commit
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**,and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
  unit 21 {
    family inet {
      address 10.0.12.2/24;
```

```
        }
    }
}
fe-1/2/1 {
    unit 26 {
        family inet {
            address 10.0.26.1/24;
        }
    }
}
lo0 {
    unit 20 {
        family inet {
            address 10.0.0.20/32;
        }
    }
}
```

user@R2# **show protocols**

```
bgp {
    group rr {
        type internal;
        local-address 10.0.0.20;
        neighbor 10.0.0.10 {
            export set_nh_self;
        }
    }
    group e1 {
        type external;
        neighbor 10.0.26.2 {
            peer-as 2;
        }
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.20 {
            passive;
        }
        interface fe-1/2/0.21;
        interface fe-1/2/1.28;
    }
}
```

user@R2# **show policy-options**

```
policy-statement set_nh_self {
    then {
        next-hop self;
    }
}
```

user@R2# **show routing-options**

```
autonomous-system 1;
```


Configuring Router R3

Step-by-Step Procedure

To configure Router R3:

1. Configure the loopback (lo0) interface and the interfaces to Router R7 and Router R1.

```
[edit interfaces]
user@R3# set fe-1/0/1 unit 31 family inet address 10.0.13.2/24

user@R3# set fe-1/0/2 unit 37 family inet address 10.0.37.1/24

user@R3# set lo0 unit 30 family inet address 10.0.0.30/32
```

2. Configure BGP and OSPF on Router R3's interfaces.

```
[edit protocols]
user@R3# set bgp group rr type internal
user@R3# set bgp group rr local-address 10.0.0.30

user@R3# set bgp group e1 type external
user@R3# set bgp group e1 neighbor 10.0.37.2 peer-as 2

user@R3# set ospf area 0.0.0.0 interface lo0.30 passive
user@R3# set ospf area 0.0.0.0 interface fe-1/0/1.31
user@R3# set ospf area 0.0.0.0 interface fe-1/0/2.37
```

3. For routes sent from Router R3 to Router R1, advertise Router R3 as the next hop, because Router R1 does not have a route to Router R7's address on the 10.0.37.0/24 network.

```
[edit]
user@R3# set policy-options policy-statement set_nh_self then next-hop self

user@R3# set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
```

4. Configure the autonomous system number.

```
[edit]
user@R3# set routing-options autonomous-system 1
```

5. If you are done configuring the device, commit the configuration.

```
user@R3# commit
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show interfaces
fe-1/0/1 {
    unit 31 {
        family inet {
            address 10.0.13.2/24;
```

```
        }
    }
}
fe-1/0/2 {
    unit 37 {
        family inet {
            address 10.0.37.1/24;
        }
    }
}
lo0 {
    unit 30 {
        family inet {
            address 10.0.0.30/32;
        }
    }
}
```

```
user@R3# show protocols
bgp {
    group rr {
        type internal;
        local-address 10.0.0.30;
        neighbor 10.0.0.10 {
            export set_nh_self;
        }
    }
    group e1 {
        type external;
        neighbor 10.0.37.2 {
            peer-as 2;
        }
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.30 {
            passive;
        }
        interface fe-1/0/1.31;
        interface fe-1/0/2.37;
    }
}
user@R3# show policy-options
policy-statement set_nh_self {
    then {
        next-hop self;
    }
}
```

```
user@R3# show routing-options
autonomous-system 1;
```


Configuring Router R4

Step-by-Step Procedure

To configure Router R4:

1. Configure the interfaces to Router R1 and Router R8, and configure the loopback (lo0) interface.

```
[edit interfaces]
user@R4# set fe-1/2/0 unit 41 family inet address 10.0.14.2/24

user@R4# set fe-1/2/1 unit 48 family inet address 10.0.48.1/24

user@R4# set lo0 unit 40 family inet address 10.0.0.40/32
```

2. Configure BGP on the interfaces, and configure IBGP route reflection.

```
[edit protocols bgp]
user@R4# set group rr type internal
user@R4# set group rr local-address 10.0.0.40
user@R4# set group rr neighbor 10.0.0.10

user@R4# set group rr_client type internal
user@R4# set group rr_client local-address 10.0.0.40
user@R4# set group rr_client cluster 10.0.0.40
```

3. Configure Router R4 to send up to six paths to its neighbor, Router R8.

   The destination of the paths can be any destination that Router R4 can reach through multiple paths.

```
[edit protocols bgp]
user@R4# set group rr_client neighbor 10.0.0.80 family inet unicast add-path send
   path-count 6
```

4. Configure Router R4 to receive multiple paths from its neighbor, Router R1.

   The destination of the paths can be any destination that Router R1 can reach through multiple paths.

```
[edit protocols bgp group rr family inet unicast]
user@R4# set add-path receive
```

5. Configure OSPF on the interfaces.

```
[edit protocols ospf area 0.0.0.0]
user@R4# set interface fe-1/2/0.41
user@R4# set interface lo0.40 passive
user@R4# set interface fe-1/2/1.48
```

6. Configure a policy that allows Router R4 to send Router R8 multiple paths to the 199.1.1.1/32 route.

   Router R4 receives multiple paths for the 198.1.1.1/32 route and the 199.1.1.1/32 route. However, because of this policy, Router R4 only sends multiple paths for the 199.1.1.1/32 route.

```
[edit protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast]
user@R4# set add-path send prefix-policy allow_199
```

```
[edit policy-options policy-statement allow_199]
user@R4# set from route-filter 199.1.1.1/32 exact
user@R4# set then accept
```

7. Configure the autonomous system number.

```
[edit routing-options]
user@R4# set autonomous-system 1
```

8. If you are done configuring the device, commit the configuration.

```
user@R4# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R4# show interfaces
fe-1/2/0 {
  unit 41 {
    family inet {
      address 10.0.14.2/24;
    }
  }
}
fe-1/2/1 {
  unit 48 {
    family inet {
      address 10.0.48.1/24;
    }
  }
}
lo0 {
  unit 40 {
    family inet {
      address 10.0.0.40/32;
    }
  }
}
```

```
user@R4# show protocols
bgp {
  group rr {
    type internal;
    local-address 10.0.0.40;
    family inet {
      unicast {
        add-path {
          receive;
        }
      }
    }
    neighbor 10.0.0.10;
  }
  group rr_client {
```



```
            type internal;
            local-address 10.0.0.40;
            cluster 10.0.0.40;
            neighbor 10.0.0.80 {
                family inet {
                    unicast {
                        add-path {
                            send {
                                path-count 6;
                                prefix-policy allow_199;
                            }
                        }
                    }
                }
            }
        }
    }
    ospf {
        area 0.0.0.0 {
            interface lo0.40 {
                passive;
            }
            interface fe-1/2/0.41;
            interface fe-1/2/1.48;
        }
    }
```

```
user@R4# show policy-options
policy-statement allow_199 {
    from {
        route-filter 199.1.1.1/32 exact;
    }
    then accept;
}
```

```
user@R4# show routing-options
autonomous-system 1;
```

Configuring Router R5

Step-by-Step Procedure

To configure Router R5:

1. Configure the loopback (lo0) interface and the interface to Router R1.

   ```
   [edit interfaces]
   user@R5# set fe-1/2/0 unit 51 family inet address 10.0.15.2/24

   user@R5# set lo0 unit 50 family inet address 10.0.0.50/32
   ```

2. Configure BGP on Router R5's interface.

   ```
   [edit protocols bgp group e1]
   user@R5# set type external
   user@R5# set neighbor 10.0.15.1 peer-as 1
   ```

3. Create static routes for redistribution into BGP.

   ```
   [edit routing-options]
   ```

```
user@R5# set static route 199.1.1.1/32 reject
user@R5# set static route 198.1.1.1/32 reject
```

4. Redistribute static and direct routes into BGP.

```
[edit protocols bgp group e1 neighbor 10.0.15.1]
user@R5# set export s2b

[edit policy-options policy-statement s2b]
user@R5# set from protocol static
user@R5# set from protocol direct
user@R5# set then as-path-expand 2
user@R5# set then accept
```

5. Configure the autonomous system number.

```
[edit routing-options]
user@R5# set autonomous-system 2
```

6. If you are done configuring the device, commit the configuration.

```
user@R5# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R5# show interfaces
fe-1/2/0 {
  unit 51 {
    family inet {
      address 10.0.15.2/24;
    }
  }
}
lo0 {
  unit 50 {
    family inet {
      address 10.0.0.50/32;
    }
  }
}

user@R5# show protocols
bgp {
  group e1 {
    type external;
    neighbor 10.0.15.1 {
      export s2b;
      peer-as 1;
    }
  }
}

user@R5# show policy-options
policy-statement s2b {
```

```
    from protocol [ static direct ];
    then {
      as-path-expand 2;
      accept;
    }
  }
```

```
user@R5# show routing-options
static {
  route 198.1.1.1/32 reject;
  route 199.1.1.1/32 reject;
}
autonomous-system 2;
```

Configuring Router R6

Step-by-Step Procedure

To configure Router R6:

1. Configure the loopback (lo0) interface and the interface to Router R2.

```
[edit interfaces]
user@R6# set fe-1/2/0 unit 62 family inet address 10.0.26.2/24

user@R6# set lo0 unit 60 family inet address 10.0.0.60/32
```

2. Configure BGP on Router R6's interface.

```
[edit protocols]
user@R6# set bgp group e1 type external
user@R6# set bgp group e1 neighbor 10.0.26.1 peer-as 1
```

3. Create static routes for redistribution into BGP.

```
[edit]
user@R6# set routing-options static route 199.1.1.1/32 reject
user@R6# set routing-options static route 198.1.1.1/32 reject
```

4. Redistribute static and direct routes from Router R6's routing table into BGP.

```
[edit protocols bgp group e1 neighbor 10.0.26.1]
user@R6# set export s2b

[edit policy-options policy-statement s2b]
user@R6# set from protocol static
user@R6# set from protocol direct
user@R6# set then accept
```

5. Configure the autonomous system number.

```
[edit routing-options]
user@R6# set autonomous-system 2
```

6. If you are done configuring the device, commit the configuration.

```
user@R6# commit
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output

does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R6# show interfaces
fe-1/2/0 {
   unit 62 {
      family inet {
         address 10.0.26.2/24;
      }
   }
}
lo0 {
   unit 60 {
      family inet {
         address 10.0.0.60/32;
      }
   }
}
```

```
user@R6# show protocols
bgp {
   group e1 {
      type external;
      neighbor 10.0.26.1 {
         export s2b;
         peer-as 1;
      }
   }
}
```

```
user@R6# show policy-options
policy-statement s2b {
   from protocol [ static direct ];
   then accept;
}
```

```
user@R6# show routing-options
static {
   route 198.1.1.1/32 reject;
   route 199.1.1.1/32 reject;
}
autonomous-system 2;
```

Configuring Router R7

Step-by-Step Procedure

To configure Router R7:

1. Configure the loopback (lo0) interface and the interface to Router R3.

   ```
   [edit interfaces]
   user@R7# set fe-1/2/0 unit 73 family inet address 10.0.37.2/24

   user@R7# set lo0 unit 70 family inet address 10.0.0.70/32
   ```

2. Configure BGP on Router R7's interface.

   ```
   [edit protocols bgp group e1]
   user@R7# set type external
   ```



```
user@R7# set neighbor 10.0.37.1 peer-as 1
```

3. Create a static route for redistribution into BGP.

```
[edit]
user@R7# set routing-options static route 199.1.1.1/32 reject
```

4. Redistribute static and direct routes from Router R7's routing table into BGP.

```
[edit protocols bgp group e1 neighbor 10.0.37.1]
user@R7# set export s2b

[edit policy-options policy-statement s2b]
user@R7# set from protocol static
user@R7# set from protocol direct
user@R7# set then accept
```

5. Configure the autonomous system number.

```
[edit routing-options]
user@R7# set autonomous-system 2
```

6. If you are done configuring the device, commit the configuration.

```
user@R7# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R7# show interfaces
fe-1/2/0 {
  unit 73 {
    family inet {
      address 10.0.37.2/24;
    }
  }
}
lo0 {
  unit 70 {
    family inet {
      address 10.0.0.70/32;
    }
  }
}

user@R7# show protocols
bgp {
  group e1 {
    type external;
    neighbor 10.0.37.1 {
      export s2b;
      peer-as 1;
    }
  }
}
```

```
user@R7# show policy-options
policy-statement s2b {
    from protocol [ static direct ];
    then accept;
}
```

```
user@R7# show routing-options
static {
    route 199.1.1.1/32 reject;
}
autonomous-system 2;
```

Configuring Router R8

Step-by-Step Procedure

To configure Router R8:

1. Configure the loopback (lo0) interface and the interface to Router R4.

   ```
   [edit interfaces]
   user@R8# set fe-1/2/0 unit 84 family inet address 10.0.48.2/24

   user@R8# set lo0 unit 80 family inet address 10.0.0.80/32
   ```

2. Configure BGP and OSPF on Router R8's interface.

   ```
   [edit protocols]
   user@R8# set bgp group rr type internal
   user@R8# set bgp group rr local-address 10.0.0.80

   user@R8# set ospf area 0.0.0.0 interface lo0.80 passive
   user@R8# set ospf area 0.0.0.0 interface fe-1/2/0.84
   ```

3. Configure Router R8 to receive multiple paths from its neighbor, Router R4.

   The destination of the paths can be any destination that Router R4 can reach through multiple paths.

   ```
   [edit protocols]
   user@R8# set bgp group rr neighbor 10.0.0.40 family inet unicast add-path receive
   ```

4. Configure the autonomous system number.

   ```
   [edit]
   user@R8# set routing-options autonomous-system 1
   ```

5. If you are done configuring the device, commit the configuration.

   ```
   user@R8# commit
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R8# show interfaces
fe-1/2/0 {
```

```
    unit 84 {
        family inet {
            address 10.0.48.2/24;
        }
    }
}
lo0 {
    unit 80 {
        family inet {
            address 10.0.0.80/32;
        }
    }
}
```

```
user@R8# show protocols
bgp {
    group rr {
        type internal;
        local-address 10.0.0.80;
        neighbor 10.0.0.40 {
            family inet {
                unicast {
                    add-path {
                        receive;
                    }
                }
            }
        }
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.80 {
            passive;
        }
        interface fe-1/2/0.84;
    }
}
```

```
user@R8# show routing-options
autonomous-system 1;
```

Verification

Confirm that the configuration is working properly.

- Verifying That the BGP Peers Have the Ability to Send and Receive Multiple Paths on page 2896
- Verifying That Router R1 Is Advertising Multiple Paths on page 2896
- Verifying That Router R4 Is Receiving and Advertising Multiple Paths on page 2897
- Verifying That Router R8 Is Receiving Multiple Paths on page 2898
- Checking the Path ID on page 2898

Verifying That the BGP Peers Have the Ability to Send and Receive Multiple Paths

Purpose Make sure that one or both of the following strings appear in the output of the **show bgp neighbor** command:

- **NLRI's for which peer can receive multiple paths: inet-unicast**
- **NLRI's for which peer can send multiple paths: inet-unicast**

Action

```
user@R1> show bgp neighbor 10.0.0.40
Peer: 10.0.0.40+179 AS 1       Local: 10.0.0.10+65237 AS 1
  Type: Internal    State: Established    Flags: <Sync>
...  NLRI's for which peer can receive multiple paths: inet-unicast
...

user@R4> show bgp neighbor 10.0.0.10
Peer: 10.0.0.10+65237 AS 1     Local: 10.0.0.40+179 AS 1
  Type: Internal    State: Established    Flags: <Sync>
...
  NLRI's for which peer can send multiple paths: inet-unicast
...

user@R4> show bgp neighbor 10.0.0.80
Peer: 10.0.0.80+55416 AS 1     Local: 10.0.0.40+179 AS 1
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  ,,,
  NLRI's for which peer can receive multiple paths: inet-unicast
  ...

user@R8> show bgp neighbor 10.0.0.40
Peer: 10.0.0.40+179 AS 1       Local: 10.0.0.80+55416 AS 1
  Type: Internal    State: Established    Flags: <Sync>
  ...
  NLRI's for which peer can send multiple paths: inet-unicast
  ...
```

Verifying That Router R1 Is Advertising Multiple Paths

Purpose Make sure that multiple paths to the 198.1.1.1/32 destination and multiple paths to the 199.1.1.1/32 destination are advertised to Router R4.

Action

```
user@R1> show route advertising-protocol bgp 10.0.0.40
inet.0: 21 destinations, 25 routes (21 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 198.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.15.2                    100        2 2 I
* 199.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 200.1.1.0/30            10.0.0.20                    100        2 I
```

Meaning When you see one prefix and more than one next hop, it means that multiple paths are advertised to Router R4.

Verifying That Router R4 Is Receiving and Advertising Multiple Paths

Purpose Make sure that multiple paths to the 199.1.1.1/32 destination are received from Router R1 and advertised to Router R8. Make sure that multiple paths to the 198.1.1.1/32 destination are received from Router R1, but only one path to this destination is advertised to Router R8.

Action

```
user@R4> show route receive-protocol bgp 10.0.0.10
inet.0: 19 destinations, 22 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 198.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.15.2                    100        2 2 I
* 199.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 200.1.1.0/30            10.0.0.20                    100        2 I
```

```
user@R4> show route advertising-protocol bgp 10.0.0.80
inet.0: 19 destinations, 22 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 198.1.1.1/32            10.0.0.20                    100        2 I
* 199.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 200.1.1.0/30            10.0.0.20                    100        2 I
```

Meaning The **show route receive-protocol** command shows that Router R4 receives two paths to the 198.1.1.1/32 destination and three paths to the 199.1.1.1/32 destination. The **show route advertising-protocol** command shows that Router R4 advertises only one path to the 198.1.1.1/32 destination and advertises all three paths to the 199.1.1.1/32 destination.

Because of the prefix policy that is applied to Router R4, Router R4 does not advertise multiple paths to the 198.1.1.1/32 destination. Router R4 advertises only one path to the 198.1.1.1/32 destination even though it receives multiple paths to this destination.

Verifying That Router R8 Is Receiving Multiple Paths

Purpose Make sure that Router R8 receives multiple paths to the 199.1.1.1/32 destination through Router R4. Make sure that Router R8 receives only one path to the 198.1.1.1/32 destination through Router R4.

Action

```
user@R8> show route receive-protocol bgp 10.0.0.40
inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 198.1.1.1/32            10.0.0.20                    100        2 I
* 199.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 200.1.1.0/30            10.0.0.20                    100        2 I
```

Checking the Path ID

Purpose On the downstream devices, Router R4 and Router R8, verify that a path ID uniquely identifies the path. Look for the **Addpath Path ID:** string.

Action `user@R4>` **show route 199.1.1.1/32 detail**

```
inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
199.1.1.1/32 (3 entries, 3 announced)
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 9
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 676
                Next hop: 10.0.14.1 via lt-1/2/0.41, selected
                Protocol next hop: 10.0.0.20
                Indirect next hop: 92041c8 262146
                State: <Active Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 1:44:37    Metric2: 2
                Task: BGP_1.10.0.0.10+65237
                Announcement bits (3): 2-KRT 3-BGP RT Background 4-Resolve tree
1
                AS path: 2 I (Originator) Cluster list:  10.0.0.10
                AS path:  Originator ID: 10.0.0.20
                Accepted
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 1
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 676
                Next hop: 10.0.14.1 via lt-1/2/0.41, selected
                Protocol next hop: 10.0.0.30
                Indirect next hop: 92042ac 262151
                State: <NotBest Int Ext>
                Inactive reason: Not Best in its group - Router ID
                Local AS:     1 Peer AS:     1
                Age: 1:44:37    Metric2: 2
                Task: BGP_1.10.0.0.10+65237
                Announcement bits (1): 3-BGP RT Background
                AS path: 2 I (Originator) Cluster list:  10.0.0.10
                AS path:  Originator ID: 10.0.0.30
                Accepted
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 2
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 676
                Next hop: 10.0.14.1 via lt-1/2/0.41, selected
                Protocol next hop: 10.0.15.2
                Indirect next hop: 92040e4 262150
                State: <Int Ext>
                Inactive reason: AS path
                Local AS:     1 Peer AS:     1
                Age: 1:44:37    Metric2: 2
                Task: BGP_1.10.0.0.10+65237
                Announcement bits (1): 3-BGP RT Background
                AS path: 2 2 I
                Accepted
```

```
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 3
```

user@R8> **show route 199.1.1.1/32 detail**

```
inet.0: 17 destinations, 19 routes (17 active, 0 holddown, 0 hidden)
199.1.1.1/32 (3 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 9
                Source: 10.0.0.40
                Next hop type: Router, Next hop index: 1045
                Next hop: 10.0.48.1 via lt-1/2/0.84, selected
                Protocol next hop: 10.0.0.20
                Indirect next hop: 91fc0e4 262148
                State: <Active Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 1:56:51    Metric2: 3
                Task: BGP_1.10.0.0.40+179
                Announcement bits (2): 2-KRT 4-Resolve tree 1
                AS path: 2 I (Originator) Cluster list:  10.0.0.40 10.0.0.10
                AS path:  Originator ID: 10.0.0.20
                Accepted
                Localpref: 100
                Router ID: 10.0.0.40
                Addpath Path ID: 1
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.40
                Next hop type: Router, Next hop index: 1045
                Next hop: 10.0.48.1 via lt-1/2/0.84, selected
                Protocol next hop: 10.0.0.30
                Indirect next hop: 91fc1c8 262152
                State: <NotBest Int Ext>
                Inactive reason: Not Best in its group - Router ID
                Local AS:     1 Peer AS:     1
                Age: 1:56:51    Metric2: 3
                Task: BGP_1.10.0.0.40+179
                AS path: 2 I (Originator) Cluster list:  10.0.0.40 10.0.0.10
                AS path:  Originator ID: 10.0.0.30
                Accepted
                Localpref: 100
                Router ID: 10.0.0.40
                Addpath Path ID: 2
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.40
                Next hop type: Router, Next hop index: 1045
                Next hop: 10.0.48.1 via lt-1/2/0.84, selected
                Protocol next hop: 10.0.15.2
                Indirect next hop: 91fc2ac 262153
                State: <Int Ext>
                Inactive reason: AS path
                Local AS:     1 Peer AS:     1
                Age: 1:56:51    Metric2: 3
                Task: BGP_1.10.0.0.40+179
                AS path: 2 2 I (Originator) Cluster list:  10.0.0.40
                AS path:  Originator ID: 10.0.0.10
```



```
Accepted
Localpref: 100
Router ID: 10.0.0.40
Addpath Path ID: 3
```

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

Example: Advertising Multiple Paths in BGP

In this example, BGP routers are configured to advertise multiple paths instead of advertising only the active path. Advertising multiple paths in BGP is specified in Internet draft draft-ietf-idr-add-paths-04, *Advertisement of Multiple Paths in BGP*.

Requirements

This example uses the following hardware and software components:

- Eight BGP-enabled devices.
- Five of the BGP-enabled devices do not necessarily need to be routers. For example, they can be EX Series Ethernet Switches.
- Three of the BGP-enabled devices are configured to send multiple paths or receive multiple paths (or both send and receive multiple paths). These three BGP-enabled devices must be M Series Multiservice Edge Routers, MX Series 3D Universal Edge Routers, or T Series Core Routers.
- The three routers must be running Junos OS Release 11.4 or later.

Overview

The following statements are used for configuring multiple paths to a destination:

```
[edit protocols bgp group group-name family family]
add-path {
  receive;
  send {
    path-count number;
    prefix-policy [ policy-names ];
  }
}
```

In this example, Router R5, Router R6, and Router R7 redistribute static routes into BGP. Router R1 and Router R4 are route reflectors. Router R2 and Router R3 are clients to Route Reflector R1. Router R8 is a client to Route Reflector R4.

Route reflection is optional when multiple-path advertisement is enabled in BGP.

With the **add-path send path-count 6** configuration, Router R1 is configured to send up to six paths (per destination) to Router R4.

With the **add-path receive** configuration, Router R4 is configured to receive multiple paths from Router R1.

With the **add-path send path-count 6** configuration, Router R4 is configured to send up to six paths to Router R8.

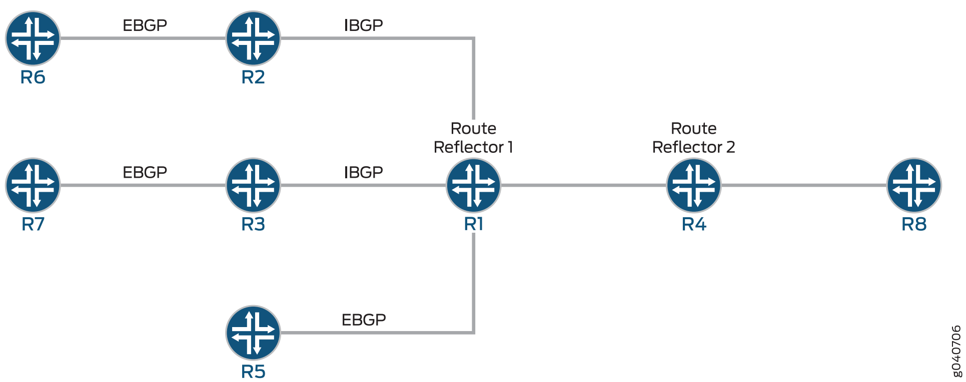
With the **add-path receive** configuration, Router R8 is configured to receive multiple paths from Router R4.

The **add-path send prefix-policy allow_199** policy configuration (along with the corresponding route filter) limits Router R4 to sending multiple paths for only the 199.1.1.1/32 route.

Topology Diagram

Figure 60 on page 2877 shows the topology used in this example.

Figure 61: Advertisement of Multiple Paths in BGP



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Router R1
```
set interfaces fe-0/0/0 unit 12 family inet address 10.0.12.1/24
set interfaces fe-0/0/1 unit 13 family inet address 10.0.13.1/24
set interfaces fe-1/0/0 unit 14 family inet address 10.0.14.1/24
set interfaces fe-1/2/0 unit 15 family inet address 10.0.15.1/24
set interfaces lo0 unit 10 family inet address 10.0.0.10/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.10
set protocols bgp group rr cluster 10.0.0.10
set protocols bgp group rr neighbor 10.0.0.20
set protocols bgp group rr neighbor 10.0.0.30
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.15.2 local-address 10.0.15.1
set protocols bgp group e1 neighbor 10.0.15.2 peer-as 2
set protocols bgp group rr_rr type internal
set protocols bgp group rr_rr local-address 10.0.0.10
set protocols bgp group rr_rr neighbor 10.0.0.40 family inet unicast add-path send
  path-count 6
set protocols ospf area 0.0.0.0 interface lo0.10 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.12
set protocols ospf area 0.0.0.0 interface fe-0/0/1.13
set protocols ospf area 0.0.0.0 interface fe-1/0/0.14
set protocols ospf area 0.0.0.0 interface fe-1/2/0.15
set routing-options router-id 10.0.0.10
set routing-options autonomous-system 1
```

Router R2
```
set interfaces fe-1/2/0 unit 21 family inet address 10.0.12.2/24
set interfaces fe-1/2/1 unit 26 family inet address 10.0.26.1/24
set interfaces lo0 unit 20 family inet address 10.0.0.20/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.20
set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.26.2 peer-as 2
set protocols ospf area 0.0.0.0 interface lo0.20 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.21
set protocols ospf area 0.0.0.0 interface fe-1/2/1.28
set policy-options policy-statement set_nh_self then next-hop self
set routing-options autonomous-system 1
```

Router R3
```
set interfaces fe-1/0/1 unit 31 family inet address 10.0.13.2/24
set interfaces fe-1/0/2 unit 37 family inet address 10.0.37.1/24
set interfaces lo0 unit 30 family inet address 10.0.0.30/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.30
set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.37.2 peer-as 2
set protocols ospf area 0.0.0.0 interface lo0.30 passive
set protocols ospf area 0.0.0.0 interface fe-1/0/1.31
set protocols ospf area 0.0.0.0 interface fe-1/0/2.37
set policy-options policy-statement set_nh_self then next-hop self
set routing-options autonomous-system 1
```

Router R4
```
set interfaces fe-1/2/0 unit 41 family inet address 10.0.14.2/24
set interfaces fe-1/2/1 unit 48 family inet address 10.0.48.1/24
```

```
set interfaces lo0 unit 40 family inet address 10.0.0.40/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.40
set protocols bgp group rr family inet unicast add-path receive
set protocols bgp group rr neighbor 10.0.0.10
set protocols bgp group rr_client type internal
set protocols bgp group rr_client local-address 10.0.0.40
set protocols bgp group rr_client cluster 10.0.0.40
set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  path-count 6
set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  prefix-policy allow_199
set protocols ospf area 0.0.0.0 interface fe-1/2/0.41
set protocols ospf area 0.0.0.0 interface lo0.40 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/1.48
set routing-options autonomous-system 1
set policy-options policy-statement allow_199 from route-filter 199.1.1.1/32 exact
set policy-options policy-statement allow_199 then accept
```

Router R5

```
set interfaces fe-1/2/0 unit 51 family inet address 10.0.15.2/24
set interfaces lo0 unit 50 family inet address 10.0.0.50/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.15.1 export s2b
set protocols bgp group e1 neighbor 10.0.15.1 peer-as 1
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then as-path-expand 2
set policy-options policy-statement s2b then accept
set routing-options autonomous-system 2
set routing-options static route 199.1.1.1/32 reject
set routing-options static route 198.1.1.1/32 reject
```

Router R6

```
set interfaces fe-1/2/0 unit 62 family inet address 10.0.26.2/24
set interfaces lo0 unit 60 family inet address 10.0.0.60/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.26.1 export s2b
set protocols bgp group e1 neighbor 10.0.26.1 peer-as 1
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then accept
set routing-options autonomous-system 2
set routing-options static route 199.1.1.1/32 reject
set routing-options static route 198.1.1.1/32 reject
```

Router R7

```
set interfaces fe-1/2/0 unit 73 family inet address 10.0.37.2/24
set interfaces lo0 unit 70 family inet address 10.0.0.70/32
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then accept
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.37.1 export s2b
set protocols bgp group e1 neighbor 10.0.37.1 peer-as 1
set routing-options autonomous-system 2
set routing-options static route 199.1.1.1/32 reject
```

Router R8

```
set interfaces fe-1/2/0 unit 84 family inet address 10.0.48.2/24
set interfaces lo0 unit 80 family inet address 10.0.0.80/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.80
set protocols bgp group rr neighbor 10.0.0.40 family inet unicast add-path receive
set protocols ospf area 0.0.0.0 interface lo0.80 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.84
set routing-options autonomous-system 1
```

Configuring Router R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router R1:

1. Configure the interfaces to Router R2, Router R3, Router R4, and Router R5, and configure the loopback (lo0) interface.

   ```
   [edit interfaces]
   user@R1# set fe-0/0/0 unit 12 family inet address 10.0.12.1/24

   user@R1# set fe-0/0/1 unit 13 family inet address 10.0.13.1/24

   user@R1# set fe-1/0/0 unit 14 family inet address 10.0.14.1/24

   user@R1# set fe-1/2/0 unit 15 family inet address 10.0.15.1/24

   user@R1#set lo0 unit 10 family inet address 10.0.0.10/32
   ```

2. Configure BGP on the interfaces, and configure IBGP route reflection.

   ```
   [edit protocols bgp]
   user@R1# set group rr type internal
   user@R1# set group rr local-address 10.0.0.10
   user@R1# set group rr cluster 10.0.0.10
   user@R1# set group rr neighbor 10.0.0.20
   user@R1# set group rr neighbor 10.0.0.30

   user@R1# set group rr_rr type internal
   user@R1# set group rr_rr local-address 10.0.0.10

   user@R1# set group e1 type external
   user@R1# set group e1 neighbor 10.0.15.2 local-address 10.0.15.1
   user@R1# set group e1 neighbor 10.0.15.2 peer-as 2
   ```

3. Configure Router R1 to send up to six paths to its neighbor, Router R4.

   The destination of the paths can be any destination that Router R1 can reach through multiple paths.

   ```
   [edit protocols bgp]
   user@R1# set group rr_rr neighbor 10.0.0.40 family inet unicast add-path send
     path-count 6
   ```

4. Configure OSPF on the interfaces.

```
[edit protocols ospf]
user@R1# set area 0.0.0.0 interface lo0.10 passive
user@R1# set area 0.0.0.0 interface fe-0/0/0.12
user@R1# set area 0.0.0.0 interface fe-0/0/1.13
user@R1# set area 0.0.0.0 interface fe-1/0/0.14
user@R1# set area 0.0.0.0 interface fe-1/2/0.15
```

5. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@R1# set router-id 10.0.0.10
user@R1# set autonomous-system 1
```

6. If you are done configuring the device, commit the configuration.

```
user@R1# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-0/0/0 {
   unit 12 {
      family inet {
         address 10.0.12.1/24;
      }
   }
}
fe-0/0/1 {
   unit 13 {
      family inet {
         address 10.0.13.1/24;
      }
   }
}
fe-1/0/0 {
   unit 14 {
      family inet {
         address 10.0.14.1/24;
      }
   }
}
fe-1/2/0 {
   unit 15 {
      family inet {
         address 10.0.15.1/24;
      }
   }
}
lo0 {
   unit 10 {
      family inet {
```



```
            address 10.0.0.10/32;
        }
    }
}

user@R1# show protocols
bgp {
    group rr {
        type internal;
        local-address 10.0.0.10;
        cluster 10.0.0.10;
        neighbor 10.0.0.20;
        neighbor 10.0.0.30;
    }
    group e1 {
        type external;
        neighbor 10.0.15.2 {
            local-address 10.0.15.1;
            peer-as 2;
        }
    }
    group rr_rr {
        type internal;
        local-address 10.0.0.10;
        neighbor 10.0.0.40 {
            family inet {
                unicast {
                    add-path {
                        send {
                            path-count 6;
                        }
                    }
                }
            }
        }
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.10 {
            passive;
        }
        interface fe-0/0/0.12;
        interface fe-0/0/1.13;
        interface fe-1/0/0.14;
        interface fe-1/2/0.15;
    }
}

user@R1# show routing-options
router-id 10.0.0.10;
autonomous-system 1;
```

Configuring Router R2

Step-by-Step Procedure

To configure Router R2:

1. Configure the loopback (lo0) interface and the interfaces to Router R6 and Router R1.

```
[edit interfaces]
user@R2# set fe-1/2/0 unit 21 family inet address 10.0.12.2/24

user@R2# set fe-1/2/1 unit 26 family inet address 10.0.26.1/24

user@R2# set lo0 unit 20 family inet address 10.0.0.20/32
```

2. Configure BGP and OSPF on Router R2's interfaces.

```
[edit protocols]
user@R2# set bgp group rr type internal
user@R2# set bgp group rr local-address 10.0.0.20

user@R2# set bgp group e1 type external
user@R2# set bgp group e1 neighbor 10.0.26.2 peer-as 2

user@R2# set ospf area 0.0.0.0 interface lo0.20 passive
user@R2# set ospf area 0.0.0.0 interface fe-1/2/0.21
user@R2# set ospf area 0.0.0.0 interface fe-1/2/1.28
```

3. For routes sent from Router R2 to Router R1, advertise Router R2 as the next hop, because Router R1 does not have a route to Router R6's address on the 10.0.26.0/24 network.

```
[edit]
user@R2# set policy-options policy-statement set_nh_self then next-hop self

user@R2# set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
```

4. Configure the autonomous system number.

```
[edit]
user@R2# set routing-options autonomous-system 1
```

5. If you are done configuring the device, commit the configuration.

```
user@R2# commit
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**,and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
    unit 21 {
        family inet {
            address 10.0.12.2/24;
```



```
        }
    }
}
fe-1/2/1 {
    unit 26 {
        family inet {
            address 10.0.26.1/24;
        }
    }
}
lo0 {
    unit 20 {
        family inet {
            address 10.0.0.20/32;
        }
    }
}
```

```
user@R2# show protocols
bgp {
    group rr {
        type internal;
        local-address 10.0.0.20;
        neighbor 10.0.0.10 {
            export set_nh_self;
        }
    }
    group e1 {
        type external;
        neighbor 10.0.26.2 {
            peer-as 2;
        }
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.20 {
            passive;
        }
        interface fe-1/2/0.21;
        interface fe-1/2/1.28;
    }
}
```

```
user@R2# show policy-options
policy-statement set_nh_self {
    then {
        next-hop self;
    }
}
```

```
user@R2# show routing-options
autonomous-system 1;
```

Configuring Router R3

Step-by-Step Procedure

To configure Router R3:

1. Configure the loopback (lo0) interface and the interfaces to Router R7 and Router R1.

```
[edit interfaces]
user@R3# set fe-1/0/1 unit 31 family inet address 10.0.13.2/24

user@R3# set fe-1/0/2 unit 37 family inet address 10.0.37.1/24

user@R3# set lo0 unit 30 family inet address 10.0.0.30/32
```

2. Configure BGP and OSPF on Router R3's interfaces.

```
[edit protocols]
user@R3# set bgp group rr type internal
user@R3# set bgp group rr local-address 10.0.0.30

user@R3# set bgp group e1 type external
user@R3# set bgp group e1 neighbor 10.0.37.2 peer-as 2

user@R3# set ospf area 0.0.0.0 interface lo0.30 passive
user@R3# set ospf area 0.0.0.0 interface fe-1/0/1.31
user@R3# set ospf area 0.0.0.0 interface fe-1/0/2.37
```

3. For routes sent from Router R3 to Router R1, advertise Router R3 as the next hop, because Router R1 does not have a route to Router R7's address on the 10.0.37.0/24 network.

```
[edit]
user@R3# set policy-options policy-statement set_nh_self then next-hop self

user@R3# set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
```

4. Configure the autonomous system number.

```
[edit]
user@R3# set routing-options autonomous-system 1
```

5. If you are done configuring the device, commit the configuration.

```
user@R3# commit
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show interfaces
fe-1/0/1 {
  unit 31 {
    family inet {
      address 10.0.13.2/24;
```



```
    }
  }
}
fe-1/0/2 {
  unit 37 {
    family inet {
      address 10.0.37.1/24;
    }
  }
}
lo0 {
  unit 30 {
    family inet {
      address 10.0.0.30/32;
    }
  }
}
```

```
user@R3# show protocols
bgp {
  group rr {
    type internal;
    local-address 10.0.0.30;
    neighbor 10.0.0.10 {
      export set_nh_self;
    }
  }
  group e1 {
    type external;
    neighbor 10.0.37.2 {
      peer-as 2;
    }
  }
}
ospf {
  area 0.0.0.0 {
    interface lo0.30 {
      passive;
    }
    interface fe-1/0/1.31;
    interface fe-1/0/2.37;
  }
}
user@R3# show policy-options
policy-statement set_nh_self {
  then {
    next-hop self;
  }
}
```

```
user@R3# show routing-options
autonomous-system 1;
```

Configuring Router R4

Step-by-Step Procedure

To configure Router R4:

1. Configure the interfaces to Router R1 and Router R8, and configure the loopback (lo0) interface.

```
[edit interfaces]
user@R4# set fe-1/2/0 unit 41 family inet address 10.0.14.2/24

user@R4# set fe-1/2/1 unit 48 family inet address 10.0.48.1/24

user@R4# set lo0 unit 40 family inet address 10.0.0.40/32
```

2. Configure BGP on the interfaces, and configure IBGP route reflection.

```
[edit protocols bgp]
user@R4# set group rr type internal
user@R4# set group rr local-address 10.0.0.40
user@R4# set group rr neighbor 10.0.0.10

user@R4# set group rr_client type internal
user@R4# set group rr_client local-address 10.0.0.40
user@R4# set group rr_client cluster 10.0.0.40
```

3. Configure Router R4 to send up to six paths to its neighbor, Router R8.

   The destination of the paths can be any destination that Router R4 can reach through multiple paths.

```
[edit protocols bgp]
user@R4# set group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  path-count 6
```

4. Configure Router R4 to receive multiple paths from its neighbor, Router R1.

   The destination of the paths can be any destination that Router R1 can reach through multiple paths.

```
[edit protocols bgp group rr family inet unicast]
user@R4# set add-path receive
```

5. Configure OSPF on the interfaces.

```
[edit protocols ospf area 0.0.0.0]
user@R4# set interface fe-1/2/0.41
user@R4# set interface lo0.40 passive
user@R4# set interface fe-1/2/1.48
```

6. Configure a policy that allows Router R4 to send Router R8 multiple paths to the 199.1.1.1/32 route.

   Router R4 receives multiple paths for the 198.1.1.1/32 route and the 199.1.1.1/32 route. However, because of this policy, Router R4 only sends multiple paths for the 199.1.1.1/32 route.

```
[edit protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast]
user@R4# set add-path send prefix-policy allow_199
```



```
[edit policy-options policy-statement allow_199]
user@R4# set from route-filter 199.1.1.1/32 exact
user@R4# set then accept
```

7. Configure the autonomous system number.

```
[edit routing-options]
user@R4# set autonomous-system 1
```

8. If you are done configuring the device, commit the configuration.

```
user@R4# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R4# show interfaces
fe-1/2/0 {
  unit 41 {
    family inet {
      address 10.0.14.2/24;
    }
  }
}
fe-1/2/1 {
  unit 48 {
    family inet {
      address 10.0.48.1/24;
    }
  }
}
lo0 {
  unit 40 {
    family inet {
      address 10.0.0.40/32;
    }
  }
}
```

```
user@R4# show protocols
bgp {
  group rr {
    type internal;
    local-address 10.0.0.40;
    family inet {
      unicast {
        add-path {
          receive;
        }
      }
    }
    neighbor 10.0.0.10;
  }
  group rr_client {
```

```
        type internal;
        local-address 10.0.0.40;
        cluster 10.0.0.40;
        neighbor 10.0.0.80 {
            family inet {
                unicast {
                    add-path {
                        send {
                            path-count 6;
                            prefix-policy allow_199;
                        }
                    }
                }
            }
        }
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.40 {
            passive;
        }
        interface fe-1/2/0.41;
        interface fe-1/2/1.48;
    }
}
```

```
user@R4# show policy-options
policy-statement allow_199 {
    from {
        route-filter 199.1.1.1/32 exact;
    }
    then accept;
}
```

```
user@R4# show routing-options
autonomous-system 1;
```

Configuring Router R5

Step-by-Step Procedure

To configure Router R5:

1. Configure the loopback (lo0) interface and the interface to Router R1.

```
[edit interfaces]
user@R5# set fe-1/2/0 unit 51 family inet address 10.0.15.2/24

user@R5# set lo0 unit 50 family inet address 10.0.0.50/32
```

2. Configure BGP on Router R5's interface.

```
[edit protocols bgp group e1]
user@R5# set type external
user@R5# set neighbor 10.0.15.1 peer-as 1
```

3. Create static routes for redistribution into BGP.

```
[edit routing-options]
```



```
user@R5# set static route 199.1.1.1/32 reject
user@R5# set static route 198.1.1.1/32 reject
```

4. Redistribute static and direct routes into BGP.

```
[edit protocols bgp group e1 neighbor 10.0.15.1]
user@R5# set export s2b

[edit policy-options policy-statement s2b]
user@R5# set from protocol static
user@R5# set from protocol direct
user@R5# set then as-path-expand 2
user@R5# set then accept
```

5. Configure the autonomous system number.

```
[edit routing-options]
user@R5# set autonomous-system 2
```

6. If you are done configuring the device, commit the configuration.

```
user@R5# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R5# show interfaces
fe-1/2/0 {
   unit 51 {
      family inet {
         address 10.0.15.2/24;
      }
   }
}
lo0 {
   unit 50 {
      family inet {
         address 10.0.0.50/32;
      }
   }
}
```

```
user@R5# show protocols
bgp {
   group e1 {
      type external;
      neighbor 10.0.15.1 {
         export s2b;
         peer-as 1;
      }
   }
}
```

```
user@R5# show policy-options
policy-statement s2b {
```

```
    from protocol [ static direct ];
    then {
        as-path-expand 2;
        accept;
    }
}
```

```
user@R5# show routing-options
static {
    route 198.1.1.1/32 reject;
    route 199.1.1.1/32 reject;
}
autonomous-system 2;
```

Configuring Router R6

Step-by-Step Procedure

To configure Router R6:

1. Configure the loopback (lo0) interface and the interface to Router R2.

   ```
   [edit interfaces]
   user@R6# set fe-1/2/0 unit 62 family inet address 10.0.26.2/24
   ```

   ```
   user@R6# set lo0 unit 60 family inet address 10.0.0.60/32
   ```

2. Configure BGP on Router R6's interface.

   ```
   [edit protocols]
   user@R6# set bgp group e1 type external
   user@R6# set bgp group e1 neighbor 10.0.26.1 peer-as 1
   ```

3. Create static routes for redistribution into BGP.

   ```
   [edit]
   user@R6# set routing-options static route 199.1.1.1/32 reject
   user@R6# set routing-options static route 198.1.1.1/32 reject
   ```

4. Redistribute static and direct routes from Router R6's routing table into BGP.

   ```
   [edit protocols bgp group e1 neighbor 10.0.26.1]
   user@R6# set export s2b
   ```

   ```
   [edit policy-options policy-statement s2b]
   user@R6# set from protocol static
   user@R6# set from protocol direct
   user@R6# set then accept
   ```

5. Configure the autonomous system number.

   ```
   [edit routing-options]
   user@R6# set autonomous-system 2
   ```

6. If you are done configuring the device, commit the configuration.

   ```
   user@R6# commit
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output

does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R6# show interfaces
fe-1/2/0 {
   unit 62 {
      family inet {
         address 10.0.26.2/24;
      }
   }
}
lo0 {
   unit 60 {
      family inet {
         address 10.0.0.60/32;
      }
   }
}
```

```
user@R6# show protocols
bgp {
   group e1 {
      type external;
      neighbor 10.0.26.1 {
         export s2b;
         peer-as 1;
      }
   }
}
```

```
user@R6# show policy-options
policy-statement s2b {
   from protocol [ static direct ];
   then accept;
}
```

```
user@R6# show routing-options
static {
   route 198.1.1.1/32 reject;
   route 199.1.1.1/32 reject;
}
autonomous-system 2;
```

Configuring Router R7

Step-by-Step Procedure

To configure Router R7:

1. Configure the loopback (lo0) interface and the interface to Router R3.

   ```
   [edit interfaces]
   user@R7# set fe-1/2/0 unit 73 family inet address 10.0.37.2/24

   user@R7# set lo0 unit 70 family inet address 10.0.0.70/32
   ```

2. Configure BGP on Router R7's interface.

   ```
   [edit protocols bgp group e1]
   user@R7# set type external
   ```

```
user@R7# set neighbor 10.0.37.1 peer-as 1
```

3. Create a static route for redistribution into BGP.

```
[edit]
user@R7# set routing-options static route 199.1.1.1/32 reject
```

4. Redistribute static and direct routes from Router R7's routing table into BGP.

```
[edit protocols bgp group e1 neighbor 10.0.37.1]
user@R7# set export s2b

[edit policy-options policy-statement s2b]
user@R7# set from protocol static
user@R7# set from protocol direct
user@R7# set then accept
```

5. Configure the autonomous system number.

```
[edit routing-options]
user@R7# set autonomous-system 2
```

6. If you are done configuring the device, commit the configuration.

```
user@R7# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R7# show interfaces
fe-1/2/0 {
   unit 73 {
      family inet {
         address 10.0.37.2/24;
      }
   }
}
lo0 {
   unit 70 {
      family inet {
         address 10.0.0.70/32;
      }
   }
}
```

```
user@R7# show protocols
bgp {
   group e1 {
      type external;
      neighbor 10.0.37.1 {
         export s2b;
         peer-as 1;
      }
   }
}
```



```
user@R7# show policy-options
policy-statement s2b {
    from protocol [ static direct ];
    then accept;
}
```

```
user@R7# show routing-options
static {
    route 199.1.1.1/32 reject;
}
autonomous-system 2;
```

Configuring Router R8

Step-by-Step Procedure

To configure Router R8:

1. Configure the loopback (lo0) interface and the interface to Router R4.

   ```
   [edit interfaces]
   user@R8# set fe-1/2/0 unit 84 family inet address 10.0.48.2/24

   user@R8# set lo0 unit 80 family inet address 10.0.0.80/32
   ```

2. Configure BGP and OSPF on Router R8's interface.

   ```
   [edit protocols]
   user@R8# set bgp group rr type internal
   user@R8# set bgp group rr local-address 10.0.0.80

   user@R8# set ospf area 0.0.0.0 interface lo0.80 passive
   user@R8# set ospf area 0.0.0.0 interface fe-1/2/0.84
   ```

3. Configure Router R8 to receive multiple paths from its neighbor, Router R4.

   The destination of the paths can be any destination that Router R4 can reach through multiple paths.

   ```
   [edit protocols]
   user@R8# set bgp group rr neighbor 10.0.0.40 family inet unicast add-path receive
   ```

4. Configure the autonomous system number.

   ```
   [edit]
   user@R8# set routing-options autonomous-system 1
   ```

5. If you are done configuring the device, commit the configuration.

   ```
   user@R8# commit
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R8# show interfaces
fe-1/2/0 {
```

```
    unit 84 {
        family inet {
            address 10.0.48.2/24;
        }
    }
}
lo0 {
    unit 80 {
        family inet {
            address 10.0.0.80/32;
        }
    }
}
```

```
user@R8# show protocols
bgp {
    group rr {
        type internal;
        local-address 10.0.0.80;
        neighbor 10.0.0.40 {
            family inet {
                unicast {
                    add-path {
                        receive;
                    }
                }
            }
        }
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.80 {
            passive;
        }
        interface fe-1/2/0.84;
    }
}
```

```
user@R8# show routing-options
autonomous-system 1;
```

Verification

Confirm that the configuration is working properly.

- Verifying That the BGP Peers Have the Ability to Send and Receive Multiple Paths on page 2921
- Verifying That Router R1 Is Advertising Multiple Paths on page 2921
- Verifying That Router R4 Is Receiving and Advertising Multiple Paths on page 2922
- Verifying That Router R8 Is Receiving Multiple Paths on page 2923
- Checking the Path ID on page 2923

Verifying That the BGP Peers Have the Ability to Send and Receive Multiple Paths

Purpose Make sure that one or both of the following strings appear in the output of the **show bgp neighbor** command:

- **NLRI's for which peer can receive multiple paths: inet-unicast**
- **NLRI's for which peer can send multiple paths: inet-unicast**

Action

```
user@R1>  show bgp neighbor 10.0.0.40
Peer: 10.0.0.40+179 AS 1       Local: 10.0.0.10+65237 AS 1
  Type: Internal    State: Established    Flags: <Sync>
...  NLRI's for which peer can receive multiple paths: inet-unicast
...

user@R4>  show bgp neighbor 10.0.0.10
Peer: 10.0.0.10+65237 AS 1     Local: 10.0.0.40+179 AS 1
  Type: Internal    State: Established    Flags: <Sync>
...
  NLRI's for which peer can send multiple paths: inet-unicast
...

user@R4>  show bgp neighbor 10.0.0.80
Peer: 10.0.0.80+55416 AS 1     Local: 10.0.0.40+179 AS 1
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  ,,,
  NLRI's for which peer can receive multiple paths: inet-unicast
  ...

user@R8>  show bgp neighbor 10.0.0.40
Peer: 10.0.0.40+179 AS 1       Local: 10.0.0.80+55416 AS 1
  Type: Internal    State: Established    Flags: <Sync>
  ...
  NLRI's for which peer can send multiple paths: inet-unicast
  ...
```

Verifying That Router R1 Is Advertising Multiple Paths

Purpose Make sure that multiple paths to the 198.1.1.1/32 destination and multiple paths to the 199.1.1.1/32 destination are advertised to Router R4.

Action

```
user@R1> show route advertising-protocol bgp 10.0.0.40
inet.0: 21 destinations, 25 routes (21 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 198.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.15.2                    100        2 2 I
* 199.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 200.1.1.0/30            10.0.0.20                    100        2 I
```

Meaning When you see one prefix and more than one next hop, it means that multiple paths are advertised to Router R4.

Verifying That Router R4 Is Receiving and Advertising Multiple Paths

Purpose Make sure that multiple paths to the 199.1.1.1/32 destination are received from Router R1 and advertised to Router R8. Make sure that multiple paths to the 198.1.1.1/32 destination are received from Router R1, but only one path to this destination is advertised to Router R8.

Action

```
user@R4> show route receive-protocol bgp 10.0.0.10
inet.0: 19 destinations, 22 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 198.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.15.2                    100        2 2 I
* 199.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 200.1.1.0/30            10.0.0.20                    100        2 I
```

```
user@R4> show route advertising-protocol bgp 10.0.0.80
inet.0: 19 destinations, 22 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 198.1.1.1/32            10.0.0.20                    100        2 I
* 199.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 200.1.1.0/30            10.0.0.20                    100        2 I
```

Meaning The **show route receive-protocol** command shows that Router R4 receives two paths to the 198.1.1.1/32 destination and three paths to the 199.1.1.1/32 destination. The **show route advertising-protocol** command shows that Router R4 advertises only one path to the 198.1.1.1/32 destination and advertises all three paths to the 199.1.1.1/32 destination.

Because of the prefix policy that is applied to Router R4, Router R4 does not advertise multiple paths to the 198.1.1.1/32 destination. Router R4 advertises only one path to the 198.1.1.1/32 destination even though it receives multiple paths to this destination.

Verifying That Router R8 Is Receiving Multiple Paths

Purpose Make sure that Router R8 receives multiple paths to the 199.1.1.1/32 destination through Router R4. Make sure that Router R8 receives only one path to the 198.1.1.1/32 destination through Router R4.

Action

```
user@R8> show route receive-protocol bgp 10.0.0.40
inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 198.1.1.1/32            10.0.0.20                    100        2 I
* 199.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 200.1.1.0/30            10.0.0.20                    100        2 I
```

Checking the Path ID

Purpose On the downstream devices, Router R4 and Router R8, verify that a path ID uniquely identifies the path. Look for the **Addpath Path ID:** string.

Action `user@R4>` **show route 199.1.1.1/32 detail**

```
inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
199.1.1.1/32 (3 entries, 3 announced)
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 9
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 676
                Next hop: 10.0.14.1 via lt-1/2/0.41, selected
                Protocol next hop: 10.0.0.20
                Indirect next hop: 92041c8 262146
                State: <Active Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 1:44:37    Metric2: 2
                Task: BGP_1.10.0.0.10+65237
                Announcement bits (3): 2-KRT 3-BGP RT Background 4-Resolve tree
1
                AS path: 2 I (Originator) Cluster list:  10.0.0.10
                AS path:  Originator ID: 10.0.0.20
                Accepted
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 1
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 676
                Next hop: 10.0.14.1 via lt-1/2/0.41, selected
                Protocol next hop: 10.0.0.30
                Indirect next hop: 92042ac 262151
                State: <NotBest Int Ext>
                Inactive reason: Not Best in its group - Router ID
                Local AS:     1 Peer AS:     1
                Age: 1:44:37    Metric2: 2
                Task: BGP_1.10.0.0.10+65237
                Announcement bits (1): 3-BGP RT Background
                AS path: 2 I (Originator) Cluster list:  10.0.0.10
                AS path:  Originator ID: 10.0.0.30
                Accepted
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 2
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 676
                Next hop: 10.0.14.1 via lt-1/2/0.41, selected
                Protocol next hop: 10.0.15.2
                Indirect next hop: 92040e4 262150
                State: <Int Ext>
                Inactive reason: AS path
                Local AS:     1 Peer AS:     1
                Age: 1:44:37    Metric2: 2
                Task: BGP_1.10.0.0.10+65237
                Announcement bits (1): 3-BGP RT Background
                AS path: 2 2 I
                Accepted
```



```
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 3
```

user@R8> **show route 199.1.1.1/32 detail**

```
inet.0: 17 destinations, 19 routes (17 active, 0 holddown, 0 hidden)
199.1.1.1/32 (3 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 9
                Source: 10.0.0.40
                Next hop type: Router, Next hop index: 1045
                Next hop: 10.0.48.1 via lt-1/2/0.84, selected
                Protocol next hop: 10.0.0.20
                Indirect next hop: 91fc0e4 262148
                State: <Active Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 1:56:51    Metric2: 3
                Task: BGP_1.10.0.0.40+179
                Announcement bits (2): 2-KRT 4-Resolve tree 1
                AS path: 2 I (Originator) Cluster list:  10.0.0.40 10.0.0.10
                AS path:  Originator ID: 10.0.0.20
                Accepted
                Localpref: 100
                Router ID: 10.0.0.40
                Addpath Path ID: 1
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.40
                Next hop type: Router, Next hop index: 1045
                Next hop: 10.0.48.1 via lt-1/2/0.84, selected
                Protocol next hop: 10.0.0.30
                Indirect next hop: 91fc1c8 262152
                State: <NotBest Int Ext>
                Inactive reason: Not Best in its group - Router ID
                Local AS:     1 Peer AS:     1
                Age: 1:56:51    Metric2: 3
                Task: BGP_1.10.0.0.40+179
                AS path: 2 I (Originator) Cluster list:  10.0.0.40 10.0.0.10
                AS path:  Originator ID: 10.0.0.30
                Accepted
                Localpref: 100
                Router ID: 10.0.0.40
                Addpath Path ID: 2
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.40
                Next hop type: Router, Next hop index: 1045
                Next hop: 10.0.48.1 via lt-1/2/0.84, selected
                Protocol next hop: 10.0.15.2
                Indirect next hop: 91fc2ac 262153
                State: <Int Ext>
                Inactive reason: AS path
                Local AS:     1 Peer AS:     1
                Age: 1:56:51    Metric2: 3
                Task: BGP_1.10.0.0.40+179
                AS path: 2 2 I (Originator) Cluster list:  10.0.0.40
                AS path:  Originator ID: 10.0.0.10
```



```
Accepted
Localpref: 100
Router ID: 10.0.0.40
Addpath Path ID: 3
```

Related Documentation

- Understanding the Advertisement of Multiple Paths to a Single Destination in BGP on page 2636
- *Understanding Adding AS Numbers to BGP AS Paths*

Configuring ECMP Next Hops for RSVP and LDP LSPs for Load Balancing

The Junos OS supports configurations of 16, 32, or 64 equal-cost multipath (ECMP) next hops for RSVP and LDP LSPs on M10i routers with an Enhanced CFEB, M320, M120, MX Series, and T Series routers, and routing devices. For networks with high-volume traffic, this provides more flexibility to load-balance the traffic over as many as 64 LSPs.

To configure the maximum limit for ECMP next hops, include the **maximum-ecmp** ***next-hops*** statement at the **[edit chassis]** hierarchy level:

```
[edit chassis]
maximum-ecmp next-hops;
```

You can configure a maximum ECMP next-hop limit of 16, 32, or 64 using this statement. The default limit is 16.

NOTE: MX Series routers with one or more Modular Port Concentrator (MPC) cards and with Junos OS 11.4 or earlier installed, support the configuration of the **maximum-ecmp** statement with only 16 next hops. You should *not* configure the **maximum-ecmp** statement with 32 or 64 next hops. When you commit the configuration with 32 or 64 next hops, the following warning message appears:

Error: Number of members in Unilist NH exceeds the maximum supported 16 on Trio.

The following types of routes support the ECMP maximum next-hop configuration for as many as 64 ECMP gateways:

- Static IPv4 and IPv6 routes with direct and indirect next-hop ECMPs
- LDP ingress and transit routes learned through associated IGP routes
- RSVP ECMP next hops created for LSPs
- OSPF IPv4 and IPv6 route ECMPs
- ISIS IPv4 and IPv6 route ECMPs
- EBGP IPv4 and IPv6 route ECMPs
- IBGP (resolving over IGP routes) IPv4 and IPv6 route ECMPs

The enhanced ECMP limit of up to 64 ECMP next hops is also applicable for Layer 3 VPNs, Layer 2 VPNs, Layer 2 circuits, and VPLS services that resolve over an MPLS route, because the available ECMP paths in the MPLS route can also be used by such traffic.

NOTE:
The following FPCs on M320, T640, and T1600 routers only support 16 ECMP next hops:

- (M320, T640, and T1600 routers only) Enhanced II FPC1
- (M320, T640, and T1600 routers only) Enhanced II FPC2
- (M320 and T640 routers only) Enhanced II FPC3
- (T640 and T1600 routers only) FPC2
- (T640 and T1600 routers only) FPC3

If a maximum ECMP next-hop limit of 32 or 64 is configured on an M320, T640, or T1600 router with any of these FPCs installed, the Packet Forwarding Engines on these FPCs use only the first 16 ECMP next hops. For Packet Forwarding Engines on FPCs that support only 16 ECMP next hops, the Junos OS generates a system log message if a maximum ECMP next-hop limit of 32 or 64 is configured. However, for Packet Forwarding Engines on other FPCs installed on the router, a maximum configured ECMP limit of 32 or 64 ECMP next hops is applicable.

NOTE: If RSVP LSPs are configured with bandwidth allocation, for ECMP next hops with more than 16 LSPs, traffic is not distributed optimally based on bandwidths configured. Some LSPs with smaller allocated bandwidths receive more traffic than the ones configured with higher bandwidths. Traffic distribution does not strictly comply with the configured bandwidth allocation. This caveat is applicable to the following routers:

- T1600 and T640 routers with Enhanced Scaling FPC1, Enhanced Scaling FPC2, Enhanced Scaling FPC3, Enhanced Scaling FPC 4, and all Type 4 FPCs
- M320 routers with Enhanced III FPC1, Enhanced III FPC2, and Enhanced III FPC3
- MX Series routers with all types of FPCs and DPCs, excluding MPCs. This caveat is not applicable to MX Series routers with line cards based on the Junos Trio chipset.
- M120 routers with Type 1, Type 2, and Type 3 FPCs
- M10i routers with Enhanced CFEB

Next-hop cloning and permutations are disabled on T Series routers with Enhanced Scaling FPCs (Enhanced Scaling FPC1, Enhanced Scaling FPC2, Enhanced Scaling FPC3, and Enhanced Scaling FPC 4) that support enhanced load-balancing capability. As a result, memory utilization is reduced for a highly scaled system with a high number of next hops on ECMP or aggregated interfaces. Next-hop cloning and permutations are also disabled on T Series routers with Type-4 FPCs.

To view the details of the ECMP next hops, issue the **show route** command. The **show route summary command** also shows the current configuration for the maximum ECMP limit. To view details of the ECMP LDP paths, issue the **traceroute mpls ldp** command.

Related Documentation

- *maximum-ecmp*

IBGP Scaling Configuration

Example: Configuring BGP Route Reflectors

Understanding BGP Route Reflectors

Because of the internal BGP (IBGP) full-mesh requirement, most networks use route reflectors to simplify configuration. The formula to compute the number of sessions required for a full mesh is v * (v - 1)/2, where v is the number of BGP-enabled devices. The full-mesh model does not scale well. Using a route reflector, you group routers into clusters, which are identified by numeric identifiers unique to the autonomous system (AS). Within the cluster, you must configure a BGP session from a single router (the route reflector) to each internal peer. With this configuration, the IBGP full-mesh requirement is met.

To use route reflection in an AS, you designate one or more routers as a route reflector—typically, one per point of presence (POP). Route reflectors have the special BGP ability to readvertise routes learned from an internal peer to other internal peers. So rather than requiring all internal peers to be fully meshed with each other, route reflection requires only that the route reflector be fully meshed with all internal peers. The route reflector and all of its internal peers form a cluster, as shown in Figure 62 on page 2929.

NOTE: For some Juniper Networks devices, you must have an Advanced BGP Feature license installed on each device that uses a route reflector. For license details, see the *Junos OS Initial Configuration Guide for Security Devices*.

Figure 62: Simple Route Reflector Topology (One Cluster)

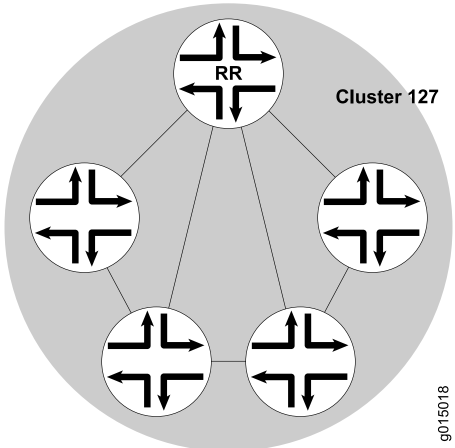


Figure 62 on page 2929 shows Router RR configured as the route reflector for Cluster 127. The other routers are designated internal peers within the cluster. BGP routes are advertised to Router RR by any of the internal peers. RR then readvertises those routes to all other peers within the cluster.

You can configure multiple clusters and link them by configuring a full mesh of route reflectors (see Figure 63 on page 2929).

Figure 63: Basic Route Reflection (Multiple Clusters)

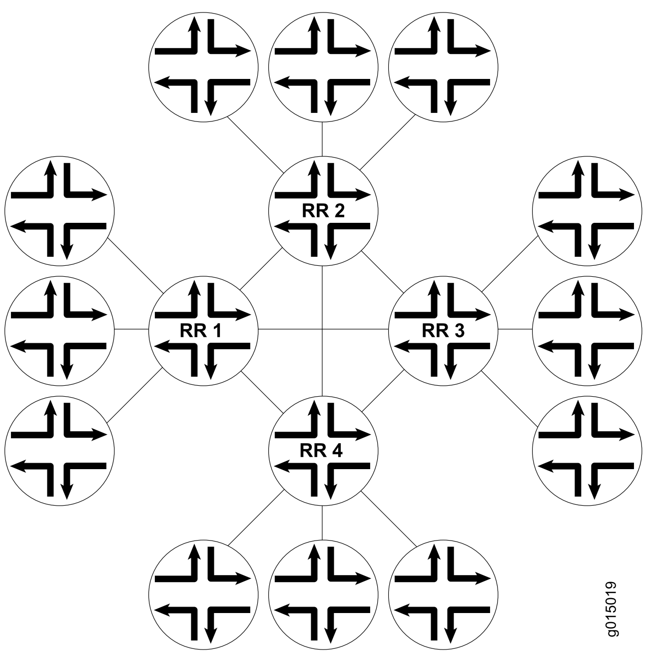


Figure 63 on page 2929 shows Route Reflectors RR 1, RR 2, RR 3, and RR 4 as fully meshed internal peers. When a router advertises a route to RR 1, RR 1 readvertises the route to the other route reflectors, which, in turn, readvertise the route to the remaining routers within the AS. Route reflection allows the route to be propagated throughout the AS without the scaling problems created by the full mesh requirement.

However, as clusters become large, a full mesh with a route reflector becomes difficult to scale, as does a full mesh between route reflectors. To help offset this problem, you can group clusters of routers together into clusters of clusters for hierarchical route reflection (see Figure 64 on page 2930).

Figure 64: Hierarchical Route Reflection (Clusters of Clusters)

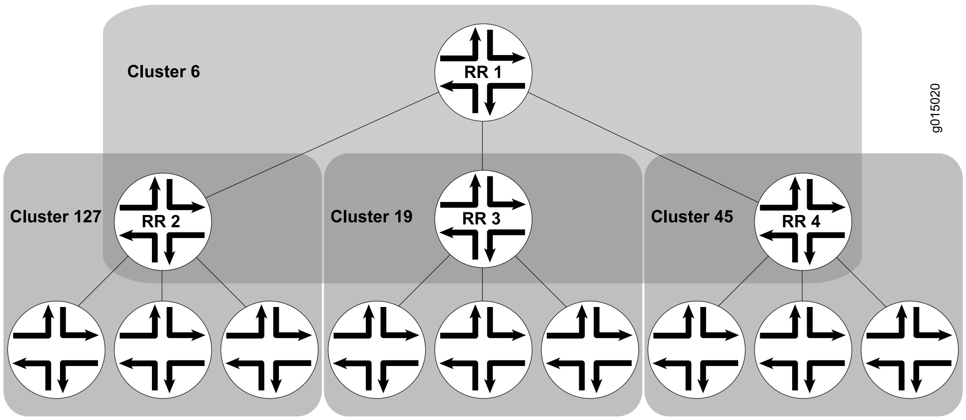


Figure 64 on page 2930 shows RR 2, RR 3, and RR 4 as the route reflectors for Clusters 127, 19, and 45, respectively. Rather than fully mesh those route reflectors, the network administrator has configured them as part of another cluster (Cluster 6) for which RR 1 is the route reflector. When a router advertises a route to RR 2, RR 2 readvertises the route to all the routers within its own cluster, and then readvertises the route to RR 1. RR 1 readvertises the route to the routers in its cluster, and those routers propagate the route down through their clusters.

Example: Configuring a Route Reflector

This example shows how to configure a route reflector.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

Generally, internal BGP (IBGP)-enabled devices need to be fully meshed, because IBGP does not readvertise updates to other IBGP-enabled devices. The full mesh is a logical mesh achieved through configuration of multiple **neighbor** statements on each IBGP-enabled device. The full mesh is not necessarily a physical full mesh. Maintaining a full mesh (logical or physical) does not scale well in large deployments.

Figure 65 on page 2932 shows an IBGP network with Device A acting as a route reflector. Device B and Device C are clients of the route reflector. Device D and Device E are outside the cluster, so they are nonclients of the route reflector.

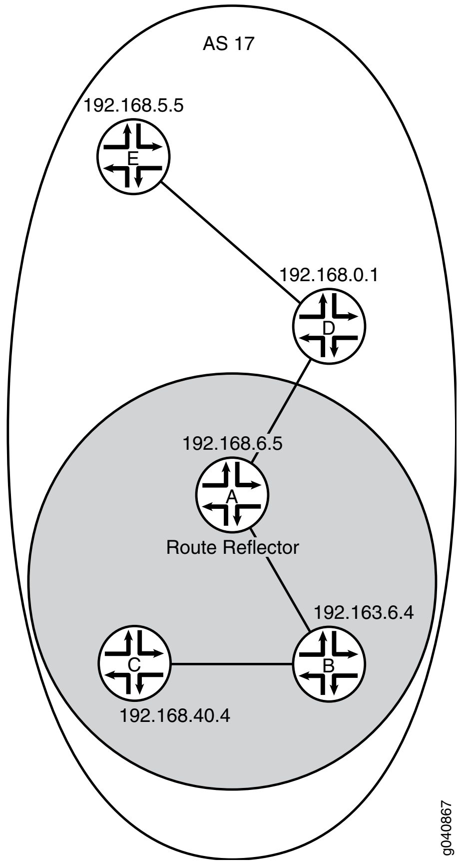
On Device A (the route reflector), you must form peer relationships with all of the IBGP-enabled devices by including the **neighbor** statement for the clients (Device B and Device C) and the nonclients (Device D and Device E). You must also include the **cluster** statement and a cluster identifier. The cluster identifier can be any 32-bit value. This example uses the loopback interface IP address of the route reflector.

On Device B and Device C, the route reflector clients, you only need one **neighbor** statement that forms a peer relationship with the route reflector, Device A.

On Device D and Device E, the nonclients, you need a **neighbor** statement for each nonclient device (D-to-E and E-to-D). You also need a **neighbor** statement for the route reflector (D-to-A and E-to-A). Device D and Device E do not need **neighbor** statements for the client devices (Device B and Device C).

TIP: Device D and Device E are considered to be nonclients because they have explicitly configured peer relationships with each other. To make them RRroute reflector clients, remove the **neighbor 192.168.5.5** statement from the configuration on Device D, and remove the **neighbor 192.168.0.1** statement from the configuration on Device E.

Figure 65: IBGP Network Using a Route Reflector



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device A

```
set interfaces fe-0/0/0 unit 1 description to-B
set interfaces fe-0/0/0 unit 1 family inet address 10.10.10.1/30
set interfaces fe-0/0/1 unit 3 description to-D
set interfaces fe-0/0/1 unit 3 family inet address 10.10.10.9/30
set interfaces lo0 unit 1 family inet address 192.168.6.5/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.168.6.5
set protocols bgp group internal-peers export send-ospf
set protocols bgp group internal-peers cluster 192.168.6.5
set protocols bgp group internal-peers neighbor 192.163.6.4
set protocols bgp group internal-peers neighbor 192.168.40.4
set protocols bgp group internal-peers neighbor 192.168.0.1
set protocols bgp group internal-peers neighbor 192.168.5.5
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.1
set protocols ospf area 0.0.0.0 interface fe-0/0/1.3
set policy-options policy-statement send-ospf term 2 from protocol ospf
```



```
set policy-options policy-statement send-ospf term 2 then accept
set routing-options router-id 192.168.6.5
set routing-options autonomous-system 17
```

Device B

```
set interfaces fe-0/0/0 unit 2 description to-A
set interfaces fe-0/0/0 unit 2 family inet address 10.10.10.2/30
set interfaces fe-0/0/1 unit 5 description to-C
set interfaces fe-0/0/1 unit 5 family inet address 10.10.10.5/30
set interfaces lo0 unit 2 family inet address 192.163.6.4/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.163.6.4
set protocols bgp group internal-peers export send-ospf
set protocols bgp group internal-peers neighbor 192.168.6.5
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.2
set protocols ospf area 0.0.0.0 interface fe-0/0/1.5
set policy-options policy-statement send-ospf term 2 from protocol ospf
set policy-options policy-statement send-ospf term 2 then accept
set routing-options router-id 192.163.6.4
set routing-options autonomous-system 17
```

Device C

```
set interfaces fe-0/0/0 unit 6 description to-B
set interfaces fe-0/0/0 unit 6 family inet address 10.10.10.6/30
set interfaces lo0 unit 3 family inet address 192.168.40.4/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.168.40.4
set protocols bgp group internal-peers export send-ospf
set protocols bgp group internal-peers neighbor 192.168.6.5
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.6
set policy-options policy-statement send-ospf term 2 from protocol ospf
set policy-options policy-statement send-ospf term 2 then accept
set routing-options router-id 192.168.40.4
set routing-options autonomous-system 17
```

Device D

```
set interfaces fe-0/0/0 unit 4 description to-A
set interfaces fe-0/0/0 unit 4 family inet address 10.10.10.10/30
set interfaces fe-0/0/1 unit 7 description to-E
set interfaces fe-0/0/1 unit 7 family inet address 10.10.10.13/30
set interfaces lo0 unit 4 family inet address 192.168.0.1/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.168.0.1
set protocols bgp group internal-peers export send-ospf
set protocols bgp group internal-peers neighbor 192.168.6.5
set protocols bgp group internal-peers neighbor 192.168.5.5
set protocols ospf area 0.0.0.0 interface lo0.4 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.4
set protocols ospf area 0.0.0.0 interface fe-0/0/1.7
set policy-options policy-statement send-ospf term 2 from protocol ospf
set policy-options policy-statement send-ospf term 2 then accept
set routing-options router-id 192.168.0.1
set routing-options autonomous-system 17
```

Device E

```
set interfaces fe-0/0/0 unit 8 description to-D
set interfaces fe-0/0/0 unit 8 family inet address 10.10.10.14/30
```

```
set interfaces lo0 unit 5 family inet address 192.168.5.5/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.168.5.5
set protocols bgp group internal-peers export send-ospf
set protocols bgp group internal-peers neighbor 192.168.0.1
set protocols bgp group internal-peers neighbor 192.168.6.5
set protocols ospf area 0.0.0.0 interface lo0.5 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.8
set policy-options policy-statement send-ospf term 2 from protocol ospf
set policy-options policy-statement send-ospf term 2 then accept
set routing-options router-id 192.168.5.5
set routing-options autonomous-system 17
```

Configuring the Route Reflector

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure IBGP in the network using Juniper Networks Device A as a route reflector:

1. Configure the interfaces.

```
[edit interfaces]
user@A# set fe-0/0/0 unit 1 description to-B
user@A# set fe-0/0/0 unit 1 family inet address 10.10.10.1/30
user@A# set fe-0/0/1 unit 3 description to-D
user@A# set fe-0/0/1 unit 3 family inet address 10.10.10.9/30
user@A# set lo0 unit 1 family inet address 192.168.6.5/32
```

2. Configure BGP, including the cluster identifier and neighbor relationships with all IBGP-enabled devices in the autonomous system (AS).

   Also apply the policy that redistributes OSPF routes into BGP.

```
[edit protocols bgp group internal-peers]
user@A# set type internal
user@A# set local-address 192.168.6.5
user@A# set export send-ospf
user@A# set cluster 192.168.6.5
user@A# set neighbor192.163.6.4
user@A# set neighbor 192.168.40.4
user@A# set neighbor 192.168.0.1
user@A# set neighbor 192.168.5.5
```

3. Configure static routing or an interior gateway protocol (IGP).

   This example uses OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@A# set interface lo0.1 passive
user@A# set interface fe-0/0/0.1
user@A# set interface fe-0/0/1.3
```

4. Configure the policy that redistributes OSPF routes into BGP.

```
[edit policy-options policy-statement send-ospf term 2]
user@A# set from protocol ospf
user@A# set then accept
```


5. Configure the router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@A# set router-id 192.168.6.5
user@A# set autonomous-system 17
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@A# show interfaces
fe-0/0/0 {
  unit 1 {
    description to-B;
    family inet {
      address 10.10.10.1/30;
    }
  }
}
fe-0/0/1 {
  unit 3 {
    description to-D;
    family inet {
      address 10.10.10.9/30;
    }
  }
}
lo0 {
  unit 1 {
    family inet {
      address 192.168.6.5/32;
    }
  }
}
```

```
user@A# show protocols
bgp {
  group internal-peers {
    type internal;
    local-address 192.168.6.5;
    export send-ospf;
    cluster 192.168.6.5;
    neighbor 192.163.6.4;
    neighbor 192.168.40.4;
    neighbor 192.168.0.1;
    neighbor 192.168.5.5;
  }
}
ospf {
  area 0.0.0.0 {
    interface lo0.1 {
      passive;
    }
    interface fe-0/0/0.1;
    interface fe-0/0/1.3;
```

```
    }
}
user@A# show policy-options
policy-statement send-ospf {
    term 2 {
        from protocol ospf;
        then accept;
    }
}
user@A# show routing-options
router-id 192.168.6.5;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

NOTE: Repeat these steps for each nonclient BGP peer within the cluster that you are configuring, if the other nonclient devices are from Juniper Networks. Otherwise, consult the device's documentation for instructions.

Configuring Client Peers

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure client peers:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@B# set fe-0/0/0 unit 2 description to-A
   user@B# set fe-0/0/0 unit 2 family inet address 10.10.10.2/30
   user@B# set fe-0/0/1 unit 5 description to-C
   user@B# set fe-0/0/1 unit 5 family inet address 10.10.10.5/30
   user@B# set lo0 unit 2 family inet address 192.163.6.4/32
   ```

2. Configure the BGP neighbor relationship with the route reflector.

   Also apply the policy that redistributes OSPF routes into BGP.

   ```
   [edit protocols bgp group internal-peers]
   user@B# set type internal
   user@B# set local-address 192.163.6.4
   user@B# set export send-ospf
   user@B# set neighbor 192.168.6.5
   ```

3. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@B# set interface lo0.2 passive
   user@B# set interface fe-0/0/0.2
   user@B# set interface fe-0/0/1.5
   ```

4. Configure the policy that redistributes OSPF routes into BGP.


```
[edit policy-options policy-statement send-ospf term 2]
user@B# set from protocol ospf
user@B# set then accept
```

5. Configure the router ID and the AS number.

```
[edit routing-options]
user@B# set router-id 192.163.6.4
user@B# set autonomous-system 17
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@B# show interfaces
fe-0/0/0 {
  unit 2 {
    description to-A;
    family inet {
      address 10.10.10.2/30;
    }
  }
}
fe-0/0/1 {
  unit 5 {
    description to-C;
    family inet {
      address 10.10.10.5/30;
    }
  }
}
lo0 {
  unit 2 {
    family inet {
      address 192.163.6.4/32;
    }
  }
}
```

```
user@B# show protocols
bgp {
  group internal-peers {
    type internal;
    local-address 192.163.6.4;
    export send-ospf;
    neighbor 192.168.6.5;
  }
}
ospf {
  area 0.0.0.0 {
    interface lo0.2 {
      passive;
    }
    interface fe-0/0/0.2;
    interface fe-0/0/1.5;
```

```
    }
}
user@B# show policy-options
policy-statement send-ospf {
    term 2 {
        from protocol ospf;
        then accept;
    }
}
user@B# show routing-options
router-id 192.163.6.4;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

NOTE: Repeat these steps for each client BGP peer within the cluster that you are configuring if the other client devices are from Juniper Networks. Otherwise, consult the device's documentation for instructions.

Configuring Nonclient Peers

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure nonclient peers:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@D# set fe-0/0/0 unit 4 description to-A
   user@D# set fe-0/0/0 unit 4 family inet address 10.10.10.10/30
   user@D# set fe-0/0/1 unit 7 description to-E
   user@D# set fe-0/0/1 unit 7 family inet address 10.10.10.13/30
   user@D# set lo0 unit 4 family inet address 192.168.0.1/32
   ```

2. Configure the BGP neighbor relationships with the RRroute reflector and with the other nonclient peers.

   Also apply the policy that redistributes OSPF routes into BGP.

   ```
   [edit protocols bgp group internal-peers]
   user@D# set type internal
   user@D# set local-address 192.168.0.1
   user@D# set export send-ospf
   user@D# set neighbor 192.168.6.5
   user@D# set neighbor 192.168.5.5
   ```

3. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@D# set interface lo0.4 passive
   user@D# set interface fe-0/0/0.4
   ```



```
user@D# set interface fe-0/0/1.7
```

4. Configure the policy that redistributes OSPF routes into BGP.

```
[edit policy-options policy-statement send-ospf term 2]
user@D# set from protocol ospf
user@D# set then accept
```

5. Configure the router ID and the AS number.

```
[edit routing-options]
user@D# set router-id 192.168.0.1
user@D# set autonomous-system 17
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@D# show interfaces
fe-0/0/0 {
   unit 4 {
      description to-A;
      family inet {
         address 10.10.10.10/30;
      }
   }
}
fe-0/0/1 {
   unit 7 {
      description to-E;
      family inet {
         address 10.10.10.13/30;
      }
   }
}
lo0 {
   unit 4 {
      family inet {
         address 192.168.0.1/32;
      }
   }
}
```

```
user@D# show protocols
bgp {
   group internal-peers {
      type internal;
      local-address 192.168.0.1;
      export send-ospf;
      neighbor 192.168.6.5;
      neighbor 192.168.5.5;
   }
}
ospf {
   area 0.0.0.0 {
      interface lo0.4 {
```

```
            passive;
          }
          interface fe-0/0/0.4;
          interface fe-0/0/1.7;
        }
      }
user@D# show policy-options
policy-statement send-ospf {
  term 2 {
    from protocol ospf;
    then accept;
  }
}
user@D# show routing-options
router-id 192.168.0.1;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

NOTE: Repeat these steps for each nonclient BGP peer within the cluster that you are configuring if the other nonclient devices are from Juniper Networks. Otherwise, consult the device's documentation for instructions.

Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 2940
- Verifying BGP Groups on page 2943
- Verifying BGP Summary Information on page 2943
- Verifying Routing Table Information on page 2943

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is established for each neighbor address.

Action From operational mode, enter the **show bgp neighbor** command.

```
user@A> show bgp neighbor
Peer: 192.163.6.4+179 AS 17    Local: 192.168.6.5+62857 AS 17
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-ospf ]
  Options: <Preference LocalAddress Cluster Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.163.6.4     Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
```



```
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            6
    Accepted prefixes:            1
    Suppressed due to damping:    0
    Advertised prefixes:          6
  Last traffic (seconds): Received 5    Sent 3    Checked 19
  Input messages:  Total 2961   Updates 7       Refreshes 0     Octets 56480
  Output messages: Total 2945   Updates 6       Refreshes 0     Octets 56235
  Output Queue[0]: 0

Peer: 192.168.0.1+179 AS 17    Local: 192.168.6.5+60068 AS 17
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-ospf ]
  Options: <Preference LocalAddress Cluster Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.168.0.1     Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 3
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            6
    Accepted prefixes:            1
    Suppressed due to damping:    0
    Advertised prefixes:          6
  Last traffic (seconds): Received 18   Sent 20   Checked 12
  Input messages:  Total 15     Updates 5       Refreshes 0     Octets 447
  Output messages: Total 554    Updates 4       Refreshes 0     Octets 32307
```

```
  Output Queue[0]: 0

Peer: 192.168.5.5+57458 AS 17  Local: 192.168.6.5+179 AS 17
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-ospf ]
  Options: <Preference LocalAddress Cluster Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.168.5.5     Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 2
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            7
    Accepted prefixes:            7
    Suppressed due to damping:    0
    Advertised prefixes:          6
  Last traffic (seconds): Received 17   Sent 3    Checked 9
  Input messages:  Total 2967   Updates 7       Refreshes 0     Octets 56629
  Output messages: Total 2943   Updates 6       Refreshes 0     Octets 56197
  Output Queue[0]: 0

Peer: 192.168.40.4+53990 AS 17 Local: 192.168.6.5+179 AS 17
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-ospf ]
  Options: <Preference LocalAddress Cluster Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.168.40.4    Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
```



```
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            7
    Accepted prefixes:            7
    Suppressed due to damping:    0
    Advertised prefixes:          6
  Last traffic (seconds): Received 5    Sent 23   Checked 52
  Input messages:  Total 2960   Updates 7       Refreshes 0     Octets 56496
  Output messages: Total 2943   Updates 6       Refreshes 0     Octets 56197
  Output Queue[0]: 0
```

Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From operational mode, enter the **show bgp group** command.

```
user@A> show bgp group
Group Type: Internal    AS: 17                    Local AS: 17
  Name: internal-peers  Index: 0                  Flags: <>
  Export: [ send-ospf ]
  Options: <Cluster>
  Holdtime: 0
  Total peers: 4        Established: 4
  192.163.6.4+179
  192.168.40.4+53990
  192.168.0.1+179
  192.168.5.5+57458
  inet.0: 0/26/16/0

Groups: 1  Peers: 4    External: 0    Internal: 4    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                26          0          0          0          0          0
```

Verifying BGP Summary Information

Purpose Verify that the BGP configuration is correct.

Action From operational mode, enter the **show bgp summary** command.

```
user@A> show bgp summary

Groups: 1 Peers: 4 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                26          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.163.6.4              17       2981       2965       0       0    22:19:15 0/6/1/0              0/0/0/0
192.168.0.1              17         36        575       0       0       13:43 0/6/1/0              0/0/0/0
192.168.5.5              17       2988       2964       0       0    22:19:10 0/7/7/0              0/0/0/0
192.168.40.4             17       2980       2964       0       0    22:19:14 0/7/7/0              0/0/0/0
```

Verifying Routing Table Information

Purpose Verify that the routing table contains the IBGP routes.

Action From operational mode, enter the **show route** command.

```
user@A> show route
inet.0: 12 destinations, 38 routes (12 active, 0 holddown, 10 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.0/30      *[Direct/0] 22:22:03
                    > via fe-0/0/0.1
                    [BGP/170] 22:20:55, MED 2, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
                    [BGP/170] 22:20:51, MED 3, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
10.10.10.1/32      *[Local/0] 22:22:03
                      Local via fe-0/0/0.1
10.10.10.4/30      *[OSPF/10] 22:21:13, metric 2
                    > to 10.10.10.2 via fe-0/0/0.1
                    [BGP/170] 22:20:51, MED 4, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
10.10.10.8/30      *[Direct/0] 22:22:03
                    > via fe-0/0/1.3
                    [BGP/170] 22:20:51, MED 2, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 22:20:55, MED 3, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
10.10.10.9/32      *[Local/0] 22:22:03
                      Local via fe-0/0/1.3
10.10.10.12/30     *[OSPF/10] 22:21:08, metric 2
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 22:20:55, MED 4, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
192.163.6.4/32     *[OSPF/10] 22:21:13, metric 1
                    > to 10.10.10.2 via fe-0/0/0.1
                    [BGP/170] 22:20:55, MED 1, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
                    [BGP/170] 22:20:51, MED 3, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
192.168.0.1/32     *[OSPF/10] 22:21:08, metric 1
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 22:20:51, MED 1, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 22:20:55, MED 3, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
192.168.5.5/32     *[OSPF/10] 22:21:08, metric 2
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 00:15:24, MED 1, localpref 100, from 192.168.0.1
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 22:20:55, MED 4, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
192.168.6.5/32     *[Direct/0] 22:22:04
```



```
                          > via lo0.1
                          [BGP/170] 22:20:51, MED 2, localpref 100, from 192.168.5.5
                            AS path: I
                          > to 10.10.10.10 via fe-0/0/1.3
                          [BGP/170] 22:20:55, MED 2, localpref 100, from 192.168.40.4
                            AS path: I
                          > to 10.10.10.2 via fe-0/0/0.1
192.168.40.4/32          *[OSPF/10] 22:21:13, metric 2
                          > to 10.10.10.2 via fe-0/0/0.1
                          [BGP/170] 22:20:55, MED 1, localpref 100, from 192.163.6.4
                            AS path: I
                          > to 10.10.10.2 via fe-0/0/0.1
                          [BGP/170] 22:20:51, MED 4, localpref 100, from 192.168.5.5
                            AS path: I
                          > to 10.10.10.10 via fe-0/0/1.3
224.0.0.5/32             *[OSPF/10] 22:22:07, metric 1
                            MultiRecv
```

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

Example: Configuring BGP Confederations

Understanding BGP Confederations

BGP confederations are another way to solve the scaling problems created by the BGP full mesh requirement. BGP confederations effectively break up a large autonomous system (AS) into subautonomous systems (sub-ASs). Each sub-AS must be uniquely identified within the confederation AS by a sub-AS number. Typically, sub-AS numbers are taken from the private AS numbers between 64,512 and 65,535.

Within a sub-AS, the same internal BGP (IBGP) full mesh requirement exists. Connections to other confederations are made with standard external BGP (EBGP), and peers outside the sub-AS are treated as external. To avoid routing loops, a sub-AS uses a confederation sequence, which operates like an AS path but uses only the privately assigned sub-AS numbers.

The confederation AS appears whole to other confederation ASs. The AS path received by other ASs shows only the globally assigned AS number. It does not include the confederation sequence or the privately assigned sub-AS numbers. The sub-AS numbers are removed when the route is advertised out of the confederation AS.
Figure 66 on page 2946 shows an AS divided into four confederations.

Figure 66: BGP Confederations

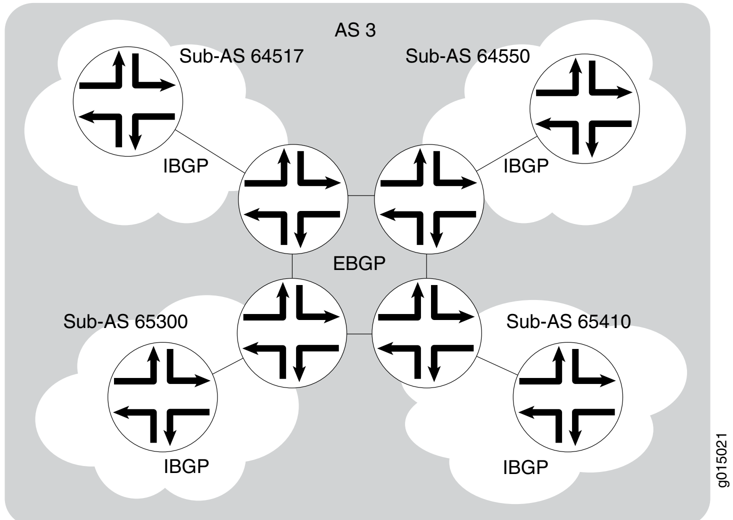


Figure 66 on page 2946 shows AS 3 divided into four sub-ASs, 64517, 64550, 65300, and 65410, which are linked through EBGP sessions. Because the confederations are connected by EBGP, they do not need to be fully meshed. EBGP routes are readvertised to other sub-ASs.

Example: Configuring BGP Confederations

This example shows how to configure BGP confederations.

Requirements

- Configure network interfaces.
- Configure external peer sessions. See “Example: Configuring External BGP Point-to-Point Peer Sessions” on page 2640.
- Configure interior gateway protocol (IGP) sessions between peers.
- Configure a routing policy to advertise the BGP routes.

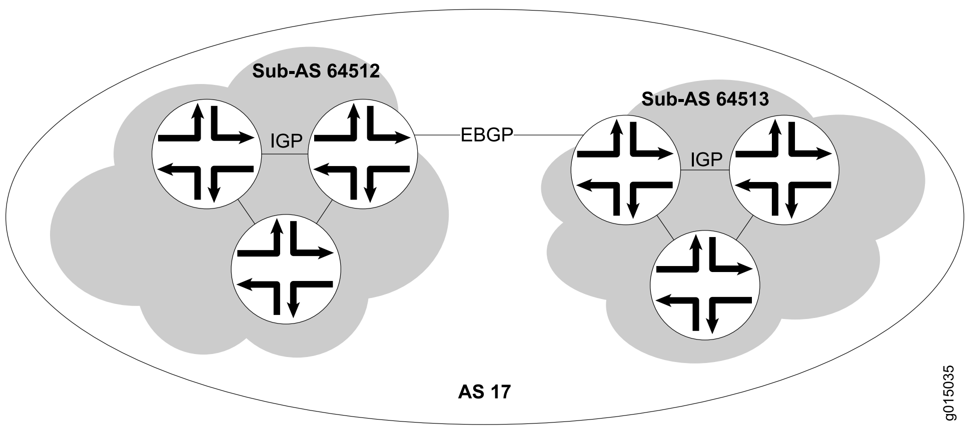
Overview

Within a BGP confederation, the links between the confederation member autonomous systems (ASs) must be external BGP (EBGP) links, not internal BGP (IBGP) links.

Similar to route reflectors, BGP confederations reduce the number of peer sessions and TCP sessions to maintain connections between IBGP routing devices. BGP confederation is one method used to solve the scaling problems created by the IBGP full mesh requirement. BGP confederations effectively break up a large AS into subautonomous systems. Each sub-AS must be uniquely identified within the confederation AS by a sub-AS number. Typically, sub-AS numbers are taken from the private AS numbers between 64512 and 65535. Within a sub-AS, the same IBGP full mesh requirement exists. Connections to other confederations are made with standard EBGP, and peers outside the sub-AS are treated as external. To avoid routing loops, a sub-AS uses a confederation sequence, which operates like an AS path but uses only the privately assigned sub-AS numbers.

Figure 67 on page 2947 shows a sample network in which AS 17 has two separate confederations: sub-AS 64512 and sub-AS 64513, each of which has multiple routers. Within a sub-AS, an IGP is used to establish network connectivity with internal peers. Between sub-ASs, an EBGP peer session is established.

Figure 67: Typical Network Using BGP Confederations



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

All Devices in Sub-AS 64512

```
set routing-options autonomous-system 64512
set routing-options confederation 17 members 64512
set routing-options confederation 17 members 64513
set protocols bgp group sub-AS-64512 type internal
set protocols bgp group sub-AS-64512 local-address 192.168.5.1
set protocols bgp group sub-AS-64512 neighbor 192.168.8.1
set protocols bgp group sub-AS-64512 neighbor 192.168.15.1
```

Border Device in Sub-AS 64512

```
set protocols bgp group to-sub-AS-64513 type external
set protocols bgp group to-sub-AS-64513 peer-as 64513
set protocols bgp group to-sub-AS-64513 neighbor 192.168.5.2
```

All Devices in Sub-AS 64513

```
set routing-options autonomous-system 64513
set routing-options confederation 17 members 64512
set routing-options confederation 17 members 64513
set protocols bgp group sub-AS-64513 type internal
set protocols bgp group sub-AS-64513 local-address 192.168.5.2
set protocols bgp group sub-AS-64513 neighbor 192.168.9.1
```

set protocols bgp group sub-AS-64513 neighbor 192.168.16.1

Border Device in Sub-AS 64513

set protocols bgp group to-sub-AS-64512 type external
set protocols bgp group to-sub-AS-64512 peer-as 64512
set protocols bgp group to-sub-AS-64512 neighbor 192.168.5.1

Step-by-Step Procedure

This procedure shows the steps for the devices that are in sub-AS 64512.

The **autonomous-system** statement sets the sub-AS number of the device.

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure BGP confederations:

1. Set the sub-AS number for the device.

   ```
   [edit routing-options]
   user@host# set autonomous-system 64512
   ```

2. In the confederation, include all sub-ASs in the main AS.

   The number 17 represents the main AS. The **members** statement lists all the sub-ASs in the main AS.

   ```
   [edit routing-options confederation]
   user@host# set 17 members 64512
   user@host# set 17 members 64513
   ```

3. On the border device in sub-AS 64512, configure an EBGP connection to the border device in AS 64513.

   ```
   [edit protocols bgp group to-sub-AS-64513]
   user@host# set type external
   user@host# set neighbor 192.168.5.2
   user@host# set peer-as 64513
   ```

4. Configure an IBGP group for peering with the devices within sub-AS 64512.

   ```
   [edit protocols bgp group sub-AS-64512]
   user@host# set type internal
   user@host# set local-address 192.168.5.1
   user@host# neighbor 192.168.8.1
   user@host# neighbor 192.168.15.1
   ```

Results

From configuration mode, confirm your configuration by entering the **show routing-options** and **show protocols** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show routing-options
autonomous-system 64512;
confederation 17 members [ 64512 64513 ];
```

```
user@host# show protocols
bgp {
  group to-sub-AS-64513 { # On the border devices only
    type external;
```



```
        peer-as 64513;
        neighbor 192.168.5.2;
    }
    group sub-AS-64512 {
        type internal;
        local-address 192.168.5.1;
        neighbor 192.168.8.1;
        neighbor 192.168.15.1;
    }
}
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat these steps for sSub-AS 64513.

Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 2949
- Verifying BGP Groups on page 2950
- Verifying BGP Summary Information on page 2951

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is active for each neighbor address.

Action From the CLI, enter the **show bgp neighbor** command.

Sample Output

```
user@host> show bgp neighbor
Peer: 10.255.245.12+179 AS 35  Local: 10.255.245.13+2884 AS 35
  Type: Internal    State: Established  (route reflector client)Flags: Sync
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: Preference LocalAddress HoldTime Cluster AddressFamily Rib-group Refresh

  Address families configured: inet-vpn-unicast inet-labeled-unicast
  Local Address: 10.255.245.13 Holdtime: 90 Preference: 170
  Flags for NLRI inet-vpn-unicast: AggregateLabel
  Flags for NLRI inet-labeled-unicast: AggregateLabel
  Number of flaps: 0
  Peer ID: 10.255.245.12    Local ID: 10.255.245.13    Active Holdtime: 90
  Keepalive Interval: 30
  NLRI advertised by peer: inet-vpn-unicast inet-labeled-unicast
  NLRI for this session: inet-vpn-unicast inet-labeled-unicast
  Peer supports Refresh capability (2)
Restart time configured on the peer: 300
  Stale routes from peer are kept for: 60
  Restart time requested by this peer: 300
  NLRI that peer supports restart for: inet-unicast inet6-unicast
  NLRI that restart is negotiated for: inet-unicast inet6-unicast
  NLRI of received end-of-rib markers: inet-unicast inet6-unicast
  NLRI of all end-of-rib markers sent: inet-unicast inet6-unicast
  Table inet.0 Bit: 10000
    RIB State: restart is complete
    Send state: in sync
```



```
    Active prefixes: 4
    Received prefixes: 6
    Suppressed due to damping: 0
  Table inet6.0 Bit: 20000
    RIB State: restart is complete
    Send state: in sync
    Active prefixes: 0
    Received prefixes: 2
    Suppressed due to damping: 0
  Last traffic (seconds): Received 3    Sent 3    Checked 3
  Input messages:  Total 9      Updates 6       Refreshes 0     Octets 403
  Output messages: Total 7      Updates 3       Refreshes 0     Octets 365
  Output Queue[0]: 0
  Output Queue[1]: 0
  Trace options: detail packets
  Trace file: /var/log/bgpgr size 131072 files 10
```

Meaning The output shows a list of the BGP neighbors with detailed session information. Verify the following information:

- Each configured peering neighbor is listed.
- For **State**, each BGP session is **Established**.
- For **Type**, each peer is configured as the correct type (either internal or external).
- For **AS**, the AS number of the BGP neighbor is correct.

Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From the CLI, enter the **show bgp group** command.

Sample Output

```
user@host> show bgp group
Group Type: Internal    AS: 10045       Local AS: 10045
  Name: pe-to-asbr2                                     Flags: Export Eval
  Export: [ match-all ]
  Total peers: 1        Established: 1
  10.0.0.4+179
  bgp.l3vpn.0: 1/1/0
  vpn-green.inet.0: 1/1/0

Groups: 1   Peers: 1    External: 0    Internal: 1    Down peers: 0   Flaps: 0
Table            Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l3vpn.0              1          1          0          0          0          0
```

Meaning The output shows a list of the BGP groups with detailed group information. Verify the following information:

- Each configured group is listed.
- For **AS**, each group's remote AS is configured correctly.
- For **Local AS**, each group's local AS is configured correctly.
- For **Group Type**, each group has the correct type (either internal or external).

- For **Total peers**, the expected number of peers within the group is shown.
- For **Established**, the expected number of peers within the group have BGP sessions in the **Established** state.
- The IP addresses of all the peers within the group are present.

Verifying BGP Summary Information

Purpose Verify that the BGP configuration is correct.

Action From the CLI, enter the **show bgp summary** command.

Sample Output

```
user@host> show bgp summary
Groups: 1 Peers: 3 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 6          4          0          0          0          0
Peer                AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.0.0.2         65002      88675      88652       0       2       42:38 2/4/0
             0/0/0
10.0.0.3         65002      54528      54532       0       1     2w4d22h 0/0/0
             0/0/0
10.0.0.4         65002      51597      51584       0       0     2w3d22h 2/2/0
             0/0/0
```

Meaning The output shows a summary of BGP session information. Verify the following information:

- For **Groups**, the total number of configured groups is shown.
- For **Peers**, the total number of BGP peers is shown.
- For **Down Peers**, the total number of unestablished peers is 0. If this value is not zero, one or more peering sessions are not yet established.
- Under **Peer**, the IP address for each configured peer is shown.
- Under **AS**, the peer AS for each configured peer is correct.
- Under **Up/Dwn State**, the BGP state reflects the number of paths received from the neighbor, the number of these paths that have been accepted, and the number of routes being damped (such as 0/0/0). If the field is **Active**, it indicates a problem in the establishment of the BGP session.

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

BGP Security Configuration

- Example: Configuring BGP Route Authentication on page 2952
- Examples: Configuring TCP and BGP Security on page 2958

Example: Configuring BGP Route Authentication

Understanding Route Authentication

The use of router and route authentication and route integrity greatly mitigates the risk of being attacked by a machine or router that has been configured to share incorrect routing information with another router. In this kind of attack, the attacked router can be tricked into creating a routing loop, or the attacked router's routing table can be greatly increased thus impacting performance, or routing information can be redirected to a place in the network for the attacker to analyze it. Bogus route advertisements can be sent out on a segment. These updates can be accepted into the routing tables of neighbor routers unless an authentication mechanism is in place to verify the source of the routes.

Router and route authentication enables routers to share information only if they can verify that they are talking to a trusted source, based on a password (key). In this method, a hashed key is sent along with the route being sent to another router. The receiving router compares the sent key to its own configured key. If they are the same, it accepts the route. By using a hashing algorithm, the key is not sent over the wire in plain text. Instead, a hash is calculated using the configured key. The routing update is used as the input text, along with the key, into the hashing function. This hash is sent along with the route update to the receiving router. The receiving router compares the received hash with a hash it generates on the route update using the preshared key configured on it. If the two hashes are the same, the route is assumed to be from a trusted source. The key is known only to the sending and receiving routers.

To further strengthen security, you can configure a series of authentication keys (a *keychain*). Each key has a unique start time within the keychain. Keychain authentication allows you to change the password information periodically without bringing down peering sessions. This keychain authentication method is referred to as *hitless* because the keys roll over from one to the next without resetting any peering sessions or interrupting the routing protocol.

The sending peer uses the following rules to identify the active authentication key:

- The start time is less than or equal to the current time (in other words, not in the future).
- The start time is greater than that of all other keys in the chain whose start time is less than the current time (in other words, closest to the current time).

The receiving peer determines the key with which it authenticates based on the incoming key identifier.

The sending peer identifies the current authentication key based on a configured start time and then generates a hash value using the current key. The sending peer then inserts a TCP-enhanced authentication option object into the BGP update message. The object contains an object ID (assigned by IANA), the object length, the current key, and a hash value.

The receiving peer examines the incoming TCP-enhanced authentication option, looks up the received authentication key, and determines whether the key is acceptable based on the start time, the system time, and the tolerance parameter. If the key is accepted, the receiving peer calculates a hash and authenticates the update message.

Initial application of a keychain to a TCP session causes the session to reset. However, once the keychain is applied, the addition or removal of a password from the keychain does not cause the TCP session to reset. Also, the TCP session does not reset when the keychain changes from one authentication algorithm to another.

Example: Configuring Route Authentication for BGP

All BGP protocol exchanges can be authenticated to guarantee that only trusted routing devices participate in autonomous system (AS) routing updates. By default, authentication is disabled.

Requirements

Before you begin:

- Configure the router interfaces.
- Configure an interior gateway protocol (IGP).

Overview

When you configure authentication, the algorithm creates an encoded checksum that is included in the transmitted packet. The receiving routing device uses an authentication key (password) to verify the packet's checksum.

This example includes the following statements for configuring and applying the keychain:

- **key**—A keychain can have multiple keys. Each key within a keychain must be identified by a unique integer value. The range of valid identifier values is from 0 through 63.

  The key can be up to 126 characters long. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (“ ”).

- **tolerance**—(Optional) For each keychain, you can configure a clock-skew tolerance value in seconds. The clock-skew tolerance is applicable to the receiver accepting keys for BGP updates. The configurable range is 0 through 999,999,999 seconds. During the tolerance period, either the current or previous password is acceptable.

- **key-chain**—For each keychain, you must specify a name. This example defines one keychain: **bgp-auth**. You can have multiple keychains on a routing device. For example, you can have a keychain for BGP, a keychain for OSPF, and a keychain for LDP.

- **secret**—For each key in the keychain, you must set a secret password. This password can be entered in either encrypted or plain text format in the **secret** statement. It is always displayed in encrypted format.
- **start-time**—Each key must specify a start time in UTC format. Control gets passed from one key to the next. When a configured start time arrives (based on the routing device's clock), the key with that start time becomes active. Start times are specified in the local time zone for a routing device and must be unique within the keychain.
- **authentication-key-chain**—Enables you to apply a keychain at the global BGP level for all peers, for a group, or for a neighbor. This example applies the keychain to the peers defined in the external BGP (EBGP) group called **ext**.
- **authentication-algorithm**—For each keychain, you can specify a hashing algorithm. The algorithm can be AES-128, MD5, or SHA-1.

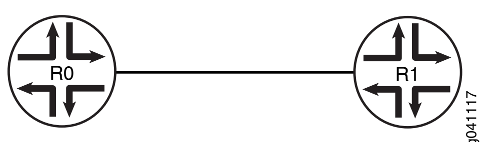
  You associate a keychain and an authentication algorithm with a BGP neighboring session.

This example configures a keychain named **bgp-auth**. Key 0 will be sent and accepted starting at 2011-6-23.20:19:33 -0700, and will stop being sent and accepted when the next key in the keychain (key 1) becomes active. Key 1 becomes active one year later at 2012-6-23.20:19:33 -0700, and will not stop being sent and accepted unless another key is configured with a start time that is later than the start time of key 1. A clock-skew tolerance of 30 seconds applies to the receiver accepting the keys. During the tolerance period, either the current or previous key is acceptable. The keys are shared-secret passwords. This means that the neighbors receiving the authenticated routing updates must have the same authentication keychain configuration, including the same keys (passwords). So Router R0 and Router R1 must have the same authentication-key-chain configuration if they are configured as peers. This example shows the configuration on only one of the routing devices.

Topology Diagram

Figure 68 on page 2954 shows the topology used in this example.

Figure 68: Authentication for BGP



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols bgp group ext type external
set protocols bgp group ext peer-as 65530
set protocols bgp group ext neighbor 172.16.2.1
set routing-options autonomous-system 65533
```

```
set protocols bgp group ext authentication-key-chain bgp-auth
set protocols bgp group ext authentication-algorithm md5
set security authentication-key-chains key-chain bgp-auth tolerance 30
set security authentication-key-chains key-chain bgp-auth key 0 secret
  this-is-the-secret-password
set security authentication-key-chains key-chain bgp-auth key 0 start-time
  2011-6-23.20:19:33-0700
set security authentication-key-chains key-chain bgp-auth key 1 secret
  this-is-another-secret-password
set security authentication-key-chains key-chain bgp-auth key 1 start-time
  2012-6-23.20:19:33-0700
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router R1 to accept route filters from Device CE1 and perform outbound route filtering using the received filters:

1. Configure the local autonomous system.

   ```
   [edit routing-options]
   user@R1# set autonomous-system 65533
   ```

2. Configure one or more BGP groups.

   ```
   [edit protocols bgp group ext]
   user@R1# set type external
   user@R1# set peer-as 65530
   user@R1# set neighbor 172.16.2.1
   ```

3. Configure authentication with multiple keys.

   ```
   [edit security authentication-key-chains key-chain bgp-auth]
   user@R1# set key 0 secret this-is-the-secret-password
   user@R1# set key 0 start-time 2011-6-23.20:19:33-0700
   user@R1# set key 1 secret this-is-another-secret-password
   user@R1# set key 1 start-time 2012-6-23.20:19:33-0700
   ```

   The start time of each key must be unique within the keychain.

4. Apply the authentication keychain to BGP, and set the hashing algorithm.

   ```
   [edit protocols bgp group ext]
   user@R1# set authentication-key-chain bgp-auth
   user@R1# set authentication-algorithm md5
   ```

5. (Optional) Apply a clock-skew tolerance value in seconds.

   ```
   [edit security authentication-key-chains key-chain bgp-auth]
   user@R1# set tolerance 30
   ```

Results

From configuration mode, confirm your configuration by entering the **show protocols**, **show routing-options**, and **show security** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show protocols
bgp {
```

```
    group ext {
      type external;
      peer-as 65530;
      neighbor 172.16.2.1;
      authentication-key-chain bgp-auth;
      authentication-algorithm md5;
    }
  }
```

```
user@R1# show routing-options
autonomous-system 65533;
```

```
user@R1# show security
authentication-key-chains {
  key-chain bgp-auth {
    tolerance 30;
      key 0 {
      secret
        "$9$5T6AREylK8RhxNdwaJn/CtO1cyKvWx9AylMWdVgoJDjqP5FCA0z3lEhcMWLxNbgJDi.F6A";
        ## SECRET-DATA
      start-time "2011-6-23.20:19:33 -0700";
    }
    key 1 {
      secret "$9$UyD.59CuO1h9AylKW-dqmfT369CuRhSP5hrvMN-JGDiqfu0IleWpuh.";
        ## SECRET-DATA
      start-time "2012-6-23.20:19:33 -0700";
    }
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Repeat the procedure for every BGP-enabled device in the network, using the appropriate interface names and addresses for each BGP-enabled device.

Verification

Confirm that the configuration is working properly.

- Verifying Authentication for the Neighbor on page 2956
- Verifying That Authorization Messages Are Sent on page 2957
- Checking Authentication Errors on page 2958
- Verifying the Operation of the Keychain on page 2958

Verifying Authentication for the Neighbor

Purpose Make sure that the **AutheKeyChain** option appears in the output of the **show bgp neighbor** command.

Action From operational mode, enter the **show bgp neighbor** command.

```
user@R1> show bgp neighbor
Peer: 172.16.2.1+179 AS 65530  Local: 172.16.2.2+1222 AS 65533
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
```



```
  Export: [ direct-lo0 ]
  Options: <Preference PeerAS Refresh>
  Options: <AutheKeyChain>
  Authentication key is configured
  Authentication key chain: jni
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 172.16.2.1       Local ID: 10.255.124.35    Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  Local Interface: fe-0/0/1.0
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              2
    Received prefixes:            2
    Suppressed due to damping:    0
    Advertised prefixes:          1
  Last traffic (seconds): Received 2    Sent 2    Checked 2
  Input messages:  Total 21     Updates 2       Refreshes 0     Octets 477
  Output messages: Total 22     Updates 1       Refreshes 0     Octets 471
  Output Queue[0]: 0
```

Verifying That Authorization Messages Are Sent

Purpose Confirm that BGP has the enhanced authorization option.

Action From operational mode, enter the monitor traffic **interface fe-0/0/1** command.

```
user@R1> monitor traffic interface fe-0/0/1
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Listening on fe-0/0/1, capture size 96 bytes

13:08:00.618402  In arp who-has 172.16.2.66 tell 172.16.2.69
13:08:02.408249 Out IP 172.16.2.2.1122 > 172.16.2.1.646: P
1889289217:1889289235(18) ack 2215740969 win 58486 <nop,nop,timestamp 167557
1465469,nop,Enhanced Auth keyid 0 diglen 12 digest: fe3366001f45767165f17037>:
13:08:02.418396  In IP 172.16.2.1.646 > 172.16.2.2.1122: P 1:19(18) ack 18 win
57100 <nop,nop,timestamp 1466460 167557,nop,Enhanced Auth keyid 0 diglen 12
digest: a18c31eda1b14b2900921675>:
13:08:02.518146 Out IP 172.16.2.2.1122 > 172.16.2.1.646: . ack 19 win 58468
<nop,nop,timestamp 167568 1466460,nop,Enhanced Auth keyid 0 diglen 12 digest:
c3b6422eb6bd3fd9cf79742b>
13:08:28.199557 Out IP 172.16.2.2.nerv > 172.16.2.1.bgp: P
286842489:286842508(19) ack 931203976 win 57200 <nop,Enhanced Auth keyid 0
diglen 12 digest: fc0e42900a73736bcc07c1a4>: BGP, length: 19
13:08:28.209661  In IP 172.16.2.1.bgp > 172.16.2.2.nerv: P 1:20(19) ack 19 win
56835 <nop,Enhanced Auth keyid 0 diglen 12 digest: 0fc8578c489fabce63aeb2c3>:
BGP, length: 19
13:08:28.309525 Out IP 172.16.2.2.nerv > 172.16.2.1.bgp: . ack 20 win 57181
<nop,Enhanced Auth keyid 0 diglen 12 digest: ef03f282fb2ece0039491df8>
13:08:32.439708 Out IP 172.16.2.2.1122 > 172.16.2.1.646: P 54:72(18) ack 55 win
58432 <nop,nop,timestamp 170560 1468472,nop,Enhanced Auth keyid 0 diglen 12
digest: 76e0cf926f348b726c631944>:
13:08:32.449795  In IP 172.16.2.1.646 > 172.16.2.2.1122: P 55:73(18) ack 72 win
57046 <nop,nop,timestamp 1469463 170560,nop,Enhanced Auth keyid 0 diglen 12
digest: dae3eec390d18a114431f4d8>:
13:08:32.549726 Out IP 172.16.2.2.1122 > 172.16.2.1.646: . ack 73 win 58414
<nop,nop,timestamp 170571 1469463,nop,Enhanced Auth keyid 0 diglen 12 digest:
```

```
851df771aee2ea7a43a0c46c>
13:08:33.719880  In arp who-has 172.16.2.66 tell 172.16.2.69
^C
35 packets received by filter
0 packets dropped by kernel
```

Checking Authentication Errors

Purpose Check the number of packets dropped by TCP because of authentication errors.

Action From operational mode, enter the **show system statistics tcp | match auth** command.

```
user@R1> show system statistics tcp | match auth
        0 send packets dropped by TCP due to auth errors
        58 rcv packets dropped by TCP due to auth errors
```

Verifying the Operation of the Keychain

Purpose Check the number of packets dropped by TCP because of authentication errors.

Action From operational mode, enter the **show security keychain detail** command.

```
user@R1> show security keychain detail
keychain                 Active-ID       Next-ID       Transition  Tolerance
                       Send  Receive   Send  Receive
 bgp-auth                3      3         1      1        1d 23:58    30
  Id 3, Algorithm hmac-md5, State send-receive, Option basic
  Start-time Wed Aug 11 16:28:00 2010, Mode send-receive
  Id 1, Algorithm hmac-md5, State inactive, Option basic
  Start-time Fri Aug 20 11:30:57 2010, Mode send-receive
```

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

Examples: Configuring TCP and BGP Security

Understanding Security Options for BGP with TCP

Among routing protocols, BGP is unique in using TCP as its transport protocol. BGP peers are established by manual configuration between routing devices to create a TCP session on port 179. A BGP-enabled device periodically sends keepalive messages to maintain the connection.

Over time, BGP has become the dominant interdomain routing protocol on the Internet. However, it has limited guarantees of stability and security. Configuring security options for BGP must balance suitable security measures with acceptable costs. No one method has emerged as superior to other methods. Each network administrator must configure security measures that meet the needs of the network being used.

For detailed information about the security issues associated with BGP's use of TCP as a transport protocol, see RFC 4272, *BGP Security Vulnerabilities Analysis*.

Example: Configuring a Filter to Block TCP Access to a Port Except from Specified BGP Peers

This example shows how to configure a standard stateless firewall filter that blocks all TCP connection attempts to port 179 from all requesters except from specified BGP peers.

Requirements

No special configuration beyond device initialization is required before you configure this example.

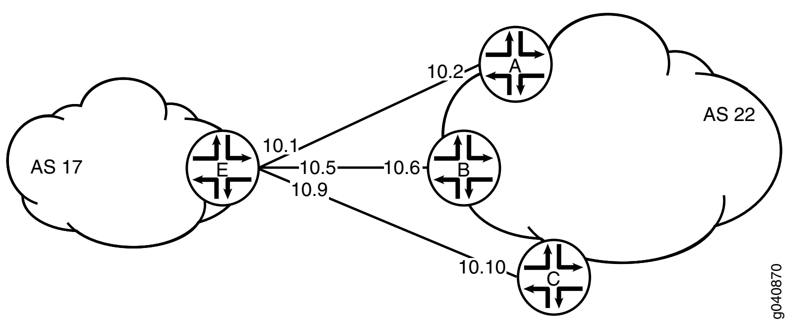
Overview

In this example, you create a stateless firewall filter that blocks all TCP connection attempts to port 179 from all requesters except the specified BGP peers.

The stateless firewall filter **filter_bgp179** matches all packets from the directly connected interfaces on Device A and Device B to the destination port number 179.

Figure 69 on page 2959 shows the topology used in this example. Device C attempts to make a TCP connection to Device E. Device E blocks the connection attempt. This example shows the configuration on Device E.

Figure 69: Typical Network with BGP Peer Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device C

```
set interfaces ge-1/2/0 unit 10 description to-E
set interfaces ge-1/2/0 unit 10 family inet address 10.10.10.10/30
set protocols bgp group external-peers type external
set protocols bgp group external-peers peer-as 17
set protocols bgp group external-peers neighbor 10.10.10.9
set routing-options autonomous-system 22
```

Device E

```
set interfaces ge-1/2/0 unit 0 description to-A
set interfaces ge-1/2/0 unit 0 family inet address 10.10.10.1/30
set interfaces ge-1/2/1 unit 5 description to-B
set interfaces ge-1/2/1 unit 5 family inet address 10.10.10.5/30
set interfaces ge-1/0/0 unit 9 description to-C
set interfaces ge-1/0/0 unit 9 family inet address 10.10.10.9/30
set interfaces lo0 unit 2 family inet filter input filter_bgp179
set interfaces lo0 unit 2 family inet address 192.168.0.1/32
set protocols bgp group external-peers type external
set protocols bgp group external-peers peer-as 22
set protocols bgp group external-peers neighbor 10.10.10.2
set protocols bgp group external-peers neighbor 10.10.10.6
set protocols bgp group external-peers neighbor 10.10.10.10
set routing-options autonomous-system 17
set firewall family inet filter filter_bgp179 term 1 from source-address 10.10.10.2/32
set firewall family inet filter filter_bgp179 term 1 from source-address 10.10.10.6/32
set firewall family inet filter filter_bgp179 term 1 from destination-port bgp
set firewall family inet filter filter_bgp179 term 1 then accept
set firewall family inet filter filter_bgp179 term 2 then reject
```

Configuring Device E

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device E with a stateless firewall filter that blocks all TCP connection attempts to port 179 from all requestors except specified BGP peers:

1. Configure the interfaces.

   ```
   user@E# set interfaces ge-1/2/0 unit 0 description to-A
   user@E# set interfaces ge-1/2/0 unit 0 family inet address 10.10.10.1/30

   user@E# set interfaces ge-1/2/1 unit 5 description to-B
   user@E# set interfaces ge-1/2/1 unit 5 family inet address 10.10.10.5/30

   user@E# set interfaces ge-1/0/0 unit 9 description to-C
   user@E# set interfaces ge-1/0/0 unit 9 family inet address 10.10.10.9/30
   ```

2. Configure BGP.

   ```
   [edit protocols bgp group external-peers]
   user@E# set type external
   user@E# set peer-as 22
   user@E# set neighbor 10.10.10.2
   user@E# set neighbor 10.10.10.6
   user@E# set neighbor 10.10.10.10
   ```

3. Configure the autonomous system number.

```
[edit routing-options]
user@E# set autonomous-system 17
```

4. Define the filter term that accepts TCP connection attempts to port 179 from the specified BGP peers.

```
[edit firewall family inet filter filter_bgp179]
user@E# set term 1 from source-address 10.10.10.2/32
user@E# set term 1 from source-address 10.10.10.6/32
user@E# set term 1 from destination-port bgp
user@E# set term 1 then accept
```

5. Define the other filter term to reject packets from other sources.

```
[edit firewall family inet filter filter_bgp179]
user@E# set term 2 then reject
```

6. Apply the firewall filter to the loopback interface.

```
[edit interfaces lo0 unit 2 family inet]
user@E# set filter input filter_bgp179
user@E# set address 192.168.0.1/32
```

Results From configuration mode, confirm your configuration by entering the **show firewall**, **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@E# show firewall
family inet {
    filter filter_bgp179 {
        term 1 {
            from {
                source-address {
                    10.10.10.2/32;
                    10.10.10.6/32;
                }
                destination-port bgp;
            }
            then accept;
        }
        term 2 {
            then {
                reject;
            }
        }
    }
}
```

```
user@E# show interfaces
lo0 {
    unit 2 {
        family inet {
            filter {
                input filter_bgp179;
```

```
            }
            address 192.168.0.1/32;
        }
    }
}
ge-1/2/0 {
    unit 0 {
        description to-A;
        family inet {
            address 10.10.10.1/30;
        }
    }
}
ge-1/2/1 {
    unit 5 {
        description to-B;
        family inet {
            address 10.10.10.5/30;
        }
    }
}
ge-1/0/0 {
    unit 9 {
        description to-C;
        family inet {
            address 10.10.10.9/30;
        }
    }
}
```

```
user@E# show protocols
bgp {
    group external-peers {
        type external;
        peer-as 22;
        neighbor 10.10.10.2;
        neighbor 10.10.10.6;
        neighbor 10.10.10.10;
    }
}
```

```
user@E# show routing-options
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying That the Filter Is Configured on page 2963
- Verifying the TCP Connections on page 2963
- Monitoring Traffic on the Interfaces on page 2963

Verifying That the Filter Is Configured

Purpose Make sure that the filter is listed in output of the **show firewall filter** command.

Action

```
user@E> show firewall filter filter_bgp179
Filter: filter_bgp179
```

Verifying the TCP Connections

Purpose Verify the TCP connections.

Action From operational mode, run the show system connections **extensive** command on Device C and Device E.

The output on Device C shows the attempt to establish a TCP connection. The output on Device E shows that connections are established with Device A and Device B only.

```
user@C> show system connections extensive | match 10.10.10

tcp4       0      0  10.10.10.9.51872     10.10.10.10.179       SYN_SENT
```

```
user@E> show system connections extensive | match 10.10.10

tcp4       0      0  10.10.10.5.179        10.10.10.6.62096     ESTABLISHED
tcp4       0      0  10.10.10.6.62096      10.10.10.5.179       ESTABLISHED
tcp4       0      0  10.10.10.1.179        10.10.10.2.61506     ESTABLISHED
tcp4       0      0  10.10.10.2.61506      10.10.10.1.179       ESTABLISHED
```

Monitoring Traffic on the Interfaces

Purpose Use the monitor traffic command to compare the traffic on an interface that establishes a TCP connection with the traffic on an interface that does not establish a TCP connection.

Action From operational mode, run the monitor traffic command on the Device E interface to Device B and on the Device E interface to Device C. The following sample output verifies that in the first example, acknowledgment (**ack**) messages are received. In the second example, **ack** messages are not received.

```
user@E> monitor traffic size 1500 interface ge-1/2/1.5
19:02:49.700912 Out IP 10.10.10.5.bgp > 10.10.10.6.62096: P
3330573561:3330573580(19) ack 915601686 win 16384 <nop,nop,timestamp 1869518816
1869504850>: BGP, length: 19
19:02:49.801244  In IP 10.10.10.6.62096 > 10.10.10.5.bgp: . ack 19 win 16384
<nop,nop,timestamp 1869518916 1869518816>
19:03:03.323018  In IP 10.10.10.6.62096 > 10.10.10.5.bgp: P 1:20(19) ack 19 win
16384 <nop,nop,timestamp 1869532439 1869518816>: BGP, length: 19
19:03:03.422418 Out IP 10.10.10.5.bgp > 10.10.10.6.62096: . ack 20 win 16384
<nop,nop,timestamp 1869532539 1869532439>
19:03:17.220162 Out IP 10.10.10.5.bgp > 10.10.10.6.62096: P 19:38(19) ack 20 win
 16384 <nop,nop,timestamp 1869546338 1869532439>: BGP, length: 19
19:03:17.320501  In IP 10.10.10.6.62096 > 10.10.10.5.bgp: . ack 38 win 16384
<nop,nop,timestamp 1869546438 1869546338>
```

```
user@E> monitor traffic size 1500 interface ge-1/0/0.9

18:54:20.175471 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
```

```
 win 16384 <mss 1460,nop,wscale 0,nop,nop,timestamp 1869009240 0,sackOK,eol>
18:54:23.174422 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
 win 16384 <mss 1460,nop,wscale 0,nop,nop,timestamp 1869012240 0,sackOK,eol>
18:54:26.374118 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
 win 16384 <mss 1460,nop,wscale 0,nop,nop,timestamp 1869015440 0,sackOK,eol>
18:54:29.573799 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
 win 16384 <mss 1460,sackOK,eol>
18:54:32.773493 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
 win 16384 <mss 1460,sackOK,eol>
18:54:35.973185 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
 win 16384 <mss 1460,sackOK,eol>
```

Example: Configuring a Filter to Limit TCP Access to a Port Based On a Prefix List

This example shows how to configure a standard stateless firewall filter that limits certain TCP and Internet Control Message Protocol (ICMP) traffic destined for the Routing Engine by specifying a list of prefix sources that contain allowed BGP peers.

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

In this example, you create a stateless firewall filter that blocks all TCP connection attempts to port 179 from all requesters except BGP peers that have a specified prefix.

A source prefix list, **plist_bgp179**, is created that specifies the list of source prefixes that contain allowed BGP peers.

The stateless firewall filter **filter_bgp179** matches all packets from the source prefix list **plist_bgp179** to the destination port number 179.

Configuration

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode*.

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set policy-options prefix-list plist_bgp179 apply-path "protocols bgp group <*> neighbor
  <*>"
set firewall family inet filter filter_bgp179 term 1 from source-address 0.0.0.0/0
```

```
set firewall family inet filter filter_bgp179 term 1 from source-prefix-list plist_bgp179 except
set firewall family inet filter filter_bgp179 term 1 from destination-port bgp
set firewall family inet filter filter_bgp179 term 1 then reject
set firewall family inet filter filter_bgp179 term 2 then accept
set interfaces lo0 unit 0 family inet filter input filter_bgp179
set interfaces lo0 unit 0 family inet address 127.0.0.1/32
```

Configure the Filter

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the filter:

1. Expand the prefix list **bgp179** to include all prefixes pointed to by the BGP peer group defined by **protocols bgp group <*> neighbor <*>**.

   ```
   [edit policy-options prefix-list plist_bgp179]
   user@host# set apply-path "protocols bgp group <*> neighbor <*>"
   ```

2. Define the filter term that rejects TCP connection attempts to port 179 from all requesters except the specified BGP peers.

   ```
   [edit firewall family inet filter filter_bgp179]
   user@host# set term term1 from source-address 0.0.0.0/0
   user@host# set term term1 from source-prefix-list bgp179 except
   user@host# set term term1 from destination-port bgp
   user@host# set term term1 then reject
   ```

3. Define the other filter term to accept all packets.

   ```
   [edit firewall family inet filter filter_bgp179]
   user@host# set term term2 then accept
   ```

4. Apply the firewall filter to the loopback interface.

   ```
   [edit interfaces lo0 unit 0 family inet]
   user@host# set filter input filter_bgp179
   user@host# set address 127.0.0.1/32
   ```

Results

From configuration mode, confirm your configuration by entering the **show firewall**, **show interfaces**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show firewall
family inet {
    filter filter_bgp179 {
        term 1 {
            from {
                source-address {
                    0.0.0.0/0;
                }
                source-prefix-list {
                    plist_bgp179 except;
```

```
            }
            destination-port bgp;
        }
        then {
            reject;
        }
    }
    term 2 {
        then {
            accept;
        }
    }
  }
}
```

```
user@host# show interfaces
lo0 {
  unit 0 {
    family inet {
      filter {
        input filter_bgp179;
      }
      address 127.0.0.1/32;
    }
  }
}
```

```
user@host# show policy-options
prefix-list plist_bgp179 {
  apply-path "protocols bgp group <*> neighbor <*>";
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Repeat the procedure, where appropriate, for every BGP-enabled device in the network, using the appropriate interface names and addresses for each BGP-enabled device.

Verification

Confirm that the configuration is working properly.

Displaying the Firewall Filter Applied to the Loopback Interface

Purpose Verify that the firewall filter **filter_bgp179** is applied to the IPv4 input traffic at logical interface **lo0.0**.

Action Use the **show interfaces statistics** operational mode command for logical interface **lo0.0**, and include the **detail** option. Under the **Protocol inet** section of the command output section, the **Input Filters** field displays the name of the stateless firewall filter applied to the logical interface in the input direction:

```
[edit]
user@host> show interfaces statistics lo0.0 detail
  Logical interface lo0.0 (Index 321) (SNMP ifIndex 16) (Generation 130)
    Flags: SNMP-Traps Encapsulation: Unspecified
    Traffic statistics:
     Input  bytes  :                   0
```



```
      Output bytes  :                0
      Input  packets:                0
      Output packets:                0
     Local statistics:
      Input  bytes  :                0
      Output bytes  :                0
      Input  packets:                0
      Output packets:                0
     Transit statistics:
      Input  bytes  :                0                    0 bps
      Output bytes  :                0                    0 bps
      Input  packets:                0                    0 pps
      Output packets:                0                    0 pps
     Protocol inet, MTU: Unlimited, Generation: 145, Route table: 0
       Flags: Sendbcast-pkt-to-re
       Input Filters: filter_bgp179
       Addresses, Flags: Primary
         Destination: Unspecified, Local: 127.0.0.1, Broadcast: Unspecified,
Generation: 138
```

Example: Limiting TCP Segment Size for BGP

This example shows how to avoid Internet Control Message Protocol (ICMP) vulnerability issues by limiting TCP segment size when you are using maximum transmission unit (MTU) discovery. Using MTU discovery on TCP paths is one method of avoiding BGP packet fragmentation.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

TCP negotiates a maximum segment size (MSS) value during session connection establishment between two peers. The MSS value negotiated is primarily based on the maximum transmission unit (MTU) of the interfaces to which the communicating peers are directly connected. However, due to variations in link MTU on the path taken by the TCP packets, some packets in the network that are well within the MSS value might be fragmented when the packet size exceeds the link's MTU.

To configure the TCP MSS value, include the **tcp-mss** statement with a segment size from 1 through 4096.

If the router receives a TCP packet with the SYN bit and the MSS option set, and the MSS option specified in the packet is larger than the MSS value specified by the **tcp-mss** statement, the router replaces the MSS value in the packet with the lower value specified by the **tcp-mss** statement.

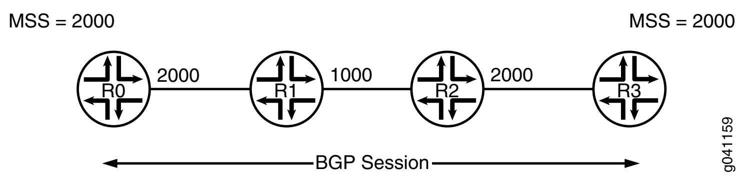
The configured MSS value is used as the maximum segment size for the sender. The assumption is that the TCP MSS value used by the sender to communicate with the BGP neighbor is the same as the TCP MSS value that the sender can accept from the BGP neighbor. If the MSS value from the BGP neighbor is less than the MSS value configured, the MSS value from the BGP neighbor is used as the maximum segment size for the sender.

This feature is supported with TCP over IPv4 and TCP over IPv6.

Topology Diagram

Figure 70 on page 2968 shows the topology used in this example.

Figure 70: TCP Maximum Segment Size for BGP



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

R0

```
set interfaces fe-1/2/0 unit 1 family inet address 1.1.0.1/30
set interfaces lo0 unit 1 family inet address 10.255.14.179/32
set protocols bgp group-int tcp-mss 2020
set protocols bgp group int type internal
set protocols bgp group int local-address 10.255.14.179
set protocols bgp group int mtu-discovery
set protocols bgp group int neighbor 10.255.71.24 tcp-mss 2000
set protocols bgp group int neighbor 10.255.14.177
set protocols bgp group int neighbor 10.0.14.4 tcp-mss 4000
set protocols ospf area 0.0.0.0 interface fe-1/2/0.1
set protocols ospf area 0.0.0.0 interface 10.255.14.179
set routing-options autonomous-system 65000
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router R0:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@R0# set fe-1/2/0 unit 1 family inet address 1.1.0.1/30
   user@R0# set lo0 unit 1 family inet address 10.255.14.179/32
   ```

2. Configure an interior gateway protocol (IGP), OSPF in this example.

   ```
   [edit protocols ospf area 0.0.0.0]
   ```

user@R0# **set interface fe-1/2/0.1**
user@R0# **set interface 10.255.14.179**

3. Configure one or more BGP groups.

   [edit protocols bgp group int]
   user@R0# **set type internal**
   user@R0# **set local-address 10.255.14.179**

4. Configure MTU discovery to prevent packet fragmentation.

   [edit protocols bgp group int]
   user@R0# **set mtu-discovery**

5. Configure the BGP neighbors, with the TCP MSS set globally for the group or specifically for the various neighbors.

   [edit protocols bgo group int]
   user@R0# **set tcp-mss 2020**
   user@R0# **set neighbor 10.255.14.177**
   user@R0# **set neighbor 10.255.71.24 tcp-mss 2000**
   user@R0# **set neighbor 10.0.14.4 tcp-mss 4000**

   NOTE: **The TCP MSS neighbor setting overrides the group setting.**

6. Configure the local autonomous system.

   [edit routing-options]
   user@R0# **set autonomous-system 65000**

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R0# show interfaces
fe-1/2/0 {
  unit 1 {
    family inet {
      address 1.1.0.1/30;
    }
  }
}
lo0 {
  unit 1 {
    family inet {
      address 10.255.14.179/32;
    }
  }
}
```

```
user@R0# show protocols
bgp {
  group int {
    type internal;
    local-address 10.255.14.179;
```

```
            mtu-discovery;
            tcp-mss 2020;
            neighbor 10.255.71.24 {
                tcp-mss 2000;
            }
            neighbor 10.255.14.177;
            neighbor 10.0.14.4 {
                tcp-mss 4000;
            }
        }
    }
    ospf {
        area 0.0.0.0 {
            interface fe-1/2/0.1;
            interface 10.255.14.179;
        }
    }
```

```
    user@R0# show routing-options
    autonomous-system 65000;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

To confirm that the configuration is working properly, run the following commands:

- show system connections **extensive | find <neighbor-address>**, to check the negotiated TCP MSS value.
- monitor traffic **interface**, to monitor BGP traffic and to make sure that the configured TCP MSS value is used as the MSS option in the TCP SYN packet.

Troubleshooting

- MSS Calculation with MTU Discovery on page 2970

MSS Calculation with MTU Discovery

Problem Consider an example in which two routing devices (R1 and R2) have an internal BGP (IBGP) connection. On both of the routers, the connected interfaces have 4034 as the IPv4 MTU.

```
user@R1# show protocols bgp | display set
[edit]
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 45.45.45.2
set protocols bgp group ibgp mtu-discovery
set protocols bgp group ibgp neighbor 45.45.45.1
```

```
user@R1# run show interfaces xe-0/0/3 extensive | match mtu

  Link-level type: Ethernet, MTU: 4048, LAN-PHY mode, Speed: 10Gbps,
    FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
    Protocol inet, MTU: 4034, Generation: 180, Route table: 0
    Protocol multiservice, MTU: Unlimited, Generation: 181, Route table: 0
```


In the following packet capture on Device R1, the negotiated MSS is 3994. In the **show system connections extensive** information for MSS, it is set to 2048.

```
05:50:01.575218 Out
        Juniper PCAP Flags [Ext], PCAP Extension(s) total length 16
          Device Media Type Extension TLV #3, length 1, value: Ethernet (1)
          Logical Interface Encapsulation Extension TLV #6, length 1, value:
Ethernet (14)
          Device Interface Index Extension TLV #1, length 2, value: 137
          Logical Interface Index Extension TLV #4, length 4, value: 69
        -----original packet-----
        00:21:59:e1:e8:03 > 00:19:e2:20:79:01, ethertype IPv4 (0x0800), length
78: (tos 0xc0, ttl 64, id 53193, offset 0, flags [DF], proto: TCP (6), length:
64) 45.45.45.2.62840 > 45.45.45.1.bgp: S 2939345813:2939345813(0) win 16384 **mss
 3994,nop,wscale 0,nop,nop,timestamp 70559970 0,sackOK,eol>
05:50:01.575875 In
        Juniper PCAP Flags [Ext, no-L2, In], PCAP Extension(s) total length 16
          Device Media Type Extension TLV #3, length 1, value: Ethernet (1)
          Logical Interface Encapsulation Extension TLV #6, length 1, value:
Ethernet (14)
          Device Interface Index Extension TLV #1, length 2, value: 137
          Logical Interface Index Extension TLV #4, length 4, value: 69
        -----original packet-----
  PFE proto 2 (ipv4): (tos 0xc0, ttl 255, id 37709, offset 0, flags [DF], proto:
 TCP (6), length: 64) 45.45.45.1.bgp > 45.45.45.2.62840: S 2634967984:2634967984(0)
 ack 2939345814 win 16384 **mss 3994,nop,wscale 0,nop,nop,timestamp 174167273
70559970,sackOK,eol>
```

```
user@R1# run show system connections extensive | find 45.45

tcp4       0      0  45.45.45.2.62840                           45.45.45.1.179
                                 ESTABLISHED
   sndsbcc:          0 sndsbmbcnt:         0  sndsbmbmax:     131072
sndsblowat:       2048 sndsbhiwat:      16384
   rcvsbcc:          0 rcvsbmbcnt:         0  rcvsbmbmax:     131072
rcvsblowat:          1 rcvsbhiwat:      16384
   proc id:      19725  proc name:        rpd
       iss: 2939345813      sndup: 2939345972
    snduna: 2939345991     sndnxt: 2939345991      sndwnd:      16384
    sndmax: 2939345991    sndcwnd:      10240 sndssthresh: 1073725440
       irs: 2634967984      rcvup: 2634968162
    rcvnxt: 2634968162     rcvadv: 2634984546      rcvwnd:      16384
       rtt:          0       srtt:       1538        rttv:       1040
    rxtcur:       1200   rxtshift:          0       rtseq: 2939345972
    rttmin:       1000  mss:        2048
```

Solution This is expected behavior with Junos OS. The MSS value is equal to the MTU value minus the IP or IPv6 and TCP headers. This means that the MSS value is generally 40 bytes less than the MTU (for IPv4) and 60 bytes less than the MTU (for IPv6). This value is negotiated between the peers. In this example, it is 4034 - 40 = 3994. Junos OS then rounds this value to a multiple of 2 KB. The value is 3994 / 2048 * 2048=2048. So it is not necessary to see same MSS value with in the **show system connections** output.

3994 / 2048 = 1.95

1.95 is rounded to 1.

1 * 2048 = 2048

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

BGP Flap Configuration

Example: Preventing BGP Session Resets

Understanding BGP Session Resets

Certain configuration actions and events cause BGP sessions to be reset (dropped and then reestablished).

If you configure both route reflection and VPNs on the same routing device, the following modifications to the route reflection configuration cause current BGP sessions to be reset:

- Adding a cluster ID—If a BGP session shares the same autonomous system (AS) number with the group where you add the cluster ID, all BGP sessions are reset regardless of whether the BGP sessions are contained in the same group.
- Creating a new route reflector—If you have an internal BGP (IBGP) group with an AS number and create a new route reflector group with the same AS number, all BGP sessions in the IBGP group and the new route reflector group are reset.
- Changing configuration statements that affect BGP peers, such as renaming a BGP group, resets the BGP sessions.
- If you change the address family specified in the **[edit protocols bgp family]** hierarchy level, all current BGP sessions on the routing device are dropped and then reestablished.

Example: Preventing BGP Session Flaps When VPN Families Are Configured

This example shows a workaround for a known issue in which BGP sessions sometimes go down and then come back up (in other words, flap) when virtual private network (VPN) families are configured. If any VPN family (for example, **inet-vpn**, **inet6-vpn**, **inet-mpvn**, **inet-mdt**, **inet6-mpvn**, **l2vpn**, **iso-vpn**, and so on) is configured on a BGP master instance, a flap of either a route reflector (RR) internal BGP (IBGP) session or an external BGP (EBGP) session causes flaps of other BGP sessions configured with the same VPN family.

Requirements

Before you begin:

- Configure router interfaces.
- Configure an interior gateway protocol (IGP).
- Configure BGP.
- Configure VPNs.

Overview

When a router or switch is configured as either a route reflector (RR) or an AS boundary router (an external BGP peer) and a VPN family (for example, the **family inet-vpn unicast** statement) is configured, a flap of either the RR IBGP session or the EBGP session causes flaps of all other BGP sessions that are configured with the **family inet-vpn unicast** statement. This example shows how to prevent these unnecessary session flaps.

The reason for the flapping behavior is related to BGP operation in Junos OS when originating VPN routes.

BGP has the following two modes of operation with respect to originating VPN routes:

- If BGP does not need to propagate VPN routes because the session has no EBGP peer and no RR clients, BGP exports VPN routes directly from the ***instance*.inet.0** routing table to other PE routers. This behavior is efficient in that it avoids the creation of two copies of many routes (one in the ***instance*.inet.0** table and one in the **bgp.l3vpn.0** table).
- If BGP does need to propagate VPN routes because the session has an EBGP peer or RR clients, BGP first exports the VPN routes from the ***instance*.inet.0** table to the **bgp.l3vpn.0** table. Then BGP exports the routes to other PE routers. In this scenario, two copies of the route are needed to enable best-route selection. A PE router might receive the same VPN route from a CE device and also from an RR client or EBGP peer.

When, because of a configuration change, BGP transitions from needing two copies of a route to not needing two copies of a route (or the reverse), all sessions over which VPN routes are exchanged go down and then come back up. Although this example focuses on the **family inet-vpn unicast** statement, the concept applies to all VPN network layer reachability information (NLRI) families. This issue impacts logical systems as well. All BGP sessions in the master instance related to the VPN NLRI family are brought down to implement the table advertisement change for the VPN NLRI family. Changing an RR to a non-RR or the reverse (by adding or removing the **cluster** statement) causes the table advertisement change. Also, configuring the first EBGP session or removing the EBGP session from the configuration in the master instance for a VPN NLRI family causes the table advertisement change.

The way to prevent these unnecessary session flaps is to configure an extra RR client or EBGP session as a passive session with a neighbor address that does not exist. This example focuses on the EBGP case, but the same workaround works for the RR case.

When a session is passive, the routing device does not send Open requests to a peer. Once you configure the routing device to be passive, the routing device does not originate the TCP connection. However, when the routing device receives a connection from the peer and an Open message, it replies with another BGP Open message. Each routing device declares its own capabilities.

Figure 71 on page 2975 shows the topology for the EBGP case. Router R1 has an IBGP session with Routers R2 and R3 and an EBGP session with Router R4. All sessions have the **family inet-vpn unicast** statement configured. If the R1-R4 EBGP session flaps, the R1-R2 and R1-R3 BGP sessions flap also.

Figure 71: Topology for the EBGP Case

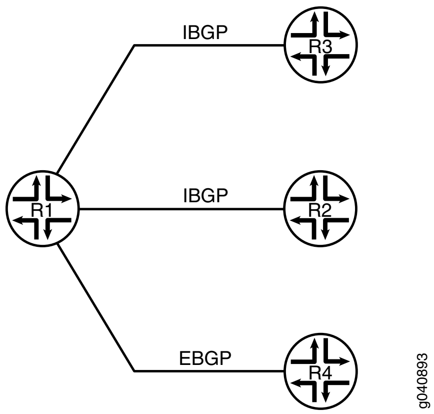
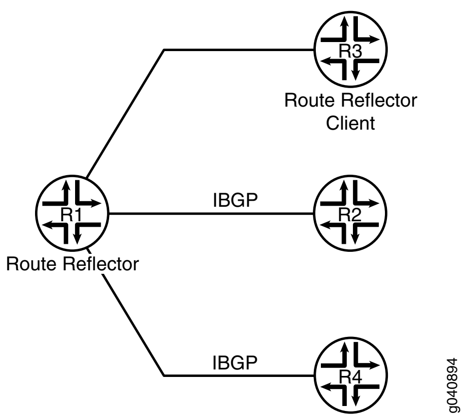


Figure 72 on page 2975 shows the topology for the RR case. Router R1 is the RR, and Router R3 is the client. Router R1 has IBGP sessions with Routers R2 and R3. All sessions have the **family inet-vpn unicast** statement configured. If the R1-R3 session flaps, the R1-R2 and R1-R4 sessions flap also.

Figure 72: Topology for the RR Case



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols bgp family inet-vpn unicast
set protocols bgp family l2vpn signaling
set protocols bgp group R1-R4 type external
set protocols bgp group R1-R4 local-address 4.4.4.2
set protocols bgp group R1-R4 neighbor 4.4.4.1 peer-as 200
set protocols bgp group R1-R2-R3 type internal
set protocols bgp group R1-R2-R3 log-updown
set protocols bgp group R1-R2-R3 local-address 15.15.15.15
set protocols bgp group R1-R2-R3 neighbor 12.12.12.12
set protocols bgp group R1-R2-R3 neighbor 13.13.13.13
set protocols bgp group Fake type external
```


set protocols bgp group Fake passive
set protocols bgp group Fake neighbor 100.100.100.100 peer-as 500

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the EBGP scenario:

1. Configure one or more VPN families.

   [edit protocols bgp]
   user@R1# **set family inet-vpn unicast**
   user@R1# **set family l2vpn signaling**

2. Configure the EBGP session.

   [edit protocols bgp]
   user@R1# **set group R1-R4 type external**
   user@R1# **set group R1-R4 local-address 4.4.4.2**
   user@R1# **set group R1-R4 neighbor 4.4.4.1 peer-as 200**

3. Configure the IBGP sessions.

   [edit protocols bgp]
   user@R1# **set group R1-R2-R3 type internal**
   user@R1# **set group R1-R2-R3 local-address 15.15.15.15**
   user@R1# **set group R1-R2-R3 neighbor 12.12.12.12**
   user@R1# **set group R1-R2-R3 neighbor 13.13.13.13**

4. (Optional) Configure BGP so that it generates a **syslog** message whenever a BGP peer makes a state transition.

   [edit protocols bgp]
   user@R1# **set group R1-R2-R3** log-updown

   Enabling the **log-updown** statement causes BGP state transitions to be logged at **warning** level.

Step-by-Step Procedure

To verify that unnecessary session flaps are occurring:

1. Run the **show bgp summary** command to verify that the sessions have been established.

```
user@R1> show bgp summary
Groups: 2 Peers: 3 Down peers: 0
Table       Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0         0         0          0       0          0
bgp.l2vpn.0 0         0         0          0       0          0
inet.0      0         0         0          0       0          0
Peer        AS  InPkt OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
4.4.4.1     200 6     5      0    0     1:08 Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
12.12.12.12 100 3     7      0    0     1:18 Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
13.13.13.13 100 3     6      0    0     1:14 Establ
```

```
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
```

2. Deactivate the EBGP session.

   user@R1# **deactivate group R1-R4**
   user@R1# **commit**

```
Mar 10 18:27:40 R1: rpd[1464]: bgp_peer_delete:6589: NOTIFICATION sent to
4.4.4.1 (External AS 200): code 6 (Cease) subcode 3 (Peer Unconfigured),
Reason: Peer Deletion
Mar 10 18:27:40 R1: rpd[1464]: bgp_adv_main_update:7253: NOTIFICATION sent
to 12.12.12.12 (Internal AS 100): code 6 (Cease) subcode 6 (Other
Configuration Change), Reason: Configuration change - VPN table advertise
Mar 10 18:27:40 R1: rpd[1464]: bgp_adv_main_update:7253: NOTIFICATION sent
to 13.13.13.13 (Internal AS 100): code 6 (Cease) subcode 6 (Other
Configuration Change), Reason: Configuration change - VPN table advertise
```

3. Run the **show bgp summary** command to view the session flaps.

```
user@R1> show bgp summary
Groups: 1 Peers: 2 Down peers: 2
Table       Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0         0         0          0       0          0
bgp.l2vpn.0 0         0         0          0       0          0
inet.0      0         0         0          0       0          0
Peer        AS   InPkt  OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
12.12.12.12 100  4      9      0    1     19   Active
13.13.13.13 100  4      8      0    1     19   Active
```

```
user@R1> show bgp summary
Groups: 1 Peers: 2 Down peers: 0
Table       Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0         0         0          0       0          0
bgp.l2vpn.0 0         0         0          0       0          0
inet.0      0         0         0          0       0          0
Peer        AS  InPkt OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
12.12.12.12 100 2     3      0    1     0    Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
13.13.13.13 100 2     3      0    1     0    Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To prevent unnecessary BGP session flaps:

1. Add a passive EBGP session with a neighbor address that does not exist in the peer autonomous system (AS).

   [edit protocols bgp]
   user@R1# **set group Fake type external**
   user@R1# **set group Fake** passive
   user@R1# **set neighbor 100.100.100.100 peer-as 500**

2. Run the **show bgp summary** command to verify that the real sessions have been established and the passive session is idle.

```
user@R1> show bgp summary
Groups: 3 Peers: 4 Down peers: 1
Table       Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0         0         0          0       0          0
bgp.l2vpn.0 0         0         0          0       0          0
Peer            AS   InPkt OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
4.4.4.1         200  9500   9439   0    0     2d   23:14:23 Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
12.12.12.12     100  10309  10239  0    0     3d    5:17:49 Establ
bgp.l3vpn.0: 0/0/0/0
13.13.13.13     100  10306  10241  0    0     3d    5:18:25 Establ
bgp.l3vpn.0: 0/0/0/0
100.100.100.100 500  0      0      0    0     2d   23:38:52 Idle
```

Verification

Confirm that the configuration is working properly.

- Bringing Down the EBGP Session on page 2978
- Verifying That the IBGP Sessions Remain Up on page 2978

Bringing Down the EBGP Session

Purpose Try to cause the flap issue after the workaround is configured.

Action

```
user@R1# deactivate group R1-R4
user@R1# commit
```

Verifying That the IBGP Sessions Remain Up

Purpose Make sure that the IBGP sessions do not flap after the EBGP session is deactivated.

Action

```
user@R1> show bgp summary
Groups: 2 Peers: 3 Down peers: 1
Table        Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0          0         0          0       0          0
bgp.l2vpn.0 0          0         0          0       0          0
Peer            AS   InPkt OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
12.12.12.12      100 10312 10242  0    0     3d    5:19:01  Establ
bgp.l3vpn.0: 0/0/0/0
13.13.13.13      100 10309 10244  0    0     3d    5:19:37  Establ
bgp.l3vpn.0: 0/0/0/0
100.100.100.100  500 0     0      0    0     2d   23:40:04  Idle

user@R1> show bgp summary
Groups: 3 Peers: 4 Down peers: 1
Table        Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0          0         0          0       0          0
bgp.l2vpn.0 0          0         0          0       0          0
Peer            AS   InPkt OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
4.4.4.1          200 5     4      0    0     28             Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
12.12.12.12      100 10314 10244  0    0     3d    5:19:55  Establ
bgp.l3vpn.0: 0/0/0/0
13.13.13.13      100 10311 10246  0    0     3d    5:20:31  Establ
bgp.l3vpn.0: 0/0/0/0
100.100.100.100  500 0     0      0    0     2d   23:40:58  Idle
```

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

Examples: Configuring BGP Flap Damping

Understanding Damping Parameters

BGP *route flapping* describes the situation in which BGP systems send an excessive number of update messages to advertise network reachability information. BGP *flap damping* is a method of reducing the number of update messages sent between BGP peers, thereby reducing the load on these peers, without adversely affecting the route convergence time for stable routes.

Flap damping reduces the number of update messages by marking routes as ineligible for selection as the active or preferable route. Marking routes in this way leads to some delay, or *suppression*, in the propagation of route information, but the result is increased network stability. You typically apply flap damping to external BGP (EBGP) routes (routes in different ASs). You can also apply flap damping within a confederation, between confederation member ASs. Because routing consistency within an AS is important, do not apply flap damping to internal BGP (IBGP) routes. (If you do, it is ignored.) The exception to this rule is when flap damping is applied at the address family level, which is supported in Junos OS Release 12.2 and later. When you apply flap damping at the address family level, it works for both IBGP and EBGP.

By default, route flap damping is not enabled. Damping is applied to external peers and to peers at confederation boundaries.

When you enable damping, default parameters are applied, as summarized in Table 228 on page 2980.

Table 228: Damping Parameters

Damping Parameter	Description	Default Value	Possible Values
half-life ***minutes***	Decay half-life—Number of minutes after which an arbitrary value is halved if a route stays stable.	15 (minutes)	1 through 45
max-suppress ***minutes***	Maximum hold-down time for a route, in minutes.	60 (minutes)	1 through 720
reuse	Reuse threshold—Arbitrary value below which a suppressed route can be used again.	750	1 through 20,000
suppress	Cutoff (suppression) threshold—Arbitrary value above which a route can no longer be used or included in advertisements.	3000	1 through 20,000

To change the default BGP flap damping values, you define actions by creating a named set of damping parameters and including it in a routing policy with the damping action. For the damping routing policy to work, you also must enable BGP route flap damping.

Example: Configuring Damping Parameters

This example shows how to configure damping parameters.

Requirements

Before you begin, configure router interfaces and configure routing protocols.

Overview

This example has three routing devices. Device R2 has external BGP (EBGP) connections with Device R1 and Device R3.

Device R1 and Device R3 have some static routes configured for testing purposes, and these static routes are advertised through BGP to Device R2.

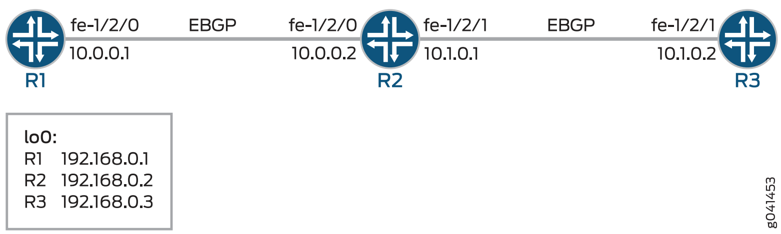
Device R2 damps routes received from Device R1 and Device R3 according to these criteria:

- Damp all prefixes with a mask length equal to or greater than 17 more aggressively than routes with a mask length between 9 and 16.
- Damp routes with a mask length between 0 and 8, inclusive, less than routes with a mask length greater than 8.
- Do not damp the 10.128.0.0/9 prefix at all.

The routing policy is evaluated when routes are being exported from the routing table into the forwarding table. Only the active routes are exported from the routing table.

Figure 73 on page 2981 shows the sample network.

Figure 73: BGP Flap Damping Topology



"CLI Quick Configuration" on page 2981 shows the configuration for all of the devices in Figure 73 on page 2981.

The section "Step-by-Step Procedure" on page 2982 describes the steps on Device R2.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct-and-static
set protocols bgp group ext peer-as 200
set protocols bgp group ext neighbor 10.0.0.2
set policy-options policy-statement send-direct-and-static term 1 from protocol direct
set policy-options policy-statement send-direct-and-static term 1 from protocol static
set policy-options policy-statement send-direct-and-static term 1 then accept
set routing-options static route 172.16.0.0/16 reject
set routing-options static route 172.16.128.0/17 reject
set routing-options static route 172.16.192.0/20 reject
set routing-options static route 10.0.0.0/9 reject
set routing-options static route 224.0.0.0/7 reject
set routing-options static route 10.224.0.0/11 reject
set routing-options static route 0.0.0.0/0 reject
set routing-options autonomous-system 100
```

Device R2

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 0 family inet address 10.1.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
```



```
set protocols bgp damping
set protocols bgp group ext type external
set protocols bgp group ext import damp
set protocols bgp group ext export send-direct
set protocols bgp group ext neighbor 10.0.0.1 peer-as 100
set protocols bgp group ext neighbor 10.1.0.2 peer-as 300
set policy-options policy-statement damp term 1 from route-filter 10.128.0.0/9 exact
  damping dry
set policy-options policy-statement damp term 1 from route-filter 0.0.0.0/0
  prefix-length-range /0-/8 damping timid
set policy-options policy-statement damp term 1 from route-filter 0.0.0.0/0
  prefix-length-range /17-/32 damping aggressive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options damping aggressive half-life 30
set policy-options damping aggressive suppress 2500
set policy-options damping timid half-life 5
set policy-options damping dry disable
set routing-options autonomous-system 200
```

Device R3

```
set interfaces fe-1/2/1 unit 0 family inet address 10.1.0.2/30
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct-and-static
set protocols bgp group ext peer-as 200
set protocols bgp group ext neighbor 10.1.0.1
set policy-options policy-statement send-direct-and-static term 1 from protocol direct
set policy-options policy-statement send-direct-and-static term 1 from protocol static
set policy-options policy-statement send-direct-and-static term 1 then accept
set routing-options static route 10.128.0.0/9 reject
set routing-options autonomous-system 300
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure damping parameters:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@R2# set fe-1/2/0 unit 0 family inet address 10.0.0.2/30

   user@R2# set fe-1/2/1 unit 0 family inet address 10.1.0.1/30

   user@R2# set lo0 unit 0 family inet address 192.168.0.2/32
   ```

2. Configure the BGP neighbors.

   ```
   [edit protocols bgp group ext]
   user@R2# set type external
   user@R2# set neighbor 10.0.0.1 peer-as 100
   user@R2# set neighbor 10.1.0.2 peer-as 300
   ```

3. Create and configure the damping parameter groups.

```
[edit policy-options]
user@R2# set damping aggressive half-life 30
user@R2# set damping aggressive suppress 2500
user@R2# set damping timid half-life 5
user@R2# set damping dry disable
```

4. Configure the damping policy.

```
[edit policy-options policy-statement damp term 1]
user@R2# set from route-filter 10.128.0.0/9 exact damping dry
user@R2# set from route-filter 0.0.0.0/0 prefix-length-range /0-/8 damping timid
user@R2# set from route-filter 0.0.0.0/0 prefix-length-range /17-/32 damping
  aggressive
```

5. Enable damping for BGP.

```
[edit protocols bgp]
user@R2# set damping
```

6. Apply the policy as an import policy for the BGP neighbor.

```
[edit protocols bgp group ext]
user@R2# set import damp
```

NOTE: You can refer to the same routing policy one or more times in the same or different **import** statements.

7. Configure an export policy.

```
[edit policy-options policy-statement send-direct term 1]
user@R2# set from protocol direct
user@R2# set then accept
```

8. Apply the export policy.

```
[edit protocols bgp group ext]
user@R2# set export send-direct
```

9. Configure the autonomous system (AS) number.

```
[edit routing-options]
user@R2# set autonomous-system 200
```

Results From configuration mode, confirm your configuration by issuing the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
  unit 0 {
    family inet {
      address 10.0.0.2/30;
    }
```

```
    }
}
fe-1/2/1 {
    unit 0 {
        family inet {
            address 10.1.0.1/30;
        }
    }
}
lo0 {
    unit 0 {
        family inet {
            address 192.168.0.2/32;
        }
    }
}
```

```
user@R2# show protocols
bgp {
    damping;
    group ext {
        type external;
        import damp;
        export send-direct;
        neighbor 10.0.0.1 {
            peer-as 100;
        }
        neighbor 10.1.0.2 {
            peer-as 300;
        }
    }
}
```

```
user@R2# show policy-options
policy-statement damp {
    term 1 {
        from {
            route-filter 10.128.0.0/9 exact damping dry;
            route-filter 0.0.0.0/0 prefix-length-range /0-/8 damping timid;
            route-filter 0.0.0.0/0 prefix-length-range /17-/32 damping aggressive;
        }
    }
}
policy-statement send-direct {
    term 1 {
        from protocol direct;
        then accept;
    }
}
damping aggressive {
    half-life 30;
    suppress 2500;
}
damping timid {
    half-life 5;
}
damping dry {
```

```
    disable;
  }
user@R2# show routing-options
autonomous-system 200;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Causing Some Routes to Flap

Purpose To verify your route flap damping policy, some routes must flap. Having a live Internet feed almost guarantees that a certain number of route flaps will be present. If you have control over a remote system that is advertising the routes, you can modify the advertising router's policy to effect the advertisement and withdrawal of all routes or of a given prefix. In a test environment, you can cause routes to flap by clearing the BGP neighbors or by restarting the routing process on the BGP neighbors, as shown here.

Action From operational mode on Device R1 and Device R3, enter the **restart routing** command.

CAUTION: **Use this command cautiously in a production network.**

```
user@R1> restart routing

R1 started, pid 10474

user@R3> restart routing

R3 started, pid 10478
```

Meaning On Device R2, all of the routes from the neighbors are withdrawn and re-advertised.

Checking the Route Flaps

Purpose View the number of neighbor flaps.

Action From operational mode, enter the **show bgp summary** command.

```
user@R2> show bgp summary
```

```
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                      12          1         11          0         11          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.0.0.1                100         10         10       0       4        2:50
0/9/0/9              0/0/0/0
10.1.0.2                300         10         10       0       4        2:53
1/3/1/2              0/0/0/0
```

Meaning This output was captured after the routing process was restarted on Device R2's neighbors four times.

Verifying Route Flap Damping

Purpose Verify that routes are being hidden due to damping.

Action From operational mode, enter the **show route damping suppressed** command.

```
user@R2> show route damping suppressed

inet.0: 15 destinations, 17 routes (6 active, 0 holddown, 11 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0          [BGP ] 00:00:12, localpref 100
                     AS path: 100 I, validation-state: unverified
                   > to 10.0.0.1 via fe-1/2/0.0
10.0.0.0/9         [BGP ] 00:00:12, localpref 100
                     AS path: 100 I, validation-state: unverified
                   > to 10.0.0.1 via fe-1/2/0.0
10.0.0.0/30        [BGP ] 00:00:12, localpref 100
                     AS path: 100 I, validation-state: unverified
                   > to 10.0.0.1 via fe-1/2/0.0
10.1.0.0/30        [BGP ] 00:00:15, localpref 100
                     AS path: 300 I, validation-state: unverified
                   > to 10.1.0.2 via fe-1/2/1.0
10.224.0.0/11      [BGP ] 00:00:12, localpref 100
                     AS path: 100 I, validation-state: unverified
                   > to 10.0.0.1 via fe-1/2/0.0
172.16.0.0/16      [BGP ] 00:00:12, localpref 100
                     AS path: 100 I, validation-state: unverified
                   > to 10.0.0.1 via fe-1/2/0.0
172.16.128.0/17    [BGP ] 00:00:12, localpref 100
                     AS path: 100 I, validation-state: unverified
                   > to 10.0.0.1 via fe-1/2/0.0
172.16.192.0/20    [BGP ] 00:00:12, localpref 100
                     AS path: 100 I, validation-state: unverified
                   > to 10.0.0.1 via fe-1/2/0.0
192.168.0.1/32     [BGP ] 00:00:12, localpref 100
                     AS path: 100 I, validation-state: unverified
                   > to 10.0.0.1 via fe-1/2/0.0
192.168.0.3/32     [BGP ] 00:00:15, localpref 100
                     AS path: 300 I, validation-state: unverified
                   > to 10.1.0.2 via fe-1/2/1.0
224.0.0.0/7        [BGP ] 00:00:12, localpref 100
                     AS path: 100 I, validation-state: unverified
                   > to 10.0.0.1 via fe-1/2/0.0
```


Meaning The output shows some routing instability. Eleven routes are hidden due to damping.

Displaying the Details of a Damped Route

Purpose Display the details of damped routes.

Action From operational mode, enter the **show route damping suppressed 172.16.192.0/20 detail** command.

user@R2> **show route damping suppressed 172.16.192.0/20 detail**

```
inet.0: 15 destinations, 17 routes (6 active, 0 holddown, 11 hidden)
172.16.192.0/20 (1 entry, 0 announced)
         BGP                /-101
                Next hop type: Router, Next hop index: 758
                Address: 0x9414484
                Next-hop reference count: 9
                Source: 10.0.0.1
                Next hop: 10.0.0.1 via fe-1/2/0.0, selected
                Session Id: 0x100201
                State: <Hidden Ext>
                Local AS:   200 Peer AS:   100
                Age: 52
                Validation State: unverified
                Task: BGP_100.10.0.0.1+55922
                AS path: 100 I
                Localpref: 100
                Router ID: 192.168.0.1
                Merit (last update/now): 4278/4196
                damping-parameters: aggressive
                Last update:       00:00:52 First update:       01:01:55
                Flaps: 8
                Suppressed. Reusable in:       01:14:40
                Preference will be: 170
```

Meaning This output indicates that the displayed route has a mask length that is equal to or greater than /17, and confirms that it has been correctly mapped to the aggressive damping profile. You can also see the route's current (and last) figure of merit value, and when the route is expected to become active if it remains stable.

Verifying That Default Damping Parameters Are in Effect

Purpose Locating a damped route with a /16 mask confirms that the default parameters are in effect.

Action From operational mode, enter the **show route damping suppressed detail | match 0/16** command.

user@R2> **show route damping suppressed detail | match 0/16**

```
172.16.0.0/16 (1 entry, 0 announced)
```

user@R2> **show route damping suppressed 172.16.0.0/16 detail**

```
inet.0: 15 destinations, 17 routes (6 active, 0 holddown, 11 hidden)
172.16.0.0/16 (1 entry, 0 announced)
```

```
        BGP                /-101
               Next hop type: Router, Next hop index: 758
               Address: 0x9414484
               Next-hop reference count: 9
               Source: 10.0.0.1
               Next hop: 10.0.0.1 via fe-1/2/0.0, selected
               Session Id: 0x100201
               State: <Hidden Ext>
               Local AS:   200 Peer AS:   100
               Age: 1:58
               Validation State: unverified
               Task: BGP_100.10.0.0.1+55922
               AS path: 100 I
               Localpref: 100
               Router ID: 192.168.0.1
               Merit (last update/now): 3486/3202
               Default damping parameters used
               Last update:      00:01:58 First update:      01:03:01
               Flaps: 8
               Suppressed. Reusable in:      00:31:40
               Preference will be: 170
```

Meaning Routes with a /16 mask are not impacted by the custom damping rules. Therefore, the default damping rules are in effect.

To repeat, the custom rules are as follows:

- Damp all prefixes with a mask length equal to or greater than 17 more aggressively than routes with a mask length between 9 and 16.
- Damp routes with a mask length between 0 and 8, inclusive, less than routes with a mask length greater than 8.
- Do not damp the 10.128.0.0/9 prefix at all.

Filtering the Damping Information

Purpose Use OR groupings or cascaded piping to simplify the determination of what damping profile is being used for routes with a given mask length.

Action From operational mode, enter the **show route damping suppressed** command.

`user@R2>` **show route damping suppressed detail | match "0 announced | damp"**

```
0.0.0.0/0 (1 entry, 0 announced)
                damping-parameters: timid
10.0.0.0/9 (1 entry, 0 announced)
                Default damping parameters used
                damping-parameters: aggressive
                damping-parameters: aggressive
10.224.0.0/11 (1 entry, 0 announced)
                Default damping parameters used
172.16.0.0/16 (1 entry, 0 announced)
                Default damping parameters used
172.16.128.0/17 (1 entry, 0 announced)
                damping-parameters: aggressive
172.16.192.0/20 (1 entry, 0 announced)
                damping-parameters: aggressive
192.168.0.1/32 (1 entry, 0 announced)
```



```
                    damping-parameters: aggressive
192.168.0.3/32 (1 entry, 0 announced)
                    damping-parameters: aggressive
224.0.0.0/7 (1 entry, 0 announced)
                    damping-parameters: timid
```

Meaning When you are satisfied that your EBGP routes are correctly associated with a damping profile, you can issue the **clear bgp damping** operational mode command to restore an active status to your damped routes, which will return your connectivity to normal operation.

Example: Configuring BGP Route Flap Damping Based on the MBGP MVPN Address Family

This example shows how to configure an multiprotocol BGP multicast VPN (also called Next-Generation MVPN) with BGP route flap damping.

Requirements

This example uses Junos OS Release 12.2. BGP route flap damping support for MBGP MVPN, specifically, and on an address family basis, in general, is introduced in Junos OS Release 12.2.

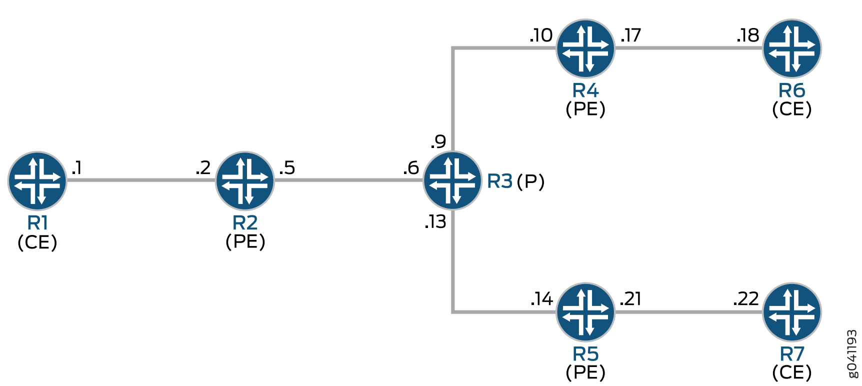
Overview

BGP route flap damping helps to diminish route instability caused by routes being repeatedly withdrawn and readvertised when a link is intermittently failing.

This example uses the default damping parameters and demonstrates an MBGP MVPN scenario with three provider edge (PE) routing devices, three customer edge (CE) routing devices, and one provider (P) routing device.

Figure 74 on page 2989 shows the topology used in this example.

Figure 74: MBGP MVPN with BGP Route Flap Damping



On PE Device R4, BGP route flap damping is configured for address family **inet-mvpn**. A routing policy called **dampPolicy** uses the **nlri-route-type** match condition to damp only MVPN route types 3, 4, and 5. All other MVPN route types are not damped.

This example shows the full configuration on all devices in the "CLI Quick Configuration" on page 2990 section. The "Configuring Device R4" on page 2993 section shows the step-by-step configuration for PE Device R4.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces ge-1/2/0 unit 1 family inet address 10.1.1.1/30
set interfaces ge-1/2/0 unit 1 family mpls
set interfaces lo0 unit 1 family inet address 1.1.1.1/32
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.1
set protocols pim rp static address 100.1.1.2
set protocols pim interface all
set routing-options router-id 1.1.1.1
```

Device R2

```
set interfaces ge-1/2/0 unit 2 family inet address 10.1.1.2/30
set interfaces ge-1/2/0 unit 2 family mpls
set interfaces ge-1/2/1 unit 5 family inet address 10.1.1.5/30
set interfaces ge-1/2/1 unit 5 family mpls
set interfaces vt-1/2/0 unit 2 family inet
set interfaces lo0 unit 2 family inet address 1.1.1.2/32
set interfaces lo0 unit 102 family inet address 100.1.1.2/32
set protocols mpls interface ge-1/2/1.5
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 1.1.1.2
set protocols bgp group ibgp family inet-vpn any
set protocols bgp group ibgp family inet-mvpn signaling
set protocols bgp group ibgp neighbor 1.1.1.4
set protocols bgp group ibgp neighbor 1.1.1.5
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/1.5
set protocols ldp interface ge-1/2/1.5
set protocols ldp p2mp
set policy-options policy-statement parent_vpn_routes from protocol bgp
set policy-options policy-statement parent_vpn_routes then accept
set routing-instances vpn-1 instance-type vrf
set routing-instances vpn-1 interface ge-1/2/0.2
set routing-instances vpn-1 interface vt-1/2/0.2
set routing-instances vpn-1 interface lo0.102
set routing-instances vpn-1 route-distinguisher 100:100
set routing-instances vpn-1 provider-tunnel ldp-p2mp
set routing-instances vpn-1 vrf-target target:1:1
set routing-instances vpn-1 protocols ospf export parent_vpn_routes
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface lo0.102 passive
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface ge-1/2/0.2
set routing-instances vpn-1 protocols pim rp static address 100.1.1.2
```

```
set routing-instances vpn-1 protocols pim interface ge-1/2/0.2 mode sparse
set routing-instances vpn-1 protocols mvpn
set routing-options router-id 1.1.1.2
set routing-options autonomous-system 1001
```

Device R3

```
set interfaces ge-1/2/0 unit 6 family inet address 10.1.1.6/30
set interfaces ge-1/2/0 unit 6 family mpls
set interfaces ge-1/2/1 unit 9 family inet address 10.1.1.9/30
set interfaces ge-1/2/1 unit 9 family mpls
set interfaces ge-1/2/2 unit 13 family inet address 10.1.1.13/30
set interfaces ge-1/2/2 unit 13 family mpls
set interfaces lo0 unit 3 family inet address 1.1.1.3/32
set protocols mpls interface ge-1/2/0.6
set protocols mpls interface ge-1/2/1.9
set protocols mpls interface ge-1/2/2.13
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.6
set protocols ospf area 0.0.0.0 interface ge-1/2/1.9
set protocols ospf area 0.0.0.0 interface ge-1/2/2.13
set protocols ldp interface ge-1/2/0.6
set protocols ldp interface ge-1/2/1.9
set protocols ldp interface ge-1/2/2.13
set protocols ldp p2mp
set routing-options router-id 1.1.1.3
```

Device R4

```
set interfaces ge-1/2/0 unit 10 family inet address 10.1.1.10/30
set interfaces ge-1/2/0 unit 10 family mpls
set interfaces ge-1/2/1 unit 17 family inet address 10.1.1.17/30
set interfaces ge-1/2/1 unit 17 family mpls
set interfaces vt-1/2/0 unit 4 family inet
set interfaces lo0 unit 4 family inet address 1.1.1.4/32
set interfaces lo0 unit 104 family inet address 100.1.1.4/32
set protocols rsvp interface all aggregate
set protocols mpls interface all
set protocols mpls interface ge-1/2/0.10
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 1.1.1.4
set protocols bgp group ibgp family inet-vpn unicast
set protocols bgp group ibgp family inet-vpn any
set protocols bgp group ibgp family inet-mvpn signaling damping
set protocols bgp group ibgp neighbor 1.1.1.2 import dampPolicy
set protocols bgp group ibgp neighbor 1.1.1.5
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface lo0.4 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.10
set protocols ldp interface ge-1/2/0.10
set protocols ldp p2mp
set policy-options policy-statement dampPolicy term term1 from family inet-mvpn
set policy-options policy-statement dampPolicy term term1 from nlri-route-type 3
set policy-options policy-statement dampPolicy term term1 from nlri-route-type 4
set policy-options policy-statement dampPolicy term term1 from nlri-route-type 5
set policy-options policy-statement dampPolicy term term1 then accept
set policy-options policy-statement dampPolicy then damping no-damp
set policy-options policy-statement dampPolicy then accept
```

```
set policy-options policy-statement parent_vpn_routes from protocol bgp
set policy-options policy-statement parent_vpn_routes then accept
set policy-options damping no-damp disable
set routing-instances vpn-1 instance-type vrf
set routing-instances vpn-1 interface vt-1/2/0.4
set routing-instances vpn-1 interface ge-1/2/1.17
set routing-instances vpn-1 interface lo0.104
set routing-instances vpn-1 route-distinguisher 100:100
set routing-instances vpn-1 vrf-target target:1:1
set routing-instances vpn-1 protocols ospf export parent_vpn_routes
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface lo0.104 passive
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface ge-1/2/1.17
set routing-instances vpn-1 protocols pim rp static address 100.1.1.2
set routing-instances vpn-1 protocols pim interface ge-1/2/1.17 mode sparse
set routing-instances vpn-1 protocols mvpn
set routing-options router-id 1.1.1.4
set routing-options autonomous-system 1001
```

Device R5

```
set interfaces ge-1/2/0 unit 14 family inet address 10.1.1.14/30
set interfaces ge-1/2/0 unit 14 family mpls
set interfaces ge-1/2/1 unit 21 family inet address 10.1.1.21/30
set interfaces ge-1/2/1 unit 21 family mpls
set interfaces vt-1/2/0 unit 5 family inet
set interfaces lo0 unit 5 family inet address 1.1.1.5/32
set interfaces lo0 unit 105 family inet address 100.1.1.5/32
set protocols mpls interface ge-1/2/0.14
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 1.1.1.5
set protocols bgp group ibgp family inet-vpn any
set protocols bgp group ibgp family inet-mvpn signaling
set protocols bgp group ibgp neighbor 1.1.1.2
set protocols bgp group ibgp neighbor 1.1.1.4
set protocols ospf area 0.0.0.0 interface lo0.5 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.14
set protocols ldp interface ge-1/2/0.14
set protocols ldp p2mp
set policy-options policy-statement parent_vpn_routes from protocol bgp
set policy-options policy-statement parent_vpn_routes then accept
set routing-instances vpn-1 instance-type vrf
set routing-instances vpn-1 interface vt-1/2/0.5
set routing-instances vpn-1 interface ge-1/2/1.21
set routing-instances vpn-1 interface lo0.105
set routing-instances vpn-1 route-distinguisher 100:100
set routing-instances vpn-1 vrf-target target:1:1
set routing-instances vpn-1 protocols ospf export parent_vpn_routes
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface lo0.105 passive
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface ge-1/2/1.21
set routing-instances vpn-1 protocols pim rp static address 100.1.1.2
set routing-instances vpn-1 protocols pim interface ge-1/2/1.21 mode sparse
set routing-instances vpn-1 protocols mvpn
set routing-options router-id 1.1.1.5
set routing-options autonomous-system 1001
```

Device R6

```
set interfaces ge-1/2/0 unit 18 family inet address 10.1.1.18/30
set interfaces ge-1/2/0 unit 18 family mpls
```



```
set interfaces lo0 unit 6 family inet address 1.1.1.6/32
set protocols sap listen 224.1.1.1
set protocols ospf area 0.0.0.0 interface lo0.6 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.18
set protocols pim rp static address 100.1.1.2
set protocols pim interface all
set routing-options router-id 1.1.1.6
```

Device R7

```
set interfaces ge-1/2/0 unit 22 family inet address 10.1.1.22/30
set interfaces ge-1/2/0 unit 22 family mpls
set interfaces lo0 unit 7 family inet address 1.1.1.7/32
set protocols ospf area 0.0.0.0 interface lo0.7 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.22
set protocols pim rp static address 100.1.1.2
set protocols pim interface all
set routing-options router-id 1.1.1.7
```

Configuring Device R4

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R4:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@R4# set ge-1/2/0 unit 10 family inet address 10.1.1.10/30
   user@R4# set ge-1/2/0 unit 10 family mpls

   user@R4# set ge-1/2/1 unit 17 family inet address 10.1.1.17/30
   user@R4# set ge-1/2/1 unit 17 family mpls

   user@R4# set vt-1/2/0 unit 4 family inet

   user@R4# set lo0 unit 4 family inet address 1.1.1.4/32
   user@R4# set lo0 unit 104 family inet address 100.1.1.4/32
   ```

2. Configure MPLS and the signaling protocols on the interfaces.

   ```
   [edit protocols]
   user@R4# set mpls interface all
   user@R4# set mpls interface ge-1/2/0.10
   user@R4# set rsvp interface all aggregate
   user@R4# set ldp interface ge-1/2/0.10
   user@R4# set ldp p2mp
   ```

3. Configure BGP.

   The BGP configuration enables BGP route flap damping for the **inet-mvpn** address family. The BGP configuration also imports into the routing table the routing policy called **dampPolicy**. This policy is applied to neighbor PE Device R2.

   ```
   [edit protocols bgp group ibgp]
   user@R4# set type internal
   ```

user@R4# **set local-address 1.1.1.4**
user@R4# **set family inet-vpn unicast**
user@R4# **set family inet-vpn any**
user@R4# **set family inet-mvpn signaling damping**
user@R4# **set neighbor 1.1.1.2 import dampPolicy**
user@R4# **set neighbor 1.1.1.5**

4. Configure an interior gateway protocol.

   [edit protocols ospf]
   user@R4# **set traffic-engineering**

   [edit protocols ospf area 0.0.0.0]
   user@R4# **set interface all**
   user@R4# **set interface lo0.4 passive**
   user@R4# **set interface ge-1/2/0.10**

5. Configure a damping policy that uses the **nlri-route-type** match condition to damp only MVPN route types 3, 4, and 5.

   [edit policy-options policy-statement dampPolicy term term1]
   user@R4# **set from family inet-mvpn**
   user@R4# **set from nlri-route-type 3**
   user@R4# **set from nlri-route-type 4**
   user@R4# **set from nlri-route-type 5**
   user@R4# **set then accept**

6. Configure the **damping** policy to disable BGP route flap damping.

   The **no-damp** policy (**damping no-damp disable**) causes any damping state that is present in the routing table to be deleted. The **then damping no-damp** statement applies the **no-damp** policy as an action and has no **from** match conditions. Therefore, all routes that are not matched by **term1** are matched by this term, with the result that all other MVPN route types are not damped.

   [edit policy-options policy-statement dampPolicy]
   user@R4# **set then damping no-damp**
   user@R4# **set then accept**

   [edit policy-options]
   user@R4# **set damping no-damp disable**

7. Configure the **parent_vpn_routes** to accept all other BGP routes that are not from the **inet-mvpn** address family.

   This policy is applied as an OSPF export policy in the routing instance.

   [edit policy-options policy-statement parent_vpn_routes]
   user@R4# **set from protocol bgp**
   user@R4# **set then accept**

8. Configure the VPN routing and forwarding (VRF) instance.

   [edit routing-instances vpn-1]
   user@R4# **set instance-type vrf**
   user@R4# **set interface vt-1/2/0.4**
   user@R4# **set interface ge-1/2/1.17**
   user@R4# **set interface lo0.104**


```
user@R4# set route-distinguisher 100:100
user@R4# set vrf-target target:1:1
user@R4# set protocols ospf export parent_vpn_routes
user@R4# set protocols ospf area 0.0.0.0 interface lo0.104 passive
user@R4# set protocols ospf area 0.0.0.0 interface ge-1/2/1.17
user@R4# set protocols pim rp static address 100.1.1.2
user@R4# set protocols pim interface ge-1/2/1.17 mode sparse
user@R4# set protocols mvpn
```

9. Configure the router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@R4# set router-id 1.1.1.4
user@R4# set autonomous-system 1001
```

10. If you are done configuring the device, commit the configuration.

```
user@R4# commit
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, **show routing-instances**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R4# show interfaces
ge-1/2/0 {
   unit 10 {
      family inet {
         address 10.1.1.10/30;
      }
      family mpls;
   }
}
ge-1/2/1 {
   unit 17 {
      family inet {
         address 10.1.1.17/30;
      }
      family mpls;
   }
}
vt-1/2/0 {
   unit 4 {
      family inet;
   }
}
lo0 {
   unit 4 {
      family inet {
         address 1.1.1.4/32;
      }
   }
   unit 104 {
      family inet {
```

```
            address 100.1.1.4/32;
        }
    }
}
```

user@R4# **show protocols**

```
rsvp {
    interface all {
        aggregate;
    }
}
mpls {
    interface all;
    interface ge-1/2/0.10;
}
bgp {
    group ibgp {
        type internal;
        local-address 1.1.1.4;
        family inet-vpn {
            unicast;
            any;
        }
        family inet-mvpn {
            signaling {
                damping;
            }
        }
        neighbor 1.1.1.2 {
            import dampPolicy;
        }
        neighbor 1.1.1.5;
    }
}
ospf {
    traffic-engineering;
    area 0.0.0.0 {
        interface all;
        interface lo0.4 {
            passive;
        }
        interface ge-1/2/0.10;
    }
}
ldp {
    interface ge-1/2/0.10;
    p2mp;
}
```

user@R4# **show policy-options**

```
policy-statement dampPolicy {
    term term1 {
        from {
            family inet-mvpn;
            nlri-route-type [ 3 4 5 ];
        }
        then accept;
```

```
    }
    then {
      damping no-damp;
      accept;
    }
  }
  policy-statement parent_vpn_routes {
    from protocol bgp;
    then accept;
  }
  damping no-damp {
    disable;
  }
```

```
user@R4# show routing-instances
vpn-1 {
  instance-type vrf;
  interface vt-1/2/0.4;
  interface ge-1/2/1.17;
  interface lo0.104;
  route-distinguisher 100:100;
  vrf-target target:1:1;
  protocols {
    ospf {
      export parent_vpn_routes;
      area 0.0.0.0 {
        interface lo0.104 {
          passive;
        }
        interface ge-1/2/1.17;
      }
    }
    pim {
      rp {
        static {
          address 100.1.1.2;
        }
      }
      interface ge-1/2/1.17 {
        mode sparse;
      }
    }
    mvpn;
  }
}
```

```
user@R4# show routing-optons
router-id 1.1.1.4;
autonomous-system 1001;
```

Verification

Confirm that the configuration is working properly.

- Verifying That Route Flap Damping Is Disabled on page 2998
- Verifying Route Flap Damping on page 2998

Verifying That Route Flap Damping Is Disabled

Purpose Verify the presence of the **no-damp** policy, which disables damping for MVPN route types other than 3, 4, and 5.

Action From operational mode, enter the **show policy damping** command.

```
user@R4> show policy damping
Default damping information:
  Halflife: 15 minutes
  Reuse merit: 750 Suppress/cutoff merit: 3000
  Maximum suppress time: 60 minutes
  Computed values:
    Merit ceiling: 12110
    Maximum decay: 6193
Damping information for "no-damp":
 Damping disabled
```

Meaning The output shows that the default damping parameters are in effect and that the **no-damp** policy is also in effect for the specified route types.

Verifying Route Flap Damping

Purpose Check whether BGP routes have been damped.

Action From operational mode, enter the **show bgp summary** command.

```
user@R4> show bgp summary
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State     Pending
bgp.l3vpn.0
                       6          6          0          0          0          0
bgp.l3vpn.2
                       0          0          0          0          0          0
bgp.mvpn.0
                       2          2          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
1.1.1.2                1001       3159       3155       0       0    23:43:47
Establ
  bgp.l3vpn.0: 3/3/3/0
  bgp.l3vpn.2: 0/0/0/0
  bgp.mvpn.0: 1/1/1/0
  vpn-1.inet.0: 3/3/3/0
  vpn-1.mvpn.0: 1/1/1/0
1.1.1.5                1001       3157       3154       0       0    23:43:40
Establ
  bgp.l3vpn.0: 3/3/3/0
  bgp.l3vpn.2: 0/0/0/0
  bgp.mvpn.0: 1/1/1/0
  vpn-1.inet.0: 3/3/3/0
  vpn-1.mvpn.0: 1/1/1/0
```

Meaning The Damp State field shows that zero routes in the bgp.mvpn.0 routing table have been damped. Further down, the last number in the State field shows that zero routes have been damped for BGP peer 1.1.1.2.

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

BGP Monitoring Configuration

Example: Configuring BGP Trace Operations

Understanding Trace Operations for BGP Protocol Traffic

You can trace various BGP protocol traffic to help you debug BGP protocol issues. To trace BGP protocol traffic, include the **traceoptions** statement at the **[edit protocols bgp]** hierarchy level. For routing instances, include the **traceoptions** statement at the **[edit routing-instances *routing-instance-name* protocols bgp]** hierarchy level.

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

You can specify the following BGP protocol-specific trace options using the **flag** statement:

- **4byte-as**—4-byte AS events.
- **bfd**—BFD protocol events.
- **damping**—Damping operations.
- **graceful-restart**—Graceful restart events.
- **keepalive**—BGP keepalive messages.
- **nsr-synchronization**—Nonstop active routing synchronization events.
- **open**—BGP open packets. These packets are sent between peers when they are establishing a connection.
- **packets**—All BGP protocol packets.
- **refresh**—BGP refresh packets.
- **update**—BGP update packets. These packets provide routing updates to BGP systems.

Global tracing options are inherited from the configuration set by the **traceoptions** statement at the **[edit routing-options]** hierarchy level. You can override the following global trace options for the BGP protocol using the **traceoptions flag** statement included at the **[edit protocols bgp]** hierarchy level:

- **all**—All tracing operations
- **general**—All normal operations and routing table changes (a combination of the normal and route trace operations)
- **normal**—Normal events
- **policy**—Policy processing
- **route**—Routing information
- **state**—State transitions
- **task**—Routing protocol task processing
- **timer**—Routing protocol timer processing

You can optionally specify one or more of the following flag modifiers:

- **detail**—Detailed trace information.
- **filter**—Filter trace information. Applies only to **route** and **damping** tracing flags.
- **receive**—Packets being received.
- **send**—Packets being transmitted.

NOTE: Use the **all** trace flag and the **detail** flag modifier with caution because these might cause the CPU to become very busy.

NOTE: If you only enable the **update** flag, received keepalive messages do not generate a trace message.

You can filter trace statements and display only the statement information that passes through the filter by specifying the **filter** flag modifier. The **filter** modifier is only supported for the **route** and **damping** tracing flags.

The **match-on** statement specifies filter matches based on prefixes. It is used to match on route filters.

NOTE: Per-neighbor trace filtering is not supported on a BGP per-neighbor level for **route** and **damping** flags. Trace option filtering support is on a peer group level.

Example: Viewing BGP Trace Files on Logical Systems

This example shows how to list and view files that are stored on a logical system.

- Requirements on page 3001
- Overview on page 3001
- Configuration on page 3002
- Verification on page 3005

Requirements

- You must have the **view** privilege for the logical system.
- Configure a network, such as the BGP network shown in “Example: Configuring Internal BGP Peering Sessions on Logical Systems” on page 2674.

Overview

Logical systems have their individual directory structure created in the **/var/logical-systems/*logical-system-name*** directory. It contains the following subdirectories:

- **/config**—Contains the active configuration specific to the logical system.
- **/log**—Contains system log and tracing files specific to the logical system.

  To maintain backward compatibility for the log files with previous versions of Junos OS, a symbolic link (symlink) from the **/var/logs/*logical-system-name*** directory to the **/var/logical-systems/*logical-system-name*** directory is created when a logical system is configured.
- **/tmp**—Contains temporary files specific to the logical system.

The file system for each logical system enables logical system users to view trace logs and modify logical system files. Logical system administrators have full access to view and modify all files specific to the logical system.

Logical system users and administrators can save and load configuration files at the logical-system level using the **save** and **load** configuration mode commands. In addition, they can also issue the **show log**, **monitor**, and **file** operational mode commands at the logical-system level.

This example shows how to configure and view a BGP trace file on a logical system. The steps can be adapted to apply to trace operations for any Junos OS hierarchy level that supports trace operations.

TIP: To view a list of hierarchy levels that support tracing operations, enter the **help apropos traceoptions** command in configuration mode.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set logical-systems A protocols bgp group internal-peers traceoptions file bgp-log
set logical-systems A protocols bgp group internal-peers traceoptions file size 10k
set logical-systems A protocols bgp group internal-peers traceoptions file files 2
set logical-systems A protocols bgp group internal-peers traceoptions flag update detail
```

Configuring Trace Operations

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the trace operations:

1. Configure trace operations on the logical system.

```
[edit logical-systems A protocols bgp group internal-peers]
user@host# set traceoptions file bgp-log
user@host# set traceoptions file size 10k
user@host# set traceoptions file files 2
user@host# set traceoptions flag update detail
```

2. If you are done configuring the device, commit the configuration.

```
[edit]
user@host# commit
```

Viewing the Trace File

Step-by-Step Procedure

To view the trace file:

1. In operational mode on the main router, list the directories on the logical system.

```
user@host> file list /var/logical-systems/A
/var/logical-systems/A:
config/
log/
tmp/
```

2. In operational mode on the main router, list the log files on the logical system.

```
user@host> file list /var/logical-systems/A/log/
/var/logical-systems/A/log:
bgp-log
```

3. View the contents of the **bgp-log** file.


```
user@host> file show /var/logical-systems/A/log/bgp-log
Aug 10 17:12:01 trace_on: Tracing to "/var/log/A/bgp-log" started
Aug 10 17:14:22.826182 bgp_peer_mgmt_clear:5829: NOTIFICATION sent to
192.163.6.4 (Internal AS 17): code 6 (Cease) subcode 4 (Administratively
Reset), Reason: Management session cleared BGP neighbor
Aug 10 17:14:22.826445 bgp_send: sending 21 bytes to 192.163.6.4 (Internal
AS 17)
Aug 10 17:14:22.826499
Aug 10 17:14:22.826499 BGP SEND 192.168.6.5+64965 -> 192.163.6.4+179
Aug 10 17:14:22.826559 BGP SEND message type 3 (Notification) length 21
Aug 10 17:14:22.826598 BGP SEND Notification code 6 (Cease) subcode 4
(Administratively Reset)
Aug 10 17:14:22.831756 bgp_peer_mgmt_clear:5829: NOTIFICATION sent to
192.168.40.4 (Internal AS 17): code 6 (Cease) subcode 4 (Administratively
Reset), Reason: Management session cleared BGP neighbor
Aug 10 17:14:22.831851 bgp_send: sending 21 bytes to 192.168.40.4 (Internal
 AS 17)
Aug 10 17:14:22.831901
Aug 10 17:14:22.831901 BGP SEND 192.168.6.5+53889 -> 192.168.40.4+179
Aug 10 17:14:22.831959 BGP SEND message type 3 (Notification) length 21
Aug 10 17:14:22.831999 BGP SEND Notification code 6 (Cease) subcode 4
(Administratively Reset)
...
```

4. Filter the output of the log file.

```
user@host> file show /var/logical-systems/A/log/bgp-log | match "flags 0x40"
Aug 10 17:14:54.867460 BGP SEND flags 0x40 code Origin(1): IGP
Aug 10 17:14:54.867595 BGP SEND flags 0x40 code ASPath(2) length 0: <null>
Aug 10 17:14:54.867650 BGP SEND flags 0x40 code NextHop(3): 192.168.6.5
Aug 10 17:14:54.867692 BGP SEND flags 0x40 code LocalPref(5): 100
Aug 10 17:14:54.884529 BGP RECV flags 0x40 code Origin(1): IGP
Aug 10 17:14:54.884581 BGP RECV flags 0x40 code ASPath(2) length 0: <null>
Aug 10 17:14:54.884628 BGP RECV flags 0x40 code NextHop(3): 192.163.6.4
Aug 10 17:14:54.884667 BGP RECV flags 0x40 code LocalPref(5): 100
Aug 10 17:14:54.911377 BGP RECV flags 0x40 code Origin(1): IGP
Aug 10 17:14:54.911422 BGP RECV flags 0x40 code ASPath(2) length 0: <null>
Aug 10 17:14:54.911466 BGP RECV flags 0x40 code NextHop(3): 192.168.40.4
Aug 10 17:14:54.911507 BGP RECV flags 0x40 code LocalPref(5): 100
Aug 10 17:14:54.916008 BGP SEND flags 0x40 code Origin(1): IGP
Aug 10 17:14:54.916054 BGP SEND flags 0x40 code ASPath(2) length 0: <null>
Aug 10 17:14:54.916100 BGP SEND flags 0x40 code NextHop(3): 192.168.6.5
Aug 10 17:14:54.916143 BGP SEND flags 0x40 code LocalPref(5): 100
Aug 10 17:14:54.920304 BGP RECV flags 0x40 code Origin(1): IGP
Aug 10 17:14:54.920348 BGP RECV flags 0x40 code ASPath(2) length 0: <null>
Aug 10 17:14:54.920393 BGP RECV flags 0x40 code NextHop(3): 10.0.0.10
Aug 10 17:14:54.920434 BGP RECV flags 0x40 code LocalPref(5): 100
```

5. View the tracing operations in real time.

```
user@host> clear bgp neighbor logical-system A
Cleared 2 connections
```

CAUTION: Clearing the BGP neighbor table is disruptive in a production environment.

6. Run the **monitor start** command with an optional **match** condition.

```
user@host> monitor start A/bgp-log | match 0.0.0.0/0
```

```
Aug 10 19:21:40.773467 BGP RECV         0.0.0.0/0
Aug 10 19:21:40.773685 bgp_rcv_nlri: 0.0.0.0/0
Aug 10 19:21:40.773778 bgp_rcv_nlri: 0.0.0.0/0 belongs to meshgroup
Aug 10 19:21:40.773832 bgp_rcv_nlri: 0.0.0.0/0 qualified bnp->ribact 0x0
l2afcb 0x0
```

7. Pause the **monitor** command by pressing Esc-Q.
   To unpause the output, press Esc-Q again.

8. Halt the **monitor** command by pressing Enter and typing **monitor stop**.

   ```
   [Enter]
   user@host> monitor stop
   ```

9. When you are finished troubleshooting, consider deactivating trace logging to avoid any unnecessary impact to system resources.

   ```
   [edit protocols bgp group internal-peers]
   user@host:A# deactivate traceoptions
   user@host:A# commit
   ```

   When configuration is deactivated, it appears in the configuration with the **inactive** tag.To reactivate trace operations, use the **activate** configuration-mode statement.

   ```
   [edit protocols bgp group internal-peers]
   user@host:A# show

   type internal;
   inactive: traceoptions {
       file bgp-log size 10k files 2;
       flag update detail;
       flag all;
   }
   local-address 192.168.6.5;
   export send-direct;
   neighbor 192.163.6.4;
   neighbor 192.168.40.4;
   ```

10. To reactivate trace operations, use the **activate** configuration-mode statement.

    ```
    [edit protocols bgp group internal-peers]
    user@host:A# activate traceoptions
    user@host:A# commit
    ```

Deactivating and Reactivating Trace Logging

Step-by-Step Procedure

To deactivate and reactivate the trace file:

1. When you are finished troubleshooting, consider deactivating trace logging to avoid an unnecessary impact to system resources.

   ```
   [edit protocols bgp group internal-peers]
   user@host:A# deactivate traceoptions
   user@host:A# commit
   ```

   When configuration is deactivated, the statement appears in the configuration with the **inactive** tag.

   ```
   [edit protocols bgp group internal-peers]
   user@host:A# show
   ```



```
type internal;
inactive: traceoptions {
    file bgp-log size 10k files 2;
    flag update detail;
    flag all;
}
local-address 192.168.6.5;
export send-direct;
neighbor 192.163.6.4;
neighbor 192.168.40.4;
```

2. To reactivate logging, use the **activate** configuration-mode statement.

   [edit protocols bgp group internal-peers]
   user@host:A# **activate traceoptions**
   user@host:A# **commit**

Results

From configuration mode, confirm your configuration by entering the **show logical-systems A protocols bgp group internal-peers** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

user@host# **show logical-systems A protocols bgp group internal-peers**
traceoptions {
  file bgp-log size 10k files 2;
  flag update detail;
}

Verification

Confirm that the configuration is working properly.

Verifying That the Trace Log File Is Operating

Purpose Make sure that events are being written to the log file.

Action

```
user@host:A> show log bgp-log
Aug 12 11:20:57 trace_on: Tracing to "/var/log/A/bgp-log" started
```

Related Documentation

- Understanding External BGP Peering Sessions on page 2639
- *BGP Configuration Overview*

Tracing BMP Operations

You can trace BMP operations for all BMP stations by configuring the **traceoptions** statement at the **[edit routing-options** bmp**]** hierarchy level or for specific BMP stations at the **[edit rouiting-options bmp** station ***station-name*]** hierarchy level.

To trace BMP operations, complete the following steps:

1. Configure the **traceoptions** statement:

   traceoptions {

```
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
}
```

2. Specify the name of the file to receive the output of the tracing operation using the **file** option. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. We recommend that you place BMP tracing output in the file **bmp-log**.
3. (Optional) Specify the maximum number of trace files using the **files** option. When a trace file named ***trace-file*.0** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.
4. (Optional) Specify the maximum size of each trace file using the **size** option in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.
5. (Optional) You can specify that the log files are either **world-readalbe** (accessible to all users on the device) or **no-world-readable** (not accessible to all users on the device).
6. You can specify the following BMP-specific trace options using the **flag** statement:
   - **all**—Trace all BMP monitoring operations.
   - **down**—Down messages.
   - **error**—Error conditions.
   - **event**—Major events, station establishment, errors, and events.
   - **general**—General events.
   - **normal**—Normal events.
   - **packets**—All messages.
   - **policy**—Policy processing.
   - **route**—Routing information.
   - **route-monitoring**—Route monitoring messages.
   - **state**—State transitions.
   - **statistics**—Statistics messages.
   - **task**—Routing protocol task processing.
   - **timer**—Routing protocol timer processing.
   - **up**—Up messages.
   - **write**—Writing of messages.

You can optionally specify one or more of the following flag modifiers:

- **detail**—Provide detailed trace information.
- **disable**—Disable the tracing flag.
- **receive**—Trace the packets being received.
- **send**—Trace the packets being transmitted.

NOTE: Use the **all** trace flag and the **detail** flag modifier with caution due to the increased computer processing power required.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 2685

Configuration Statements

accept-remote-nexthop

Syntax accept-remote-nexthop;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify that a single-hop EBGP peer accepts a remote next hop with which it does not share a common subnet. Configure a separate import policy on the EBGP peer to specify the remote next hop. You cannot configure **multihop** and **accept-remote-nexthop** statements for the same EBGP peer.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Single-Hop EBGP Peers to Accept Remote Next Hops on page 2863
- Understanding Route Advertisement on page 2803
- *multipath*

advertise-external

Syntax advertise-external {*conditional*};

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *neighbor-address*]

Release Information Statement introduced in Junos OS Release 9.3.
Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify BGP to advertise the best external route into an IBGP mesh group, a route reflector cluster, or an AS confederation even if the best route is an internal route.

In general, deployed BGP implementations do not advertise the external route with the highest local preference value to internal peers unless it is the best route. Although this behavior was required by an earlier version of the BGP version 4 specification, RFC 1771, it was typically not followed in order to minimize the amount of advertised information and to prevent routing loops. However, there are scenarios in which advertising the best external route is beneficial, in particular, situations that can result in IBGP route oscillation.

The **advertise-external** statement is supported at both the group and neighbor level. If you configure the statement at the neighbor level, you must configure it for all neighbors in a group. Otherwise, the group is automatically split into different groups.

In a confederation, when advertising a route to a confederation border router, any route from a different confederation sub-AS is considered external. When configuring the **advertise-external** statement for an AS confederation, it is recommended that EBGP peers belonging to different autonomous systems are configured in a separate EBGP peer group. This ensures consistency while BGP sends the best external route to peers in the configured peer group.

To configure the **advertise-external** statement on a route reflector, you must disable intracluster reflection with the **no-client-reflect** statement.

When a routing device is configured as a route reflector for a cluster, a route advertised by the route reflector is considered internal if it is received from an internal peer with the same cluster identifier or if both peers have no cluster identifier configured. A route received from an internal peer that belongs to another cluster, that is, with a different cluster identifier, is considered external.

The **conditional** option causes BGP to advertise the external route only if the route selection process reaches the point where the multiple exit discriminator (MED) metric is evaluated. As a result, an external route with an AS path longer than that of the active path is not advertised.

Junos OS also provides support for configuring a BGP export policy that matches on the state of an advertised route. You can match on either active or inactive routes.

Default BGP does not advertise the external route with the highest local preference value to internal peers unless it is the best route.

Options **conditional**—(Optional) Advertise the best external path only if the route selection process reaches the point at which the multiple exit discriminator (MED) metric is evaluated. The **conditional** option restricts advertisement to when the best external path and the active path are equal until the MED step of the route selection process. This implies that external routes with a longer AS path length than the active path, for instance, are not advertised. The criteria used for selecting the best external path is the same whether or not the **conditional** option is configured.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring BGP to Advertise the Best External Route to Internal Peers*
- advertise-inactive on page 3013

advertise-inactive

Syntax advertise-inactive;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the routing table to export to BGP the best route learned by BGP even if Junos OS did not select this route to be an active route.

One way to achieve multivendor compatibility is to include the **advertise-inactive** statement in the external BGP (EBGP) configuration. By default, BGP stores the route information it receives from update messages in the Junos OS routing table, and the routing table exports only active routes into BGP, which BGP then advertises to its peers. The **advertise-inactive** statement causes Junos OS to advertise the best BGP route that is inactive because of IGP preference. When you use the **advertise-inactive** statement, the Junos OS device uses, for example, the OSPF route for forwarding, and the other vendor's device uses the EBGP route for forwarding. However, from the perspective of an EBGP peer in a neighboring AS, both vendors' devices appear to behave the same way.

Default By default, BGP stores the route information it receives from update messages in the Junos OS routing table, and the routing table exports only active routes into BGP, which BGP then advertises to its peers.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Setting BGP to Advertise Inactive Routes*
- Example: Configuring the Preference Value for BGP Routes on page 2821
- Example: Configuring BGP Route Preference (Administrative Distance) on page 2820

- advertise-external on page 3011

advertise-peer-as

Syntax advertise-peer-as;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Disable the default behavior of suppressing AS routes.

If you include the **advertise-peer-as** statement in the configuration, BGP advertises routes learned from one external BGP (EBGP) peer back to another EBGP peer in the same autonomous system (AS).

Another way to disable the route suppression default behavior is with the **as-override** statement. If you include both the **as-override** and **no-advertise-peer-as** statements in the configuration, the **no-advertise-peer-as** statement is ignored.

Default By default, Junos OS does not advertise the routes learned from one EBGP peer back to the same external BGP (EBGP) peer. In addition, the software does not advertise those routes back to any EBGP peers that are in the same AS as the originating peer, regardless of the routing instance.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Disabling Suppression of Route Advertisements*
- *Example: Configuring a Layer 3 VPN with Route Reflection and AS Override*
- no-advertise-peer-as on page 3091

algorithm (BGP BFD Authentication)

Syntax algorithm *algorithm-name*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit protocols bgp bgp bfd-liveness-detection authentication],
[edit protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp bgp bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication]

Release Information Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the algorithm used to authenticate the specified BFD session.

Options *algorithm-name*—Authentication algorithm name: **simple-password**, **keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**.

simple-password—Plain-text password. One to 16 bytes of plain text are used to authenticate the BFD session. One or more passwords can be configured. This method is the least secure and should be used only when BFD sessions are not subject to packet interception.

keyed-md5—Keyed Message Digest 5 hash algorithm for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed MD5 uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than or equal to the last sequence number received. Although more secure than a simple password, this method is vulnerable to replay attacks. Increasing the rate at which the sequence number is updated can reduce this risk.

meticulous-keyed-md5—Meticulous keyed Message Digest 5 hash algorithm. This method works in the same manner as keyed MD5, but the sequence number is updated with every packet. Although more secure than keyed MD5 and simple passwords, this method can take additional time to authenticate the session.

keyed-sha-1—Keyed Secure Hash Algorithm I for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed SHA uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. The key is not carried within the packets. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than the last sequence number received.

meticulous-keyed-sha-1—Meticulous keyed Secure Hash Algorithm I. This method works in the same manner as keyed SHA, but the sequence number is updated with every packet. Although more secure than keyed SHA and simple passwords, this method can take additional time to authenticate the session.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BFD Authentication for Static Routes on page 2332
- Example: Configuring BGP Route Authentication on page 2952
- Example: Configuring EBGP Multihop Sessions on page 2811
- **authentication on page 3018**
- **bfd-liveness-detection on page 3023**
- **key-chain on page 3059**
- **loose-check on page 3071**

apply-groups

Syntax apply-groups [*group-names*];

Hierarchy Level All hierarchy levels

Release Information Statement introduced before Junos OS Release 7.4.

Description Apply a configuration group to a specific hierarchy level in a configuration, to have a configuration inherit the statements in the configuration group.

You can specify more than one group name. You must list them in order of inheritance priority. The configuration data in the first group takes priority over the data in subsequent groups.

Options ***group-names***—One or more names specified in the **groups** statement.

Required Privilege Level configure—To enter configuration mode, but other required privilege levels depend on where the statement is located in the configuration hierarchy.

Related Documentation

- *Applying a Junos Configuration Group*
- *groups*

apply-groups-except

Syntax apply-groups-except [*group-names*];

Hierarchy Level All hierarchy levels except the top level

Release Information Statement introduced before Junos OS Release 7.4.

Description Disable inheritance of a configuration group.

Options ***group-names***—One or more names specified in the **groups** statement.

Required Privilege Level configure—To enter configuration mode, but other required privilege levels depend on where the statement is located in the configuration hierarchy.

Related Documentation

- *groups*
- *Disabling Inheritance of a Junos OS Configuration Group*

authentication (BGP BFD Liveness Detection)

Syntax

```
authentication {
  algorithm algorithm-name;
  key-chain key-chain-name;
  loose-check ;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit protocols bgp bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Specify the router and route authentication to mitigate the risk of being attacked by a machine or router that has been configured to share incorrect routing information with another router. Router and route authentication enables routers to share information only if they can verify that they are talking to a trusted source, based on a password (key). In this method, a hashed key is sent along with the route being sent to another router. The receiving router compares the sent key to its own configured key. If they are the same, the receiving router accepts the route.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BFD for Static Routes on page 2319
- Example: Configuring BFD Authentication for Static Routes on page 2332
- Example: Configuring BGP Route Authentication on page 2952
- **algorithm on page 3015**

- bfd-liveness-detection on page 3023
- key-chain on page 3059
- loose-check on page 3071

authentication-algorithm

Syntax

authentication-algorithm *algorithm*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* protocols ldp session *session-address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ldp session *session-address*],
[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit protocols ldp session *session-address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols ldp session *session-address*],
[edit routing-options bmp],
[edit routing-options bmp station *station-name*]

Release Information

Statement introduced in Junos OS Release 7.6.
Statement introduced for BGP in Junos OS Release 8.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.3.

Description

Configure an authentication algorithm type.

Options

algorithm—Specify one of the following types of authentication algorithms:

- **aes-128-cmac-96**—Cipher-based message authentication code (AES128, 96 bits).
- **hmac-sha-1-96**—Hash-based message authentication code (SHA1, 96 bits).
- **md5**—Message digest 5.

Default: hmac-sha-1-96

NOTE: The default is not displayed in the output of the **show bgp bmp** command unless a key or key-chain is also configured.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Route Authentication for BGP on page 2953
- Configuring BGP Monitoring Protocol Version 3 on page 2685

authentication-key (Protocols BGP and BMP)

Syntax

authentication-key *key*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit routing-options bmp],
[edit routing-options bmp station *station-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced for BMP version 3 in Junos OS Release 13.3.

Description

Configure an MD5 authentication key (password). Neighboring routing devices use the same password to verify the authenticity of BGP packets sent from this system.

Options

key—Authentication password. It can be up to 126 characters. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (“ ”).

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Route Authentication for BGP on page 2953
- Configuring BGP Monitoring Protocol Version 3 on page 2685

authentication-key-chain (Protocols BGP and BMP)

Syntax authentication-key-chain *key-chain*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit routing-options bmp],
[edit routing-options bmp station *station-name*]

Release Information
Statement introduced in Junos OS Release 8.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.3.

Description Apply and enable an authentication keychain to the routing device. Note that the referenced key chain must be defined. When configuring the authentication key update feature for BGP, you cannot commit the **0.0.0.0/allow** statement with authentication keys or key chains. The CLI issues a warning and fails to commit the configuration.

Options *key-chain*—Authentication keychain name. It can be up to 126 characters. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (“ ”).

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Route Authentication for BGP on page 2953
- Example: Configuring BFD Authentication for Static Routes on page 2332
- *Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols*
- Configuring BGP Monitoring Protocol Version 3 on page 2685

bfd-liveness-detection (Protocols BGP)

Syntax

```
bfd-liveness-detection {
  authentication {
    algorithm algorithm-name;
    key-chain key-chain-name;
    loose-check;
  }
  detection-time {
    threshold milliseconds;
  }
  hold-down-interval milliseconds;
  minimum-interval milliseconds;
  minimum-receive-interval milliseconds;
  multiplier number;
  no-adaptation;
  session-mode (automatic | multihop | single-hop);
  transmit-interval {
    minimum-interval milliseconds;
    threshold milliseconds;
  }
  version (1 | automatic);
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
detection-time threshold and **transmit-interval threshold** options introduced in Junos OS Release 8.2
Support for logical routers introduced in Junos OS Release 8.3.
Support for IBGP and multihop EBGP sessions introduced in Junos OS Release 8.3.
holddown-interval statement introduced in Junos OS Release 8.5. You can configure this statement only for EBGP peers at the **[edit protocols bgp group *group-name* neighbor *address*]** hierarchy level.
no-adaptation statement introduced in Junos OS Release 9.0.
Support for BFD authentication introduced in Junos OS Release 9.6.

Support for BFD on IPv6 interfaces with BGP introduced in Junos OS Release 11.2.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure bidirectional failure detection (BFD) timers and authentication for BGP.

For IBGP and multihop EBGP support, configure the **bfd-liveness-detection** statement at the global **[edit bgp protocols]** hierarchy level. You can also configure IBGP and multihop support for a routing instance or a logical system.

Options

authentication algorithm ***algorithm-name*** (Optional)—Configure the algorithm used to authenticate the specified BFD session: **simple-password**, **keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**.

authentication key-chain ***key-chain-name*** (Optional)—Associate a security key with the specified BFD session using the name of the security keychain. The keychain name must match one of the keychains configured in the **authentication-key-chains key-chain** statement at the **[edit security]** hierarchy level.

authentication loose-check—(Optional) Configure loose authentication checking on the BFD session. Use only for transitional periods when authentication may not be configured at both ends of the BFD session.

detection-time threshold ***milliseconds*** (Optional)—Configure a threshold. When the BFD session detection time adapts to a value equal to or greater than the threshold, a single trap and a single system log message are sent.

holddown-interval ***milliseconds*** (Optional)—Configure an interval specifying how long a BFD session must remain up before a state change notification is sent. When you configure the hold-down interval for the BFD protocol for EBGP, the BFD session is unaware of the BGP session during this time. In this case, if the BGP session goes down during the configured hold-down interval, BFD already assumes it is down and does not send a state change notification. The **holddown-interval** statement is supported only for EBGP peers at the **[edit protocols bgp group** ***group-name*** **neighbor** ***address*****]** hierarchy level. If the BFD session goes down and then comes back up during the configured hold-down interval, the timer is restarted. You must configure the hold-down interval on both EBGP peers. If you configure the hold-down interval for a multihop EBGP session, you must also configure a local IP address by including the **local-address** statement at the **[edit protocols bgp group** ***group-name*****]** hierarchy level.

Range: 0 through 255,000

Default: 0

minimum-interval ***milliseconds*** (Required)—Configure the minimum intervals at which the local routing device transmits hello packets and then expects to receive a reply from a neighbor with which it has established a BFD session. This value represents the minimum interval at which the local routing device transmits hello packets as well as the minimum interval that the routing device expects to receive a reply from a neighbor with which it has established a BFD session. You can configure a value in the range from 1 through 255,000 milliseconds. Optionally, instead of using this statement, you can specify the minimum transmit and receive intervals separately (using the **minimum-receive-interval** and **transmit-interval minimal-interval** statements).

Range: 1 through 255,000

minimum-receive-interval ***milliseconds*** (Optional)— Configure only the minimum interval at which the local routing device expects to receive a reply from a neighbor with which it has established a BFD session.

Range: 1 through 255,000

multiplier ***number*** (Optional)—Configure the number of hello packets not received by a neighbor that causes the originating interface to be declared down.

Range: 1 through 255

Default: 3

no-adaptation (Optional)—Configure BFD sessions not to adapt to changing network conditions. We recommend that you not disable BFD adaptation unless it is preferable to not to have BFD adaptation enabled in your network.

transmit-interval threshold ***milliseconds*** (Optional)—Configure a threshold. When the BFD session transmit interval adapts to a value greater than the threshold, a single trap and a single system message are sent. The interval threshold must be greater than the minimum transmit interval.

Range: 0 through 4,294,967,295 (2^{32} – 1)

transmit-interval minimum-interval ***milliseconds*** (Optional)—Configure only the minimum interval at which the local routing device transmits hello packets to a neighbor with which it has established a BFD session.

Range: 1 through 255,000

version (Optional)—Configure the BFD version to detect.

Range: **1** or **automatic** (autodetect the BFD version)

Default: **automatic**

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BFD for Static Routes on page 2319
- Example: Configuring BFD Authentication for Static Routes on page 2332
- Example: Configuring BFD on Internal BGP Peer Sessions on page 2845
- Example: Configuring BFD Authentication for BGP on page 2854
- Understanding BFD for BGP on page 2844

bgp

Syntax bgp { ... }

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit protocols],
[edit routing-instances *routing-instance-name* protocols]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Enable BGP on the routing device or for a routing instance.

Default BGP is disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *BGP Feature Guide for Routing Devices*

bgp-orf-cisco-mode

Syntax bgp-orf-cisco-mode;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp outbound-route-filter],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* outbound-route-filter],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp outbound-route-filter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* outbound-route-filter,
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options outbound-route-filter],
[edit logical-systems *logical-system-name* routing-options outbound-route-filter],
[edit protocols bgp outbound-route-filter],
[edit protocols bgp group *group-name* outbound-route-filter],
[edit protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit routing-instances *routing-instance-name* protocols bgp outbound-route-filter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* outbound-route-filter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit routing-instances *routing-instance-name* routing-options outbound-route-filter],
[edit routing-options outbound-route-filter]

Release Information Statement introduced in Junos OS Release 9.2.
Statement introduced in Junos OS Release 9.2 for EX Series switches.
Support for the BGP group and neighbor hierarchy levels introduced in Junos OS Release 9.2.
Support for the BGP group and neighbor hierarchy levels introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Enable interoperability with routing devices that use the vendor-specific outbound route filter compatibility code of 130 and code type of 128.

NOTE: To enable interoperability for all BGP peers configured on the routing device, include the statement at the [edit routing-options outbound-route-filter] hierarchy level.

Default Disabled

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BGP Prefix-Based Outbound Route Filtering on page 2807

cluster

Syntax cluster *cluster-identifier*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify the cluster identifier to be used by the route reflector cluster in an internal BGP group.

CAUTION:
If you configure both route reflection and VPNs on the same routing device, the following modifications to the route reflection configuration cause current BGP sessions to be reset:

- Adding a cluster ID—If a BGP session shares the same AS number with the group where you add the cluster ID, all BGP sessions are reset regardless of whether the BGP sessions are contained in the same group.
- Creating a new route reflector—If you have an IBGP group with an AS number and create a new route reflector group with the same AS number, all BGP sessions in the IBGP group and the new route reflector group are reset.

NOTE: If you change the address family specified in the **[edit protocols bgp family]** hierarchy level, all current BGP sessions on the routing device are dropped and then reestablished.

Options *cluster-identifier*—4-byte identifier (such as an IPv4 address).

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BGP Route Reflectors on page 2928
- Understanding External BGP Peering Sessions on page 2639
- **no-client-reflect on page 3093**

connection-mode

Syntax connection-mode (active | passive);

Hierarchy Level [edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information Statement introduced for BMP in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.3.

Description Specifies whether the BMP station connection is **active** or **passive**.

Options **active**—BMP initiates the connection to the BMP station.

passive—BMP does not initiate a connection the BMP station. However, it does listen for a connection request from active BMP stations and will connect if a station is available.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 2685

damping (Protocols BGP)

Syntax damping;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp family *family*],
[edit logical-systems *logical-system-name* protocols bgp family *family*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family *family*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family *family*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family *family*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family *family*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family *family*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family *family*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family *family*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family *family*],
[edit protocols bgp],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* family *family*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp group *group-name* neighbor *address* family *family*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp family *family*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family *family*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family *family*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Support for flap damping at the address family level introduced in Junos OS Release 12.2.

Description Enable route flap damping. BGP route flapping describes the situation in which BGP systems send an excessive number of update messages to advertise network reachability information. Flap damping reduces the number of update messages sent between BGP peers, thereby reducing the load on these peers, without adversely affecting the route convergence time for stable routes.

You typically apply flap damping to external BGP (EBGP) routes (that is, to routes in different ASs). You can also apply it within a confederation, between confederation member ASs. Because routing consistency within an AS is important, do not apply flap damping to internal BGP (IBGP) routes. (If you do, it is ignored.) The exception to this rule is when flap damping is applied at the address family level. When you apply flap damping at the address family level, it works for both IBGP and EBGP.

Default Flap damping is disabled on the routing device.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Examples: Configuring BGP Flap Damping on page 2979
- Example: Configuring BGP Route Flap Damping Based on the MBGP MVPN Address Family on page 2989

description (Protocols BGP)

Syntax description *text-description*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Provide a description of the global, group, or neighbor configuration. If the text includes one or more spaces, enclose it in quotation marks (“ “). The test is displayed in the output of the **show** command and has no effect on the configuration.

Options ***text-description***—Text description of the configuration. It is limited to 255 characters.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *BGP Feature Guide for Routing Devices*

detection-time (BFD Liveness Detection)

Syntax

```
detection-time {
  threshold milliseconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPNs and VPLS.

Description

Enable BFD failure detection. The BFD failure detection timers are adaptive and can be adjusted to be faster or slower. The lower the BFD failure detection timer value, the faster the failure detection and vice versa. For example, the timers can adapt to a higher value if the adjacency fails (that is, the timer detects failures more slowly). Or a neighbor can negotiate a higher value for a timer than the configured value. The timers adapt to a higher value when a BFD session flap occurs more than three times in a span of 15 seconds. A back-off algorithm increases the receive (Rx) interval by two if the local BFD instance is the reason for the session flap. The transmission (Tx) interval is increased by two if the remote BFD instance is the reason for the session flap. You can use the **clear bfd adaptation** command to return BFD interval timers to their configured values. The **clear bfd adaptation** command is hitless, meaning that the command does not affect traffic flow on the routing device.

The remaining statement is explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- Example: Configuring BFD for BGP on page 2844
- **bfd-liveness-detection on page 3023**
- **threshold on page 3115**

disable (Protocols BGP)

Syntax disable;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Disable BGP on the system.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

disable (BGP Graceful Restart)

Syntax disable;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* graceful-restart],
[edit protocols bgp graceful-restart],
[edit protocols bgp group *group-name* graceful-restart],
[edit protocols bgp group *group-name* neighbor *address* graceful-restart]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Disable graceful restart for BGP. Graceful restart allows a routing device undergoing a restart to inform its adjacent neighbors and peers of its condition.

NOTE: When you disable graceful restart at one level in the configuration statement hierarchy, it is also disabled at lower levels in the same hierarchy. For example, if you disable graceful restart at the **[edit protocols bgp group *group-name*]** hierarchy level, it is disabled for all the peers in the group. Therefore, if you want to enable graceful restart for some peers in a group and disable it for others, enable graceful restart at the **[edit protocols bgp group *group-name*]** hierarchy level and disable graceful restart for each peer at the **[edit protocols bgp group *group-name* neighbor *address*]** hierarchy level.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Graceful Restart Options for BGP on page 1740
- *Configuring Graceful Restart for QFabric Systems*
- graceful-restart on page 1765

export (Protocols BGP)

Syntax
export [*policy-names*];

Hierarchy Level
[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description
Apply one or more policies to routes being exported from the routing table into BGP.

If you specify more than one policy, they are evaluated in the order specified, from left to right, and the first matching filter is applied to the route. If no routes match the filters, the routing table exports into BGP only the routes that it learned from BGP. If an action specified in one of the policies manipulates a route characteristic, the policy framework software carries the new route characteristic forward during the evaluation of the remaining policies. For example, if the action specified in the first policy of a chain sets a route's metric to 500, this route matches the criterion of **metric 500** defined in the next policy.

Options
policy-names—Name of one or more policies.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Understanding Route Advertisement on page 2803
- *Routing Policy Feature Guide for Routing Devices*
- import on page 3053

family (Protocols BGP)

Syntax

```
family {
  (inet | inet6 | inet-vpn | inet6-vpn | iso-vpn) {
    (any | flow | labeled-unicast | multicast | unicast) {
      accepted-prefix-limit {
        maximum number;
        teardown <percentage-threshold> idle-timeout (forever | minutes);
      }
      add-path {
        send {
          path-count number;
          prefix-policy [ policy-names ];
          }
        receive;
      }
      aigp [disable];
      loops number;
      prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      protection;
    rib-group group-name;
      topology name {
        community {
          target identifier;
        }
      }
    flow {
      no-validate policy-name;
    }
    labeled-unicast {
      accepted-prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      aggregate-label {
        community community-name:
      }
      explicit-null {
        connected-only;
      }
      prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      resolve-vpn;
      rib (inet.3 | inet6.3);
      rib-group group-name;
      traffic-statistics {
        file filename <world-readable | no-world-readable>;
        interval seconds;
      }
```

```
        }
      }
      route-target {
        accepted-prefix-limit {
          maximum number;
          proxy-generate <route-target-policy route-target-policy-name>;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        advertise-default;
        external-paths number;
        prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
      }
      (evpn | inet-mdt | inet-mvpn | inet6-mvpn | l2vpn) {
        signaling {
          accepted-prefix-limit {
            maximum number;
            teardown <percentage-threshold> idle-timeout (forever | minutes);
          }
          add-path {
            send {
              path-count number;
              prefix-policy [ policy-names ];
              }
            receive;
          }
          aigp [disable];
          damping;
          loops number;
          prefix-limit {
            maximum number;
            teardown <percentage> <idle-timeout (forever | minutes)>;
          }
          rib-group group-name;
        }
      }
    }
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
inet-mvpn and **inet6-mpvn** statements introduced in Junos OS Release 8.4.
inet-mdt statement introduced in Junos OS Release 9.4.
Support for the **loops** statement introduced in Junos OS Release 9.6.
evpn statement introduced in Junos OS Release 13.2.

Description Enable multiprotocol BGP (MP-BGP) by configuring BGP to carry network layer reachability information (NLRI) for address families other than unicast IPv4, to specify MP-BGP to carry NLRI for the IPv6 address family, or to carry NLRI for VPNs.

Options

any—Configure the family type to be both unicast and multicast.

evpn—Configure NLRI parameters for Ethernet VPNs (EVPNs).

inet—Configure NLRI parameters for IPv4.

inet6—Configure NLRI parameters for IPv6.

inet-mdt—Configure NLRI parameters for the multicast distribution tree (MDT) subaddress family identifier (SAFI) for IPv4 traffic in Layer 3 VPNs.

inet-mvpn—Configure NLRI parameters for IPv4 for multicast VPNs.

inet6-mvpn—Configure NLRI parameters for IPv6 for multicast VPNs.

inet-vpn—Configure NLRI parameters for IPv4 for Layer 3 VPNs.

inet6-vpn—Configure NLRI parameters for IPv6 for Layer 3 VPNs.

iso-vpn—Configure NLRI parameters for IS-IS for Layer 3 VPNs.

l2vpn—Configure NLRI parameters for IPv4 for MPLS-based Layer 2 VPNs and VPLS.

labeled-unicast—Configure the family type to be labeled-unicast. This means that the BGP peers are being used only to carry the unicast routes that are being used by labeled-unicast for resolving the labeled-unicast routes. This statement is supported only with **inet** and **inet6**.

multicast—Configure the family type to be multicast. This means that the BGP peers are being used only to carry the unicast routes that are being used by multicast for resolving the multicast routes.

unicast—Configure the family type to be unicast. This means that the BGP peers only carry the unicast routes that are being used for unicast forwarding purposes. The default family type is **unicast**.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring IBGP Sessions Between PE Routers in VPNs*
- *Understanding Multiprotocol BGP*
- autonomous-system on page 2346
- local-as on page 3064

graceful-restart (Protocols BGP)

Syntax

```
graceful-restart {
  disable;
  restart-time seconds;
  stale-routes-time seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure graceful restart for BGP. Graceful restart allows a routing device undergoing a restart to inform its adjacent neighbors and peers of its condition. Graceful restart is disabled by default.

To configure the duration of the BGP graceful restart period, include the **restart-time** statement at the **[edit protocols bgp graceful-restart]** hierarchy level. To set the length of time the router waits to receive messages from restarting neighbors before declaring them down, include the **stale-routes-time** statement at the **[edit protocols bgp graceful-restart]** hierarchy level.

NOTE: **If you configure graceful restart after a BGP session has been established, the BGP session restarts and the peers negotiate graceful restart capabilities.**

Configure graceful restart globally at the **[edit routing-options]** or **[edit routing-instances *instance-name* routing-options]** hierarchy level to enable the feature. You cannot enable graceful restart for specific protocols unless graceful restart is also enabled globally. You can, optionally, modify the global settings at the individual protocol level.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Graceful Restart Options for BGP on page 1740
- *Configuring Graceful Restart for QFabric Systems*
- *Junos OS High Availability Library for Routing Devices*

group (Protocols BGP)

Syntax

```
group group-name {
  advertise-inactive;
  allow [ network/mask-length ];
  authentication-key key;
  cluster cluster-identifier;
  damping;
  description text-description;
  export [ policy-names ];
  family {
    (inet | inet6 | inet-vpn | inet6-vpn | l2-vpn) {
      (any | multicast | unicast | signaling) {
        accepted-prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        add-path {
          send {
            path-count number;
            prefix-policy [ policy-names ];
            }
          receive;
        }
        aigp [disable];
        damping;
        prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        rib-group group-name;
        topology name {
          community {
            target identifier;
          }
        }
      }
      flow {
        no-validate policy-name;
      }
      labeled-unicast {
        accepted-prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        explicit-null {
          connected-only;
        }
        prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        resolve-vpn;
        rib inet.3;
```



```
            rib-group group-name;
          }
        }
        route-target {
          accepted-prefix-limit {
            maximum number;
            teardown <percentage> <idle-timeout (forever | minutes)>;
          }
          advertise-default;
          external-paths number;
          prefix-limit {
            maximum number;
            teardown <percentage> <idle-timeout (forever | minutes)>;
          }
        }
      }
      hold-time seconds;
      import [ policy-names ];
      ipsec-sa ipsec-sa;
      keep (all | none);
      local-address address;
      local-as autonomous-system <private>;
      local-preference local-preference;
      log-updown;
      metric-out metric;
      multihop <ttl-value>;
      multipath {
        multiple-as;
      }
      no-aggregator-id;
      no-client-reflect;
      out-delay seconds;
      passive;
      peer-as autonomous-system;
      preference preference;
      remove-private;
      tcp-mss segment-size;
      traceoptions {
        file filename <files number> <size size> <world-readable | no-world-readable>;
        flag flag <flag-modifier> <disable>;
      }
      type type;
      neighbor address {
        ... peer-specific-options ...
      }
    }
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Define a BGP peer group. BGP peer groups share a common type, peer autonomous system (AS) number, and cluster ID, if present. To configure multiple BGP groups, include multiple **group** statements.

By default, the group's options are identical to the global BGP options. To override the global options, include group-specific options within the **group** statement.

The **group** statement is one of the statements you must include in the configuration to run BGP on the routing device.

Each group must contain at least one peer.

Options ***group-name***—Name of the BGP group.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *BGP Feature Guide for Routing Devices*

hold-down

Syntax

```
hold-down {
  seconds;
  flaps number;
  period seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description

If the connection to a BMP station flaps and the **hold-down** statement is configured, the station is prevented from reconnecting to the device for the specified period of time. A flap is when the TCP session unexpectedly switches from established to non-established. If you alter the configuration of the **hold-down** statement, the hold down timer and flap counter are reset.

You can effectively disable the **hold-down** statement by setting the **flaps** option to 10 and the **period** option to 30 seconds.

Options

seconds—Specify the time in seconds to wait before allowing the BMP station to reconnect to the device.

Default: 600 seconds

Range: 30 through 65,535 seconds

flaps *number*—Specify the number of BMP station flaps allowed before terminating the connection to the BMP station and triggering the hold down timer.

Default: 3 flaps

Range: 2 to 10 flaps

period *seconds*—Specify the time in seconds for the BGP station flaps (specified using the **flaps** option) to occur before triggering the hold down timer. Every time a flap occurs, the number of flaps in the last time period is checked to see if the criteria is met.

For example, if you defined the **period** as 60 seconds and the **flaps** as 4 and the BGP station flaps just 2 times in a 60 second period, the hold down timer would not be triggered. However, if the BGP station flaps 4 times in a 60 second period, the hold down timer would be triggered.

Default: 300 seconds

Range: 30 through 65,535 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 2685

hold-down-interval (BGP BFD Liveness Detection)

Syntax

holddown-interval *milliseconds*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure an interval specifying how long a BFD session must remain up before a state change notification is sent.

When you configure the hold-down interval for the BFD protocol for EBGP, the BFD session is unaware of the BGP session during this time. In this case, if the BGP session goes down during the configured hold-down interval, BFD already assumes the BGP session is down and does not send a state change notification. The **holddown-interval** statement is supported only for EBGP peers at the **[edit protocols bgp group *group-name* neighbor *address*]** hierarchy level. If the BFD session goes down and then comes back up during the configured hold-down interval, the timer is restarted. You must configure the hold-down interval on both EBGP peers. If you configure the hold-down interval for a multihop EBGP session, you must also configure a local IP address by including the **local-address** statement at the **[edit protocols bgp group *group-name*]** hierarchy level.

Options

milliseconds—Specify the hold-down interval value.

Range: 0 through 255,000

Default: 0

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BFD for Static Routes on page 2319
- **bfd-liveness-detection on page 3023**

hold-time (Protocols BGP)

Syntax hold-time *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify the hold-time value to use when negotiating a connection with the peer. The hold-time value is advertised in open packets and indicates to the peer the length of time that it should consider the sender valid. If the peer does not receive a keepalive, update, or notification message within the specified hold time, the BGP connection to the peer is closed and routing devices through that peer become unavailable.

The hold time is three times the interval at which keepalive messages are sent.

BGP on the local routing device uses the smaller of either the local hold-time value or the peer's hold-time value received in the open message as the hold time for the BGP connection between the two peers.

Starting in Junos OS Release 12.3, the BGP hold-time value can be zero (0). This implies that the speaker does not expect keepalive messages from its peer to maintain the BGP session. When negotiating between two peers, if one side requests a nonzero hold time and the other requests a zero hold time, the negotiation settles on the nonzero value and keepalive intervals are determined accordingly. Both sides must be set to zero for keepalive messages to stop being sent.

Options *seconds*—Hold time.

Range: 10 through 65,535 seconds (or 0 for infinite hold time)

Default: 90 seconds

TIP: When you set a hold-time value of 1 though 19 seconds, we recommend that you also configure the BGP **precision-timers** statement. The **precision-timers** statement ensures that if scheduler slip messages occur, the routing device continues to send keepalive messages. When the **precision-timers** statement is included, keepalive message generation is performed in a dedicated kernel thread, which helps to prevent BGP session flaps.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- BGP Messages Overview on page 2635
- *precision-timers*

import (Protocols BGP)

Syntax import [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Apply one or more routing policies to routes being imported into the Junos OS routing table from BGP.

If you specify more than one policy, they are evaluated in the order specified, from left to right, and the first matching filter is applied to the route. If no match is found, BGP places into the routing table only those routes that were learned from BGP routing devices. The policy framework software evaluates the routing policies in a chain sequentially. If an action specified in one of the policies manipulates a route characteristic, the policy framework software carries the new route characteristic forward during the evaluation of the remaining policies. For example, if the action specified in the first policy of a chain sets a route's metric to 500, this route matches the criterion of **metric 500** defined in the next policy.

It is also important to understand that in Junos OS, although an import policy (inbound route filter) might reject a route, not use it for traffic forwarding, and not include it in an advertisement to other peers, the router retains these routes as hidden routes. These hidden routes are not available for policy or routing purposes. However, they do occupy memory space on the router. A service provider filtering routes to control the amount of information being kept in memory and processed by a router might want the router to entirely drop the routes being rejected by the import policy.

Hidden routes can be viewed by using the **show route receive-protocol bgp *neighbor-address* hidden** command. The hidden routes can then be retained or dropped from the routing table by configuring the **keep all | none** statement at the **[edit protocols bgp]** or **[edit protocols bgp group *group-name*]** hierarchy level.

The rules of BGP route retention are as follows:

- By default, all routes learned from BGP are retained, except those where the AS path is looped. (The AS path includes the local AS.)
- By configuring the **keep all** statement, all routes learned from BGP are retained, even those with the local AS in the AS path.
- By configuring the **keep none** statement, all routes received are discarded. When this statement is configured and the inbound policy changes, Junos OS re-advertises all the routes advertised by the peer.

Options *policy-names*—Name of one or more policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BGP Interactions with IGPs on page 2799
- Understanding Route Advertisement on page 2803
- *Routing Policy Feature Guide for Routing Devices*
- export on page 3038

include-mp-next-hop

Syntax include-mp-next-hop;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Enable multiprotocol updates to contain next-hop reachability information.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Examples: Configuring Multiprotocol BGP*

initiation-message

Syntax initiation-message *text*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description (Optional) Allows you to specify an initiation message for a type 0 TLV to be sent to the BMP station. The message is transmitted when a BMP station establishes a connection to the device. You can provide some information to the BMP station system administrator (for example, a contact phone number). The initiation message includes a type 1 TLV containing the SNMP sysDescr value specified in RFC 1213 *Management Information Base for Network Management of TCP/IP-based internets: MIB-II* and a type 2 TLV containing the SNMP sysName value also from RFC 1213. The string in the initiation-message message is UTF-8.

The normal time for sending an initiation message is when the BMP session is first established. However, an initiation message change also triggers the transmission of an initiation message to current BMP sessions.

Another event that triggers the transmission of an initiation message is when you change in the sysName or sysDescr values in the SNMP configuration. The initiation message is sent to current BMP sessions.

Options *text*—Specify a character string for a type 0 TLV to send with the initiation message.

Range: 1 through 255 characters

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 2685

keep

Syntax keep (all | none);

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Control whether or not Junos OS keeps in memory and hides certain routes.

If the **keep none** statement is used, Junos OS does not retain in memory and hide routes that are rejected because of a BGP import policy. Nor does BGP keep in memory and hide routes that are declared unfeasible due to BGP sanity checks. The **keep none** statement causes Junos OS to discard from memory the routes that are rejected due to BGP-specific logic or BGP evaluation. When a route is rejected because of some non-BGP-specific reason, the **keep none** statement has no effect on this route. This rejected route is retained in memory and hidden even though **keep none** is configured. An example of this type of hidden route is a route for which the protocol nexthop is unresolved.

The routing table can retain the route information learned from BGP in one of the following ways:

- Default (omit the **keep** statement)—Keep all route information that was learned from BGP, except for routes whose AS path is looped and whose loop includes the local AS.
- **keep all**—Keep all route information that was learned from BGP.
- **keep none**—Discard routes that were received from a peer and that were rejected by import policy or other sanity checking, such as AS path or next hop. When you configure **keep none** for the BGP session and the inbound policy changes, Junos OS forces readvertisement of the full set of routes advertised by the peer.

In an AS path healing situation, routes with looped paths theoretically could become usable during a soft reconfiguration when the AS path loop limit is changed. However, there is a significant memory usage difference between the default and **keep all**.

Consider the following scenarios:

- A peer readvertises routes back to the peer from which it learned them.

  This can happen in the following cases:

  - Another vendor's routing device advertises the routes back to the sending peer.
  - The Junos OS peer's default behavior of not readvertising routes back to the sending peer is overridden by configuring **advertise-peer-as**.
- A provider edge (PE) routing device discards any VPN route that does not have any of the expected route targets.

When **keep all** is configured, the behavior of discarding routes received in the above scenarios is overridden.

CAUTION: When you configure **keep (all | none)**, the associated BGP sessions are restarted.

Default By default, BGP retains incoming rejected routes in memory and hides them. If you do not include the **keep** statement, most routes are retained in the routing table. BGP keeps all route information that was learned from BGP, except for routes whose AS path is looped and whose loop includes the local AS.

Options **all**—Retain all routes.

none—Discard routes that were received from a peer and that were rejected by import policy or other sanity checking. When **keep none** is configured for the BGP session and the inbound policy changes, Junos OS forces readvertisement of the full set of routes advertised by the peer.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- out-delay on page 3094
- *Interprovider VPN Example—MP-EBGP Between ISP Peer Routers*
- *Example: Configuring Conditional Installation of Prefixes in a Routing Table*

key-chain (BGP BFD Authentication)

Syntax key-chain *key-chain-name*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit protocols bgp bgp bfd-liveness-detection authentication],
[edit protocols bgp group *group-name* bgp bfd-liveness-detection authentication],
[edit protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication]

Release Information Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Associate a security key with the specified BFD session using the name of the security keychain. Each key has a unique start time within the keychain. Keychain authentication allows you to change the password information periodically without bringing down peering sessions. This keychain authentication method is referred to as *hitless* because the keys roll over from one to the next without resetting any peering sessions or interrupting the routing protocol.

Options ***key-chain-name***—Name of the authentication keychain. The keychain name must match one of the keychains configured with the **key-chain *key-chain-name*** statement at the **[edit security authentication-key-chain]** hierarchy level.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BFD for Static Routes on page 2319
- Example: Configuring BFD Authentication for Static Routes on page 2332
- Example: Configuring BFD on Internal BGP Peer Sessions on page 2845
- Example: Configuring BGP Route Authentication on page 2952

- Example: Configuring EBGP Multihop Sessions on page 2811

local-address (Protocols BGP)

Syntax local-address *address*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify the address of the local end of a BGP session. This address is used to accept incoming connections to the peer and to establish connections to the remote peer. When none of the operational interfaces are configured with the specified local address, a session with a BGP peer is placed in the idle state.

You generally configure a local address to explicitly configure the system's IP address from BGP's point of view. This IP address can be either an IPv6 or IPv4 address. Typically, an IP address is assigned to a loopback interface, and that IP address is configured here.

For internal BGP (IBGP) peering sessions, generally the loopback interface (lo0) is used to establish connections between the IBGP peers. The loopback interface is always up as long as the device is operating. If there is a route to the loopback address, the IBGP peering session stays up. If a physical interface address is used instead and that interface goes up and down, the IBGP peering session also goes up and down. Thus, the loopback interface provides fault tolerance in case the physical interface or the link goes down, if the device has link redundancy.

When a device peers with a remote device's loopback interface address, the local device expects BGP update messages to come from (be sourced by) the remote device's loopback interface address. The **local-address** statement enables you to specify the source information in BGP update messages. If you omit the **local-address** statement, the expected source of BGP update messages is based on the device's source address selection rules, which normally result in the egress interface address being the expected source of update messages. When this happens, the peering session is not established because a mismatch exists between the expected source address (the egress interface of the peer) and the actual source (the loopback interface of the peer). To ensure that the expected source address matches the actual source address, specify the loopback interface address in the **local-address** statement.

NOTE: **Although a BGP session can be established when only one of the paired routing devices has local-address configured, we strongly recommend that you configure local-address on both paired routing devices for IBGP and multihop EBGP sessions. The local-address statement ensures that deterministic fixed addresses are used for the BGP session end-points.**

If you include the **default-address-selection** statement in the configuration, the software chooses the system default address as the source for most locally generated IP packets. For protocols in which the local address is unconstrained by the protocol specification, for example IBGP and multihop EBGP, if you do not configure a specific local address when configuring the protocol, the local address is chosen using the same methods as other locally generated IP packets.

Default If you do not configure a local address, BGP uses the routing device's source address selection rules to set the local address.

Options ***address***—IPv6 or IPv4 address of the local end of the connection.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Internal BGP Peering Sessions on Logical Systems on page 2674
- Example: Configuring Internal BGP Peer Sessions on page 2663
- Understanding Internal BGP Peering Sessions on page 2662
- **router-id on page 2424**

local-address (Protocols BMP)

Syntax local-address *address*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description (Optional) Specifies the IPv4 or IPv6 address for the BMP connection on the device. We recommend that you configure a local address. For both active and passive modes, configure a loopback local address. This provides a consistent local endpoint, is useful for debugging, and assures greater reliability for the BMP connection since it is not tied to a single router interface.

For passive mode, specifying a local address is required. It also provides some security against a malicious BMP connection. For active mode, we also recommend configuring a local address to help ensure reliability.

If you change the local address, the BMP station connection flaps when you commit the configuration.

Options *address*—Specify the IPv4 or IPv6 address for the BMP connection on the local device.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring BGP Monitoring Protocol Version 3 on page 2685

local-as

Syntax local-as *autonomous-system* <loops *number*> <private | alias> <no-prepend-global-as>;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
alias option introduced in Junos OS Release 9.5.
no-prepend-global-as option introduced in Junos OS Release 9.6.

Description Specify the local autonomous system (AS) number. An AS is a set of routing devices that are under a single technical administration and generally use a single interior gateway protocol (IGP) and metrics to propagate routing information within the set of routing devices.

Internet service providers (ISPs) sometimes acquire networks that belong to a different AS. When this occur, there is no seamless method for moving the BGP peers of the acquired network to the AS of the acquiring ISP. The process of configuring the BGP peers with the new AS number can be time-consuming and cumbersome. In this case, it might not be desirable to modify peer arrangements or configuration. During this kind of transition period, it can be useful to configure BGP-enabled devices in the new AS to use the former AS number in BGP updates. This former AS number is called a *local AS*.

NOTE: If you are using BGP on the routing device, you must configure an AS number before you specify the **local as** number.

In Junos OS Release 9.1 and later, the AS numeric range in plain-number format is extended to provide BGP support for 4-byte AS numbers, as defined in RFC 4893, *BGP Support for Four-octet AS Number Space*.

In Junos OS Release 9.3 and later, you can also configure a 4-byte AS number using the AS-dot notation format of two integer values joined by a period: *<16-bit high-order value in decimal>.<16-bit low-order value in decimal>*. For example, the 4-byte AS number of 65546 in plain-number format is represented as 1.10 in the AS-dot notation format.

Options

alias—(Optional) Configure the local AS as an alias of the global AS number configured for the router at the **[edit routing-options]** hierarchy level. As a result, a BGP peer considers any local AS to which it is assigned as equivalent to the primary AS number configured for the routing device. When you use the **alias** option, only the AS (global or local) used to establish the BGP session is prepended in the AS path sent to the BGP neighbor.

autonomous-system—AS number.

Range: 1 through 4,294,967,295 (2^{32} – 1) in plain-number format

Range: 0.0 through 65535.65535 in AS-dot notation format

loops *number*—(Optional) Specify the number of times detection of the AS number in the AS_PATH attribute causes the route to be discarded or hidden. For example, if you configure **loops 1**, the route is hidden if the AS number is detected in the path one or more times. This is the default behavior. If you configure **loops 2**, the route is hidden if the AS number is detected in the path two or more times.

NOTE: If you configure the local AS values for any BGP group, the detection of routing loops is performed using both the AS and the local AS values for all BGP groups.

If the local AS for the EBGP or IBGP peer is the same as the current AS, do not use the **local-as** statement to specify the local AS number.

When you configure the local AS within a VRF, this impacts the AS path loop-detection mechanism. All of the **local-as** statements configured on the device are part of a single AS domain. The AS path loop-detection mechanism is based on looking for a matching AS present in the domain.

Range: 1 through 10

Default: 1

no-prepend-global-as—(Optional) Specify to strip the global AS and to prepend only the local AS in AS paths sent to external peers.

private—(Optional) Configure to use the local AS only during the establishment of the BGP session with a BGP neighbor but to hide it in the AS path sent to external BGP peers. Only the global AS is included in the AS path sent to external peers.

NOTE: The **private** and **alias** options are mutually exclusive. You cannot configure both options with the same **local-as** statement.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Examples: Configuring BGP Local AS on page 2740
- Example: Configuring a Local AS for EBGP Sessions on page 2745
- **autonomous-system on page 2346**
- **family on page 3039**

local-port

Syntax local-port *port*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description Specifies the listening port for the BMP station connection.

If you configure the connection-mode statement as **active**, do not configure the **local-port** statement. If you configure the connection-mode statement as **passive**, you must configure **local-port** statement.

If you change the local port, the BMP station connection flaps when you commit the configuration.

Options *port*—Specify the local port for the BMP station connection.

Range: 1 through 65,535

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 2685

local-preference

Syntax

local-preference *local-preference*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Modify the value of the **LOCAL_PREF** path attribute, which is a metric used by BGP sessions to indicate the degree of preference for an external route. The route with the highest local preference value is preferred.

The **LOCAL_PREF** path attribute always is used in inbound routing policy and is advertised to internal BGP peers and to neighboring confederations. It is never advertised to external BGP peers.

Default

If you omit this statement, the **LOCAL_PREF** path attribute, if present, is not modified.

Options

local-preference—Preference to assign to routes learned from BGP or from the group or peer.

Range: 0 through 4,294,967,295 (2^{32} – 1)

Default: If the **LOCAL_PREF** path attribute is present, do not modify its value. If a BGP route is received without a **LOCAL_PREF** attribute, the route is handled locally (it is stored in the routing table and advertised by BGP) as if it were received with a **LOCAL_PREF** value of 100. By default, non-BGP routes that are advertised by BGP are advertised with a **LOCAL_PREF** value of 100.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring the Local Preference Value for BGP Routes on page 2688
- Understanding Internal BGP Peering Sessions on page 2662

- preference on page 3103

log-updown (Protocols BGP)

Syntax log-updown;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify to generate a log a message whenever a BGP peer makes a state transition. Messages are logged using the system logging mechanism located at the **[edit system syslog]** hierarchy level.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Preventing BGP Session Resets on page 2972
- *Junos OS Administration Library for Routing Devices*
- traceoptions on page 3119

loops

Syntax loops *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp family *address-family*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family *address-family*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* local-as],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family *address-family*],
[edit logical-systems *logical-system-name*protocols bgp group *group-name* neighbor *address* local-as]
[edit logical-systems *logical-system-name* protocols bgp local-as],
[edit logical-systems *logical-system-name* routing-options autonomous-system *as-number*],
[edit protocols bgp family *address-family*],
[edit protocols bgp group *group-name* family *address-family*],
[edit protocols bgp group *group-name* local-as],
[edit protocols bgp group *group-name* neighbor *address* family *address-family*],
[edit protocols bgp group *group-name* neighbor *address* local-as]
[edit protocols bgp local-as],
[edit routing-options autonomous-system *as-number*]

Release Information Statement introduced in Junos OS Release 9.6.

Description Globally, for the local-AS BGP attribute, or the specified address family, allow the local device's AS number to be in the received AS paths, and specify the number of times detection of the local device's AS number in the AS_PATH attribute causes the route to be discarded or hidden. For example, if you configure **loops 1**, the route is hidden if the local device's AS number is detected in the path one or more times. This prevents routing loops and is the default behavior. If you configure **loops 2**, the route is hidden if the local device's AS number is detected in the path two or more times.

Some examples of BGP address families are as follows:

- **inet unicast**
- **inet-vpn multicast**
- **inet6 any**
- **l2vpn auto-discovery-only**
- ...

This list is truncated for brevity. For a complete list of protocol families for which you can specify the **loops** statement, enter the **help apropos loops** configuration command at the **[edit protcols bgp]** hierarchy level on your device.

```
[edit protocols bgp]
user@host# help apropos loops
set family inet unicast loops
    Allow local AS in received AS paths
set family inet unicast loops <loops>
    AS-Path loop count
set family inet multicast loops
```

```
    Allow local AS in received AS paths
set family inet multicast loops <loops>
    AS-Path loop count
set family inet flow loops
    Allow local AS in received AS paths
set family inet flow loops <loops>
    AS-Path loop count
set family inet any loops
    Allow local AS in received AS paths
set family inet any loops <loops>
    AS-Path loop count
set family inet labeled-unicast loops
    Allow local AS in received AS paths
...
```

NOTE: When you configure the **loops** statement for a specific BGP address family, that value is used to evaluate the AS path for routes received by a BGP peer for the specified address family, rather than the loops value configured for the global AS number with the **loops** statement at the **[edit routing-options autonomous-system *as-number*]** hierarchy level.

Options *number*—Number of times detection of the AS number in the AS_PATH attribute causes the route to be discarded or hidden.

Range: 1 through 10

Default: 1

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Disabling Suppression of Route Advertisements*
- autonomous-system on page 2346
- family on page 3039
- local-as on page 3064

loose-check (BGP BFD Authentication)

Syntax

loose-check ;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit protocols bgp bgp bfd-liveness-detection authentication],
[edit protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication]

Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Specify loose authentication checking on the BFD session. Use loose authentication for transitional periods only when authentication might not be configured at both ends of the BFD session.

By default, strict authentication is enabled and authentication is checked at both ends of each BFD session. Optionally, to smooth migration from nonauthenticated sessions to authenticated sessions, you can configure *loose checking*. When loose checking is configured, packets are accepted without authentication being checked at each end of the session.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BFD for Static Routes on page 2319
- Example: Configuring BFD Authentication for Static Routes on page 2332
- Example: Configuring BFD on Internal BGP Peer Sessions on page 2845
- Example: Configuring BGP Route Authentication on page 2952
- Example: Configuring EBGP Multihop Sessions on page 2811

maximum-ecmp

Syntax maximum-ecmp *next-hops*;

Hierarchy Level [edit chassis]

Release Information Statement introduced in Junos OS Release 13.2 for QFX switches.

Description Configure 16, 32, or 64 ECMP next hops for RSVP or LDP LSPs, or MPLS static LSPs that are configured using **set protocols mpls static-label-switched-path**.

Default 16

Options **next-hops**—Specify the number of next hops (16, 32, or 64) for RSVP or LDP LSPs, or MPLS static LSPs

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
-

metric-out (Protocols BGP)

Syntax metric-out (*metric* | minimum-igp *offset* | igp (delay-med-update | *offset*);

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Option **delay-med-update** introduced in Junos OS Release 9.0.

Description Specify the metric for all routes sent using the multiple exit discriminator (MED, or **MULTI_EXIT_DISC**) path attribute in update messages. This path attribute is used to discriminate among multiple exit points to a neighboring AS. If all other factors are equal, the exit point with the lowest metric is preferred.

You can specify a constant metric value by including the ***metric*** option. For configurations in which a BGP peer sends third-party next hops that require the local system to perform next-hop resolution—IBGP configurations, configurations within confederation peers, or EBGP configurations that include the **multihop** command—you can specify a variable metric by including the **minimum-igp** or **igp** option.

You can increase or decrease the variable metric calculated from the IGP metric (either from the **igp** or **minimum-igp** statement) by specifying a value for ***offset***. The metric is increased by specifying a positive value for ***offset***, and decreased by specifying a negative value for ***offset***.

In Junos OS Release 9.0 and later, you can specify that a BGP group or peer not advertise updates for the MED path attributes used to calculate IGP costs for BGP next hops unless the MED is lower. You can also configure an interval to delay when MED updates are sent by including the **med-igp-update-interval** ***minutes*** statement at the **[edit routing-options]** hierarchy level.

Options **delay-med-update**—Specify that a BGP group or peer configured with the **metric-out igp** statement not advertise MED updates unless the current MED value is lower than the previously advertised MED value, or another attribute associated with the route has changed, or the BGP peer is responding to a refresh route request.

NOTE: You cannot configure the **delay-med–update** statement at the global BGP level.

igp—Set the metric to the most recent metric value calculated in the IGP to get to the BGP next hop. Routes learned from an EBGP peer usually have a next hop on a directly connected interface and thus the IGP value is equal to zero. This is the value advertised.

metric—Primary metric on all routes sent to peers.

Range: 0 through 4,294,967,295 (2^{32} – 1)

Default: No metric is sent.

minimum-igp—Set the metric to the minimum metric value calculated in the IGP to get to the BGP next hop. If a newly calculated metric is greater than the minimum metric value, the metric value remains unchanged. If a newly calculated metric is lower, the metric value is lowered to that value. When you change a neighbor's export policy from any configuration to a configuration that sets the minimum IGP offset on an exported route, the advertised MED is not updated if the value would increase as a result, even if the previous configuration does not use a minimum IGP-based MED value. This behavior helps to prevent unnecessary route flapping when an IGP cost changes, by not forcing a route update if the metric value increases past the previous lowest known value.

offset—Increases or decreases the metric by this value.

Range: -2^{31} through $2^{31} - 1$

Default: None

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Associating the MED Path Attribute with the IGP Metric and Delaying MED Updates on page 2730
- Examples: Configuring BGP MED on page 2701
- Example: Configuring the MED Attribute Directly on page 2703
- Understanding the MED Attribute on page 2701
- **med-igp-update-interval on page 2389**

minimum-interval (BFD Liveness Detection)

Syntax minimum-interval *milliseconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.

Description Configure the minimum interval after which the local routing device transmits hello packets and then expects to receive a reply from a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can specify the minimum transmit and receive intervals separately using the minimum-interval (specified under the **transmit-interval** statement) and minimum-receive-interval statements.

Options *milliseconds*—Specify the minimum interval value for BFD liveliness detection.

Range: 1 through 255,000

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- Example: Configuring BFD for Static Routes on page 2319
- **bfd-liveness-detection on page 3023**
- **minimum-receive-interval on page 3079**
- **transmit-interval on page 3124**

minimum-interval (transmit-interval)

Syntax minimum-interval *milliseconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection transmit-interval],
[edit protocols bgp bfd-liveness-detection transmit-interval],
[edit protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection transmit-interval]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.

Description Configure the minimum interval at which the local routing device transmits hello packets to a neighbor with which it has established a BFD session. Optionally, instead of using this statement at this hierarchy level, you can configure the minimum transmit interval using the minimum-interval statement at the **bfd-liveness-detection** hierarchy level.

Options *milliseconds*—Minimum transmit interval value.

Range: 1 through 255,000

NOTE: The threshold value specified in the **threshold** statement must be greater than the value specified in the **minimum-interval** statement for the **transmit-interval** statement.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- Example: Configuring BFD for Static Routes on page 2319
- bfd-liveness-detection on page 3023
- minimum-interval on page 3075
- threshold on page 3117

minimum-receive-interval (BFD Liveness Detection)

Syntax minimum-receive-interval *milliseconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.

Description Configure the minimum interval after which the local routing device must receive a reply from a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum receive interval using the **minimum-interval** statement.

Options *milliseconds*—Specify the minimum receive interval value.

Range: 1 through 255,000

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- Example: Configuring BFD for Static Routes on page 2319
- **bfd-liveness-detection on page 3023**
- **minimum-interval on page 3075**
- **transmit-interval on page 3124**

monitor (Protocols BMP)

Syntax
monitor (enable | disable);

Hierarchy Level
[edit logical-systems *logical-system-name* protocols bgp bmp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bmp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bmp],
[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit protocols bgp bmp],
[edit protocols bgp group *group-name* bmp],
[edit protocols bgp group *group-name* neighbor *address* bmp],
[edit routing-options bmp],
[edit routing-options bmp station *station-name*]

Release Information
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description
BMP monitoring is enabled by default. You can explicitly enable BMP monitoring or disable it. You can also selectively enable or disable BMP monitoring at various hierarchy levels (for example, **[edit protocols bgp group *group-name*]** or **[edit protocols bgp group *group-name* neighbor *address*]**). If you disable BMP monitoring, withdrawal messages are sent for any previously advertised routes. These are followed by a down message. If you enable BMP monitoring, an up message is sent first and then the route advertisements follow.

Options
enable—Enable BMP monitoring.

Default: BMP monitoring is enabled by default.

disable—Disable BMP monitoring.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

mtu-discovery

Syntax mtu-discovery;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure TCP path maximum transmission unit (MTU) discovery.

TCP path MTU discovery enables BGP to automatically discover the best TCP path MTU for each BGP session. In Junos OS, TCP path MTU discovery is disabled by default for all BGP neighbor sessions.

When MTU discovery is disabled, TCP sessions that are not directly connected transmit packets of 512-byte maximum segment size (MSS). These small packets minimize the chances of packet fragmentation at a device along the path to the destination. However, because most links use an MTU of at least 1500 bytes, 512-byte packets do not result in the most efficient use of link bandwidth. For directly connected EBGP sessions, MTU mismatches prevent the BGP session from being established. As a workaround, enable path MTU discovery within the EBGP group.

Path MTU discovery dynamically determines the MTU size on the network path between the source and the destination, with the goal of avoiding IP fragmentation. Path MTU discovery works by setting the Don’t Fragment (DF) bit in the IP headers of outgoing packets. When a device along the path has an MTU that is smaller than the packet, the device drops the packet. The device also sends back an ICMP Fragmentation Needed (Type 3, Code 4) message that contains the device’s MTU, thus allowing the source to reduce its path MTU appropriately. The process repeats until the MTU is small enough to traverse the entire path without fragmentation.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Limiting TCP Segment Size for BGP on page 2967
- *Configuring the Junos OS for IPv6 Path MTU Discovery*
- *Configuring the Junos OS for Path MTU Discovery on Outgoing GRE Tunnel Connections*

multihop

Syntax

```
multihop {
  no-nexthop-change;
  ttl ttl-value;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure an EBGP multihop session.

For Layer 3 VPNs, you configure the EBGP multihop session between the PE and CE routing devices. This allows you to configure one or more routing devices between the PE and CE routing devices.

An external confederation peer is a special case that allows unconnected third-party next hops. You do not need to configure multihop sessions explicitly in this particular case because multihop behavior is implied.

If you have external BGP confederation peer-to-loopback addresses, you still need the multihop configuration.

NOTE: You cannot configure the **accept-remote-nexthop** statement at the same time.

Default

If you omit this statement, all EBGP peers are assumed to be directly connected (that is, you are establishing a nonmultihop, or “regular,” BGP session), and the default time-to-live (TTL) value is 1.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring EBGP Multihop Sessions on page 2811
- *Configuring EBGP Multihop Sessions Between PE and CE Routers in Layer 3 VPNs*
- **accept-remote-nexthop on page 3010**
- *no-nexthop-change*
- *ttl*

multiplier (BFD Liveness Detection)

Syntax multiplier *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.

Description Configure the number of hello packets not received by a neighbor that causes the originating interface to be declared down.

Options *number*—Number of hello packets.

Range: 1 through 255

Default: 3

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- Example: Configuring BFD for Static Routes on page 2319
- **bfd-liveness-detection on page 3023**

neighbor (Protocols BGP)

Syntax

```
neighbor address {
  accept-remote-nexthop;
  advertise-external <conditional>;
  advertise-inactive;
  (advertise-peer-as | no-advertise-peer-as);
  as-override;
  authentication-algorithm algorithm;
  authentication-key key;
  authentication-key-chain key-chain;
  cluster cluster-identifier;
  damping;
  description text-description;
  export [ policy-names ];
  family {
    (inet | inet6 | inet-mvpn | inet6-mpvn | inet-vpn | inet6-vpn | iso-vpn | l2-vpn) {
      (any | flow | multicast | unicast | signaling) {
        accepted-prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        damping;
        prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        rib-group group-name;
        topology name {
          community {
            target identifier;
          }
        }
      }
      flow {
        no-validate policy-name;
      }
      labeled-unicast {
        accepted-prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        aggregate-label {
          community community-name:
        }
        explicit-null {
          connected-only;
        }
        prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        resolve-vpn;
        rib inet.3;
```

```
          rib-group group-name;
          topology name {
            community {
              target identifier;
            }
          }
        }
      }
      route-target {
        advertise-default;
        external-paths number;
        accepted-prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
      }
      signaling {
        prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
      }
    }
    graceful-restart {
      disable;
      restart-time seconds;
      stale-routes-time seconds;
    }
    hold-time seconds;
    import [ policy-names ];
    ipsec-sa ipsec-sa;
    keep (all | none);
    local-address address;
    local-as autonomous-system <private>;
    local-interface interface-name;
    local-preference preference;
    log-updown;
    metric-out (metric | minimum-igp <offset> | igp <offset>);
    mtu-discovery;
    multihop <ttl-value>;
    multipath {
      multiple-as;
    }
    no-aggregator-id;
    no-client-reflect;
    out-delay seconds;
    passive;
    peer-as autonomous-system;
    preference preference;
    tcp-mss segment-size;
    traceoptions {
      file filename <files number> <size size> <world-readable | no-world-readable>;
```

```
    flag flag <flag-modifier> <disable>;
  }
  vpn-apply-export;
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Explicitly configure a neighbor (peer). To configure multiple BGP peers, include multiple **neighbor** statements.

By default, the peer's options are identical to those of the group. You can override these options by including peer-specific option statements within the **neighbor** statement.

The **neighbor** statement is one of the statements you can include in the configuration to define a minimal BGP configuration on the routing device. (You can include an **allow all** statement in place of a **neighbor** statement.)

Options ***address***—IPv6 or IPv4 address of a single peer.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *BGP Feature Guide for Routing Devices*

no-adaptation (BFD Liveness Detection)

Syntax no-adaptation;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information Statement introduced in Junos OS Release 9.0
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.

Description Configure BFD sessions not to adapt to changing network conditions. We recommend that you *do not* disable BFD adaptation unless it is preferable to have BFD adaptation disabled in your network.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Configuring BFD for Layer 2 VPN and VPLS*

- Example: Configuring BFD for Static Routes on page 2319
- **bfd-liveness-detection on page 3023**

no advertise-peer-as

Syntax no-advertise-peer-as;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Enable the default behavior of suppressing AS routes.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Configuring BGP Route Advertisement on page 2803
- Understanding Route Advertisement on page 2803
- **advertise-peer-as on page 3014**

no-aggregator-id

Syntax no-aggregator-id;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Prevent different routing devices within an AS from creating aggregate routes that contain different AS paths.

Junos OS performs route aggregation, which is the process of combining the characteristics of different routes so that only a single route is advertised. Aggregation reduces the amount of information that BGP must store and exchange with other BGP systems. When aggregation occurs, the local routing device adds the local AS number and the router ID to the aggregator path attiribute. The **no-aggregator-id** statement causes Junos OS to place a 0 in the router ID field and thus eliminate the possibility of having multiple aggregate advertisements in the network, each with different path information.

Default If you omit this statement, the router ID is included in the BGP aggregator path attribute.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Update Messages on page 2636

no-client-reflect

Syntax no-client-reflect;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Disable intracluster route redistribution by the system acting as the route reflector. Include this statement when the client cluster is fully meshed to prevent the sending of redundant route advertisements. Route reflection provides a way to decrease BGP control traffic and minimizing the number of update messages sent within the AS.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BGP Route Reflectors on page 2928
- cluster on page 3030

out-delay

Syntax out-delay *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Control how often BGP and the routing table exchange route information by specifying how long a route must be present in the Junos OS routing table before it is exported to BGP. Use this time delay to help bundle routing updates and to avoid sending updates too often.

Alternatively or in addition, external BGP (EBGP) sessions can also use the route-flap damping mechanism upon the reception of BGP messages coming from an external neighbor.

BGP stores the route information it receives from update messages in the routing table, and the routing table exports active routes from the routing table into BGP. BGP then advertises the exported routes to its peers. The **out-delay** statement enables a form of rate limiting. The delay is added to each update for each prefix individually. When a routing device changes its best path to a destination prefix, the device does not inform its peer about the change unless the route has been present in its routing table for the specified **out-delay**. If you use **out-delay** to perform rate-limiting, you can expect a less bursty pattern of updates. You will see a pattern in which updates arrive in a steady flow, and two updates for the same prefix are always spaced by at least the **out-delay** timer value (for example, 30 seconds). Thus, the **out-delay** setting is useful for limiting oscillation (sometimes called *churn*) in a network. Keep in mind that, regardless of the **out-delay** setting, BGP peers exchange routes immediately after neighbor establishment. The **out-delay** setting is only designed to delay the exchange of routes between BGP and the local routing table.

Caution is warranted because an **out-delay** can delay convergence. If your network is configured in a way that avoids oscillation, setting an **out-delay** is not necessary.

When configured, the **out-delay** value displays as **Outbound Timer** when using **show bgp group** or **show bgp group neighbor** commands.

Default By default, the exchange of route information between BGP and the routing table occurs immediately after the routes are received. This immediate exchange of route information might cause instabilities in the network reachability information. If you omit this statement, routes are exported to BGP immediately after they have been added to the routing table.

Options *seconds*—Output delay time.

Range: 0 through 65,535 seconds

Default: 0 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- keep on page 3057

outbound-route-filter

Syntax

```
outbound-route-filter {
  bgp-orf-cisco-mode;
  prefix-based {
    accept {
      (inet | inet6);
    }
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 9.2.
Statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure a BGP peer to accept outbound route filters from a remote peer.

Options

accept—Specify that outbound route filters from a BGP peer be accepted.

inet—Specify that IPv4 prefix-based outbound route filters be accepted.

inet6—Specify that IPv6 prefix-based outbound route filters be accepted.

NOTE: You can specify that both IPv4 and IPv6 outbound route filters be accepted.

prefix-based—Specify that prefix-based filters be accepted.

The **bgp-orf-cisco-mode** statement is explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BGP Prefix-Based Outbound Route Filtering on page 2807

passive (Protocols BGP)

Syntax

passive;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure the routing device so that active open messages are not sent to the peer. Once you configure the routing device to be passive, the routing device will wait for the peer to issue an open request before a message is sent.

Default

If you omit this statement, all explicitly configured peers are active, and each peer periodically sends open requests until its peer responds.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Preventing BGP Session Flaps When VPN Families Are Configured on page 2972

path-selection

Syntax

```
path-selection {
  (always-compare-med | cisco-non-deterministic | external-router-id);
  as-path-ignore;
  l2vpn-use-bgp-rules;
  med-plus-igp {
    igp-multiplier number;
    med-multiplier number;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
med-plus-igp option introduced in Junos OS Release 8.1.
as-path-ignore and **l2vpn-use-bgp-rules** options introduced in Junos OS Release 10.2.

Description

Configure BGP path selection.

Default

If the **path-selection** statement is not included in the configuration, only the multiple exit discriminators (MEDs) of routes that have the same peer ASs are compared.

Options

always-compare-med—Always compare MEDs whether or not the peer ASs of the compared routes are the same.

NOTE: We recommend that you configure the **always-compare-med** option.

as-path-ignore—In the best-path algorithm, skip the step that compares the autonomous system (AS) path lengths. By default, the best-path algorithm evaluates the length of the AS paths and prefers the route with the shortest AS path length.

NOTE: The **as-path-ignore** statement is not supported with routing instances.

cisco-non-deterministic—Emulate the Cisco IOS default behavior. This mode evaluates routes in the order that they are received and does not group them according to their neighboring AS. With **cisco-non-deterministic** mode, the active path is always first. All inactive, but eligible, paths follow the active path and are maintained in the order in which they were received, with the most recent path first. Ineligible paths remain at the end of the list.

As an example, suppose you have three path advertisements for the 192.168.1.0 /24 route:

- Path 1—learned through EBGP; AS Path of 65010; MED of 200
- Path 2—learned through IBGP; AS Path of 65020; MED of 150; IGP cost of 5
- Path 3—learned through IBGP; AS Path of 65010; MED of 100; IGP cost of 10

These advertisements are received in quick succession, within a second, in the order listed. Path 3 is received most recently, so the routing device compares it against path 2, the next most recent advertisement. The cost to the IBGP peer is better for path 2, so the routing device eliminates path 3 from contention. When comparing paths 1 and 2, the routing device prefers path 1 because it is received from an EBGP peer. This allows the routing device to install path 1 as the active path for the route.

NOTE: **We do not recommend using this configuration option in your network. It is provided solely for interoperability to allow all routing devices in the network to make consistent route selections.**

external-router-id—Compare the router ID between external BGP paths to determine the active path.

igp-multiplier ***number***—The multiplier value for the IGP cost to a next-hop address. This option is useful for making the MED and IGP cost comparable.

Range: 1 through 1000

Default: 1

med-multiplier ***number***—The multiplier value for the MED calculation. This option is useful for making the MED and IGP cost comparable.

Range: 1 through 1000

Default: 1

med-plus-igp—Add the IGP cost to the indirect next-hop destination to the MED before comparing MED values for path selection. This statement only affects best-path selection. It does not affect the advertised MED.

The other option is explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding BGP Path Selection on page 2827
- Example: Ignoring the AS Path Attribute When Selecting the Best Path on page 2830

peer-as (Protocols BGP)

Syntax

peer-as *autonomous-system*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Specify the neighbor (peer) autonomous system (AS) number.

For EBGP, the peer is in another AS, so the AS number you specify in the **peer-as** statement must be different from the local router's AS number, which you specify in the **autonomous-system** statement. For IBGP, the peer is in the same AS, so the two AS numbers that you specify in the **autonomous-system** and **peer-as** statements must be the same.

The AS numeric range in plain-number format has been extended in Junos OS Release 9.1 to provide BGP support for 4-byte AS numbers, as defined in RFC 4893, *BGP Support for Four-octet AS Number Space*. RFC 4893 introduces two new optional transitive BGP attributes, AS4_PATH and AS4_AGGREGATOR. These new attributes are used to propagate 4-byte AS path information across BGP speakers that do not support 4-byte AS numbers. RFC 4893 also introduces a reserved, well-known, 2-byte AS number, AS 23456. This reserved AS number is called AS_TRANS in RFC 4893. All releases of the Junos OS support 2-byte AS numbers.

In Junos OS Release 9.2 and later, you can also configure a 4-byte AS number using the AS-dot notation format of two integer values joined by a period: *<16-bit high-order value in decimal>.<16-bit low-order value in decimal>*. For example, the 4-byte AS number of 65,546 in plain-number format is represented as 1.10 in the AS-dot notation format.

With the introduction of 4-byte AS numbers, you might have a combination of routers that support 4-byte AS numbers and 2-byte AS numbers. For more information about what happens when establishing BGP peer relationships between 4-byte and 2-byte capable routers, see the following topics:

- *Using 4-Byte Autonomous System Numbers in BGP Networks Technology Overview*.

Options ***autonomous-system***—AS number.

Range: 1 through 4,294,967,295 (2^{32} – 1) in plain-number format for 4-byte AS numbers

Range: 1 through 65,535 in plain-number format for 2-byte AS numbers (this is a subset of the 4-byte range)

Range: 0.0 through 65535.65535 in AS-dot notation format for 4-byte AS numbers

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

post-policy

Syntax

```
post-policy {
  exclude-non-eligible;
}
```

Hierarchy Level [edit protocols bgp bmp route-monitoring],
[edit protocols bgp group *group-name* bmp route-monitoring],
[edit protocols bgp group neighbor*group-name* neighbor *address* bmp route-monitoring],
[edit routing-options bmp route-monitoring],
[edit rouiting-options bmp station *station-name* route-monitoring]

Release Information Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description For BMP route monitoring, allows you to excludes routes that are non-eligible for the decision process (for example, protocol nexthop not resolved). This represents the view of the BGP routes after running the import policy. If the import policy has rejected the BGP route, the route does not exist in the post policy view.

Options **exclude-non-eligible**—Exclude routes that are non-eligible for the decision process.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 2685

pre-policy

Syntax

```
pre-policy {
  exclude-non-feasible;
}
```

Hierarchy Level

[edit protocols bgp bmp route-monitoring],
[edit protocols bgp group *group-name* bmp route-monitoring],
[edit protocols bgp group neighbor*group-name* neighbor *address* bmp route-monitoring],
[edit routing-options bmp route-monitoring],
[edit rouiting-options bmp station *station-name* route-monitoring]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description

Excludes routes that are non-feasible from the BMP route monitoring decision process (for example, a route loop). This represents the view of the BGP routes before running the import policy.

Options

exclude-non-feasible—Exclude routes that are non-feasible for the decision process.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 2685

preference (Protocols BGP)

Syntax

preference *preference*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Specify the preference for routes learned from BGP.

At the BGP global level, the preference statement sets the preference for routes learned from BGP. You can override this preference in a BGP group or peer preference statement.

At the group or peer level, the preference statement sets the preference for routes learned from the group or peer. Use this statement to override the preference set in the BGP global preference statement when you want to favor routes from one group or peer over those of another.

Options

preference—Preference to assign to routes learned from BGP or from the group or peer.

Range: 0 through 4,294,967,295 (2^{32} – 1)

Default: 170 for the primary preference

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **local-preference on page 3067**
- Example: Configuring the Preference Value for BGP Routes on page 2821

remove-private

Syntax remove-private all replace nearest;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description When advertising AS paths to remote systems, have the local system strip private AS numbers from the AS path. The numbers are stripped from the AS path starting at the left end of the AS path (the end where AS paths have been most recently added). The routing device stops searching for private ASs when it finds the first nonprivate AS or a peer's private AS. If the AS path contains the AS number of the external BGP (EBGP) neighbor, BGP does not remove the private AS number.

NOTE: As of Junos OS 10.0R2 and higher, if there is a need to send prefixes to an EBGP peer that has an AS number that matches an AS number in the AS path, consider using the **as-override** statement instead of the **remove-private** statement.

The operation takes place after any confederation member ASs have already been removed from the AS path, if applicable.

The Junos OS recognizes the set of AS numbers that is considered private, a range that is defined in the Internet Assigned Numbers Authority (IANA) assigned numbers document.

The set of reserved AS numbers is in the range from 64,512 through 65,535.

Options **all**—Remove all private AS numbers from the original path. Do not stop the process of removing private AS numbers, even if a public AS number is encountered.

nearest—When you use the **all** and **replace** options, choose the last (right-most) public AS number encountered in the original AS path for the replacement value, as the AS path is processed from left to right. If no public AS number is encountered, the default replacement value is used. (See the **replace** option for information about the default replacement value.)

replace—When you use the **all** option, instead of a removing private AS numbers, perform a replace operation. The default replacement value for the private AS number is the local AS number at the BGP group level for the BGP peer. If you are unsure about the replacement value, check the local AS value displayed in the output of the **show bgp group *group-name*** command.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Removing Private AS Numbers from AS Paths on page 2839

restart-time (BGP Graceful Restart)

Syntax restart-time *seconds*;

Hierarchy Level [edit protocols (bgp | rip | ripng) graceful-restart],
[edit logical-systems *logical-system-name* protocols (bgp | rip | ripng) graceful-restart (Enabling Globally)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp graceful-restart],
[edit routing-instances *routing-instance-name* protocols bgp graceful-restart]

Release Information Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the duration of the BGP, RIP, or next-generation RIP (RIPng) graceful restart period.

Options ***seconds***—Length of time for the graceful restart period.

Range: 1 through 600 seconds

Default: Varies by protocol:

- BGP—120 seconds
- RIP and RIPng—60 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Graceful Restart Options for BGP on page 1740
- Configuring Graceful Restart Options for RIP and RIPng on page 1743
- *Configuring Graceful Restart for QFabric Systems*
- stale-routes-time on page 1774

route-monitoring

Syntax

```
route-monitoring {
  none;
  post-policy {
    exclude-non-eligble;
  }
  pre-policy {
    exclude-non-feasible;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bmp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bmp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bmp],
[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit protocols bgp bmp],
[edit protocols bgp group *group-name* bmp],
[edit protocols bgp group *group-name* neighbor *address* bmp],
[edit routing-options bmp],
[edit routing-options bmp station *station-name*]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description

Specify whether BMP should send pre-policy route monitoring messages, post-policy route monitoring messages, both types of messages, or none at all. The pre-policy can be configured to exclude routes that are non-feasible for the decision process (for example, a route loop). The post-policy can be configured to exclude routes that are not eligible for the decision process (for example, protocol nexthop not resolved).

You can also selectively enable or disable BMP route monitoring at various hierarchy levels (for example, **[edit protocols bgp group *group-name*]** or **[edit protocols bgp group *group-name* neighbor *address*]**).

Options

none—Explicitly disables BMP route montioring.

Default: If you configure the **route-monitoring** statement at the **[edit routing-options bmp]** hierarchy level, the default option is **pre-policy**.If you configure the **route-monitoring** statement at any of the **[edit protocols bgp]** hierarchy levels, the default option is to inherit the configuration from the **route-monitoring** statement configured at the **[edit routing-options bmp]** hierarchy level.

The other statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 2685

session-mode

Syntax

session-mode (automatic | multihop | single-hop);

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 11.1.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure BFD session mode to be single-hop or multihop. By default, BGP uses single-hop BFD sessions if the peer is directly connected to the router's interface. BGP uses multihop BFD sessions if the peer is not directly connected to the router's interface. If the peer session's **local-address** option is configured, the directly connected check is based partly on the source address that would be used for BGP and BFD.

For backward compatibility, you can override the default behavior by configuring the **single-hop** or **multihop** option. Before Junos OS Release 11.1, the behavior was to assume that IBGP peer sessions were multihop.

Options

automatic—Configure BGP to use single-hop BFD sessions if the peer is directly connected to the router's interface, and multihop BFD sessions if the peer is not directly connected to the router's interface

multihop—Configure BGP to use multihop BFD sessions.

single-hop—Configure BGP to use single-hop BFD sessions.

Default: automatic

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BFD Authentication for BGP on page 2854
- Example: Configuring BFD on Internal BGP Peer Sessions on page 2845

- Example: Configuring BFD Authentication for BGP on page 2854
- Understanding BFD Authentication for BGP on page 2853

stale-routes-time

Syntax stale-routes-time *seconds*;

Hierarchy Level [edit logical-systems *logical-routing-name* protocols bgp graceful-restart],
[edit logical-systems *logical-routing-name* routing-instances *routing-instance-name* protocols bgp graceful-restart],
[edit protocols bgp graceful-restart],
[edit routing-instances *routing-instance-name* protocols bgp graceful-restart]

Release Information Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the maximum time that stale routes are kept during a restart. The **stale-routes-time** statement allows you to set the length of time the routing device waits to receive messages from restarting neighbors before declaring them down.

Options *seconds*—Time the router device waits to receive messages from restarting neighbors before declaring them down.

Range: 1 through 600 seconds

Default: 300 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Graceful Restart Options for BGP on page 1740
- *Configuring Graceful Restart for QFabric Systems*
- **restart-time (BGP Graceful Restart) on page 1773**

station

Syntax

```
station station-name {
  authentication-algorithm (aes-128-cmac-96 | hmac-sha-1-96 | md5);
  authentication-key key;
  authentication-key-chain authentication-key-chain;
  connection-mode (active | passive);
  hold-down {
    seconds;
    flaps flaps;
    period seconds;
  }
  initiation-message text;
  local-address address;
  local-port port;
  monitor (disable | enable);
  priority (high | low | medium);
  route-monitoring {
    none;
    post-policy {
      exclude-non-eligble;
    }
    pre-policy {
      exclude-non-feasible;
    }
  }
  station-address (ip-address | name);
  station-port port-number;
  statistics-timeout seconds;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier>;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options bmp],
[edit routing-options bmp]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description

Specify and configure a BMP monitoring station. Be aware that each BMP monitoring station can use a significant amount of a device's resources. You can configure up to 3 BMP monitoring stations.

Options

station-name—Specify a name for the BMP station.

The other statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

station-address

Syntax

station-address (*address* | *station-name*);

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description

Specify the name or address for the BMP monitoring station. You can specify one or the other but not both.

Options

station-address—Specify the address for the BMP station. The address should be a valid IPv4 or IPv6 address.

station-name—Specify the name for the BMP station.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 2685

station-port

Syntax station-port *port*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description Specify the port number for the BMP monitoring station.

Options *port*—Specify the port number for the BMP monitoring station. If the connection-mode statement is configured as **active** a station port number is required. If the **connection-mode** statement is configured as **passive**, you must not configure a station port number.

Range: 1 though 65535

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 2685
- connection-mode on page 3031

statistics-timeout

Syntax

statistics-timeout *seconds*;

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description

Specify how often statistics messages are sent to the BMP monitoring station. If you configure a value of 0, no statistics messages are sent.

Options

seconds—Specify the number for the BMP monitoring station.

Default: 3600 seconds

Range: 15 though 65535 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 2685

tcp-mss (Protocols BGP)

Syntax tcp-mss *segment-size*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *neighbor-name*],
[edit protocols bgp],
[edit protocol bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *neighbor-name*]

Release Information
Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the maximum segment size (MSS) for the TCP connection for BGP neighbors.

The MSS is only valid in increments of 2 KB. The value used is based on the value set, but is rounded down to the nearest multiple of 2048.

Options ***segment-size***—MSS for the TCP connection.

Range: 1 through 4096

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Limiting TCP Segment Size for BGP on page 2967

threshold (detection-time)

Syntax

threshold *milliseconds*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection detection-time],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection detection-time],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection detection-time],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection detection-time],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection detection-time],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection detection-time],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection detection-time],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection detection-time],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection detection-time],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection detection-time],
[edit protocols bgp bfd-liveness-detection detection-time],
[edit protocols bgp group *group-name* bfd-liveness-detection detection-time],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection detection-time]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection detection-time]

Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPNs and VPLS.

Description

Specify the threshold for the adaptation of the BFD session detection time. When the detection time adapts to a value equal to or greater than the threshold, a single trap and a single system log message are sent.

NOTE: The threshold value must be equal to or greater than the transmit interval.

The threshold time must be equal to or greater than the value specified in the **minimum-interval** or the **minimum-receive-interval** statement.

Options *milliseconds*—Value for the detection time adaptation threshold.

Range: 1 through 255,000

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- Example: Configuring BFD for Static Routes on page 2319

threshold (transmit-interval)

Syntax threshold *milliseconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection transmit-interval],
[edit protocols bgp bfd-liveness-detection transmit-interval],
[edit protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection transmit-interval]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.

Description Specify the threshold for the adaptation of the BFD session transmit interval. When the transmit interval adapts to a value greater than the threshold, a single trap and a single system message are sent.

Options *milliseconds*—Value for the transmit interval adaptation threshold.

Range: 0 through 4,294,967,295 ($2^{32} - 1$)

NOTE: The threshold value specified in the **threshold** statement must be greater than the value specified in the **minimum-interval** statement for the **transmit-interval** statement.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- Example: Configuring BFD for Static Routes on page 2319
- bfd-liveness-detection on page 3023

traceoptions (Protocols BGP)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
4byte-as statement introduced in Junos OS Release 9.2.
4byte-as statement introduced in Junos OS Release 9.2 for EX Series switches.

Description

Configure BGP protocol-level tracing options. To specify more than one tracing operation, include multiple flag statements.

NOTE: **The traceoptions statement is not supported on QFabric systems.**

Default

The default BGP protocol-level tracing options are inherited from the routing protocols **traceoptions** statement included at the **[edit routing-options]** hierarchy level. The default group-level trace options are inherited from the BGP protocol-level **traceoptions** statement. The default peer-level trace options are inherited from the group-level **traceoptions** statement.

Options

disable—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *name*—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. We recommend that you place BGP tracing output in the file **bgp-log**.

files ***number***—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 10 files

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

BGP Tracing Flags

- **4byte-as**—4-byte AS events.
- **bfd**—BFD protocol events.
- **damping**—Damping operations.
- **graceful-restart**—Graceful restart events.
- **keepalive**—BGP keepalive messages. If you enable the the BGP **update** flag only, received keepalive messages do not generate a trace message.
- **nsr-synchronization**—Nonstop routing synchronization events.
- **open**—Open packets. These packets are sent between peers when they are establishing a connection.
- **packets**—All BGP protocol packets.
- **refresh**—BGP refresh packets.
- **update**—Update packets. These packets provide routing updates to BGP systems. If you enable only this flag, received keepalive messages do not generate a trace message. Use the **keepalive** flag to generate a trace message for keepalive messages.

Global Tracing Flags

- **all**—All tracing operations
- **general**—A combination of the **normal** and **route** trace operations
- **normal**—All normal operations

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **policy**—Policy operations and actions
- **route**—Routing table changes
- **state**—State transitions
- **task**—Routing protocol task processing
- **timer**—Routing protocol timer processing

flag-modifier—(Optional) Modifier for the tracing flag. You can specify one or more of these modifiers:

- **detail**—Provide detailed trace information.
- **filter**—Provide filter trace information. Applies only to **route**, **damping**, and **update** tracing flags.
- **receive**—Trace the packets being received.
- **send**—Trace the packets being transmitted.

no-world-readable—(Optional) Prevent any user from reading the log file.

size ***size***—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 128 KB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation

- **log-updown on page 3068** statement
- Understanding Trace Operations for BGP Protocol Traffic on page 2999
- Configuring OSPF Refresh and Flooding Reduction in Stable Topologies on page 3430

traceoptions (Protocols BMP)

Syntax

```
traceoptions {
  file file-name <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.

Description

Configure tracing options for BMP monitoring. To specify more than one tracing operation, include multiple flag statements.

Options

file *file-name*—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. We recommend that you place BMP tracing output in the file **bmp-log**.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*.0** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 10 files

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

- **all**—Trace all BMP monitoring operations.
- **down**—Down messages.
- **error**—Error conditions.
- **event**—Major events, station establishment, errors, and events.
- **general**—General events.
- **normal**—Normal events.
- **packets**—All messages.
- **policy**—Policy processing.
- **route**—Routing information.
- **route-monitoring**—Route monitoring messages.
- **state**—State transitions.

- **statistics**—Statistics messages.
- **task**—Routing protocol task processing.
- **timer**—Routing protocol timer processing.
- **up**—Up messages.
- **write**—Writing of messages.

flag-modifier—(Optional) Modifier for the tracing flag. You can specify one or more of these modifiers:

- **detail**—Provide detailed trace information.
- **disable**—Disable the tracing flag.
- **receive**—Trace the packets being received.
- **send**—Trace the packets being transmitted.

no-world-readable—(Optional) Prevent any user from reading the log file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.
Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB
Range: 10 KB through the maximum file size supported on your system
Default: 128 KB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level
routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation

- Tracing BMP Operations on page 3005
- Understanding Trace Operations for BGP Protocol Traffic on page 2999
- Configuring OSPF Refresh and Flooding Reduction in Stable Topologies on page 3430

transmit-interval (BFD Liveness Detection)

Syntax

```
transmit-interval {
  minimum-interval milliseconds;
  threshold milliseconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.

Description

Specify the transmit interval for the **bfd-liveness-detection** statement. The negotiated transmit interval for a peer is the interval between the sending of BFD packets to peers. The receive interval for a peer is the minimum time that it requires between packets sent from its peer; the receive interval is not negotiated between peers. To determine the transmit interval, each peer compares its configured minimum transmit interval with its peer's minimum receive interval. The larger of the two numbers is accepted as the transmit interval for that peer.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- Example: Configuring BFD for Static Routes on page 2319
- **bfd-liveness-detection on page 3023**
- **threshold on page 3117**
- **minimum-interval on page 3077**
- **minimum-receive-interval on page 3079**

version (BFD Liveness Detection)

Syntax

version (0 | 1 | automatic);

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.1
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.

Description

Specify the BFD version for detection. You can explicitly configure BFD version 0, version 1, or the routing device can automatically detect the BFD version. By default, the routing device automatically detects the BFD version, which is either 0 or 1.

Options

Configure the BFD version to detect: **0** (BFD version 0), **1** (BFD version 1), or **automatic** (autodetect the BFD version)

Default: automatic

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- Example: Configuring BFD Authentication for BGP on page 2854
- Example: Configuring BFD on Internal BGP Peer Sessions on page 2845
- Example: Configuring BFD Authentication for BGP on page 2854
- Understanding BFD Authentication for BGP on page 2853

CHAPTER 33

Administration

Routine Monitoring

Monitoring BGP Routing Information

Purpose Use the monitoring functionality to monitor BGP routing information on the routing device.

Action To view BGP routing information in the CLI, enter the following commands:

- **show bgp summary**
- **show bgp neighbor**

Related Documentation

- **show bgp neighbor on page 1802**
- **show bgp summary on page 3158**

Operational Commands

- clear bgp damping
- clear bgp neighbor
- clear bgp table
- show bgp bmp
- show bgp group
- show bgp neighbor
- show bgp summary
- show policy damping
- show route damping
- show route detail

clear bgp damping

Syntax

clear bgp damping
<logical-system (all | *logical-system-name*)>
<*prefix*>

Syntax (EX Series Switch and QFX Series)

clear bgp damping
<*prefix*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Clear BGP route flap damping information.

Options

none—Clear all BGP route flap damping information.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

prefix—(Optional) Clear route flap damping information for only the specified destination prefix.

Required Privilege Level

clear

Related Documentation

- show policy damping on page 3163
- show route damping on page 2482

List of Sample Output

clear bgp damping on page 3130

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear bgp damping

```
user@host> clear bgp damping
```

clear bgp neighbor

Syntax

clear bgp neighbor
<as *as-number*>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<malformed-route>
<*neighbor*>
<soft | soft-inbound>
<soft-minimum-igp>

Syntax (EX Series Switch and QFX Series)

clear bgp neighbor
<as *as-number*>
<instance *instance-name*>
<malformed-route>
<*neighbor*>
<soft | soft-inbound>
<soft-minimum-igp>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
malformed-route option introduced in Junos OS Release 13.2.

Description

Perform one of the following tasks:

- Change the state of one or more BGP neighbors to **IDLE**. For neighbors in the **ESTABLISHED** state, this command drops the TCP connection to the neighbors and then reestablishes the connection.
- (**soft** keyword only) Reapply export policies or import policies, respectively, to one or more BGP neighbors without changing their state.
- (**soft-inbound** keyword only) Reapply export policies or import policies, respectively, and send refresh updates to one or more BGP neighbors without changing their state.

Options

none—Change the state of all BGP neighbors to **IDLE**.

as ***as-number***—(Optional) Apply this command only to neighbors in the specified autonomous system (AS).

instance ***instance-name***—(Optional) Apply this command only to neighbors for the specified routing instance.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

malformed-route—(Optional) Remove malformed routes. If a specific neighbor is provided, Junos OS removes malformed routes for that particular neighbor. Otherwise, Junos OS removes malformed routes for all BGP neighbors. To find routes that have malformed attributes, run the **show route hidden** command, and look for routes marked with **MalformedAttr** in the AS path field.

neighbor—(Optional) IP address of a BGP peer. Apply this command only to the specified neighbor.

soft—(Optional) Reapply any export policies to neighbors without clearing the state.

soft-inbound—(Optional) Reapply any import policies and send refresh updates to neighbors without clearing the state.

soft-minimum-igp—(Optional) Provides soft refresh of the outbound state when the interior gateway protocol (IGP) metric is reset.

Required Privilege Level clear

Related Documentation

- show bgp neighbor on page 1802

List of Sample Output clear bgp neighbor on page 3132

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear bgp neighbor

```
user@host> clear bgp neighbor
```


clear bgp table

Syntax **clear bgp table *table-name***
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and QFX Series) **clear bgp table *table-name***

Release Information Command introduced in Junos OS Release 9.0.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description Request that BGP refresh routes in a specified routing table.

Options **logical-system (all | *logical-system-name*)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

table-name—Request that BGP refresh routes in the specified table.

Additional Information In some cases, a prefix limit is associated with a routing table for a VPN instance. When this limit is exceeded (for example, because of a network misconfiguration), some routes might not be inserted in the table. Such routes need to be added to the table after the network issue is resolved. Use the **clear bgp table** command to request that BGP refresh routes in a VPN instance table.

Required Privilege Level clear

List of Sample Output
clear bgp table private.inet.0 on page 3133
clear bgp table inet.6 logical-system all on page 3133
clear bgp table private.inet.6 logical-system ls1 on page 3133
clear bgp table logical-system all inet.0 on page 3133
clear bgp table logical-system ls2 private.inet.0 on page 3134

Output Fields This command produces no output.

Sample Output

clear bgp table private.inet.0

```
user@host> clear bgp table private.inet.0
```

clear bgp table inet.6 logical-system all

```
user@host> clear bgp table inet.6 logical-system all
```

clear bgp table private.inet.6 logical-system ls1

```
user@host> clear bgp table private.inet.6 logical-system ls1
```

clear bgp table logical-system all inet.0

```
user@host> clear bgp table logical-system all inet.0
```


clear bgp table logical-system ls2 private.inet.0

`user@host>` **clear bgp table logical-system ls2 private.inet.0**

show bgp bmp

Syntax show bgp bmp

Release Information Command introduced in Junos OS Release 9.5.
Command introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Display information about the BGP Monitoring Protocol (BMP).

Options This command has no options.

Required Privilege Level view

List of Sample Output show bgp bmp on page 3135

Output Fields Table 229 on page 3135 lists the output fields for the **show bgp bmp** command. Output fields are listed in the approximate order in which they appear.

Table 229: show bgp bmp Output Fields

Field Name	Field Description
BMP station address/port	IP address and port number of the monitoring station to which BGP Monitoring Protocol (BMP) statistics are sent.
BMP session state	Status of the BMP session: **UP** or **DOWN**.
Memory consumed by BMP	Memory used by the active BMP session.
Statistics timeout	Amount of time, in seconds, between transmissions of BMP data to the monitoring station.
Memory limit	Threshold, in bytes, at which the routing device stops collecting BMP data.
Memory-connect retry timeout	Amount of time, in seconds, after which the routing device attempts to resume a BMP session that was ended after the configured memory threshold was exceeded.

Sample Output

show bgp bmp

```
user@host> show bgp bmp
  BMP station address/port: 172.24.24.157+5454
  BMP session state: DOWN
  Memory consumed by BMP: 0
  Statistics timeout: 15
  Memory limit: 10485760
  Memory connect retry timeout: 600
```

show bgp group

Syntax

show bgp group
<brief | detail | summary>
<*group-name*>
<exact-instance *instance-name*>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<rtf>

Syntax (EX Series Switch and QFX Series)

show bgp group
<brief | detail | summary>
<*group-name*>
<exact-instance *instance-name*>
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
exact-instance option introduced in Junos OS Release 11.4.

Description

Display information about the configured BGP groups.

Options

none—Display group information about all BGP groups.

brief | detail | summary—(Optional) Display the specified level of output.

group-name—(Optional) Display group information for the specified group.

exact-instance *instance-name*—(Optional) Display information for the specified instance only.

instance *instance-name*—(Optional) Display information about BGP groups for all routing instances whose name begins with this string (for example, **cust1**, **cust11**, and **cust111** are all displayed when you run the **show bgp group instance cust1** command). The instance name can be master for the main instance, or any valid configured instance name or its prefix.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

rtf—(Optional) Display BGP group route targeting information.

Required Privilege Level

view

List of Sample Output

show bgp group on page 3141
show bgp group brief on page 3141
show bgp group detail on page 3142
show bgp group rtf detail on page 3143
show bgp group summary on page 3143

Output Fields Table 230 on page 3138 describes the output fields for the **show bgp group** command. Output fields are listed in the approximate order in which they appear.

Table 230: show bgp group Output Fields

Field Name	Field Description	Level of Output
Group Type or **Group**	Type of BGP group: **Internal** or **External**.	All levels
group-index	Index number for the BGP peer group. The index number differentiates between groups when a single BGP group is split because of different configuration options at the group and peer levels.	**rtf detail**
AS	AS number of the peer. For internal BGP (IBGP), this number is the same as **Local AS**.	**brief detail** none
Local AS	AS number of the local routing device.	**brief detail** none
Name	Name of a specific BGP group.	**brief detail** none
Index	Unique index number of a BGP group.	**brief detail** none
Flags	Flags associated with the BGP group. This field is used by Juniper Networks customer support.	**brief detail** none
Remove-private options	Options associated with the remove-private statement.	**brief detail** none
Holdtime	Maximum number of seconds allowed to elapse between successive keepalive or update messages that BGP receives from a peer in the BGP group, after which the connection to the peer is closed and routing devices through that peer become unavailable.	**brief detail** none
Export	Export policies configured for the BGP group with the **export** statement.	**brief detail** none
MED tracks IGP metric update delay	Time, in seconds, that updates to multiple exit discriminator (MED) are delayed. Also displays the time remaining before the interval is set to expire	All levels
Traffic Statistics Interval	Time between sample periods for labeled-unicast traffic statistics, in seconds.	**brief detail** none
Total peers	Total number of peers in the group.	**brief detail** none
Established	Number of peers in the group that are in the established state.	All levels

Table 230: show bgp group Output Fields *(continued)*

Field Name	Field Description	Level of Output

Active/Received/Accepted/Damped	Multipurpose field that displays information about BGP peer sessions. The field's contents depend upon whether a session is established and whether it was established in the main routing device or in a routing instance.
	• If a peer is not established, the field shows the state of the peer session: **Active**, **Connect**, or **Idle**.
	• If a BGP session is established in the main routing device, the field shows the number of active, received, accepted, and damped routes that are received from a neighbor and appear in the **inet.0** (main) and **inet.2** (multicast) routing tables. For example, **8/10/10/2 and 2/4/4/0** indicate the following:
	  ◦ 8 active routes, 10 received routes, 10 accepted routes, and 2 damped routes from a BGP peer appear in the **inet.0** routing table.
	  ◦ 2 active routes, 4 received routes, 4 accepted routes, and no damped routes from a BGP peer appear in the **inet.2** routing table.
		summary

ip-addresses	List of peers who are members of the group. The address is followed by the peer's port number.	All levels
Route Queue Timer	Number of seconds until queued routes are sent. If this time has already elapsed, this field displays the number of seconds by which the updates are delayed.	**detail**
Route Queue	Number of prefixes that are queued up for sending to the peers in the group.	**detail**
inet.*number*	Number of active, received, accepted, and damped routes in the routing table. For example, **inet.0: 7/10/9/0** indicates the following: • 7 active routes, 10 received routes, 9 accepted routes, and no damped routes from a BGP peer appear in the **inet.0** routing table.	none

Table 230: show bgp group Output Fields *(continued)*

Field Name	Field Description	Level of Output
Table inet.*number*	Information about the routing table. • **Received prefixes**—Total number of prefixes from the peer, both active and inactive, that are in the routing table. • **Active prefixes**—Number of prefixes received from the peer that are active in the routing table. • **Suppressed due to damping**—Number of routes currently inactive because of damping or other reasons. These routes do not appear in the forwarding table and are not exported by routing protocols. • **Advertised prefixes**—Number of prefixes advertised to a peer. • **Received external prefixes**—Total number of prefixes from the external BGP (EBGP) peers, both active and inactive, that are in the routing table. • **Active external prefixes**—Number of prefixes received from the EBGP peers that are active in the routing table. • **Externals suppressed**—Number of routes received from EBGP peers currently inactive because of damping or other reasons. • **Received internal prefixes**—Total number of prefixes from the IBGP peers, both active and inactive, that are in the routing table. • **Active internal prefixes**—Number of prefixes received from the IBGP peers that are active in the routing table. • **Internals suppressed**—Number of routes received from IBGP peers currently inactive because of damping or other reasons. • **RIB State**—Status of the graceful restart process for this routing table: **BGP restart is complete**, **BGP restart in progress**, **VPN restart in progress**, or **VPN restart is complete**.	**detail**
Groups	Total number of groups.	All levels
Peers	Total number of peers.	All levels
External	Total number of external peers.	All levels
Internal	Total number of internal peers.	All levels
Down peers	Total number of unavailable peers.	All levels
Flaps	Total number of flaps that occurred.	All levels
Table	Name of a routing table.	**brief**, none
Tot Paths	Total number of routes.	**brief**, none
Act Paths	Number of active routes.	**brief**, none
Suppressed	Number of routes currently inactive because of damping or other reasons. These routes do not appear in the forwarding table and are not exported by routing protocols.	**brief**, none

Table 230: show bgp group Output Fields *(continued)*

Field Name	Field Description	Level of Output
History	Number of withdrawn routes stored locally to keep track of damping history.	**brief**, none
Damp State	Number of active routes with a figure of merit greater than zero, but lower than the threshold at which suppression occurs.	**brief**, none
Pending	Routes being processed by the BGP import policy.	**brief**, none
Group	Group the peer belongs to in the BGP configuration.	**detail**
Receive mask	Mask of the received target included in the advertised route.	**detail**
Entries	Number of route entries received.	**detail**
Target	Route target that is to be passed by route-target filtering. If a route advertised from the provider edge (PE) routing device matches an entry in the route-target filter, the route is passed to the peer.	**detail**
Mask	Mask which specifies that the peer receive routes with the given route target.	**detail**

Sample Output

show bgp group

```
user@host> show bgp group
 Groups: 2  Peers: 2    External: 0    Internal: 2    Down peers: 1   Flaps: 0
 Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending

 inet.0
                      0          0          0          0          0          0

 bgp.l3vpn.0
                      0          0          0          0          0          0

 bgp.rtarget.0
                      2          0          0          0          0          0
```

show bgp group brief

```
user@host> show bgp group brief
 Groups: 2  Peers: 2    External: 0    Internal: 2    Down peers: 1   Flaps: 0
 Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending

 inet.0
                      0          0          0          0          0          0

 bgp.l3vpn.0
                      0          0          0          0          0          0

 bgp.rtarget.0
                      2          0          0          0          0          0
```


show bgp group detail

```
user@host> show bgp group detail
Group Type: Internal    AS: 1                    Local AS: 1
  Name: ibgp            Index: 0                 Flags: <Export Eval>
  Holdtime: 0
  Total peers: 3        Established: 0
  22.0.0.2
  22.0.0.8
  22.0.0.5

Groups: 1  Peers: 3    External: 0    Internal: 3    Down peers: 3   Flaps: 3
  Table bgp.l3vpn.0
    Received prefixes:            0
    Accepted prefixes:            0
    Active prefixes:              0
    Suppressed due to damping:    0
    Received external prefixes:   0
    Active external prefixes:     0
    Externals suppressed:         0
    Received internal prefixes:   0
    Active internal prefixes:     0
    Internals suppressed:         0
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
  Table bgp.mdt.0
    Received prefixes:            0
    Accepted prefixes:            0
    Active prefixes:              0
    Suppressed due to damping:    0
    Received external prefixes:   0
    Active external prefixes:     0
    Externals suppressed:         0
    Received internal prefixes:   0
    Active internal prefixes:     0
    Internals suppressed:         0
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
  Table VPN-A.inet.0
    Received prefixes:            0
    Accepted prefixes:            0
    Active prefixes:              0
    Suppressed due to damping:    0
    Received external prefixes:   0
    Active external prefixes:     0
    Externals suppressed:         0
    Received internal prefixes:   0
    Active internal prefixes:     0
    Internals suppressed:         0
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
  Table VPN-A.mdt.0
    Received prefixes:            0
    Accepted prefixes:            0
    Active prefixes:              0
    Suppressed due to damping:    0
    Received external prefixes:   0
    Active external prefixes:     0
    Externals suppressed:         0
    Received internal prefixes:   0
    Active internal prefixes:     0
```



```
  Internals suppressed:        0
  RIB State: BGP restart is complete
  RIB State: VPN restart is complete
```

show bgp group rtf detail

```
user@host> show bgp group rtf detail
 Group: internal (group-index: 0)
     Receive mask: 00000002
     Table: bgp.rtarget.0                                 Entries: 2
         Target                           Mask
         100:100/64                       00000002
         200:201/64                       (Group)
 Group: internal (group-index: 1)
     Table: bgp.rtarget.0                                 Entries: 1
         Target                           Mask
         200:201/64                       (Group)
```

show bgp group summary

```
user@host> show bgp group summary
Group        Type        Peers      Established    Active/Received/Accepted/Damped
ibgp         Internal    3          0

Groups: 1  Peers: 3    External: 0    Internal: 3    Down peers: 3   Flaps: 3
  bgp.l3vpn.0      : 0/0/0/0 External: 0/0/0/0 Internal: 0/0/0/0
  bgp.mdt.0        : 0/0/0/0 External: 0/0/0/0 Internal: 0/0/0/0
  VPN-A.inet.0     : 0/0/0/0 External: 0/0/0/0 Internal: 0/0/0/0
  VPN-A.mdt.0      : 0/0/0/0 External: 0/0/0/0 Internal: 0/0/0/0
```

show bgp neighbor

Syntax

show bgp neighbor
<exact-instance *instance-name*>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<*neighbor-address*>
<orf (detail | *neighbor-address*)

Syntax (EX Series Switch and QFX Series)

show bgp neighbor
<instance *instance-name*>
<exact-instance *instance-name*>
<*neighbor-address*>
<orf (*neighbor-address* | detail)

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
orf option introduced in Junos OS Release 9.2.
exact-instance option introduced in Junos OS Release 11.4.

Description

Display information about BGP peers.

Options

none—Display information about all BGP peers.

exact-instance *instance-name*—(Optional) Display information for the specified instance only.

instance *instance-name*—(Optional) Display information about BGP peers for all routing instances whose name begins with this string (for example, **cust1**, **cust11**, and **cust111** are all displayed when you run the **show bgp neighbor instance cust1** command).

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

neighbor-address—(Optional) Display information for only the BGP peer at the specified IP address.

orf (detail | *neighbor-address*)—(Optional) Display outbound route-filtering information for all BGP peers or only for the BGP peer at the specified IP address. The default is to display brief output. Use the **detail** option to display detailed output.

Additional Information

For information about the **local-address, nlri**, **hold-time,** and **preference** statements, see the *Junos OS Routing Protocols Library for Routing Devices*.

Required Privilege Level

view

Related Documentation

- clear bgp neighbor on page 3131

List of Sample Output

Output Fields

Table 154 on page 1803 describes the output fields for the **show bgp neighbor** command. Output fields are listed in the approximate order in which they appear.

Table 231: show bgp neighbor Output Fields

Field Name	Field Description
Peer	Address of the BGP neighbor. The address is followed by the neighbor port number.
AS	AS number of the peer.
Local	Address of the local routing device. The address is followed by the peer port number.
Type	Type of peer: **Internal** or **External**.
State	Current state of the BGP session: • **Active**—BGP is initiating a transport protocol connection in an attempt to connect to a peer. If the connection is successful, BGP sends an Open message. • **Connect**—BGP is waiting for the transport protocol connection to be completed. • **Established**—The BGP session has been established, and the peers are exchanging update messages. • **Idle**—This is the first stage of a connection. BGP is waiting for a Start event. • **OpenConfirm**—BGP has acknowledged receipt of an open message from the peer and is waiting to receive a keepalive or notification message. • **OpenSent**—BGP has sent an open message and is waiting to receive an open message from the peer.
Flags	Internal BGP flags: • **Aggregate Label**—BGP has aggregated a set of incoming labels (labels received from the peer) into a single forwarding label. • **CleanUp**—The peer session is being shut down. • **Delete**—This peer has been deleted. • **Idled**—This peer has been permanently idled. • **ImportEval**—At the last commit operation, this peer was identified as needing to reevaluate all received routes. • **Initializing**—The peer session is initializing. • **SendRtn**—Messages are being sent to the peer. • **Sync**—This peer is synchronized with the rest of the peer group. • **TryConnect**—Another attempt is being made to connect to the peer. • **Unconfigured**—This peer is not configured. • **WriteFailed**—An attempt to write to this peer failed.

Table 231: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Last state	Previous state of the BGP session: • **Active**—BGP is initiating a transport protocol connection in an attempt to connect to a peer. If the connection is successful, BGP sends an Open message. • **Connect**—BGP is waiting for the transport protocol connection to be completed. • **Established**—The BGP session has been established, and the peers are exchanging update messages. • **Idle**—This is the first stage of a connection. BGP is waiting for a Start event. • **OpenConfirm**—BGP has acknowledged receipt of an open message from the peer and is waiting to receive a keepalive or notification message. • **OpenSent**—BGP has sent an open message and is waiting to receive an open message from the peer.
Last event	Last activity that occurred in the BGP session: • **Closed**—The BGP session closed. • **ConnectRetry**—The transport protocol connection failed, and BGP is trying again to connect. • **HoldTime**—The session ended because the hold timer expired. • **KeepAlive**—The local routing device sent a BGP keepalive message to the peer. • **Open**—The local routing device sent a BGP open message to the peer. • **OpenFail**—The local routing device did not receive an acknowledgment of a BGP open message from the peer. • **RecvKeepAlive**—The local routing device received a BGP keepalive message from the peer. • **RecvNotify**—The local routing device received a BGP notification message from the peer. • **RecvOpen**—The local routing device received a BGP open message from the peer. • **RecvUpdate**—The local routing device received a BGP update message from the peer. • **Start**—The peering session started. • **Stop**—The peering session stopped. • **TransportError**—A TCP error occurred.
Last error	Last error that occurred in the BGP session: • **Cease**—An error occurred, such as a version mismatch, that caused the session to close. • **Finite State Machine Error**—In setting up the session, BGP received a message that it did not understand. • **Hold Time Expired**—The session's hold time expired. • **Message Header Error**—The header of a BGP message was malformed. • **Open Message Error**—A BGP open message contained an error. • **None**—No errors occurred in the BGP session. • **Update Message Error**—A BGP update message contained an error.
Export	Name of the export policy that is configured on the peer.
Import	Name of the import policy that is configured on the peer.

Table 231: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Options	Configured BGP options: • **AddressFamily**—Configured address family: **inet** or **inet-vpn**. • **AutheKeyChain**—Authentication key change is enabled. • **DropPathAttributes**—Certain path attributes are configured to be dropped from neighbor updates during inbound processing. • **GracefulRestart**—Graceful restart is configured. • **HoldTime**—Hold time configured with the **hold-time** statement. The hold time is three times the interval at which keepalive messages are sent. • **IgnorePathAttributes**—Certain path attributes are configured to be ignored in neighbor updates during inbound processing. • **Local Address**—Address configured with the **local-address** statement. • **Multihop**—Allow BGP connections to external peers that are not on a directly connected network. • **NLRI**—Configured MBGP state for the BGP group: **multicast**, **unicast**, or both if you have configured **nlri any**. • **Peer AS**—Configured peer autonomous system (AS). • **Preference**—Preference value configured with the **preference** statement. • **Refresh**—Configured to refresh automatically when the policy changes. • **Rib-group**—Configured routing table group.
Path-attributes dropped	Path attribute codes that are dropped from neighbor updates.
Path-attributes ignored	Path attribute codes that are ignored during neighbor updates.
Authentication key change	(appears only if the **authentication-keychain** statement has been configured) Name of the authentication keychain enabled.
Authentication algorithm	(appears only if the **authentication-algorithm** statement has been configured) Type of authentication algorithm enabled: **hmac** or **md5**.
Address families configured	Names of configured address families for the VPN.
Local Address	Address of the local routing device.
Remove-private options	Options associated with the remove-private statement.
Holdtime	Hold time configured with the **hold-time** statement. The hold time is three times the interval at which keepalive messages are sent.
Flags for NLRI inet-label-unicast	Flags related to labeled-unicast: • **TrafficStatistics**—Collection of statistics for labeled-unicast traffic is enabled.

Table 231: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Traffic statistics	Information about labeled-unicast traffic statistics: • **Options**—Options configured for collecting statistics about labeled-unicast traffic. • **File**—Name and location of statistics log files. • **size**—Size of all the log files, in bytes. • **files**—Number of log files.
Traffic Statistics Interval	Time between sample periods for labeled-unicast traffic statistics, in seconds.
Preference	Preference value configured with the **preference** statement.
Outbound Timer	Time for which the route is available in Junos OS routing table before it is exported to BGP. This field is displayed in the output only if the **out-delay** parameter is configured to a non-zero value.
Number of flaps	Number of times the BGP session has gone down and then come back up.
Peer ID	Router identifier of the peer.
Group index	Index number for the BGP peer group. The index number differentiates between groups when a single BGP group is split because of different configuration options at the group and peer levels.
Peer index	Index that is unique within the BGP group to which the peer belongs.
Local ID	Router identifier of the local routing device.
Local Interface	Name of the interface on the local routing device.
Active holdtime	Hold time that the local routing device negotiated with the peer.
Keepalive Interval	Keepalive interval, in seconds.
BFD	Status of BFD failure detection.
Local Address	Name of directly connected interface over which direct EBGP peering is established.
NLRI for restart configured on peer	Names of address families configured for restart.
NLRI advertised by peer	Address families supported by the peer: **unicast** or **multicast**.
NLRI for this session	Address families being used for this session.
Peer supports Refresh capability	Remote peer's ability to send and request full route table readvertisement (route refresh capability). For more information, see RFC 2918, *Route Refresh Capability for BGP-4*.
Restart time configured on peer	Configured time allowed for restart on the neighbor.

Table 231: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Stale routes from peer are kept for	When graceful restart is negotiated, the maximum time allowed to hold routes from neighbors after the BGP session has gone down.
Peer does not support Restarter functionality	Graceful restart restarter-mode is disabled on the peer.
Peer does not support Receiver functionality	Graceful restart helper-mode is disabled on the peer.
Restart time requested by this peer	Restart time requested by this neighbor during capability negotiation.
Restart flag received from the peer	When this field appears, the BGP speaker has restarted (Restarting), and this peer should not wait for the **end-of-rib** marker from the speaker before advertising routing information to the speaker.
NLRI that peer supports restart for	Neighbor supports graceful restart for this address family.
NLRI peer can save forwarding state	Neighbor supporting this address family saves all forwarding states.
NLRI that peer saved forwarding for	Neighbor saves all forwarding states for this address family.
NLRI that restart is negotiated for	Router supports graceful restart for this address family.
NLRI of received end-of-rib markers	Address families for which end-of-routing-table markers are received from the neighbor.
NLRI of all end-of-rib markers sent	Address families for which end-of-routing-table markers are sent to the neighbor.
Peer supports 4 byte AS extension (peer-as 1)	Peer understands 4-byte AS numbers in BGP messages. The peer is running Junos OS Release 9.1 or later.
NLRIs for which peer can receive multiple paths	Appears in the command output of the local router if the downstream peer is configured to receive multiple BGP routes to a single destination, instead of only receiving the active route. Possible value is **inet-unicast**.
NLRIs for which peer can send multiple paths: inet-unicast	Appears in the command output of the local router if the upstream peer is configured to send multiple BGP routes to a single destination, instead of only sending the active route. Possible value is **inet-unicast**.

Table 231: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Table inet.*number*	Information about the routing table: • **RIB State**—BGP is in the graceful restart process for this routing table: **restart is complete** or **restart in progress**. • **Bit**—Number that represents the entry in the routing table for this peer. • **Send state**—State of the BGP group: **in sync**, **not in sync**, or **not advertising**. • **Active prefixes**—Number of prefixes received from the peer that are active in the routing table. • **Received prefixes**—Total number of prefixes from the peer, both active and inactive, that are in the routing table. • **Accepted prefixes**—Total number of prefixes from the peer that have been accepted by a routing policy. • **Suppressed due to damping**—Number of routes currently inactive because of damping or other reasons. These routes do not appear in the forwarding table and are not exported by routing protocols.
Last traffic (seconds)	Last time any traffic was received from the peer or sent to the peer, and the last time the local routing device checked.
Input messages	Messages that BGP has received from the receive socket buffer, showing the total number of messages, number of update messages, number of times a policy is changed and refreshed, and the buffer size in octets. The buffer size is 16 KB.
Output messages	Messages that BGP has written to the transmit socket buffer, showing the total number of messages, number of update messages, number of times a policy is changed and refreshed, and the buffer size in octets. The buffer size is 16 KB.
Input dropped path attributes	Information about dropped path attributes: • Code—Path attribute code. • Count—Path attribute count.
Input ignored path attributes	Information about ignored path attributes: • Code—Path attribute code. • Count—Path attribute count.
Output queue	Number of BGP packets that are queued to be transmitted to a particular neighbor for a particular routing table. Output queue **0** is for unicast NLRIs, and queue **1** is for multicast NLRIs.
Trace options	Configured tracing of BGP protocol packets and operations.
Trace file	Name of the file to receive the output of the tracing operation.
Filter Updates recv	(**orf** option only) Number of outbound-route filters received for each configured address family. NOTE: The counter is cumulative. For example, the counter is increased after the remote peer either resends or clears the outbound route filtering prefix list.

Table 231: show bgp neighbor Output Fields *(continued)*

Field Name	Field Description
Immediate	(**orf** option only) Number of route updates received with the immediate flag set. The immediate flag indicates that the BGP peer should readvertise the updated routes. NOTE: The counter is cumulative. For example, the counter is increased after the remote peer either resends or clears the outbound route filtering prefix list.
Filter	(**orf** option only) Type of prefix filter received: **prefix-based** or **extended-community**.
Received filter entries	(**orf** option only) List of received filters displayed.
seq	(**orf** option only) Numerical order assigned to this prefix entry among all the received outbound route filter prefix entries.
prefix	(**orf** option only) Address for the prefix entry that matches the filter.
minlength	(**orf** option only) Minimum prefix length, in bits, required to match this prefix.
maxlength	(**orf** option only) Maximum prefix length, in bits, required to match this prefix.
match	(**orf** option only) For this prefix match, whether to **permit** or **deny** route updates.

Sample Output

show bgp neighbor

```
user@host > show bgp neighbor
Peer: 10.255.7.250+179 AS 10   Local: 10.255.7.248+63740 AS 10
  Type: Internal    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ redist_static ]
  Options: <Preference LocalAddress PeerAS Refresh>
  Local Address: 10.255.7.248 Holdtime: 90 Preference: 170 Outbound Timer: 50
  Number of flaps: 0
  Peer ID: 10.255.7.250    Local ID: 10.255.7.248      Active Holdtime: 90
  Keepalive Interval: 30         Group index: 0    Peer index: 0
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 10)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              1
    Received prefixes:            1
```

```
    Accepted prefixes:            1
    Suppressed due to damping:    0
    Advertised prefixes:          1
  Last traffic (seconds): Received 9    Sent 5    Checked 5
  Input messages:  Total 36     Updates 2       Refreshes 0     Octets 718
  Output messages: Total 37     Updates 1       Refreshes 0     Octets 796
  Output Queue[0]: 0

Peer: 10.255.162.214+52193 AS 100 Local: 10.255.167.205+179 AS 100
   Type: Internal    State: Established  (route reflector client)Flags: <Sync>
   Last State: OpenConfirm   Last Event: RecvKeepAlive
   Last Error: None
   Options: <Preference LocalAddress Cluster AddressFamily Rib-group Refresh>
   Address families configured: inet-unicast inet-vpn-unicast route-target
   Local Address: 10.255.167.205 Holdtime: 90 Preference: 170
   Number of flaps: 0
   Peer ID: 10.255.162.214  Local ID: 10.255.167.205    Active Holdtime: 90
   Keepalive Interval: 30         Group index: 0    Peer index: 1
```

show bgp neighbor (CLNS)

```
user@host> show bgp neighbor
Peer: 10.245.245.1+179 AS 200  Local: 10.245.245.3+3770 AS 100
  Type: External    State: Established    Flags: <ImportEval Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Multihop Preference LocalAddress HoldTime AddressFamily PeerAS
Rib-group Refresh>
  Address families configured: iso-vpn-unicast
  Local Address: 10.245.245.3 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.245.245.1     Local ID: 10.245.245.3     Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  NLRI advertised by peer: iso-vpn-unicast
  NLRI for this session: iso-vpn-unicast
  Peer supports Refresh capability (2)
  Table bgp.isovpn.0 Bit: 10000
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
    Send state: in sync
    Active prefixes:              3
    Received prefixes:            3
    Suppressed due to damping:    0
    Advertised prefixes:          3
  Table aaaa.iso.0
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
    Send state: not advertising
    Active prefixes:              3
    Received prefixes:            3
    Suppressed due to damping:    0
  Last traffic (seconds): Received 6    Sent 5    Checked 5
  Input messages:  Total 1736   Updates 4       Refreshes 0     Octets 33385
  Output messages: Total 1738   Updates 3       Refreshes 0     Octets 33305
  Output Queue[0]: 0
  Output Queue[1]: 0
```

show bgp neighbor (Layer 2 VPN)

```
user@host> show bgp neighbor
Peer: 10.69.103.2     AS 65100 Local: 10.69.103.1     AS 65103
  Type: External    State: Active         Flags: <ImportEval>
```



```
    Last State: Idle          Last Event: Start
    Last Error: None
    Export: [ BGP-INET-import ]
   Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily   PeerAS
  Refresh>
    Address families configured: inet-unicast
    Local Address: 10.69.103.1 Holdtime: 90 Preference: 170
    Number of flaps: 0
  Peer: 10.69.104.2     AS 65100 Local: 10.69.104.1     AS 65104
    Type: External    State: Active         Flags: <ImportEval>
    Last State: Idle          Last Event: Start
    Last Error: None
    Export: [ BGP-L-import ]
   Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily PeerAS
  Refresh>
    Address families configured: inet-labeled-unicast
    Local Address: 10.69.104.1 Holdtime: 90 Preference: 170
    Number of flaps: 0
  Peer: 10.255.14.182+179 AS 69    Local: 10.255.14.176+2131 AS 69
    Type: Internal    State: Established    Flags: <ImportEval>
    Last State: OpenConfirm   Last Event: RecvKeepAlive
    Last Error: None
    Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily
    Rib-group Refresh>
    Address families configured: inet-vpn-unicast l2vpn
    Local Address: 10.255.14.176 Holdtime: 90 Preference: 170
    Number of flaps: 0
    Peer ID: 10.255.14.182    Local ID: 10.255.14.176    Active Holdtime: 90
    Keepalive Interval: 30
    NLRI for restart configured on peer: inet-vpn-unicast l2vpn
    NLRI advertised by peer: inet-vpn-unicast l2vpn
    NLRI for this session: inet-vpn-unicast l2vpn
    Peer supports Refresh capability (2)
    Restart time configured on the peer: 120
    Stale routes from peer are kept for: 300
    Restart time requested by this peer: 120
    NLRI that peer supports restart for: inet-vpn-unicast l2vpn
    NLRI peer can save forwarding state: inet-vpn-unicast l2vpn
    NLRI that peer saved forwarding for: inet-vpn-unicast l2vpn
    NLRI that restart is negotiated for: inet-vpn-unicast l2vpn
    NLRI of received end-of-rib markers: inet-vpn-unicast l2vpn
    Table bgp.l3vpn.0 Bit: 10000
      RIB State: BGP restart in progress
      RIB State: VPN restart in progress
      Send state: in sync
      Active prefixes:            10
      Received prefixes:          10
      Suppressed due to damping:  0
    Table bgp.l2vpn.0 Bit: 20000
      RIB State: BGP restart in progress
      RIB State: VPN restart in progress
      Send state: in sync
      Active prefixes:            1
      Received prefixes:          1
      Suppressed due to damping:  0
    Table BGP-INET.inet.0 Bit: 30000
      RIB State: BGP restart in progress
      RIB State: VPN restart in progress
      Send state: in sync
      Active prefixes:            2
      Received prefixes:          2
```

```
    Suppressed due to damping:  0
  Table BGP-L.inet.0 Bit: 40000
    RIB State: BGP restart in progress
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            2
    Received prefixes:          2
    Suppressed due to damping:  0
  Table LDP.inet.0 Bit: 50000
    RIB State: BGP restart is complete
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            1
    Received prefixes:          1
    Suppressed due to damping:  0
  Table OSPF.inet.0 Bit: 60000
    RIB State: BGP restart is complete
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            2
    Received prefixes:          2
    Suppressed due to damping:  0
  Table RIP.inet.0 Bit: 70000
    RIB State: BGP restart is complete
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            2
    Received prefixes:          2
    Suppressed due to damping:  0
  Table STATIC.inet.0 Bit: 80000
    RIB State: BGP restart is complete
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            1
    Received prefixes:          1
    Suppressed due to damping:  0
  Table L2VPN.l2vpn.0 Bit: 90000
    RIB State: BGP restart is complete
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            1
    Received prefixes:          1
    Suppressed due to damping:  0
  Last traffic (seconds): Received 0    Sent 0    Checked 0
  Input messages:  Total 14     Updates 13      Refreshes 0     Octets 1053
  Output messages: Total 3      Updates 0       Refreshes 0     Octets 105
  Output Queue[0]: 0
  Output Queue[1]: 0
  Output Queue[2]: 0
  Output Queue[3]: 0
  Output Queue[4]: 0
  Output Queue[5]: 0
  Output Queue[6]: 0
  Output Queue[7]: 0
  Output Queue[8]: 0
```

show bgp neighbor (Layer 3 VPN)

```
user@host> show bgp neighbor
Peer: 4.4.4.4+179     AS 10045 Local: 5.5.5.5+1214    AS 10045
  Type: Internal    State: Established    Flags: <ImportEval>
```



```
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ match-all ] Import: [ match-all ]
  Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily
   Rib-group Refresh>
  Address families configured: inet-vpn-unicast
  Local Address: 5.5.5.5 Holdtime: 90 Preference: 170
  Flags for NLRI inet-labeled-unicast: TrafficStatistics
  Traffic Statistics: Options: all File: /var/log/bstat.log
                                         size 131072 files 10
  Traffic Statistics Interval: 60
  Number of flaps: 0
  Peer ID: 192.168.1.110    Local ID: 192.168.1.111    Active Holdtime: 90
  Keepalive Interval: 30
  NLRI for restart configured on peer: inet-vpn-unicast
  NLRI advertised by peer: inet-vpn-unicast
  NLRI for this session: inet-vpn-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-vpn-unicast
  NLRI peer can save forwarding state: inet-vpn-unicast
  NLRI that peer saved forwarding for: inet-vpn-unicast
  NLRI that restart is negotiated for: inet-vpn-unicast
  NLRI of received end-of-rib markers: inet-vpn-unicast
  NLRI of all end-of-rib markers sent: inet-vpn-unicast
  Table bgp.l3vpn.0 Bit: 10000
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
    Send state: in sync
    Active prefixes:            2
    Received prefixes:          2
    Suppressed due to damping:  0
  Table vpn-green.inet.0 Bit: 20001
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
    Send state: in sync
    Active prefixes:            2
    Received prefixes:          2
    Suppressed due to damping:  0
  Last traffic (seconds): Received 15   Sent 20   Checked 20
  Input messages:  Total 40     Updates 2       Refreshes 0     Octets 856
  Output messages: Total 44     Updates 2       Refreshes 0     Octets 1066
  Output Queue[0]: 0
  Output Queue[1]: 0
  Trace options: detail packets
  Trace file: /var/log/bgpgr.log size 131072 files 10
```

show bgp neighbor neighbor-address

user@host> **show bgp neighbor 192.168.1.111**

```
Peer: 10.255.245.12+179 AS 35  Local: 10.255.245.13+2884 AS 35
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference LocalAddress HoldTime Cluster AddressFamily Rib-group
  Refresh>
  Address families configured: inet-vpn-unicast inet-labeled-unicast
  Local Address: 10.255.245.13 Holdtime: 90 Preference: 170
  Flags for NLRI inet-vpn-unicast: AggregateLabel
```

```
    Flags for NLRI inet-labeled-unicast: AggregateLabel
    Number of flaps: 0
    Peer ID: 10.255.245.12    Local ID: 10.255.245.13    Active Holdtime: 90
    Keepalive Interval: 30
  BFD: disabled
    NLRI advertised by peer: inet-vpn-unicast inet-labeled-unicast
    NLRI for this session: inet-vpn-unicast inet-labeled-unicast
    Peer supports Refresh capability (2)
    Restart time configured on the peer: 300
    Stale routes from peer are kept for: 60
    Restart time requested by this peer: 300
    NLRI that peer supports restart for: inet-unicast inet6-unicast
    NLRI that restart is negotiated for: inet-unicast inet6-unicast
    NLRI of received end-of-rib markers: inet-unicast inet6-unicast
    NLRI of all end-of-rib markers sent: inet-unicast inet6-unicast
    Table inet.0 Bit: 10000
      RIB State: restart is complete
      Send state: in sync
      Active prefixes: 4
      Received prefixes: 6
      Suppressed due to damping: 0
    Table inet6.0 Bit: 20000
      RIB State: restart is complete
      Send state: in sync
      Active prefixes: 0
      Received prefixes: 2
      Suppressed due to damping: 0
    Last traffic (seconds): Received 3    Sent 3    Checked 3
    Input messages:  Total 9      Updates 6       Refreshes 0     Octets 403
    Output messages: Total 7      Updates 3       Refreshes 0     Octets 365
    Output Queue[0]: 0
    Output Queue[1]: 0
    Trace options: detail packets
    Trace file: /var/log/bgpgr size 131072 files 10
```

show bgp neighbor neighbor-address

```
user@host> show bgp neighbor 192.168.4.222
Peer: 192.168.4.222+4902 AS 65501 Local: 192.168.4.221+179 AS 65500
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: Cease
  Export: [ export-policy ] Import: [ import-policy ]
  Options: <Preference HoldTime AddressFamily PeerAS PrefixLimit Refresh>
  Address families configured: inet-unicast inet-multicast
  Holdtime: 60000 Preference: 170
  Number of flaps: 4
  Last flap event: RecvUpdate
  Error: 'Cease' Sent: 5 Recv: 0
  Peer ID: 10.255.245.6     Local ID: 10.255.245.5     Active Holdtime: 60000
  Keepalive Interval: 20000      Peer index: 0
  BFD: disabled, down
  Local Interface: fxp0.0
  NLRI advertised by peer: inet-unicast inet-multicast
  NLRI for this session: inet-unicast inet-multicast
  Peer supports Refresh capability (2)
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:            8
    Received prefixes:          10
```



```
    Accepted prefixes:            10
    Suppressed due to damping:    0
    Advertised prefixes:          3
  Table inet.2 Bit: 20000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 357  Sent 357  Checked 357
  Input messages:  Total 4 Updates 2  Refreshes 0  Octets 211
  Output messages: Total 4 Updates 1  Refreshes 0  Octets 147
  Output Queue[0]: 0
  Output Queue[1]: 0
  Trace options:  all
  Trace file: /var/log/bgp size 10485760 files 10
```

show bgp neighbor orf neighbor-address detail

```
user@host > show bgp neighbor orf 192.168.165.56 detail
Peer: 192.168.165.56+179 Type: External
  Group: ext1

  inet-unicast
    Filter updates recv:          1 Immediate:          1
    Filter: prefix-based  receive
      Received filter entries:
        seq 1: prefix 2.2.2.2/32: minlen 32: maxlen 32: match deny:

  inet6-unicast
    Filter updates recv:          0 Immediate:          1
    Filter: prefix-based  receive
      Received filter entries:
        *:*
```

show bgp summary

Syntax

show bgp summary
<exact-instance *instance-name*>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and QFX Series)

show bgp summary
<exact-instance *instance-name*>
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
exact-instance option introduced in Junos OS Release 11.4.

Description

Display BGP summary information.

Options

none—Display BGP summary information for all routing instances.

exact-instance ***instance-name***—(Optional) Display information for the specified instance only.

instance ***instance-name***—(Optional) Display information for all routing instances whose name begins with this string (for example, **cust1**, **cust11**, and **cust111** are all displayed when you run the **show bgp summary instance cust1** command). The instance name can be master for the main instance, or any valid configured instance name or its prefix.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show bgp summary (When a Peer Is Not Established) on page 3161
show bgp summary (When a Peer Is Established) on page 3161
show bgp summary (CLNS) on page 3161
show bgp summary (Layer 2 VPN) on page 3161
show bgp summary (Layer 3 VPN) on page 3162

Output Fields

Table 232 on page 3158 describes the output fields for the **show bgp summary** command. Output fields are listed in the approximate order in which they appear.

Table 232: show bgp summary Output Fields

Field Name	Field Description
Groups	Number of BGP groups.
Peers	Number of BGP peers.

Table 232: show bgp summary Output Fields *(continued)*

Field Name	Field Description
Down peers	Number of down BGP peers.
Table	Name of routing table.
Tot Paths	Total number of paths.
Act Paths	Number of active routes.
Suppressed	Number of routes currently inactive because of damping or other reasons. These routes do not appear in the forwarding table and are not exported by routing protocols.
History	Number of withdrawn routes stored locally to keep track of damping history.
Damp State	Number of routes with a figure of merit greater than zero, but still active because the value has not reached the threshold at which suppression occurs.
Pending	Routes in process by BGP import policy.
Peer	Address of each BGP peer. Each peer has one line of output.
AS	Peer's AS number.
InPkt	Number of packets received from the peer.
OutPkt	Number of packets sent to the peer.
OutQ	Number of BGP packets that are queued to be transmitted to a particular neighbor. It normally is **0** because the queue usually is emptied quickly.
Flaps	Number of times the BGP session has gone down and then come back up.
Last Up/Down	Last time since the neighbor transitioned to or from the established state.

Table 232: show bgp summary Output Fields *(continued)*

<table>
<tr><th>Field Name</th><th>Field Description</th></tr>
<tr><td>State|#Active /Received/Accepted /Damped</td><td>
Multipurpose field that displays information about BGP peer sessions. The field’s contents depend upon whether a session is established and whether it was established on the main routing device or in a routing instance.

If a peer is not established, the field shows the state of the peer session: Active, Connect, or Idle.
In general, the Idle state is the first stage of a connection. BGP is waiting for a Start event. A session can be idle for other reasons as well. The reason that a session is idle is sometimes displayed. For example: Idle (Removal in progress) or Idle (LicenseFailure).
If a BGP session is established on the main routing device, the field shows the number of active, received, accepted, and damped routes that are received from a neighbor and appear in the inet.0 (main) and inet.2 (multicast) routing tables. For example, 8/10/10/2 and 2/4/4/0 indicate the following:

8 active routes, 10 received routes, 10 accepted routes, and 2 damped routes from a BGP peer appear in the inet.0 routing table.
2 active routes, 4 received routes, 4 accepted routes, and no damped routes from a BGP peer appear in the inet.2 routing table.

If a BGP session is established in a routing instance, the field indicates the established (Establ) state, identifies the specific routing table that receives BGP updates, and shows the number of active, received, and damped routes that are received from a neighbor. For example, Establ VPN-AB.inet.0: 2/4/0 indicates the following:

The BGP session is established.
Routes are received in the VPN-AB.inet.0 routing table.
The local routing device has two active routes, four received routes, and no damped routes from a BGP peer.

When a BGP session is established, the peers are exchanging update messages.

</td></tr>
</table>

Sample Output

show bgp summary (When a Peer Is Not Established)

```
user@host> show bgp summary
Groups: 2 Peers: 4 Down peers: 1
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 6          4          0          0          0          0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.0.0.3        65002         86         90       0       2       42:54 0/0/0

0/0/0
10.0.0.4        65002         90         91       0       1       42:54 0/2/0

0/0/0
10.0.0.6        65002         87         90       0       3           3 Active
10.1.12.1       65001         89         89       0       1       42:54 4/4/0

0/0/0
```

show bgp summary (When a Peer Is Established)

```
user@host> show bgp summary
Groups: 1 Peers: 3 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 6          4          0          0          0          0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.0.0.2        65002      88675      88652       0       2       42:38 2/4/0

0/0/0
10.0.0.3        65002      54528      54532       0       1     2w4d22h 0/0/0

 0/0/0
10.0.0.4        65002      51597      51584       0       0     2w3d22h 2/2/0

0/0/0
```

show bgp summary (CLNS)

```
user@host> show bgp summary
Groups: 1 Peers: 1 Down peers: 0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.245.245.1      200       1735       1737       0       0    14:26:12 Establ
  bgp.isovpn.0: 3/3/0
  aaaa.iso.0: 3/3/0
```

show bgp summary (Layer 2 VPN)

```
user@host> show bgp summary
Groups: 1 Peers: 5 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l2vpn.0            1          1          0          0          0          0
inet.0                 0          0          0          0          0          0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last
Up/Dwn State|#Active/Received/Damped...
10.255.245.35   65299         72         74       0       1       19:00 Establ
  bgp.l2vpn.0: 1/1/0
  frame-vpn.l2vpn.0: 1/1/0
```

```
10.255.245.36   65299       2164       2423       0       4       19:50 Establ
  bgp.l2vpn.0: 0/0/0
  frame-vpn.l2vpn.0: 0/0/0
10.255.245.37   65299         36         37       0       4       17:07 Establ
  inet.0: 0/0/0
10.255.245.39   65299        138        168       0       6       53:48 Establ
  bgp.l2vpn.0: 0/0/0
  frame-vpn.l2vpn.0: 0/0/0
10.255.245.69   65299        134        140       0       6       53:42 Establ
  inet.0: 0/0/0
```

show bgp summary (Layer 3 VPN)

```
user@host> show bgp summary
Groups: 2 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State Pending
bgp.l3vpn.0            2          2          0          0          0       0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.39.1.5           2         21         22       0       0        6:26 Establ
  VPN-AB.inet.0: 1/1/0
10.255.71.15        1         19         21       0       0        6:17 Establ
  bgp.l3vpn.0: 2/2/0
  VPN-A.inet.0: 1/1/0
  VPN-AB.inet.0: 2/2/0
  VPN-B.inet.0: 1/1/0
```


show policy damping

Syntax

show policy damping
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and QFX Series)

show policy damping

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display information about BGP route flap damping parameters.

Options

none—Display information about BGP route flap damping parameters.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Additional Information

In the output from this command, figure-of-merit values correlate with the probability of future instability of a routing device. Routes with higher figure-of-merit values are suppressed for longer periods of time. The figure-of-merit value decays exponentially over time. A figure-of-merit value of zero is assigned to each new route. The value is increased each time the route is withdrawn or readvertised, or when one of its path attributes changes.

Required Privilege Level

view

Related Documentation

- "Configuring BGP Flap Damping Parameters" in the *Routing Policy Feature Guide for Routing Devices*
- clear bgp damping on page 3130
- show route damping on page 2482

List of Sample Output

show policy damping on page 3164

Output Fields

Table 233 on page 3163 describes the output fields for the **show policy damping** command. Output fields are listed in the approximate order in which they appear.

Table 233: show policy damping Output Fields

Field Name	Field Description
Halflife	Decay half-life, in minutes. The value represents the period during which the accumulated figure-of-merit value is reduced by half if the route remains stable. If a route has flapped, but then becomes stable, the figure-of-merit value for the route decays exponentially. For example, for a route with a figure-of-merit value of 1500, if no incidents occur, its figure-of-merit value is reduced to 750 after 15 minutes and to 375 after another 15 minutes.

Table 233: show policy damping Output Fields *(continued)*

Field Name	Field Description
Reuse merit	Figure-of-merit value below which a suppressed route can be used again. A suppressed route becomes reusable when its figure-of-merit value decays to a value below a reuse threshold, and the route once again is considered usable and can be installed in the forwarding table and exported from the routing table.
Suppress/cutoff merit	Figure-of-merit value above which a route is suppressed for use or inclusion in advertisements. When a route's figure-of-merit value reaches a particular level, called the cutoff or suppression threshold, the route is suppressed. When a route is suppressed, the routing table no longer installs the route into the forwarding table and no longer exports this route to any of the routing protocols.
Maximum suppress time	Maximum hold-down time, in minutes. The value represents the maximum time that a route can be suppressed no matter how unstable it has been before this period of stability.
Computed values	• **Merit ceiling**—Maximum merit that a flapping route can collect. • **Maximum decay**—Maximum decay half-life, in minutes.

Sample Output

show policy damping

```
user@host> show policy damping
Default damping information:
  Halflife: 15 minutes
  Reuse merit: 750 Suppress/cutoff merit: 3000
  Maximum suppress time: 60 minutes
  Computed values:
    Merit ceiling: 12110
    Maximum decay: 6193
Damping information for "standard-damping":
  Halflife: 10 minutes
  Reuse merit: 4000 Suppress/cutoff merit: 8000
  Maximum suppress time: 30 minutes
  Computed values:
    Merit ceiling: 32120
    Maximum decay: 12453
```


show route damping

Syntax

show route damping (decayed | history | suppressed)
<brief | detail | extensive | terse>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and QFX Series)

show route damping (decayed | history | suppressed)
<brief | detail | extensive | terse>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display the BGP routes for which updates might have been reduced because of route flap damping.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to brief.

decayed—Display route damping entries that might no longer be valid, but are not suppressed.

history—Display entries that have already been withdrawn, but have been logged.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

suppressed—Display entries that have been suppressed and are no longer being installed into the forwarding table or exported by routing protocols.

Required Privilege Level

view

Related Documentation

- clear bgp damping on page 3130
- show policy damping on page 3163

List of Sample Output

show route damping decayed detail on page 3168
show route damping history on page 3169
show route damping history detail on page 3169

Output Fields

Table 211 on page 2482 lists the output fields for the **show route damping** command. Output fields are listed in the approximate order in which they appear.

Table 234: show route damping Output Fields

Field Name	Field Description	Level of Output
routing-table-name	Name of the routing table—for example, **inet.0**.	All levels
destinations	Number of destinations for which there are routes in the routing table.	All levels

Table 234: show route damping Output Fields *(continued)*

Field Name	Field Description	Level of Output
number routes	Number of routes in the routing table and total number of routes in the following states: • **active** • **holddown** (routes that are in a pending state before being declared inactive) • **hidden** (the routes are not used because of a routing policy)	All levels
destination-prefix (entry, announced)	Destination prefix. The **entry** value is the number of routes for this destination, and the **announced** value is the number of routes being announced for this destination.	**detail extensive**
[*protocol*, *preference*]	Protocol from which the route was learned and the preference value for the route. • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the LocalPref value for Route 1 is 100, the Preference2 value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.	All levels
Next-hop reference count	Number of references made to the next hop.	**detail extensive**
Source	IP address of the route source.	**detail extensive**
Next hop	Network layer address of the directly reachable neighboring system.	**detail extensive**
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the interface that is actually used is followed by the word **Selected**.	**detail extensive**
Protocol next hop	Network layer address of the remote routing device that advertised the prefix. This address is used to derive a forwarding next hop.	**detail extensive**
Indirect next hop	Index designation used to specify the mapping between protocol next hops, tags, kernel export policy, and the forwarding next hops.	**detail extensive**
State	Flags for this route. For a description of possible values for this field, see the output field table for the show route detail command.	**detail extensive**
Local AS	AS number of the local routing device.	**detail extensive**
Peer AS	AS number of the peer routing device.	**detail extensive**

Table 234: show route damping Output Fields *(continued)*

Field Name	Field Description	Level of Output
Age	How long the route has been known.	**detail extensive**
Metric	Metric for the route.	**detail extensive**
Task	Name of the protocol that has added the route.	**detail extensive**
Announcement bits	List of protocols that announce this route. ***n*-Resolve inet** indicates that the route is used for route resolution for next hops found in the routing table. ***n*** is an index used by Juniper Networks customer support only.	**detail extensive**
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the local AS number associated with the AS path if more than one AS number is configured on the routing device or if AS path prepending is configured. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.	All levels
to	Next hop to the destination. An angle bracket (>) indicates that the route is the selected route.	**brief** none
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the interface that is actually used is followed by the word **Selected**.	**brief** none
Communities	Community path attribute for the route. See the output field table for the show route detail command.	**detail extensive**
Localpref	Local preference value included in the route.	All levels
Router ID	BGP router ID as advertised by the neighbor in the open message.	**detail extensive**
Merit (last update/now)	Last updated and current figure-of-merit value.	**detail extensive**

Table 234: show route damping Output Fields *(continued)*

Field Name	Field Description	Level of Output
damping-parameters	Name that identifies the damping parameters used, which is defined in the damping statement at the **[edit policy-options]** hierarchy level.	**detail extensive**
Last update	Time of most recent change in path attributes.	**detail extensive**
First update	Time of first change in path attributes, which started the route damping process.	**detail extensive**
Flaps	Number of times the route has gone up or down or its path attributes have changed.	**detail extensive**
Suppressed	(**suppressed** keyword only) This route is currently suppressed. A suppressed route does not appear in the forwarding table and routing protocols do not export it.	All levels
Reusable in	(**suppressed** keyword only) Time when a suppressed route will again be available.	All levels
Preference will be	(**suppressed** keyword only) Preference value that will be applied to the route when it is again active.	All levels

Sample Output

show route damping decayed detail

```
user@host> show route damping decayed detail
inet.0: 173319 destinations, 1533668 routes (172625 active, 4 holddown, 108083
hidden)
10.0.111.0/24 (7 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next-hop reference count: 151973
                Source: 172.23.2.129
                Next hop: via so-1/2/0.0
                Next hop: via so-5/1/0.0, selected
                Next hop: via so-6/0/0.0
                Protocol next hop: 172.23.2.129
                Indirect next hop: 89a1a00 264185
                State: <Active Ext>
                Local AS: 65000 Peer AS:   65490
                Age: 3:28       Metric2: 0
                Task: BGP_65490.172.23.2.129+179
                Announcement bits (6): 0-KRT 1-RT 4-KRT 5-BGP.0.0.0.0+179

         6-Resolve tree 2 7-Resolve tree 3
                AS path: 65490 65520 65525 65525 65525 65525 I ()
                Communities: 65501:390 65501:2000 65501:3000 65504:701
                Localpref: 100
                Router ID: 172.23.2.129
                Merit (last update/now): 1934/1790
                damping-parameters: damping-high
                Last update:       00:03:28 First update:       00:06:40
                Flaps: 2
```

show route damping history

```
user@host> show route damping history
inet.0: 173320 destinations, 1533529 routes (172624 active, 6 holddown, 108122
hidden)
+ = Active Route, - = Last Active, * = Both

10.108.0.0/15       [BGP ] 2d 22:47:58, localpref 100
                      AS path: 65220 65501 65502 I
                    > to 192.168.60.85 via so-3/1/0.0
```

show route damping history detail

```
user@host> show route damping history detail
inet.0: 173319 destinations, 1533435 routes (172627 active, 2 holddown, 108105
hidden)
10.108.0.0/15 (3 entries, 1 announced)
         BGP                 /-101
                Next-hop reference count: 69058
                Source: 192.168.60.85
                Next hop: 192.168.60.85 via so-3/1/0.0, selected
                State: <Hidden Ext>
                Inactive reason: Unusable path
                Local AS: 65000 Peer AS:  65220
                Age: 2d 22:48:10
                Task: BGP_65220.192.168.60.85+179
                AS path: 65220 65501 65502 I ()
                Communities: 65501:390 65501:2000 65501:3000 65504:3561
                Localpref: 100
                Router ID: 192.168.80.25
                Merit (last update/now): 1000/932
                damping-parameters: set-normal
                Last update:       00:01:05 First update:       00:01:05
                Flaps: 1
```


show route detail

Syntax

show route detail
<*destination-prefix*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show route detail
<*destination-prefix*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description

Display detailed information about the active entries in the routing tables.

Options

none—Display all active entries in the routing table on all systems.

destination-prefix—(Optional) Display active entries for the specified address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route detail on page 3179
show route detail (with BGP Multipath) on page 3184
show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs) on page 3185

Output Fields

Table 212 on page 2487 describes the output fields for the **show route detail** command. Output fields are listed in the approximate order in which they appear.

Table 235: show route detail Output Fields

Field Name	Field Description
routing-table-name	Name of the routing table (for example, inet.0).
number destinations	Number of destinations for which there are routes in the routing table.
number routes	Number of routes in the routing table and total number of routes in the following states: • **active** (routes that are active) • **holddown** (routes that are in the pending state before being declared inactive) • **hidden** (routes that are not used because of a routing policy)

Table 235: show route detail Output Fields *(continued)*

Field Name	Field Description

route-destination **(entry, announced)**	Route destination (for example:10.0.0.1/24). The **entry** value is the number of routes for this destination, and the **announced** value is the number of routes being announced for this destination. Sometimes the route destination is presented in another format, such as:
	• ***MPLS-label*** (for example, 80001).
	• ***interface-name*** (for example, ge-1/0/2).
	• ***neighbor-address*:*control-word-status*:*encapsulation type*:*vc-id*:*source*** (Layer 2 circuit only; for example, 10.1.1.195:NoCtrlWord:1:1:Local/96).
	  ◦ ***neighbor-address***—Address of the neighbor.
	  ◦ ***control-word-status***—Whether the use of the control word has been negotiated for this virtual circuit: **NoCtrlWord** or **CtrlWord**.
	  ◦ ***encapsulation type***—Type of encapsulation, represented by a number: (1) Frame Relay DLCI, (2) ATM AAL5 VCC transport, (3) ATM transparent cell transport, (4) Ethernet, (5) VLAN Ethernet, (6) HDLC, (7) PPP, (8) ATM VCC cell transport, (10) ATM VPC cell transport.
	  ◦ ***vc-id***—Virtual circuit identifier.
	  ◦ ***source***—Source of the advertisement: **Local** or **Remote**.

label stacking	(Next-to-the-last-hop routing device for MPLS only) Depth of the MPLS label stack, where the label-popping operation is needed to remove one or more labels from the top of the stack. A pair of routes is displayed, because the pop operation is performed only when the stack depth is two or more labels. • **S=0 route** indicates that a packet with an incoming label stack depth of 2 or more exits this routing device with one fewer label (the label-popping operation is performed). • If there is no **S=** information, the route is a normal MPLS route, which has a stack depth of 1 (the label-popping operation is not performed).
[*protocol*, *preference*]	Protocol from which the route was learned and the preference value for the route. • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the **LocalPref** value for Route 1 is 100, the **Preference2** value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.
Level	(IS-IS only). In IS-IS, a single AS can be divided into smaller groups called areas. Routing between areas is organized hierarchically, allowing a domain to be administratively divided into smaller areas. This organization is accomplished by configuring Level 1 and Level 2 intermediate systems. Level 1 systems route within an area. When the destination is outside an area, they route toward a Level 2 system. Level 2 intermediate systems route between areas and toward other ASs.
Route Distinguisher	IP subnet augmented with a 64-bit prefix.
PMSI	Provider multicast service interface (MVPN routing table).
Next-hop type	Type of next hop. For a description of possible values for this field, see Table 213 on page 2491.

Table 235: show route detail Output Fields *(continued)*

Field Name	Field Description
Next-hop reference count	Number of references made to the next hop.
Flood nexthop branches exceed maximum message	Indicates that the number of flood next-hop branches exceeded the system limit of 32 branches, and only a subset of the flood next-hop branches were installed in the kernel.
Source	IP address of the route source.
Next hop	Network layer address of the directly reachable neighboring system.
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the name of the interface that is actually used is followed by the word **Selected**. This field can also contain the following information: • Weight—Value used to distinguish primary, secondary, and fast reroute backup routes. Weight information is available when MPLS label-switched path (LSP) link protection, node-link protection, or fast reroute is enabled, or when the standby state is enabled for secondary paths. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible. • Balance—Balance coefficient indicating how traffic of unequal cost is distributed among next hops when a routing device is performing unequal-cost load balancing. This information is available when you enable BGP multipath load balancing.
Label-switched-path ***lsp-path-name***	Name of the LSP used to reach the next hop.
Label operation	MPLS label and operation occurring at this routing device. The operation can be **pop** (where a label is removed from the top of the stack), **push** (where another label is added to the label stack), or **swap** (where a label is replaced by another label).
Interface	(Local only) Local interface name.
Protocol next hop	Network layer address of the remote routing device that advertised the prefix. This address is used to derive a forwarding next hop.
Indirect next hop	Index designation used to specify the mapping between protocol next hops, tags, kernel export policy, and the forwarding next hops.
State	State of the route (a route can be in more than one state). See Table 214 on page 2493.
Local AS	AS number of the local routing device.
Age	How long the route has been known.
AIGP	Accumulated interior gateway protocol (AIGP) BGP attribute.
Metric*n*	Cost value of the indicated route. For routes within an AS, the cost is determined by IGP and the individual protocol metrics. For external routes, destinations, or routing domains, the cost is determined by a preference value.

Table 235: show route detail Output Fields *(continued)*

<table>
<tr><th>Field Name</th><th>Field Description</th></tr>
<tr><td>MED-plus-IGP</td><td>Metric value for BGP path selection to which the IGP cost to the next-hop destination has been added.</td></tr>
<tr><td>TTL-Action</td><td>For MPLS LSPs, state of the TTL propagation attribute. Can be enabled or disabled for all RSVP-signaled and LDP-signaled LSPs or for specific VRF routing instances.

For sample output, see show route table.</td></tr>
<tr><td>Task</td><td>Name of the protocol that has added the route.</td></tr>
<tr><td>Announcement bits</td><td>List of protocols that announce this route. n-Resolve inet indicates that the route is used for route resolution for next hops found in the routing table. n is an index used by Juniper Networks customer support only.</td></tr>
<tr><td>AS path</td><td>AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated:

• I—IGP.
• E—EGP.
• Recorded—The AS path is recorded by the sample process (sampled).
• ?—Incomplete; typically, the AS path was aggregated.

When AS path numbers are included in the route, the format is as follows:

• [ ]—Brackets enclose the number that precedes the AS path. This number represents the number of ASs present in the AS path, when calculated as defined in RFC 4271. This value is used in the AS-path merge process, as defined in RFC 4893.
• [ ]—If more than one AS number is configured on the routing device, or if AS path prepending is configured, brackets enclose the local AS number associated with the AS path.
• { }—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order.
• ( )—Parentheses enclose a confederation.
• ([ ])—Parentheses and brackets enclose a confederation set.

NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.</td></tr>
<tr><td>validation-state</td><td>(BGP-learned routes) Validation status of the route:

• Invalid—Indicates that the prefix is found, but either the corresponding AS received from the EBGP peer is not the AS that appears in the database, or the prefix length in the BGP update message is longer than the maximum length permitted in the database.
• Unknown—Indicates that the prefix is not among the prefixes or prefix ranges in the database.
• Unverified—Indicates that the origin of the prefix is not verified against the database. This is because the database got populated and the validation is not called for in the BGP import policy, although origin validation is enabled, or the origin validation is not enabled for the BGP peers.
• Valid—Indicates that the prefix and autonomous system pair are found in the database.</td></tr>
<tr><td>FECs bound to route</td><td>Point-to-multipoint root address, multicast source address, and multicast group address when multipoint LDP (M-LDP) inband signaling is configured.</td></tr>
</table>

Table 235: show route detail Output Fields *(continued)*

Field Name	Field Description
VC Label	MPLS label assigned to the Layer 2 circuit virtual connection.
MTU	Maximum transmission unit (MTU) of the Layer 2 circuit.
VLAN ID	VLAN identifier of the Layer 2 circuit.
Prefixes bound to route	Forwarding equivalent class (FEC) bound to this route. Applicable only to routes installed by LDP.
Communities	Community path attribute for the route. See Table 215 on page 2495 for all possible values for this field.
Layer2-info: encaps	Layer 2 encapsulation (for example, VPLS).
control flags	Control flags: **none** or **Site Down**.
mtu	Maximum transmission unit (MTU) information.
Label-Base, range	First label in a block of labels and label block size. A remote PE routing device uses this first label when sending traffic toward the advertising PE routing device.
status vector	Layer 2 VPN and VPLS network layer reachability information (NLRI).
Accepted Multipath	Current active path when BGP multipath is configured.
Accepted MultipathContrib	Path currently contributing to BGP multipath.
Localpref	Local preference value included in the route.
Router ID	BGP router ID as advertised by the neighbor in the open message.
Primary Routing Table	In a routing table group, the name of the primary routing table in which the route resides.
Secondary Tables	In a routing table group, the name of one or more secondary tables in which the route resides.

Table 213 on page 2491 describes all possible values for the Next-hop Types output field.

Table 236: Next-hop Types Output Field Values

Next-Hop Type	Description
Broadcast (bcast)	Broadcast next hop.
Deny	Deny next hop.
Discard	Discard next hop.

Table 236: Next-hop Types Output Field Values *(continued)*

Next-Hop Type	Description
Flood	Flood next hop. Consists of components called branches, up to a maximum of 32 branches. Each flood next-hop branch sends a copy of the traffic to the forwarding interface. Used by point-to-multipoint RSVP, point-to-multipoint LDP, point-to-multipoint CCC, and multicast.
Hold	Next hop is waiting to be resolved into a unicast or multicast type.
Indexed (idxd)	Indexed next hop.
Indirect (indr)	Used with applications that have a protocol next hop address that is remote. You are likely to see this next-hop type for internal BGP (IBGP) routes when the BGP next hop is a BGP neighbor that is not directly connected.
Interface	Used for a network address assigned to an interface. Unlike the router next hop, the interface next hop does not reference any specific node on the network.
Local (locl)	Local address on an interface. This next-hop type causes packets with this destination address to be received locally.
Multicast (mcst)	Wire multicast next hop (limited to the LAN).
Multicast discard (mdsc)	Multicast discard.
Multicast group (mgrp)	Multicast group member.
Receive (recv)	Receive.
Reject (rjct)	Discard. An ICMP unreachable message was sent.
Resolve (rslv)	Resolving next hop.
Routed multicast (mcrt)	Regular multicast next hop.
Router	A specific node or set of nodes to which the routing device forwards packets that match the route prefix. To qualify as next-hop type router, the route must meet the following criteria: • Must not be a direct or local subnet for the routing device. • Must have a next hop that is directly connected to the routing device.
Table	Routing table next hop.

Table 236: Next-hop Types Output Field Values *(continued)*

Next-Hop Type	Description
Unicast (ucst)	Unicast.
Unilist (ulst)	List of unicast next hops. A packet sent to this next hop goes to any next hop in the list.

Table 214 on page 2493 describes all possible values for the State output field. A route can be in more than one state (for example, **<Active NoReadvrt Int Ext>**).

Table 237: State Output Field Values

Value	Description
Accounting	Route needs accounting.
Active	Route is active.
Always Compare MED	Path with a lower multiple exit discriminator (MED) is available.
AS path	Shorter AS path is available.
Cisco Non-deterministic MED selection	Cisco nondeterministic MED is enabled, and a path with a lower MED is available.
Clone	Route is a clone.
Cluster list length	Length of cluster list sent by the route reflector.
Delete	Route has been deleted.
Ex	Exterior route.
Ext	BGP route received from an external BGP neighbor.
FlashAll	Forces all protocols to be notified of a change to any route, active or inactive, for a prefix. When not set, protocols are informed of a prefix only when the active route changes.
Hidden	Route not used because of routing policy.
IfCheck	Route needs forwarding RPF check.
IGP metric	Path through next hop with lower IGP metric is available.
Inactive reason	Flags for this route, which was not selected as best for a particular destination.
Initial	Route being added.

Table 237: State Output Field Values *(continued)*

Value	Description
Int	Interior route.
Int Ext	BGP route received from an internal BGP peer or a BGP confederation peer.
Interior > Exterior > Exterior via Interior	Direct, static, IGP, or EBGP path is available.
Local Preference	Path with a higher local preference value is available.
Martian	Route is a martian (ignored because it is obviously invalid).
MartianOK	Route exempt from martian filtering.
Next hop address	Path with lower metric next hop is available.
No difference	Path from neighbor with lower IP address is available.
NoReadvrt	Route not to be advertised.
NotBest	Route not chosen because it does not have the lowest MED.
Not Best in its group	Incoming BGP AS is not the best of a group (only one AS can be the best).
NotInstall	Route not to be installed in the forwarding table.
Number of gateways	Path with a greater number of next hops is available.
Origin	Path with a lower origin code is available.
Pending	Route pending because of a hold-down configured on another route.
Release	Route scheduled for release.
RIB preference	Route from a higher-numbered routing table is available.
Route Distinguisher	64-bit prefix added to IP subnets to make them unique.
Route Metric or MED comparison	Route with a lower metric or MED is available.
Route Preference	Route with lower preference value is available
Router ID	Path through a neighbor with lower ID is available.
Secondary	Route not a primary route.

Table 237: State Output Field Values *(continued)*

Value	Description
Unusable path	Path is not usable because of one of the following conditions: • The route is damped. • The route is rejected by an import policy. • The route is unresolved.
Update source	Last tiebreaker is the lowest IP address value.

Table 215 on page 2495 describes the possible values for the Communities output field.

Table 238: Communities Output Field Values

Value	Description
area-number	4 bytes, encoding a 32-bit area number. For AS-external routes, the value is **0**. A nonzero value identifies the route as internal to the OSPF domain, and as within the identified area. Area numbers are relative to a particular OSPF domain.
bandwidth: ***local AS number:link-bandwidth-number***	Link-bandwidth community value used for unequal-cost load balancing. When BGP has several candidate paths available for multipath purposes, it does not perform unequal-cost load balancing according to the link-bandwidth community unless all candidate paths have this attribute.
domain-id	Unique configurable number that identifies the OSPF domain.
domain-id-vendor	Unique configurable number that further identifies the OSPF domain.
link-bandwidth-number	Link-bandwidth number: from **0** through **4,294,967,295** (bytes per second).
local AS number	Local AS number: from **1** through **65,535**.
options	1 byte. Currently this is only used if the route type is **5** or **7**. Setting the least significant bit in the field indicates that the route carries a type 2 metric.
origin	(Used with VPNs) Identifies where the route came from.
ospf-route-type	1 byte, encoded as **1** or **2** for intra-area routes (depending on whether the route came from a type 1 or a type 2 LSA); **3** for summary routes; **5** for external routes (area number must be**0**); **7** for NSSA routes; or **129** for sham link endpoint addresses.
route-type-vendor	Displays the area number, OSPF route type, and option of the route. This is configured using the BGP extended community attribute **0x8000**. The format is ***area-number:ospf-route-type:options***.
rte-type	Displays the area number, OSPF route type, and option of the route. This is configured using the BGP extended community attribute **0x0306**. The format is ***area-number:ospf-route-type:options***.
target	Defines which VPN the route participates in; **target** has the format ***32-bit IP address:16-bit number***. For example, 10.19.0.0:100.

Table 238: Communities Output Field Values *(continued)*

Value	Description
unknown IANA	Incoming IANA codes with a value between **0x1** and **0x7fff**. This code of the BGP extended community attribute is accepted, but it is not recognized.
unknown OSPF vendor community	Incoming IANA codes with a value above **0x8000**. This code of the BGP extended community attribute is accepted, but it is not recognized.

Sample Output

show route detail

```
user@host> show route detail

inet.0: 22 destinations, 23 routes (21 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 29
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 1:31:43
                Task: RT
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

10.31.1.0/30 (2 entries, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 2
                Next hop: via so-0/3/0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:30:17
                Task: IF
                Announcement bits (1): 3-Resolve tree 2
                AS path: I
         OSPF   Preference: 10
                Next-hop reference count: 1
                Next hop: via so-0/3/0.0, selected
                State: <Int>
                Inactive reason: Route Preference
                Local AS:    69
                Age: 1:30:17    Metric: 1
                Area: 0.0.0.0
                Task: OSPF
                AS path: I

10.31.1.1/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 7
                Interface: so-0/3/0.0
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:30:20
                Task: IF
```

```
                Announcement bits (1): 3-Resolve tree 2
                AS path: I

...

10.31.2.0/30 (1 entry, 1 announced)
        *OSPF   Preference: 10
                Next-hop reference count: 9
                Next hop: via so-0/3/0.0
                Next hop: 10.31.1.6 via ge-3/1/0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:29:56    Metric: 2
                Area: 0.0.0.0
                Task: OSPF
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

...

224.0.0.2/32 (1 entry, 1 announced)
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:45
                Task: PIM Recv
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

...

224.0.0.22/32 (1 entry, 1 announced)
        *IGMP   Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:43
                Task: IGMP
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

10.255.70.103/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
                Next-hop reference count: 6
                Next hop: 10.31.1.6 via ge-3/1/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 100096
                State: <Active Int>
                Local AS:    69
                Age: 1:25:49    Metric: 2
                Task: RSVP
                Announcement bits (2): 1-Resolve tree 1 2-Resolve tree 2
                AS path: I

10.255.71.238/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
```

```
                Next-hop reference count: 6
                Next hop: via so-0/3/0.0 weight 0x1, selected
                Label-switched-path green-r1-r2
                State: <Active Int>
                Local AS:    69
                Age: 1:25:49    Metric: 1
                Task: RSVP
                Announcement bits (2): 1-Resolve tree 1 2-Resolve tree 2
                AS path: I

private__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

47.0005.80ff.f800.0000.0108.0001.0102.5507.1052/152 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:31:44
                Task: IF
                AS path: I

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
0   (1 entry, 1 announced)
        *MPLS   Preference: 0
                Next hop type: Receive
                Next-hop reference count: 6
                State: <Active Int>
                Local AS:    69
                Age: 1:31:45    Metric: 1
                Task: MPLS
                Announcement bits (1): 0-KRT
                AS path: I

...

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

  299840 (1 entry, 1 announced)
  TSI:
  KRT in-kernel 299840 /52 -> {indirect(1048575)}
          *RSVP   Preference: 7/2
                  Next hop type: Flood
                  Address: 0x9174a30
                  Next-hop reference count: 4
                  Next hop type: Router, Next hop index: 798
                  Address: 0x9174c28
                  Next-hop reference count: 2
                  Next hop: 8.0.0.2 via lt-1/2/0.9 weight 0x1
                  Label-switched-path R2-to-R4-2p2mp
                  Label operation: Pop
                  Next hop type: Router, Next hop index: 1048574
                  Address: 0x92544f0
                  Next-hop reference count: 2
                  Next hop: 7.0.0.2 via lt-1/2/0.7 weight 0x1
                  Label-switched-path R2-to-R200-p2mp
                  Label operation: Pop
                  Next hop: 6.0.0.2 via lt-1/2/0.5 weight 0x8001
```

```
                    Label operation: Pop
                    State: <Active Int>
                    Age: 1:29       Metric: 1
                    Task: RSVP
                    Announcement bits (1): 0-KRT
                    AS path: I...

800010 (1 entry, 1 announced)
        *VPLS   Preference: 7
                Next-hop reference count: 2
                Next hop: via vt-3/2/0.32769, selected
                Label operation: Pop
                State: <Active Int>
                Age: 1:29:30
                Task: Common L2 VC
                Announcement bits (1): 0-KRT
                AS path: I

vt-3/2/0.32769 (1 entry, 1 announced)
        *VPLS   Preference: 7
                Next-hop reference count: 2
                Next hop: 10.31.1.6 via ge-3/1/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 800012, Push 100096(top)
                Protocol next hop: 10.255.70.103
                Push 800012
                Indirect next hop: 87272e4 1048574
                State: <Active Int>
                Age: 1:29:30    Metric2: 2
                Task: Common L2 VC
                Announcement bits (2): 0-KRT 1-Common L2 VC
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0

inet6.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

abcd::10:255:71:52/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:31:44
                Task: IF
                AS path: I

fe80::280:42ff:fe10:f179/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:44
                Task: IF
                AS path: I

ff02::2/128 (1 entry, 1 announced)
        *PIM    Preference: 0
```

```
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:45
                Task: PIM Recv6
                Announcement bits (1): 0-KRT
                AS path: I

ff02::d/128 (1 entry, 1 announced)
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:45
                Task: PIM Recv6
                Announcement bits (1): 0-KRT
                AS path: I

ff02::16/128 (1 entry, 1 announced)
        *MLD    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:43
                Task: MLD
                Announcement bits (1): 0-KRT
                AS path: I

private.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

fe80::280:42ff:fe10:f179/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.16385, selected
                State: <Active NoReadvrt Int>
                Age: 1:31:44
                Task: IF
                AS path: I

green.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)

10.255.70.103:1:3:1/96 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 10.255.70.103:1
                Next-hop reference count: 7
                Source: 10.255.70.103
                Protocol next hop: 10.255.70.103
                Indirect next hop: 2 no-forward
                State: <Secondary Active Int Ext>
                Local AS:    69 Peer AS:    69
                Age: 1:25:49    Metric2: 1
                AIGP 210
                Task: BGP_69.10.255.70.103+179
                Announcement bits (1): 0-green-l2vpn
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0
                Label-base: 800008, range: 8
                Localpref: 100
                Router ID: 10.255.70.103
```

```
                Primary Routing Table bgp.l2vpn.0

10.255.71.52:1:1:1/96 (1 entry, 1 announced)
        *L2VPN  Preference: 170/-1
                Next-hop reference count: 5
                Protocol next hop: 10.255.71.52
                Indirect next hop: 0 -
                State: <Active Int Ext>
                Age: 1:31:40    Metric2: 1
                Task: green-l2vpn
                Announcement bits (1): 1-BGP.0.0.0.0+179
                AS path: I
                Communities: Layer2-info: encaps:VPLS, control flags:Site-Down,
                mtu: 0
                Label-base: 800016, range: 8, status-vector: 0x9F

10.255.71.52:1:5:1/96 (1 entry, 1 announced)
        *L2VPN  Preference: 170/-101
                Next-hop reference count: 5
                Protocol next hop: 10.255.71.52
                Indirect next hop: 0 -
                State: <Active Int Ext>
                Age: 1:31:40    Metric2: 1
                Task: green-l2vpn
                Announcement bits (1): 1-BGP.0.0.0.0+179
                AS path: I
                Communities: Layer2-info: encaps:VPLS, control flags:, mtu: 0
                Label-base: 800008, range: 8, status-vector: 0x9F

...

l2circuit.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
10.245.255.63:CtrlWord:4:3:Local/96 (1 entry, 1 announced)
        *L2CKT  Preference: 7
                Next hop: via so-1/1/2.0 weight 1, selected
                Label-switched-path my-lsp
                Label operation: Push 100000[0]
                Protocol next hop: 10.245.255.63 Indirect next hop: 86af000 296
                State: <Active Int>
                Local AS:    99
                Age: 10:21
                Task: l2 circuit
                Announcement bits (1): 0-LDP
                AS path: I
                VC Label 100000, MTU 1500, VLAN ID 512
```

show route detail (with BGP Multipath)

```
user@host> show route detail

10.1.1.8/30 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 262142
                Address: 0x901a010
                Next-hop reference count: 2
                Source: 10.1.1.2
                Next hop: 10.1.1.2 via ge-0/3/0.1, selected
                Next hop: 10.1.1.6 via ge-0/3/0.5
                State: <Active Ext>
                Local AS:     1 Peer AS:     2
                Age: 5:04:43
```



```
                Validation State: unverified
                 Task: BGP_2.10.1.1.2+59955
                 Announcement bits (1): 0-KRT
                 AS path: 2 I
                 Accepted Multipath
                 Localpref: 100
                 Router ID: 1.1.1.2
          BGP    Preference: 170/-101
                 Next hop type: Router, Next hop index: 678
                 Address: 0x8f97520
                 Next-hop reference count: 9
                 Source: 10.1.1.6
                 Next hop: 10.1.1.6 via ge-0/3/0.5, selected
                 State: <NotBest Ext>
                 Inactive reason: Not Best in its group - Active preferred
                 Local AS:     1 Peer AS:     2
                 Age: 5:04:43
              Validation State: unverified
                 Task: BGP_2.10.1.1.6+58198
                 AS path: 2 I
                 Accepted MultipathContrib
                 Localpref: 100
                 Router ID: 1.1.1.3
```

show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs)

```
user@host> show route label 299872 detail
mpls.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
299872 (1 entry, 1 announced)
        *LDP    Preference: 9
                Next hop type: Flood
                Next-hop reference count: 3
                Address: 0x9097d90
                Next hop: via vt-0/1/0.1
                Next-hop index: 661
                Label operation: Pop
                Address: 0x9172130
                Next hop: via so-0/0/3.0
                Next-hop index: 654
                Label operation: Swap 299872
                State: **Active Int>
                Local AS:  1001
                Age: 8:20       Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
               FECs bound to route: P2MP root-addr 10.255.72.166, grp 232.1.1.1,
 src 192.168.142.2
```

PART 11

Intermediate System to Intermediate System

CHAPTER 34

Overview

IS-IS Overview

IS-IS Overview

The IS-IS protocol is an interior gateway protocol (IGP) that uses link-state information to make routing decisions.

IS-IS is a link-state IGP that uses the shortest-path-first (SPF) algorithm to determine routes. IS-IS evaluates the topology changes and determines whether to perform a full SPF recalculation or a partial route calculation (PRC). This protocol originally was developed for routing International Organization for Standardization (ISO) Connectionless Network Protocol (CLNP) packets.

Like OSPF routing, IS-IS uses hello packets that allow network convergence to occur quickly when network changes are detected. IS-IS uses the SPF algorithm to determine routes. Using SPF, IS-IS evaluates network topology changes and determines if a full or partial route calculation is required.

NOTE: **Because IS-IS uses ISO addresses, the configuration of IP version 6 (IPv6) and IP version 4 (IPv4) implementations of IS-IS is identical.**

This section discusses the following topics:

IS-IS Terminology

An IS-IS network is a single autonomous system (AS), also called a *routing domain*, that consists of *end systems* and *intermediate systems*. End systems are network entities that send and receive packets. Intermediate systems send and receive packets and relay (forward) packets. (Intermediate system is the Open System Interconnection [OSI] term for a router.) ISO packets are called network PDUs.

In IS-IS, a single AS can be divided into smaller groups called *areas*. Routing between areas is organized hierarchically, allowing a domain to be administratively divided into smaller areas. This organization is accomplished by configuring *Level 1* and *Level 2* intermediate systems. Level 1 systems route within an area; when the destination is outside an area, they route toward a Level 2 system. Level 2 intermediate systems route between areas and toward other ASs. No IS-IS area functions strictly as a backbone.

Level 1 routers share intra-area routing information, and Level 2 routers share interarea information about IP addresses available within each area. Uniquely, IS-IS routers can act as both Level 1 and Level 2 routers, sharing intra-area routes with other Level 1 routers and interarea routes with other Level 2 routers.

The propagation of link-state updates is determined by the level boundaries. All routers within a level maintain a complete link-state database of all other routers in the same level. Each router then uses the Dijkstra algorithm to determine the shortest path from the local router to other routers in the link-state database.

ISO Network Addresses

IS-IS uses ISO network addresses. Each address identifies a point of connection to the network, such as a router interface, and is called a *network service access point* (*NSAP*).

IS-IS supports multiple NSAP addresses on the loopback lo0 interface.

An end system can have multiple NSAP addresses, in which case the addresses differ only by the last byte (called the *n-selector*). Each NSAP represents a service that is available at that node. In addition to having multiple services, a single node can belong to multiple areas.

Each network entity also has a special network address called a *network entity title* (*NET*). Structurally, an NET is identical to an NSAP address but has an n-selector of 00. Most end systems and intermediate systems have one NET. Intermediate systems that participate in multiple areas can have multiple NETs.

The following ISO addresses illustrate the IS-IS address format:

```
49.0001.00a0.c96b.c490.00
49.0001.2081.9716.9018.00
```

NETs take several forms, depending on your network requirements. NET addresses are hexadecimal and range from 8 octets to 20 octets in length. Generally, the format consists of an authority and format Identifier (AFI), a domain ID, an area ID, a system identifier, and a selector. The simplest format omits the domain ID and is 10 octets long. For example, the NET address 49.0001.1921.6800.1001.00 consists of the following parts:

- 49—AFI
- 0001—Area ID
- 1921.6800.1001—System identifier
- 00—Selector

The system identifier must be unique within the network. For an IP-only network, we recommend using the IP address of an interface on the router. Configuring a loopback NET address with the IP address is helpful when troubleshooting is required on the network.

The first portion of the address is the area number, which is a variable number from 1 through 13 bytes. The first byte of the area number (49) is the authority and format indicator (AFI). The next bytes are the assigned domain (area) identifier, which can be from 0 through 12 bytes. In the examples above, the area identifier is 0001.

The next six bytes form the system identifier. The system identifier can be any six bytes that are unique throughout the entire domain. The system identifier commonly is the media access control (MAC) address (as in the first example, 00a0.c96b.c490) or the IP address expressed in binary-coded decimal (BCD) (as in the second example, 2081.9716.9018, which corresponds to IP address 208.197.169.18). The last byte (00) is the n-selector.

NOTE: **The system identifier cannot be 0000.0000.0000. All 0s is an illegal setting, and the adjacency is not formed with this setting.**

To provide help with IS-IS debugging, the Junos® operating system (Junos OS) supports dynamic mapping of ISO system identifiers to the hostname. Each system can be configured with a hostname, which allows the system identifier-to-hostname mapping to be carried in a dynamic hostname type, length, and value (TLV) tuple in IS-IS link-state PDUs. This enables intermediate systems in the routing domain to learn about the ISO system identifier of a particular intermediate system.

IS-IS Packets

Each IS-IS PDU shares a common header. IS-IS uses the following PDUs to exchange protocol information:

- IS-IS hello (IIH) PDUs—Broadcast to discover the identity of neighboring IS-IS systems and to determine whether the neighbors are Level 1 or Level 2 intermediate systems.

  IS-IS hello PDUs establish adjacencies with other routers and have three different formats: one for point-to-point hello packets, one for Level 1 broadcast links, and one for Level 2 broadcast links. Level 1 routers must share the same area address to form an adjacency, while Level 2 routers do not have this limitation. The request for adjacency is encoded in the Circuit type field of the PDU.

  Hello PDUs have a preset length assigned to them. The IS-IS router does not resize any PDU to match the maximum transmission unit (MTU) on a router interface. Each interface supports the maximum IS-IS PDU of 1492 bytes, and hello PDUs are padded to meet the maximum value. When the hello is sent to a neighboring router, the connecting interface supports the maximum PDU size.

- Link-state PDUs—Contain information about the state of adjacencies to neighboring IS-IS systems. Link-state PDUs are flooded periodically throughout an area.

  Also included is metric and IS-IS neighbor information. Each link-state PDU must be refreshed periodically on the network and is acknowledged by information within a sequence number PDU.

  On point-to-point links, each link-state PDU is acknowledged by a partial sequence number PDU (PSNP), but on broadcast links, a complete sequence number PDU (CSNP) is sent out over the network. Any router that finds newer link-state PDU information in the CSNP then purges the out-of-date entry and updates the link-state database.

  Link-state PDUs support variable-length subnet mask addressing.

- Complete sequence number PDUs (CSNPs)—Contain a complete list of all link-state PDUs in the IS-IS database. CSNPs are sent periodically on all links, and the receiving systems use the information in the CSNP to update and synchronize their link-state PDU databases. The designated router multicasts CSNPs on broadcast links in place of sending explicit acknowledgments for each link-state PDU.

  Contained within the CSNP is a link-state PDU identifier, a lifetime, a sequence number, and a checksum for each entry in the database. Periodically, a CSNP is sent on both broadcast and point-to-point links to maintain a correct database. Also, the advertisement of CSNPs occurs when an adjacency is formed with another router. Like IS-IS hello PDUs, CSNPs come in two types: Level 1 and Level 2.

  When a device receives a CSNP, it checks the database entries against its own local link-state database. If it detects missing information, the device requests specific link-state PDU details using a partial sequence number PDU (PSNP).

- Partial sequence number PDUs (PSNPs)—Sent multicast by a receiver when it detects that it is missing a link-state PDU (when its link-state PDU database is out of date). The receiver sends a PSNP to the system that transmitted the CSNP, effectively requesting that the missing link-state PDU be transmitted. That routing device, in turn, forwards the missing link-state PDU to the requesting routing device.

A PSNP is used by an IS-IS router to request link-state PDU information from a neighboring router. A PSNP can also explicitly acknowledge the receipt of a link-state PDU on a point-to-point link. On a broadcast link, a CSNP is used as implicit knowledge. Like hello PDUs and CSNPs, the PSNP also has two types: Level 1 and Level 2.

When a device compares a CSNP to its local database and determines that a link-state PDU is missing, the router issues a PSNP for the missing link-state PDU, which is returned in a link-state PDU from the router sending the CSNP. The received link-state PDU is then stored in the local database, and an acknowledgment is sent back to the originating router.

Persistent Route Reachability

IPv4 and IPv6 route reachability information in IS-IS link-state PDUs is preserved when you commit a configuration. IP prefixes are preserved with their original packet fragment upon link-state PDU regeneration.

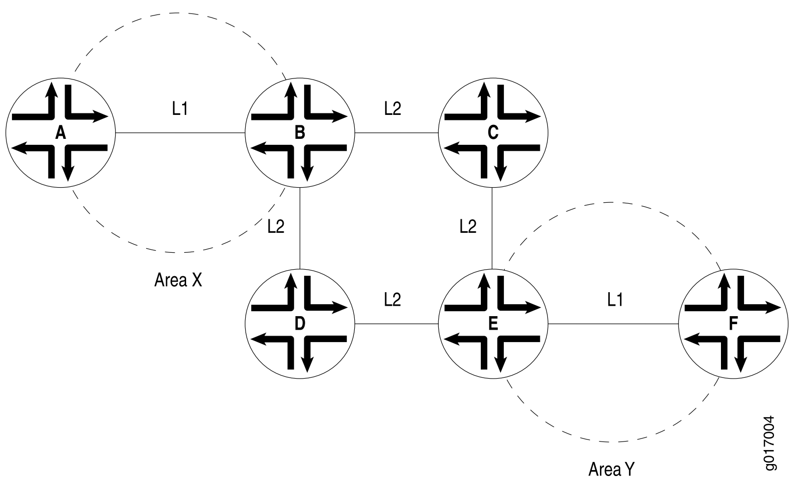
IS-IS Support for Multipoint Network Clouds

IS-IS does not support multipoint configurations. Therefore, when configuring Frame Relay or Asynchronous Transfer Mode (ATM) networks, you must configure them as collections of point-to-point links, not as multipoint clouds.

Installing a Default Route to the Nearest Routing Device That Operates at Both IS-IS Levels

When a routing device that operates as both a Level 1 and Level 2 router (Router B) determines that it can reach at least one area other than its own (for example, in Area Y), it sets the ATTACHED bit in its Level 1 link-state PDU. Thereafter, the Level 1 router (Router A) introduces a default route pointing to the nearest attached routing device that operates as both a Level 1 and Level 2 router (Router B). See Figure 75 on page 3193.

Figure 75: Install Default Route to Nearest Routing Device That Operates at Both Level 1 and Level 2



Related Documentation

- *IS-IS Feature Guide for Routing Devices*

Understanding BFD Authentication for IS-IS

Bidirectional Forwarding Detection (BFD) enables rapid detection of communication failures between adjacent systems. By default, authentication for BFD sessions is disabled. However, when running BFD over Network Layer protocols, the risk of service attacks can be significant. We strongly recommend using authentication if you are running BFD over multiple hops or through insecure tunnels. Beginning with Junos OS Release 9.6, Junos OS supports authentication for BFD sessions running over IS-IS. BFD authentication is only supported in the domestic image and is not available in the export image.

You authenticate BFD sessions by specifying an authentication algorithm and keychain, and then associating that configuration information with a security authentication keychain using the keychain name.

The following sections describe the supported authentication algorithms, security keychains, and level of authentication that can be configured:

BFD Authentication Algorithms

Junos OS supports the following algorithms for BFD authentication:

- **simple-password**—Plain-text password. One to 16 bytes of plain text are used to authenticate the BFD session. One or more passwords might be configured. This method is the least secure and should be used only when BFD sessions are not subject to packet interception.
- **keyed-md5**—Keyed Message Digest 5 hash algorithm for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed MD5 uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than or equal to the last sequence number received. Although more secure than a simple password, this method is vulnerable to replay attacks. Increasing the rate at which the sequence number is updated can reduce this risk.
- **meticulous-keyed-md5**—Meticulous keyed Message Digest 5 hash algorithm. This method works in the same manner as keyed MD5, but the sequence number is updated with every packet. Although more secure than keyed MD5 and simple passwords, this method might take additional time to authenticate the session.
- **keyed-sha-1**—Keyed Secure Hash Algorithm I for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed SHA uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. The key is not carried within the packets. With this method,

packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than the last sequence number received.

- **meticulous-keyed-sha-1**—Meticulous keyed Secure Hash Algorithm I. This method works in the same manner as keyed SHA, but the sequence number is updated with every packet. Although more secure than keyed SHA and simple passwords, this method might take additional time to authenticate the session.

NOTE: Nonstop active routing (NSR) is not supported with meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.

Security Authentication Keychains

The security authentication keychain defines the authentication attributes used for authentication key updates. When the security authentication keychain is configured and associated with a protocol through the keychain name, authentication key updates can occur without interrupting routing and signaling protocols.

The authentication keychain contains one or more keychains. Each keychain contains one or more keys. Each key holds the secret data and the time at which the key becomes valid. The algorithm and keychain must be configured on both ends of the BFD session, and they must match. Any mismatch in configuration prevents the BFD session from being created.

BFD allows multiple clients per session, and each client can have its own keychain and algorithm defined. To avoid confusion, we recommend specifying only one security authentication keychain.

Strict Versus Loose Authentication

By default, strict authentication is enabled and authentication is checked at both ends of each BFD session. Optionally, to smooth migration from nonauthenticated sessions to authenticated sessions, you can configure *loose checking*. When loose checking is configured, packets are accepted without authentication being checked at each end of the session. This feature is intended for transitional periods only.

Related Documentation

- Example: Configuring BFD Authentication for IS-IS on page 3229

Understanding Hitless Authentication Key Rollover for IS-IS

IS-IS protocol exchanges can be authenticated to guarantee that only trusted routing devices participate in routing. By default, authentication is disabled. The authentication algorithm creates an encoded checksum that is included in the transmitted packet. The receiving routing device uses an authentication key (password) to verify the packet's checksum.

If you configure authentication for all peers, each peer in that group inherits the group's authentication.

You can update authentication keys without resetting any IS-IS neighbor sessions. This is referred to as *hitless authentication key rollover*.

Hitless authentication key rollover uses authentication keychains, which consist of the authentication keys that are being updated. The keychain includes multiple keys. Each key in the keychain has a unique start time. At the next key's start time, a rollover occurs from the current key to the next key, and the next key becomes the current key.

You can choose the algorithm through which authentication is established. You can configure MD5 or SHA-1 authentication. You associate a keychain and the authentication algorithm with an IS-IS neighboring session. Each key contains an identifier and a secret password.

The sending peer chooses the active key based on the system time and the start times of the keys in the keychain. The receiving peer determines the key with which it authenticates based on the incoming key identifier.

You can configure either RFC 5304-based encoding or RFC 5310-based encoding for the IS-IS protocol transmission encoding format.

Related Documentation

- Example: Configuring Hitless Authentication Key Rollover for IS-IS on page 3211

CHAPTER 35

Configuration

Configuration Guidelines

Example: Configuring IS-IS

This example shows how to configure IS-IS.

Requirements

No special configuration beyond device initialization is required before configuring this example.

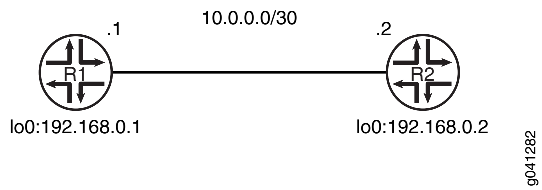
Overview

In this example, you configure the two IS-IS routing devices in a single area. The devices have NET addresses 49.0002.0192.0168.0001.00 and 49.0002.0192.0168.0002.00 on the lo0 interfaces. Additionally, you configure the ISO family on the IS-IS interfaces.

For Junos OS security devices only, you configure the **mode packet-based** statement at the **[edit security forwarding-options family iso]** hierarchy level.

Figure 76 on page 3198 shows the topology used in this example.

Figure 76: Simple IS-IS Topology



"CLI Quick Configuration" on page 3198 shows the configuration for both of the devices in Figure 76 on page 3198. The section "Step-by-Step Procedure" on page 3198 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set security forwarding-options family iso mode packet-based
set interfaces ge-1/2/0 unit 0 description to-R2
set interfaces ge-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces ge-1/2/0 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0001.00
set protocols isis interface ge-1/2/0.0
set protocols isis interface lo0.0
```

Device R2

```
set security forwarding-options family iso mode packet-based
set interfaces ge-1/2/0 unit 0 description to-R1
set interfaces ge-1/2/0 unit 0 family inet address 10.0.0.2/30
set interfaces ge-1/2/0 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0002.00
set protocols isis interface ge-1/2/0.0
set protocols isis interface lo0.0
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure IS-IS:

1. Enable IS-IS if your router is in secure context.

   ```
   [edit security forwarding-options family iso]
   user@R1# set mode packet-based
   ```

2. Create the interface that connects to Device R2, and configure the ISO family on the interface.

   ```
   [edit interfaces ge-1/2/0 unit 0]
   user@R1# set description to-R2
   user@R1# set family inet address 10.0.0.1/30
   user@R1# set family iso
   ```

3. Create the loopback interface, set the IP address, and set the NET address.

```
[edit interfaces lo0 unit 0]
user@R1# set family inet address 192.168.0.1/32
user@R1# set family iso address 49.0002.0192.0168.0001.00
```

4. Enable IS-IS on the interfaces.

```
[edit protocols isis]
user@R1# set interface ge-1/2/0.0
user@R1# set interface lo0.0
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show security** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show security
forwarding-options {
  family iso {
    mode packet-based;
  }
}
```

```
user@R1# show interfaces
ge-1/2/0 {
  unit 0 {
    description to-R2;
    family inet {
      address 10.0.0.1/30;
    }
    family iso;
  }
}
lo0 {
  unit 0 {
    family inet {
      address 192.168.0.1/32;
    }
    family iso {
      address 49.0002.0192.0168.0001.00;
    }
  }
}
```

```
user@R1# show protocols
isis {
  interface ge-1/2/0.0;
  interface lo0.0;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying IS-IS Interface Configuration on page 3200
- Verifying IS-IS Interface Configuration in Detail on page 3200
- Verifying IS-IS Adjacencies on page 3201
- Verifying IS-IS Adjacencies in Detail on page 3201

Verifying IS-IS Interface Configuration

Purpose Verify the status of the IS-IS-enabled interfaces.

Action From operational mode, enter the **show isis interface brief** command.

```
user@R1> show isis interface brief
IS-IS interface database:
Interface             L CirID Level 1 DR        Level 2 DR        L1/L2 Metric
lo0.0                 0   0x1 Passive           Passive                 0/0
ge-1/2/0.0            3   0x1 R2.02         R2.02             10/10
```

Meaning Verify that the output shows the intended configuration of the interfaces on which IS-IS is enabled.

Verifying IS-IS Interface Configuration in Detail

Purpose Verify the details of IS-IS-enabled interfaces.

Action From operational mode, enter the **show isis interface detail** command.

```
user@R1> show isis interface detail
IS-IS interface database:
lo0.0
  Index: 75, State: 0x6, Circuit id: 0x1, Circuit type: 0
  LSP interval: 100 ms, CSNP interval: disabled
  Adjacency advertisement: Advertise
  Level Adjacencies Priority Metric Hello (s) Hold (s) Designated Router
    1             0       64      0 Passive
    2             0       64      0 Passive
ge-1/2/0.0
  Index: 77, State: 0x6, Circuit id: 0x1, Circuit type: 3
  LSP interval: 100 ms, CSNP interval: 10 s
  Adjacency advertisement: Advertise
  Level Adjacencies Priority Metric Hello (s) Hold (s) Designated Router
    1             1       64     10     9.000       27 R2.02 (not us)
    2             1       64     10     9.000       27 R2.02 (not us)
```

Meaning Check the following output fields and verify that the output shows the intended configuration of IS-IS-enabled interfaces:

- Interface—Interface configured for IS-IS.
- State—Internal implementation information.
- Circuit id—Circuit identifier.

- Circuit type—Configured level of IS-IS:
  - 1—Level 1 only
  - 2—Level 2 only
  - 3—Level 1 and Level 2
- link-state PDU interval—Time between IS-IS information messages.
- L or Level—Type of adjacency:
  - 1—Level 1 only
  - 2—Level 2 only
  - 3—Level 1 and Level 2
- Adjacencies—Adjacencies established on the interface.
- Priority—Priority value established on the interface.
- Metric—Metric value for the interface.
- Hello(s)—Intervals between hello PDUs.
- Hold(s)—Hold time on the interface.

Verifying IS-IS Adjacencies

Purpose Display brief information about IS-IS neighbors.

Action From operational mode, enter the **show isis adjacency brief** command.

```
user@R1> show isis adjacency brief
Interface             System         L State        Hold (secs) SNPA
ge-1/2/0.0            R2          1  Up                   6  0:5:85:8f:c8:bd
ge-1/2/0.0            R2          2  Up                   6  0:5:85:8f:c8:bd
```

Meaning Verify the adjacent routers in the IS-IS database.

Verifying IS-IS Adjacencies in Detail

Purpose Display extensive information about IS-IS neighbors.

Action From operational mode, enter the **show isis adjacency extensive** command.

```
user@R1> show isis adjacency extensive
R2
  Interface: ge-1/2/0.0, Level: 1, State: Up, Expires in 6 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 00:40:28 ago
  Circuit type: 3, Speaks: IP, IPv6, MAC address: 0:5:85:8f:c8:bd
  Topologies: Unicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R2.02, IP addresses: 10.0.0.2
  Transition log:
  When                  State        Event           Down reason
  Thu May 31 11:18:48   Up           Seenself

R2
```

```
Interface: ge-1/2/0.0, Level: 2, State: Up, Expires in 8 secs
Priority: 64, Up/Down transitions: 1, Last transition: 00:40:28 ago
Circuit type: 3, Speaks: IP, IPv6, MAC address: 0:5:85:8f:c8:bd
Topologies: Unicast
Restart capable: Yes, Adjacency advertisement: Advertise
LAN id: R2.02, IP addresses: 10.0.0.2
Transition log:
When                  State        Event           Down reason
Thu May 31 11:18:48   Up           Seenself
```

Meaning Check the following fields and verify the adjacency information about IS-IS neighbors:

- Interface—Interface through which the neighbor is reachable.
- L or Level—Configured level of IS-IS:
  - 1—Level 1 only
  - 2—Level 2 only
  - 3—Level 1 and Level 2

  An exclamation point before the level number indicates that the adjacency is missing an IP address.
- State—Status of the adjacency: **Up**, **Down**, **New**, **One-way**, **Initializing**, or **Rejected**.
- Event—Message that identifies the cause of a state.
- Down reason—Reason the adjacency is down.
- Restart capable—A neighbor is configured for graceful restart.
- Transition log—List of transitions including **When**, **State**, and **Reason**.

Related Documentation

- *Understanding IS-IS Configuration*
- Example: Configuring Designated Router Election Priority for IS-IS on page 3259
- *Junos OS Feature Support Reference for SRX Series and J Series Devices*

Configuration Examples

Example: Configuring Multi-Level IS-IS

This example shows how to configure a multi-level IS-IS topology.

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

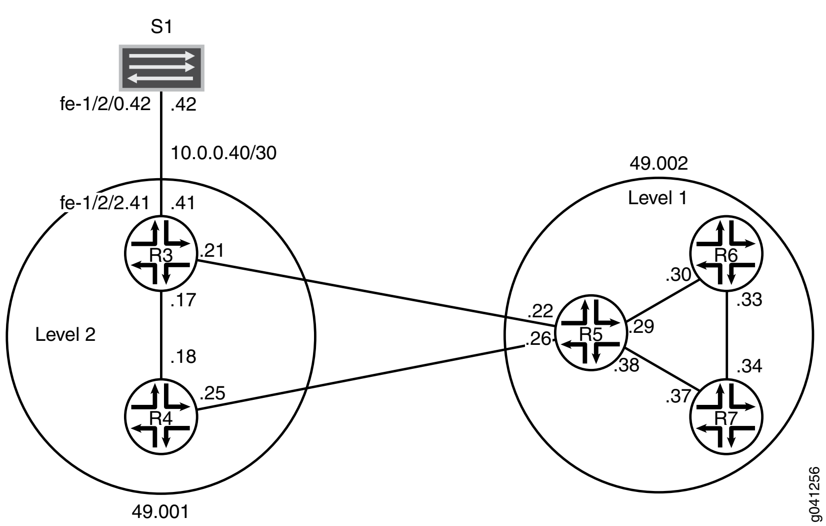
Like OSPF, the IS-IS protocol supports the partitioning of a routing domain into multiple areas with levels that control interarea flooding. The use of multiple levels improves protocol scalability, as Level 2 (backbone) link-state PDUs are normally not flooded into a Level 1 area.

An IS-IS Level 2 area is analogous to the OSPF backbone area (0), while a Level 1 area operates much like an OSPF totally stubby area, in that a default route is normally used to reach both inter-level and AS external routes.

Unlike OSPF, IS-IS area boundaries occur between routers, such that a given routing device is always wholly contained within a particular area. Level 1 adjacencies can be formed between routers that share a common area number, while a Level 2 adjacency can be formed between routers that might or might not share an area number.

Figure 77 on page 3203 shows the topology used in this example.

Figure 77: IS-IS Multi-Level Topology



"CLI Quick Configuration" on page 3204 shows the configuration for all of the devices in Figure 77 on page 3203. The section "Step-by-Step Procedure" on page 3205 describes the steps on Device R5.

This example has the following characteristics:

- Device R5 functions as a Level 1/Level 2 router to interconnect the Level 2 backbone area 49.001 and the Level 1 area 49.002 containing Device R6 and Device R7.
- The system ID is based on the devices' IPv4 lo0 addresses.
- Loss of any individual interface does not totally disrupt the IS-IS operation.
- The IPv4 lo0 addresses of all routers are reachable through IS-IS.
- The link between Device R3 and Device S1 appears in area 49.001 as an intra-area route. No IS-IS adjacencies can be established on this interface. This is accomplished by configuring the **passive** statement on Device R3's interface to Device S1.
- The loopback addresses of Level 2 devices do not appear in a Level 1 area.
- There is only one adjacency for each device pairing.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R3

```
set interfaces fe-1/2/0 unit 0 description to-R4
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.17/30
set interfaces fe-1/2/0 unit 0 family iso
set interfaces fe-1/2/1 unit 0 description to-R5
set interfaces fe-1/2/1 unit 0 family inet address 10.0.0.21/30
set interfaces fe-1/2/1 unit 0 family iso
set interfaces fe-1/2/2 unit 0 family inet address 10.0.0.41/30
set interfaces fe-1/2/2 unit 0 description to-S1
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set interfaces lo0 unit 0 family iso address 49.001.0192.0168.0003.00
set protocols isis interface fe-1/2/0.0 level 1 disable
set protocols isis interface fe-1/2/1.0 level 1 disable
set protocols isis interface lo0.0 level 1 disable
set protocols isis interface fe-1/2/2.0 passive
```

Device R4

```
set interfaces fe-1/2/0 unit 0 description to-R3
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.18/30
set interfaces fe-1/2/0 unit 0 family iso
set interfaces fe-1/2/1 unit 0 description to-R5
set interfaces fe-1/2/1 unit 0 family inet address 10.0.0.25/30
set interfaces fe-1/2/1 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.4/32
set interfaces lo0 unit 0 family iso address 49.001.0192.0168.0004.00
set protocols isis interface fe-1/2/0.0 level 1 disable
set protocols isis interface fe-1/2/1.0 level 1 disable
set protocols isis interface lo0.0 level 1 disable
```

Device R5

```
set interfaces fe-1/2/0 unit 0 description to-R3
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.22/30
set interfaces fe-1/2/0 unit 0 family iso
set interfaces fe-1/2/1 unit 0 description to-R4
set interfaces fe-1/2/1 unit 0 family inet address 10.0.0.26/30
set interfaces fe-1/2/1 unit 0 family iso
set interfaces fe-1/2/2 unit 0 description to-R6
set interfaces fe-1/2/2 unit 0 family inet address 10.0.0.29/30
set interfaces fe-1/2/2 unit 0 family iso
set interfaces fe-1/2/3 unit 0 description to-R7
set interfaces fe-1/2/3 unit 0 family inet address 10.0.0.38/30
set interfaces fe-1/2/3 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.5/32
set interfaces lo0 unit 0 family iso address 49.002.0192.0168.0005.00
set protocols isis interface fe-1/2/0.0 level 1 disable
set protocols isis interface fe-1/2/1.0 level 1 disable
set protocols isis interface fe-1/2/2.0 level 2 disable
set protocols isis interface fe-1/2/3.0 level 2 disable
set protocols isis interface lo0.0 level 1 disable
```

Device R6

```
set interfaces fe-1/2/0 unit 0 description to-R5
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.30/30
set interfaces fe-1/2/0 unit 0 family iso
set interfaces fe-1/2/1 unit 0 description to-R7
set interfaces fe-1/2/1 unit 0 family inet address 10.0.0.33/30
set interfaces fe-1/2/1 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.6/32
set interfaces lo0 unit 0 family iso address 49.002.0192.0168.0006.00
set protocols isis interface fe-1/2/0.0 level 2 disable
set protocols isis interface fe-1/2/1.0 level 2 disable
set protocols isis interface lo0.0 level 2 disable
```

Device R7

```
set interfaces fe-1/2/0 unit 0 description to-R6
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.34/30
set interfaces fe-1/2/0 unit 0 family iso
set interfaces fe-1/2/1 unit 0 description to-R5
set interfaces fe-1/2/1 unit 0 family inet address 10.0.0.37/30
set interfaces fe-1/2/1 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.7/32
set interfaces lo0 unit 0 family iso address 49.002.0192.0168.0007.00
set protocols isis interface fe-1/2/0.0 level 2 disable
set protocols isis interface fe-1/2/1.0 level 2 disable
set protocols isis interface lo0.0 level 2 disable
```

Device S1

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.42/30
set interfaces fe-1/2/0 unit 0 description to-R3
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure multi-level IS-IS:

1. Configure the network interfaces.

Enable IS-IS on the interfaces by Including the ISO address family on each interface.

```
[edit interfaces]
user@R5# set fe-1/2/0 unit 0 description to-R3
user@R5# set fe-1/2/0 unit 0 family inet address 10.0.0.22/30
user@R5# set fe-1/2/0 unit 0 family iso
user@R5# set fe-1/2/1 unit 0 description to-R4
user@R5# set fe-1/2/1 unit 0 family inet address 10.0.0.26/30
user@R5# set fe-1/2/1 unit 0 family iso
user@R5# set fe-1/2/2 unit 0 description to-R6
user@R5# set fe-1/2/2 unit 0 family inet address 10.0.0.29/30
user@R5# set fe-1/2/2 unit 0 family iso
user@R5# set fe-1/2/3 unit 0 description to-R7
user@R5# set fe-1/2/3 unit 0 family inet address 10.0.0.38/30
user@R5# set fe-1/2/3 unit 0 family iso
```

2. Configure two loopback interface addresses.

   One address is for IPv4.

   The other is for the IS-IS area 49.002 so that Device R5 can form adjacencies with the other Level 1 devices in area 49.002. Even though Device R5's NET identifies itself as belonging to the Level 1 area 49.002, its loopback interface is not configured as a Level 1 interface. Doing so would cause the route to Device R5's loopback to be injected into the Level 1 area.

```
[edit interfaces lo0 unit 0]
user@R5# set family inet address 192.168.0.5/32
user@R5# set family iso address 49.002.0192.0168.0005.00
```

3. Specify the IS-IS level on a per-interface basis.

   Device R5 becomes adjacent to the other routing devices on the same level on each link.

   By default, IS-IS is enabled for IS-IS areas on all interfaces on which the ISO protocol family is enabled (at the **[edit interfaces *interface-name* unit *logical-unit-number*]** hierarchy level). To disable IS-IS at any particular level on an interface, include the **disable** statement.

   Device R5's loopback interface is configured to run Level 2 only. If Level 1 operation were enabled on lo0.0, Device R5 would include its loopback address in its Level 1 link-state PDU, which is incorrect for this example in which the loopback addresses of Level 2 devices must not appear in a Level 1 area.

   Unlike OSPF, you must explicitly list the router's lo0 interface at the **[edit protocols isis]** hierarchy level, because this interface is the source of the router's NET, and therefore must be configured as an IS-IS interface. In IS-IS, the lo0 interface operates in the passive mode by default, which is ideal because adjacency formation can never occur on a virtual interface.

```
[edit protocols isis]
user@R5# set interface fe-1/2/0.0 level 1 disable
user@R5# set interface fe-1/2/1.0 level 1 disable
user@R5# set interface fe-1/2/0.0 level 2 disable
user@R5# set interface fe-1/2/3.0 level 2 disable
user@R5# set interface lo0.0 level 1 disable
```


Results From configuration mode, confirm your configuration by entering the **show interfaces** and **show protocols** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R5# show interfaces
fe-1/2/0 {
   unit 0{
      description to-R3;
      family inet {
         address 10.0.0.22/30;
      }
      family iso;
   }
}
fe-1/2/1 {
   unit 0 {
      description to-R4;
      family inet {
         address 10.0.0.26/30;
      }
      family iso;
   }
}
fe-1/2/2 {
   unit 0 {
      description to-R6;
      family inet {
         address 10.0.0.29/30;
      }
      family iso;
   }
}
fe-1/2/3 {
   unit 0 {
      description to-R7;
      family inet {
         address 10.0.0.38/30;
      }
      family iso;
   }
}
lo0 {
   unit 0 {
      family inet {
         address 192.168.0.5/32;
      }
      family iso {
         address 49.002.0192.0168.0005.00;
      }
   }
}
```

```
user@R5# show protocols
isis {
   interface fe-1/2/0.0 {
      level 1 disable;
```

```
    }
    interface fe-1/2/1.0 {
      level 1 disable;
    }
    interface fe-1/2/0.0 {
      level 2 disable;
    }
    interface fe-1/2/3.0 {
      level 2 disable;
    }
    interface lo0.0 {
      level 1 disable;
    }
  }
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking Interface-to-Area Associations on page 3208
- Verifying IS-IS Adjacencies on page 3208
- Examining the IS-IS Database on page 3209

Checking Interface-to-Area Associations

Purpose Make sure that the interface-to-area associations are configured as expected.

Action From operational mode, enter the **show isis interface** command.

```
user@R5> show isis interface
IS-IS interface database:
Interface           L CirID Level 1 DR        Level 2 DR        L1/L2 Metric
lo0.0               0   0x1 Disabled          Passive                 0/0
fe-1/2/0.0         2   0x3 Disabled          R5.03             10/10
fe-1/2/1.0         2   0x2 Disabled          R5.02             10/10
fe-1/2/0.0         1   0x1 R6.02         Disabled              10/10
fe-1/2/3.0         1   0x4 R5.04         Disabled              10/10
```

Meaning The output shows that Device R5's interfaces have been correctly configured with the ISO family, and that the interfaces have been placed into the correct levels.

You can also see that Device R5 has elected itself as the designated intermediate system (DIS) on its broadcast-capable IS-IS interfaces.

Verifying IS-IS Adjacencies

Purpose Verify that the expected adjacencies have formed between Device R5 and its IS-IS neighbors.

Action From operational mode, enter the **show isis adjacency detail** command.

```
user@R5> show isis adjacency detail
```



```
R3
  Interface: fe-1/2/0.0, Level: 2, State: Up, Expires in 25 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 03:19:31 ago
  Circuit type: 2, Speaks: IP, IPv6, MAC address: 0:5:85:8f:c8:bc
  Topologies: Unicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R5.03, IP addresses: 10.0.0.21

R4
  Interface: fe-1/2/1.0, Level: 2, State: Up, Expires in 24 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 03:19:36 ago
  Circuit type: 2, Speaks: IP, IPv6, MAC address: 0:5:85:8f:c8:bc
  Topologies: Unicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R5.02, IP addresses: 10.0.0.25

R6
  Interface: fe-1/2/0.0, Level: 1, State: Up, Expires in 6 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 03:20:24 ago
  Circuit type: 1, Speaks: IP, IPv6, MAC address: 0:5:85:8f:c8:bd
  Topologies: Unicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R6.02, IP addresses: 10.0.0.30

R7
  Interface: fe-1/2/3.0, Level: 1, State: Up, Expires in 21 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 03:19:29 ago
  Circuit type: 1, Speaks: IP, IPv6, MAC address: 0:5:85:8f:c8:bc
  Topologies: Unicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R5.04, IP addresses: 10.0.0.37
```

Meaning These results confirm that Device R5 has two Level 2 adjacencies and two Level 1 adjacencies.

Examining the IS-IS Database

Purpose Because Device R5 is a L1/L2 attached router, examine the Level 1 link-state database associated with area 49.002 to confirm that loopback addresses from backbone routers are not being advertised into the Level 1 area.

Action From operational mode, enter the **show isis database detail** command.

```
user@R5> show isis database detail
IS-IS level 1 link-state database:

R5.00-00 Sequence: 0x19, Checksum: 0x7488, Lifetime: 727 secs
   IS neighbor: R5.04                     Metric:       10
   IS neighbor: R6.02                     Metric:       10
   IP prefix: 10.0.0.28/30                    Metric:       10 Internal Up
   IP prefix: 10.0.0.36/30                    Metric:       10 Internal Up

R5.04-00 Sequence: 0x14, Checksum: 0x2668, Lifetime: 821 secs
   IS neighbor: R5.00                     Metric:        0
   IS neighbor: R7.00                     Metric:        0

R6.00-00 Sequence: 0x17, Checksum: 0xa65, Lifetime: 774 secs
   IS neighbor: R6.02                     Metric:       10
   IS neighbor: R7.02                     Metric:       10
```



```
   IP prefix: 10.0.0.28/30                    Metric:       10 Internal Up
   IP prefix: 10.0.0.32/30                    Metric:       10 Internal Up
   IP prefix: 192.168.0.6/32                  Metric:        0 Internal Up

R6.02-00 Sequence: 0x13, Checksum: 0xd1c0, Lifetime: 908 secs
   IS neighbor: R5.00                     Metric:        0
   IS neighbor: R6.00                     Metric:        0

R7.00-00 Sequence: 0x17, Checksum: 0xe39, Lifetime: 775 secs
   IS neighbor: R5.04                     Metric:       10
   IS neighbor: R7.02                     Metric:       10
   IP prefix: 10.0.0.32/30                    Metric:       10 Internal Up
   IP prefix: 10.0.0.36/30                    Metric:       10 Internal Up
   IP prefix: 192.168.0.7/32                  Metric:        0 Internal Up

R7.02-00 Sequence: 0x13, Checksum: 0x404d, Lifetime: 966 secs
   IS neighbor: R6.00                     Metric:        0
   IS neighbor: R7.00                     Metric:        0

IS-IS level 2 link-state database:

R3.00-00 Sequence: 0x17, Checksum: 0x5f84, Lifetime: 1085 secs
   IS neighbor: R4.02                     Metric:       10
   IS neighbor: R5.03                     Metric:       10
   IP prefix: 10.0.0.16/30                    Metric:       10 Internal Up
   IP prefix: 10.0.0.20/30                    Metric:       10 Internal Up
   IP prefix: 10.0.0.40/30                    Metric:       10 Internal Up
   IP prefix: 192.168.0.3/32                  Metric:        0 Internal Up

R4.00-00 Sequence: 0x17, Checksum: 0xab3a, Lifetime: 949 secs
   IS neighbor: R4.02                     Metric:       10
   IS neighbor: R5.02                     Metric:       10
   IP prefix: 10.0.0.16/30                    Metric:       10 Internal Up
   IP prefix: 10.0.0.24/30                    Metric:       10 Internal Up
   IP prefix: 192.168.0.4/32                  Metric:        0 Internal Up

R4.02-00 Sequence: 0x14, Checksum: 0xf2a8, Lifetime: 1022 secs
   IS neighbor: R3.00                     Metric:        0
   IS neighbor: R4.00                     Metric:        0

R5.00-00 Sequence: 0x1f, Checksum: 0x20d7, Lifetime: 821 secs
   IS neighbor: R5.02                     Metric:       10
   IS neighbor: R5.03                     Metric:       10
   IP prefix: 10.0.0.20/30                    Metric:       10 Internal Up
   IP prefix: 10.0.0.24/30                    Metric:       10 Internal Up
   IP prefix: 10.0.0.28/30                    Metric:       10 Internal Up
   IP prefix: 10.0.0.32/30                    Metric:       20 Internal Up
   IP prefix: 10.0.0.36/30                    Metric:       10 Internal Up
   IP prefix: 192.168.0.5/32                  Metric:        0 Internal Up
   IP prefix: 192.168.0.6/32                  Metric:       10 Internal Up
   IP prefix: 192.168.0.7/32                  Metric:       10 Internal Up

R5.02-00 Sequence: 0x14, Checksum: 0x6135, Lifetime: 977 secs
   IS neighbor: R4.00                     Metric:        0
   IS neighbor: R5.00                     Metric:        0

R5.03-00 Sequence: 0x14, Checksum: 0x1483, Lifetime: 1091 secs
   IS neighbor: R3.00                     Metric:        0
   IS neighbor: R5.00                     Metric:        0
```


Meaning This display indicates that Device R5's loopback interface is correctly configured to run Level 2 only. Had Level 1 operation been enabled on lo0.0, Device R5 would have then included its loopback address in its Level 1 link-state PDU.

You can also see that Device R5 has Level 2 link-state PDUs, received from its adjacent neighbors.

Like an OSPF totally stubby area, no backbone (Level 2) or external prefixes are leaked into a Level 1 area, by default. Level 1 prefixes are leaked up into the IS-IS backbone, however, as can be seen in Device R5's Level 2 link-state PDU.

Related Documentation

- *Understanding IS-IS Areas*

Example: Configuring Hitless Authentication Key Rollover for IS-IS

This example shows how to configure hitless authentication key rollover for IS-IS.

Requirements

No special configuration beyond device initialization is required before configuring hitless authentication key rollover for IS-IS.

Overview

Authentication guarantees that only trusted routers participate in routing updates. This keychain authentication method is referred to as hitless because the keys roll over from one to the next without resetting any peering sessions or interrupting the routing protocol. Junos OS supports both RFC 5304, *IS-IS Cryptographic Authentication* and RFC 5310, *IS-IS Generic Cryptographic Authentication*.

This example includes the following statements for configuring the keychain:

- **algorithm**—For each key in the keychain, you can specify an encryption algorithm. The algorithm can be SHA-1 or MD-5.
- **key**—A keychain can have multiple keys. Each key within a keychain must be identified by a unique integer value. The range of valid identifier values is from 0 through 63.
- **key-chain**—For each keychain, you must specify a name. This example defines two keychains: **base-key-global** and **base-key-inter**.
- **options**—For each key in the keychain, you can specify the encoding for the message authentication code:**isis-enhanced** or **basic**. The basic (RFC 5304) operation is enabled by default.

When you configure the **isis-enhanced** option, Junos OS sends RFC 5310-encoded routing protocol packets and accepts both RFC 5304-encoded and RFC 5310-encoded routing protocol packets that are received from other devices.

When you configure **basic** (or do not include the **options** statement in the key configuration), Junos OS sends and receives RFC 5304-encoded routing protocols packets, and drops 5310-encoded routing protocol packets that are received from other devices.

Because this setting is for IS-IS only, the TCP and the BFD protocols ignore the encoding option configured in the key.

- **secret**—For each key in the keychain, you must set a secret password. This password can be entered in either encrypted or plain text format in the **secret** statement. It is always displayed in encrypted format.
- **start-time**—Each key must specify a start time in UTC format. Control gets passed from one key to the next. When a configured start time arrives (based on the routing device's clock), the key with that start time becomes active. Start times are specified in the local time zone for a routing device and must be unique within the key chain.

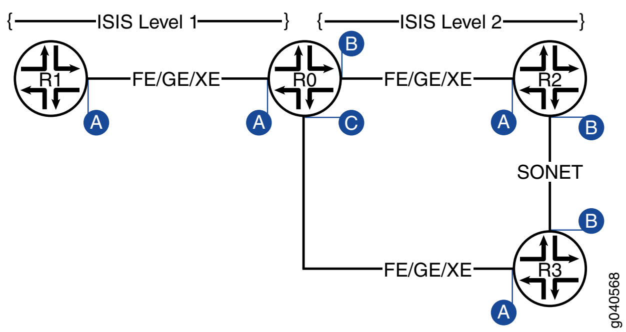
You can apply a keychain globally to all interfaces or more granularly to specific interfaces.

This example includes the following statements for applying the keychain to all interfaces or to particular interfaces:

- **authentication-key-chain**—Enables you to apply a keychain at the global IS-IS level for all Level 1 or all Level 2 interfaces.
- **hello-authentication-key-chain**—Enables you to apply a keychain at the individual IS-IS interface level. The interface configuration overrides the global configuration.

Figure 78 on page 3212 shows the topology used in the example.

Figure 78: Hitless Authentication Key Rollover for IS-IS



This example shows the configuration for Router R0.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set interfaces ge-0/0/0 unit 0 description "interface A"
set interfaces ge-0/0/0 unit 0 family inet address 10.0.0.1/30
set interfaces ge-0/0/0 unit 0 family iso
set interfaces ge-0/0/0 unit 0 family inet6 address fe80::200:f8ff:fe21:67cf/128
set interfaces ge-0/0/1 unit 0 description "interface B"
set interfaces ge-0/0/1 unit 0 family inet address 10.0.0.5/30
set interfaces ge-0/0/1 unit 0 family iso
set interfaces ge-0/0/1 unit 0 family inet6 address 10FB::C:ABC:1F0C:44DA/128
set interfaces ge-0/0/2 unit 0 description "interface C"
set interfaces ge-0/0/2 unit 0 family inet address 10.0.0.9/30
set interfaces ge-0/0/2 unit 0 family iso
set interfaces ge-0/0/2 unit 0 family inet6 address ff06::c3/128
set security authentication-key-chains key-chain base-key-global key 63 secret
  "$9$jfkqfTQnCpBDiCt"
set security authentication-key-chains key-chain base-key-global key 63 start-time
  "2011-8-6.06:54:00-0700"
set security authentication-key-chains key-chain base-key-global key 63 algorithm
  hmac-sha-1
set security authentication-key-chains key-chain base-key-global key 63 options
  isis-enhanced
set security authentication-key-chains key-chain base-key-inter key 0 secret
  "$9$8sgx7Vws4ZDkWLGD"
set security authentication-key-chains key-chain base-key-inter key 0 start-time
  "2011-8-6.06:54:00-0700"
set security authentication-key-chains key-chain base-key-inter key 0 algorithm md5
set security authentication-key-chains key-chain base-key-inter key 0 options basic
set protocols isis level 1 authentication-key-chain base-key-global
set protocols isis interface ge-0/0/0.0 level 1 hello-authentication-key-chain
  base-key-inter
```

Step-by-Step Procedure

To configure hitless authentication key rollover for IS-IS:

1. Configure the Router R0 interfaces.

```
[edit interfaces ge-0/0/0 unit 0]
user@R0# set description "interface A"
user@R0# set family inet address 10.0.0.1/30
user@R0# set family iso
user@R0# set family inet6 address fe80::200:f8ff:fe21:67cf/128
[edit interfaces ge-0/0/1 unit 0]
user@R0# set interfaces ge-0/0/1 unit 0 description "interface B"
user@R0# set interfaces ge-0/0/1 unit 0 family inet address 10.0.0.5/30
user@R0# set interfaces ge-0/0/1 unit 0 family iso
user@R0# set interfaces ge-0/0/1 unit 0 family inet6 address
  10FB::C:ABC:1F0C:44DA/128
[edit interfaces ge-0/0/2 unit 0]
user@R0# set description "interface C"
user@R0# set family inet address 10.0.0.9/30
user@R0# set interfaces ge-0/0/2 unit 0 family iso
user@R0# set interfaces ge-0/0/2 unit 0 family inet6 address ff06::c3/128
```

2. Configure one or more authentication keys.

```
[edit security authentication-key-chains key-chain base-key-global]
user@R0# set key 63 secret "$9$jfkqfTQnCpBDiCt"
user@R0# set key 63 start-time "2011-8-6.06:54:00-0700"
```

```
user@R0# set key 63 algorithm hmac-sha-1
user@R0# set key 63 options isis-enhanced
[edit security authentication-key-chains key-chain base-key-inter]
user@R0# set key 0 secret "$9$8sgx7Vws4ZDkWLGD"
user@R0# set key 0 start-time "2011-8-6.06:54:00-0700"
user@R0# set key 0 algorithm md5
user@R0# set key 0 options basic
```

3. Apply the base-key-global keychain to all Level 1 IS-IS interfaces on Router R0.

```
[edit protocols isis level 1]
user@R0# set authentication-key-chain base-key-global
```

4. Apply the base-key-inter keychain to the ge-0/0/0.0 interface on Router R0.

```
[edit protocols isis interface ge-0/0/0.0 level 1]
user@R0# set hello-authentication-key-chain base-key-inter
```

5. If you are done configuring the device, commit the configuration.

```
user@R0# commit
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show security** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R0# show interfaces
ge-0/0/0 {
   unit 0 {
      description "interface A";
      family inet {
         address 10.0.0.1/30;
      }
      family iso;
      family inet6 {
         address fe80::200:f8ff:fe21:67cf/128;
      }
   }
}
ge-0/0/1 {
   unit 0 {
      description "interface B";
      family inet {
         address 10.0.0.5/30;
      }
      family iso;
      family inet6 {
         address 10FB::C:ABC:1F0C:44DA/128;
      }
   }
}
ge-0/0/2 {
   unit 0 {
      description "interface C";
      family inet {
```



```
        address 10.0.0.9/30;
      }
      family iso;
      family inet6 {
        address ff06::c3/128;
      }
    }
  }
```

```
user@R0# show protocols
isis {
  level 1 authentication-key-chain base-key-global;
  interface ge-0/0/0.0 {
    level 1 hello-authentication-key-chain base-key-inter;
  }
}
```

```
user@R0# show security
authentication-key-chains {
  key-chain base-key-global {
    key 63 {
      secret "$9$jfkqfTQnCpBDiCt"; ## SECRET-DATA
      start-time "2011-8-6.06:54:00-0700";
      algorithm hmac-sha-1;
      options isis-enhanced;
    }
  }
  key-chain base-key-inter {
    key 0 {
      secret "$9$8sgx7Vws4ZDkWLGD"; ## SECRET-DATA
      start-time "2011-8-6.06:54:00-0700";
      algorithm md5;
      options basic;
    }
  }
}
```

Verification

To verify the configuration, run the following commands:

- show isis authentication
- **show security keychain**

Related Documentation

- Understanding Hitless Authentication Key Rollover for IS-IS on page 3195

Example: Redistributing OSPF Routes into IS-IS

This example shows how to redistribute OSPF routes into an IS-IS network.

- Requirements on page 3216
- Overview on page 3216

- Configuration on page 3217
- Verification on page 3222

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

Export policy can be applied to IS-IS to facilitate route redistribution.

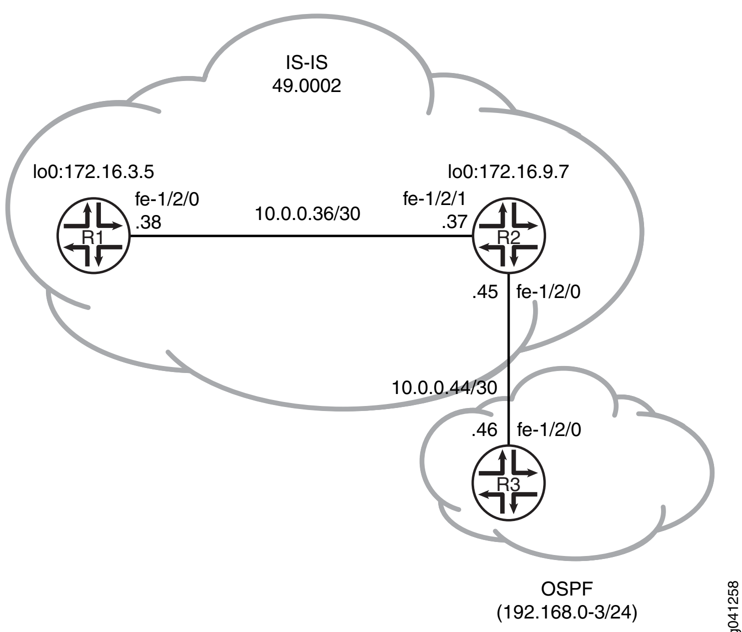
Junos OS does not support the application of import policy for link-state routing protocols like IS-IS because such policies can lead to inconsistent link-state database (LSDB) entries, which in turn can result in routing inconstancies.

In this example, OSPF routes 192.168.0/24 through 192.168.3/24 are redistributed into IS-IS area 49.0002 from Device R2.

In addition, policies are configured to ensure that Device R1 can reach destinations on the 10.0.0.44/30 network, and that Device R3 can reach destinations on the 10.0.0.36/30 network. This enables end-to-end reachability.

Figure 79 on page 3216 shows the topology used in this example.

Figure 79: IS-IS Route Redistribution Topology



"CLI Quick Configuration" on page 3217 shows the configuration for all of the devices in Figure 79 on page 3216. The section "Step-by-Step Procedure" on page 3218 describes the steps on Device R2. "Step-by-Step Procedure" on page 3219 describes the steps on Device R3.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 0 description to-R7
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.38/30
set interfaces fe-1/2/0 unit 0 family iso
set interfaces lo0 unit 0 family inet address 172.16.3.5/32
set interfaces lo0 unit 0 family iso address 49.0002.0172.0016.0305.00
set protocols isis interface fe-1/2/0.38
set protocols isis interface lo0.0
```

Device R2

```
set interfaces fe-1/2/1 unit 0 description to-R5
set interfaces fe-1/2/1 unit 0 family inet address 10.0.0.37/30
set interfaces fe-1/2/1 unit 0 family iso
set interfaces fe-1/2/0 unit 0 description to-OSPF-network
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.45/30
set interfaces lo0 unit 0 family inet address 172.16.9.7/32
set interfaces lo0 unit 0 family iso address 49.0002.0172.0016.0907.00
set protocols isis export ospf-isis
set protocols isis export send-direct-to-isis-neighbors
set protocols isis interface fe-1/2/1.0
set protocols isis interface lo0.0
set protocols ospf export send-direct-to-ospf-neighbors
set protocols ospf area 0.0.0.1 interface fe-1/2/0.0
set protocols ospf area 0.0.0.1 interface lo0.0 passive
set policy-options policy-statement ospf-isis term 1 from protocol ospf
set policy-options policy-statement ospf-isis term 1 from route-filter 192.168.0.0/22
  longer
set policy-options policy-statement ospf-isis term 1 then accept
set policy-options policy-statement send-direct-to-isis-neighbors from protocol direct
set policy-options policy-statement send-direct-to-isis-neighbors from route-filter
  10.0.0.44/30 exact
set policy-options policy-statement send-direct-to-isis-neighbors then accept
set policy-options policy-statement send-direct-to-ospf-neighbors from protocol direct
set policy-options policy-statement send-direct-to-ospf-neighbors from route-filter
  10.0.0.36/30 exact
set policy-options policy-statement send-direct-to-ospf-neighbors then accept
```

Device R3

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.46/30
set interfaces lo0 unit 0 family inet address 192.168.1.1/32
set interfaces lo0 unit 0 family inet address 192.168.2.1/32
set interfaces lo0 unit 0 family inet address 192.168.3.1/32
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set protocols ospf export ospf
set protocols ospf area 0.0.0.1 interface fe-1/2/0.0
set protocols ospf area 0.0.0.1 interface lo0.0 passive
set policy-options policy-statement ospf term 1 from protocol static
set policy-options policy-statement ospf term 1 then accept
set routing-options static route 192.168.0.0/24 discard
set routing-options static route 192.168.1.0/24 discard
set routing-options static route 192.168.3.0/24 discard
```

set routing-options static route 192.168.2.0/24 discard

Step-by-Step Procedure

To configure Device R2:

1. Configure the network interfaces.

```
[edit interfaces]
user@R2# set fe-1/2/1 unit 0 description to-R5
user@R2# set fe-1/2/1 unit 0 family inet address 10.0.0.37/30
user@R2# set fe-1/2/1 unit 0 family iso
user@R2# set fe-1/2/0 unit 0 description to-OSPF-network
user@R2# set fe-1/2/0 unit 0 family inet address 10.0.0.45/30
user@R2# set lo0 unit 0 family inet address 172.16.9.7/32
user@R2# set lo0 unit 0 family iso address 49.0002.0172.0016.0907.00
```

2. Configure IS-IS on the interface facing Device R1 and the loopback interface.

```
[edit protocols isis]
user@R2# set interface fe-1/2/1.0
user@R2# set interface lo0.0
```

3. Configure the policy that enables Device R1 to reach the 10.0.0.44/30 network.

```
[edit policy-options policy-statement send-direct-to-isis-neighbors]
user@R2# set from protocol direct
user@R2# set from route-filter 10.0.0.44/30 exact
user@R2# set then accept
```

4. Apply the policy that enables Device R1 to reach the 10.0.0.44/30 network.

```
[edit protocols isis]
user@R2# set export send-direct-to-isis-neighbors
```

5. Configure OSPF on the interfaces.

```
[edit protocols ospf]
user@R2# set area 0.0.0.1 interface fe-1/2/0.0
user@R2# set area 0.0.0.1 interface lo0.0 passive
```

6. Configure the OSPF route redistribution policy.

```
[edit policy-options policy-statement ospf-isis term 1]
user@R2# set from protocol ospf
user@R2# set from route-filter 192.168.0.0/22 longer
user@R2# set then accept
```

7. Apply the OSPF route redistribution policy to the IS-IS instance.

```
[edit protocols isis]
user@R2# set export ospf-isis
```

8. Configure the policy that enables Device R3 to reach the 10.0.0.36/30 network.

```
[edit policy-options policy-statement send-direct-to-ospf-neighbors]
user@R2# set from protocol direct
user@R2# set from route-filter 10.0.0.36/30 exact
user@R2# set then accept
```

9. Apply the policy that enables Device R3 to reach the 10.0.0.36/30 network.

```
[edit protocols ospf]
user@R2# set export send-direct-to-ospf-neighbors
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure multi-level IS-IS:

1. Configure the network interfaces.

   Multiple addresses are configured on the loopback interface to simulate multiple route destinations.

   ```
   [edit interfaces]
   user@R3# set fe-1/2/0 unit 0 family inet address 10.0.0.46/30
   user@R3# set lo0 unit 0 family inet address 192.168.1.1/32
   user@R3# set lo0 unit 0 family inet address 192.168.2.1/32
   user@R3# set lo0 unit 0 family inet address 192.168.3.1/32
   user@R3# set lo0 unit 0 family inet address 192.168.0.1/32
   ```

2. Configure static routes to the loopback interface addresses.

   These are the routes that are redistributed into IS-IS.

   ```
   [edit routing-options static]
   user@R3# set route 192.168.0.0/24 discard
   user@R3# set route 192.168.1.0/24 discard
   user@R3# set route 192.168.3.0/24 discard
   user@R3# set route 192.168.2.0/24 discard
   ```

3. Configure OSPF on the interfaces.

   ```
   [edit protocols ospf area 0.0.0.1]
   user@R3# set interface fe-1/2/0.0
   user@R3# set interface lo0.0 passive
   ```

4. Configure the OSPF policy to export the static routes.

   ```
   [edit policy-options policy-statement ospf term 1]
   user@R3# set from protocol static
   user@R3# set then accept
   ```

5. Apply the OSPF export policy.

   ```
   [edit protocols ospf]
   user@R3# set export ospf
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Device R2

```
user@R2# show interfaces
fe-1/2/1 {
  unit 0 {
    description to-R5;
    family inet {
      address 10.0.0.37/30;
    }
    family iso;
  }
```

```
    }
    fe-1/2/0 {
        unit 0 {
            description to-OSPF-network;
            family inet {
                address 10.0.0.45/30;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 172.16.9.7/32;
            }
            family iso {
                address 49.0002.0172.0016.0907.00;
            }
        }
    }

user@R2# show protocols
isis {
    export [ ospf-isis send-direct-to-isis-neighbors ];
    interface fe-1/2/1.0;
    interface lo0.0;
}
ospf {
    export send-direct-to-ospf-neighbors;
    area 0.0.0.1 {
        interface fe-1/2/0.0;
        interface lo0.0 {
            passive;
        }
    }
}

user@R2# show policy-options
policy-statement ospf-isis {
    term 1 {
        from {
            protocol ospf;
            route-filter 192.168.0.0/22 longer;
        }
        then accept;
    }
}
policy-statement send-direct-to-isis-neighbors {
    from {
        protocol direct;
        route-filter 10.0.0.44/30 exact;
    }
    then accept;
}
policy-statement send-direct-to-ospf-neighbors {
    from {
        protocol direct;
```

```
    route-filter 10.0.0.36/30 exact;
  }
  then accept;
}
```

Device R3

```
user@R3# show interfaces
fe-1/2/0 {
  unit 0 {
    family inet {
      address 10.0.0.46/30;
    }
  }
}
lo0 {
  unit 0 {
    family inet {
      address 192.168.1.1/32;
      address 192.168.2.1/32;
      address 192.168.3.1/32;
      address 192.168.0.1/32;
    }
  }
}

user@R3# show protocols
ospf {
  export ospf;
  area 0.0.0.1 {
    interface fe-1/2/0.0;
    interface lo0.0 {
      passive;
    }
  }
}

user@R3# show policy-options
policy-statement ospf {
  term 1 {
    from protocol static;
    then accept;
  }
}

user@R3# show routing-options
static {
  route 192.168.0.0/24 discard;
  route 192.168.1.0/24 discard;
  route 192.168.3.0/24 discard;
  route 192.168.2.0/24 discard;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying OSPF Route Advertisement on page 3222
- Verifying Route Redistribution on page 3222
- Verifying Connectivity on page 3223

Verifying OSPF Route Advertisement

Purpose Make sure that the expected routes are advertised by OSPF.

Action From operational mode on Device R2, enter the **show route protocol ospf** command.

```
user@R2> show route protocol ospf

inet.0: 15 destinations, 15 routes (15 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.0.0/24     *[OSPF/150] 03:54:21, metric 0, tag 0
                    > to 10.0.0.46 via fe-1/2/0.0
192.168.0.1/32     *[OSPF/10] 03:54:21, metric 1
                    > to 10.0.0.46 via fe-1/2/0.0
192.168.1.0/24     *[OSPF/150] 03:54:21, metric 0, tag 0
                    > to 10.0.0.46 via fe-1/2/0.0
192.168.1.1/32     *[OSPF/10] 03:54:21, metric 1
                    > to 10.0.0.46 via fe-1/2/0.0
192.168.2.0/24     *[OSPF/150] 03:54:21, metric 0, tag 0
                    > to 10.0.0.46 via fe-1/2/0.0
192.168.2.1/32     *[OSPF/10] 03:54:21, metric 1
                    > to 10.0.0.46 via fe-1/2/0.0
192.168.3.0/24     *[OSPF/150] 03:54:21, metric 0, tag 0
                    > to 10.0.0.46 via fe-1/2/0.0
192.168.3.1/32     *[OSPF/10] 03:54:21, metric 1
                    > to 10.0.0.46 via fe-1/2/0.0
224.0.0.5/32       *[OSPF/10] 03:56:03, metric 1
                         MultiRecv

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

Meaning The 192.168/16 routes are advertised by OSPF.

Verifying Route Redistribution

Purpose Make sure that the expected routes are redistributed from OSPF into IS-IS.

Action From operational mode on Device R1, enter the **show route protocol isis** command.

```
user@R1> show route protocol isis

inet.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.44/30       *[IS-IS/160] 03:45:24, metric 20
                    > to 10.0.0.37 via fe-1/2/0.0
```



```
172.16.9.7/32      *[IS-IS/15] 03:49:46, metric 10
                    > to 10.0.0.37 via fe-1/2/0.0
192.168.0.0/24     *[IS-IS/160] 03:49:46, metric 10
                    > to 10.0.0.37 via fe-1/2/0.0
192.168.0.1/32     *[IS-IS/160] 03:49:46, metric 11, tag2 1
                    > to 10.0.0.37 via fe-1/2/0.0
192.168.1.0/24     *[IS-IS/160] 03:49:46, metric 10
                    > to 10.0.0.37 via fe-1/2/0.0
192.168.1.1/32     *[IS-IS/160] 03:49:46, metric 11, tag2 1
                    > to 10.0.0.37 via fe-1/2/0.0
192.168.2.0/24     *[IS-IS/160] 03:49:46, metric 10
                    > to 10.0.0.37 via fe-1/2/0.0
192.168.2.1/32     *[IS-IS/160] 03:49:46, metric 11, tag2 1
                    > to 10.0.0.37 via fe-1/2/0.0
192.168.3.0/24     *[IS-IS/160] 03:49:46, metric 10
                    > to 10.0.0.37 via fe-1/2/0.0
192.168.3.1/32     *[IS-IS/160] 03:49:46, metric 11, tag2 1
                    > to 10.0.0.37 via fe-1/2/0.0

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

Meaning The 192.168/16 routes are redistributed into IS-IS.

Verifying Connectivity

Purpose Check that Device R1 can reach the destinations on Device R3.

Action From operational mode, enter the **ping** command.

```
user@R1> ping 192.168.1.1
PING 192.168.1.1 (192.168.1.1): 56 data bytes
64 bytes from 192.168.1.1: icmp_seq=0 ttl=63 time=2.089 ms
64 bytes from 192.168.1.1: icmp_seq=1 ttl=63 time=1.270 ms
64 bytes from 192.168.1.1: icmp_seq=2 ttl=63 time=2.135 ms
```

Meaning These results confirm that Device R1 can reach the destinations in the OSPF network.

Related Documentation

- *Understanding Routing Policies*

Example: Configuring BFD for IS-IS

This example describes how to configure the Bidirectional Forwarding Detection (BFD) protocol to detect failures in an IS-IS network.

Requirements

Before you begin, configure IS-IS on both routers. See “Example: Configuring IS-IS” on page 3197 for information about the required IS-IS configuration.

This example uses the following hardware and software components:

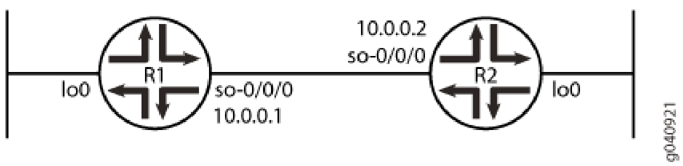
- Junos OS Release 7.3 or later
- M Series, MX Series, and T Series routers

Overview

This example shows two routers connected to each other. A loopback interface is configured on each router. IS-IS and BFD protocols are configured on both routers.

Figure 80 on page 3224 shows the sample network.

Figure 80: Configuring BFD for IS-IS



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Router R1

```
set protocols isis interface so-0/0/0 bfd-liveness-detection detection-time threshold 5
set protocols isis interface so-0/0/0 bfd-liveness-detection minimum-interval 2
set protocols isis interface so-0/0/0 bfd-liveness-detection minimum-receive-interval 1
set protocols isis interface so-0/0/0 bfd-liveness-detection no-adaptation
set protocols isis interface so-0/0/0 bfd-liveness-detection transmit-interval threshold 3
set protocols isis interface so-0/0/0 bfd-liveness-detection transmit-interval
  minimum-interval 1
set protocols isis interface so-0/0/0 bfd-liveness-detection multiplier 2
set protocols isis interface so-0/0/0 bfd-liveness-detection version automatic
```

Router R2

```
set protocols isis interface so-0/0/0 bfd-liveness-detection detection-time threshold 6
set protocols isis interface so-0/0/0 bfd-liveness-detection minimum-interval 3
set protocols isis interface so-0/0/0 bfd-liveness-detection minimum-receive-interval 1
set protocols isis interface so-0/0/0 bfd-liveness-detection no-adaptation
set protocols isis interface so-0/0/0 bfd-liveness-detection transmit-interval threshold 4
set protocols isis interface so-0/0/0 bfd-liveness-detection transmit-interval
  minimum-interval 1
set protocols isis interface so-0/0/0 bfd-liveness-detection multiplier 2
set protocols isis interface so-0/0/0 bfd-liveness-detection version automatic
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode*.

NOTE: To simply configure BFD for IS-IS, only the **minimum-interval** statement is required. The BFD protocol selects default parameters for all the other configuration statements when you use the **bfd-liveness-detection** statement without specifying any parameters.

NOTE: You can change parameters at any time without stopping or restarting the existing session. BFD automatically adjusts to the new parameter value. However, no changes to BFD parameters take place until the values resynchronize with each BFD peer.

To configure BFD for IS-IS on Routers R1 and R2:

1. Enable BFD failure detection for IS-IS.

```
[edit protocols isis]
user@R1# set interface so-0/0/0 bfd-liveness-detection
```

```
[edit protocols isis]
user@R2# set interface so-0/0/0 bfd-liveness-detection
```

2. Configure the threshold for the adaptation of the detection time, which must be greater than the multiplier number multiplied by the minimum interval.

```
[edit protocols isis interface so-0/0/0 bfd-liveness-detection]
user@R1# set detection-time threshold 5
```

```
[edit protocols isis interface so-0/0/0 bfd-liveness-detection]
user@R2# set detection-time threshold 6
```

3. Configure the minimum transmit and receive intervals for failure detection.

```
[edit protocols isis interface so-0/0/0 bfd-liveness-detection]
user@R1# set minimum-interval 2
```

```
[edit protocols isis interface so-0/0/0 bfd-liveness-detection]
user@R2# set minimum-interval 3
```

4. Configure only the minimum receive interval for failure detection.

```
[edit protocols isis interface so-0/0/0 bfd-liveness-detection]
user@R1# set minimum-receive-interval 1
```

```
[edit protocols isis interface so-0/0/0 bfd-liveness-detection]
user@R2# set minimum-receive-interval 1
```

5. Disable BFD adaptation.

```
[edit protocols isis interface so-0/0/0 bfd-liveness-detection]
user@R1# set no-adaptation
```

[edit protocols isis interface so-0/0/0 bfd-liveness-detection]
user@R2# **set no-adaptation**

6. Configure the threshold for the transmit interval, which must be greater than the minimum transmit interval.

   [edit protocols isis interface so-0/0/0 bfd-liveness-detection]
   user@R1# **set transmit-interval threshold 3**

   [edit protocols isis interface so-0/0/0 bfd-liveness-detection]
   user@R2# **set transmit-interval threshold 4**

7. Configure the minimum transmit interval for failure detection.

   [edit protocols isis interface so-0/0/0 bfd-liveness-detection]
   user@R1# **set transmit-interval minimum-interval 1**

   [edit protocols isis interface so-0/0/0 bfd-liveness-detection]
   user@R2# **set transmit-interval minimum-interval 1**

8. Configure the multiplier number, which is the number of hello packets not received by the neighbor that causes the originating interface to be declared down.

   [edit protocols isis interface so-0/0/0 bfd-liveness-detection]
   user@R1# **set multiplier 2**

   [edit protocols isis interface so-0/0/0 bfd-liveness-detection]
   user@R2# **set multiplier 2**

9. Configure the BFD version used for detection.

   The default is to have the version detected automatically.

   [edit protocols isis interface so-0/0/0 bfd-liveness-detection]
   user@R1# **set version automatic**

   [edit protocols isis interface so-0/0/0 bfd-liveness-detection]
   user@R2# **set version automatic**

Results

From configuration mode, confirm your configuration by issuing the **show protocols isis interface** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

`user@R1#` **show protocols isis interface so-0/0/0**

```
    bfd-liveness-detection {
        version automatic;
        minimum-interval 2;
        minimum-receive-interval 1;
        multiplier 2;
        no-adaptation;
        transmit-interval {
            minimum-interval 1;
            threshold 3;
        }
        detection-time {
            threshold 5;
        }
}
...
```



```
user@R2# show protocols isis interface so-0/0/0

    bfd-liveness-detection {
        version automatic;
        minimum-interval 3;
        minimum-receive-interval 1;
        multiplier 2;
        no-adaptation;
        transmit-interval {
            minimum-interval 1;
            threshold 4;
        }
        detection-time {
            threshold 6;
        }
}
...
```

Verification

Confirm that the configuration is working properly.

Verifying the Connection Between Routers R1 and R2

Purpose Make sure that Routers R1 and R2 are connected to each other.

Action Ping the other router to check the connectivity between the two routers as per the network topology.

```
user@R1> ping 10.0.0.2

PING 10.0.0.2 (10.0.0.2): 56 data bytes
64 bytes from 10.0.0.2: icmp_seq=0 ttl=64 time=1.367 ms
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=1.662 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=1.291 ms
^C
--- 10.0.0.2 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.291/1.440/1.662/0.160 ms
```

```
user@R2> ping 10.0.0.1

PING 10.0.0.1 (10.0.0.1): 56 data bytes
64 bytes from 10.0.0.1: icmp_seq=0 ttl=64 time=1.287 ms
64 bytes from 10.0.0.1: icmp_seq=1 ttl=64 time=1.310 ms
64 bytes from 10.0.0.1: icmp_seq=2 ttl=64 time=1.289 ms
^C
--- 10.0.0.1 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.287/1.295/1.310/0.010 ms
```

Meaning Routers R1 and R2 are connected to each other.

Verifying That IS-IS Is Configured

Purpose Make sure that the IS-IS instance is running on both routers.

Action Use the **show isis database** statement to check if the IS-IS instance is running on both routers, R1 and R2.

```
user@R1> show isis database

IS-IS level 1 link-state database:
LSP ID         Sequence Checksum Lifetime Attributes
R1.00-00       0x4a571   0x30c5     1195 L1 L2
R2.00-00       0x4a586   0x4b7e     1195 L1 L2
R2.02-00       0x330ca1  0x3492     1196 L1 L2
  3 LSPs

IS-IS level 2 link-state database:
LSP ID         Sequence Checksum Lifetime Attributes
R1.00-00       0x4a856   0x5db0     1194 L1 L2
R2.00-00       0x4a89d   0x149b     1194 L1 L2
R2.02-00       0x1fb2ff  0xd302     1194 L1 L2
  3 LSPs
```

```
user@R2> show isis database

IS-IS level 1 link-state database:
LSP ID            Sequence Checksum Lifetime Attributes
R1.00-00          0x4b707   0xcc80     1195 L1 L2
R2.00-00          0x4b71b   0xeb37     1198 L1 L2
R2.02-00          0x33c2ce  0xb52d     1198 L1 L2
  3 LSPs

IS-IS level 2 link-state database:
LSP ID             Sequence Checksum Lifetime Attributes
R1.00-00           0x4b9f2   0xee70     1192 L1 L2
R2.00-00           0x4ba41   0x9862     1197 L1 L2
R2.02-00               0x3   0x6242     1198 L1 L2
  3 LSPs
```

Meaning IS-IS is configured on both routers, R1 and R2.

Verifying That BFD Is configured

Purpose Make sure that the BFD instance is running on both routers, R1 and R2.

Action Use the **show bfd session detail** statement to check if BFD instance is running on the routers.

```
user@R1> show bfd session detail
                                                   Detect   Transmit
Address                 State     Interface      Time     Interval  Multiplier
10.0.0.2                Up        so-0/0/0     2.000     1.000       2
 Client ISIS R2, TX interval 0.001, RX interval 0.001
 Client ISIS R1, TX interval 0.001, RX interval 0.001
 Session down time 00:00:00, previous up time 00:00:15
 Local diagnostic NbrSignal, remote diagnostic NbrSignal
 Remote state AdminDown, version 1
 Router 3, routing table index 17
```



```
1 sessions, 2 clients
Cumulative transmit rate 1.0 pps, cumulative receive rate 1.0 pps
```

```
user@R2> show bfd session detail
                                                  Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
10.0.0.1                 Up        so-0/0/0     2.000     1.000        2
 Client ISIS R2, TX interval 0.001, RX interval 0.001
 Session down time 00:00:00, previous up time 00:00:05
 Local diagnostic NbrSignal, remote diagnostic NbrSignal
 Remote state AdminDown, version 1
 Router 2, routing table index 15

1 sessions, 1 clients
Cumulative transmit rate 1.0 pps, cumulative receive rate 1.0 pps
```

Meaning BFD is configured on Routers R1 and R2 for detecting failures in the IS-IS network.

Related Documentation

- *Understanding BFD for IS-IS*

Example: Configuring BFD Authentication for IS-IS

This example shows how to configure BFD authentication for IS-IS.

Requirements

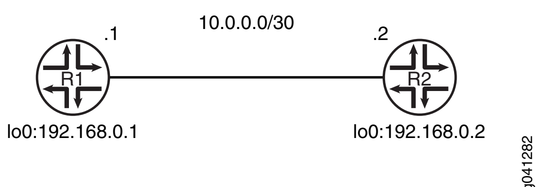
Before you begin, configure IS-IS on both routers. See “Example: Configuring IS-IS” on page 3197 for information about the required IS-IS configuration.

Overview

In this example, a BFD authentication keychain is configured with meticulous keyed MD5 authentication.

Figure 81 on page 3229 shows the topology used in this example.

Figure 81: IS-IS BFD Authentication Topology



“CLI Quick Configuration” on page 3230 shows the configuration for both of the devices in Figure 81 on page 3229. The section “Step-by-Step Procedure” on page 3230 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set security authentication-key-chains key-chain secret123 description for-isis-bfd
set security authentication-key-chains key-chain secret123 key 1 secret "$9$cW-yrv"
set security authentication-key-chains key-chain secret123 key 1 start-time
  "2012-5-31.13:00:00 -0700"
set security authentication-key-chains key-chain secret123 key 2 secret "$9$m5T3"
set security authentication-key-chains key-chain secret123 key 2 start-time
  "2013-5-31.13:00:00 -0700"
set security authentication-key-chains key-chain secret123 key 3 secret "$9$mTQn"
set security authentication-key-chains key-chain secret123 key 3 start-time
  "2014-5-31.13:00:00 -0700"
set protocols isis interface ge-1/2/0.0 bfd-liveness-detection minimum-interval 100
set protocols isis interface ge-1/2/0.0 bfd-liveness-detection authentication key-chain
  secret123
set protocols isis interface ge-1/2/0.0 bfd-liveness-detection authentication algorithm
  meticulous-keyed-md5
```

Device R2

```
set security authentication-key-chains key-chain secret123 description for-isis-bfd
set security authentication-key-chains key-chain secret123 key 1 secret "$9$cW-yrv"
set security authentication-key-chains key-chain secret123 key 1 start-time
  "2012-5-31.13:00:00 -0700"
set security authentication-key-chains key-chain secret123 key 2 secret "$9$m5T3"
set security authentication-key-chains key-chain secret123 key 2 start-time
  "2013-5-31.13:00:00 -0700"
set security authentication-key-chains key-chain secret123 key 3 secret "$9$mTQn"
set security authentication-key-chains key-chain secret123 key 3 start-time
  "2014-5-31.13:00:00 -0700"
set protocols isis interface ge-1/2/0.0 bfd-liveness-detection minimum-interval 100
set protocols isis interface ge-1/2/0.0 bfd-liveness-detection authentication key-chain
  secret123
set protocols isis interface ge-1/2/0.0 bfd-liveness-detection authentication algorithm
  meticulous-keyed-md5
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure IS-IS BFD authentication:

1. Configure the authentication keychain.

```
[edit security authentication-key-chains key-chain secret123]
user@R1# set description for-isis-bfd
user@R1# set key 1 secret "$9$cW-yrv"
user@R1# set key 1 start-time "2012-5-31.13:00:00 -0700"
user@R1# set key 2 secret "$9$m5T3"
user@R1# set key 2 start-time "2013-5-31.13:00:00 -0700"
user@R1# set key 3 secret "$9$mTQn"
user@R1# set key 3 start-time "2014-5-31.13:00:00 -0700"
```


2. Enable BFD.

   ```
   [edit protocols isis interface ge-1/2/0.0 bfd-liveness-detection]
   user@R1# set minimum-interval 100
   ```

3. Apply the authentication keychain.

   ```
   [edit protocols isis interface ge-1/2/0.0 bfd-liveness-detection]
   user@R1# set authentication key-chain secret123
   ```

4. Set the authentication type.

   ```
   [edit protocols isis interface ge-1/2/0.0 bfd-liveness-detection]
   user@R1# set authentication algorithm meticulous-keyed-md5
   ```

Results From configuration mode, confirm your configuration by entering the **show protocols** and **show security** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show protocols
isis {
  interface ge-1/2/0.0 {
    bfd-liveness-detection {
      minimum-interval 100;
      authentication {
        key-chain secret123;
        algorithm meticulous-keyed-md5;
      }
    }
  }
}
```

```
user@R1# show security
authentication-key-chains {
  key-chain secret123 {
    description for-isis-bfd;
    key 1 {
      secret "$9$cW-yrv"; ## SECRET-DATA
      start-time "2012-5-31.13:00:00 -0700";
    }
    key 2 {
      secret "$9$m5T3"; ## SECRET-DATA
      start-time "2013-5-31.13:00:00 -0700";
    }
    key 3 {
      secret "$9$mTQn"; ## SECRET-DATA
      start-time "2014-5-31.13:00:00 -0700";
    }
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying IS-IS BFD Authentication

Purpose Verify the status of IS-IS BFD authentication.

Action From operational mode, enter the **show bfd session extensive** command.

```
user@R1> show bfd session extensive
                                                  Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
10.0.0.2                 Down      ge-1/2/0.0     0.300     1.000       3
 Client ISIS L1, TX interval 0.100, RX interval 0.100, Authenticate
        keychain secret123, algo meticulous-keyed-md5, mode strict
 Client ISIS L2, TX interval 0.100, RX interval 0.100, Authenticate
        keychain secret123, algo meticulous-keyed-md5, mode strict
 Session down time 00:35:13, previous up time 00:12:17
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 Logical system 2, routing table index 85
 Min async interval 0.100, min slow interval 1.000
 Adaptive async TX interval 0.100, RX interval 0.100
 Local min TX interval 1.000, minimum RX interval 0.100, multiplier 3
 Remote min TX interval 0.100, min RX interval 0.100, multiplier 3
 Local discriminator 2, remote discriminator 1
 Echo mode disabled/inactive, no-absorb, no-refresh
 Authentication enabled/active, keychain secret123, algo meticulous-keyed-md5,
mode strict
  Session ID: 0x100101

1 sessions, 2 clients
Cumulative transmit rate 1.0 pps, cumulative receive rate 10.0 pps
```

Meaning The output shows that BFD authentication is enabled on IS-IS Level 1 and Level 2.

Related Documentation

- *Configuring BFD Authentication for IS-IS*
- *Example: Configuring BFD for IS-IS*

Example: Configuring IS-IS IPv4 and IPv6 Unicast Topologies

Understanding IS-IS IPv4 and IPv6 Unicast Topologies

You can configure IS-IS to calculate an alternate IPv6 unicast topology, in addition to the normal IPv4 unicast topology, and add the corresponding routes to inet6.0. The IS-IS interface metrics for the IPv4 topology can be configured independently of the IPv6 metrics. You can also selectively disable interfaces from participating in the IPv6 topology while continuing to participate in the IPv4 topology. This enables you to exercise control over the paths that unicast data takes through a network.

A topology is the set of joined nodes. IS-IS evaluates all the paths in a single topology for each IS-IS level and uses the shortest-path-first (SPF) algorithm to determine the best path among all the feasible paths. Topology discovery and SPF calculation is performed in a protocol-neutral fashion because it is done at Layer 2 of the OSI model.

If you load the topology with reachability information for a certain protocol (for example, IP), the assumption is that the circuits that are supposed to provide reachability between routing devices can carry the protocol. The SPF algorithm has a per-link orientation, not a per-address family or per-protocol orientation.

Multitopology routing enables you to override this default behavior by enabling a per-address family, per-protocol SPF calculation.

The additional CPU load associated with multiple runs of the SPF algorithm is generally not an issue with the processing power available on today's routing device control planes.

The multitopology extensions alter existing type, length, and value (TLV) tuples by adding a topology ID. Each routing device in a given topology maintains its adjacencies and runs a per-topology SPF calculation.

Example: Configuring IS-IS IPv4 and IPv6 Unicast Topologies

This example shows how to configure IS-IS to calculate an alternate IPv6 unicast topology, in addition to the normal IPv4 unicast topology.

- Requirements on page 3233
- Overview on page 3233
- Configuration on page 3235
- Verification on page 3238

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

This example focuses on IPv4 and IPv6 unicast topologies. The IS-IS interface metrics for the IPv4 topology can be configured independently of the IPv6 metrics. You can also selectively disable interfaces from participating in the IPv6 topology while continuing to participate in the IPv4 topology. This enables you to exercise control over the paths that unicast data takes through a network.

To enable an IPv6 unicast topology for IS-IS, include the **ipv6-unicast** statement:

```
isis {
  topologies {
    ipv6-unicast;
  }
}
```

To configure a metric for the IPv6 unicast topology, include the **ipv6-unicast-metric** statement:

```
isis {
  interface interface-name {
    level level-number {
      ipv6-unicast-metric number;
    }
```

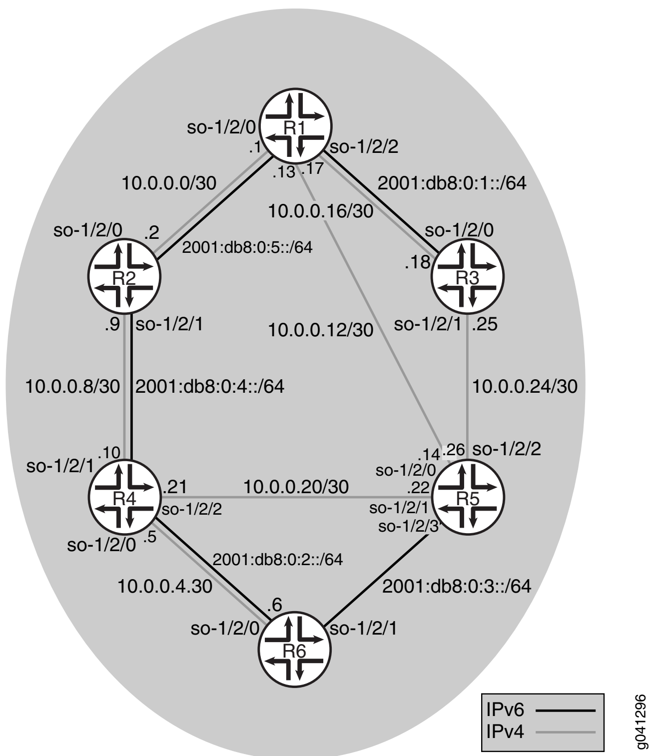
```
    }
  }
```

To exclude an interface from the IPv6 unicast topologies for IS-IS, include the **no-ipv6-unicast** statement:

```
isis {
    interface interface-name {
        no-ipv6-unicast;
    }
}
```

Figure 82 on page 3234 shows the topology used in this example. The black lines indicate link membership in the IPv6 topology. The gray lines indicate membership to the IPv4 topology. Using regular TLVs, it would not be possible to build multiple topologies and run an SPF calculation based on them. The multitopology extensions describe an extension to carry the set of supported protocols in the hello packet. After activating multitopology routing support on a link, the link carries all the topologies that the underlying circuit is able to relay.

Figure 82: IS-IS IPv4 and IPv6 Unicast Topologies



"CLI Quick Configuration" on page 3235 shows the configuration for all of the devices in Figure 82 on page 3234. The section "Step-by-Step Procedure" on page 3236 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces so-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces so-1/2/0 unit 0 family iso
set interfaces so-1/2/0 unit 0 family inet6 address 2001:db8:0:5::/64 eui-64
set interfaces so-1/2/1 unit 0 family inet address 10.0.0.13/30
set interfaces so-1/2/1 unit 0 family iso
set interfaces so-1/2/2 unit 0 family inet address 10.0.0.17/30
set interfaces so-1/2/2 unit 0 family iso
set interfaces so-1/2/2 unit 0 family inet6 address 2001:db8:0:1::/64 eui-64
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0001.00
set interfaces lo0 unit 0 family inet6 address 2001:db8::1/128
set protocols isis topologies ipv6-unicast
set protocols isis interface so-1/2/0.0
set protocols isis interface so-1/2/1.0 no-ipv6-unicast
set protocols isis interface so-1/2/2.0
set protocols isis interface lo0.0
```

Device R2

```
set interfaces so-1/2/0 unit 0 family inet address 10.0.0.2/30
set interfaces so-1/2/0 unit 0 family iso
set interfaces so-1/2/0 unit 0 family inet6 address 2001:db8:0:5::/64 eui-64
set interfaces so-1/2/1 unit 0 family inet address 10.0.0.9/30
set interfaces so-1/2/1 unit 0 family iso
set interfaces so-1/2/1 unit 0 family inet6 address 2001:db8:0:4::/64 eui-64
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0002.00
set interfaces lo0 unit 0 family inet6 address 2001:db8::2/128
set protocols isis topologies ipv6-unicast
set protocols isis interface so-1/2/0.2
set protocols isis interface so-1/2/1.0
set protocols isis interface lo0.0
```

Device R3

```
set interfaces so-1/2/0 unit 0 family inet address 10.0.0.18/30
set interfaces so-1/2/0 unit 0 family iso
set interfaces so-1/2/0 unit 0 family inet6 address 2001:db8:0:1::/64 eui-64
set interfaces so-1/2/1 unit 0 family inet address 10.0.0.25/30
set interfaces so-1/2/1 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0003.00
set interfaces lo0 unit 0 family inet6 address 2001:db8::3/128
set protocols isis topologies ipv6-unicast
set protocols isis interface so-1/2/0.0
set protocols isis interface so-1/2/1.0 no-ipv6-unicast
set protocols isis interface lo0.0
```

Device R4

```
set interfaces so-1/2/0 unit 0 family inet address 10.0.0.5/30
set interfaces so-1/2/0 unit 0 family iso
set interfaces so-1/2/0 unit 0 family inet6 address 2001:db8:0:2::/64 eui-64
set interfaces so-1/2/1 unit 0 family inet address 10.0.0.10/30
```



```
set interfaces so-1/2/1 unit 0 family iso
set interfaces so-1/2/1 unit 0 family inet6 address 2001:db8:0:1::/64 eui-64
set interfaces so-1/2/2 unit 0 family inet address 10.0.0.21/30
set interfaces so-1/2/2 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.4/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0004.00
set interfaces lo0 unit 0 family inet6 address 2001:db8::4/128
set protocols isis topologies ipv6-unicast
set protocols isis interface so-1/2/0.0
set protocols isis interface so-1/2/1.0
set protocols isis interface so-1/2/2.0 no-ipv6-unicast
set protocols isis interface lo0.0
```

Device R5

```
set interfaces so-1/2/0 unit 0 family inet address 10.0.0.14/30
set interfaces so-1/2/0 unit 0 family iso
set interfaces so-1/2/1 unit 0 family inet address 10.0.0.22/30
set interfaces so-1/2/1 unit 0 family iso
set interfaces so-1/2/2 unit 0 family inet address 10.0.0.26/30
set interfaces so-1/2/2 unit 0 family iso
set interfaces so-1/2/3 unit 0 family iso
set interfaces so-1/2/3 unit 0 family inet6 address 2001:db8:0:3::/64 eui-64
set interfaces lo0 unit 0 family inet address 192.168.0.5/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0005.00
set interfaces lo0 unit 0 family inet6 address 2001:db8::5/128
set protocols isis topologies ipv6-unicast
set protocols isis interface so-1/2/0.0 no-ipv6-unicast
set protocols isis interface so-1/2/1.0 no-ipv6-unicast
set protocols isis interface so-1/2/2.0 no-ipv6-unicast
set protocols isis interface so-1/2/3.0
set protocols isis interface lo0.0
```

Device R6

```
set interfaces so-1/2/0 unit 0 family inet address 10.0.0.6/30
set interfaces so-1/2/0 unit 0 family iso
set interfaces so-1/2/0 unit 0 family inet6 address 2001:db8:0:2::/64 eui-64
set interfaces so-1/2/1 unit 0 family iso
set interfaces so-1/2/1 unit 0 family inet6 address 2001:db8:0:3::/64 eui-64
set interfaces lo0 unit 0 family inet address 192.168.0.6/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0006.00
set interfaces lo0 unit 0 family inet6 address 2001:db8::6/128
set protocols isis topologies ipv6-unicast
set protocols isis interface so-1/2/0.0
set protocols isis interface so-1/2/1.0
set protocols isis interface lo0.0
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure an alternate IPv6 unicast topology:

1. Configure the interfaces.

   ```
   [edit interfaces]
   user@R1# set so-1/2/0 unit 0 family inet address 10.0.0.1/30
   user@R1# set so-1/2/0 unit 0 family iso
   ```



```
user@R1# set so-1/2/0 unit 0 family inet6 address 2001:db8:0:5::/64 eui-64
user@R1# set so-1/2/1 unit 0 family inet address 10.0.0.13/30
user@R1# set so-1/2/1 unit 0 family iso
user@R1# set so-1/2/2 unit 0 family inet address 10.0.0.17/30
user@R1# set so-1/2/2 unit 0 family iso
user@R1# set so-1/2/2 unit 0 family inet6 address 2001:db8:0:1::/64 eui-64
user@R1# set lo0 unit 0 family inet address 192.168.0.1/32
user@R1# set lo0 unit 0 family iso address 49.0002.0192.0168.0001.00
user@R1# set lo0 unit 0 family inet6 address 2001:db8::1/128
```

2. Enable IS-IS on the interfaces.

```
[edit protocols isis]
user@R1# set interface so-1/2/0.0
user@R1# set interface so-1/2/1.0
user@R1# set interface so-1/2/2.0
user@R1# set interface lo0.0
```

3. Enable multitopology routing on the IS-IS interfaces.

   The **ipv6-unicast** statement enables multitopology IS-IS routing on all interfaces that have **family iso** and **family inet6** configured and are listed at the **[edit protocols isis interface]** hierarchy level.

```
[edit protocols isis]
user@R1# set topologies ipv6-unicast
```

4. Disable IPv6 unicast support on a given interface.

   If you do not want to run multitopology IS-IS routing for IPv6 on a given interface, you can disable multitopology routing by including the **no-ipv6-unicast** statement in the IS-IS interface configuration.

```
[edit protocols isis]
user@R1# set interface so-1/2/1.0 no-ipv6-unicast
```

Results From configuration mode, confirm your configuration by entering the **show interfaces** and **show protocols** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
so-1/2/0 {
  unit 0 {
    family inet {
      address 10.0.0.1/30;
    }
    family iso;
    family inet6 {
      address 2001:db8:0:5::/64 {
        eui-64;
      }
    }
  }
}
so-1/2/1 {
  unit 0 {
    family inet {
```

```
            address 10.0.0.13/30;
          }
          family iso;
        }
      }
      so-1/2/2 {
        unit 0 {
          family inet {
            address 10.0.0.17/30;
          }
          family iso;
          family inet6 {
            address 2001:db8:0:1::/64 {
              eui-64;
            }
          }
        }
      }
      lo0 {
        unit 0 {
          family inet {
            address 192.168.0.1/32;
          }
          family iso {
            address 49.0002.0192.0168.0001.00;
          }
          family inet6 {
            address 2001:db8::1/128;
          }
        }
      }
```

```
user@R1# show protocols
isis {
  topologies ipv6-unicast;
  interface so-1/2/0.0;
  interface so-1/2/1.0 {
    no-ipv6-unicast;
  }
  interface so-1/2/2.0;
  interface lo0.0;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the Topologies on Neighbors on page 3238
- Checking the IS-IS SPF Calculations on page 3239
- Checking the Tcpdump Output on page 3240

Checking the Topologies on Neighbors

Purpose Determine what topologies are supported on neighboring IS-IS devices.

Action From operational mode, enter the **show isis adjacency detail** command.

```
user@R1> show isis adjacency detail

R2
  Interface: so-1/2/0.0, Level: 3, State: Up, Expires in 24 secs
  Priority: 0, Up/Down transitions: 1, Last transition: 05:28:16 ago
  Circuit type: 3, Speaks: IP, IPv6
  Topologies: Unicast, IPV6-Unicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  IP addresses: 10.0.0.2
  IPv6 addresses: fe80::2a0:a514:0:24c

R5
  Interface: so-1/2/1.0, Level: 3, State: Up, Expires in 21 secs
  Priority: 0, Up/Down transitions: 1, Last transition: 05:27:47 ago
  Circuit type: 3, Speaks: IP, IPv6
  Topologies: Unicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  IP addresses: 10.0.0.14

R3
  Interface: so-1/2/2.0, Level: 3, State: Up, Expires in 22 secs
  Priority: 0, Up/Down transitions: 1, Last transition: 05:27:25 ago
  Circuit type: 3, Speaks: IP, IPv6
  Topologies: Unicast, IPV6-Unicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  IP addresses: 10.0.0.18
  IPv6 addresses: fe80::2a0:a514:0:124c
```

Meaning As expected, the adjacency with Device R5 only supports the IPv4 unicast topology, while the adjacencies with Device R2 and Device R3 support both the IPv4 and IPv6 topologies.

Checking the IS-IS SPF Calculations

Purpose Verify that separate SPF calculations are being run for IPv4 and IPv6.

Action From operational mode, enter the **show isis spf brief** command.

```
user@R1> show isis spf brief
IPV4 Unicast IS-IS level 1 SPF results:
Node                 Metric     Interface        NH   Via             SNPA
R6.00        20         so-1/2/1.0      IPV4 R5
R4.00        20         so-1/2/0.0       IPV4 R2
R5.00        10         so-1/2/1.0      IPV4 R5
R3.00        10         so-1/2/2.0      IPV4 R3
R2.00        10         so-1/2/0.0       IPV4 R2
R1.00        0
  6 nodes

IPV4 Unicast IS-IS level 2 SPF results:
Node                 Metric     Interface        NH   Via             SNPA
R6.00        20         so-1/2/1.0      IPV4 R5
R4.00        20         so-1/2/0.0       IPV4 R2
R5.00        10         so-1/2/1.0      IPV4 R5
R3.00        10         so-1/2/2.0      IPV4 R3
R2.00        10         so-1/2/0.0       IPV4 R2
R1.00        0
  6 nodes
```

```
IPV6 Unicast IS-IS level 1 SPF results:
Node                 Metric      Interface        NH   Via              SNPA
R5.00          40          so-1/2/0.0       IPV6 R2
R6.00          30          so-1/2/0.0       IPV6 R2
R4.00          20          so-1/2/0.0       IPV6 R2
R3.00          10          so-1/2/2.0      IPV6 R3
R2.00          10          so-1/2/0.0       IPV6 R2
R1.00          0
  6 nodes

IPV6 Unicast IS-IS level 2 SPF results:
Node                 Metric      Interface        NH   Via              SNPA
R5.00          40          so-1/2/0.0       IPV6 R2
R6.00          30          so-1/2/0.0       IPV6 R2
R4.00          20          so-1/2/0.0       IPV6 R2
R3.00          10          so-1/2/2.0      IPV6 R3
R2.00          10          so-1/2/0.0       IPV6 R2
R1.00          0
  6 nodes
```

Meaning As expected, SPF calculations are being performed for IPv4 and IPv6 topologies.

Checking the Tcpdump Output

Purpose Verify that the link can be a member of both the IPv4 unicast topology and the IPv6 unicast topology.

Action

```
user@R1> monitor traffic detail interface so-1/2/0.0
[...]

15:52:35.719540  In IS-IS, length 82
        p2p IIH, hlen: 20, v: 1, pdu-v: 1, sys-id-len: 6 (0), max-area: 3 (0)
          source-id: 0192.0168.0002, holding time: 27s, Flags: [Level 1, Level
2]
          circuit-id: 0x01, PDU length: 82
            Point-to-point Adjacency State TLV #240, length: 15
              Adjacency State: Up (0)
              Extended Local circuit-ID: 0x00000054
              Neighbor System-ID: 0192.0168.0001
              Neighbor Extended Local circuit-ID: 0x00000043
            Protocols supported TLV #129, length: 2
              NLPID(s): IPv4 (0xcc), IPv6 (0x8e)
            IPv4 Interface address(es) TLV #132, length: 4
              IPv4 interface address: 10.0.0.2
            IPv6 Interface address(es) TLV #232, length: 16
              IPv6 interface address: fe80::2a0:a514:0:24c
            Area address(es) TLV #1, length: 4
              Area address (length: 3): 49.0002
            Restart Signaling TLV #211, length: 3
              Flags [none], Remaining holding time 0s
            Multi Topology TLV #229, length: 4
              IPv4 unicast Topology (0x000), Flags: [none]
              IPv6 unicast Topology (0x002), Flags: [none]
```

Meaning The IS-IS hello (IIH) packet shows that IPv4 and IPv6 are supported. The hello packet lists valid IPv4 and IPv6 addresses, and therefore the routing device can create valid next-hop entries. The supported protocols are listed in the multitopology TLV #229.

Related Documentation

- *Example: Configuring IS-IS Dual Stacking of IPv4 and IPv6 Unicast Addresses*

Example: Configuring IS-IS Multicast Topology

IS-IS Multicast Topologies Overview

Most multicast routing protocols perform a reverse-path forwarding (RPF) check on the source of multicast data packets. If a packet comes in on the interface that is used to send data to the source, the packet is accepted and forwarded to one or more downstream interfaces. Otherwise, the packet is discarded and a notification is sent to the multicast routing protocol running on the interface.

In certain instances, the unicast routing table used for the RPF check is also the table used for forwarding unicast data packets. Thus, unicast and multicast routing are congruent. In other cases, where it is preferred that multicast routing be independent of unicast routing, the multicast routing protocols are configured to perform the RPF check using an alternate unicast routing table inet.2.

You can configure IS-IS to calculate an alternate IPv4 multicast topology, in addition to the normal IPv4 unicast topology, and add the corresponding routes to inet.2. The IS-IS interface metrics for the multicast topology can be configured independently of the unicast metrics. You can also selectively disable interfaces from participating in the multicast topology while continuing to participate in the regular unicast topology. This enables you to exercise control over the paths that multicast data takes through a network so that it is independent of unicast data paths. You can also configure IS-IS to calculate an alternate IPv6 multicast topology, in addition to the normal IPv6 unicast topology.

NOTE: IS-IS only starts advertising the routes when the interface routes are in inet.2.

Table 239 on page 3241 lists the various IPv4 statements you can use to configure IS-IS topologies.

Table 239: IPv4 Statements

Statement	Description
ipv4-multicast	Enables an alternate IPv4 multicast topology.
ipv4-multicast-metric *number*	Configures the multicast metric for an alternate IPv4 multicast topology.
no-ipv4-multicast	Excludes an interface from the IPv4 multicast topology.
no-unicast-topology	Excludes an interface from the IPv4 unicast topologies.

Table 240 on page 3242 lists the various IPv6 statements you can use to configure IS-IS topologies.

Table 240: IPv6 Statements

Statement	Description
ipv6-multicast	Enables an alternate IPv6 multicast topology.
ipv6-multicast-metric *number*	Configures the multicast metric for an alternate IPv6 multicast topology.
ipv6-unicast-metric *number*	Configures the unicast metric for an alternate IPv6 multicast topology.
no-ipv6-multicast	Excludes an interface from the IPv6 multicast topology.
no-ipv6-unicast	Excludes an interface from the IPv6 unicast topologies.

For a list of hierarchy levels at which you can include these statements, see the statement summary sections for these statements.

Example: Configuring IS-IS Multicast Topology

This example shows how to configure a multicast topology for an IS-IS network.

Requirements

Before you begin, configure IS-IS on all routers. See “Example: Configuring IS-IS” on page 3197 for information about the required IS-IS configuration.

This example uses the following hardware and software components:

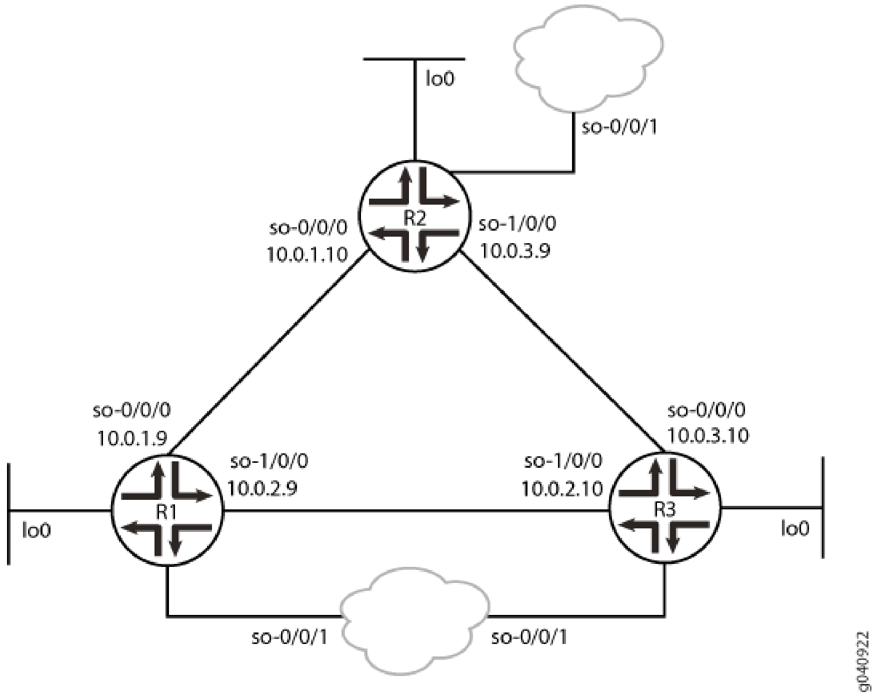
- Junos OS Release 7.3 or later
- M Series, MX Series, and T Series routers

Overview

This example shows an IS-IS multicast topology configuration. Three routers are connected to each other. A loopback interface is configured on each router.

Figure 83 on page 3243 shows the sample network.

Figure 83: Configuring IS-IS Multicast Topology



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Router R1

```
set protocols isis traceoptions file isis size 5m world-readable
set protocols isis traceoptions flag error
set protocols isis topologies ipv4-multicast
set protocols isis interface so-0/0/0 level 1 metric 15
set protocols isis interface so-0/0/0 level 1 ipv4-multicast-metric 18
set protocols isis interface so-0/0/0 level 2 metric 20
set protocols isis interface so-0/0/0 level 2 ipv4-multicast-metric 14
set protocols isis interface so-1/0/0 level 1 metric 13
set protocols isis interface so-1/0/0 level 1 ipv4-multicast-metric 12
set protocols isis interface so-1/0/0 level 2 metric 29
set protocols isis interface so-1/0/0 level 2 ipv4-multicast-metric 23
set protocols isis interface fxp0.0 disable
```

Router R2

```
set protocols isis traceoptions file isis size 5m world-readable
set protocols isis traceoptions flag error
set protocols isis topologies ipv4-multicast
set protocols isis interface so-0/0/0 level 1 metric 13
set protocols isis interface so-0/0/0 level 1 ipv4-multicast-metric 12
set protocols isis interface so-0/0/0 level 2 metric 29
```

set protocols isis interface so-0/0/0 level 2 ipv4-multicast-metric 23
set protocols isis interface so-1/0/0 level 1 metric 14
set protocols isis interface so-1/0/0 level 1 ipv4-multicast-metric 18
set protocols isis interface so-1/0/0 level 2 metric 32
set protocols isis interface so-1/0/0 level 2 ipv4-multicast-metric 26
set protocols isis interface fxp0.0 disable

Router R3

set protocols isis traceoptions file isis size 5m world-readable
set protocols isis traceoptions flag error
set protocols isis topologies ipv4-multicast
set protocols isis interface so-0/0/0 level 1 metric 19
set protocols isis interface so-0/0/0 level 1 ipv4-multicast-metric 11
set protocols isis interface so-0/0/0 level 2 metric 27
set protocols isis interface so-0/0/0 level 2 ipv4-multicast-metric 21
set protocols isis interface so-1/0/0 level 1 metric 16
set protocols isis interface so-1/0/0 level 1 ipv4-multicast-metric 26
set protocols isis interface so-1/0/0 level 2 metric 30
set protocols isis interface so-1/0/0 level 2 ipv4-multicast-metric 20
set protocols isis interface fxp0.0 disable

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure IS-IS multicast topologies:

1. Enable the multicast topology for IS-IS by using the **ipv4-multicast** statement.

   Routers R1, R2, and R3

   [edit protocols isis]
   user@host# **set traceoptions file isis size 5m world-readable**
   user@host# **set traceoptions flag error**
   user@host# **set topologies ipv4-multicast**

2. Enable multicast metrics on the first SONET/SDH Interface by using the **ipv4-multicast-metric** statement.

   Router R1

   [edit protocols isis interface so-0/0/0]
   user@R1# **set level 1 metric 15**
   user@R1# **set level 1 ipv4-multicast-metric 18**
   user@R1# **set level 2 metric 20**
   user@R1# **set level 2 ipv4-multicast-metric 14**

   Router R2

   [edit protocols isis interface so-0/0/0]
   user@R2# **set level 1 metric 13**
   user@R2# **set level 1 ipv4-multicast-metric 12**
   user@R2# **set level 2 metric 29**
   user@R2# **set level 2 ipv4-multicast-metric 23**

   Router R3

   [edit protocols isis interface so-0/0/0]

user@R3# **set level 1 metric 19**
user@R3# **set level 1 ipv4-multicast-metric 11**
user@R3# **set level 2 metric 27**
user@R3# **set level 2 ipv4-multicast-metric 21**

3. Enable multicast metrics on a second sonet Interface by using the **ipv4-multicast-metric** statement.

   Router R1

   [edit protocols isis interface so-1/0/0]
   user@R1# **set level 1 metric 13**
   user@R1# **set level 1 ipv4-multicast-metric 12**
   user@R1# **set level 2 metric 29**
   user@R1# **set level 2 ipv4-multicast-metric 23**

   Router R2

   [edit protocols isis interface so-1/0/0]
   user@R2# **set level 1 metric 14**
   user@R2# **set level 1 ipv4-multicast-metric 18**
   user@R2# **set level 2 metric 32**
   user@R2# **set level 2 ipv4-multicast-metric 26**

   Router R3

   [edit protocols isis interface so-1/0/0]
   user@R3# **set level 1 metric 16**
   user@R3# **set level 1 ipv4-multicast-metric 26**
   user@R3# **set level 2 metric 30**
   user@R3# **set level 2 ipv4-multicast-metric 20**

4. Disable the out-of-band management port, fxp0.

   Routers R1, R2, and R3

   [edit protocols isis]
   user@host# **set interface fxp0.0 disable**

5. If you are done configuring the routers, commit the configuration.

   Routers R1, R2, and R3

   [edit]
   user@host# **commit**

Results From configuration mode, confirm your configuration by using the **show protocols isis** statement. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Router R1

```
user@R1# show protocols isis

traceoptions {
    file isis size 5m world-readable;
    flag error;
}
topologies ipv4-multicast;
interface so-0/0/0 {
    level 1 {
```

```
        metric 15;
        ipv4-multicast-metric 18;
    }
    level 2 {
        metric 20;
        ipv4-multicast-metric 14;
    }
}
interface so-1/0/0 {
    level 1 {
        metric 13;
        ipv4-multicast-metric 12;
    }
    level 2 {
        metric 29;
        ipv4-multicast-metric 23;
    }
}
interface fxp0.0 {
    disable;
}
```

Router R2

`user@R2#` **show protocols isis**

```
traceoptions {
    file isis size 5m world-readable;
    flag error;
}
topologies ipv4-multicast;
interface so-0/0/0 {
    level 1 {
        metric 13;
        ipv4-multicast-metric 12;
    }
    level 2 {
        metric 29;
        ipv4-multicast-metric 23;
    }
}
interface so-1/0/0 {
    level 1 {
        metric 14;
        ipv4-multicast-metric 18;
    }
    level 2 {
        metric 32;
        ipv4-multicast-metric 26;
    }
}
interface fxp0.0 {
    disable;
}
```

Router R3

`user@R3#` **show protocols isis**

```
traceoptions {
    file isis size 5m world-readable;
    flag error;
```



```
}
topologies ipv4-multicast;
interface so-0/0/0 {
    level 1 {
        metric 19;
        ipv4-multicast-metric 11;
    }
    level 2 {
        metric 27;
        ipv4-multicast-metric 21;
    }
}
interface so-1/0/0 {
    level 1 {
        metric 16;
        ipv4-multicast-metric 26;
    }
    level 2 {
        metric 30;
        ipv4-multicast-metric 20;
    }
}
interface fxp0.0 {
    disable;
}
```

Verification

Confirm that the configuration is working properly.

- Verifying the Connection Between Routers R1, R2, and R3 on page 3247
- Verifying That IS-IS Is Configured on page 3249
- Verifying the Configured Multicast Metric Values on page 3251
- Verifying the Configuration of the Multicast Topology on page 3252

Verifying the Connection Between Routers R1, R2, and R3

Purpose Make sure that Routers R1, R2, and R3 are connected to each other.

Action Ping the other two routers from any router, to check the connectivity between the three routers as per the network topology.

```
user@R1> ping 10.0.3.9

PING 10.0.3.9 (10.0.3.9): 56 data bytes
64 bytes from 10.0.3.9: icmp_seq=0 ttl=64 time=1.299 ms
64 bytes from 10.0.3.9: icmp_seq=1 ttl=64 time=52.304 ms
64 bytes from 10.0.3.9: icmp_seq=2 ttl=64 time=1.271 ms
64 bytes from 10.0.3.9: icmp_seq=3 ttl=64 time=1.343 ms
64 bytes from 10.0.3.9: icmp_seq=4 ttl=64 time=1.434 ms
64 bytes from 10.0.3.9: icmp_seq=5 ttl=64 time=1.306 ms
^C
--- 10.0.3.9 ping statistics ---
6 packets transmitted, 6 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.271/9.826/52.304/18.997 ms

user@R1> ping 10.0.3.10
```



```
PING 10.0.3.10 (10.0.3.10): 56 data bytes
64 bytes from 10.0.3.10: icmp_seq=0 ttl=64 time=1.431 ms
64 bytes from 10.0.3.10: icmp_seq=1 ttl=64 time=1.296 ms
64 bytes from 10.0.3.10: icmp_seq=2 ttl=64 time=1.887 ms
^C
--- 10.0.3.10 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.296/1.538/1.887/0.253 ms
```

`user@R2>` **ping 10.0.2.9**

```
PING 10.0.2.9 (10.0.2.9): 56 data bytes
64 bytes from 10.0.2.9: icmp_seq=0 ttl=64 time=1.365 ms
64 bytes from 10.0.2.9: icmp_seq=1 ttl=64 time=1.813 ms
64 bytes from 10.0.2.9: icmp_seq=2 ttl=64 time=1.290 ms
^C
--- 10.0.2.9 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.290/1.489/1.813/0.231 ms
```

`user@R2>` **ping 10.0.2.10**

```
PING 10.0.2.10 (10.0.2.10): 56 data bytes
64 bytes from 10.0.2.10: icmp_seq=0 ttl=63 time=1.318 ms
64 bytes from 10.0.2.10: icmp_seq=1 ttl=63 time=1.394 ms
64 bytes from 10.0.2.10: icmp_seq=2 ttl=63 time=1.366 ms
64 bytes from 10.0.2.10: icmp_seq=3 ttl=63 time=1.305 ms
^C
--- 10.0.2.10 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.305/1.346/1.394/0.036 ms
```

`user@R3>` **ping 10.0.1.10**

```
PING 10.0.1.10 (10.0.1.10): 56 data bytes
64 bytes from 10.0.1.10: icmp_seq=0 ttl=63 time=1.316 ms
64 bytes from 10.0.1.10: icmp_seq=1 ttl=63 time=1.418 ms
64 bytes from 10.0.1.10: icmp_seq=2 ttl=63 time=1.277 ms
^C
--- 10.0.1.10 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.277/1.337/1.418/0.059 ms
```

`user@R3>` **ping 10.0.1.9**

```
PING 10.0.1.9 (10.0.1.9): 56 data bytes
64 bytes from 10.0.1.9: icmp_seq=0 ttl=64 time=1.381 ms
64 bytes from 10.0.1.9: icmp_seq=1 ttl=64 time=1.499 ms
64 bytes from 10.0.1.9: icmp_seq=2 ttl=64 time=1.300 ms
64 bytes from 10.0.1.9: icmp_seq=3 ttl=64 time=1.397 ms
^C
--- 10.0.1.9 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.300/1.394/1.499/0.071 ms
```

Meaning Routers R1, R2, and R3 have a peer relationship with each other.

Verifying That IS-IS Is Configured

Purpose Make sure that the IS-IS instance is running on Routers R1, R2, and R3, and that they are adjacent to each other.

Action Use the **show isis adjacency detail** command to check the adjacency between the routers.

Router R1

```
user@R1> show isis adjacency detail

R2
  Interface: so-0/0/0, Level: 1, State: Up, Expires in 8 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:23:59 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bd
  Topologies: IPV4-Multicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R2.02, IP addresses: 10.0.1.10

R2
  Interface: so-0/0/0, Level: 2, State: Up, Expires in 8 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:23:58 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bd
  Topologies: IPV4-Multicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R2.02, IP addresses: 10.0.1.10

R3
  Interface: so-1/0/0, Level: 1, State: Up, Expires in 7 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:24:20 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bd
  Topologies: IPV4-Multicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R3.02, IP addresses: 10.0.2.10

R3
  Interface: so-1/0/0, Level: 2, State: Up, Expires in 6 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:24:20 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bd
  Topologies: IPV4-Multicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R3.02, IP addresses: 10.0.2.10
```

Router R2

```
user@R2> show isis adjacency detail

R1
  Interface: so-0/0/0, Level: 1, State: Up, Expires in 20 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:27:50 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bc
  Topologies: IPV4-Multicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R2.02, IP addresses: 10.0.1.9

R1
  Interface: so-0/0/0, Level: 2, State: Up, Expires in 26 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:27:50 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bc
  Topologies: IPV4-Multicast
```



```
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R2.02, IP addresses: 10.0.1.9

R3
  Interface: so-1/0/0, Level: 1, State: Up, Expires in 8 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:27:22 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bd
  Topologies: IPV4-Multicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R3.03, IP addresses: 10.0.3.10

R3
  Interface: so-1/0/0, Level: 2, State: Up, Expires in 8 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:27:22 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bd
  Topologies: IPV4-Multicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R3.03, IP addresses: 10.0.3.10
```

Router R3

`user@R3>` **show isis adjacency detail**

```
R2
  Interface: so-0/0/0, Level: 1, State: Up, Expires in 18 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:33:09 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bc
  Topologies: IPV4-Multicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R3.03, IP addresses: 10.0.3.9

R2
  Interface: so-0/0/0, Level: 2, State: Up, Expires in 22 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:33:09 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bc
  Topologies: IPV4-Multicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R3.03, IP addresses: 10.0.3.9

R1
  Interface: so-1/0/0, Level: 1, State: Up, Expires in 21 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:33:59 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bc
  Topologies: IPV4-Multicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R3.02, IP addresses: 10.0.2.9

R1
  Interface: so-1/0/0, Level: 2, State: Up, Expires in 19 secs
  Priority: 64, Up/Down transitions: 1, Last transition: 2d 19:33:59 ago
  Circuit type: 3, Speaks: IP, MAC address: 0:1b:c0:86:54:bc
  Topologies: IPV4-Multicast
  Restart capable: Yes, Adjacency advertisement: Advertise
  LAN id: R3.02, IP addresses: 10.0.2.9
```

Meaning IS-IS is configured on Routers R1, R2, and R3, and they are adjacent to each other.

Verifying the Configured Multicast Metric Values

Purpose Make sure that the SPF calculations are accurate as per the configured multicast metric values on Routers R1, R2, and R3.

Action Use the **show isis spf results** command to check the SPF calculations for the network.

Router R1

```
user@R1> show isis spf results
...
IPV4 Multicast IS-IS level 1 SPF results:
Node   Metric     Interface      NH   Via   SNPA
R3.03  28         so-1/0/0       IPV4 R3    0:1b:c0:86:54:bd
R2.00  18         so-0/0/0       IPV4 R2    0:1b:c0:86:54:bd
R3.00  17         so-1/0/0       IPV4 R3    0:1b:c0:86:54:bd
R1.00  0
  4 nodes

IPV4 Multicast IS-IS level 2 SPF results:
Node   Metric     Interface      NH   Via   SNPA
R3.03  40         so-0/0/0       IPV4 R2    0:1b:c0:86:54:bd
R3.00  22         so-1/0/0       IPV4 R3    0:1b:c0:86:54:bd
R2.00  14         so-0/0/0       IPV4 R2    0:1b:c0:86:54:bd
R1.00  0
  4 nodes
```

Router R2

```
user@R2> show isis spf results
...
IPV4 Multicast IS-IS level 1 SPF results:
Node   Metric     Interface      NH   Via   SNPA
R3.02  29         so-0/0/0       IPV4 R1    0:1b:c0:86:54:bc
R3.00  18         so-1/0/0       IPV4 R3    0:1b:c0:86:54:bd
R1.00  12         so-0/0/0       IPV4 R1    0:1b:c0:86:54:bc
R2.02  12
R2.00  0
  5 nodes

IPV4 Multicast IS-IS level 2 SPF results:
Node   Metric     Interface      NH   Via   SNPA
R3.02  45         so-0/0/0       IPV4 R1    0:1b:c0:86:54:bc
R3.00  26         so-1/0/0       IPV4 R3    0:1b:c0:86:54:bd
R1.00  23         so-0/0/0       IPV4 R1    0:1b:c0:86:54:bc
R2.02  23
R2.00  0
  5 nodes
```

Router R3

```
user@R3> show isis spf results
...
IPV4 Multicast IS-IS level 1 SPF results:
Node   Metric     Interface      NH   Via   SNPA
R3.02  26
R1.00  23         so-0/0/0       IPV4 R2    0:1b:c0:86:54:bc
R2.02  23         so-0/0/0       IPV4 R2    0:1b:c0:86:54:bc
R2.00  11         so-0/0/0       IPV4 R2    0:1b:c0:86:54:bc
R3.03  11
```

```
R3.00  0
  6 nodes

IPV4 Multicast IS-IS level 2 SPF results:
Node   Metric     Interface      NH   Via   SNPA
R2.02  34         so-1/0/0       IPV4 R1    0:1b:c0:86:54:bc
R2.00  21         so-0/0/0       IPV4 R2    0:1b:c0:86:54:bc
R3.03  21
R1.00  20         so-1/0/0       IPV4 R1    0:1b:c0:86:54:bc
R3.02  20
R3.00  0
  6 nodes
```

Meaning The configured multicast metric values are used in SPF calculations for the IS-IS network.

Verifying the Configuration of the Multicast Topology

Purpose Make sure that the multicast topology is configured on Routers R1, R2, and R3.

Action Use the **show isis database detail** command to verify the multicast topology configuration on the routers.

Router R1

```
user@R1> show isis database detail

IS-IS level 1 link-state database:

R1.00-00 Sequence: 0x142, Checksum: 0xd07, Lifetime: 663 secs
   IPV4 Unicast IS neighbor: R2.02   Metric:       15
   IPV4 Unicast IS neighbor: R3.02   Metric:       15
   IPV4 Multicast IS neighbor: R2.02  Metric:       18
   IPV4 Multicast IS neighbor: R3.02  Metric:       17
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       15 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       15 Internal Up

R2.00-00 Sequence: 0x13f, Checksum: 0xf02b, Lifetime: 883 secs
   IPV4 Unicast IS neighbor: R2.02   Metric:       13
   IPV4 Unicast IS neighbor: R3.03   Metric:       14
   IPV4 Multicast IS neighbor: R2.02  Metric:       12
   IPV4 Multicast IS neighbor: R3.03  Metric:       18
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       13 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       14 Internal Up

R2.02-00 Sequence: 0x13c, Checksum: 0x57e2, Lifetime: 913 secs
   IPV4 Unicast IS neighbor: R1.00   Metric:        0
   IPV4 Unicast IS neighbor: R2.00   Metric:        0

R3.00-00 Sequence: 0x13c, Checksum: 0xc8de, Lifetime: 488 secs
   IPV4 Unicast IS neighbor: R3.02   Metric:       16
   IPV4 Unicast IS neighbor: R3.03   Metric:       19
   IPV4 Multicast IS neighbor: R3.02  Metric:       26
   IPV4 Multicast IS neighbor: R3.03  Metric:       11
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       16 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       19 Internal Up

R3.02-00 Sequence: 0x139, Checksum: 0xfb0e, Lifetime: 625 secs
   IPV4 Unicast IS neighbor: R1.00   Metric:        0
   IPV4 Unicast IS neighbor: R3.00   Metric:        0
```



```
R3.03-00 Sequence: 0x138, Checksum: 0xad56, Lifetime: 714 secs
   IPV4 Unicast IS neighbor: R2.00   Metric:       0
   IPV4 Unicast IS neighbor: R3.00   Metric:       0

IS-IS level 2 link-state database:

R1.00-00 Sequence: 0x142, Checksum: 0x2c7c, Lifetime: 816 secs
   IPV4 Unicast IS neighbor: R2.02   Metric:      20
   IPV4 Unicast IS neighbor: R3.02   Metric:      31
   IPV4 Multicast IS neighbor: R2.02  Metric:      14
   IPV4 Multicast IS neighbor: R3.02  Metric:      22
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       20 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       31 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       29 Internal Up

R2.00-00 Sequence: 0x13f, Checksum: 0x4826, Lifetime: 966 secs
   IPV4 Unicast IS neighbor: R2.02   Metric:      29
   IPV4 Unicast IS neighbor: R3.03   Metric:      32
   IPV4 Multicast IS neighbor: R2.02  Metric:      23
   IPV4 Multicast IS neighbor: R3.03  Metric:      26
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       29 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       28 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       32 Internal Up

R2.02-00 Sequence: 0x13c, Checksum: 0x57e2, Lifetime: 966 secs
   IPV4 Unicast IS neighbor: R1.00   Metric:       0
   IPV4 Unicast IS neighbor: R2.00   Metric:       0

R3.00-00 Sequence: 0x13d, Checksum: 0x1b19, Lifetime: 805 secs
   IPV4 Unicast IS neighbor: R3.02   Metric:      30
   IPV4 Unicast IS neighbor: R3.03   Metric:      27
   IPV4 Multicast IS neighbor: R3.02  Metric:      20
   IPV4 Multicast IS neighbor: R3.03  Metric:      21
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       31 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       30 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       27 Internal Up

R3.02-00 Sequence: 0x139, Checksum: 0xfb0e, Lifetime: 844 secs
   IPV4 Unicast IS neighbor: R1.00   Metric:       0
   IPV4 Unicast IS neighbor: R3.00   Metric:       0

R3.03-00 Sequence: 0x139, Checksum: 0xab57, Lifetime: 844 secs
   IPV4 Unicast IS neighbor: R2.00   Metric:       0
   IPV4 Unicast IS neighbor: R3.00   Metric:       0
```

Router R2

```
user@R2> show isis database detail

IS-IS level 1 link-state database:

R1.00-00 Sequence: 0x142, Checksum: 0xd07, Lifetime: 524 secs
   IPV4 Unicast IS neighbor: R2.02    Metric:      15
   IPV4 Unicast IS neighbor: R3.02    Metric:      15
   IPV4 Multicast IS neighbor: R2.02   Metric:      18
   IPV4 Multicast IS neighbor: R3.02   Metric:      17
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       15 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       15 Internal Up

R2.00-00 Sequence: 0x13f, Checksum: 0xf02b, Lifetime: 748 secs
   IPV4 Unicast IS neighbor: R2.02    Metric:      13
```

```
   IPV4 Unicast IS neighbor: R3.03    Metric:       14
   IPV4 Multicast IS neighbor: R2.02   Metric:       12
   IPV4 Multicast IS neighbor: R3.03   Metric:       18
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       13 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       14 Internal Up

R2.02-00 Sequence: 0x13c, Checksum: 0x57e2, Lifetime: 777 secs
   IPV4 Unicast IS neighbor: R1.00   Metric:       0
   IPV4 Unicast IS neighbor: R2.00   Metric:       0

R3.00-00 Sequence: 0x13d, Checksum: 0xc6df, Lifetime: 1102 secs
   IPV4 Unicast IS neighbor: R3.02    Metric:       16
   IPV4 Unicast IS neighbor: R3.03    Metric:       19
   IPV4 Multicast IS neighbor: R3.02   Metric:       26
   IPV4 Multicast IS neighbor: R3.03   Metric:       11
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       16 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       19 Internal Up

R3.02-00 Sequence: 0x139, Checksum: 0xfb0e, Lifetime: 488 secs
   IPV4 Unicast IS neighbor: R1.00    Metric:       0
   IPV4 Unicast IS neighbor: R3.00    Metric:       0

R3.03-00 Sequence: 0x138, Checksum: 0xad56, Lifetime: 577 secs
   IPV4 Unicast IS neighbor: R2.00    Metric:       0
   IPV4 Unicast IS neighbor: R3.00    Metric:       0

IS-IS level 2 link-state database:

R1.00-00 Sequence: 0x142, Checksum: 0x2c7c, Lifetime: 676 secs
   IPV4 Unicast IS neighbor: R2.02    Metric:       20
   IPV4 Unicast IS neighbor: R3.02    Metric:       31
   IPV4 Multicast IS neighbor: R2.02   Metric:       14
   IPV4 Multicast IS neighbor: R3.02   Metric:       22
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       20 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       31 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       29 Internal Up

R2.00-00 Sequence: 0x13f, Checksum: 0x4826, Lifetime: 831 secs
   IPV4 Unicast IS neighbor: R2.02    Metric:       29
   IPV4 Unicast IS neighbor: R3.03    Metric:       32
   IPV4 Multicast IS neighbor: R2.02   Metric:       23
   IPV4 Multicast IS neighbor: R3.03   Metric:       26
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       29 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       28 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       32 Internal Up

R2.02-00 Sequence: 0x13c, Checksum: 0x57e2, Lifetime: 831 secs
   IPV4 Unicast IS neighbor: R1.00    Metric:       0
   IPV4 Unicast IS neighbor: R2.00    Metric:       0

R3.00-00 Sequence: 0x13d, Checksum: 0x1b19, Lifetime: 667 secs
   IPV4 Unicast IS neighbor: R3.02    Metric:       30
   IPV4 Unicast IS neighbor: R3.03    Metric:       27
   IPV4 Multicast IS neighbor: R3.02   Metric:       20
   IPV4 Multicast IS neighbor: R3.03   Metric:       21
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       31 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       30 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       27 Internal Up

R3.02-00 Sequence: 0x139, Checksum: 0xfb0e, Lifetime: 707 secs
   IPV4 Unicast IS neighbor: R1.00    Metric:       0
```

```
   IPV4 Unicast IS neighbor: R3.00    Metric:        0

R3.03-00 Sequence: 0x139, Checksum: 0xab57, Lifetime: 707 secs
   IPV4 Unicast IS neighbor: R2.00    Metric:        0
   IPV4 Unicast IS neighbor: R3.00    Metric:        0
```

Router R3

`user@R3>` **show isis database detail**

```
IS-IS level 1 link-state database:

R1.00-00 Sequence: 0x143, Checksum: 0xb08, Lifetime: 1155 secs
   IPV4 Unicast IS neighbor: R2.02    Metric:       15
   IPV4 Unicast IS neighbor: R3.02    Metric:       15
   IPV4 Multicast IS neighbor: R2.02   Metric:       18
   IPV4 Multicast IS neighbor: R3.02   Metric:       17
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       15 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       15 Internal Up

R2.00-00 Sequence: 0x13f, Checksum: 0xf02b, Lifetime: 687 secs
   IPV4 Unicast IS neighbor: R2.02    Metric:       13
   IPV4 Unicast IS neighbor: R3.03    Metric:       14
   IPV4 Multicast IS neighbor: R2.02   Metric:       12
   IPV4 Multicast IS neighbor: R3.03   Metric:       18
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       13 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       14 Internal Up

R2.02-00 Sequence: 0x13c, Checksum: 0x57e2, Lifetime: 716 secs
   IPV4 Unicast IS neighbor: R1.00   Metric:       0
   IPV4 Unicast IS neighbor: R2.00   Metric:       0

R3.00-00 Sequence: 0x13d, Checksum: 0xc6df, Lifetime: 1044 secs
   IPV4 Unicast IS neighbor: R3.02    Metric:       16
   IPV4 Unicast IS neighbor: R3.03    Metric:       19
   IPV4 Multicast IS neighbor: R3.02   Metric:       26
   IPV4 Multicast IS neighbor: R3.03   Metric:       11
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       16 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       19 Internal Up

R3.02-00 Sequence: 0x139, Checksum: 0xfb0e, Lifetime: 430 secs
   IPV4 Unicast IS neighbor: R1.00    Metric:        0
   IPV4 Unicast IS neighbor: R3.00    Metric:        0

R3.03-00 Sequence: 0x138, Checksum: 0xad56, Lifetime: 519 secs
   IPV4 Unicast IS neighbor: R2.00    Metric:        0
   IPV4 Unicast IS neighbor: R3.00    Metric:        0

IS-IS level 2 link-state database:

R1.00-00 Sequence: 0x142, Checksum: 0x2c7c, Lifetime: 617 secs
   IPV4 Unicast IS neighbor: R2.02    Metric:       20
   IPV4 Unicast IS neighbor: R3.02    Metric:       31
   IPV4 Multicast IS neighbor: R2.02   Metric:       14
   IPV4 Multicast IS neighbor: R3.02   Metric:       22
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       20 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       31 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       29 Internal Up

R2.00-00 Sequence: 0x13f, Checksum: 0x4826, Lifetime: 769 secs
   IPV4 Unicast IS neighbor: R2.02    Metric:       29
   IPV4 Unicast IS neighbor: R3.03    Metric:       32
```

```
   IPV4 Multicast IS neighbor: R2.02   Metric:       23
   IPV4 Multicast IS neighbor: R3.03   Metric:       26
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       29 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       28 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       32 Internal Up

R2.02-00 Sequence: 0x13c, Checksum: 0x57e2, Lifetime: 769 secs
   IPV4 Unicast IS neighbor: R1.00    Metric:        0
   IPV4 Unicast IS neighbor: R2.00    Metric:        0

R3.00-00 Sequence: 0x13d, Checksum: 0x1b19, Lifetime: 610 secs
   IPV4 Unicast IS neighbor: R3.02    Metric:       30
   IPV4 Unicast IS neighbor: R3.03    Metric:       27
   IPV4 Multicast IS neighbor: R3.02   Metric:       20
   IPV4 Multicast IS neighbor: R3.03   Metric:       21
   IP IPV4 Unicast prefix: 10.0.1.8/30  Metric:       31 Internal Up
   IP IPV4 Unicast prefix: 10.0.2.8/30  Metric:       30 Internal Up
   IP IPV4 Unicast prefix: 10.0.3.8/30  Metric:       27 Internal Up

R3.02-00 Sequence: 0x139, Checksum: 0xfb0e, Lifetime: 649 secs
   IPV4 Unicast IS neighbor: R1.00    Metric:        0
   IPV4 Unicast IS neighbor: R3.00    Metric:        0

R3.03-00 Sequence: 0x139, Checksum: 0xab57, Lifetime: 649 secs
   IPV4 Unicast IS neighbor: R2.00    Metric:        0
   IPV4 Unicast IS neighbor: R3.00    Metric:        0
```

Meaning Multicast topology is configured on Routers R1, R2, and R3.

Related Documentation

- *Example: Configuring Multitopology Routing Based on a Multicast Source*
- Example: Configuring IS-IS IPv4 and IPv6 Unicast Topologies on page 3232

Example: Configuring IS-IS for CLNS

Understanding IS-IS for CLNS

IS-IS extensions provide the basic interior gateway protocol (IGP) support for collecting intradomain routing information for Connectionless Network Service (CLNS) destinations within a CLNS network. Routers that learn host addresses through End System-to-Intermediate System (ES-IS) can advertise the addresses to other routers (intermediate systems) by using IS-IS.

For more information about IS-IS, see the ISO 10589 standard.

Example: Configuring IS-IS for CLNS

This example shows how to create a routing instance and enable the IS-IS protocol on all interfaces.

- Configuration on page 3257
- Verification on page 3258

Requirements

Before you begin, configure the network interfaces. See the *Junos OS Interfaces Configuration Guide for Security Devices*.

Overview

The configuration instructions in this topic describe how to create a routing instance called aaaa, enable IS-IS on all interfaces, define the BGP export policy name (dist-bgp), family (ISO), and protocol (BGP), and apply the export policy to IS-IS.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set routing-instances aaaa protocols isis clns-routing
set routing-instances aaaa protocols isis interface all
set routing-instances aaaa protocols isis no-ipv4-routing no-ipv6-routing
set policy-options policy-statement dist-bgp from family iso protocol bgp
set policy-options policy-statement dist-bgp then accept
set routing-instances aaaa protocols isis export dist-bgp
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure IS-IS for CLNS:

1. Enable CLNS routing.

   ```
   [edit routing-instances aaaa]
   user@host# set protocols isis clns-routing
   ```

2. Enable IS-IS on all interfaces.

   ```
   [edit routing-instances aaaa]
   user@host# set protocols isis interface all
   ```

3. (Optional) Disable IPv4 and IPv6 routing to configure a pure CLNS network.

   ```
   [edit routing-instances aaaa]
   user@host# set protocols isis no-ipv4-routing no-ipv6-routing
   ```

4. Define the BGP export policy name, family, and protocol.

   ```
   [edit policy-options]
   user@host# set policy-statement dist-bgp from family iso protocol bgp
   ```

5. Define the action for the export policy.

   ```
   [edit policy-options]
   user@host# set policy-statement dist-bgp then accept
   ```

6. Apply the export policy to IS-IS.

```
[edit routing-instances aaaa]
user@host# set protocols isis export dist-bgp
```

Results From configuration mode, confirm your configuration by entering the **show routing-instances** and **show policy-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show routing-instances
aaaa {
  protocols {
    isis {
      export dist-bgp;
      no-ipv4-routing;
      no-ipv6-routing;
      clns-routing;
      interface all;
    }
user@host# show policy-options
policy-statement dist-bgp {
  from {
    family iso;
    protocol bgp;
  }
  then accept;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying the ISO Routes on page 3258
- Checking the SPF Calculations on page 3258

Verifying the ISO Routes

Purpose Verify that the expected ISO routes are displayed in the IS-IS routing table.

Action From operational mode, enter the **show isis route** command.

Checking the SPF Calculations

Purpose Display information about IS-IS shortest-path-first (SPF) calculations.

Action From operational mode, enter the **show isis spf** command.

Example: Configuring IS-IS Designated Routers

- Understanding IS-IS Designated Routers on page 3259
- Example: Configuring Designated Router Election Priority for IS-IS on page 3259

Understanding IS-IS Designated Routers

A router advertises its priority to become a designated router in its hello packets. On all multiaccess networks (physical networks that support the attachment of more than two routers, such as Ethernet networks), IS-IS uses the advertised priorities to elect a designated router for the network. This router is responsible for sending network link-state advertisements, which describe all the routers attached to the network. These advertisements are flooded throughout a single area. The priority value is meaningful only on a multiaccess network. It has no meaning on a point-to-point interface.

A router's priority for becoming the designated router is indicated by an arbitrary number from 0 through 127, which you configure on the IS-IS interface. The router with the highest priority becomes the designated router for the area (Level 1, Level 2, or both), also configured on the IS-IS interface. If routers in the network have the same priority, then the router with the highest MAC address is elected as the designated router. By default, routers have a priority value of 64.

Example: Configuring Designated Router Election Priority for IS-IS

This example shows how to configure the designated router election priority for IS-IS.

Before you begin:

- Configure network interfaces. See the *Junos OS Interfaces Configuration Guide for Security Devices*.
- Enable IS-IS on the interfaces. See "Example: Configuring IS-IS" on page 3197.

In this example, you configure the priority for logical interface ge-0/0/1.0 to be 100 and the level number to be 1. If this interface has the highest priority value, the router becomes the designated router for the Level 1 area.

To configure a designated router election priority for IS-IS:

```
[edit]
user@host# set protocols isis interface ge-0/0/1.0 level 1 priority 100
```

Related Documentation

- *Example: Configuring IS-IS*

Example: Enabling Packet Checksums on IS-IS Interfaces

This example shows how to enable packet checksums for IS-IS interfaces.

Requirements

Before you begin, configure IS-IS on both routers. See "Example: Configuring IS-IS" on page 3197 for information about the sample IS-IS configuration.

Overview

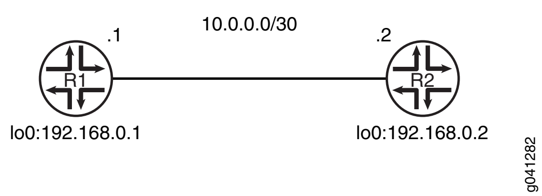
Junos OS supports IS-IS checksums as documented in RFC 3358, *Optional Checksums in Intermediate System to Intermediate System (ISIS)*.

IS-IS protocol data units (PDUs) include link-state PDUs, complete sequence number PDUs (CSNPs), partial sequence number PDUs (PSNPs), and IS-IS hello (IIH) packets. These PDUs can be corrupt due to faulty implementations of Layer 2 hardware or lack of checksums on a specific network technology. Corruption of length or type, length, and value (TLV) fields can lead to the generation of extensive numbers of empty link-state PDUs in the receiving node. Because authentication is not a replacement for a checksum mechanism, you might want to enable the optional checksum TLV on your IS-IS interfaces.

The checksum cannot be enabled with MD5 hello authentication on the same interface.

Figure 84 on page 3260 shows the topology used in this example.

Figure 84: IS-IS Checksum Topology



This example describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set protocols isis traceoptions file isis
set protocols isis traceoptions flag all
set protocols isis interface fe-1/2/0.1 checksum
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure IS-IS checksums:

1. Enable checksums.

   ```
   [edit protocols isis interface fe-1/2/0.1]
   user@R1# set checksum
   ```

2. (Optional) Enable tracing for tracking checksum operations.

   ```
   [edit protocols isis traceoptions]
   user@R1# set file isis
   user@R1# set flag all
   ```

Results From configuration mode, confirm your configuration by entering the **show protocols** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show protocols
isis {
  traceoptions {
    file isis;
    flag all;
  }
  interface fe-1/2/0.1 {
    checksum;
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying Checksums

Purpose Verify that checksums are performed.

Action From operational mode, enter the **show log isis | match checksum** command.

```
user@R1> show log isis | match checksum

May 31 16:47:39.513267     sequence 0x49 checksum 0x8e64
May 31 16:47:39.513394     sequence 0x4e checksum 0x34b3
May 31 16:47:39.513517     sequence 0x50 checksum 0x9dcb
May 31 16:47:46.563781     sequence 0x45 checksum 0x7e1a
May 31 16:47:46.563970     sequence 0x46 checksum 0x226d
May 31 16:47:46.564104     sequence 0x52 checksum 0x99cd
May 31 16:47:46.581087     sequence 0x49 checksum 0x8e64
May 31 16:47:46.581222     sequence 0x4e checksum 0x34b3
May 31 16:47:46.581353     sequence 0x50 checksum 0x9dcb
May 31 16:47:55.799090     sequence 0x45 checksum 0x7e1a
May 31 16:47:55.799223     sequence 0x46 checksum 0x226d
May 31 16:47:55.799347     sequence 0x52 checksum 0x99cd
May 31 16:47:55.818255     sequence 0x49 checksum 0x8e64
May 31 16:47:55.818473     sequence 0x4e checksum 0x34b3
May 31 16:47:55.818606     sequence 0x50 checksum 0x9dcb
May 31 16:48:03.455816     sequence 0x49 checksum 0x8e64
May 31 16:48:03.455973     sequence 0x4e checksum 0x34b3
```

Meaning The output shows that checksum information is captured in the IS-IS trace log file.

Related Documentation

- *Understanding Checksums on IS-IS Interfaces*

Configuration Tasks

Configuring IS-IS Authentication

All IS-IS protocol exchanges can be authenticated to guarantee that only trusted routing devices participate in the autonomous system (AS) routing. By default, IS-IS authentication is disabled on the routing device.

To configure IS-IS authentication, you must define an authentication password and specify the authentication type.

You can configure one of the following authentication methods:

- Simple authentication—Uses a text password that is included in the transmitted packet. The receiving routing device uses an authentication key (password) to verify the packet. Simple authentication is included for compatibility with existing IS-IS implementations. However, we recommend that you do *not* use this authentication method because it is insecure (the text can be “sniffed”).

CAUTION: A simple password that exceeds 254 characters is truncated.

- HMAC-MD5 authentication—Uses an iterated cryptographic hash function. The receiving routing device uses an authentication key (password) to verify the packet.

You can also configure more fine-grained interface-level authentication for hello packets.

To enable authentication and specify an authentication method, include the **authentication-type** statement, specifying the **simple** or **md5** authentication type:

authentication-type *authentication*;

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

To configure a password, include the **authentication-key** statement. The authentication password for all routing devices in a domain must be the same.

authentication-key *key*;

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

To configure hitless authentication key rollover, include the authentication-key-chain (Protocols IS-IS) statement.

The password can contain up to 255 characters. If you include spaces, enclose all characters in quotation marks (“ ”).

If you are using the Junos OS IS-IS software with another implementation of IS-IS, the other implementation must be configured to use the same password for the domain, the area, and all interfaces that are shared with a Junos OS implementation.

Authentication of hello packets, partial sequence number PDU (PSNP), and complete sequence number PDU (CSNP) can be suppressed to enable interoperability with the routing software of different vendors. Different vendors handle authentication in various ways, and suppressing authentication for different PDU types might be the simplest way to allow compatibility within the same network.

To configure IS-IS to generate authenticated packets, but not to check the authentication on received packets, include the **no-authentication-check** statement:

```
no-authentication-check;
```

To suppress authentication of IS-IS hello packets, include the **no-hello-authentication** statement:

```
no-hello-authentication;
```

To suppress authentication of PSNPs, include the **no-psnp-authentication** statement:

```
no-psnp-authentication;
```

To suppress authentication of CSNPs, include the **no-csnp-authentication** statement:

```
no-csnp-authentication;
```

For a list of hierarchy levels at which you can include these statements, see the statement summary sections for these statements.

NOTE: The **authentication** and the **no-authentication** statements must be configured at the same hierarchy level. Configuring **authentication** at the **[edit protocols isis interface *interface-name*]** hierarchy level and configuring **no-authentication** at the **[edit protocols isis]** hierarchy level has no effect.

Related Documentation

- Configuring Authentication Without Network-Wide Deployment on page 3263

Configuring Authentication Without Network-Wide Deployment

To allow the use of authentication without requiring network-wide deployment, include the **loose-authentication-check** statement:

```
loose-authentication-check;
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

Related Documentation

- *Example: Configuring Hitless Authentication Key Rollover for IS-IS*

Configuration Statements

authentication-key (Protocols IS-IS)

Syntax authentication-key *key*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis level *level-number*],
[edit protocols isis level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Authentication key (password). Neighboring routing devices use the password to verify the authenticity of packets sent from this interface. For the key to work, you also must include the **authentication-type** statement.

All routing devices must use the same password. If you are using the Junos OS IS-IS software with another implementation of IS-IS, the other implementation must be configured to use the same password for the domain, the area, and all interfaces adjacent to the Juniper Networks routing device.

Default If you do not include this statement and the **authentication-type** statement, IS-IS authentication is disabled.

Options *key*—Authentication password. The password can be up to 1024 characters long. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (“ ”).

CAUTION: **A simple password for authentication is truncated if it exceeds 254 characters.**

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Hitless Authentication Key Rollover for IS-IS*

authentication-key-chain (Protocols IS-IS)

Syntax authentication-key-chain *key-chain-name*;

Hierarchy Level [edit logical-systems *name* protocols isis level *level-number*],
[edit logical-systems *name* routing-instances *instance-name* protocols isis level *level-number*],
[edit protocols isis level *level-number*],
[edit routing-instances *instance-name* protocols isis level *level-number*]

Release Information Statement introduced in Junos OS Release 11.2.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Apply and enable an authentication keychain to the routing device.

Options ***key-chain***—Authentication keychain name. It can be up to 126 characters. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (“ ”).

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Hitless Authentication Key Rollover for IS-IS on page 3211
- Example: Configuring Route Authentication for BGP on page 2953
- Example: Configuring BFD Authentication for Static Routes on page 2332
- *Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols*
- Understanding Hitless Authentication Key Rollover for IS-IS on page 3195

authentication-type (Protocols IS-IS)

Syntax authentication-type *authentication*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis level *level-number*],
[edit protocols isis level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable authentication and specify the authentication scheme for IS-IS. If you enable authentication, you must specify a password by including the **authentication-key** statement.

Default If you do not include this statement and the **authentication-key** statement, IS-IS authentication is disabled.

Options ***authentication***—Authentication scheme:

- **md5**—Use HMAC authentication in combination with MD5. HMAC-MD5 authentication is defined in RFC 2104, *HMAC: Keyed-Hashing for Message Authentication*.
- **simple**—Use a simple password for authentication. The password is included in the transmitted packet, making this method of authentication relatively insecure. We recommend that you *not* use this authentication method.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Hitless Authentication Key Rollover for IS-IS*
- authentication-key on page 3266
- no-authentication-check on page 3301

bfd-liveness-detection (Protocols IS-IS)

Syntax

```
bfd-liveness-detection {
  authentication {
    algorithm algorithm-name;
    key-chain key-chain-name;
    loose-check;
  }
  detection-time {
    threshold milliseconds;
  }
  minimum-interval milliseconds;
  minimum-receive-interval milliseconds;
  multiplier number;
  no-adaptation;
  transmit-interval {
    minimum-interval milliseconds;
    threshold milliseconds;
  }
  version (1 | automatic);
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
detection-time threshold and **transmit-interval threshold** options added in Junos OS Release 8.2.
Support for logical systems introduced in Junos OS Release 8.3.
no-adaptation statement introduced in Junos OS Release 9.0.
authentication algorithm, **authentication key-chain**, and **authentication loose-check** options introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure bidirectional failure detection timers and authentication.

Options

authentication algorithm ***algorithm-name*** —Configure the algorithm used to authenticate the specified BFD session: **simple-password**, **keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**.

authentication key-chain ***key-chain-name***—Associate a security key with the specified BFD session using the name of the security keychain. The name you specify must match one of the keychains configured in the **authentication-key-chains key-chain** statement at the **[edit security]** hierarchy level.

authentication loose-check—(Optional) Configure loose authentication checking on the BFD session. Use only for transitional periods when authentication might not be configured at both ends of the BFD session.

detection-time threshold ***milliseconds***—Configure a threshold for the adaptation of the BFD session detection time. When the detection time adapts to a value equal to or greater than the threshold, a single trap and a single system log message are sent.

minimum-interval ***milliseconds***—Configure the minimum interval after which the local routing device transmits a hello packet and then expects to receive a reply from the neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can specify the minimum transmit and receive intervals separately using the **transmit-interval minimum-interval** and **minimum-receive-interval** statements.

Range: 1 through 255,000

minimum-receive-interval ***milliseconds***—Configure the minimum interval after which the local routing device expects to receive a reply from a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum receive interval using the **minimum-interval** statement.

Range: 1 through 255,000

multiplier ***number***—Configure the number of hello packets not received by a neighbor that causes the originating interface to be declared down.

Range: 1 through 255

Default: 3

no-adaptation—Specify that BFD sessions not adapt to changing network conditions. We recommend that you not disable BFD adaptation unless it is preferable not to have BFD adaptation enabled in your network.

transmit-interval threshold ***milliseconds***—Configure the threshold for the adaptation of the BFD session transmit interval. When the transmit interval adapts to a value greater than the threshold, a single trap and a single system message are sent. The interval threshold must be greater than the minimum transmit interval.

Range: 0 through 4,294,967,295 ($2^{32} – 1$)

transmit-interval minimum-interval ***milliseconds***—Configure a minimum interval after which the local routing device transmits hello packets to a neighbor. Optionally, instead of using this statement, you can configure the minimum transmit interval using the **minimum-interval** statement.

Range: 1 through 255,000

version—Configure the BFD version to detect: **1** (BFD version 1) or **automatic** (autodetect the BFD version)

Default: **automatic**

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring BFD for IS-IS*
- *Example: Configuring BFD Authentication for IS-IS*

checksum (Protocols IS-IS)

Syntax checksum;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable checksums for packets on this interface.

Junos OS supports IS-IS checksums as documented in RFC 3358, *Optional Checksums in Intermediate System to Intermediate System (ISIS)*.

The checksum cannot be enabled with MD5 hello authentication on the same interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Enabling Packet Checksums on IS-IS Interfaces*

csnp-interval

Syntax csnp-interval (*seconds* | disable);

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the interval between complete sequence number PDUs (CSNPs) on a LAN interface.

If the routing device is the designated router on a LAN, IS-IS sends CSN packets every 10 seconds. If the routing device is on a point-to-point interface, it sends CSN packets every 5 seconds. To protect against link-state PDU flooding, we recommend modifying the default interval.

To modify the CSNP interval, include the **csnp-interval** statement.

To configure the interface not to send any CSNPs, specify the **disable** option.

Default By default, IS-IS sends CSNPs periodically. If the routing device is the designated router on a LAN, IS-IS sends CSNPs every 10 seconds. If the routing device is on a point-to-point interface, it sends CSNPs every 5 seconds.

Options **disable**—Do not send CSNPs on this interface.

seconds—Number of seconds between the sending of CSNPs.
Range: 1 through 65,535 seconds
Default: 10 seconds on LAN broadcast links. 5 seconds on point-to-point links.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring the Transmission Frequency for CSNP Packets on IS-IS Interfaces*

disable (Protocols IS-IS)

Syntax

disable;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* protocols isis interface *interface-name* level *level-number*],
[edit logical-systems *logical-system-name* protocols isis traffic-engineering],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis traffic-engineering],
[edit protocols isis],
[edit protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name* level *level-number*],
[edit protocols isis traffic-engineering],
[edit routing-instances *routing-instance-name* protocols isis],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis traffic-engineering]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Disable IS-IS on the routing device, on an interface, or on a level.

At the **[edit protocols isis traffic-engineering]** hierarchy level, disable IS-IS support for traffic engineering.

Enabling IS-IS on an interface (by including the **interface** statement at the **[edit protocols isis]** or the **[edit routing-instances *routing-instance-name* protocols isis]** hierarchy level), disabling it (by including the **disable** statement), and not actually having IS-IS run on an interface (by including the **passive** statement) are mutually exclusive states.

Default

IS-IS is enabled for Level 1 and Level 2 routers on all interfaces on which **family iso** is enabled.

IS-IS support for traffic engineering is enabled.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Multi-Level IS-IS on page 3203
- IS-IS Overview on page 3189

export (Protocols IS-IS)

Syntax export [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Apply one or more policies to routes being exported from the routing table into IS-IS.

All routing protocols store the routes that they learn in the routing table. The routing table uses this collected route information to determine the active routes to destinations. The routing table then installs the active routes into its forwarding table and exports them into the routing protocols. It is these exported routes that the protocols advertise.

For each protocol, you control which routes the protocol stores in the routing table and which routes the routing table exports into the protocol from the routing table by defining a *routing policy* for that protocol.

NOTE: For IS-IS, you cannot apply routing policies that affect how routes are imported into the routing table; doing so with a link-state protocol can easily lead to an inconsistent topology database.

Options ***policy-names***—Name of one or more policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Redistributing OSPF Routes into IS-IS*
- *Example: Configuring an IS-IS Default Route Policy on Logical Systems*

external-preference (Protocols IS-IS)

Syntax external-preference *preference*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis level *level-number*],
[edit protocols isis level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the preference of external routes.

Options *preference*—Preference value.

Range: 0 through 4,294,967,295 (2^{32} – 1)

Default: 15 (for Level 1 internal routes), 18 (for Level 2 internal routes), 160 (for Level 1 external routes), 165 (for Level 2 external routes)

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Route Preferences Overview*
- *Example: Redistributing OSPF Routes into IS-IS*
- *Example: Redistributing BGP Routes with a Specific Community Tag into IS-IS*
- preference on page 3313

family (Protocols IS-IS)

Syntax

```
family inet {
  shortcuts {
    multicast-rpf-routes;
  }
}
family inet6 {
  shortcuts;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols isis traffic-engineering],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis traffic-engineering],
[edit protocols isis traffic-engineering],
[edit routing-instances *routing-instance-name* protocols isis traffic-engineering]

Release Information

Statement introduced in Junos OS Release 9.3.
Support for IPv6 for IGP shortcuts introduced in Junos OS Release 9.3.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure the address family for traffic engineering IS-IS interior gateway protocol (IGP) shortcuts.

Options

inet—IPv4 address family

inet6—IPv6 address family

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

•

hello-authentication-key

Syntax

hello-authentication-key *password*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols isis interface *interface-name* level *number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name* level *number*],
[edit protocols isis interface *interface-name* level *number*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name* level *number*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure an authentication key (password) for hello packets. Neighboring routing devices use the password to verify the authenticity of packets sent from an interface. For the key to work, you also must include the **hello-authentication-type** statement.

Default

By default, hello authentication is not configured on an interface. However, if IS-IS authentication is configured, the hello packets are authenticated using the IS-IS authentication type and password.

Options

password—Authentication password. The password can be up to 255 characters. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (“ ”).

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- authentication-key on page 3266
- authentication-type on page 3268
- hello-authentication-type on page 3279

hello-authentication-key-chain

Syntax hello-authentication-key-chain *key-chain-name*;

Hierarchy Level [edit logical-systems *name* protocols isis interface *interface-name* level *level-number*],
[edit logical-systems *name* routing-instances *instance-name* protocols isis interface *interface-name* level *level-number*],
[edit protocols isis interface *interface-name* level *level-number*],
[edit routing-instances *instance-name* protocols isis interface *interface-name* level *level-number*]

Release Information Statement introduced in Junos OS Release 11.2.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Apply an authentication keychain to the IS-IS interface.

Options ***key-chain-name***—Authentication keychain name. It can be up to 126 characters. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (“ ”).

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Hitless Authentication Key Rollover for IS-IS*

hello-authentication-type

Syntax hello-authentication-type (md5 | simple);

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name* level *number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name* level *number*],
[edit protocols isis interface *interface-name* level *number*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name* level *number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable authentication on an interface for hello packets. If you enable authentication on hello packets, you must specify a password by including the **hello-authentication-key** statement.

You can configure authentication for a given IS-IS level on an interface. On a point-to-point link, if you enable hello authentication for both IS-IS levels, the password configured for Level 1 is used for both levels.

CAUTION: **If no authentication is configured for Level 1 on a point-to-point link with both levels enabled, the hello packets are sent without any password, regardless of the Level 2 authentication configurations.**

Default By default, hello authentication is not configured on an interface. However, if IS-IS authentication is configured, the hello packets are authenticated using the IS-IS authentication type and password.

Options **md5**—Specifies Message Digest 5 as the packet verification type.

simple—Specifies simple authentication as the packet verification type.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- authentication-key on page 3266
- authentication-type on page 3268
- hello-authentication-key on page 3277

hello-interval (Protocols IS-IS)

Syntax hello-interval *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name* level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*],
[edit protocols isis interface *interface-name* level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Modify the frequency with which the routing device sends hello packets out of an interface, in seconds.

Routing devices send hello packets at a fixed interval on all interfaces to establish and maintain neighbor relationships. This interval is advertised in the hello interval field in the hello packet.

You can send out hello packets in subsecond intervals. To send out hello packets every 333 milliseconds, set the **hello-interval** value to **1**.

Options *seconds*—Frequency of transmission for hello packets.

Range: 1 through 20,000 seconds

Default: 3 seconds (for designated intermediate system [DIS] routers), 9 seconds (for non-DIS routers)

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *hold-time*

hello-padding

Syntax hello-padding (adaptive | disable | loose | strict);

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*]

Release Information Statement introduced in Junos OS Release 8.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure padding on hello packets to accommodate asymmetrical maximum transfer units (MTUs) from different hosts.

This helps to prevent a premature adjacency Up state when one routing device's MTU does not meet the requirements to establish the adjacency.

As an OSI Layer 2 protocol, IS-IS does not support data fragmentation. Therefore, maximum packet sizes must be established and supported between two routers. During adjacency establishment, the IS-IS protocol makes sure that the link supports a packet size of 1492 bytes by padding outgoing hello packets up to the maximum packet size of 1492 bytes.

This is the default behavior of the Junos OS IS-IS implementation. However, Junos OS provides an option to disable hello padding that can override this behavior.

There are four types of hello padding:

- Adaptive padding—On point-to-point connections, the hello packets are padded from the initial detection of a new neighbor until the neighbor verifies the adjacency as Up in the adjacency state type, length, and value (TLV) tuple. If the neighbor does not support the adjacency state TLV, then padding continues. On LAN connections, padding starts from the initial detection of a new neighbor until there is at least one active adjacency on the interface. Adaptive padding has more overhead than loose padding and is able to detect MTU asymmetry from one side of the connection. This one-sided detection can result in generation of extra link-state PDUs that are flooded throughout the network. Specify the **adaptive** option to configure enough padding to establish an adjacency to neighbors.
- Disabled padding—Padding is disabled on all types of interfaces for all adjacency states. Specify the **disable** option to accommodate interfaces that support less than the default packet size of 1492 bytes.
- Loose padding (the default)—The hello packet is padded from the initial detection of a new neighbor until the adjacency transitions to the Up state. Loose padding might not be able to detect certain situations such as asymmetrical MTUs between the routing devices. Specify the **loose** option to configure enough padding to initialize an adjacency to neighbors.

- Strict padding—Padding is done on all interface types and for all adjacency states, and is continuous. Strict padding has the most overhead. The advantage is that strict padding detects MTU issues on both sides of a link. Specify the **strict** option to configure padding to allow all adjacency states with neighbors.

Options

adaptive—Configure padding until the neighbor adjacency is established and active.

disable—Disable padding on all types of interfaces for all adjacency states.

loose—Configure padding until the state of the adjacency is initialized.

strict—Configure padding for all adjacency states.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring IS-IS*

hold-time (Protocols IS-IS)

Syntax hold-time *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name*level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*],
[edit protocols isis interface *interface-name* level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Set the length of time a neighbor considers this router to be operative (up) after receiving a hello packet. If the neighbor does not receive another hello packet within the specified time, it marks this routing device as inoperative (down). The hold time itself is advertised in the hello packets.

The hold time specifies how long a neighbor should consider this routing device to be operative without receiving another hello packet. If the neighbor does not receive a hello packet from this routing device within the hold time, it marks the routing device as being unavailable.

Options *seconds*—Hold-time value, in seconds.

Range: 3 through 65,535 seconds, or 1 to send out hello packets every 333 milliseconds

Default: 9 seconds (for designated intermediate system [DIS] routers), 27 seconds (for non-DIS routers; three times the default hello interval)

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring IS-IS*
- hello-interval on page 3280

ignore-attached-bit

Syntax ignore-attached-bit;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Ignore the attached bit on IS-IS Level 1 routers. Configuring this statement enables the routing device to ignore the attached bit on incoming Level 1 link-state PDUs. If the attached bit is ignored, no default route, which points to the routing device which has set the attached bit, is installed.

There might be times, such as during a denial-of-service (DoS) attack, that you do not want a Level 1 router to be able to forward traffic based on a default route.

To prevent a routing device from being able to reach interarea destinations, you can prevent the routing device from installing the default route without affecting the status of its IS-IS adjacencies. The **ignore-attached-bit** statement is used to tell the routing device to ignore the presence of the attached bit in Level 1 link-state PDUs, which blocks the installation of the IS-IS default route.

Default The **ignore-attached-bit** statement is disabled by default.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

-

interface (Protocols IS-IS)

Syntax

```
interface (all | interface-name) {
  disable;
  bfd-liveness-detection {
    authentication {
      algorithm algorithm-name;
      key-chain key-chain-name;
      loose-check;
    }
    detection-time {
      threshold milliseconds;
    }
    minimum-interval milliseconds;
    minimum-receive-interval milliseconds;
    transmit-interval {
      threshold milliseconds;
      minimum-interval milliseconds;
    }
    multiplier number;
  }
  checksum;
  csnp-interval (seconds | disable);
  hello-padding (adaptive | loose | strict);
  ldp-synchronization {
    disable;
    hold-time seconds;
  }
  lsp-interval milliseconds;
  mesh-group (value | blocked);
  no-adjacency-holddown;
  no-ipv4-multicast;
  no-ipv6-multicast;
  no-ipv6-unicast;
  no-unicast-topology;
  passive;
  point-to-point;
  level level-number {
    disable;
    hello-authentication-key key;
    hello-authentication-key-chain key-chain-name;
    hello-authentication-type authentication;
    hello-interval seconds;
    hold-time seconds;
    ipv4-multicast-metric metric;
    ipv6-multicast-metric metric;
    ipv6-unicast-metric metric;
    metric metric;
    passive;
    priority number;
    te-metric metric;
  }
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure interface-specific IS-IS properties. To configure more than one interface, include the **interface** statement multiple times.

Enabling IS-IS on an interface (by including the **interface** statement at the **[edit protocols isis]** or the **[edit routing-instances *routing-instance-name* protocols isis]** hierarchy level), disabling it (by including the **disable** statement), and not actually having IS-IS run on an interface (by including the **passive** statement) are mutually exclusive states.

Options **all**—Have Junos OS create IS-IS interfaces automatically. If you include this option, disable IS-IS on the management interface (fxp0).

interface-name—Name of an interface. Specify the full interface name, including the physical and logical address components.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring IS-IS*
- *Example: Configuring Multi-Level IS-IS*

ipv4-multicast

Syntax ipv4-multicast;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis topologies],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis topologies],
[edit protocols isis topologies],
[edit routing-instances *routing-instance-name* protocols isis topologies]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure alternate IPv4 multicast topologies.

NOTE: The IS-IS interface metrics for the IPv4 topology can be configured independently of the IPv6 metrics. You can also selectively disable interfaces from participating in the IPv6 topology while continuing to participate in the IPv4 topology. This lets you exercise control over the paths that unicast data takes through a network.

Default Multicast topologies are disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS Multicast Topology on page 3241

ipv4-multicast-metric

Syntax ipv4-multicast-metric *metric*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name* level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*],
[edit protocols isis interface *interface-name* level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the multicast topology metric value for the level.

Options *metric*—Metric value.

Range: 0 through 16,777,215

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS Multicast Topology on page 3241

ipv6-multicast

Syntax ipv6-multicast;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis topologies],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis topologies],
[edit protocols isis topologies],
[edit routing-instances *routing-instance-name* protocols isis topologies]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Configure alternate IPv6 multicast topologies.

Default Multicast topologies are disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS Multicast Topology on page 3241

ipv6-multicast-metric

Syntax ipv6-multicast-metric *metric*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name* level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*],
[edit protocols isis interface *interface-name* level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify the IPv6 alternate multicast topology metric value for the level.

Options *metric*—Metric value.

Range: 0 through 16,777,215

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS Multicast Topology on page 3241

ipv6-unicast

Syntax ipv6-unicast;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis topologies],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis topologies],
[edit protocols isis topologies],
[edit routing-instances *routing-instance-name* protocols isis topologies]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Configure alternate IPv6 unicast topologies.

This statement causes IS-IS to calculate an alternate IPv6 unicast topology, in addition to the normal IPv4 unicast topology, and add the corresponding routes to inet6.0.

NOTE: The IS-IS interface metrics for the IPv4 topology can be configured independently of the IPv6 metrics. You can also selectively disable interfaces from participating in the IPv6 topology while continuing to participate in the IPv4 topology. This lets you exercise control over the paths that unicast data takes through a network.

Default IPv6 unicast topologies are disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS IPv4 and IPv6 Unicast Topologies on page 3232

ipv6-unicast-metric

Syntax ipv6-unicast-metric *metric*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name* level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*],
[edit protocols isis interface *interface-name* level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify the IPv6 unicast topology metric value for the level. The IS-IS interface metrics for the IPv4 topology can be configured independently of the IPv6 metrics.

Options *metric*—Metric value.

Range: 0 through 16,777,215

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS IPv4 and IPv6 Unicast Topologies on page 3232

isis

Syntax isis { ... }

Hierarchy Level [edit logical-systems *logical-system-name* protocols],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols],
[edit protocols],
[edit routing-instances *routing-instance-name* protocols]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable IS-IS routing on the routing device or for a routing instance.

The **isis** statement is the one statement you must include in the configuration to run IS-IS on the routing device or in a routing instance.

Default IS-IS is disabled on the routing device.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS on page 3197
- Example: Configuring Multi-Level IS-IS on page 3203

level (Global IS-IS)

Syntax

```
level level-number {
  authentication-key key;
  authentication-key-chain (Protocols IS-IS) key-chain-name;
  authentication-type type;
  external-preference preference;
  no-csnp-authentication;
  no-hello-authentication;
  no-psnp-authentication;
  preference preference;
  wide-metrics-only;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure the global-level properties.

You can administratively divide a single AS into smaller groups called areas. You configure each routing device interface to be in an area. Any interface can be in any area. The area address applies to the entire routing device. You cannot specify one interface to be in one area and another interface in a different area. To route between areas, you must have two adjacent Level 2 routers that communicate with each other.

Level 1 routers can only route within their IS-IS area. To send traffic outside their area, Level 1 routers must send packets to the nearest intra-area Level 2 router. A routing device can be a Level 1 router, a Level 2 router, or both. You specify the router level on a per-interface basis, and a routing device becomes adjacent to other routing devices on the same level on that link only.

You can configure one Level 1 routing process and one Level 2 routing process on each interface, and you can configure the two levels differently.

Options

level-number—IS-IS level number.

Values: 1 or 2

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring IS-IS*
- *Example: Configuring Multi-Level IS-IS*

loose-authentication-check

Syntax loose-authentication-check;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Allow the use of MD5 authentication without requiring network-wide deployment.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Hitless Authentication Key Rollover for IS-IS*

lsp-interval

Syntax lsp-interval *milliseconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the link-state PDU interval time.

By default, the routing device sends one link-state PDU packet out an interface every 100 milliseconds. To disable the transmission of all link-state PDUs, set the interval to 0.

Link-state PDU throttling by use of the **lsp-interval** statement controls the flooding pace to neighboring routing devices in order to not overload them.

Also, consider that control traffic (such as link-state PDUs and related packets) might delay user traffic (information packets) because control traffic always has precedence in terms of scheduling on the routing device interface cards. Unfortunately, the control traffic transmission rate is not decreased on low-bandwidth interfaces, such as DS-0 or fractional T1 and E1 interface. Line control traffic stays the same. On a low-bandwidth circuit that is transmitting 30 full-MTU-sized packets, there is not much bandwidth left over for other types of packets.

Default By default, the routing device sends one link-state PDU out an interface every 100 milliseconds.

Options *milliseconds*—Number of milliseconds between the sending of link-state PDUs. Specifying a value of 0 blocks all link-state PDU transmission.

Range: 0 through 1000 milliseconds

Default: 100 milliseconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring the Transmission Frequency for Link-State PDUs on IS-IS Interfaces*

lsp-lifetime

Syntax lsp-lifetime *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify how long a link-state PDU originating from the routing device should persist in the network. The routing device sends link-state PDUs often enough so that the link-state PDU lifetime never expires.

Because link-state PDUs have a maximum lifetime, they need to be refreshed. Refreshing means that a routing device needs to re-originate its link-state PDUs periodically. The re-origination interval must be less than the link-state PDU's lifetime. For example, if the link-state PDU is valid for 1200 seconds, the routing device needs to refresh the link-state PDU in less than 1200 seconds to avoid removal of the link-state PDU from the link-state database by other routing devices. The recommended maximum link-state PDU origination interval is the lifetime minus 300 seconds. So, in a default environment this would be 900 seconds. In Junos OS, the refresh interval is derived from the lifetime and is equal to the lifetime minus 317 seconds. You can change the lifetime to a higher value to reduce the number of refreshes in the network. (You would rarely want to increase the number of refreshes.) Often theses periodic link-state PDU refreshes are referred to as refresh noise, and network administrators want to reduce this noise as much as possible.

The show isis overview command displays the link-state PDU lifetime.

Default By default, link-state PDUs are maintained in network databases for 1200 seconds (20 minutes) before being considered invalid. This length of time, called the *LSP lifetime*, normally is sufficient to guarantee that link-state PDUs never expire.

Options ***seconds***—link-state PDU lifetime, in seconds.

Range: 350 through 65,535 seconds

Default: 1200 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring the Transmission Frequency for Link-State PDUs on IS-IS Interfaces*
- http://www.juniper.net/us/en/training/certification/JNCIP_studyguide.pdf

max-areas

Syntax max-areas *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis]
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Modify the maximum number of IS-IS areas advertised.

This value is included in the Maximum Address Area field of the IS-IS common PDU header included in all outgoing PDUs.

The maximum number of areas you can advertise is restricted to 36 to ensure that the IIH PDUs have enough space to include other type, length, and value (TLV) fields, such as the Authentication and IPv4 and IPv6 Interface Address TLVs.

Options *number*—Maximum number of areas to include in the IS-IS hello (IIH) PDUs and link-state PDUs.

Range: 3 through 36

Default: 3

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Multi-Level IS-IS*

mesh-group (Protocols IS-IS)

Syntax mesh-group (blocked | *value*);

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure an interface to be part of a mesh group, which is a set of fully connected nodes.

A *mesh group* is a set of routing devices that are fully connected. That is, they have a fully meshed topology. When link-state PDUs are being flooded throughout an area, each router within a mesh group receives only a single copy of a link-state PDU instead of receiving one copy from each neighbor, thus minimizing the overhead associated with the flooding of link-state PDUs.

To create a mesh group and designate that an interface be part of the group, assign a mesh-group number to all the routing device interfaces in the group. To prevent an interface in the mesh group from flooding link-state PDUs, configure blocking on that interface.

Options **blocked**—Configure the interface so that it does not flood link-state PDUs.

value—Number that identifies the mesh group.
Range: 1 through 4,294,967,295 (2^{32} – 1; 32 bits are allocated to identify a mesh group)

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Mesh Groups of IS-IS Interfaces*

metric (Protocols IS-IS)

Syntax metric *metric*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name* level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*],
[edit protocols isis interface *interface-name* level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the metric value for the level.

All IS-IS routes have a cost, which is a routing metric that is used in the IS-IS link-state calculation. The cost is an arbitrary, dimensionless integer that can be from 1 through 63, or from 1 through 16,777,215 (2^{24} – 1) if you are using wide metrics.

Similar to other routing protocols, IS-IS provides a way of exporting routes from the routing table into the IS-IS network. When a route is exported into the IS-IS network without a specified metric, IS-IS uses default metric values for the route, depending on the protocol that was used to learn the route.

Table 241 on page 3299 depicts IS-IS route export metric default values.

Table 241: Default Metric Values for Routes Exported into IS-IS

Protocol Used for Learning the Route	Default Metric Value
Direct	10
Static	Same as reported by the protocol used for exporting the route
Aggregate	10
Generate	10
RIP	Same as reported by the protocol used for exporting the route
OSPF	Same as reported by the protocol used for exporting the route
BGP	10

The default metric values behavior can be customized by using routing policies.

Options *metric*—Metric value.

Range: 1 through 63, or 1 through 16,777,215 (if you have configured wide metrics)

Default: 10 (for all interfaces except lo0), 0 (for the lo0 interface)

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Enabling Wide IS-IS Metrics for Traffic Engineering*
- *te-metric*
- wide-metrics-only on page 3325

no-adjacency-holddown

Syntax
no-adjacency-holddown;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information
Statement introduced in Junos OS Release 8.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description
Disable the hold-down timer for IS-IS adjacencies.

A hold-down timer delays the advertising of adjacencies by waiting until a time period has elapsed before labeling adjacencies in the up state. You can disable this hold-down timer, which labels adjacencies up faster. However, disabling the hold-down timer creates more frequent link-state PDU updates and SPF computation.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- hold-time on page 3283

no-authentication-check

Syntax no-authentication-check;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Generate authenticated packets and check the authentication on received packets, but do not reject packets that cannot be authenticated.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

-
- csnp-interval on page 3272
- hello-authentication-type on page 3279

no-csnp-authentication

Syntax no-csnp-authentication;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis level *level-number*],
[edit protocols isis level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Suppress authentication check on complete sequence number PDU (CSNP) packets.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- csnp-interval on page 3272

no-hello-authentication

Syntax no-hello-authentication;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis level *level-number*],
[edit protocols isis level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Suppress authentication check on complete sequence number hello packets.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- hello-authentication-type on page 3279

no-ipv4-multicast

Syntax no-ipv4-multicast;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Exclude an interface from IPv4 multicast topologies.

Default Multicast topologies are disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS Multicast Topology on page 3241

no-ipv4-routing

Syntax
no-ipv4-routing;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description
Disable IP version 4 (IPv4) routing.

Disabling IPv4 routing has the following results:

- The routing device does not advertise the network layer protocol identifier (NLPID) for IPv4 in the Junos OS link-state PDU fragment zero.
- The routing device does not advertise any IPv4 prefixes in Junos OS link-state PDUs.
- The routing device does not advertise the NLPID for IPv4 in Junos OS hello packets.
- The routing device does not advertise any IPv4 addresses in Junos OS hello packets.
- The routing device does not calculate any IPv4 routes.

NOTE: Note: Even when **no-ipv4-routing** is configured, an IS-IS traceoptions log can list rejected IPv4 addresses. When a configuration is committed, IS-IS schedules a scan of the routing table to determine whether any routes need to be exported into the IS-IS link state database. The implicit default export policy action is to reject everything. IPv4 addresses from the routing table are examined for export, rejected by the default policy, and the rejections are logged.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Configuring IS-IS IPv4 and IPv6 Unicast Topologies on page 3232

no-ipv6-multicast

Syntax no-ipv6-multicast;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Exclude an interface from the IPv6 multicast topologies.

Default Multicast topologies are disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS Multicast Topology on page 3241

no-ipv6-routing

Syntax no-ipv6-routing;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Disable IP version 6 (IPv6) routing.

Disabling IPv6 routing has the following results:

- The routing device does not advertise the network layer protocol identifier (NLPID) for IPv6 in the Junos OS link-state PDU fragment zero.
- The routing device does not advertise any IPv6 prefixes in Junos OS link-state PDUs.
- The routing device does not advertise the NLPID for IPv6 in Junos OS hello packets.
- The routing device does not advertise any IPv6 addresses in Junos OS hello packets.
- The routing device does not calculate any IPv6 routes.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS IPv4 and IPv6 Unicast Topologies on page 3232

no-ipv6-unicast

Syntax no-ipv6-unicast;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Exclude an interface from the IPv6 unicast topologies. This enables you to exercise control over the paths that unicast data takes through a network.

Default IPv6 unicast topologies are disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS IPv4 and IPv6 Unicast Topologies on page 3232

no-psnp-authentication

Syntax no-psnp-authentication;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis level *level-number*],
[edit protocols isis level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Suppress authentication check on partial sequence number PDU (PSNP) packets.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring IS-IS Authentication on page 3262

no-unicast-topology

Syntax no-unicast-topology;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Exclude an interface from the IPv4 unicast topologies.

Default IPv4 unicast topologies are disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS Multicast Topology on page 3241

overload (Protocols IS-IS)

Syntax

```
overload {
  advertise-high-metrics;
  allow-route-leaking;
  timeout seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure the local routing device so that it appears to be overloaded. This statement causes the routing device to continue participating in IS-IS routing, but prevents it from being used for transit traffic. Traffic destined to immediately attached subnets continues to transit the routing device.

You can also advertise maximum link metrics in network layer reachability information (NLRI) instead of setting the overload bit.

You configure or disable overload mode in IS-IS with or without a timeout. Without a timeout, overload mode is set until it is explicitly deleted from the configuration. With a timeout, overload mode is set if the time elapsed since the IS-IS instance started is less than the specified timeout.

A timer is started for the difference between the timeout and the time elapsed since the instance started. If the time elapsed after the IS-IS instance is enabled is less than the specified timeout, overload mode is set. When the timer expires, overload mode is cleared. In overload mode, the routing device IS-IS advertisements are originated with the overload bit set. This causes the transit traffic to take paths around the routing device. However, the overloaded routing device's own links are still accessible.

The value of the overload bit depends on these three scenarios:

1. When the overload bit has already been set to a given value and the routing process is restarted: Link-state PDUs are regenerated with the overload bit cleared.
2. When the overload bit is reset to a lesser value while the routing process is running: Link-state PDUs are regenerated with the overload bit cleared.
3. When the overload bit is reset to a greater value while the routing process is running: Link-state PDUs are regenerated with the overload bit set to the difference between the old and new value.

In overload mode, the routing device advertisement is originated with all the transit routing device links (except stub) set to a metric of 0xFFFF. The stub routing device links are advertised with the actual cost of the interfaces corresponding to the stub. This causes the transit traffic to avoid the overloaded routing device and take paths around the routing device.

To understand the reason for setting the overload bit, consider that BGP converges slowly. It is not very good at detecting that a neighbor is down because it has slow-paced keepalive timers. Once the BGP neighbor is determined to be down, it can take up to 2 minutes for a BGP router to declare the neighbor down. IS-IS is much quicker. IS-IS only takes 10-30 seconds to detect absent peers. It is the slowness of BGP, more precisely the slowness of internal BGP (IBGP), that necessitates the use of the overload bit. IS-IS and BGP routing are mutually dependent on each other. If both do not converge at the same time, traffic is dropped without notification (black holed).

You might want to configure the routing device so that it appears to be overloaded when you are restarting routing on the device. Setting the overload bit for a fixed amount of time right after a restart of the routing protocol process (rpd) ensures that the router does not receive transit traffic while the routing protocols (especially IBGP) are still converging.

Setting the overload bit is useful when performing hardware or software maintenance work on a routing device. After the maintenance work, clear the overload bit to carry on forwarding transit traffic. Manual clearing of the overload bit is not always possible. What is needed is an automated way of clearing the overload bit after some amount of time. Most networks use a time value of 300 seconds. This 5-minute value provides a good balance, allowing time to bring up even large internal IBGP meshes, while still relatively quick.

Another appropriate application for setting for the overload bit is on dedicated devices such as BGP route reflectors, which are intentionally not meant to carry any transit traffic. In this case, you would not use the timer.

You can verify that the overload bit is set by running the **show isis database** command.

Options

advertise-high-metrics—Advertise maximum link metrics in NLRIs instead of setting the overload bit.

The **advertise-high-metric** setting is only valid while the routing device is in overload mode. When **advertise-high-metric** is configured, IS-IS does not set the overload bit. Rather, it sets the metric to 63 or 16,777,214, depending whether wide metrics are enabled. This allows the overloaded routing device to be used for transit as a last resort.

An L1-L2 router in overload mode stops leaking route information between L1 and L2 levels and clears its attached bit. This is also true when **advertise-high-metrics** is configured.

allow-route-leaking—Enable leaking of route information into the network even if the overload bit is set.

NOTE: **The allow-route-leaking option does not work if the routing device is in dynamic overload mode. Dynamic overload can occur if the device has exceeded its resource limits, such as the prefix limit.**

timeout *seconds*—Number of seconds at which the overloading is reset.

Range: 60 through 1800 seconds

Default: 0 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring IS-IS*

passive (Protocols IS-IS)

Syntax

passive;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* protocols isis interface *interface-name* level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*],
[edit protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name* level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Advertise the direct interface addresses on an interface or into a level on the interface without actually running IS-IS on that interface or level.

This statement effectively prevents IS-IS from running on the interface. To enable IS-IS on an interface, include the **interface** statement at the **[edit protocols isis]** or the **[edit routing-instances *routing-instance-name* protocols isis]** hierarchy level. To disable it, include the **disable** statement at those hierarchy levels. The three states—enabling, disabling, or not running IS-IS on an interface—are mutually exclusive.

NOTE: Configuring IS-IS on a loopback interface automatically renders it as a passive interface, irrespective of whether the **passive** statement was used in the configuration of the interface.

If neither passive mode nor the **family iso** option is configured on the IS-IS interface, then the routing device treats the interface as not being operational, and no direct IPv4/IPv6 routes are exported into IS-IS. (You configure the **family iso** option at the **[edit interfaces *interface-name* unit *logical-unit-number*]** hierarchy level.)

Default

By default, IS-IS must be configured on an interface or a level for direct interface addresses to be advertised into that level.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Multi-Level IS-IS on page 3203
- *disable*

point-to-point

Syntax point-to-point;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name*],
[edit protocols isis interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure an IS-IS interface to behave like a point-to-point connection.

You can use the **point-to-point** statement to configure a LAN interface to act like a point-to-point interface for IS-IS. You do not need an unnumbered LAN interface, and it has no effect if configured on an interface that is already point-to-point.

The **point-to-point** statement affects only IS-IS protocol procedures on that interface. All other protocols continue to treat the interface as a LAN interface. Only two IS-IS routing devices can be connected to the LAN interface, and both must be configured as point-to-point.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- IS-IS Overview on page 3189
- Understanding IS-IS Designated Routers on page 3259

- *Example: Configuring Synchronization Between IS-IS and LDP*

preference (Protocols IS-IS)

Syntax preference *preference*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis level *level-number*],
[edit protocols isis level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the preference of internal routes.

Route preferences (also known as administrative distances) are used to select which route is installed in the forwarding table when several protocols calculate routes to the same destination. The route with the lowest preference value is selected.

To change the preference values, include the **preference** statement (for internal routes) or the **external-preference** statement.

Options *preference*—Preference value.

Range: 0 through 4,294,967,295 (2^{32} – 1)

Default: 15 (for Level 1 internal routes), 18 (for Level 2 internal routes), 160 (for Level 1 external routes), 165 (for Level 2 external routes)

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Route Preferences Overview*
- *Example: Redistributing OSPF Routes into IS-IS*
- *Example: Redistributing BGP Routes with a Specific Community Tag into IS-IS*
- external-preference on page 3275

prefix-export-limit (Protocols IS-IS)

Syntax prefix-export-limit *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis level *level-number*],
[edit protocols isis level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure a limit to the number of prefixes exported into IS-IS.

By default, there is no limit to the number of prefixes that can be exported into IS-IS. To configure a limit to the number of prefixes that can be exported into IS-IS, include the **prefix-export-limit** statement. The **prefix-export-limit** statement protects the rest of the network from a malicious policy by applying a threshold filter for exported routes.

The number of prefixes depends on the size of your network. Good design advice is to set it to double the total number of IS-IS Level 1 and Level 2 routing devices in your network.

If the number of prefixes exported into IS-IS exceeds the configured limit, the overload bit is set and the overload state is reached. When other routers detect that this bit is set, they do not use this routing device for transit traffic, but they do use it for packets destined to the overloaded routing device's directly connected networks and IP prefixes. The overload state can be cleared by using the **clear isis overload** command.

The **show isis overview** command displays the prefix export limit when it is configured.

Options *number*—Prefix limit.

Range: 0 through 4,294,967,295 ($2^{32} – 1$)

Default: None

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Redistributing BGP Routes with a Specific Community Tag into IS-IS*
- *Example: Redistributing OSPF Routes into IS-IS*

priority (Protocols IS-IS)

Syntax priority *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis interface *interface-name* level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*],
[edit protocols isis interface *interface-name* level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis interface *interface-name* level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the interface's priority for becoming the designated router. The interface with the highest priority value becomes that level's designated router.

The priority value is meaningful only on a multiaccess network. It has no meaning on a point-to-point interface.

A routing device advertises its priority to become a designated router in its hello packets. On all multiaccess networks, IS-IS uses the advertised priorities to elect a designated router for the network. This routing device is responsible for sending network link-state advertisements, which describe all the routing devices attached to the network. These advertisements are flooded throughout a single area.

A routing device's priority for becoming the designated router is indicated by an arbitrary number from 0 through 127. Routing devices with a higher value are more likely to become the designated router.

Options *number*—Priority value.

Range: 0 through 127

Default: 64

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS Designated Routers on page 3258

reference-bandwidth (Protocols IS-IS)

Syntax reference-bandwidth *reference-bandwidth*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Optimize routing based on bandwidth by setting the reference bandwidth used in calculating the default interface cost.

All IS-IS interfaces have a cost, which is a routing metric that is used in the IS-IS link-state calculation. Routes with lower total path metrics are preferred over those with higher path metrics. When there are several equal-cost routes to a destination, traffic is distributed equally among them.

The cost of a route is described by a single dimensionless metric that is determined using the following formula:

cost = reference-bandwidth/bandwidth

For example, if you set the reference bandwidth to 1 Gbps (that is, ***reference-bandwidth*** is set to 1,000,000,000), a 100-Mbps interface has a routing metric of 10.

All IS-IS interfaces have a cost, which is a routing metric that is used in the IS-IS link-state calculation. Routes with lower total path metrics are preferred over those with higher path metrics.

Options ***reference-bandwidth***—Reference bandwidth value in bits per second.

Range: 9600 through 1,000,000,000,000 bps

Default: None

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring IS-IS*
- http://www.juniper.net/us/en/training/certification/JNCIP_studyguide.pdf

rib-group (Protocols IS-IS)

Syntax

```
rib-group {
  inet group-name;
  inet6 group-name;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Install routes learned from IS-IS routing instances into routing tables in the IS-IS routing table group. You can install IPv4 routes or IPv6 routes.

Support for IPv6 routing table groups in IS-IS enables IPv6 routes that are learned from IS-IS routing instances to be installed into other routing tables defined in an IS-IS routing table group.

Options

group-name—Name of the routing table group.

inet—Install IPv4 IS-IS routes.

inet6—Install IPv6 IS-IS routes.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Exporting Specific Routes from One Routing Table Into Another Routing Table*
- *Example: Importing Direct and Static Routes Into a Routing Instance*
- *Understanding Multiprotocol BGP*

topologies (Protocols IS-IS)

Syntax

```
topologies {
  ipv4-multicast;
  ipv6-multicast;
  ipv6-unicast;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure alternate IS-IS topologies.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IS-IS IPv4 and IPv6 Unicast Topologies on page 3232
- Example: Configuring IS-IS Multicast Topology on page 3241

traceoptions (Protocols IS-IS)

Syntax

traceoptions {
  file *name* <size *size*> <files *number*> <world-readable | no-world-readable>;
  flag *flag* <*flag-modifier*> <disable>;
}

Hierarchy Level

[edit logical-systems *logical-system-name* protocols isis],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis],
[edit protocols isis],
[edit routing-instances *routing-instance-name* protocols isis]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure IS-IS protocol-level tracing options. To specify more than one tracing operation, include multiple **flag** statements.

NOTE: **The traceoptions statement is not supported on QFabric systems.**

Default

The default IS-IS protocol-level tracing options are those inherited from the routing protocols **traceoptions** statement included at the **[edit routing-options]** hierarchy level.

Options

disable—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *name*—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks (“ ”). All files are placed in the directory **/var/log**. We recommend that you place IS-IS tracing output in the file **isis-log**.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten.

If you specify a maximum number of files, you also must specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 10 files

flag *flag*—Tracing operation to perform. To specify more than one flag, include multiple **flag** statements.

IS-IS Protocol-Specific Tracing Flags

- **csn**—Complete sequence number PDU (CSNP) packets
- **error**—Errored IS-IS packets
- **graceful-restart**—Graceful restart operation
- **hello**—Hello packets
- **ldp-synchronization**—Synchronization between IS-IS and LDP
- **lsp**—Link-state PDUs
- **lsp-generation**—Link-state PDU generation packets
- **packets**—All IS-IS protocol packets
- **psn**—Partial sequence number PDU (PSNP) packets
- **spf**—Shortest-path-first calculations

Global Tracing Flags

- **all**—All tracing operations
- **general**—A combination of the **normal** and **route** trace operations
- **normal**—All normal operations, including adjacency changes

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **policy**—Policy operations and actions
- **route**—Routing table changes
- **state**—State transitions
- **task**—Routing protocol task processing
- **timer**—Routing protocol timer processing

flag-modifier—(Optional) Modifier for the tracing flag. You can specify one or more of these modifiers:

- **detail**—Provide detailed trace information.
- **receive**—Trace the packets being received.
- **send**—Trace the packets being transmitted.

no-world-readable—(Optional) Prevent any user from reading the log file.

size ***size***—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. Note that if you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 128 KB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring the Transmission Frequency for CSNPs on IS-IS Interfaces*
- *Example: Configuring the Transmission Frequency for Link-State PDUs on IS-IS Interfaces*
- *Example: Enabling Packet Checksums on IS-IS Interfaces*

traffic-engineering (Protocols IS-IS)

Syntax

```
traffic-engineering {
  disable;
  credibility-protocol-preference;
  family inet {
    shortcuts {
      multicast-rpf-routes;
    }
  }
  family inet6 {
    shortcuts;
  }
  multipath {
    lsp-equal-cost;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols isis],
[edit protocols isis]

Release Information

Statement introduced before Junos OS Release 7.4.
Support for the **family** statement introduced in Junos OS Release 9.3.
Support for the **credibility-protocol-preference** statement introduced in Junos OS Release 9.4.
Support for the **multipath** statement introduced in Junos OS Release 9.6.
Support for the **lsp-equal-cost** statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure traffic engineering properties for IS-IS.

IS-IS always performs shortest-path-first (SPF) calculations to determine next hops. For prefixes reachable through a particular next hop, IS-IS places that next hop for that prefix in the inet.0 routing table. In addition, for routers running MPLS, IS-IS installs the prefix for IPv4 routes in the inet.3 routing table as well. The inet.3 table, which is present on the ingress router, contains the host address of each MPLS label-switched path (LSP) egress router. BGP uses this routing table to resolve next-hop addresses.

If you enable IS-IS traffic engineering shortcuts and if there is a label-switched path to a point along the path to that prefix, IS-IS installs the prefix in the inet.3 routing table and uses the LSP as a next hop. The net result is that for BGP egress routers for which there is no LSP, BGP automatically uses an LSP along the path to reach the egress router.

In Junos OS Release 9.3 and later, IS-IS traffic engineering shortcuts support IPv6 routes. LSPs to be used for shortcuts continue to be signaled using IPv4. However, by default, shortcut routes calculated through IPv6 routes are added to the inet6.3 routing table. The default behavior is for only BGP to use LSPs in its calculations. If you configure MPLS so that both BGP and interior gateway protocols use LSPs for forwarding traffic, shortcut routes calculated through IPv6 are added to the inet6.0 routing table. IS-IS ensures that the IPv6 routes running over the IPv4 MPLS LSP are correctly de-encapsulated at the tunnel egress by pushing an extra IPv6 explicit null label between the IPv6 payload and the IPv4 transport label.

RSVP LSPs with a higher preference than IS-IS routes are not considered during the computation of traffic engineering shortcuts.

To configure IS-IS so that it uses LSPs as shortcuts when installing information in the inet.3 or inet6.3 routing table, include the following statements:

```
family inet {
  shortcuts {
    multicast-rpf-routes;
  }
}
family inet6 {
  shortcuts;
}
```

For IPv4 traffic, include the **inet** statement. For IPv6 traffic, include the **inet6** statement.

To configure load balancing across multiple LSPs, include the **multipath** statement.

When traffic engineering shortcuts are used, RSVP first looks at the **metric2** value, which is derived from the IGP cost. After this, RSVP considers the LSP metric value. So, if a certain path changes for an LSP and the cost changes, not all LSPs are used to load-balance the network.

When a route with an improved metric is added to the IS-IS internal routing table, IS-IS flushes all next-hop information (including LSP next-hop information) for a route. This is undesirable, because certain equal-cost multipath (ECMP) combinations can be lost during route calculation. To override this default behavior for load balancing, include the **lsp-equal-cost** statement to retain the equal cost path information in the routing table.

```
multipath {
  lsp-equal-cost;
}
```

Because the inet.3 routing table is present only on ingress routers, you can configure LSP shortcuts only on these routers.

Default IS-IS traffic engineering support is enabled.

By default, IS-IS supports traffic engineering by exchanging basic information with the traffic engineering database. To disable this support, and to disable IS-IS shortcuts if they are configured, include the **disable** statement.

Options

credibility-protocol-preference—Specify that IS-IS should use the configured protocol preference for IGP routes to determine the traffic engineering database credibility value. By default, the traffic engineering database prefers IS-IS routes even when the routes of another IGP are configured with a lower, that is, more preferred value. Use this statement to override this default behavior.

The traffic engineering database assigns a credibility value to each IGP and prefers the routes of the IGP with the highest credibility value. In Junos OS Release 9.4 and later, you can configure IS-IS to take protocol preference into account to determine the traffic engineering database credibility value. When protocol preference is used to determine the credibility value, IS-IS routes are not automatically preferred by the traffic engineering database, depending on your configuration. For example, OSPF routes have a default preference value of 10, whereas IS-IS Level 1 routes have a default preference value of 15. When protocol preference is enabled, the credibility value is determined by deducting the protocol preference value from a base value of 512. Using default protocol preference values, OSPF has a credibility value of 502, whereas IS-IS has a credibility value of 497. Because the traffic engineering database prefers IGP routes with the highest credibility value, OSPF routes are now preferred.

NOTE: This feature is also supported for OSPFv2.

lsp-equal-cost—Configure LSPs to be retained as equal cost paths for load balancing when a better path metric is found during the IS-IS internal routing table calculation. When a route with an improved metric is added to the IS-IS internal routing table, IS-IS flushes all next-hop information (including LSP next-hop information) for a route. This is undesirable, because certain equal-cost multipath (ECMP) combinations can be lost during route calculation. To override this default IS-IS behavior, include the **lsp-equal-cost** statement for load balancing, so that the equal cost path information is retained in the routing table.

multipath—Enable load balancing for multiple LSPs.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Enabling OSPF Traffic Engineering Support on page 3481
- *Example: Enabling IS-IS Traffic Engineering Support*
- **traffic-engineering (OSPF) on page 3566**

wide-metrics-only

Syntax wide-metrics-only;

Hierarchy Level [edit logical-systems *logical-system-name* protocols isis level *level-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols isis level *level-number*],
[edit protocols isis level *level-number*],
[edit routing-instances *routing-instance-name* protocols isis level *level-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure IS-IS to generate metric values greater than 63 on a per IS-IS level basis.

Normally, IS-IS metrics can have values up to 63, and IS-IS generates two type, length, and value (TLV) tuples, one for an IS-IS adjacency and the second for an IP prefix. To allow IS-IS to support traffic engineering, a second pair of TLVs has been added to IS-IS, one for IP prefixes and the second for IS-IS adjacency and traffic engineering information. With these TLVs, IS-IS metrics can have values up to 16,777,215 (2^{24} – 1).

To configure IS-IS to generate only the new pair of TLVs and thus to allow the wider range of metric values, include the **wide-metrics-only** statement.

Default By default, Junos OS supports the sending and receiving of wide metrics. Junos OS allows a maximum metric value of 63 and generates both pairs of TLVs.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Enabling Wide IS-IS Metrics for Traffic Engineering*
- *te-metric*

CHAPTER 36

Administration

Operational Commands

- clear isis adjacency
- clear isis database
- clear isis overload
- clear isis statistics
- show isis adjacency
- show isis authentication
- show isis database
- show isis hostname
- show isis interface
- show isis overview
- show isis route
- show isis statistics

clear isis adjacency

Syntax

clear isis adjacency
<instance *instance-name*>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>
<*neighbor*>

Syntax (EX Series Switches and QFX Series)

clear isis adjacency
<instance *instance-name*>
<interface *interface-name*>
<*neighbor*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Remove entries from the IS-IS adjacency database.

Options

none—Remove all entries from the adjacency database.

instance ***instance-name***—(Optional) Clear all adjacencies for the specified routing instance only.

interface ***interface-name***—(Optional) Clear all adjacencies for the specified interface only.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

neighbor—(Optional) Clear adjacencies for the specified neighbor only.

Required Privilege Level

clear

Related Documentation

- show isis adjacency on page 3336

List of Sample Output

clear isis adjacency on page 3328

Output Fields

See show isis adjacency for an explanation of output fields.

Sample Output

clear isis adjacency

The following sample output displays IS-IS adjacency database information before and after the **clear isis adjacency** command is entered:

```
user@host> show isis adjacency
IS-IS adjacency database:
Interface      System         L State        Hold (secs) SNPA
so-1/0/0.0     karakul        3 Up                  26
so-1/1/3.0     1921.6800.5080 3 Up                  23
```



```
so-5/0/0.0    1921.6800.5080 3 Up                   19
```

user@host> **clear isis adjacency karakul**

user@host> **show isis adjacency**
```
IS-IS adjacency database:
Interface     System         L State        Hold (secs) SNPA
so-1/0/0.0    karakul        3 Initializing         26
so-1/1/3.0    1921.6800.5080 3 Up                   24
so-5/0/0.0    1921.6800.5080 3 Up                   21
```

clear isis database

Syntax

clear isis database
<*entries*>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<purge>

Syntax (EX Series Switches and QFX Series)

clear isis database
<*entries*>
<instance *instance-name*>
<purge>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
purge option introduced in Junos OS Release 9.0.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Remove the entries from the IS-IS link-state database, which contains prefixes and topology information. You can also use **purge** with any of the options to initiate a network-wide purge of link-state PDUs rather than the local deletion of entries from the IS-IS link-state database.

CAUTION: In a production network, the **purge** command option might cause short-term network-wide traffic disruptions.

Options

none—Remove all entries from the IS-IS link-state database for all routing instances.

entries—(Optional) Name of the database entry.

instance *instance-name*—(Optional) Clear all entries for the specified routing instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

purge—(Optional) Discard all entries in the IS-IS link-state database.

Required Privilege Level

clear

Related Documentation

- show isis database on page 3342

List of Sample Output

clear isis database on page 3331

Output Fields

See show isis database for an explanation of output fields.

Sample Output

clear isis database

The following sample output displays IS-IS link-state database information before and after the **clear isis database** command is entered:

```
user@host> show isis database
IS-IS level 1 link-state database:
LSP ID                  Sequence Checksum Lifetime (secs)
crater.00-00                0x12   0x84dd            1139
  1 LSPs
IS-IS level 2 link-state database:
LSP ID                  Sequence Checksum Lifetime (secs)
crater.00-00                0x19   0xe92c            1134
badlands.00-00              0x16   0x1454             985
carlsbad.00-00              0x33   0x220b            1015
ranier.00-00                0x2e   0xfc31            1007
1921.6800.5066.00-00        0x11   0x7313             566
1921.6800.5067.00-00        0x14   0xd9d4             939
  6 LSPs
```

```
user@host> clear isis database
```

```
user@host> show isis database
IS-IS level 1 link-state database:
LSP ID                  Sequence Checksum Lifetime (secs)

IS-IS level 2 link-state database:
LSP ID                  Sequence Checksum Lifetime (secs)
```


clear isis overload

Syntax

clear isis overload
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series)

clear isis overload
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Reset the IS-IS dynamic overload bit. This command can appear to not work, continuing to display **overload** after execution. The bit is reset only if the root cause is corrected by configuration remotely or locally.

When other routers detect that the overload bit is set, they do not use this routing device for transit traffic, but they do use it for packets destined to the overloaded routing device's directly connected networks and IP prefixes.

Options

none—Reset the IS-IS dynamic overload bit.

instance ***instance-name***—(Optional) Reset the IS-IS dynamic overload bit for the specified routing instance.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

clear

Related Documentation

- show isis database on page 3342

List of Sample Output

clear isis overload on page 3332

Output Fields

See show isis database for an explanation of output fields.

Sample Output

clear isis overload

The following sample output displays IS-IS database information before and after the **clear isis overload** command is entered:

```
user@host> show isis database
IS-IS level 1 link-state database:
LSP ID                    Sequence Checksum Lifetime Attributes
pro3-c.00-00                   0x4   0x10db     1185 L1 L2 Overload

  1 LSPs
```



```
IS-IS level 2 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
pro3-c.00-00                     0x5   0x429f     1185 L1 L2 Overload


pro2-a.00-00                   0x91e   0x2589      874 L1 L2
pro2-a.02-00                     0x1    0xcbc      874 L1 L2
  3 LSPs
```

```
user@host>  clear isis overload
```

```
user@host> show isis database
IS-IS level 1 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
pro3-c.00-00                     0xa   0x429e     1183 L1 L2
  1 LSPs

IS-IS level 2 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
pro3-c.00-00                     0xc   0x9c39     1183 L1 L2
pro2-a.00-00                   0x91e   0x2589      783 L1 L2
pro2-a.02-00                     0x1    0xcbc      783 L1 L2
  3 LSPs
```

clear isis statistics

Syntax

clear isis statistics
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series)

clear isis statistics
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Set statistics about IS-IS traffic to zero.

Options

none—Set IS-IS traffic statistics to zero for all routing instances.

instance ***instance-name***—(Optional) Set IS-IS traffic statistics to zero for the specified routing instance only.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- show isis statistics on page 3361

List of Sample Output

clear isis statistics on page 3334

Output Fields

See show isis statistics for an explanation of output fields.

Sample Output

clear isis statistics

The following sample output displays IS-IS statistics before and after the **clear isis statistics** command is entered:

```
user@host> show isis statistics
IS-IS statistics for merino:

PDU type     Received  Processed      Drops       Sent     Rexmit
LSP             12793      12793          0       8666        719
IIH            116751     116751          0     118834          0
CSNP           203956     203956          0     204080          0
PSNP             7356       7350          6       8635          0
Unknown             0          0          0          0          0
Totals         340856     340850          6     340215        719

Total packets received: 340856 Sent: 340934

SNP queue length:           0 Drops:          0
```

```
LSP queue length:           0 Drops:          0

SPF runs:                1064
Fragments rebuilt:       1087
LSP regenerations:        436
Purges initiated:           0
```

user@host> **clear isis statistics**

user@host> **show isis statistics**

```
IS-IS statistics for merino:

PDU type     Received  Processed      Drops       Sent      Rexmit
LSP                 0          0          0          0           0
IIH                 3          3          0          3           0
CSNP                2          2          0          4           0
PSNP                0          0          0          0           0
Unknown             0          0          0          0           0
Totals              5          5          0          7           0

Total packets received: 5 Sent: 7

SNP queue length:           0 Drops:          0
LSP queue length:           0 Drops:          0

SPF runs:                   0
Fragments rebuilt:          0
LSP regenerations:          0
Purges initiated:           0
```

show isis adjacency

Syntax

show isis adjacency
<system-id>
<brief | detail | extensive>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series)

show isis adjacency
<system-id>
<brief | detail | extensive>
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display information about IS-IS neighbors.

Options

none—Display standard information about IS-IS neighbors for all routing instances.

system id—(Optional) Display information about IS-IS neighbors for the specified intermediate system.

brief | detail | extensive—(Optional) Display standard information about IS-IS neighbors with the specified level of output.

instance *instance-name*—(Optional) Display information about IS-IS neighbors for the specified routing instance.

logical-system (all | *logical-system-name*)—(Optional) Display information about IS-IS neighbors for all logical systems or for a particular logical system.

Required Privilege Level

view

Related Documentation

- clear isis adjacency on page 3328

List of Sample Output

show isis adjacency on page 3338
show isis adjacency brief on page 3338
show isis adjacency detail on page 3339
show isis adjacency extensive on page 3339

Output Fields

Table 242 on page 3336 describes the output fields for the **show isis adjacency** command. Output fields are listed in the approximate order in which they appear.

Table 242: show isis adjacency Output Fields

Field Name	Field Description	Level of Output
Interface	Interface through which the neighbor is reachable.	All levels

Table 242: show isis adjacency Output Fields *(continued)*

Field Name	Field Description	Level of Output
System	System identifier (**sysid**), displayed as a name, if possible.	**brief**
L or Level	Level: • **1**—Level 1 only • **2**—Level 2 only • **3**—Level 1 and Level 2 An exclamation point (**!**) preceding the level number indicates that the adjacency is missing an IP address.	All levels
State	State of the adjacency: **Up**, **Down**, **New**, **One-way**, **Initializing**, or **Rejected**.	All levels
Hold (secs)	Remaining hold time of the adjacency.	**brief**
SNPA	Subnetwork point of attachment (MAC address of the next hop).	**brief**
Expires in	How long until the adjacency expires, in seconds.	**detail**
Priority	Priority to become the designated intermediate system.	**detail extensive**
Up/Down transitions	Count of adjacency status changes from **Up** to **Down** or from **Down** to **Up**.	**detail**
Last transition	Time of the last **Up/Down** transition.	**detail**
Circuit type	Bit mask of levels on this interface: **1**=Level 1 router; **2**=Level 2 router; **3**=both Level 1 and Level 2 router.	**detail**
Speaks	Protocols supported by this neighbor.	**detail extensive**
MAC address	MAC address of the interface.	**detail extensive**
Topologies	Supported topologies.	**detail extensive**
Restart capable	Whether a neighbor is capable of graceful restart: **Yes** or **No**.	**detail extensive**
Adjacency advertisement: Advertise	This routing device has signaled to advertise this interface to its neighbors in their link-state PDUs.	**detail extensive**
Adjacency advertisement: Suppress	This neighbor has signaled not to advertise the interface in the routing device's outbound link-state PDUs.	**detail extensive**
IP addresses	IP address of this neighbor.	**detail extensive**

Table 242: show isis adjacency Output Fields *(continued)*

Field Name	Field Description	Level of Output

Transition log	List of recent transitions, including:
	• **When**—Time at which an IS-IS adjacency transition occurred.
	• **State**—Current state of the IS-IS adjacency (**up**, **down**, or **rejected**).
	  ◦ **Up**—Adjacency is up and operational.
	  ◦ **Down**—Adjacency is down and not available.
	  ◦ **Rejected**—Adjacency has been rejected.
	• **Event**—Type of transition that occurred.
	  ◦ **Seenself**—Possible routing loop has been detected.
	  ◦ **Interface down**—IS-IS interface has gone down and is no longer available.
	  ◦ **Error**—Adjacency error.
	• **Down reason**—Reason that an IS-IS adjacency is down:
	  ◦ **3-Way Handshake Failed**—Connection establishment failed.
	  ◦ **Address Mismatch**—Address mismatch caused link failure.
	  ◦ **Aged Out**—Link expired.
	  ◦ **ISO Area Mismatch**—IS-IS area mismatch caused link failure.
	  ◦ **Bad Hello**—Unacceptable hello message caused link failure.
	  ◦ **BFD Session Down**—Bidirectional failure detection caused link failure.
	  ◦ **Interface Disabled**—IS-IS interface is disabled.
	  ◦ **Interface Down**—IS-IS interface is unavailable.
	  ◦ **Interface Level Disabled**—IS-IS level is disabled.
	  ◦ **Level Changed**—IS-IS level has changed on the adjacency.
	  ◦ **Level Mismatch**—Levels on adjacency are not compatible.
	  ◦ **MPLS LSP Down**—Label-switched path (LSP) is unavailable.
	  ◦ **MT Topology Changed**—IS-IS topology has changed.
	  ◦ **MT Topology Mismatch**—IS-IS topology is mismatched.
	  ◦ **Remote System ID Changed**—Adjacency peer system ID changed.
	  ◦ **Protocol Shutdown**—IS-IS protocol is disabled.
	  ◦ **CLI Command**—Adjacency brought down by user.
	  ◦ **Unknown**—Unknown.
		extensive

Sample Output

show isis adjacency

```
user@host> show isis adjacency
Interface             System         L State        Hold (secs) SNPA
at-2/3/0.0            ranier         3  Up                   23
```

show isis adjacency brief

The output for the **show isis adjacency brief** command is identical to that for the **show isis adjacency** command. For sample output, see show isis adjacency on page 3338.

show isis adjacency detail

```
user@host> show isis adjacency detail
ranier
  Interface: at-2/3/0.0, Level: 3, State: Up, Expires in 21 secs
  Priority: 0, Up/Down transitions: 1, Last transition: 00:01:09 ago
  Circuit type: 3, Speaks: IP, IPv6
  Topologies: Unicast
  Restart capable: Yes
  IP addresses: 11.1.1.2
```

show isis adjacency extensive

```
user@host> show isis adjacency extensive
ranier
  Interface: at-2/3/0.0, Level: 3, State: Up, Expires in 22 secs
  Priority: 0, Up/Down transitions: 1, Last transition: 00:01:16 ago
  Circuit type: 3, Speaks: IP, IPv6
  Topologies: Unicast
  Restart capable: Yes
  IP addresses: 11.1.1.2
  Transition log:
  When                  State        Event           Down reason
  Wed Nov  8 21:24:25   Up           Seenself
```

show isis authentication

Syntax

show isis authentication
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series)

show isis authentication
<instance *instance-name*>

Release Information

Command introduced in Junos OS Release 7.5.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Support for hitless authentication key rollover introduced in Junos OS Release 11.2.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display information about IS-IS authentication.

Options

none—Display information about IS-IS authentication.

instance ***instance-name***—(Optional) Display IS-IS authentication for the specified routing instance.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show isis authentication on page 3341
show isis authentication (With Hitless Authentication Key Rollover Configured) on page 3341

Output Fields

Table 243 on page 3340 describes the output fields for the **show isis authentication** command. Output fields are listed in the approximate order in which they appear.

Table 243: show isis authentication Output Fields

Field Name	Field Description
Interface	Interface name.
Level	IS-IS level.
IIH Auth	IS-IS Hello (IIH) packet authentication type. Displays the name of the active keychain if hitless authentication key rollover is configured.
CSN Auth	Complete sequence number authentication type.
PSN Auth	Partial sequence number authentication type.

Table 243: show isis authentication Output Fields *(continued)*

Field Name	Field Description
L1 LSP Authentication	Layer 1 link-state PDU authentication type.
L2 LSP Authentication	Layer 2 link-state PDU authentication type.

Sample Output

show isis authentication

```
user@host> show isis authentication
Interface            Level IIH Auth  CSN Auth  PSN Auth
at-2/3/0.0           1     Simple    Simple    Simple
                     2     MD5       MD5       MD5

L1 LSP Authentication: Simple
L2 LSP Authentication: MD5
```

show isis authentication (With Hitless Authentication Key Rollover Configured)

```
user@host> show isis authentication
Interface            Level IIH Auth  CSN Auth  PSN Auth
so-0/1/3.0           2     hakrhello MD5       MD5

L2 LSP Authentication: MD5
```

show isis database

Syntax

show isis database
<system-id>
<brief | detail | extensive>
<instance *instance-name*>
<level (1 | 2)>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series)

show isis database
<system-id>
<brief | detail | extensive>
<level (1 | 2)>
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display the entries in the IS-IS link-state database, which contains data about PDU packets.

Options

none—Display standard information about IS-IS link-state database entries for all routing instances.

system id—(Optional) Display IS-IS link-state database entries for the specified intermediate system.

brief | detail | extensive—(Optional) Display the specified level of output.

instance *instance-name*—(Optional) Display IS-IS link-state database entries for the specified routing instance.

level (1 | 2)—(Optional) Display IS-IS link-state database entries for the specified IS-IS level.

logical-system (all | *logical-system-name*)—(Optional) Display standard information about IS-IS link-state database entries for all logical systems or for a particular logical system.

Required Privilege Level

view

Related Documentation

- clear isis database on page 3330

List of Sample Output

show isis database on page 3344
show isis database brief on page 3345
show isis database detail on page 3345
show isis database extensive on page 3345

Output Fields Table 244 on page 3343 describes the output fields for the **show isis database** command. Output fields are listed in the approximate order in which they appear. Fields that contain internal IS-IS information useful only in troubleshooting obscure problems are not described in the table. For more details about these fields, contact your customer support representative.

Table 244: show isis database Output Fields

Field Name	Field Description	Level of Output
Interface name	Name of the interface on which the link-state PDU has been received; always **IS-IS** for this command.	All levels
level	Level of intermediate system: • **1**—Intermediate system routes within an area; when the destination is outside an area, it routes toward a Level 2 system. • **2**—Intermediate system routes between areas and toward other ASs.	All levels
LSP ID	Link-state PDU identifier.	All levels
Sequence	Sequence number of the link-state PDU.	All levels
Checksum	Checksum value of the link-state PDU.	All levels
Lifetime (secs)	Remaining lifetime of the link-state PDU, in seconds.	All levels
Attributes	Attributes of the specified database: **L1**, **L2**, **Overload**, or **Attached** (L1 only).	none **brief**
# LSPs	Total number of link-state PDUs in the specified link-state database.	none **brief**
IP prefix	Prefix advertised by this link-state PDU.	**detail extensive**
IS neighbor	IS-IS neighbor of the advertising system.	**detail extensive**
ES neighbor	(J Series routers only) An ES-IS neighbor of the advertising system.	**detail extensive**
IP prefix	IPv4 prefix advertised by this link-state PDU.	**detail extensive**
V6 prefix	IPv6 prefix advertised by this link-state PDU.	**detail extensive**
Metric	Metric of the prefix or neighbor.	**detail extensive**
Header	• **LSP ID**—Link state PDU identifier of the header. • **Length**—Header length. • **Allocated Length**—Amount of length available for the header. • **Router ID**—Address of the local routing device. • **Remaining Lifetime**—Remaining lifetime of the link-state PDU, in seconds.	**extensive**

Table 244: show isis database Output Fields *(continued)*

Field Name	Field Description	Level of Output
Packet	• **LSP ID**—The identifier for the link-state PDU. • **Length**—Packet length. • **Lifetime**—Remaining lifetime, in seconds. • **Checksum**—The checksum of the link-state PDU. • **Sequence**—The sequence number of the link-state PDU. Every time the link-state PDU is updated, this number increments. • **Attributes**—Packet attributes. • **NLPID**—Network layer protocol identifier. • **Fixed length**—Specifies the set length for the packet.	**extensive**
TLVs	• **Area Address**—Area addresses that the routing device can reach. • **Speaks**—Supported routing protocols. • **IP router id**—ID of the routing device (usually the IP address). • **IP address**—IPv4 address. • **Hostname**—Assigned name of the routing device. • **IP prefix**—IP prefix of the routing device. • **Metric**—IS-IS metric that measures the cost of the adjacency between the originating routing device and the advertised routing device. • **IP extended prefix**—Extended IP prefix of the routing device. • **IS neighbor**—Directly attached neighbor's name and metric. • **IS extended neighbor**—Directly attached neighbor's name, metric, and IP address.	**extensive**

Sample Output

show isis database

```
user@host> show isis database
IS-IS level 1 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
kobuk.00-00                      0x3   0x3167     1057 L1 L2
camaro.00-00                     0x5   0x770e     1091 L1 L2
ranier.00-00                     0x4   0xaa95     1091 L1 L2
glacier.00-00                    0x4   0x206f     1089 L1 L2
glacier.02-00                    0x1   0xd141     1089 L1 L2
badlands.00-00                   0x3   0x87a2     1093 L1 L2
  6 LSPs

IS-IS level 2 link-state database:
LSP ID                      Sequence Checksum Lifetime Attributes
kobuk.00-00                      0x6   0x8d6b     1096 L1 L2
camaro.00-00                     0x9   0x877b     1101 L1 L2
ranier.00-00                     0x8   0x855d     1103 L1 L2
glacier.00-00                    0x7   0xf892     1098 L1 L2
glacier.02-00                    0x1   0xd141     1089 L1 L2
badlands.00-00                   0x6    0x562     1105 L1 L2
  6 LSPs
```


show isis database brief

The output for the **show isis database brief** command is identical to that for the **show isis database** command. For sample output, see show isis database on page 3344.

show isis database detail

user@host> **show isis database logical-system CE3 sisira.00-00 detail**

```
IS-IS level 1 link-state database:

sisira.00-00 Sequence: 0x11, Checksum: 0x10fc, Lifetime: 975 secs
   IS neighbor: hemantha-CE3.02               Metric:       10
   ES neighbor: 0015.0015.0015                Metric:       10 Down
   ES neighbor: 0025.0025.0025                Metric:       10 Down
   ES neighbor: 0030.0030.0030                Metric:       10 Down
   ES neighbor: 0040.0040.0040                Metric:       10 Down
   ES neighbor: sisira                        Metric:        0
   IP prefix: 1.0.0.0/24                      Metric:       10 External Down
   IP prefix: 3.0.0.0/24                      Metric:       10 External Down
   IP prefix: 4.0.0.0/24                      Metric:       10 External Down
   IP prefix: 5.0.0.0/24                      Metric:       10 Internal Up
   IP prefix: 15.15.15.15/32                  Metric:       10 External Down
   IP prefix: 25.25.25.25/32                  Metric:       10 External Down
   IP prefix: 30.30.30.30/32                  Metric:       10 External Down
   IP prefix: 40.40.40.40/32                  Metric:       10 External Down
   IP prefix: 60.60.60.60/32                  Metric:        0 Internal Up

IS-IS level 2 link-state database:

sisira.00-00 Sequence: 0x13, Checksum: 0x69ac, Lifetime: 993 secs
   IS neighbor: hemantha-CE3.02               Metric:       10
   IP prefix: 1.0.0.0/24                      Metric:       10 External Down
   IP prefix: 3.0.0.0/24                      Metric:       10 External Down
   IP prefix: 4.0.0.0/24                      Metric:       10 External Down
   IP prefix: 5.0.0.0/24                      Metric:       10 Internal Up
   IP prefix: 15.15.15.15/32                  Metric:       10 External Down
   IP prefix: 25.25.25.25/32                  Metric:       10 External Down
   IP prefix: 30.30.30.30/32                  Metric:       10 External Down
   IP prefix: 40.40.40.40/32                  Metric:       10 External Down
   IP prefix: 50.50.50.50/32                  Metric:       10 Internal Up
   IP prefix: 60.60.60.60/32                  Metric:        0 Internal Up
   ISO prefix: 60.0006.80ff.f800.0000.0108.0001.0015.0015.0015/152
                                              Metric:       10 External Down
   ISO prefix: 60.0006.80ff.f800.0000.0108.0001.0025.0025.0025/152
                                              Metric:       10 External Down
   ISO prefix: 60.0006.80ff.f800.0000.0108.0001.0030.0030.0030/152
                                              Metric:       10 External Down
   ISO prefix: 60.0006.80ff.f800.0000.0108.0001.0040.0040.0040/152
                                              Metric:       10 External Down
   ISO prefix: 60.0006.80ff.f800.0000.0108.0001.0060.0060.0060/152
                                              Metric:        0 Internal Up
```

show isis database extensive

user@host> **show isis database logical-system CE3 sisira.00-00 extensive**

```
IS-IS level 1 link-state database:

sisira.00-00 Sequence: 0x11, Checksum: 0x10fc, Lifetime: 970 secs
```

```
   IS neighbor: hemantha-CE3.02               Metric:       10
     Two-way fragment: hemantha-CE3.02-00, Two-way first fragment:
hemantha-CE3.02-00
   ES neighbor: 0015.0015.0015                Metric:       10 Down
   ES neighbor: 0025.0025.0025                Metric:       10 Down
   ES neighbor: 0030.0030.0030                Metric:       10 Down
   ES neighbor: 0040.0040.0040                Metric:       10 Down
   ES neighbor: sisira                        Metric:        0
   IP prefix: 1.0.0.0/24                      Metric:       10 External Down
   IP prefix: 3.0.0.0/24                      Metric:       10 External Down
   IP prefix: 4.0.0.0/24                      Metric:       10 External Down
   IP prefix: 5.0.0.0/24                      Metric:       10 Internal Up
   IP prefix: 15.15.15.15/32                  Metric:       10 External Down
   IP prefix: 25.25.25.25/32                  Metric:       10 External Down
   IP prefix: 30.30.30.30/32                  Metric:       10 External Down
   IP prefix: 40.40.40.40/32                  Metric:       10 External Down
   IP prefix: 60.60.60.60/32                  Metric:        0 Internal Up

  Header: LSP ID: sisira.00-00, Length: 336 bytes
    Allocated length: 336 bytes, Router ID: 0.0.0.0
    Remaining lifetime: 970 secs, Level: 1, Interface: 333
    Estimated free bytes: 144, Actual free bytes: 0
    Aging timer expires in: 970 secs
    Protocols: IP, IPv6, CLNS

  Packet: LSP ID: sisira.00-00, Length: 336 bytes, Lifetime : 1198 secs
    Checksum: 0x10fc, Sequence: 0x11, Attributes: 0xb L1 L2 Attached
    NLPID: 0x83, Fixed length: 27 bytes, Version: 1, Sysid length: 0 bytes
    Packet type: 18, Packet version: 1, Max area: 0

  TLVs:
    Area address: 60.0006.80ff.f800.0000.0108.0001 (13)
    Speaks: IP
    Speaks: IPV6
    Speaks: CLNP
    Hostname: sisira
    ES neighbor TLV: Internal, Metric: default 0, Up
      ES: sisira
    IS neighbor: hemantha-CE3.02, Internal, Metric: default 10
    IS extended neighbor: hemantha-CE3.02, Metric: default 10
    ES neighbor TLV: External, Metric: default 10, Down
      ES: 0040.0040.0040
    ES neighbor TLV: External, Metric: default 10, Down
      ES: 0025.0025.0025
    ES neighbor TLV: External, Metric: default 10, Down
      ES: 0015.0015.0015
    ES neighbor TLV: External, Metric: default 10, Down
      ES: 0030.0030.0030
    IP external prefix: 3.0.0.0/24, Internal, Metric: default 10, Down
    IP external prefix: 40.40.40.40/32, Internal, Metric: default 10, Down
    IP external prefix: 4.0.0.0/24, Internal, Metric: default 10, Down
    IP external prefix: 25.25.25.25/32, Internal, Metric: default 10, Down
    IP external prefix: 15.15.15.15/32, Internal, Metric: default 10, Down
    IP external prefix: 1.0.0.0/24, Internal, Metric: default 10, Down
    IP external prefix: 30.30.30.30/32, Internal, Metric: default 10, Down
    IP extended prefix: 3.0.0.0/24 metric 10 down
    IP extended prefix: 40.40.40.40/32 metric 10 down
    IP extended prefix: 4.0.0.0/24 metric 10 down
    IP extended prefix: 25.25.25.25/32 metric 10 down
    IP extended prefix: 15.15.15.15/32 metric 10 down
    IP extended prefix: 1.0.0.0/24 metric 10 down
```



```
    IP extended prefix: 30.30.30.30/32 metric 10 down
    IP prefix: 60.60.60.60/32, Internal, Metric: default 0, Up
    IP prefix: 5.0.0.0/24, Internal, Metric: default 10, Up
    IP extended prefix: 60.60.60.60/32 metric 0 up
    IP extended prefix: 5.0.0.0/24 metric 10 up
  No queued transmissions

IS-IS level 2 link-state database:

sisira.00-00 Sequence: 0x13, Checksum: 0x69ac, Lifetime: 988 secs
   IS neighbor: hemantha-CE3.02               Metric:       10
     Two-way fragment: hemantha-CE3.02-00, Two-way first fragment:
hemantha-CE3.02-00
   IP prefix: 1.0.0.0/24                      Metric:       10 External Down
   IP prefix: 3.0.0.0/24                      Metric:       10 External Down
   IP prefix: 4.0.0.0/24                      Metric:       10 External Down
   IP prefix: 5.0.0.0/24                      Metric:       10 Internal Up
   IP prefix: 15.15.15.15/32                  Metric:       10 External Down
   IP prefix: 25.25.25.25/32                  Metric:       10 External Down
   IP prefix: 30.30.30.30/32                  Metric:       10 External Down
   IP prefix: 40.40.40.40/32                  Metric:       10 External Down
   IP prefix: 50.50.50.50/32                  Metric:       10 Internal Up
   IP prefix: 60.60.60.60/32                  Metric:        0 Internal Up
   ISO prefix: 60.0006.80ff.f800.0000.0108.0001.0015.0015.0015/152
                                              Metric:       10 External Down
   ISO prefix: 60.0006.80ff.f800.0000.0108.0001.0025.0025.0025/152
                                              Metric:       10 External Down
   ISO prefix: 60.0006.80ff.f800.0000.0108.0001.0030.0030.0030/152
                                              Metric:       10 External Down
   ISO prefix: 60.0006.80ff.f800.0000.0108.0001.0040.0040.0040/152
                                              Metric:       10 External Down
   ISO prefix: 60.0006.80ff.f800.0000.0108.0001.0060.0060.0060/152
                                              Metric:        0 Internal Up

  Header: LSP ID: sisira.00-00, Length: 427 bytes
    Allocated length: 427 bytes, Router ID: 0.0.0.0
    Remaining lifetime: 988 secs, Level: 2, Interface: 333
    Estimated free bytes: 130, Actual free bytes: 0
    Aging timer expires in: 988 secs
    Protocols: IP, IPv6, CLNS

  Packet: LSP ID: sisira.00-00, Length: 427 bytes, Lifetime : 1198 secs
    Checksum: 0x69ac, Sequence: 0x13, Attributes: 0x3 L1 L2
    NLPID: 0x83, Fixed length: 27 bytes, Version: 1, Sysid length: 0 bytes
    Packet type: 20, Packet version: 1, Max area: 0

  TLVs:
    Area address: 60.0006.80ff.f800.0000.0108.0001 (13)
    Speaks: IP
    Speaks: IPV6
    Speaks: CLNP
    Hostname: sisira
    IS neighbor: hemantha-CE3.02, Internal, Metric: default 10
    IS extended neighbor: hemantha-CE3.02, Metric: default 10
    IP external prefix: 3.0.0.0/24, Internal, Metric: default 10, Down
    IP external prefix: 40.40.40.40/32, Internal, Metric: default 10, Down
    IP external prefix: 4.0.0.0/24, Internal, Metric: default 10, Down
    IP external prefix: 25.25.25.25/32, Internal, Metric: default 10, Down
    IP external prefix: 15.15.15.15/32, Internal, Metric: default 10, Down
    IP external prefix: 1.0.0.0/24, Internal, Metric: default 10, Down
    IP external prefix: 30.30.30.30/32, Internal, Metric: default 10, Down
```

```
  IP extended prefix: 3.0.0.0/24 metric 10 down
  IP extended prefix: 40.40.40.40/32 metric 10 down
  IP extended prefix: 4.0.0.0/24 metric 10 down
  IP extended prefix: 25.25.25.25/32 metric 10 down
  IP extended prefix: 15.15.15.15/32 metric 10 down
  IP extended prefix: 1.0.0.0/24 metric 10 down
  IP extended prefix: 30.30.30.30/32 metric 10 down
  ISO prefix-neighbor TLV: Internal, Metric: default 0, Up
    Prefix : 60.0006.80ff.f800.0000.0108.0001.0060.0060.0060/152
  ISO prefix-neighbor TLV: External, Metric: default 10, Down
    Prefix : 60.0006.80ff.f800.0000.0108.0001.0040.0040.0040/152
  ISO prefix-neighbor TLV: External, Metric: default 10, Down
    Prefix : 60.0006.80ff.f800.0000.0108.0001.0025.0025.0025/152
  ISO prefix-neighbor TLV: External, Metric: default 10, Down
    Prefix : 60.0006.80ff.f800.0000.0108.0001.0015.0015.0015/152
  ISO prefix-neighbor TLV: External, Metric: default 10, Down
    Prefix : 60.0006.80ff.f800.0000.0108.0001.0030.0030.0030/152
  IP prefix: 60.60.60.60/32, Internal, Metric: default 0, Up
  IP prefix: 5.0.0.0/24, Internal, Metric: default 10, Up
  IP prefix: 50.50.50.50/32, Internal, Metric: default 10, Up
  IP extended prefix: 60.60.60.60/32 metric 0 up
  IP extended prefix: 5.0.0.0/24 metric 10 up
  IP extended prefix: 50.50.50.50/32 metric 10 up
No queued transmissions
```

show isis hostname

Syntax

show isis hostname
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series)

show isis hostname

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display IS-IS hostname database information.

Options

none—Display IS-IS hostname database information.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show isis hostname on page 3349

Output Fields

Table 245 on page 3349 describes the output fields for the **show isis hostname** command. Output fields are listed in the approximate order in which they appear.

Table 245: show isis hostname Output Fields

Field Name	Field Description
System Id	System identifier mapped to the hostname.
Hostname	Hostname mapped to the system identifier.
Type	Type of mapping between system identifier and hostname. • **Dynamic**—Hostname mapping determined as described in RFC 2763, *Dynamic Hostname Exchange Mechanism for IS-IS*. • **Static**—Hostname mapping configured by user.

Sample Output

show isis hostname

```
user@host> show isis hostname
   IS-IS hostname database:
   System Id      Hostname                                         Type
   1921.6800.4201 isis1                                            Dynamic
   1921.6800.4202 isis2                                            Static
   1921.6800.4203 isis3                                            Dynamic
```


show isis interface

Syntax

show isis interface
<brief | detail | extensive>
<*interface-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series)

show isis interface
<brief | detail | extensive>
<*interface-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display status information about IS-IS-enabled interfaces.

NOTE: If the configured metric for an IS-IS level is above 63, and the **wide-metrics-only** statement is not configured, the **show isis interface detail** command and the **show isis interface extensive** command display 63 as the metric value for that level. Configure the **wide-metrics-only** statement to generate metric values greater than 63 on a per IS-IS level basis.

The **show isis interface** command displays the configured metric value for an IS-IS level irrespective of whether is configured or not.

Options

none—Display standard information about all IS-IS-enabled interfaces.

brief | detail | extensive—(Optional) Display the specified level of output.

interface-name—(Optional) Display information about the specified interface only.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- *Example: Enabling Wide IS-IS Metrics for Traffic Engineering*

List of Sample Output

show isis interface on page 3352
show isis interface brief on page 3352
show isis interface detail on page 3353
show isis interface extensive on page 3353
show isis interface extensive (With LDP) on page 3353

Output Fields

Table 246 on page 3351 describes the output fields for the **show isis interface** command. Output fields are listed in the approximate order in which they appear.

Table 246: show isis interface Output Fields

Field Name	Field Description	Level of Output
interface-name	Name of the interface.	**detail**
Designated router	Routing device selected by other routers that is responsible for sending link-state advertisements that describe the network. Used only on broadcast networks.	**detail**
Index	Interface index assigned by the Junos OS kernel.	**detail**
State	Internal implementation information.	**detail**
Circuit id	Circuit identifier.	**detail**
Circuit type	Circuit type: • **1**—Level 1 only • **2**—Level 2 only • **3**—Level 1 and Level 2	**detail**
LSP interval	Interval between link-state PDUs sent from the interface.	**detail**
CSNP interval	Interval between complete sequence number PDUs sent from the interface.	**detail extensive**
Sysid	System identifier.	**detail**
Interface	Interface through which the adjacency is made.	none **brief**
L or Level	Level: • **1**—Level 1 only • **2**—Level 2 only • **3**—Level 1 and Level 2	All levels
CirID	Circuit identifier.	none **brief**
Level 1 DR	Level 1 designated intermediate system.	none **brief**
Level 2 DR	Level 2 designated intermediate system.	none **brief**
L1/L2 Metric	Interface's metric for Level 1 and Level 2. If there is no information, the metric is **0**.	none **brief**
Adjacency advertisement: Advertise	This routing device has signaled to advertise this interface to its neighbors in their label-switched paths (LSPs).	**detail extensive**
Adjacency advertisement: Suppress	This neighbor has signaled not to advertise this interface in the routing device's outbound LSPs.	**detail extensive**
Adjacencies	Number of adjacencies established on this interface.	**detail**

Table 246: show isis interface Output Fields *(continued)*

Field Name	Field Description	Level of Output
Priority	Priority value for this interface.	**detail**
Metric	Metric value for this interface.	**detail**
Hello(s) / Hello Interval	Interface's hello interval.	**detail extensive**
Hold(s) / Hold Time	Interface's hold time.	**detail extensive**
Designated Router	Router responsible for sending network link-state advertisements, which describe all the routing devices attached to the network.	**detail**
Hello padding	Type of hello padding: • **Adaptive**—On point-to-point connections, the hello packets are padded from the initial detection of a new neighbor until the neighbor verifies the adjacency as Up in the adjacency state TLV. If the neighbor does not support the adjacency state TLV, then padding continues. On LAN connections, padding starts from the initial detection of a new neighbor until there is at least one active adjacency on the interface. • **Loose**—(Default) The hello packet is padded from the initial detection of a new neighbor until the adjacency transitions to the Up state. • **Strict**—Padding is performed on all interface types and for all adjacency states, and is continuous.	**extensive**
LDP sync state	Current LDP synchronization state: **in sync**, **in holddown**, or **not supported**.	**extensive**
reason	Reason for being in the LDP sync state.	**extensive**
config holdtime	Configured value of the hold timer.	**extensive**
remaining	If the state is not in sync and the hold time is not infinity, then this field displays the remaining hold time in seconds.	**extensive**

Sample Output

show isis interface

```
user@host> show isis interface
IS-IS interface database:
Interface            L CirID Level 1 DR        Level 2 DR        L1/L2 Metric
at-2/3/0.0           3   0x1 Point to Point    Point to Point        10/10
lo0.0                0   0x1 Passive           Passive                0/0
```

show isis interface brief

The output for the **show isis interface brief** command is identical to that for the **show isis interface** command. For sample output, see show isis interface on page 3352.

show isis interface detail

```
user@host> show isis interface detail
IS-IS interface database:
at-2/3/0.0
  Index: 66, State: 0x6, Circuit id: 0x1, Circuit type: 3
  LSP interval: 100 ms, CSNP interval: 5 s
  Level Adjacencies Priority Metric Hello (s) Hold (s) Designated Router
    1             1       64     10     9.000       27
    2             1       64     10     9.000       27
lo0.0
  Index: 64, State: 0x6, Circuit id: 0x1, Circuit type: 0
  LSP interval: 100 ms, CSNP interval: disabled
  Level Adjacencies Priority Metric Hello (s) Hold (s) Designated Router
    1             0       64      0 Passive
    2             0       64      0 Passive
```

show isis interface extensive

```
user@host> show isis interface extensive
IS-IS interface database:
at-2/3/0.0
  Index: 66, State: 0x6, Circuit id: 0x1, Circuit type: 3
  LSP interval: 100 ms, CSNP interval: 5 s, Loose Hello padding
  Level 1
    Adjacencies: 1, Priority: 64, Metric: 10
    Hello Interval: 9.000 s, Hold Time: 27 s
  Level 2
    Adjacencies: 1, Priority: 64, Metric: 10
    Hello Interval: 9.000 s, Hold Time: 27 s
lo0.0
  Index: 64, State: 0x6, Circuit id: 0x1, Circuit type: 0
  LSP interval: 100 ms, CSNP interval: disabled, Loose Hello padding
  Level 1
    Adjacencies: 0, Priority: 64, Metric: 0
    Passive
  Level 2
    Adjacencies: 0, Priority: 64, Metric: 0
    Passive
```

show isis interface extensive (With LDP)

```
user@host> show isis interface extensive
IS-IS interface database:
so-1/1/2.0
  Index: 114, State: 0x6, Circuit id: 0x1, Circuit type: 2
  LSP interval: 100 ms, CSNP interval: 20 s, Loose Hello padding
  Adjacency advertisement: Advertise
  LDP sync state: in sync, for: 00:01:28, reason: LDP up during config
  config holdtime: 20 seconds
  Level 2
    Adjacencies: 1, Priority: 64, Metric: 11
    Hello Interval: 9.000 s, Hold Time: 27 s
    IPV4 MulticastMetric: 10
    IPV6 UnicastMetric: 10
```

show isis overview

Syntax

show isis overview
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series)

show isis overview
<instance *instance-name*>

Release Information

Command introduced in Junos OS Release 8.5.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display IS-IS overview information.

Options

none—Display standard overview information about IS-IS for all routing instances.

instance ***instance-name***—(Optional) Display overview information for the specified routing instance.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show isis overview on page 3356

Output Fields

Table 247 on page 3354 lists the output fields for the **show isis overview** command. Output fields are listed in the approximate order in which they appear.

Table 247: show isis overview Output Fields

Field Name	Field Description
Instance	IS-IS routing intance.
Router ID	Router ID of the routing device.
Adjacency holddown	Adjacency holddown capability: **enabled** or **disabled**.
Maximum Areas	Maximum number of IS-IS areas advertised by the routing device.
LSP life time	Lifetime of the link-state PDU, in seconds.
Attached bit evaluation	Attached bit capability: **enabled** or **disabled**.
SPF delay	Delay before performing consecutive shortest-path-first (SPF) calculations.
SPF holddown	Delay before performing additional SPF calculations after the maximum number of consecutive SPF calculations is reached.

Table 247: show isis overview Output Fields *(continued)*

Field Name	Field Description
SPF rapid runs	Maximum number of SPF calculations that can be performed in succession before the holddown timer begins.
Overload bit at startup is set	Overload bit capability is enabled.
Overload high metrics	Overload high metrics capability: **enabled** or **disabled**.
Overload timeout	Time period after which overload is reset and the time that remains before the timer is set to expire.
Traffic engineering	Traffic engineering capability: **enabled** or **disabled**.
Restart	Graceful restart capability: **enabled** or **disabled**.
Restart duration	Time period for complete reacquisition of IS-IS neighbors.
Helper mode	Graceful restart helper capability: **enabled** or **disabled**.
Level	IS-IS level: • **1**—Level 1 information • **2**—Level 2 information
IPv4 is enabled	IP Protocol version 4 capability is enabled.
IPv6 is enabled	IP Protocol version 6 capability is enabled.
CLNS is enabled	(J Series routers only) OSI CLNP capability is enabled.
Internal route preference	Preference value of internal routes.
External route preference	Preference value of external routes.
Prefix export limit	Number of prefixes allowed to be exported, as configured by the prefix-export-limit statement.
Prefix export count	Number of prefixes exported.
Wide area metrics are enabled	Wide area metrics capability is enabled.
Narrow metrics are enabled	Narrow metrics capability is enabled.

Sample Output

show isis overview

```
user@host> show isis overview
Instance: master
  Router ID: 10.255.107.183
  Adjacency holddown: disabled
  Maximum Areas: 3
  LSP life time: 1200
  Attached bit evaluation: enabled
  SPF delay: 200 msec, SPF holddown: 5000 msec, SPF rapid runs: 3
  IPv4 is enabled, IPv6 is enabled
  Traffic engineering: enabled
  Restart: Disabled
    Helper mode: Enabled
  Level 1
    Internal route preference: 15
    External route preference: 160
    Wide metrics are enabled, Narrow metrics are enabled
  Level 2
    Internal route preference: 18
    External route preference: 165
    Prefix export limit: 5, Prefix export count: 5
    Wide metrics are enabled
```


show isis route

Syntax

show isis route
<*destination*>
<inet | inet6>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<topology (ipv4-multicast | ipv6-multicast | ipv6-unicast | unicast)>

Syntax (EX Series Switches and QFX Series)

show isis route
<*destination*>
<inet | inet6>
<instance *instance-name*>
<topology (ipv4-multicast | ipv6-multicast | ipv6-unicast | unicast)>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display the routes in the IS-IS routing table.

Options

none—Display all routes in the IS-IS routing table for all supported address families for all routing instances.

destination—(Optional) Destination address for the route.

inet | inet6—(Optional) Display inet (IPv4) or inet6 (IPv6) routes, respectively.

instance *instance-name*—(Optional) Display routes for the specified routing instance only.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

topology (ipv4-multicast | ipv6-multicast | ipv6-unicast | unicast)—(Optional) Display routes for the specified topology only, or use unicast to display information, if available, for both IPv4 and IPv6 unicast topologies.

Required Privilege Level

view

List of Sample Output

show isis route logical-system on page 3358
show isis route (CLNS) on page 3358
show isis route on page 3359

Output Fields

Table 248 on page 3357 describes the output fields for the **show isis route** command. Output fields are listed in the approximate order in which they appear.

Table 248: show isis route Output Fields

Field Name	Field Description
Current version	Number of the current version of the IS-IS routing table.

Table 248: show isis route Output Fields *(continued)*

Field Name	Field Description
L1	Version of Level 1 SPF that was run.
L2	Version of Level 2 SPF that was run.
Prefix	Destination of the route.
L	IS-IS level: • **1**—Level 1 only • **2**—Level 2 only • **3**—Level 1 and Level 2
Version	Version of SPF that generated the route.
Metric	Metric value associated with the route.
Type	Metric type: **int** (internal) or **ext** (external).
Interface	Interface to the next hop.
Via	System identifier of the next hop, displayed as a name if possible.
ISO Routes	ISO routing table entries.
snpa	MAC address.

Sample Output

show isis route logical-system

```
user@host> show isis route logical-system ls1
IS-IS routing table             Current version: L1: 8 L2: 11
Prefix             L Version Metric Type Interface    Via
10.9.7.0/30        2       11     20 int  gr-0/2/0.0    h
10.9.201.1/32      2       11     60 int  gr-0/2/0.0    h
IPV6 Unicast IS-IS routing table             Current version: L1: 9 L2: 11
Prefix             L Version Metric Type Interface    Via
8009:3::a09:3200/126 2      11      20 int gr-0/2/0.0  h
```

show isis route (CLNS)

```
user@host> show isis route
IS-IS routing table             Current version: L1: 10 L2: 8
IPv4/IPv6 Routes
Prefix             L Version   Metric Type Interface    Via
0.0.0.0/0          1       10       10 int  fe-0/0/1.0   ISIS.0
ISO Routes
Prefix  L   Version   Metric Type Interface    Via     snpa
0/0
        1        10       10 int  fe-0/0/1.0   isis.0 0:12:0:34:0:56
47.0005.80ff.f800.0000.0108.0001/104
```



```
        1        10        0 int
47.0005.80ff.f800.0000.0108.0001.1921.6800.4001/152
        1        10       10 int  fe-0/0/1.0 isis.0 0:12:0:34:0:56
47.0005.80ff.f800.0000.0108.0001.1921.6800.4002/152
        1        10       20 int  fe-0/0/1.0 isis.0 0:12:0:34:0:56
47.0005.80ff.f800.0000.0108.0002/104
        1        10        0 int
47.0005.80ff.f800.0000.0108.0002.1921.6800.4001/152
        1        10       10 int  fe-0/0/1.0 isis.0 0:12:0:34:0:56
```

show isis route

user@host> **show isis route**

```
IS-IS routing table             Current version: L1: 4 L2: 13
IPv4/IPv6 Routes
----------------
Prefix                 L   Version  Metric Type Interface       NH   Via
10.255.71.52/32        2      13       10   int  ae0.0           IPV4 camaro

10.255.71.238/32       2      13       20   int  so-6/0/0.0      IPV4 olympic

                                                 as0.0           IPV4 glacier

10.255.71.239/32       2      13       20   int  so-6/0/0.0      IPV4 olympic

                                                 ae0.0           IPV4 camaro

10.255.71.242/32       2      13       10   int  as0.0           IPV4 glacier

10.255.71.243/32       2      13       10   int  so-6/0/0.0      IPV4 olympic

12.13.0.0/30           2      13       20   int  so-6/0/0.0      IPV4 olympic

12.15.0.0/30           2      13       20   int  so-6/0/0.0      IPV4 olympic

13.15.0.0/30           2      13       30   int  ae0.0           IPV4 camaro

                                                 so-6/0/0.0      IPV4 olympic

                                                 as0.0           IPV4 glacier

13.16.0.0/30           2      13       25   int  as0.0           IPV4 glacier

14.15.0.0/30           2      13       20   int  ae0.0           IPV4 camaro

192.2.1.0/30           2      13       30   int  so-6/0/0.0      IPV4 olympic

                                                 as0.0           IPV4 glacier

1eee::/64              2      13       30   int  so-6/0/0.0      IPV6 olympic

                                                 as0.0           IPV6 glacier

abcd::10:255:71:52/128   2      13       10   int  ae0.0           IPV6 camaro

abcd::10:255:71:238/128  2      13       20   int  so-6/0/0.0      IPV6 olympic

                                                 as0.0           IPV6 glacier

abcd::10:255:71:239/128  2      13       20   int  so-6/0/0.0      IPV6 olympic
```

```
                                                ae0.0          IPV6 camaro
abcd::10:255:71:242/128  2      13       10   int  as0.0          IPV6 glacier
abcd::10:255:71:243/128  2      13       10   int  so-6/0/0.0     IPV6 olympic
```

show isis statistics

Syntax

show isis statistics
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series)

show isis statistics
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display statistics about IS-IS traffic.

Options

none—Display IS-IS traffic statistics for all routing instances.

instance *instance-name*—(Optional) Display statistics for the specified routing instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- clear isis statistics on page 3334

List of Sample Output

show isis statistics on page 3363

Output Fields

Table 249 on page 3362 describes the output fields for the **show isis statistics** command. Output fields are listed in the approximate order in which they appear.

Table 249: show isis statistics Output Fields

Field Name	Field Description
PDU type	PDU type: • **CSNP**—Complete sequence number PDUs contain a complete list of all link-state PDUs in the IS-IS database. CSNPs are sent periodically on all links, and the receiving systems use the information in the CSNP to update and synchronize their link-state PDU databases. The designated router multicasts CSNPs on broadcast links in place of sending explicit acknowledgments for each link-state PDU. • **IIH**—IS-IS hello packets are broadcast to discover the identity of neighboring IS-IS systems and to determine whether the neighbors are Level 1 or Level 2 intermediate systems. • **LSP**—Link-state PDUs contain information about the state of adjacencies to neighboring IS-IS systems. Link-state PDUs are flooded periodically throughout an area. • **PSNP**—Partial sequence number PDUs are sent multicast by a receiver when it detects that it is missing a link-state PDU (when its link-state PDU database is out of date). The receiver sends a PSNP to the system that transmitted the CSNP, effectively requesting that the missing link-state PDU be transmitted. That routing device, in turn, forwards the missing link-state PDU to the requesting routing device. • **Unknown**—The PDU type is unknown.
Received	Number of PDUs received since IS-IS started or since the statistics were set to zero.
Processed	Number of PDUs received less the number dropped.
Drops	Number of PDUs dropped.
Sent	Number of PDUs transmitted since IS-IS started or since the statistics were set to zero.
Rexmit	Number of PDUs retransmitted since IS-IS started or since the statistics were set to zero.
Total packets received/sent	Total number of PDUs received and transmitted since IS-IS started or since the statistics were set to zero.
SNP queue length	Number of CSPN and PSNP packets currently waiting in the queue for processing. This value is almost always **0**.
LSP queue length	Number of link-state PDUs waiting in the queue for processing. This value is almost always **0**.
SPF runs	Number of shortest-path-first (SPF) calculations that have been performed. If this number is incrementing rapidly, it indicates that the network is unstable.
Fragments rebuilt	Number of link-state PDU fragments that the local system has computed.
LSP regenerations	Number of link-state PDUs that have been regenerated. A link-state PDU is regenerated when it is nearing the end of its lifetime and it has not changed.
Purges initiated	Number of purges that the system initiated. A purge is initiated if the software decides that a link-state PDU must be removed from the network.

Sample Output

show isis statistics

```
user@host> show isis statistics
IS-IS statistics for merino:

PDU type     Received  Processed       Drops        Sent      Rexmit
LSP             12227      12227           0        8184         683
IIH            113808     113808           0      115817           0
CSNP           198868     198868           0      198934           0
PSNP             6985       6979           6        8274           0
Unknown             0          0           0           0           0
Totals         331888     331882           6      331209         683

Total packets received: 331888 Sent: 331892

SNP queue length:           0 Drops:          0
LSP queue length:           0 Drops:          0

SPF runs:                1014
Fragments rebuilt:       1038
LSP regenerations:        425
Purges initiated:           0
```

PART 12

Open Shortest Path First

CHAPTER 37

Overview

OSPF Overview

OSPF Overview

OSPF is an interior gateway protocol (IGP) that routes packets within a single autonomous system (AS). OSPF uses link-state information to make routing decisions, making route calculations using the shortest-path-first (SPF) algorithm (also referred to as the Dijkstra algorithm). Each router running OSPF floods link-state advertisements throughout the AS or area that contain information about that router's attached interfaces and routing metrics. Each router uses the information in these link-state advertisements to calculate the least cost path to each network and create a routing table for the protocol.

Junos OS supports OSPF version 2 (OSPFv2) and OSPF version 3 (OSPFv3), including virtual links, stub areas, and for OSPFv2, authentication. Junos OS does not support type-of-service (ToS) routing.

OSPF was designed for the Transmission Control Protocol/Internet Protocol (TCP/IP) environment and as a result explicitly supports IP subnetting and the tagging of externally derived routing information. OSPF also provides for the authentication of routing updates.

OSPF routes IP packets based solely on the destination IP address contained in the IP packet header. OSPF quickly detects topological changes, such as when router interfaces become unavailable, and calculates new loop-free routes quickly and with a minimum of routing overhead traffic.

NOTE: **On SRX Series devices, when only one link-protection is configured under the OSPF interface, the device does not install an alternative route in the forwarding table. When the per-packet load-balancing is enabled as a workaround, the device does not observe both the OSPF metric and sending the traffic through both the interfaces.**

An OSPF AS can consist of a single area, or it can be subdivided into multiple areas. In a single-area OSPF network topology, each router maintains a database that describes the topology of the AS. Link-state information for each router is flooded throughout the AS. In a multiarea OSPF topology, each router maintains a database that describes the topology of its area, and link-state information for each router is flooded throughout that area. All routers maintain summarized topologies of other areas within an AS. Within each area, OSPF routers have identical topological databases. When the AS or area topology changes, OSPF ensures that the contents of all routers' topological databases converge quickly.

All OSPFv2 protocol exchanges can be authenticated. OSPFv3 relies on IPsec to provide this functionality. This means that only trusted routers can participate in the AS's routing. A variety of authentication schemes can be used. A single authentication scheme is configured for each area, which enables some areas to use stricter authentication than others.

Externally derived routing data (for example, routes learned from BGP) is passed transparently throughout the AS. This externally derived data is kept separate from the OSPF link-state data. Each external route can be tagged by the advertising router, enabling the passing of additional information between routers on the boundaries of the AS.

NOTE: By default, Junos OS is compatible with RFC 1583, *OSPF Version 2*. In Junos OS Release 8.5 and later, you can disable compatibility with RFC 1583 by including the **no-rfc-1583** statement. For more information, see "Example: Disabling OSPFv2 Compatibility with RFC 1583" on page 3406.

This topic describes the following information:

OSPF Default Route Preference Values

The Junos OS routing protocol process assigns a default preference value to each route that the routing table receives. The default value depends on the source of the route. The preference value is from 0 through 4,294,967,295 (232 – 1), with a lower value indicating a more preferred route. Table 250 on page 3370 lists the default preference values for OSPF.

Table 250: Default Route Preference Values for OSPF

How Route Is Learned	Default Preference	Statement to Modify Default Preference
OSPF internal route	10	OSPF **preference**
OSPF AS external routes	150	OSPF **external-preference**

OSPF Routing Algorithm

OSPF uses the shortest-path-first (SPF) algorithm, also referred to as the Dijkstra algorithm, to determine the route to each destination. All routing devices in an area run this algorithm in parallel, storing the results in their individual topological databases. Routing devices with interfaces to multiple areas run multiple copies of the algorithm. This section provides a brief summary of how the SPF algorithm works.

When a routing device starts, it initializes OSPF and waits for indications from lower-level protocols that the router interfaces are functional. The routing device then uses the OSPF hello protocol to acquire neighbors, by sending hello packets to its neighbors and receiving their hello packets.

On broadcast or nonbroadcast multiaccess networks (physical networks that support the attachment of more than two routing devices), the OSPF hello protocol elects a designated router for the network. This routing device is responsible for sending *link-state advertisements* (LSAs) that describe the network, which reduces the amount of network traffic and the size of the routing devices' topological databases.

The routing device then attempts to form *adjacencies* with some of its newly acquired neighbors. (On multiaccess networks, only the designated router and backup designated router form adjacencies with other routing devices.) Adjacencies determine the distribution of routing protocol packets. Routing protocol packets are sent and received only on adjacencies, and topological database updates are sent only along adjacencies. When adjacencies have been established, pairs of adjacent routers synchronize their topological databases.

A routing device sends LSA packets to advertise its state periodically and when its state changes. These packets include information about the routing device's adjacencies, which allows detection of nonoperational routing devices.

Using a reliable algorithm, the routing device floods LSAs throughout the area, which ensures that all routing devices in an area have exactly the same topological database. Each routing device uses the information in its topological database to calculate a shortest-path tree, with itself as the root. The routing device then uses this tree to route network traffic.

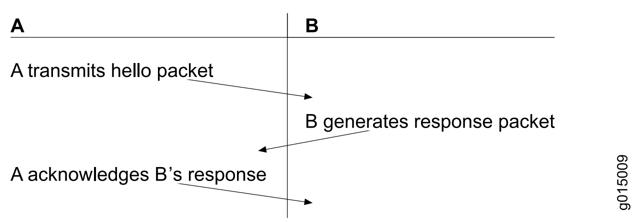
The description of the SPF algorithm up to this point has explained how the algorithm works within a single area (*intra-area routing*). For internal routers to be able to route to destinations outside the area (*interarea routing*), the area border routers must inject additional routing information into the area. Because the area border routers are connected to the backbone, they have access to complete topological data about the backbone. The area border routers use this information to calculate paths to all destinations outside its area and then advertise these paths to the area's internal routers.

Autonomous system (AS) boundary routers flood information about external autonomous systems throughout the AS, except to stub areas. Area border routers are responsible for advertising the paths to all AS boundary routers.

OSPF Three-Way Handshake

OSPF creates a topology map by flooding LSAs across OSPF-enabled links. LSAs announce the presence of OSPF-enabled interfaces to adjacent OSPF interfaces. The exchange of LSAs establishes bidirectional connectivity between all adjacent OSPF interfaces (neighbors) using a three-way handshake, as shown in Figure 85 on page 3371.

Figure 85: OSPF Three-Way Handshake



In Figure 85 on page 3371, Router A sends hello packets out all its OSPF-enabled interfaces when it comes online. Router B receives the packet, which establishes that Router B can receive traffic from Router A. Router B generates a response to Router A to acknowledge receipt of the hello packet. When Router A receives the response, it establishes that Router B can receive traffic from Router A. Router A then generates a final response packet to inform Router B that Router A can receive traffic from Router B. This three-way handshake ensures bidirectional connectivity.

As new neighbors are added to the network or existing neighbors lose connectivity, the adjacencies in the topology map are modified accordingly through the exchange (or absence) of LSAs. These LSAs advertise only the incremental changes in the network, which helps minimize the amount of OSPF traffic on the network. The adjacencies are shared and used to create the network topology in the topological database.

OSPF Version 3

OSPFv3 is a modified version of OSPF that supports IP version 6 (IPv6) addressing. OSPFv3 differs from OSPFv2 in the following ways:

- All neighbor ID information is based on a 32-bit router ID.
- The protocol runs per link rather than per subnet.
- Router and network link-state advertisements (LSAs) do not carry prefix information.
- Two new LSA types are included: link-LSA and intra-area-prefix-LSA.
- Flooding scopes are as follows:
  - Link-local
  - Area
  - AS
- Link-local addresses are used for all neighbor exchanges except virtual links.
- Authentication is removed. The IPv6 authentication header relies on the IP layer.
- The packet format has changed as follows:
  - Version number 2 is now version number 3.
  - The **db** option field has been expanded to 24 bits.
  - Authentication information has been removed.
  - Hello messages do not have address information.
  - Two new option bits are included: **R** and **V6**.
- Type 3 summary LSAs have been renamed *inter-area-prefix-LSAs*.
- Type 4 summary LSAs have been renamed *inter-area-router-LSAs*.

Related Documentation

- Understanding OSPF Areas and Backbone Areas on page 3384
- *OSPF Configuration Overview*
- *OSPF Version 3 for IPv6*
- Example: Disabling OSPFv2 Compatibility with RFC 1583 on page 3406

OSPF Areas and Router Functionality Overview

In OSPF, a single autonomous system (AS) can be divided into smaller groups called *areas*. This reduces the number of link-state advertisements (LSAs) and other OSPF overhead traffic sent on the network, and it reduces the size of the topology database that each router must maintain. The routing devices that participate in OSPF routing perform one or more functions based on their location in the network.

This topic describes the following OSPF area types and routing device functions:

Areas

An *area* is a set of networks and hosts within an AS that have been administratively grouped together. We recommend that you configure an area as a collection of contiguous IP subnetted networks. Routing devices that are wholly within an area are called *internal routers*. All interfaces on internal routers are directly connected to networks within the area.

The topology of an area is hidden from the rest of the AS, thus significantly reducing routing traffic in the AS. Also, routing within the area is determined only by the area's topology, providing the area with some protection from bad routing data.

All routing devices within an area have identical topology databases.

Area Border Routers

Routing devices that belong to more than one area and connect one or more OSPF areas to the backbone area are called *area border routers* (ABRs). At least one interface is within the backbone while another interface is in another area. ABRs also maintain a separate topological database for each area to which they are connected.

Backbone Areas

An OSPF *backbone area* consists of all networks in area ID 0.0.0.0, their attached routing devices, and all ABRs. The backbone itself does not have any ABRs. The backbone distributes routing information between areas. The backbone is simply another area, so the terminology and rules of areas apply: a routing device that is directly connected to the backbone is an internal router on the backbone, and the backbone's topology is hidden from the other areas in the AS.

The routing devices that make up the backbone must be physically contiguous. If they are not, you must configure *virtual links* to create the appearance of backbone connectivity. You can create virtual links between any two ABRs that have an interface to a common nonbackbone area. OSPF treats two routing devices joined by a virtual link as if they were connected to an unnumbered point-to-point network.

AS Boundary Routers

Routing devices that exchange routing information with routing devices in non-OSPF networks are called *AS boundary routers*. They advertise externally learned routes throughout the OSPF AS. Depending on the location of the AS boundary router in the network, it can be an ABR, a backbone router, or an internal router (with the exception of stub areas). Internal routers within a stub area cannot be an AS boundary router because stub areas cannot contain any Type 5 LSAs.

Routing devices within the area where the AS boundary router resides know the path to that AS boundary router. Any routing device outside the area only knows the path to the nearest ABR that is in the same area where the AS boundary router resides.

Backbone Router

Backbone routers are routing devices that have one or more interfaces connected to the OSPF backbone area (area ID 0.0.0.0).

Internal Router

Routing devices that connect to only one OSPF area are called *internal routers*. All interfaces on internal routers are directly connected to networks within a single area.

Stub Areas

Stub areas are areas through which or into which AS external advertisements are not flooded. You might want to create stub areas when much of the topological database consists of AS external advertisements. Doing so reduces the size of the topological databases and therefore the amount of memory required on the internal routers in the stub area.

Routing devices within a stub area rely on the default routes originated by the area's ABR to reach external AS destinations. You must configure the **default-metric** option on the ABR before it advertises a default route. Once configured, the ABR advertises a default route in place of the external routes that are not being advertised within the stub area, so that routing devices in the stub area can reach destinations outside the area.

The following restrictions apply to stub areas: you cannot create a virtual link through a stub area, a stub area cannot contain an AS boundary router, the backbone cannot be a stub area, and you cannot configure an area as both a stub area and a not-so-stubby area.

Not-So-Stubby Areas

An OSPF stub area has no external routes in it, so you cannot redistribute from another protocol into a stub area. A *not-so-stubby area* (NSSA) allows external routes to be flooded within the area. These routes are then leaked into other areas. However, external routes from other areas still do not enter the NSSA.

The following restriction applies to NSSAs: you cannot configure an area as both a stub area and an NSSA.

Transit Areas

Transit areas are used to pass traffic from one adjacent area to the backbone (or to another area if the backbone is more than two hops away from an area). The traffic does not originate in, nor is it destined for, the transit area.

Related Documentation

- OSPF Overview on page 3368
- Packets Overview on page 3375
- *OSPF Configuration Overview*
- Understanding OSPF Areas and Backbone Areas on page 3384
- Understanding OSPF Stub Areas, Totally Stubby Areas, and Not-So-Stubby Areas on page 3391

Packets Overview

There are several types of link-state advertisement (LSA) packets.

This topic describes the following information:

OSPF Packet Header

All OSPFv2 packets have a common 24-byte header, and OSPFv3 packets have a common 16-byte header, that contains all information necessary to determine whether OSPF should accept the packet. The header consists of the following fields:

- Version number—The current OSPF version number. This can be either **2** or **3**.
- Type—Type of OSPF packet.
- Packet length—Length of the packet, in bytes, including the header.
- Router ID—IP address of the router from which the packet originated.
- Area ID—Identifier of the area in which the packet is traveling. Each OSPF packet is associated with a single area. Packets traveling over a virtual link are labeled with the backbone area ID, 0.0.0.0. .

- Checksum—Fletcher checksum.
- Authentication—(OSPFv2 only) Authentication scheme and authentication information.
- Instance ID—(OSPFv3 only) Identifier used when there are multiple OSPFv3 realms configured on a link.

Hello Packets

Routers periodically send hello packets on all interfaces, including virtual links, to establish and maintain neighbor relationships. Hello packets are multicast on physical networks that have a multicast or broadcast capability, which enables dynamic discovery of neighboring routers. (On nonbroadcast networks, dynamic neighbor discovery is not possible, so you must configure all neighbors statically as described in “Example: Configuring an OSPFv2 Interface on a Nonbroadcast Multiaccess Network” on page 3411.)

Hello packets consist of the OSPF header plus the following fields:

- Network mask—(OSPFv2 only) Network mask associated with the interface.
- Hello interval—How often the router sends hello packets. All routers on a shared network must use the same hello interval.
- Options—Optional capabilities of the router.
- Router priority—The router’s priority to become the designated router.
- Router dead interval—How long the router waits without receiving any OSPF packets from a router before declaring that router to be down. All routers on a shared network must use the same router dead interval.
- Designated router—IP address of the designated router.
- Backup designated router—IP address of the backup designated router.
- Neighbor—IP addresses of the routers from which valid hello packets have been received within the time specified by the router dead interval.

Database Description Packets

When initializing an adjacency, OSPF exchanges database description packets, which describe the contents of the topological database. These packets consist of the OSPF header, packet sequence number, and the link-state advertisement’s header.

Link-State Request Packets

When a router detects that portions of its topological database are out of date, it sends a link-state request packet to a neighbor requesting a precise instance of the database. These packets consist of the OSPF header plus fields that uniquely identify the database information that the router is seeking.

Link-State Update Packets

Link-state update packets carry one or more link-state advertisements one hop farther from their origin. The router multicasts (floods) these packets on physical networks that support multicast or broadcast mode. The router acknowledges all link-state update packets and, if retransmission is necessary, sends the retransmitted advertisements unicast.

Link-state update packets consist of the OSPF header plus the following fields:

- Number of advertisements—Number of link-state advertisements included in this packet.
- Link-state advertisements—The link-state advertisements themselves.

Link-State Acknowledgment Packets

The router sends link-state acknowledgment packets in response to link-state update packets to verify that the update packets have been received successfully. A single acknowledgment packet can include responses to multiple update packets.

Link-state acknowledgment packets consist of the OSPF header plus the link-state advertisement header.

Link-State Advertisement Packet Types

Link-state request, link-state update, and link-state acknowledgment packets are used to reliably flood link-state advertisement packets. OSPF sends the following types of link-state advertisements:

- Router link advertisements—Are sent by all routers to describe the state and cost of the router's links to the area. These link-state advertisements are flooded throughout a single area only.
- Network link advertisements—Are sent by designated routers to describe all the routers attached to the network. These link-state advertisements are flooded throughout a single area only.
- Summary link advertisements—Are sent by area border routers to describe the routes that they know about in other areas. There are two types of summary link advertisements: those used when the destination is an IP network, and those used when the destination is an AS boundary router. Summary link advertisements describe interarea routes, that is, routes to destinations outside the area but within the AS. These link-state advertisements are flooded throughout the advertisement's associated areas.
- AS external link advertisement—Are sent by AS boundary routers to describe external routes that they know about. These link-state advertisements are flooded throughout the AS (except for stub areas).

Each link-state advertisement type describes a portion of the OSPF routing domain. All link-state advertisements are flooded throughout the AS.

Each link-state advertisement packet begins with a common 20-byte header.

Related Documentation

- OSPF Overview on page 3368
- OSPF Areas and Router Functionality Overview on page 3373
- *OSPF Configuration Overview*

- OSPF Designated Router Overview on page 3379
- *Understanding OSPFv2 Authentication*
- OSPF Timers Overview on page 3445

OSPF External Metrics Overview

When OSPF exports route information from external autonomous systems (ASs), it includes a cost, or *external metric*, in the route. OSPF supports two types of external metrics: Type 1 and Type 2. The difference between the two metrics is how OSPF calculates the cost of the route. Type 1 external metrics are equivalent to the link-state metric, where the cost is equal to the sum of the internal costs plus the external cost. This means that Type 1 external metrics include the external cost to the destination as well as the cost (metric) to reach the AS boundary router. Type 2 external metrics are greater than the cost of any path internal to the AS. Type 2 external metrics use only the external cost to the destination and ignore the cost (metric) to reach the AS boundary router. By default, OSPF uses the Type 2 external metric.

CHAPTER 38

Configuration

Basic OSPF Area Configuration

Examples: Configuring OSPF Designated Routers

OSPF Designated Router Overview

Large LANs that have many routing devices and therefore many OSPF adjacencies can produce heavy control-packet traffic as link-state advertisements (LSAs) are flooded across the network. To alleviate the potential traffic problem, OSPF uses designated routers on all multiaccess networks (broadcast and nonbroadcast multiaccess [NBMA] networks types). Rather than broadcasting LSAs to all their OSPF neighbors, the routing devices send their LSAs to the designated router. Each multiaccess network has a designated router, which performs two main functions:

- Originate network link advertisements on behalf of the network.

- Establish adjacencies with all routing devices on the network, thus participating in the synchronizing of the link-state databases.

In LANs, the election of the designated router takes place when the OSPF network is initially established. When the first OSPF links are active, the routing device with the highest router identifier (defined by the **router-id** configuration value, which is typically the IP address of the routing device, or the loopback address) is elected the designated router. The routing device with the second highest router identifier is elected the backup designated router. If the designated router fails or loses connectivity, the backup designated router assumes its role and a new backup designated router election takes place between all the routers in the OSPF network.

OSPF uses the router identifier for two main purposes: to elect a designated router, unless you manually specify a priority value, and to identify the routing device from which a packet is originated. At designated router election, the router priorities are evaluated first, and the routing device with the highest priority is elected designated router. If router priorities tie, the routing device with the highest router identifier, which is typically the routing device's IP address, is chosen as the designated router. If you do not configure a router identifier, the IP address of the first interface to come online is used. This is usually the loopback interface. Otherwise, the first hardware interface with an IP address is used.

At least one routing device on each logical IP network or subnet must be eligible to be the designated router for OSPFv2. At least one routing device on each logical link must be eligible to be the designated router for OSPFv3.

By default, routing devices have a priority of 128. A priority of 0 marks the routing device as ineligible to become the designated router. A priority of 1 means the routing device has the least chance of becoming a designated router. A priority of 255 means the routing device is always the designated router.

Example: Configuring an OSPF Router Identifier

This example shows how to configure an OSPF router identifier.

Requirements

Before you begin:

- Identify the interfaces on the routing device that will participate in OSPF. You must enable OSPF on all interfaces within the network on which OSPF traffic is to travel.
- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices* or the *Junos OS Interfaces Configuration Guide for Security Devices*.

Overview

The router identifier is used by OSPF to identify the routing device from which a packet originated. Junos OS selects a router identifier according to the following set of rules:

1. By default, Junos OS selects the lowest configured physical IP address of an interface as the router identifier.
2. If a loopback interface is configured, the IP address of the loopback interface becomes the router identifier.
3. If multiple loopback interfaces are configured, the lowest loopback address becomes the router identifier.
4. If a router identifier is explicitly configured using the **router-id** ***address*** statement under the **[edit routing-options]** hierarchy level, the above three rules are ignored.

NOTE: **If the router identifier is modified in a network, the link-state advertisements (LSAs) advertised by the previous router identifier are retained in the OSPF database until the LSA retransmit interval has timed out.**

If the router identifier is not configured explicitly and an interface IP address is used as the router identifier, the established OSPF adjacency flaps when the interface goes down, or when it is brought back into the network. When the interface is brought back into the network, or a new interface is introduced into the network, the router identifier is selected again based on the rules stated above. Hence, it is strongly recommended that you explicitly configure the router identifier under the **[edit routing-options]** hierarchy level to avoid unpredictable behavior if the interface address on a loopback interface changes.

NOTE: **The router identifier behavior described here holds good even when configured under [edit routing-instances *routing-instance-name* routing-options] and [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options] hierarchy levels.**

In this example, you configure the OSPF router identifier by setting its router ID value to the IP address of the device, which is 177.162.4.24.

Configuration

CLI Quick Configuration

To quickly configure an OSPF router identifier, copy the following command and paste it into the CLI.

```
[edit]
set routing-options router-id 177.162.4.24
```

Step-by-Step Procedure

To configure an OSPF router identifier:

1. Configure the OSPF router identifier by entering the **[router-id]** configuration value.

   ```
   [edit]
   ```

```
user@host# set routing-options router-id 177.162.4.24
```

2. If you are done configuring the device, commit the configuration.

```
[edit]
user@host# commit
```

Results

Confirm your configuration by entering the **show routing-options router-id** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show routing-options router-id
router-id 177.162.4.24;
```

Verification

After you configure the router ID and activate OSPF on the routing device, the router ID is referenced by multiple OSPF operational mode commands that you can use to monitor and troubleshoot the OSPF protocol. The router ID fields are clearly marked in the output.

Example: Controlling OSPF Designated Router Election

This example shows how to control OSPF designated router election.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices* or the *Junos OS Interfaces Configuration Guide for Security Devices*.
- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.

Overview

This example shows how to control OSPF designated router election. Within the example, you set the OSPF interface to **ge-/0/0/1** and the device priority to 200. The higher the priority value, the greater likelihood the routing device will become the designated router.

By default, routing devices have a priority of 128. A priority of 0 marks the routing device as ineligible to become the designated router. A priority of 1 means the routing device has the least chance of becoming a designated router.

Configuration

CLI Quick Configuration

To quickly configure an OSPF designated router election, copy the following command and paste it into the CLI.

```
[edit]
set protocols ospf area 0.0.0.3 interface ge-0/0/1 priority 200
```

Step-by-Step Procedure

To control OSPF designated router election:

1. Configure an OSPF interface and specify the device priority.

   NOTE: To specify an OSPFv3 interface, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# set protocols ospf area 0.0.0.3 interface ge-0/0/1 priority 200
   ```

2. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
area 0.0.0.3 {
  interface ge-0/0/1.0 {
    priority 200;
  }
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

- Verifying the Designated Router Election on page 3383

Verifying the Designated Router Election

Purpose Based on the priority you configured for a specific OSPF interface, you can confirm the address of the area's designated router. The DR ID, DR, or DR-ID field displays the address of the area's designated router. The BDR ID, BDR, or BDR-ID field displays the address of the backup designated router.

Action From operational mode, enter the **show ospf interface** and the **show ospf neighbor** commands for OSPFv2, and enter the **show ospf3 interface** and the **show ospf3 neighbor** commands for OSPFv3.

Related Documentation

- OSPF Areas and Router Functionality Overview on page 3373

- *OSPF Configuration Overview*

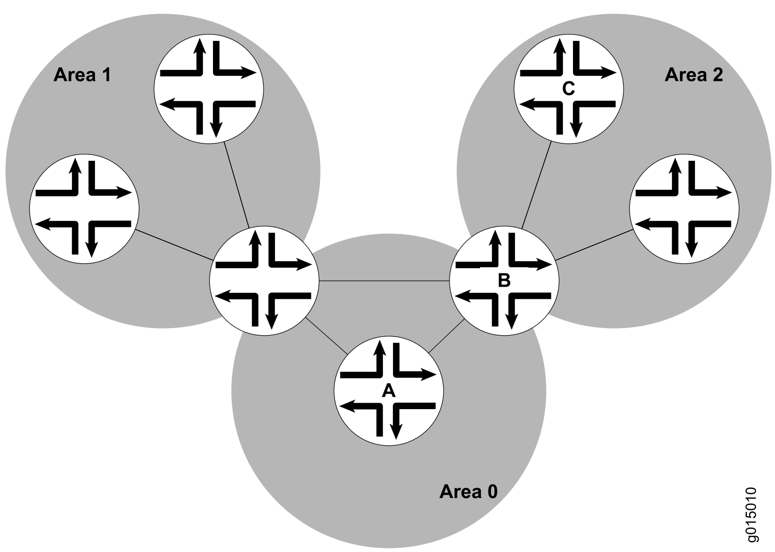
Examples: Configuring OSPF Areas

Understanding OSPF Areas and Backbone Areas

OSPF networks in an autonomous system (AS) are administratively grouped into *areas*. Each area within an AS operates like an independent network and has a unique 32-bit area ID, which functions similar to a network address. Within an area, the topology database contains only information about the area, link-state advertisements (LSAs) are flooded only to nodes within the area, and routes are computed only within the area. The topology of an area is hidden from the rest of the AS, thus significantly reducing routing traffic in the AS. Subnetworks are divided into other areas, which are connected to form the whole of the main network. Routing devices that are wholly within an area are called *internal routers*. All interfaces on internal routers are directly connected to networks within the area.

The central area of an AS, called the *backbone area*, has a special function and is always assigned the area ID 0.0.0.0. (Within a simple, single-area network, this is also the ID of the area.) Area IDs are unique numeric identifiers, in dotted decimal notation, but they are not IP addresses. Area IDs need only be unique within an AS. All other networks or areas in the AS must be directly connected to the backbone area by a routing device that has interfaces in more than one area. These connecting routing devices are called *area border routers* (ABRs). Figure 86 on page 3384 shows an OSPF topology of three areas connected by two ABRs.

Figure 86: Multiarea OSPF Topology



Because all areas are adjacent to the backbone area, OSPF routers send all traffic not destined for their own area through the backbone area. The ABRs in the backbone area are then responsible for transmitting the traffic through the appropriate ABR to the destination area. The ABRs summarize the link-state records of each area and advertise destination address summaries to neighboring areas. The advertisements contain the ID of the area in which each destination lies, so that packets are routed to the appropriate ABR. For example, in the OSPF areas shown in Figure 86 on page 3384, packets sent from Router A to Router C are automatically routed through ABR B.

Junos OS supports active backbone detection. Active backbone detection is implemented to verify that ABRs are connected to the backbone. If the connection to the backbone area is lost, then the routing device's default metric is not advertised, effectively rerouting traffic through another ABR with a valid connection to the backbone. Active backbone detection enables transit through an ABR with no active backbone connection. An ABR advertises to other routing devices that it is an ABR even if the connection to the backbone is down, so that the neighbors can consider it for interarea routes.

An OSPF restriction requires all areas to be directly connected to the backbone area so that packets can be properly routed. All packets are routed first to the backbone area by default. Packets that are destined for an area other than the backbone area are then routed to the appropriate ABR and on to the remote host within the destination area.

Example: Configuring a Single-Area OSPF Network

This example shows how to configure a single-area OSPF network.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices* or the *Junos OS Interfaces Configuration Guide for Security Devices*.
- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.

Overview

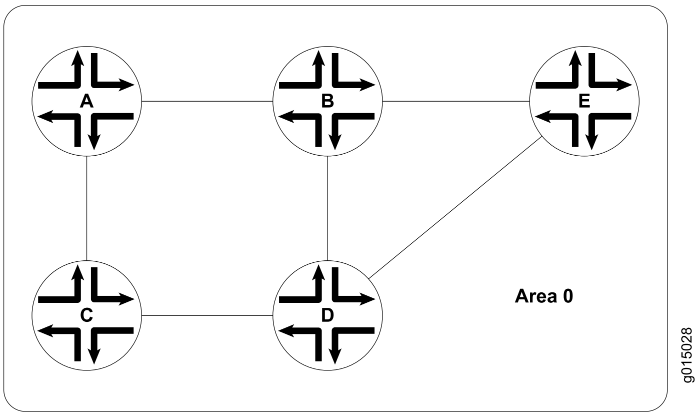
To activate OSPF on a network, you must enable the OSPF protocol on all interfaces within the network on which OSPF traffic is to travel. To enable OSPF, you must configure one or more interfaces on the device within an OSPF area. Once the interfaces are configured, OSPF LSAs are transmitted on all OSPF-enabled interfaces, and the network topology is shared throughout the network.

In an autonomous system (AS), the backbone area is always assigned area ID 0.0.0.0 (within a simple, single-area network, this is also the ID of the area). Area IDs are unique numeric identifiers, in dotted decimal notation. Area IDs need only be unique within an

AS. All other networks or areas in the AS must be directly connected to the backbone area by area border routers that have interfaces in more than one area. You must also create a backbone area if your network consists of multiple areas. In this example, you create the backbone area and add interfaces, such as **ge-0/0/0**, as needed to the OSPF area.

To use OSPF on the device, you must configure at least one OSPF area, such as the one shown in Figure 87 on page 3386.

Figure 87: Typical Single-Area OSPF Network Topology



Configuration

CLI Quick Configuration

To quickly configure a single-area OSPF network, copy the following command and paste it into the CLI. You repeat this configuration for all interfaces that are part of the OSPF area.

```
[edit]
set protocols ospf area 0.0.0.0 interface ge-0/0/0
```

Step-by-Step Procedure

To configure a single-area OSPF network:

1. Configure the single-area OSPF network by specifying the area ID and associated interface.

   NOTE: For a single-area OSPFv3 network, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# set protocols ospf area 0.0.0.0 interface ge-0/0/0
   ```

2. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
area 0.0.0.0 {
  interface ge-0/0/0.0;
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying the Interfaces in the Area

Purpose Verify that the interface for OSPF or OSPFv3 has been configured for the appropriate area. Confirm that the Area field displays the value that you configured.

Action From operational mode, enter the **show ospf interface** command for OSPFv2, and enter the **show ospf3 interface** command for OSPFv3.

Example: Configuring a Multiarea OSPF Network

This example shows how to configure a multiarea OSPF network. To reduce traffic and topology maintenance for the devices in an OSPF autonomous system (AS), you can group the OSPF-enabled routing devices into multiple areas.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices* or the *Junos OS Interfaces Configuration Guide for Security Devices*.
- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.
- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382.
- Configure a single-area OSPF network. See "Example: Configuring a Single-Area OSPF Network" on page 3385.

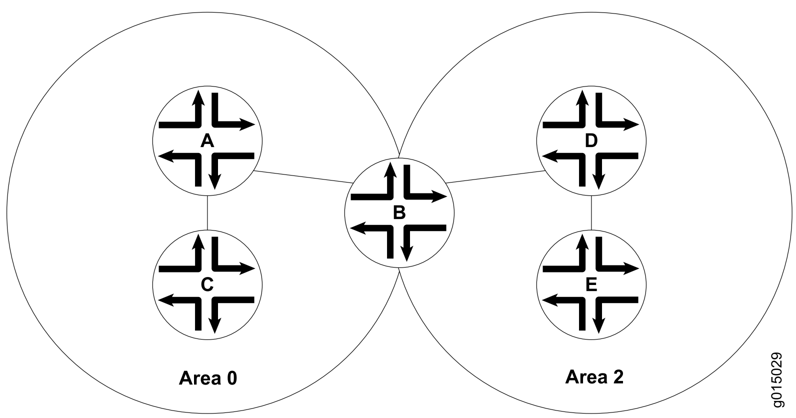
Overview

To activate OSPF on a network, you must enable the OSPF protocol on all interfaces within the network on which OSPF traffic is to travel. To enable OSPF, you must configure one or more interfaces on the device within an OSPF area. Once the interfaces are configured, OSPF LSAs are transmitted on all OSPF-enabled interfaces, and the network topology is shared throughout the network.

Each OSPF area consists of routing devices configured with the same area number. The backbone area is always assigned area ID 0.0.0.0. (All area identifiers (IDs) must be unique within an AS.) All other networks or areas in the AS must be directly connected to the backbone area by a router that has interfaces in more than one area. In Figure 88 on page 3388, Devices A and C are in the backbone area (area 0), and Devices D and E are in area 2. Device B has a special role. This is the area border router that connects area 0 and area 2. The area border router maintains a separate topological database for each area to which it is connected.

To reduce traffic and topology maintenance for the devices in an OSPF AS, you can group them into multiple areas as shown in Figure 88 on page 3388. In this example, you create the backbone area, create an additional area (area 2) and assign it unique area ID 0.0.0.2, and you configure Device B as the area border router, where interface **ge-0/0/0** participates in OSPF area 0 and interface **ge-0/0/2** participates in OSPF area 2.

Figure 88: Typical Multiarea OSPF Network Topology



Configuration

CLI Quick Configuration

To quickly configure a multiarea OSPF network, copy the following commands and paste them into the CLI. You repeat this configuration for all interfaces that are part of the OSPF area.

Device A

```
[edit]
set protocols ospf area 0.0.0.0 interface ge-0/0/0
set protocols ospf area 0.0.0.0 interface ge-0/0/1
```

Device C

```
[edit]
set protocols ospf area 0.0.0.0 interface ge-0/0/0
```

Device B

```
[edit]
```

```
set protocols ospf area 0.0.0.0 interface ge-0/0/0
set protocols ospf area 0.0.0.2 interface ge-0/0/2
```

Device D

```
[edit]
set protocols ospf area 0.0.0.2 interface ge-0/0/0
set protocols ospf area 0.0.0.2 interface ge-0/0/2
```

Device E

```
[edit]
set protocols ospf area 0.0.0.2 interface ge-0/0/2
```

Step-by-Step Procedure

To configure a multiarea OSPF network:

1. Configure the backbone area.

   NOTE: For an OSPFv3 network, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@A# set protocols ospf area 0.0.0.0 interface ge-0/0/0
   user@A# set protocols ospf area 0.0.0.0 interface ge-0/0/1
   ```

   ```
   [edit]
   user@C# set protocols ospf area 0.0.0.0 interface ge-0/0/0
   ```

   ```
   [edit]
   user@B# set protocols ospf area 0.0.0.0 interface ge-0/0/0
   ```

2. Configure an additional area for your OSPF network.

   ```
   [edit]
   user@B# set protocols ospf area 0.0.0.2 interface ge-0/0/2
   ```

   ```
   [edit]
   user@D# set protocols ospf area 0.0.0.2 interface ge-0/0/0
   user@D# set protocols ospf area 0.0.0.2 interface ge-0/0/2
   ```

   ```
   [edit]
   user@E# set protocols ospf area 0.0.0.2 interface ge-0/0/2
   ```

3. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@A# show protocols ospf
area 0.0.0.0 {
  interface ge-0/0/0.0;
  interface ge-0/0/1.0;
}
```

```
user@C# show protocols ospf
area 0.0.0.0 {
  interface ge-0/0/0.0;
}
```

```
user@B# show protocols ospf
area 0.0.0.0 {
  interface ge-0/0/0.0;
}
area 0.0.0.2 {
  interface ge-0/0/2.0;
}
```

```
user@D# show protocols ospf
area 0.0.0.2 {
  interface ge-0/0/0.0;
  interface ge-0/0/2.0;
}
```

```
user@E# show protocols ospf
area 0.0.0.2 {
  interface ge-0/0/2.0;
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

- Verifying the Interfaces in the Area on page 3390

Verifying the Interfaces in the Area

Purpose Verify that the interface for OSPF or OSPFv3 has been configured for the appropriate area. Confirm that the Area field displays the value that you configured.

Action From operational mode, enter the **show ospf interface** command for OSPFv2, and enter the **show ospf3 interface** command for OSPFv3.

Related Documentation

- OSPF Areas and Router Functionality Overview on page 3373

- *OSPF Configuration Overview*

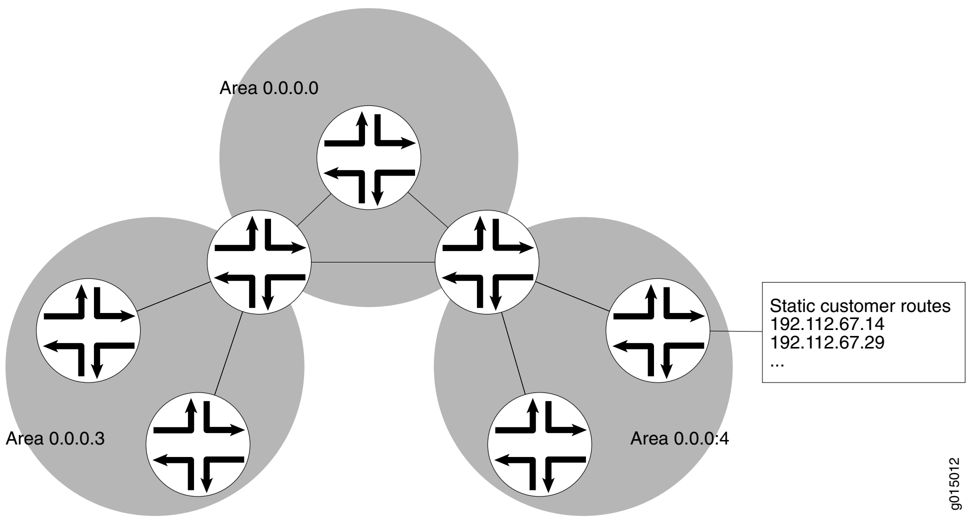
Advanced OSPF Area Configuration

Examples: Configuring OSPF Stub and Not-So-Stubby Areas

Understanding OSPF Stub Areas, Totally Stubby Areas, and Not-So-Stubby Areas

Figure 89 on page 3391 shows an autonomous system (AS) across which many external routes are advertised. If external routes make up a significant portion of a topology database, you can suppress the advertisements in areas that do not have links outside the network. By doing so, you can reduce the amount of memory the nodes use to maintain the topology database and free it for other uses.

Figure 89: OSPF AS Network with Stub Areas and NSSAs



To control the advertisement of external routes into an area, OSPF uses stub areas. By designating an area border router (ABR) interface to the area as a stub interface, you suppress external route advertisements through the ABR. Instead, the ABR advertises a default route (through itself) in place of the external routes and generates network summary (Type 3) link-state advertisements (LSAs). Packets destined for external routes are automatically sent to the ABR, which acts as a gateway for outbound traffic and routes the traffic appropriately.

NOTE: You must explicitly configure the ABR to generate a default route when attached to a stub or not-so-stubby-area (NSSA). To inject a default route with a specified metric value into the area, you must configure the **default-metric** option and specify a metric value.

For example, area 0.0.0.3 in Figure 89 on page 3391 is not directly connected to the outside network. All outbound traffic is routed through the ABR to the backbone and then to the destination addresses. By designating area 0.0.0.3 as a stub area, you reduce the size of the topology database for that area by limiting the route entries to only those routes internal to the area.

A stub area that only allows routes internal to the area and restricts Type 3 LSAs from entering the stub area is often called a *totally stubby area*. You can convert area 0.0.0.3 to a totally stubby area by configuring the ABR to only advertise and allow the default route to enter into the area. External routes and destinations to other areas are no longer summarized or allowed into a totally stubby area.

NOTE: **If you incorrectly configure a totally stubby area, you might encounter network connectivity issues. You should have advanced knowledge of OSPF and understand your network environment before configuring totally stubby areas.**

Similar to area 0.0.0.3 in Figure 89 on page 3391, area 0.0.0.4 has no external connections. However, area 0.0.0.4 has static customer routes that are not internal OSPF routes. You can limit the external route advertisements to the area and advertise the static customer routes by designating the area an NSSA. In an NSSA, the AS boundary router generates NSSA external (Type 7) LSAs and floods them into the NSSA, where they are contained. Type 7 LSAs allow an NSSA to support the presence of AS boundary routers and their corresponding external routing information. The ABR converts Type 7 LSAs into AS external (Type 5) LSAs and leaks them to the other areas, but external routes from other areas are not advertised within the NSSA.

Example: Configuring OSPF Stub and Totally Stubby Areas

This example shows how to configure an OSPF stub area and a totally stubby area to control the advertisement of external routes into an area.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices* or the *Junos OS Interfaces Configuration Guide for Security Devices*.
- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Control OSPF designated router election. See “Example: Controlling OSPF Designated Router Election” on page 3382
- Configure a multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.

Overview

The backbone area, which is 0 in Figure 90 on page 3394, has a special function and is always assigned the area ID 0.0.0.0. Area IDs are unique numeric identifiers, in dotted decimal notation. Area IDs need only be unique within an autonomous system (AS). All other networks or areas (such as 3, 7, and 9) in the AS must be directly connected to the backbone area by area border routers (ABRs) that have interfaces in more than one area.

Stub areas are areas through which or into which OSPF does not flood AS external link-state advertisements (Type 5 LSAs). You might create stub areas when much of the topology database consists of AS external advertisements and you want to minimize the size of the topology databases on the internal routers in the stub area.

The following restrictions apply to stub areas:

- You cannot create a virtual link through a stub area.
- A stub area cannot contain an AS boundary router.
- You cannot configure the backbone as a stub area.
- You cannot configure an area as both a stub area and an not-so-stubby area (NSSA).

In this example, you configure each routing device in area 7 (area ID 0.0.0.7) as a stub router and some additional settings on the ABR:

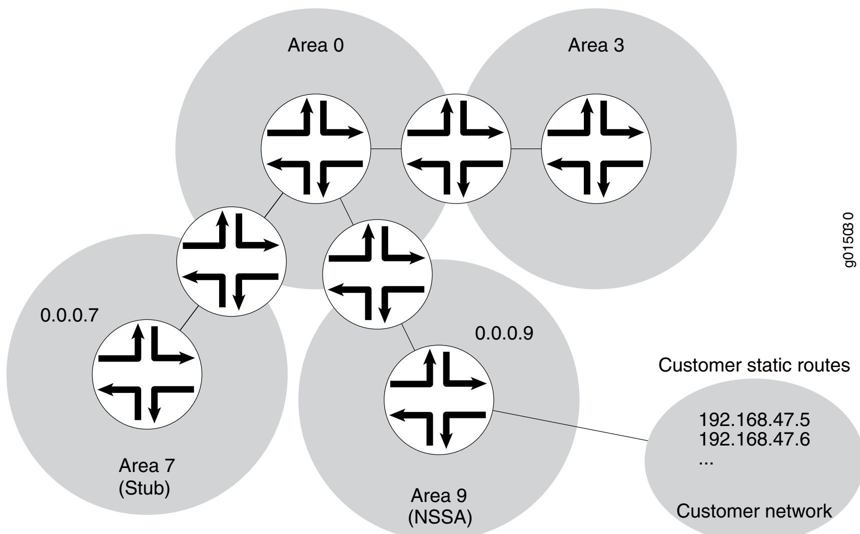
- **stub**—Specifies that this area become a stub area and not be flooded with Type 5 LSAs. You must include the **stub** statement on all routing devices that are in area 7 because this area has no external connections.
- **default-metric**—Configures the ABR to generate a default route with a specified metric into the stub area. This default route enables packet forwarding from the stub area to external destinations. You configure this option only on the ABR. The ABR does not automatically generate a default route when attached to a stub. You must explicitly configure this option to generate a default route.
- **no-summaries**—(Optional) Prevents the ABR from advertising summary routes into the stub area by converting the stub area into a totally stubby area. If configured in combination with the **default-metric** statement, a totally stubby area only allows routes internal to the area and advertises the default route into the area. External routes and destinations to other areas are no longer summarized or allowed into a totally stubby area. Only the ABR requires this additional configuration because it is the only routing device within the totally stubby area that creates Type 3 LSAs used to receive and send traffic from outside of the area.

NOTE:

In Junos OS Release 8.5 and later, the following applies:

- A router-identifier interface that is not configured to run OSPF is no longer advertised as a stub network in OSPF LSAs.
- OSPF advertises a local route with a prefix length of 32 as a stub link if the loopback interface is configured with a prefix length other than 32. OSPF also advertises the direct route with the configured mask length, as in earlier releases.

Figure 90: OSPF Network Topology with Stub Areas and NSSAs



Configuration

CLI Quick Configuration

- To quickly configure an OSPF stub area, copy the following command and paste it into the CLI. You must configure all routing devices that are part of the stub area.

```
[edit]
set protocols ospf area 0.0.0.7 stub
```

- To quickly configure the ABR to inject a default route into the area, copy the following command and paste it into the CLI. You apply this configuration only on the ABR.

```
[edit]
set protocols ospf area 0.0.0.7 stub default-metric 10
```

- (Optional) To quickly configure the ABR to restrict all summary advertisements and allow only internal routes and default route advertisements into the area, copy the following command and paste it into the CLI. You apply this configuration only on the ABR.

```
[edit]
set protocols ospf area 0.0.0.7 stub no-summaries
```

Step-by-Step Procedure

To configure OSPF stub areas:

1. On all routing devices in the area, configure an OSPF stub area.

   NOTE: To specify an OSPFv3 stub area, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# set protocols ospf area 0.0.0.7 stub
   ```

2. On the ABR, inject a default route into the area.

   ```
   [edit]
   user@host# set protocols ospf area 0.0.0.7 stub default-metric 10
   ```

3. (Optional) On the ABR, restrict summary LSAs from entering the area. This step converts the stub area into a totally stubby area.

   ```
   [edit]
   user@host# set protocols ospf area 0.0.0.7 stub no-summaries
   ```

4. If you are done configuring the devices, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Configuration on all routing devices:

```
user@host# show protocols ospf
area 0.0.0.7 {
  stub;
}
```

Configuration on the ABR (the output also includes the optional setting):

```
user@host# show protocols ospf
area 0.0.0.7 {
  stub default-metric 10 no-summaries;
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

- Verifying the Interfaces in the Area on page 3396
- Verifying the Type of OSPF Area on page 3396

Verifying the Interfaces in the Area

Purpose Verify that the interface for OSPF has been configured for the appropriate area. Confirm that the output includes Stub as the type of OSPF area.

Action From operational mode, enter the **show ospf interface detail** command for OSPFv2, and enter the **show ospf3 interface detail** command for OSPFv3.

Verifying the Type of OSPF Area

Purpose Verify that the OSPF area is a stub area. Confirm that the output displays Normal Stub as the Stub type.

Action From operational mode, enter the **show ospf overview** command for OSPFv2, and enter the **show ospf3 overview** command for OSPFv3.

Example: Configuring OSPF Not-So-Stubby Areas

This example shows how to configure an OSPF not-so-stubby area (NSSA) to control the advertisement of external routes into an area.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices* or the *Junos OS Interfaces Configuration Guide for Security Devices*.
- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.
- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382
- Configure a multiarea OSPF network. See "Example: Configuring a Multiarea OSPF Network" on page 3387.

Overview

The backbone area, which is 0 in Figure 91 on page 3398, has a special function and is always assigned the area ID 0.0.0.0. Area IDs are unique numeric identifiers, in dotted decimal notation. Area IDs need only be unique within an AS. All other networks or areas (such as 3, 7, and 9) in the AS must be directly connected to the backbone area by ABRs that have interfaces in more than one area.

An OSPF stub area has no external routes, so you cannot redistribute routes from another protocol into a stub area. OSPF NSSAs allow external routes to be flooded within the area.

In addition, you might have a situation when exporting Type 7 LSAs into the NSSA is unnecessary. When an AS boundary router is also an ABR with an NSSA attached, Type 7 LSAs are exported into the NSSA by default. If the ABR is attached to multiple NSSAs, a separate Type 7 LSA is exported into each NSSA by default. During route redistribution, this routing device generates both Type 5 LSAs and Type 7 LSAs. You can disable exporting Type 7 LSAs into the NSSA.

NOTE: **The following restriction applies to NSSAs: You cannot configure an area as both a stub area and an NSSA.**

You configure each routing device in area 9 (area ID 0.0.0.9) with the following setting:

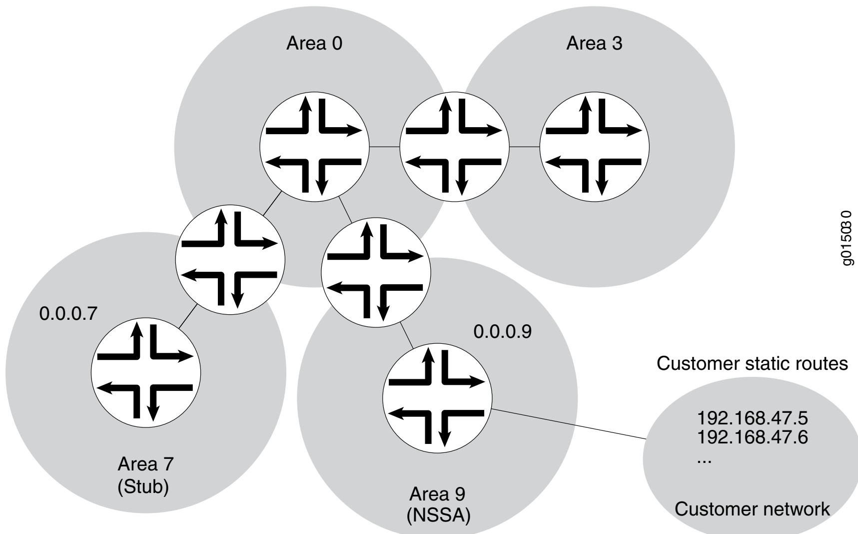
- **nssa**—Specifies an OSPF NSSA. You must include the **nssa** statement on all routing devices in area 9 because this area only has external connections to static routes.

You also configure the ABR in area 9 with the following additional settings:

- **no-summaries**—Prevents the ABR from advertising summary routes into the NSSA. If configured in combination with the **default-metric** statement, the NSSA only allows routes internal to the area and advertises the default route into the area. External routes and destinations to other areas are no longer summarized or allowed into the NSSA. Only the ABR requires this additional configuration because it is the only routing device within the NSSA that creates Type 3 LSAs used to receive and send traffic from outside the area.
- **default-lsa**—Configures the ABR to generate a default route into the NSSA. In this example, you configure the following:
  - **default-metric**—Specifies that the ABR generate a default route with a specified metric into the NSSA. This default route enables packet forwarding from the NSSA to external destinations. You configure this option only on the ABR. The ABR does not automatically generate a default route when attached to an NSSA. You must explicitly configure this option for the ABR to generate a default route.
  - **metric-type**—(Optional) Specifies the external metric type for the default LSA, which can be either Type 1 or Type 2. When OSPF exports route information from external ASs, it includes a cost, or external metric, in the route. The difference between the two metrics is how OSPF calculates the cost of the route. Type 1 external metrics are equivalent to the link-state metric, where the cost is equal to the sum of the internal costs plus the external cost. Type 2 external metrics use only the external cost assigned by the AS boundary router. By default, OSPF uses the Type 2 external metric.
  - **type-7**—(Optional) Floods Type 7 default LSAs into the NSSA if the **no-summaries** statement is configured. By default, when the **no-summaries** statement is configured, a Type 3 LSA is injected into NSSAs for Junos OS release 5.0 and later. To support backward compatibility with earlier Junos OS releases, include the **type-7** statement.

The second example also shows the optional configuration required to disable exporting Type 7 LSAs into the NSSA by including the **no-nssa-abr** statement on the routing device that performs the functions of both an ABR and an AS boundary router.

Figure 91: OSPF Network Topology with Stub Areas and NSSAs



Configuration

- Configuring Routing Devices to Participate in a Not-So-Stubby-Area on page 3398
- Disabling the Export of Type 7 Link State Advertisements into Not-So-Stubby Areas on page 3400

Configuring Routing Devices to Participate in a Not-So-Stubby-Area

CLI Quick Configuration

To quickly configure an OSPF NSSA, copy the following command and paste it into the CLI. You must configure all routing devices that are part of the NSSA.

```
[edit]
set protocols ospf area 0.0.0.9 nssa
```

To quickly configure an ABR that participates in an OSPF NSSA, copy the following commands and paste them into the CLI.

```
[edit]
set protocols ospf area 0.0.0.9 nssa default-lsa default-metric 10
set protocols ospf area 0.0.0.9 nssa default-lsa metric-type 1
set protocols ospf area 0.0.0.9 nssa default-lsa type-7
set protocols ospf area 0.0.0.9 nssa no-summaries
```

Step-by-Step Procedure

To configure OSPF NSSAs:

1. On all routing devices in the area, configure an OSPF NSSA.

NOTE: To specify an OSPFv3 NSSA area, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

```
[edit]
user@host# set protocols ospf area 0.0.0.9 nssa
```

2. On the ABR, enter OSPF configuration mode and specify the NSSA area 0.0.0.9 that you already created.

   ```
   [edit ]
   user@host# edit protocols ospf area 0.0.0.9 nssa
   ```

3. On the ABR, inject a default route into the area.

   ```
   [edit protocols ospf area 0.0.0.9 nssa]
   user@host# set default-lsa default-metric 10
   ```

4. (Optional) On the ABR, specify the external metric type for the default route.

   ```
   [edit protocols ospf area 0.0.0.9 nssa]
   user@host# set default-lsa metric-type 1
   ```

5. (Optional) On the ABR, specify the flooding of Type 7 LSAs.

   ```
   [edit protocols ospf area 0.0.0.9 nssa]
   user@host# set default-lsa type-7
   ```

6. On the ABR, restrict summary LSAs from entering the area.

   ```
   [edit protocols ospf area 0.0.0.9 nssa]
   user@host# set no-summaries
   ```

7. If you are done configuring the devices, commit the configuration.

   ```
   [edit protocols ospf area 0.0.0.9 nssa]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Configuration on all routing devices in the area:

```
user@host# show protocols ospf
area 0.0.0.9 {
  nssa;
}
```

Configuration on the ABR. The output also includes the optional **metric-type** and **type-7** statements.

```
user@host# show protocols ospf
  area 0.0.0.9 {
  nssa {
    default-lsa {
      default-metric 10;
      metric-type 1;
      type-7;
    }
    no-summaries;
  }
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Disabling the Export of Type 7 Link State Advertisements into Not-So-Stubby Areas

CLI Quick Configuration

To quickly disable exporting Type 7 LSAs into the NSSA, copy the following command and paste it into the CLI. You configure this setting on an AS boundary router that is also an ABR with an NSSA area attached.

```
[edit]
set protocols ospf no-nssa-abr
```

Step-by-Step Procedure

You can configure this setting if you have an AS boundary router that is also an ABR with an NSSA area attached.

1. Disable exporting Type 7 LSAs into the NSSA.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# set protocols ospf no-nssa-abr
   ```

2. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
no-nssa-abr;
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

- Verifying the Interfaces in the Area on page 3400
- Verifying the Type of OSPF Area on page 3401
- Verifying the Type of LSAs on page 3401

Verifying the Interfaces in the Area

Purpose

Verify that the interface for OSPF has been configured for the appropriate area. Confirm that the output includes Stub NSSA as the type of OSPF area.

Action

From operational mode, enter the **show ospf interface detail** command for OSPFv2, and enter the **show ospf3 interface detail** command for OSPFv3.

Verifying the Type of OSPF Area

Purpose Verify that the OSPF area is a stub area. Confirm that the output displays Not so Stubby Stub as the Stub type.

Action From operational mode, enter the **show ospf overview** command for OSPFv2, and enter the **show ospf3 overview** command for OSPFv3.

Verifying the Type of LSAs

Purpose Verify the type of LSAs that are in the area. If you disabled exporting Type 7 LSAs into an NSSA, confirm that the Type field does not include NSSA as a type of LSA.

Action From operational mode, enter the **show ospf database** command for OSPFv2, and enter the **show ospf3 database** command for OSPFv3.

Related Documentation

- *Example: Configuring OSPFv3 Stub and Totally Stubby Areas*
- OSPF Areas and Router Functionality Overview on page 3373
- *OSPF Configuration Overview*

Example: Configuring OSPF Multiarea Adjacency

- Multiarea Adjacency for OSPF on page 3401
- Example: Configuring Multiarea Adjacency for OSPF on page 3402

Multiarea Adjacency for OSPF

An area is a set of networks and hosts within an autonomous system (AS) that have been administratively grouped together. By default, a single interface can belong to only one OSPF area. However, in some situations, you might want to configure an interface to belong to more than one area. Doing so allows the corresponding link to be considered an intra-area link in multiple areas and to be preferred over other higher-cost intra-area paths. For example, you can configure an interface to belong to multiple areas with a high-speed backbone link between two area border routers (ABRs) so you can create multiarea adjacencies that belong to different areas.

In Junos OS Release 9.2 and later, you can configure a logical interface to belong to more than one OSPFv2 area. Support for OSPFv3 was introduced in Junos OS Release 9.4. As defined in RFC 5185, *OSPF Multi-Area Adjacency*, the ABRs establish multiple adjacencies belonging to different areas over the same logical interface. Each multiarea adjacency is announced as a point-to-point unnumbered link in the configured area by the routers connected to the link. For each area, one of the logical interfaces is treated as primary, and the remaining interfaces that are configured for the area are designated as secondary.

Any logical interface not configured as a secondary interface for an area is treated as the primary interface for that area. A logical interface can be configured as primary interface only for one area. For any other area for which you configure the interface, you must configure it as a secondary interface.

Example: Configuring Multiarea Adjacency for OSPF

This example shows how to configure multiarea adjacency for OSPF.

Requirements

Before you begin, plan your multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.

Overview

By default, a single interface can belong to only one OSPF area. You can configure a single interface to belong in multiple OSPF areas. Doing so allows the corresponding link to be considered an intra-area link in multiple areas and to be preferred over other higher-cost intra-area paths. When configuring a secondary interface, consider the following:

- For OSPFv2, you cannot configure point-to-multipoint and nonbroadcast multiaccess (NBMA) network interfaces as a secondary interface because secondary interfaces are treated as a point-to-point unnumbered link.
- Secondary interfaces are supported for LAN interfaces (the primary interface can be a LAN interface, but any secondary interfaces are treated as point-to-point unnumbered links over the LAN). In this scenario, you must ensure that there are only two routing devices on the LAN or that there are only two routing devices on the LAN that have secondary interfaces configured for a specific OSPF area.
- Since the purpose of a secondary interface is to advertise a topological path through an OSPF area, you cannot configure a secondary interface or a primary interface with one or more secondary interfaces to be passive. Passive interfaces advertise their address, but do not run the OSPF protocol (adjacencies are not formed and hello packets are not generated).
- Any logical interface not configured as a secondary interface for an area is treated as a primary interface for that area. A logical interface can be configured as the primary interface only for one area. For any other area for which you configure the interface, you must configure it as a secondary interface.
- You cannot configure the **secondary** statement with the **interface all** statement.
- You cannot configure a secondary interface by its IP address.

In this example, you configure an interface to be in two areas, creating a multiarea adjacency with a link between two ABRs: ABR R1 and ABR R2. On each ABR, area 0.0.0.1 contains the primary interface and is the primary link between the ABRs, and area 0.0.0.2 contains the secondary logical interface, which you configure by including the **secondary** statement. You configure interface **so-0/0/0** on ABR R1 and interface **so-1/0/0** on ABR R2.

Configuration

CLI Quick Configuration

To quickly configure a secondary logical interface for an OSPF area, copy the following commands and paste them into the CLI.

Configuration on ABR R1:

```
[edit]
set interfaces so-0/0/0 unit 0 family inet address 192.168.8.45/30
set routing-options router-id 10.255.0.1
set protocols ospf area 0.0.0.1 interface so-0/0/0
set protocols ospf area 0.0.0.2 interface so-0/0/0 secondary
```

Configuration on ABR R2:

```
[edit]
set interfaces so-1/0/0 unit 0 family inet address 192.168.8.37/30
set routing-options router-id 10.255.0.2
set protocols ospf area 0.0.0.1 interface so-1/0/0
set protocols ospf area 0.0.0.2 interface so-1/0/0 secondary
```

Step-by-Step Procedure

To configure a secondary logical interface:

1. Configure the device interfaces.

   NOTE: For OSPFv3, on each interface specify the **inet6** address family and include the IPv6 address.

   ```
   [edit]
   user@R1# set interfaces so-0/0/0 unit 0 family inet address 192.168.8.45/30
   ```

   ```
   [edit]
   user@R2# set interfaces so-1/0/0 unit 0 family inet address 192.168.8.37/30
   ```

2. Configure the router identifier.

   ```
   [edit]
   user@R1# set routing-options router-id 10.255.0.1
   ```

   ```
   [edit]
   user@R2# set routing-options router-id 10.255.0.2
   ```

3. On each ABR, configure the primary interface for the OSPF area.

   NOTE: For OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@R1# set protocols ospf 0.0.0.1 interface so-0/0/0
   ```

   ```
   [edit ]
   user@R2# set protocols ospf 0.0.0.2 interface so-1/0/0
   ```

4. On each ABR, configure the secondary interface for the OSPF area.

```
[edit ]
user@R1# set protocols ospf area 0.0.0.1 so-0/0/0 secondary
```

```
[edit ]
user@R2# set protocols ospf area 0.0.0.2 so-1/0/0 secondary
```

5. If you are done configuring the devices, commit the configuration.

```
[edit protocols ospf area 0.0.0.1 ]
user@host# commit
```

Results

Confirm your configuration by entering the **show interfaces**, **show routing-options**, and the **show protocols ospf** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Configuration on ABR R1:

```
user@R1# show interfaces
so-0/0/0 {
  unit 0 {
    family inet {
      address 192.168.8.45/30;
    }
  }
}
```

```
user@R1# show routing-options
router-id 10.255.0.1;
```

```
user@R1# show protocols ospf
area 0.0.0.1 {
  interface so-0/0/0.0;
}
  area 0.0.0.2 {
    interface so-0/0/0.0 {
      secondary;
    }
  }
```

Configuration on ABR R2:

```
user@R2# show interfaces
so-0/0/0 {
  unit 0 {
    family inet {
      address 192.168.8.37/30;
    }
  }
}
```

```
user@R2# show routing-options
router-id 10.255.0.2;
```

```
user@R2# show protocols ospf
area 0.0.0.1 {
```



```
    interface so-1/0/0.0;
}
    area 0.0.0.2 {
        interface so-1/0/0.0 {
            secondary;
        }
    }
```

Verification

Confirm that the configuration is working properly.

- Verifying the Secondary Interface on page 3405
- Verifying the Interfaces in the Area on page 3405
- Verifying Neighbor Adjacencies on page 3405

Verifying the Secondary Interface

Purpose Verify that the secondary interface appears for the configured area. The Secondary field displays if the interface is configured as a secondary interface. The output might also show the same interface listed in multiple areas.

Action From operational mode, enter the **show ospf interface detail** command for OSPFv2, and enter the **show ospf3 interface detail** command for OSPFv3.

Verifying the Interfaces in the Area

Purpose Verify the interfaces configured for the specified area.

Action From operational mode, enter the **show ospf interface area** ***area-id*** command for OSPFv2, and enter the **show ospf3 interface area** ***area-id*** command for OSPFv3..

Verifying Neighbor Adjacencies

Purpose Verify the primary and secondary neighbor adjacencies. The Secondary field displays if the neighbor is on a secondary interface.

Action From operational mode, enter the **show ospf neighbor detail** command for OSPFv2, and enter the **show ospf3 neighbor detail** command for OSPFv3.

Related Documentation

- OSPF Areas and Router Functionality Overview on page 3373
- Understanding OSPF Areas and Backbone Areas on page 3384

- *OSPF Configuration Overview*

Example: Disabling OSPFv2 Compatibility with RFC 1583

- OSPFv2 Compatibility with RFC 1583 Overview on page 3406
- Example: Disabling OSPFv2 Compatibility with RFC 1583 on page 3406

OSPFv2 Compatibility with RFC 1583 Overview

In the first implementation of OSPF (RFC1583, *OSPF Version 2*), the summary route assumes the cost of the granular route with the lowest cost. OSPF RFC 2328, *OSPF Version 2* changes the behavior so that the summary route assumes the cost of the granular route with the highest cost. OSPF readvertises the summary route whenever the cost of the summary changes. When using the default RFC 1583 behavior, this happens when the granular route with the lowest metric is changed or lost. When RFC 2328 is used, this happens when the granular route with the highest cost is changed or lost.

By default, the Junos OS implementation of OSPF is compatible with RFC 1583. This means that Junos OS maintains a single best route to an autonomous system (AS) boundary router in the OSPF routing table, rather than multiple intra-AS paths, if they are available. You can disable compatibility with RFC 1583. It is preferable to do so when the same external destination is advertised by AS boundary routers that belong to different OSPF areas. When you disable compatibility with RFC 1583, the OSPF routing table maintains the multiple intra-AS paths that are available, which the router uses to calculate AS external routes as defined in RFC 2328. Being able to use multiple available paths to calculate an AS external route can prevent routing loops.

Example: Disabling OSPFv2 Compatibility with RFC 1583

This example shows how to disable OSPFv2 compatibility with RFC 1583 on the routing device.

Requirements

No special configuration beyond device initialization is required before disabling OSPFv2 compatibility with RFC 1583.

Overview

The introduction of RFC 2328 changed the method used to calculate the routes in an OSPF network. By default, the Junos OS implementation of OSPFv2 is compatible with RFC 1583, so OSPF uses the minimum cost to determine the route to any of the networks within the specified range. When you disable RFC 1583 compatibility, OSPF uses the maximum cost to determine the route to any of the networks within the specified range. To minimize the potential for routing loops, configure the same RFC compatibility on all OSPF devices in an OSPF domain.

Configuration

CLI Quick Configuration

To quickly disable OSPFv2 compatibility with RFC 1583, copy the following command and paste it into the CLI. You configure this setting on all devices that are part of the OSPF domain.

```
[edit]
```



```
set protocols ospf no-rfc-1583
```

Step-by-Step Procedure

To disable OSPFv2 compatibility with RFC 1583:

1. Disable RFC 1583.

   ```
   [edit]
   user@host# set protocols ospf no-rfc-1583
   ```

2. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

NOTE: Repeat this configuration on each routing device that participates in an OSPF routing domain.

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
no-rfc-1583;
```

Verification

Confirm that the configuration is working properly.

Verifying the OSPF Routes

Purpose Verify that the OSPF routing table maintains the intra-AS paths with the largest metric, which the router uses to calculate AS external routes.

Action From operational mode, enter the **show ospf route detail** command.

Related Documentation

- OSPF Overview on page 3368

- *OSPF Configuration Overview*

OSPF Interface Configuration

Examples: Configuring OSPF Interfaces

About OSPF Interfaces

To activate OSPF on a network, you must enable the OSPF protocol on one or more interfaces on each device within the network on which traffic is to travel. How you configure the interface depends on whether the interface is connected to a broadcast or point-to-point network, a point-to-multipoint network, a nonbroadcast multiaccess (NBMA) network, or across a demand circuit.

- A broadcast interface behaves as if the routing device is connected to a LAN.
- A point-to-point interface provides a connection between a single source and a single destination (there is only one OSPF adjacency).
- A point-to-multipoint interface provides a connection between a single source and multiple destinations.
- An NBMA interface behaves in a similar fashion to a point-to-multipoint interface, but you might configure an NBMA interface to interoperate with other equipment.
- A demand circuit is a connection on which you can limit traffic based on user agreements. The demand circuit can limit bandwidth or access time based on agreements between the provider and user.

You can also configure an OSPF interface to be passive, to operate in passive traffic engineering mode, or to be a peer interface.

- A passive interface advertises its address, but does not run the OSPF protocol (adjacencies are not formed and hello packets are not generated).
- An interface operating in OSPF passive traffic engineering mode floods link address information within the autonomous system (AS) and makes it available for traffic engineering calculations.
- A peer interface can be configured for OSPFv2 routing devices. A peer interface is required for Generalized MPLS (GMPLS) to transport traffic engineering information through a link separate from the control channel. You establish this separate link by configuring a peer interface. The peer interface name must match the Link Management Protocol (LMP) peer name. A peer interface is optional for a hierarchy of RSVP label-switched paths (LSPs). After you configure the forwarding adjacency, you can configure OSPFv2 to advertise the traffic engineering properties of a forwarding adjacency to a specific peer.

Point-to-point interfaces differ from multipoint in that only one OSPF adjacency is possible. (A LAN, for instance, can have multiple addresses and can run OSPF on each subnet simultaneously.) As such, when you configure a numbered point-to-point interface to OSPF by name, multiple OSPF interfaces are created. One, which is unnumbered, is the interface on which the protocol is run. An additional OSPF interface is created for each address configured on the interface, if any, which is automatically marked as passive.

For OSPFv3, one OSPF-specific interface must be created per interface name configured under OSPFv3. OSPFv3 does not allow interfaces to be configured by IP address.

Enabling OSPF on an interface (by including the **interface** statement), disabling it (by including the **disable** statement), and not actually having OSPF run on an interface (by including the **passive** statement) are mutually exclusive states.

NOTE: When you configure OSPFv2 on an interface, you must also include the family inet statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level. When you configure OSPFv3 on an interface, you must also include the family inet6 statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level. In Junos OS Release 9.2 and later, you can configure OSPFv3 to support address families other than unicast IPv6.

Example: Configuring an Interface on a Broadcast or Point-to-Point Network

This example shows how to configure an OSPF interface on a broadcast or point-to-point network.

- Requirements on page 3409
- Overview on page 3409
- Configuration on page 3410
- Verification on page 3411

Requirements

Before you begin:

- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Control OSPF designated router election. See “Example: Controlling OSPF Designated Router Election” on page 3382
- Configure a multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.

Overview

If the interface on which you are configuring OSPF supports broadcast mode (such as a LAN), or if the interface supports point-to-point mode (such as a PPP interface or a point-to-point logical interface on Frame Relay), you specify the interface by including the IP address or the interface name for OSPFv2, or only the interface name for OSPFv3. In Junos OS Release 9.3 and later, an OSPF point-to-point interface can be an Ethernet interface without a subnet. If you configure an interface on a broadcast network, designated router and backup designated router election is performed.

NOTE: **Using both the interface name and the IP address of the same interface produces an invalid configuration.**

In this example, you configure interface **ge-0/2/0** as an OSPFv2 interface in OSPF area 0.0.0.1.

Configuration

CLI Quick Configuration

To quickly configure an OSPF interface on a broadcast or point-to-point network, copy the following commands and paste them into the CLI.

```
[edit]
set interfaces ge-0/2/0 unit 0 family inet address 10.0.0.1
set protocols ospf area 0.0.0.1 interface ge-0/2/0
```

Step-by-Step Procedure

To configure an OSPF interface on a broadcast or point-to-point network:

1. Configure the interface.

   NOTE: For an OSPFv3 interface, specify an IPv6 address.

   ```
   [edit]
   user@host# set interfaces ge-0/2/0 unit 0 family inet address 10.0.0.1
   ```

2. Create an OSPF area.

   NOTE: For an OSPFv3 interface, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# edit protocols ospf area 0.0.0.1
   ```

3. Assign the interface to the area.

   ```
   [edit protocols ospf area 0.0.0.1 ]
   user@host# set interface ge-0/2/0
   ```

4. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols ospf area 0.0.0.1 ]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show interfaces** and the **show protocols ospf** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show interfaces
ge-0/2/0 {
   unit 0 {
      family inet {
         address 10.0.0.1/32;
      }
   }
}
user@host# show protocols ospf
area 0.0.0.1 {
   interface ge-0/2/0.0;
}
```

To confirm your OSPFv3 configuration, enter the **show interfaces** and the **show protocols ospf3** commands.

Verification

Confirm that the configuration is working properly.

Verifying the OSPF Interface

Purpose Verify the interface configuration. Depending on your deployment, the Type field might display LAN or P2P.

Action From operational mode, enter the **show ospf interface detail** command for OSPFv2, and enter the **show ospf3 interface detail** command for OSPFv3.

Example: Configuring an OSPFv2 Interface on a Nonbroadcast Multiaccess Network

This example shows how to configure an OSPFv2 interface on a nonbroadcast multiaccess (NBMA) network.

Requirements

Before you begin:

- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.

- Control OSPF designated router election. See “Example: Controlling OSPF Designated Router Election” on page 3382.
- Configure a multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.

Overview

When you configure OSPFv2 on an NBMA network, you can use nonbroadcast mode rather than point-to-multipoint mode. Using this mode offers no advantages over point-to-multipoint mode, but it has more disadvantages than point-to-multipoint mode. Nevertheless, you might occasionally find it necessary to configure nonbroadcast mode to interoperate with other equipment. Because there is no autodiscovery mechanism, you must configure each neighbor.

Nonbroadcast mode treats the NBMA network as a partially connected LAN, electing designated and backup designated routers. All routing devices must have a direct connection to both the designated and backup designated routers, or unpredictable results occur.

When you configure the interface, specify either the IP address or the interface name. Using both the IP address and the interface name produces an invalid configuration. For nonbroadcast interfaces, specify the IP address of the nonbroadcast interface as the interface name.

In this example, you configure the Asynchronous Transfer Mode (ATM) interface **at-0/1/0** as an OSPFv2 interface in OSPF area 0.0.0.1, and you and specify the following settings:

- **interface-type nbma**—Sets the interface to run in NBMA mode. You must explicitly configure the interface to run in NBMA mode.
- **neighbor** ***address*** **<eligible>**—Specifies the IP address of the neighboring device. OSPF routing devices normally discover their neighbors dynamically by listening to the broadcast or multicast hello packets on the network. Because an NBMA network does not support broadcast (or multicast), the device cannot discover its neighbors dynamically, so you must configure all the neighbors statically. To configure multiple neighbors, include multiple **neighbor** statements. If you want the neighbor to be a designated router, include the **eligible** keyword.
- **poll-interval**—Specifies the length of time, in seconds, before the routing device sends hello packets out of the interface before it establishes adjacency with a neighbor. Routing devices send hello packets for a longer interval on nonbroadcast networks to minimize the bandwidth required on slow WAN links. The range is from 1 through 255 seconds. By default, the device sends hello packets out the interface every 120 seconds before it establishes adjacency with a neighbor.

  Once the routing device detects an active neighbor, the hello packet interval changes from the time specified in the **poll-interval** statement to the time specified in the **hello-interval** statement.

Configuration

CLI Quick Configuration

To quickly configure an OSPFv2 interface on an NBMA network, copy the following commands and paste them into the CLI.

```
[edit]
set interfaces at-0/1/0 unit 0 family inet address 192.0.2.1
set protocols ospf area 0.0.0.1 interface at-0/1/0.0 interface-type nbma
set protocols ospf area 0.0.0.1 interface at-0/1/0.0 neighbor 192.0.2.2 eligible
set protocols ospf area 0.0.0.1 interface at-0/1/0.0 poll-interval 130
```

Step-by-Step Procedure

To configure an OSPFv2 interface on an NBMA network:

1. Configure the interface.

   ```
   [edit]
   user@host# set interfaces at-0/1/0 unit 0 family inet address 192.0.2.1
   ```

2. Create an OSPF area.

   ```
   [edit]
   user@host# edit protocols ospf area 0.0.0.1
   ```

3. Assign the interface to the area.
   In this example, include the **eligible** keyword to allow the neighbor to be a designated router.

   ```
   [edit protocols ospf area 0.0.0.1 ]
   user@host# set interface at-0/1/0 interface-type nbma neighbor 192.0.2.2 eligible
   ```

4. Configure the poll interval.

   ```
   [edit protocols ospf area 0.0.0.1 ]
   user@host# set interface at-0/1/0 poll-interval 130
   ```

5. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols ospf area 0.0.0.1 ]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show interfaces** and the **show protocols ospf** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show interfaces
at-0/1/0 {
   unit 0 {
      family inet {
         address 192.0.2.1/32;
      }
   }
}
```

```
user@host# show protocols ospf
area 0.0.0.1 {
   interface at-0/1/0.0 {
```

```
            interface-type nbma;
            neighbor 192.0.2.2 eligible;
            poll-interval 130;
        }
    }
```

Verification

Confirm that the configuration is working properly.

Verifying the OSPF Interface

Purpose Verify the interface configuration. Confirm that the Type field displays NBMA.

Action From operational mode, enter the **show ospf interface detail** command.

Example: Configuring an OSPFv2 Interface on a Point-to-Multipoint Network

This example shows how to configure an OSPFv2 interface on a point-to-multipoint network.

Requirements

Before you begin:

- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.
- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382
- Configure a multiarea OSPF network. See "Example: Configuring a Multiarea OSPF Network" on page 3387.

Overview

When you configure OSPFv2 on a nonbroadcast multiaccess (NBMA) network, such as a multipoint Asynchronous Transfer Mode (ATM) or Frame Relay, OSPFv2 operates by default in point-to-multipoint mode. In this mode, OSPFv2 treats the network as a set of point-to-point links. Because there is no autodiscovery mechanism, you must configure each neighbor.

When you configure the interface, specify either the IP address or the interface name. Using both the IP address and the interface name produces an invalid configuration.

In this example, you configure ATM interface **at-0/1/0** as an OSPFv2 interface in OSPF area 0.0.0.1, and you and specify 192.0.2.1 as the neighbor's IP address.

Configuration

CLI Quick Configuration

To quickly configure an OSPFv2 interface on a point-to-multipoint network, copy the following commands and paste them into the CLI.

```
[edit]
set interfaces at-0/1/0 unit 0 family inet address 192.0.2.2
set protocols ospf area 0.0.0.1 interface at-0/1/0 neighbor 192.0.2.1
```

Step-by-Step Procedure

To configure an OSPFv2 interface on a point-to-multipoint network:

1. Configure the interface.

   ```
   [edit]
   user@host# set interfaces at-0/1/0 unit 0 family inet address 192.0.2.2
   ```

2. Create an OSPF area.

   ```
   [edit]
   user@host# edit protocols ospf area 0.0.0.1
   ```

3. Assign the interface to the area and specify the neighbor.

   ```
   [edit protocols ospf area 0.0.0.1]
   user@host# set interface at-0/1/0 neighbor 192.0.2.1
   ```

   To configure multiple neighbors, include a **neighbor** statement for each neighbor.

4. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols ospf area 0.0.0.1]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show interfaces** and the **show protocols ospf** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show interfaces
at-0/1/0 {
  unit 0 {
    family inet {
      address 192.0.2.2/32;
    }
  }
}
```

```
user@host# show protocols ospf
area 0.0.0.1 {
  interface at-0/1/0.0 {
    neighbor 192.0.2.1;
  }
}
```

Verification

Confirm that the configuration is working properly.

Verifying the OSPF Interface

Purpose Verify the interface configuration. Confirm that the Type field displays P2MP.

Action From operational mode, enter the **show ospf interface detail** command.

Example: Configuring OSPF Demand Circuits

This example shows how to configure an OSPF demand circuit interface.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.

NOTE: **If you are using OSPF demand circuits over an ISDN link, you must configure an ISDN interface and enable dial-on-demand routing. See the *Junos OS Network Interfaces Library for Routing Devices*.**

- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Configure a single-area OSPF network. See “Example: Configuring a Single-Area OSPF Network” on page 3385.
- Configure a multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.

Overview

OSPF sends periodic hello packets to establish and maintain neighbor adjacencies and uses link-state advertisements (LSAs) to make routing calculations and decisions. OSPF support for demand circuits is defined in RFC 1793, *Extending OSPF to Support Demand Circuits*, and suppresses the periodic hello packets and LSAs. A demand circuit is a connection on which you can limit traffic based on user agreements. The demand circuit can limit bandwidth or access time based on agreements between the provider and user.

You configure demand circuits on an OSPF interface. When the interface becomes a demand circuit, all hello packets and LSAs are suppressed as soon as OSPF synchronization is achieved. LSAs have a DoNotAge bit that stops the LSA from aging and prevents periodic updates from being sent. Hello packets and LSAs are sent and received on a demand-circuit interface only when there is a change in the network topology. This reduces the amount of traffic through the OSPF interface.

Consider the following when configuring OSPF demand circuits:

- Periodic hellos are only suppressed on point-to-point and point-to-multipoint interfaces. If you configure demand circuits on an OSPF broadcast network or on an OSPF nonbroadcast multiaccess (NBMA) network, periodic hello packets are still sent.
- Demand circuit support on an OSPF point-to-multipoint interface resembles that for point-to-point interfaces. If you configure a point-to-multipoint interface as a demand circuit, the device negotiates hello suppression separately on each interface that is part of the point-to-multipoint network.

This example assumes that you have a point-to-point connection between two devices using SONET/SDH interfaces. A demand-circuit interface automatically negotiates the demand-circuit connection with its OSPF neighbor. If the neighbor does not support demand circuits, then no demand circuit connection is established.

In this example, you configure OSPF interface **so-0/1/0** in OSPF area 0.0.0.1 as a demand circuit.

Configuration

CLI Quick Configuration

To quickly configure an OSPF demand circuit interface, copy the following command and paste it into the CLI. You must configure both neighboring interfaces for OSPF demand circuits for the connection to be established.

```
[edit]
set protocols ospf area 0.0.0.1 interface so-0/1/0 demand-circuit
```

Step-by-Step Procedure

To configure an OSPF demand circuit interface on one neighboring interface:

1. Create an OSPF area.

   NOTE: For OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit ]
   user@host# edit protocols ospf area 0.0.0.1
   ```

2. Configure the neighboring interface as a demand circuit.

   ```
   [edit protocols ospf area 0.0.0.1]
   user@host# set interface so-0/1/0 demand-circuit
   ```

3. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols ospf area 0.0.0.1]
   user@host# commit
   ```

   NOTE: Repeat this entire configuration on the other neighboring interface.

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols
ospf {
  area 0.0.0.1 {
    interface so-0/1/0.0 {
      demand-circuit;
      }
    }
  }
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying the Status of Neighboring Interfaces

Purpose Verify information about the neighboring interface. When the neighbor is configured for demand circuits, a DC flag displays.

Action From operational mode, enter the **show ospf neighbor detail** command for OSPFv2, and enter the **show ospf3 neighbor detail** command for OSPFv3.

Example: Configuring a Passive OSPF Interface

This example shows how to configure a passive OSPF interface. A passive OSPF interface advertises its address but does not run the OSPF protocol.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Configure a single-area OSPF network. See “Example: Configuring a Single-Area OSPF Network” on page 3385.
- Configure a multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.

Overview

By default, OSPF must be configured on an interface for direct interface addresses to be advertised as interior routes. To advertise the direct interface addresses without actually running OSPF on that interface (adjacencies are not formed and hello packets are not generated), you configure that interface as a passive interface.

Enabling OSPF on an interface (by including the **interface** statement), disabling it (by including the **disable** statement), and not actually having OSPF run on an interface (by including the **passive** statement) are mutually exclusive states.

NOTE: If you do not want to see notifications for state changes in a passive OSPF interface, you can disable the OSPF traps for the interface by including the **no-interface-state-traps** statement. The **no-interface-state-traps** statement is supported only for OSPFv2.

In this example, you configure interface **ge-0/2/0** as a passive OSPF interface in area 0.0.0.1 by including the **passive** statement.

Configuration

CLI Quick Configuration

To quickly configure a passive OSPF interface, copy the following command and paste it into the CLI.

```
[edit]
set protocols ospf area 0.0.0.1 interface ge-0/2/0 passive
```

Step-by-Step Procedure

To configure a passive OSPF interface:

1. Create an OSPF area.

   NOTE: For an OSPFv3 interface, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# edit protocols ospf area 0.0.0.1
   ```

2. Configure the passive interface.

   ```
   [edit protocols ospf area 0.0.0.1 ]
   user@host# set interface ge-0/2/0 passive
   ```

3. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols ospf area 0.0.0.1]
   user@host# commit
   ```


Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
  area 0.0.0.1 {
  interface ge-0/2/0.0 {
    passive;
  }
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying the Status of OSPF Interfaces

Purpose Verify the status of the OSPF interface. If the interface is passive, the Adj count field is 0 because no adjacencies have been formed. Next to this field, you might also see the word Passive.

Action From operational mode, enter the **show ospf interface detail** command for OSPFv2, and enter the **show ospf3 interface detail** command for OSPFv3.

Example: Configuring OSPFv2 Peer interfaces

This example shows how to configure an OSPFv2 peer interface.

- Requirements on page 3420
- Overview on page 3421
- Configuration on page 3421
- Verification on page 3421

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Configure a single-area OSPF network. See “Example: Configuring a Single-Area OSPF Network” on page 3385.

- Configure a multiarea OSPF network. See "Example: Configuring a Multiarea OSPF Network" on page 3387.
- Configure Generalized MPLS per your network requirements. See *LMP Configuration Overview* in the *Junos OS MPLS Applications Library for Routing Devices*.

Overview

You can configure an OSPFv2 peer interface for many reasons, including when you configure Generalized MPLS (GMPLS). This example configures a peer interface for GMPLS. GMPLS requires traffic engineering information to be transported through a link separate from the control channel. You establish this separate link by configuring a peer interface. The OSPFv2 peer interface name must match the Link Management Protocol (LMP) peer name. You configure GMPLS and the LMP settings separately from OSPF.

This example assumes that GMPLS and the LMP peer named **oxc1** are already configured, and you need to configure the OSPFv2 peer interface in area 0.0.0.0.

Configuration

CLI Quick Configuration

To quickly configure an OSPFv2 peer interface, copy the following command and paste it into the CLI.

```
[edit]
set protocols ospf area 0.0.0.0 peer-interface oxc1
```

Step-by-Step Procedure

To configure a peer OSPFv2 interface used by the LMP:

1. Create an OSPF area.

   ```
   [edit]
   user@host# edit protocols ospf area 0.0.0.0
   ```

2. Configure the peer interface.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@host# set peer-interface oxc1
   ```

3. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
  area 0.0.0.0 {
  peer-interface oxc1;
}
```

Verification

Confirm that the configuration is working properly.

Verifying the Configured OSPFv2 Peer

Purpose Verify the status of the OSPFv2 peer. When an OSPFv2 peer is configured for GMPLS, the Peer Name field displays the name of the LMP peer that you created for GMPLS, which is also the configured OSPFv2 peer.

Action From operational mode, enter the **show link-management** command.

Related Documentation

- OSPF Overview on page 3368
- *OSPF Configuration Overview*

OSPF Route Control Configuration

Examples: Configuring OSPF Route Summarization

Understanding OSPF Route Summarization

Area border routers (ABRs) send summary link advertisements to describe the routes to other areas. Depending on the number of destinations, an area can get flooded with a large number of link-state records, which can utilize routing device resources. To minimize the number of advertisements that are flooded into an area, you can configure the ABR to coalesce, or summarize, a range of IP addresses and send reachability information about these addresses in a single link-state advertisement (LSA). You can summarize one or more ranges of IP addresses, where all routes that match the specified area range are filtered at the area boundary, and the summary is advertised in their place.

For an OSPF area, you can summarize and filter intra-area prefixes. All routes that match the specified area range are filtered at the area boundary, and the summary is advertised in their place. For an OSPF not-so-stubby area (NSSA), you can only coalesce or filter NSSA external (Type 7) LSAs before they are translated into AS external (Type 5) LSAs and enter the backbone area. All external routes learned within the area that do not fall into the range of one of the prefixes are advertised individually to other areas.

In addition, you can also limit the number of prefixes (routes) that are exported into OSPF. By setting a user-defined maximum number of prefixes, you prevent the routing device from flooding an excessive number of routes into an area.

Example: Summarizing Ranges of Routes in OSPF Link-State Advertisements

This example shows how to summarize routes sent into the backbone area.

Requirements

Before you begin:

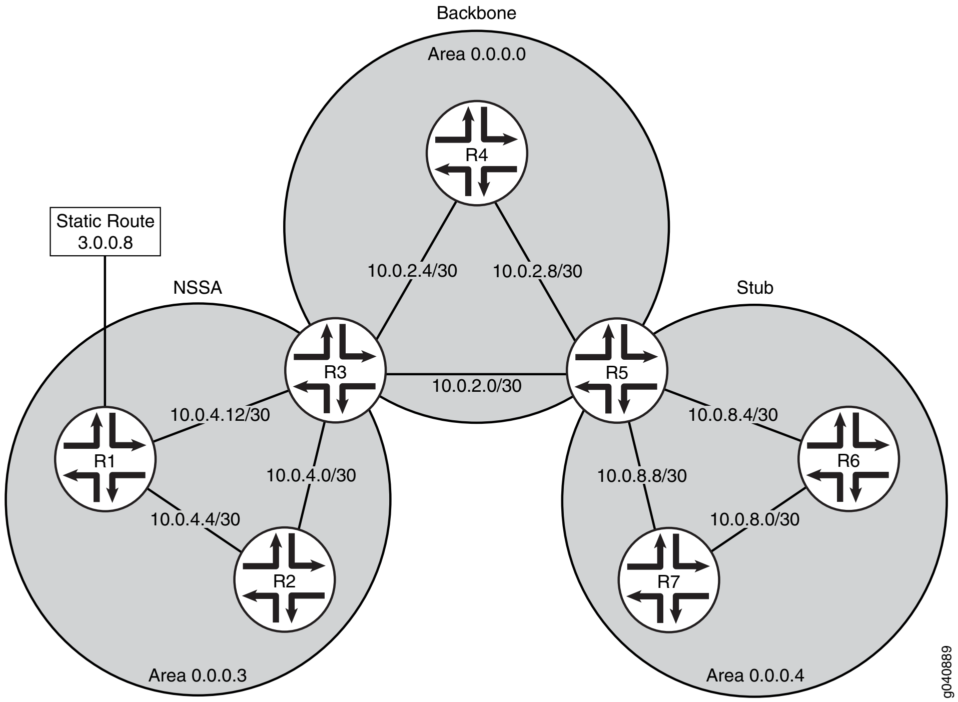
- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Control OSPF designated router election. See “Example: Controlling OSPF Designated Router Election” on page 3382
- Configure a static route. See *Examples: Configuring Static Routes* in the *Junos OS Routing Protocols Library for Routing Devices*.

Overview

You can summarize a range of IP addresses to minimize the size of the backbone router’s link-state database. All routes that match the specified area range are filtered at the area boundary, and the summary is advertised in their place.

Figure 92 on page 3424 shows the topology used in this example. R5 is the ABR between area 0.0.0.4 and the backbone. The networks in area 0.0.0.4 are 10.0.8.4/30, 10.0.8.0/30, and 10.0.8.8/30, which can be summarized as 10.0.8.0/28. R3 is the ABR between NSSA area 0.0.0.3 and the backbone. The networks in area 0.0.0.3 are 10.0.4.4/30, 10.0.4.0/30, and 10.0.4.12/30, which can be summarized as 10.0.4.0/28. Area 0.0.0.3 also contains external static route 3.0.0.8 that you will prevent from flooding throughout the network.

Figure 92: Summarizing Ranges of Routes in OSPF



In this example, you configure the ABRs for route summarization by including the following settings:

- **area-range**—For an area, summarizes a range of IP addresses when sending summary intra-area link advertisements. For an NSSA, summarizes a range of IP addresses when sending NSSA link-state advertisements (Type 7 LSAs). The specified prefixes are used to aggregate external routes learned within the area when the routes are advertised to other areas.
- **network/mask-length**—Indicates the summarized IP address range and the number of significant bits in the network mask.
- **restrict**—On the NSSA ABR, prevents the configured summary from being advertised. In this example, we do not want to flood the external route outside of area 0.0.0.3.

Configuration

CLI Quick Configuration

- To quickly configure route summarization for an OSPF area, copy the following commands and paste them into the CLI. The following is the configuration on ABR R5:

```
[edit]
set interfaces fe-0/0/1 unit 0 family inet address 10.0.8.3
set interfaces fe-0/0/2 unit 0 family inet address 10.0.8.4
set interfaces fe-0/0/0 unit 0 family inet address 10.0.2.3
set interfaces fe-0/0/4 unit 0 family inet address 10.0.2.5
set protocols ospf area 0.0.0.4 stub
set protocols ospf area 0.0.0.4 interface fe-0/0/1
set protocols ospf area 0.0.0.4 interface fe-0/0/2
set protocols ospf area 0.0.0.0 interface fe-0/0/0
```

```
set protocols ospf area 0.0.0.0 interface fe-0/0/4
set protocols ospf area 0.0.0.4 area-range 10.0.8.0/28
```

- To quickly configure route summarization for an OSPF NSSA, copy the following commands and paste them into the CLI. The following is the configuration on ABR R3:

```
[edit]
set interfaces fe-0/0/1 unit 0 family inet address 10.0.4.10
set interfaces fe-0/0/2 unit 0 family inet address 10.0.4.1
set interfaces fe-0/0/0 unit 0 family inet address 10.0.2.1
set interfaces fe-0/0/4 unit 0 family inet address 10.0.2.7
set protocols ospf area 0.0.0.3 interface fe-0/0/1
set protocols ospf area 0.0.0.3 interface fe-0/0/2
set protocols ospf area 0.0.0.0 interface fe-0/0/0
set protocols ospf area 0.0.0.0 interface fe-0/0/4
set protocols ospf area 0.0.0.3 area-range 10.0.4.0/28
set protocols ospf area 0.0.0.3 nssa
set protocols ospf area 0.0.0.3 nssa area-range 3.0.0.0/8 restrict
```

Step-by-Step Procedure

To summarize routes sent to the backbone area:

1. Configure the interfaces.

   NOTE: For OSPFv3, include IPv6 addresses.

```
[edit]
user@R5# set interfaces fe-0/0/1 unit 0 family inet address 10.0.8.3
user@R5# set interfaces fe-0/0/2 unit 0 family inet address 10.0.8.4
user@R5# set interfaces fe-0/0/0 unit 0 family inet address 10.0.2.3
user@R5# set interfaces fe-0/0/4 unit 0 family inet address 10.0.2.5
```

```
[edit]
user@R3# set interfaces fe-0/0/1 unit 0 family inet address 10.0.4.10
user@R3# set interfaces fe-0/0/2 unit 0 family inet address 10.0.4.1
user@R3# set interfaces fe-0/0/0 unit 0 family inet address 10.0.2.1
user@R3# set interfaces fe-0/0/4 unit 0 family inet address 10.0.2.7
```

2. Configure the type of OSPF area.

   NOTE: For OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

```
[edit]
user@R5# set protocols ospf area 0.0.0.4 stub
```

```
[edit]
user@R3# set protocols ospf area 0.0.0.3 nssa
```

3. Assign the interfaces to the OSPF areas.

```
user@R5# set protocols ospf area 0.0.0.4 interface fe-0/0/1
user@R5# set protocols ospf area 0.0.0.4 interface fe-0/0/2
```

```
user@R5# set protocols ospf area 0.0.0.0 interface fe-0/0/0
user@R5# set protocols ospf area 0.0.0.0 interface fe-0/0/4
```

```
user@R3# set protocols ospf area 0.0.0.3 interface fe-0/0/1
user@R3# set protocols ospf area 0.0.0.3 interface fe-0/0/2
user@R3# set protocols ospf area 0.0.0.0 interface fe-0/0/0
user@R3# set protocols ospf area 0.0.0.0 interface fe-0/0/4
```

4. Summarize the routes that are flooded into the backbone.

```
[edit]
user@R5# set protocols ospf area 0.0.0.4 area-range 10.0.8.0/28
```

```
[edit]
user@R3# set protocols ospf area 0.0.0.3 area-range 10.0.4.0/28
```

5. On ABR R3, restrict the external static route from leaving area 0.0.0.3.

```
[edit]
user@R3# set protocols ospf area 0.0.0.3 nssa area-range 3.0.0.0/8 restrict
```

6. If you are done configuring the devices, commit the configuration.

```
[edit]
user@host# commit
```

Results

Confirm your configuration by entering the **show interfaces** and the **show protocols ospf** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Configuration on ABR R5:

```
user@R5# show interfaces
fe-0/0/0 {
  unit 0 {
    family inet {
      address 10.0.2.3/32;
    }
  }
}
fe-0/0/1 {
  unit 0 {
    family inet {
      address 10.0.8.3/32;
    }
  }
}
fe-0/0/2 {
  unit 0 {
    family inet {
      address 10.0.8.4/32;
    }
  }
}
fe-0/0/4 {
  unit 0 {
```



```
        family inet {
            address 10.0.2.5/32;
        }
    }
}
```

```
user@R5# show protocols ospf
area 0.0.0.0 {
    interface fe-0/0/0.0;
    interface fe-0/0/4.0;
}
    area 0.0.0.4 {
        stub;
        area-range 10.0.8.0/28;
        interface fe-0/0/1.0;
        interface fe-0/0/2.0;
    }
```

Configuration on ABR R3:

```
user@R3# show interfaces
fe-0/0/0 {
    unit 0 {
        family inet {
            address 10.0.2.1/32;
        }
    }
}
fe-0/0/1 {
    unit 0 {
        family inet {
            address 10.0.4.10/32;
        }
    }
}
fe-0/0/2 {
    unit 0 {
        family inet {
            address 10.0.4.1/32;
        }
    }
}
fe-0/0/4 {
    unit 0 {
        family inet {
            address 10.0.2.7/32;
        }
    }
}
```

```
user@R3t# show protocols ospf
area 0.0.0.0 {
    interface fe-0/0/0.0;
    interface fe-0/0/4.0;
}
area 0.0.0.3 {
    nssa {
```



```
        area-range 3.0.0.0/8 restrict;
      }
      area-range 10.0.4.0/28;
      interface fe-0/0/1.0;
      interface fe-0/0/2.0;
    }
```

To confirm your OSPFv3 configuration, enter the **show interfaces** and **show protocols ospf3** commands.

Verification

Confirm that the configuration is working properly.

Verifying the Summarized Route

Purpose Verify that the routes you configured for route summarization are being aggregated by the ABRs before the routes enter the backbone area. Confirm route summarization by checking the entries of the OSPF link-state database for the routing devices in the backbone.

Action From operational mode, enter the **show ospf database** command for OSPFv2, and enter the **show ospf3 database** command for OSPFv3.

Example: Limiting the Number of Prefixes Exported to OSPF

This example shows how to limit the number of prefixes exported to OSPF.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.
- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382
- Configure a single-area OSPF network. See "Example: Configuring a Single-Area OSPF Network" on page 3385.
- Configure a multiarea OSPF network. See "Example: Configuring a Multiarea OSPF Network" on page 3387.

Overview

By default, there is no limit to the number of prefixes (routes) that can be exported into OSPF. By allowing any number of routes to be exported into OSPF, the routing device can become overwhelmed and potentially flood an excessive number of routes into an area.

You can limit the number of routes exported into OSPF to minimize the load on the routing device and prevent this potential problem. If the routing device exceeds the configured prefix export value, the routing device purges the external prefixes and enters into an overload state. This state ensures that the routing device is not overwhelmed as it attempts to process routing information. The prefix export limit number can be a value from 0 through 4,294,967,295.

In this example, you configure a prefix export limit of 100,000 by including the **prefix-export-limit** statement.

Configuration

CLI Quick Configuration

To quickly limit the number of prefixes exported to OSPF, copy the following command and paste it into the CLI.

```
[edit]
set protocols ospf prefix-export-limit 100000
```

Step-by-Step Procedure

To limit the number of prefixes exported to OSPF:

1. Configure the prefix export limit value.

   NOTE: For OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# set protocols ospf prefix-export-limit 100000
   ```

2. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
prefix-export-limit 100000;
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying the Prefix Export Limit

Purpose Verify the prefix export counter that displays the number or routes exported into OSPF.

Action From operational mode, enter the **show ospf overview** command for OSPFv2, and enter the **show ospf3 overview** command for OSPFv3.

Configuring OSPF Refresh and Flooding Reduction in Stable Topologies

The OSPF standard requires that every link-state advertisement (LSA) be refreshed every 30 minutes. The Juniper Networks implementation refreshes LSAs every 50 minutes. By default, any LSA that is not refreshed expires after 60 minutes. This requirement can result in traffic overhead that makes it difficult to scale OSPF networks. You can override the default behavior by specifying that the DoNotAge bit be set in self-originated LSAs when they are initially sent by the router or switch. Any LSA with the DoNotAge bit set is reflooded only when a change occurs in the LSA. This feature thus reduces protocol traffic overhead while permitting any changed LSAs to be flooded immediately. Routers or switches enabled for flood reduction continue to send hello packets to their neighbors and to age self-originated LSAs in their databases.

The Juniper implementation of OSPF refresh and flooding reduction is based on RFC 4136, *OSPF Refresh and Flooding Reduction in Stable Topologies*. However, the Juniper implementation does not include the forced-flooding interval defined in the RFC. Not implementing the forced-flooding interval ensures that LSAs with the DoNotAge bit set are reflooded only when a change occurs.

This feature is supported for the following:

- OSPFv2 and OSPFv3 interfaces
- OSPFv3 realms
- OSPFv2 and OSPFv3 virtual links
- OSPFv2 sham links
- OSPFv2 peer interfaces
- All routing instances supported by OSPF
- Logical systems

To configure flooding reduction for an OSPF interface, include the **flood-reduction** statement at the **[edit protocols (ospf | ospf3) area *area-id* interface *interface-id*]** hierarchy level.

NOTE: If you configure flooding reduction for an interface configured as a demand circuit, the LSAs are not initially flooded, but sent only when their content has changed. Hello packets and LSAs are sent and received on a demand-circuit interface only when a change occurs in the network topology.

In the following example, the OSPF interface **so-0/0/1.0** is configured for flooding reduction. As a result, all the LSAs generated by the routes that traverse the specified interface have the DoNotAge bit set when they are initially flooded, and LSAs are refreshed only when a change occurs.

```
[edit]
protocols ospf {
  area 0.0.0.0 {
    interface so-0/0/1.0 {
      flood-reduction;
    }
    interface lo0.0;
    interface so-0/0/0.0;
  }
}
```

NOTE: Beginning with Junos OS Release 12.2, you can configure a global default link-state advertisement (LSA) flooding interval in OSPF for self-generated LSAs by including the **lsa-refresh-interval** *minutes* statement at the **[edit protocols (ospf | ospf3)]** hierarchy level. The Juniper Networks implementation refreshes LSAs every 50 minutes. The range is 25 through 50 minutes. By default, any LSA that is not refreshed expires after 60 minutes.

If you have both the global LSA refresh interval configured for OSPF and OSPF flooding reduction configured for a specific interface in an OSPF area, the OSPF flood reduction configuration takes precedence for that specific interface.

Related Documentation

- OSPF Overview on page 3368
- *OSPF Configuration Overview*

Examples: Configuring OSPF Traffic Control

Understanding OSPF Traffic Control

Once a topology is shared across the network, OSPF uses the topology to route packets between network nodes. Each path between neighbors is assigned a cost based on the throughput, round-trip time, and reliability of the link. The sum of the costs across a particular path between hosts determines the overall cost of the path. Packets are then routed along the shortest path using the shortest-path-first (SPF) algorithm. Routes with lower total path metrics are preferred over those with higher path metrics.

You can use the following methods to control OSPF traffic:

- Control the cost of individual OSPF network segments
- Dynamically adjust OSPF interface metrics based on bandwidth
- Control OSPF route selection

Controlling the Cost of Individual OSPF Network Segments

OSPF uses the following formula to determine the cost of a route:

cost = reference-bandwidth / interface bandwidth

You can modify the reference-bandwidth value, which is used to calculate the default interface cost. The interface bandwidth value is not user-configurable and refers to the actual bandwidth of the physical interface.

By default, OSPF assigns a default cost metric of 1 to any link faster than 100 Mbps, and a default cost metric of 0 to the loopback interface (**lo0**). No bandwidth is associated with the loopback interface.

To control the flow of packets across the network, OSPF allows you to manually assign a cost (or metric) to a particular path segment. When you specify a metric for a specific OSPF interface, that value is used to determine the cost of routes advertised from that interface. For example, if all routers in the OSPF network use default metric values, and you increase the metric on one interface to 5, all paths through that interface have a calculated metric higher than the default and are not preferred.

NOTE: Any value you configure for the metric overrides the default behavior of using the reference-bandwidth value to calculate the route cost for that interface.

When there are multiple equal-cost routes to the same destination in a routing table, an equal-cost multipath (ECMP) set is formed. If there is an ECMP set for the active route, the Junos OS software uses a hash algorithm to choose one of the next-hop addresses in the ECMP set to install in the forwarding table.

You can configure Junos OS so that multiple next-hop entries in an ECMP set are installed in the forwarding table. Define a load-balancing routing policy by including one or more **policy-statement** configuration statements at the [**edit policy-options**] hierarchy level, with the action **load-balance per-packet**. Then apply the routing policy to routes exported from the routing table to the forwarding table.

Dynamically Adjusting OSPF Interface Metrics Based on Bandwidth

You can specify a set of bandwidth threshold values and associated metric values for an OSPF interface or for a topology on an OSPF interface. When the bandwidth of an interface changes, the Junos OS automatically sets the interface metric to the value associated with the appropriate bandwidth threshold value. Junos OS uses the smallest configured bandwidth threshold value that is equal to or greater than the actual interface bandwidth to determine the metric value. If the interface bandwidth is greater than any of the configured bandwidth threshold values, the metric value configured for the interface is used instead of any of the bandwidth-based metric values configured. The ability to recalculate the metric for an interface when its bandwidth changes is especially useful for aggregate interfaces.

NOTE: You must also configure a metric for the interface when you enable bandwidth-based metrics.

Controlling OSPF Route Preferences

You can control the flow of packets through the network using route preferences. Route preferences are used to select which route is installed in the forwarding table when several protocols calculate routes to the same destination. The route with the lowest preference value is selected.

By default, internal OSPF routes have a preference value of 10, and external OSPF routes have a preference value of 150. Although the default settings are appropriate for most environments, you might want to modify the default settings if all of the routing devices in your OSPF network use the default preference values, or if you are planning to migrate from OSPF to a different interior gateway protocol (IGP). If all of the devices use the default route preference values, you can change the route preferences to ensure that the path through a particular device is selected for the forwarding table any time multiple equal-cost paths to a destination exist. When migrating from OSPF to a different IGP, modifying the route preferences allows you to perform the migration in a controlled manner.

Example: Controlling the Cost of Individual OSPF Network Segments

This example shows how to control the cost of individual OSPF network segments.

- Requirements on page 3433
- Overview on page 3434
- Configuration on page 3435
- Verification on page 3437

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices* or the *Junos OS Interfaces Configuration Guide for Security Devices*.
- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.
- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382
- Configure a single-area OSPF network. See "Example: Configuring a Single-Area OSPF Network" on page 3385.

Overview

All OSPF interfaces have a cost, which is a routing metric that is used in the link-state calculation. Routes with lower total path metrics are preferred to those with higher path metrics. In this example, we explore how to control the cost of OSPF network segments.

By default, OSPF assigns a default cost metric of 1 to any link faster than 100 Mbps, and a default cost metric of 0 to the loopback interface (**lo0**). No bandwidth is associated with the loopback interface. This means that all interfaces faster than 100 Mbps have the same default cost metric of 1. If multiple equal-cost paths exist between a source and destination address, OSPF routes packets along each path alternately, in round-robin fashion.

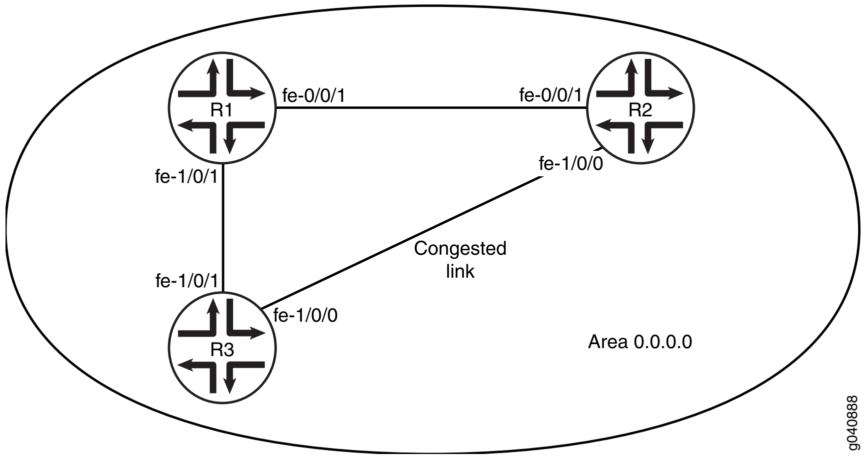
Having the same default metric might not be a problem if all of the interfaces are running at the same speed. If the interfaces operate at different speeds, you might notice that traffic is not routed over the fastest interface because OSPF equally routes packets across the different interfaces. For example, if your routing device has Fast Ethernet and Gigabit Ethernet interfaces running OSPF, each of these interfaces have a default cost metric of 1.

In the first example, you set the reference bandwidth to 10g (10 Gbps, as denoted by 10,000,000,000 bits) by including the **reference-bandwidth** statement. With this configuration, OSPF assigns the Fast Ethernet interface a default metric of 100, and the Gigabit Ethernet interface a metric of 10. Since the Gigabit Ethernet interface has the lowest metric, OSPF selects it when routing packets. The range is 9600 through 1,000,000,000,000 bits.

Figure 93 on page 3435 shows three routing devices in area 0.0.0.0 and assumes that the link between Device R2 and Device R3 is congested with other traffic. You can also control the flow of packets across the network by manually assigning a metric to a particular path segment. Any value you configure for the metric overrides the default behavior of using the reference-bandwidth value to calculate the route cost for that interface. To prevent the traffic from Device R3 going directly to Device R2, you adjust the metric on the interface on Device R3 that connects with Device R1 so that all traffic goes through Device R1.

In the second example, you set the metric to 5 on interface **fe-1/0/1** on Device R3 that connects with Device R1 by including the **metric** statement. The range is 1 through 65,535.

Figure 93: OSPF Metric Configuration



Configuration

- Configuring the Reference Bandwidth on page 3435
- Configuring a Metric for a Specific OSPF Interface on page 3436

Configuring the Reference Bandwidth

CLI Quick Configuration

To quickly configure the reference bandwidth, copy the following command and paste it into the CLI.

```
[edit]
set protocols ospf reference-bandwidth 10g
```

Step-by-Step Procedure

To configure the reference bandwidth:

1. Configure the reference bandwidth to calculate the default interface cost.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# set protocols ospf reference-bandwidth 10g
   ```

   TIP: As a shortcut in this example, you enter **10g** to specify 10 Gbps reference bandwidth. Whether you enter **10g** or **10000000000**, the output of **show protocols ospf** command displays 10 Gbps as **10g**, not **10000000000**.

2. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```


NOTE: Repeat this entire configuration on all routing devices in a shared network.

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
reference-bandwidth 10g;
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Configuring a Metric for a Specific OSPF Interface

CLI Quick Configuration

To quickly configure a metric for a specific OSPF interface, copy the following command and paste it into the CLI.

```
[edit]
set protocols ospf area 0.0.0.0 interface fe-1/0/1 metric 5
```

Step-by-Step Procedure

To configure the metric for a specific OSPF interface:

1. Create an OSPF area.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# edit protocols ospf area 0.0.0.0
   ```

2. Configure the metric of the OSPF network segment.

   ```
   [edit protocols ospf area 0.0.0.0 ]
   user@host# set interface fe-1/0/1 metric 5
   ```

3. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols ospf area 0.0.0.0 ]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
area 0.0.0.0 {
  interface fe-1/0/1.0 {
    metric 5;
  }
```

```
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying the Configured Metric

Purpose Verify the metric setting on the interface. Confirm that the Cost field displays the interface's configured metric (cost). When choosing paths to a destination, OSPF uses the path with the lowest cost.

Action From operational mode, enter the **show ospf interface detail** command for OSPFv2, and enter the **show ospf3 interface detail** command for OSPFv3.

Verifying the Route

Purpose When choosing paths to a destination, OSPF uses the path with the lowest total cost. Confirm that OSPF is using the appropriate path.

Action From operational mode, enter the **show route** command.

Example: Dynamically Adjusting OSPF Interface Metrics Based on Bandwidth

This example shows how to dynamically adjust OSPF interface metrics based on bandwidth.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.
- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382
- Configure a single-area OSPF network. See "Example: Configuring a Single-Area OSPF Network" on page 3385.

Overview

You can specify a set of bandwidth threshold values and associated metric values for an OSPF interface. When the bandwidth of an interface changes, the Junos OS automatically sets the interface metric to the value associated with the appropriate bandwidth threshold value. When you configure bandwidth-based metric values, you typically configure multiple bandwidth and metric values.

In this example, you configure OSPF interface **ae0** for bandwidth-based metrics by including the **bandwidth-based-metrics** statement and the following settings:

- **bandwidth**—Specifies the bandwidth threshold in bits per second. The range is 9600 through 1,000,000,000,000,000.
- **metric**—Specifies the metric value to associate with a specific bandwidth value. The range is 1 through 65,535.

Configuration

CLI Quick Configuration

To quickly configure bandwidth threshold values and associated metric values for an OSPF interface, copy the following commands, remove any line breaks, and then paste the commands into the CLI.

```
[edit]
set protocols ospf area 0.0.0.0 interface ae0.0 metric 5
set protocols ospf area 0.0.0.0 interface ae0.0 bandwidth-based-metrics bandwidth 1g
  metric 60
set protocols ospf area 0.0.0.0 interface ae0.0 bandwidth-based-metrics bandwidth 10g
  metric 50
```

To configure the metric for a specific OSPF interface:

1. Create an OSPF area.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# edit protocols ospf area 0.0.0.0
   ```

2. Configure the metric of the OSPF network segment.

   ```
   [edit protocols ospf area 0.0.0.0 ]
   user@host# set interface ae0 metric 5
   ```

3. Configure the bandwidth threshold values and associated metric values.

   ```
   [edit protocols ospf area 0.0.0.0 ]
   user@host# set interface ae0.0 bandwidth-based-metrics bandwidth 1g metric 60
   user@host# set interface ae0.0 bandwidth-based-metrics bandwidth 10g metric 50
   ```

4. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols ospf area 0.0.0.0 ]
   user@host# commit
   ```


Results Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
area 0.0.0.0 {
  interface ae0.0 {
    bandwidth-based-metrics {
      bandwidth 1g metric 60;
      bandwidth 10g metric 50;
    }
    metric 5;
  }
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying the Configured Metric

Purpose Verify the metric setting on the interface. Confirm that the Cost field displays the interface's configured metric (cost). When choosing paths to a destination, OSPF uses the path with the lowest cost.

Action From operational mode, enter the **show ospf interface detail** command for OSPFv2, and enter the **show ospf3 interface detail** command for OSPFv3.

Example: Controlling OSPF Route Preferences

This example shows how to control OSPF route selection in the forwarding table. This example also shows how you might control route selection if you are migrating from OSPF to another IGP.

- Requirements on page 3439
- Overview on page 3440
- Configuration on page 3440
- Verification on page 3441

Requirements

This example assumes that OSPF is properly configured and running in your network, and you want to control route selection because you are planning to migrate from OSPF to a different IGP.

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices* or the *Junos OS Interfaces Configuration Guide for Security Devices*.
- Configure the IGP that you want to migrate to. See the *Junos OS Routing Protocols Library for Routing Devices*.

Overview

Route preferences are used to select which route is installed in the forwarding table when several protocols calculate routes to the same destination. The route with the lowest preference value is selected.

By default, internal OSPF routes have a preference value of 10, and external OSPF routes have a preference value of 150. You might want to modify this setting if you are planning to migrate from OSPF to a different IGP. Modifying the route preferences enables you to perform the migration in a controlled manner.

This example makes the following assumptions:

- OSPF is already running in your network.
- You want to migrate from OSPF to IS-IS.
- You configured IS-IS per your network requirements and confirmed it is working properly.

In this example, you increase the OSPF route preference values to make them less preferred than IS-IS routes by specifying 168 for internal OSPF routes and 169 for external OSPF routes. IS-IS internal routes have a preference of either 15 (for Level1) or 18 (for Level 2), and external routes have a preference of 160 (for Level 1) or 165 (for Level 2). In general, it is preferred to leave the new protocol at its default settings to minimize complexities and simplify any future addition of routing devices to the network. To modify the OSPF route preference values, configure the following settings:

- **preference**—Specifies the route preference for internal OSPF routes. By default, internal OSPF routes have a value of 10. The range is from 0 through 4,294967,295 (2^{32} – 1).
- **external-preference**—Specifies the route preference for external OSPF routes. By default, external OSPF routes have a value of 150. The range is from 0 through 4,294967,295 (2^{32} – 1).

Configuration

CLI Quick Configuration

To quickly configure the OSPF route preference values, copy the following command and paste it into the CLI.

```
[edit]
set protocols ospf preference 168 external-preference 169
```

To configure route selection:

1. Enter OSPF configuration mode and set the external and internal routing preferences.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# set protocols ospf preference 168 external-preference 169
   ```

2. If you are done configuring the device, commit the configuration.

```
[edit]
user@host# commit
```

Results Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
preference 168;
external-preference 169;
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying the Route

Purpose Verify that the IGP is using the appropriate route. After the new IGP becomes the preferred protocol (in this example, IS-IS), you should monitor the network for any issues. After you confirm that the new IGP is working properly, you can remove the OSPF configuration from the routing device by entering the **delete ospf** command at the **[edit protocols]** hierarchy level.

Action From operational mode, enter the **show route** command.

Related Documentation

- OSPF Overview on page 3368
- *OSPF Configuration Overview*

Example: Configuring OSPF Overload Mode

OSPF Overload Function Overview

If the time elapsed after the OSPF instance is enabled is less than the specified timeout, overload mode is set.

You can configure the local routing device so that it appears to be overloaded. An overloaded routing device determines it is unable to handle any more OSPF transit traffic, which results in sending OSPF transit traffic to other routing devices. OSPF traffic to directly attached interfaces continues to reach the routing device. You might configure overload mode for many reasons, including:

- If you want the routing device to participate in OSPF routing, but do not want it to be used for transit traffic. This could include a routing device that is connected to the network for analysis purposes, but is not considered part of the production network, such as network management routing devices.

- If you are performing maintenance on a routing device in a production network. You can move traffic off that routing device so network services are not interrupted during your maintenance window.

You configure or disable overload mode in OSPF with or without a timeout. Without a timeout, overload mode is set until it is explicitly deleted from the configuration. With a timeout, overload mode is set if the time elapsed since the OSPF instance started is less than the specified timeout.

A timer is started for the difference between the timeout and the time elapsed since the instance started. When the timer expires, overload mode is cleared. In overload mode, the router link-state advertisement (LSA) is originated with all the transit router links (except stub) set to a metric of 0xFFFF. The stub router links are advertised with the actual cost of the interfaces corresponding to the stub. This causes the transit traffic to avoid the overloaded routing device and to take paths around the routing device. However, the overloaded routing device's own links are still accessible.

NOTE: The routing device can also dynamically enter the overload state, regardless of configuring the device to appear overloaded. For example, if the routing device exceeds the configured OSPF prefix limit, the routing device purges the external prefixes and enters into an overload state. You can limit the number of routes exported into OSPF to minimize the load on the routing device and prevent this potential problem.

Example: Configuring OSPF to Make Routing Devices Appear Overloaded

This example shows how to configure a routing device running OSPF to appear to be overloaded.

- Requirements on page 3442
- Overview on page 3443
- Configuration on page 3443
- Verification on page 3444

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.
- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382

- Configure a single-area OSPF network. See "Example: Configuring a Single-Area OSPF Network" on page 3385.
- Configure a multiarea OSPF network. See "Example: Configuring a Multiarea OSPF Network" on page 3387.

Overview

You can configure a local routing device running OSPF to appear to be overloaded, which allows the local routing device to participate in OSPF routing, but not for transit traffic. When configured, the transit interface metrics are set to the maximum value of 65535.

This example includes the following settings:

- **overload**—Configures the local routing device so it appears to be overloaded. You might configure this if you want the routing device to participate in OSPF routing, but do not want it to be used for transit traffic, or you are performing maintenance on a routing device in a production network.
- **timeout** ***seconds***—(Optional) Specifies the number of seconds at which the overload is reset. If no timeout interval is specified, the routing device remains in the overload state until the overload statement is deleted or a timeout is set. In this example, you configure 60 seconds as the amount of time the routing device remains in the overload state. By default, the timeout interval is 0 seconds (this value is not configured). The range is from 60 through 1800 seconds.

Configuration

CLI Quick Configuration

To quickly configure a local routing device to appear as overloaded, copy the following command and paste it into the CLI.

```
[edit]
set protocols ospf overload timeout 60
```

Step-by-Step Procedure

To configure a local routing device to appear overloaded:

1. Enter OSPF configuration mode.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host edit protocols ospf
   ```

2. Configure the local routing device to be overloaded.

   ```
   [edit protocols ospf]
   user@host set overload
   ```

3. (Optional) Configure the number of seconds at which overload is reset.

   ```
   [edit protocols ospf]
   user@host set overload timeout 60
   ```


4. If you are done configuring the device, commit the configuration.

   [edit protocols ospf]
   user@host# **commit**

Results Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration. The output includes the optional **timeout** statement.

```
user@host# show protocols ospf
overload timeout 60;
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

- Verifying Traffic Has Moved Off Devices on page 3444
- Verifying Transit Interface Metrics on page 3444
- Verifying the Overload Configuration on page 3444
- Verifying the Viable Next Hop on page 3445

Verifying Traffic Has Moved Off Devices

Purpose Verify that the traffic has moved off the upstream devices.

Action From operational mode, enter the **show interfaces detail** command.

Verifying Transit Interface Metrics

Purpose Verify that the transit interface metrics are set to the maximum value of 65535 on the downstream neighboring device.

Action From operational mode, enter the **show ospf database router detail advertising-router** ***address*** command for OSPFv2, and enter the **show ospf3 database router detail advertising-router** ***address*** command for OSPFv3.

Verifying the Overload Configuration

Purpose Verify that overload is configured by reviewing the Configured overload field. If the overload timer is also configured, this field also displays the time that remains before it is set to expire.

Action From operational mode, enter the **show ospf overview** command for OSPFv2, and the **show ospf3 overview** command for OSPFv3.

Verifying the Viable Next Hop

Purpose Verify the viable next hop configuration on the upstream neighboring device. If the neighboring device is overloaded, it is not used for transit traffic and is not displayed in the output.

Action From operational mode, enter the **show route *address*** command.

Related Documentation

- OSPF Overview on page 3368
- *OSPF Configuration Overview*

OSPF Fault Detection Configuration

Example: Configuring OSPF Timers

OSPF Timers Overview

OSPF routing devices constantly track the status of their neighbors, sending and receiving hello packets that indicate whether each neighbor still is functioning, and sending and receiving link-state advertisement (LSA) and acknowledgment packets. OSPF sends packets and expects to receive packets at specified intervals.

You configure OSPF timers on the interface of the routing device participating in OSPF. Depending on the timer, the configured interval must be the same on all routing devices on a shared network (area).

You can configure the following OSPF timers:

- Hello interval—Routing devices send hello packets at a fixed interval on all interfaces, including virtual links, to establish and maintain neighbor relationships. The hello interval specifies the length of time, in seconds, before the routing device sends a hello packet out of an interface. This interval must be the same on all routing devices on a shared network. By default, the routing device sends hello packets every 10 seconds (broadcast and point-to-point networks) and 30 seconds (nonbroadcast multiple access (NBMA) networks).
- Poll interval—(OSPFv2, Nonbroadcast networks only) Routing devices send hello packets for a longer interval on nonbroadcast networks to minimize the bandwidth required on slow WAN links. The poll interval specifies the length of time, in seconds, before the routing device sends hello packets out of the interface before establishing adjacency with a neighbor. By default, the routing device sends hello packets every 120 seconds until active neighbors are detected.

Once the routing device detects an active neighbor, the hello packet interval changes from the time specified in the poll interval to the time specified in the hello interval.

- LSA retransmission interval—When a routing device sends LSAs to its neighbors, the routing device expects to receive an acknowledgment packet from each neighbor within a certain amount of time. The LSA retransmission interval specifies the length of time, in seconds, that the routing device waits to receive an LSA packet before retransmitting the LSA to an interface's neighbors. By default, the routing device waits 5 seconds for an acknowledgment before retransmitting the LSA.
- Dead interval—If a routing device does not receive a hello packet from a neighbor within a fixed amount of time, the routing device modifies its topology database to indicate that the neighbor is nonoperational. The dead interval specifies the length of time, in seconds, that the routing device waits before declaring that a neighboring routing device is unavailable. This is an interval during which the routing device receives no hello packets from the neighbor. This interval must be the same on all routing devices on a shared network. By default, this interval is four times the default hello interval, which is 40 seconds (broadcast and point-to-point networks) and 120 seconds (NBMA networks).
- Transit delay—Before a link-state update packet is propagated out of an interface, the routing device must increase the age of the packet. The transit delay sets the estimated time required to transmit a link-state update on the interface. By default, the transit delay is 1 second. You should never have to modify the transit delay time.

Example: Configuring OSPF Timers

This example shows how to configure the OSPF timers.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.
- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382
- Configure a single-area OSPF network. See "Example: Configuring a Single-Area OSPF Network" on page 3385.
- Configure a multiarea OSPF network. See "Example: Configuring a Multiarea OSPF Network" on page 3387.

Overview

The default OSPF timer settings are optimal for most networks. However, depending on your network requirements, you might need to modify the timer settings. This example explains why you might need to modify the following timers:

- Hello interval
- Dead interval
- LSA retransmission interval
- Transit delay

Hello Interval and Dead Interval

The hello interval and the dead interval optimize convergence times by efficiently tracking neighbor status. By lowering the values of the hello interval and the dead interval, you can increase the convergence of OSPF routes if a path fails. These intervals must be the same on all routing devices on a shared network. Otherwise, OSPF cannot establish the appropriate adjacencies.

In the first example, you lower the hello interval to 2 seconds and the dead interval to 8 seconds on point-to-point OSPF interfaces **fe-0/0/1** and **fe-1/0/1** in area 0.0.0.0 by configuring the following settings:

- **hello-interval**—Specifies the length of time, in seconds, before the routing device sends a hello packet out of an interface. By default, the routing device sends hello packets every 10 seconds. The range is from 1 through 255 seconds.
- **dead-interval**—Specifies the length of time, in seconds, that the routing device waits before declaring that a neighboring routing device is unavailable. This is an interval during which the routing device receives no hello packets from the neighbor. By default, the routing device waits 40 seconds (four times the hello interval). The range is 1 through 65,535 seconds.

LSA Retransmission Interval

The link-state advertisement (LSA) retransmission interval optimizes the sending and receiving of LSA and acknowledgement packets. You must configure the LSA retransmission interval to be equal to or greater than 3 seconds to avoid triggering a retransmit trap because the Junos OS delays LSA acknowledgments by up to 2 seconds. If you have a virtual link, you might find increased performance by increasing the value of the LSA retransmission interval.

In the second example, you increase the LSA retransmission timer to 8 seconds on OSPF interface **fe-0/0/1** in area 0.0.0.1 by configuring the following setting:

- **retransmit-interval**—Specifies the length of time, in seconds, that the routing device waits to receive an LSA packet before retransmitting LSA to an interface's neighbors. By default, the routing device retransmits LSAs to its neighbors every 5 seconds. The range is from 1 through 65,535 seconds.

Transit Delay

The transit delay sets the time the routing device uses to age a link-state update packet. If you have a slow link (for example, one with an average propagation delay of multiple seconds), you should increase the age of the packet by a similar amount. Doing this ensures that you do not receive a packet back that is younger than the original copy.

In the final example, you increase the transit delay to 2 seconds on OSPF interface **fe-1/0/1** in area 0.0.0.1. By configuring the following setting, this causes the routing device to age the link-state update packet by 2 seconds:

- **transit-delay**—Sets the estimated time required to transmit a link-state update on the interface. You should never have to modify the transit delay time. By default, the routing device ages the packet by 1 second. The range is from 1 through 65,535 seconds.

Configuration

Configuring the Hello Interval and the Dead Interval

CLI Quick Configuration

To quickly configure the hello and dead intervals, copy the following commands and paste them into the CLI.

```
[edit]
set protocols ospf area 0.0.0.0 interface fe-0/0/1 hello-interval 2
set protocols ospf area 0.0.0.0 interface fe-0/0/1 dead-interval 8
set protocols ospf area 0.0.0.0 interface fe-1/0/1 hello-interval 2
set protocols ospf area 0.0.0.0 interface fe-1/0/1 dead-interval 8
```

Step-by-Step Procedure

To configure the hello and dead intervals:

1. Create an OSPF area.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# edit protocols ospf area 0.0.0.0
   ```

2. Specify the interfaces.

```
[edit protocols ospf area 0.0.0.0]
user@host# set interface fe-0/0/1
user@host# set interface fe-1/0/1
```

3. Configure the hello interval.

```
[edit protocols ospf area 0.0.0.0 ]
user@host# set interface fe-0/0/1 hello-interval 2
user@host# set interface fe-1/0/1 hello-interval 2
```

4. Configure the dead interval.

```
[edit protocols ospf area 0.0.0.0 ]
user@host# set interface fe-0/0/1 dead-interval 8
user@host# set interface fe-1/0/1 dead-interval 8
```

5. If you are done configuring the device, commit the configuration.

```
[edit protocols ospf area 0.0.0.0 ]
user@host# commit
```

NOTE: **Repeat this entire configuration on all routing devices in a shared network.**

Results Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
area 0.0.0.0 {
  interface fe-0/0/1.0 {
    hello-interval 2;
    dead-interval 8;
  }
  interface fe-1/0/1.0 {
    hello-interval 2;
    dead-interval 8;
  }
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Controlling the LSA Retransmission Interval

CLI Quick Configuration To quickly configure the LSA retransmission interval, copy the following command and paste it into the CLI.

```
[edit]
set protocols ospf area 0.0.0.1 interface fe-0/0/1 retransmit-interval 8
```

Step-by-Step Procedure To configure the LSA retransmission interval:

1. Create an OSPF area.

NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

```
[edit]
user@host# edit protocols ospf area 0.0.0.1
```

2. Specify the interface.

```
[edit protocols ospf area 0.0.0.1]
user@host# set interface fe-0/0/1
```

3. Configure the LSA retransmission interval.

```
[edit protocols ospf area 0.0.0.1 ]
user@host# set interface fe-0/0/1 retransmit-interval 8
```

4. If you are done configuring the device, commit the configuration.

```
[edit protocols ospf area 0.0.0.1]
user@host# commit
```

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
area 0.0.0.1 {
  interface fe-0/0/1.0 {
    retransmit-interval 8;
  }
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Specifying the Transit Delay

CLI Quick Configuration

To quickly configure the transit delay, copy the following command and paste it into the CLI.

```
[edit]
set protocols ospf area 0.0.0.1 interface fe-1/0/1 transit-delay 2
```

Step-by-Step Procedure

To configure the transit delay:

1. Create an OSPF area.

NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

```
[edit]
user@host# edit protocols ospf area 0.0.0.1
```

2. Specify the interface.

   [edit protocols ospf area 0.0.0.1]
   user@host# **set interface fe-1/0/1**

3. Configure the transit delay.

   [edit protocols ospf area 0.0.0.1]
   user@host# **set interface fe-1/0/1 transit-delay 2**

4. If you are done configuring the device, commit the configuration.

   [edit protocols ospf area 0.0.0.1]
   user@host# **commit**

Results Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
area 0.0.0.1 {
  interface fe-1/0/1.0 {
    transit-delay 2;
  }
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying the Timer Configuration

Purpose Verify that the interface for OSPF or OSPFv3 has been configured with the applicable timer values. Confirm that the Hello field, the Dead field, and the ReXmit field display the values that you configured.

Action From operational mode, enter the **show ospf interface detail** for OSPFv2, and enter the **show ospf3 interface detail** command for OSPFv3.

Related Documentation

- OSPF Overview on page 3368
- *OSPF Configuration Overview*

Example: Configuring BFD for OSPF

BFD for OSPF Overview

The Bidirectional Forwarding Detection (BFD) protocol is a simple hello mechanism that detects failures in a network. BFD works with a wide variety of network environments and topologies. A pair of routing devices exchange BFD packets. Hello packets are sent at a specified, regular interval. A neighbor failure is detected when the routing device stops receiving a reply after a specified interval. The BFD failure detection timers have shorter time limits than the OSPF failure detection mechanisms, so they provide faster detection.

The BFD failure detection timers are adaptive and can be adjusted to be faster or slower. The lower the BFD failure detection timer value, the faster the failure detection and vice versa. For example, the timers can adapt to a higher value if the adjacency fails (that is, the timer detects failures more slowly). Or a neighbor can negotiate a higher value for a timer than the configured value. The timers adapt to a higher value when a BFD session flap occurs more than three times in a span of 15 seconds. A back-off algorithm increases the receive (Rx) interval by two if the local BFD instance is the reason for the session flap. The transmission (Tx) interval is increased by two if the remote BFD instance is the reason for the session flap. You can use the **clear bfd adaptation** command to return BFD interval timers to their configured values. The **clear bfd adaptation** command is hitless, meaning that the command does not affect traffic flow on the routing device.

NOTE: BFD is supported for OSPFv3 in Junos OS Release 9.3 and later.

You can configure the following BFD protocol settings:

- **detection-time threshold**—Threshold for the adaptation of the detection time. When the BFD session detection time adapts to a value equal to or greater than the configured threshold, a single trap and a single system log message are sent.
- **full-neighbors-only**—Ability to establish BFD sessions only for OSPF neighbors with full neighbor adjacency. The default behavior is to establish BFD sessions for all OSPF neighbors. This setting is available in Junos OS Release 9.5 and later.
- **minimum-interval**—Minimum transmit and receive interval for failure detection. This setting configures both the minimum interval after which the local routing device transmits hello packets and the minimum interval after which the routing device expects to receive a reply from the neighbor with which it has established a BFD session. Both intervals are in milliseconds. You can also specify the minimum transmit and receive intervals separately using the **transmit-interval minimum-interval** and **minimum-receive-interval** statements.

NOTE: BFD is an intensive protocol that consumes system resources. Specifying a minimum interval for BFD of less than 100 ms for Routing Engine-based sessions and 10 ms for distributed BFD sessions can cause undesired BFD flapping.

Depending on your network environment, these additional recommendations might apply:

- For large-scale network deployments with a large number of BFD sessions, specify a minimum interval of 300 ms for Routing Engine-based sessions and 100 ms for distributed BFD sessions.
- For very large-scale network deployments with a large number of BFD sessions, contact Juniper Networks customer support for more information.
- For BFD sessions to remain up during a Routing Engine switchover event when nonstop active routing (NSR) is configured, specify a minimum interval of 2500 ms for Routing Engine-based sessions. Without NSR, Routing Engine-based sessions can have a minimum interval of 100 ms. In OSPFv3, BFD is always based in the Routing Engine, meaning that BFD is not distributed. For distributed BFD sessions with NSR configured, the minimum interval recommendations are unchanged and depend only on your network deployment.

- **minimum-receive-interval**—Minimum receive interval for failure detection. This setting configures the minimum receive interval, in milliseconds, after which the routing device expects to receive a hello packet from a neighbor with which it has established a BFD session. You can also specify the minimum receive interval using the **minimum-interval** statement.
- **multiplier**—Multiplier for hello packets. This setting configures the number of hello packets that are not received by a neighbor, which causes the originating interface to be declared down. By default, three missed hello packets cause the originating interface to be declared down.
- **no-adaptation**—Disables BFD adaption. This setting disables BFD sessions from adapting to changing network conditions. This setting is available in Junos OS Release 9.0 and later.

NOTE: We recommend that you do not disable BFD adaptation unless it is preferable not to have BFD adaptation in your network.

- **transmit-interval minimum-interval**—Minimum transmit interval for failure detection. This setting configures the minimum transmit interval, in milliseconds, at which the local routing device transmits hello packets to the neighbor with which it has established a BFD session. You can also specify the minimum transmit interval using the **minimum-interval** statement.

- **transmit-interval threshold**—Threshold for the adaptation of the BFD session transmit interval. When the transmit interval adapts to a value greater than the threshold, a single trap and a single system log message are sent. The threshold value must be greater than the minimum transmit interval. If you attempt to commit a configuration with a threshold value less than the minimum transmit interval, the routing device displays an error and does not accept the configuration.
- **version**—BFD version. This setting configures the BFD version used for detection. You can explicitly configure BFD version 1, or the routing device can automatically detect the BFD version. By default, the routing device automatically detects the BFD version automatically, which is either 0 or 1.

You can also trace BFD operations for troubleshooting purposes.

Example: Configuring BFD for OSPF

This example shows how to configure the Bidirectional Forwarding Detection (BFD) protocol for OSPF.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Control OSPF designated router election. See “Example: Controlling OSPF Designated Router Election” on page 3382.
- Configure a single-area OSPF network. See “Example: Configuring a Single-Area OSPF Network” on page 3385.
- Configure a multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.
- Configure a multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.

Overview

An alternative to adjusting the OSPF hello interval and dead interval settings to increase route convergence is to configure BFD. The BFD protocol is a simple hello mechanism that detects failures in a network. The BFD failure detection timers have shorter timer limits than the OSPF failure detection mechanisms, thereby providing faster detection.

BFD is useful on interfaces that are unable to detect failure quickly, such as Ethernet interfaces. Other interfaces, such as SONET interfaces, already have built-in failure detection. Configuring BFD on those interfaces is unnecessary.

You configure BFD on a pair of neighboring OSPF interfaces. Unlike the OSPF hello interval and dead interval settings, you do not have to enable BFD on all interfaces in an OSPF area.

In this example, you enable failure detection by including the **bfd-liveness-detection** statement on the neighbor OSPF interface **fe-0/1/0** in area 0.0.0.0 and configure the BFD packet exchange interval to 300 milliseconds, configure 4 as the number of missed hello packets that causes the originating interface to be declared down, and configure BFD sessions only for OSPF neighbors with full neighbor adjacency by including the following settings:

- **full-neighbors-only**—In Junos OS Release 9.5 and later, configures the BFD protocol to establish BFD sessions only for OSPF neighbors with full neighbor adjacency. The default behavior is to establish BFD sessions for all OSPF neighbors.
- **minimum-interval**—Configures the minimum interval, in milliseconds, after which the local routing device transmits hello packets as well as the minimum interval after which the routing device expects to receive a reply from the neighbor with which it has established a BFD session. You can configure a number in the range from 1 through 255,000 milliseconds. You can also specify the minimum transmit and receive intervals separately using the **transmit-interval minimum-interval** and **minimum-receive-interval** statements.

NOTE: BFD is an intensive protocol that consumes system resources. Specifying a minimum interval for BFD of less than 100 ms for Routing Engine-based sessions and 10 ms for distributed BFD sessions can cause undesired BFD flapping.

Depending on your network environment, these additional recommendations might apply:

- For large-scale network deployments with a large number of BFD sessions, specify a minimum interval of 300 ms for Routing Engine-based sessions and 100 ms for distributed BFD sessions.
- For very large-scale network deployments with a large number of BFD sessions, contact Juniper Networks customer support for more information.
- For BFD sessions to remain up during a Routing Engine switchover event when nonstop active routing (NSR) is configured, specify a minimum interval of 2500 ms for Routing Engine-based sessions. For distributed BFD sessions with NSR configured, the minimum interval recommendations are unchanged and depend only on your network deployment.

- **multiplier**—Configures the number of hello packets not received by a neighbor that causes the originating interface to be declared down. By default, three missed hello packets cause the originating interface to be declared down. You can configure a value in the range from 1 through 255.

Configuration

CLI Quick Configuration

To quickly configure the BFD protocol for OSPF, copy the following commands, remove any line breaks, and then paste the commands into the CLI.

```
[edit]
set protocols ospf area 0.0.0.0 interface fe-0/0/1 bfd-liveness-detection minimum-interval
  300
set protocols ospf area 0.0.0.0 interface fe-0/0/1 bfd-liveness-detection multiplier 4
set protocols ospf area 0.0.0.0 interface fe-0/0/1 bfd-liveness-detection full-neighbors-only
```

Step-by-Step Procedure

To configure the BFD protocol for OSPF on one neighboring interface:

1. Create an OSPF area.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# edit protocols ospf area 0.0.0.0
   ```

2. Specify the interface.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@host# set interface fe-0/0/1
   ```

3. Specify the minimum transmit and receive intervals.

   ```
   [edit protocols ospf area 0.0.0.0 ]
   user@host# set interface fe-0/0/1 bfd-liveness-detection minimum-interval 300
   ```

4. Configure the number of missed hello packets that cause the originating interface to be declared down.

   ```
   [edit protocols ospf area 0.0.0.0 ]
   user@host# set interface fe-0/0/1 bfd-liveness-detection multiplier 4
   ```

5. Configure BFD sessions only for OSPF neighbors with full neighbor adjacency.

   ```
   [edit protocols ospf area 0.0.0.0 ]
   user@host# set interface fe-0/0/1 bfd-liveness-detection full-neighbors-only
   ```

6. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols ospf area 0.0.0.0 ]
   user@host# commit
   ```

   NOTE: Repeat this entire configuration on the other neighboring interface.

Results Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
area 0.0.0.0 {
  interface fe-0/0/1.0 {
    bfd-liveness-detection {
      minimum-interval 300;
      multiplier 4;
      full-neighbors-only;
    }
  }
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying the BFD Sessions

Purpose Verify that the OSPF interfaces have active BFD sessions, and that session components have been configured correctly.

Action From operational mode, enter the **show bfd session detail** command.

Meaning The output displays information about the BFD sessions.

- The Address field displays the IP address of the neighbor.
- The Interface field displays the interface you configured for BFD.
- The State field displays the state of the neighbor and should show Full to reflect the full neighbor adjacency that you configured.
- The Transmit Interval field displays the time interval you configured to send BFD packets.
- The Multiplier field displays the multiplier you configured.

Related Documentation

- *OSPF Configuration Overview*
- BFD Authentication for OSPF Overview on page 3458

Example: Configuring BFD Authentication for OSPF

- BFD Authentication for OSPF Overview on page 3458
- Configuring BFD Authentication for OSPF on page 3459

BFD Authentication for OSPF Overview

Bidirectional Forwarding Detection (BFD) enables rapid detection of communication failures between adjacent systems. By default, authentication for BFD sessions is disabled. However, when you run BFD over Network Layer protocols, the risk of service attacks can be significant. We strongly recommend using authentication if you are running BFD over multiple hops or through insecure tunnels. Beginning with Junos OS Release 9.6, Junos OS supports authentication for BFD sessions running over OSPFv2. BFD authentication is not supported on MPLS OAM sessions. BFD authentication is only supported in the Canada and United States version of the Junos OS image and is not available in the export version.

You authenticate BFD sessions by specifying an authentication algorithm and keychain, and then associating that configuration information with a security authentication keychain using the keychain name.

The following sections describe the supported authentication algorithms, security keychains, and level of authentication that can be configured:

BFD Authentication Algorithms

Junos OS supports the following algorithms for BFD authentication:

- **simple-password**—Plain-text password. One to 16 bytes of plain text are used to authenticate the BFD session. One or more passwords can be configured. This method is the least secure and should be used only when BFD sessions are not subject to packet interception.
- **keyed-md5**—Keyed Message Digest 5 hash algorithm for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed MD5 uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than or equal to the last sequence number received. Although more secure than a simple password, this method is vulnerable to replay attacks. Increasing the rate at which the sequence number is updated can reduce this risk.
- **meticulous-keyed-md5**—Meticulous keyed Message Digest 5 hash algorithm. This method works in the same manner as keyed MD5, but the sequence number is updated with every packet. Although more secure than keyed MD5 and simple passwords, this method might take additional time to authenticate the session.
- **keyed-sha-1**—Keyed Secure Hash Algorithm I for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed SHA uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. The key is not carried within the packets. With this method,

packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than the last sequence number received.

- **meticulous-keyed-sha-1**—Meticulous keyed Secure Hash Algorithm I. This method works in the same manner as keyed SHA, but the sequence number is updated with every packet. Although more secure than keyed SHA and simple passwords, this method might take additional time to authenticate the session.

NOTE: **Nonstop active routing (NSR) is not supported with the meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.**

Security Authentication Keychains

The security authentication keychain defines the authentication attributes used for authentication key updates. When the security authentication keychain is configured and associated with a protocol through the keychain name, authentication key updates can occur without interrupting routing and signaling protocols.

The authentication keychain contains one or more keychains. Each keychain contains one or more keys. Each key holds the secret data and the time at which the key becomes valid. The algorithm and keychain must be configured on both ends of the BFD session, and they must match. Any mismatch in configuration prevents the BFD session from being created.

BFD allows multiple clients per session, and each client can have its own keychain and algorithm defined. To avoid confusion, we recommend specifying only one security authentication keychain.

Strict Versus Loose Authentication

By default, strict authentication is enabled and authentication is checked at both ends of each BFD session. Optionally, to smooth migration from nonauthenticated sessions to authenticated sessions, you can configure *loose checking*. When loose checking is configured, packets are accepted without authentication being checked at each end of the session. This feature is intended for transitional periods only.

Configuring BFD Authentication for OSPF

Beginning with Junos OS Release 9.6, you can configure authentication for BFD sessions running over OSPFv2. Routing instances are also supported.

The following sections provide instructions for configuring and viewing BFD authentication on OSPF:

- Configuring BFD Authentication Parameters on page 3459
- Viewing Authentication Information for BFD Sessions on page 3461

Configuring BFD Authentication Parameters

Only three steps are needed to configure authentication on a BFD session:

1. Specify the BFD authentication algorithm for the OSPFv2 protocol.
2. Associate the authentication keychain with the OSPFv2 protocol.
3. Configure the related security authentication keychain.

To configure BFD authentication:

1. Specify the algorithm (**keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**, or **simple-password**) to use for BFD authentication on an OSPF route or routing instance.

   ```
   [edit]
   user@host# set protocols ospf area 0.0.0.1 interface if2-ospf bfd-liveness-detection
     authentication algorithm keyed-sha-1
   ```

   NOTE: Nonstop active routing (NSR) is not supported with meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.

2. Specify the keychain to be used to associate BFD sessions on the specified OSPF route or routing instance with the unique security authentication keychain attributes.

   This keychain should match the keychain name configured at the **[edit security authentication key-chains]** hierarchy level.

   ```
   [edit]
   user@host# set protocols ospf area 0.0.0.1 interface if2-ospf bfd-liveness-detection
     authentication keychain bfd-ospf
   ```

   NOTE: The algorithm and keychain must be configured on both ends of the BFD session, and they must match. Any mismatch in configuration prevents the BFD session from being created.

3. Specify the unique security authentication information for BFD sessions:

   - The matching keychain name as specified in Step 2.
   - At least one key, a unique integer between 0 and 63. Creating multiple keys enables multiple clients to use the BFD session.
   - The secret data used to allow access to the session.
   - The time at which the authentication key becomes active, in the format *yyyy-mm-dd.hh:mm:ss*.

   ```
   [edit security]
   user@host# authentication-key-chains key-chain bfd-ospf key 53 secret
     $9$ggaJDmPQ6/tJgF/AtREVsyPsnCtUHm start-time 2009-06-14.10:00:00
   ```

4. (Optional) Specify loose authentication checking if you are transitioning from nonauthenticated sessions to authenticated sessions.


```
[edit]
user@host> set protocols ospf interface if2-ospf bfd-liveness-detection authentication
  loose-check
```

5. (Optional) View your configuration using the **show bfd session detail** or **show bfd session extensive** command.
6. Repeat the steps in this procedure to configure the other end of the BFD session.

NOTE: BFD authentication is only supported in the Canada and United States version of the Junos OS image and is not available in the export version.

Viewing Authentication Information for BFD Sessions

You can view the existing BFD authentication configuration using the **show bfd session detail** and **show bfd session extensive** commands.

The following example shows BFD authentication configured for the **if2-ospf** BGP group. It specifies the keyed SHA-1 authentication algorithm and a keychain name of **bfd-ospf**. The authentication keychain is configured with two keys. Key **1** contains the secret data "**9ggaJDmPQ6/tJgF/AtREVsyPsnCtUHm**" and a start time of June 1, 2009, at 9:46:02 AM PST. Key **2** contains the secret data "**9a5jiKW9l.reP38ny.TszF2/9**" and a start time of June 1, 2009, at 3:29:20 PM PST.

```
[edit protocols ospf]
area 0.0.0.1 {
  interface if2-ospf {
    bfd-liveness-detection {
      authentication {
        algorithm keyed-sha-1;
        key-chain bfd-ospf;
      }
    }
  }
}
[edit security]
authentication key-chains {
  key-chain bfd-ospf {
    key 1 {
      secret "$9$ggaJDmPQ6/tJgF/AtREVsyPsnCtUHm";
      start-time "2009-6-1.09:46:02 -0700";
    }
    key 2 {
      secret "$9$a5jiKW9l.reP38ny.TszF2/9";
      start-time "2009-6-1.15:29:20 -0700";
    }
  }
}
```

If you commit these updates to your configuration, you see output similar to the following. In the output for the **show bfd session detail** command, **Authenticate** is displayed to indicate that BFD authentication is configured.

show bfd session detail

```
user@host# show bfd session detail

                                                    Detect   Transmit
Address                  State     Interface       Time     Interval  Multiplier
10.9.1.33            Up        so-7/1/0.0         0.600     0.200      3
  Client OSPF, TX interval 0.200, RX interval 0.200, multiplier 3, Authenticate
  Session up time 3d 00:34
  Local diagnostic None, remote diagnostic None
  Remote state Up, version 1
  Replicated

1 sessions, 1 clients
Cumulative transmit rate 10.0 pps, cumulative receive rate 10.0 pps
```

For more information about the configuration, use the **show bfd session extensive** command. The output for this command provides the keychain name, the authentication algorithm and mode for each client in the session, and the overall BFD authentication configuration status, keychain name, and authentication algorithm and mode.

show bfd session extensive

```
user@host# show bfd session extensive
                                                    Detect   Transmit
Address                  State     Interface       Time     Interval  Multiplier
10.9.1.33            Up        so-7/1/0.0         0.600     0.200      3
  Client OSPF, TX interval 0.200, RX interval 0.200, multiplier 3, Authenticate
       keychain bfd-ospf, algo keyed-md5, mode loose

  Session up time 3d 00:34
  Local diagnostic None, remote diagnostic None
  Remote state Up, version 1
  Replicated
  Min async interval 0.200, min slow interval 1.000
  Adaptive async tx interval 0.200, rx interval 0.200
  Local min tx interval 0.200, min rx interval 0.200, multiplier 3
  Remote min tx interval 0.100, min rx interval 0.100, multiplier 3
  Threshold transmission interval 0.000, Threshold for detection time 0.000
  Local discriminator 11, remote discriminator 80
  Echo mode disabled/inactive
 Authentication enabled/active, keychain bfd-ospf, algo keyed-sha-1, mode strict
1 sessions, 1 clients
Cumulative transmit rate 10.0 pps, cumulative receive rate 10.0 pps
```

Related Documentation

- *OSPF Configuration Overview*
- BFD for OSPF Overview on page 3451

OSPF Redundancy Features Configuration

Examples: Configuring Graceful Restart for OSPF

- Example: Configuring the Helper Capability Mode for OSPFv2 Graceful Restart on page 3468
- Example: Configuring the Helper Capability Mode for OSPFv3 Graceful Restart on page 3472
- Example: Disabling Strict LSA Checking for OSPF Graceful Restart on page 3475

Graceful Restart for OSPF Overview

Graceful restart allows a routing device undergoing a restart to inform its adjacent neighbors and peers of its condition. During a graceful restart, the restarting device and its neighbors continue forwarding packets without disrupting network performance. Because neighboring devices assist in the restart (these neighbors are called *helper routers*), the restarting device can quickly resume full operation without recalculating algorithms.

NOTE: **On a broadcast link with a single neighbor, when the neighbor initiates an OSPFv3 graceful restart operation, the restart might be terminated at the point when the local routing device assumes the role of a helper. A change in the LSA is considered a topology change, which terminates the neighbor's restart operation.**

Graceful restart is disabled by default. You can globally enable graceful restart for all routing protocols by including the **graceful-restart** statement at the **[edit routing-options]** hierarchy level. To enable graceful restart specifically for OSPF, first you need to globally enable graceful restart for all routing protocols.

This topic describes the following information:

- Helper Mode for Graceful Restart on page 3463
- Planned and Unplanned Graceful Restart on page 3464

Helper Mode for Graceful Restart

When a device enabled for OSPF graceful restart restarts, it retains routes learned before the restart in its forwarding table. The device does not allow new OSPF link-state advertisements (LSAs) to update the routing table. This device continues to forward traffic to other OSPF neighbors (or helper routers), and sends only a limited number of LSAs during the restart period. To reestablish OSPF adjacencies with neighbors, the restarting device must send a grace LSA to all neighbors. In response, the helper routers enter helper mode (the ability to assist a neighboring device attempting a graceful restart) and send an acknowledgment back to the restarting device. If there are no topology changes, the helper routers continue to advertise LSAs as if the restarting device had remained in continuous OSPF operation.

NOTE: **Helper mode is enabled by default when you start the routing platform, even if graceful restart is not enabled. You can disable helper mode specifically for OSPF.**

When the restarting device receives replies from all the helper routers, the restarting device selects routes, updates the forwarding table, and discards the old routes. At this point, full OSPF adjacencies are reestablished and the restarting device receives and processes OSPF LSAs as usual. When the helper routers no longer receive grace LSAs from the restarting device or when the topology of the network changes, the helper routers also resume normal operation.

Beginning with Junos OS Release 11.4, you can configure restart signaling-based helper mode for OSPFv2 graceful restart configurations. The Junos OS implementation is based on RFC 4811, *OSPF Out-of-Band Link State Database (LSDB) Resynchronization*, RFC 4812, *OSPF Restart Signaling*, and RFC 4813, *OSPF Link-Local Signaling*. In restart signaling-based helper mode implementations, the restarting device informs its restart status to its neighbors only after the restart is complete. When the restart is complete, the restarting device sends hello messages to its helper routers with the restart signal (RS) bit set in the hello packet header. When a helper router receives a hello packet with the RS bit set in the header, the helper router returns a hello message to the restarting device. The reply hello message from the helper router contains the ResyncState flag and the ResyncTimeout timer that enable the restarting device to keep track of the helper routers that are syncing up with it. When all helpers complete the synchronization, the restarting device exits the restart mode.

NOTE: Restart signaling-based graceful restart helper mode is not supported for OSPFv3 configurations.

Planned and Unplanned Graceful Restart

OSPF supports two types of graceful restart: planned and unplanned. During a planned restart, the restarting routing device informs the neighbors before restarting. The neighbors act as if the routing device is still within the network topology, and continue forwarding traffic to the restarting routing device. A grace period is set to specify when the neighbors should consider the restarting routing device as part of the topology. During an unplanned restart, the routing device restarts without warning.

Example: Configuring Graceful Restart for OSPF

This example shows how to configure graceful restart specifically for OSPF.

Requirements

Before you begin:

- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.
- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382.
- Configure a single-area OSPF network. See "Example: Configuring a Single-Area OSPF Network" on page 3385.
- Configure a multiarea OSPF network. See "Example: Configuring a Multiarea OSPF Network" on page 3387.

Overview

Graceful restart enables a routing device undergoing a restart to inform its adjacent neighbors and peers of its condition. During a graceful restart, the restarting routing device and its neighbors continue forwarding packets without disrupting network performance. By default, graceful restart is disabled. You can globally enable graceful restart for all routing protocols by including the **graceful-restart** statement at the **[edit routing-options]** hierarchy level, or you can enable graceful restart specifically for OSPF by including the **graceful-restart** statement at the **[edit protocols (ospf|ospf3)]** hierarchy level.

The first example shows how to enable graceful restart and configure the optional settings for the grace period interval. In this example, interfaces **fe-1/1/1** and **fe-1/1/2** are in OSPF area 0.0.0.0, and you configure those interfaces for graceful restart. The grace period interval for OSPF graceful restart is determined as equal to or less than the sum of the **notify-duration** time interval and the **restart-duration** time interval. The grace period is the number of seconds that the routing device's neighbors continue to advertise the routing device as fully adjacent, regardless of the connection state between the routing device and its neighbors.

The **notify-duration** statement configures how long (in seconds) the routing device notifies helper routers that it has completed graceful restart by sending purged grace link-state advertisements (LSAs) over all interfaces. By default, the routing device sends grace LSAs for 30 seconds. The range is from 1 through 3600 seconds.

The **restart-duration** statement configures the amount of time the routing device waits (in seconds) to complete reacquisition of OSPF neighbors from each area. By default, the routing device allows 180 seconds. The range is from 1 through 3600 seconds.

The second example shows how to disable graceful restart for OSPF by including the **disable** statement.

Configuration

Enabling Graceful Restart for OSPF

CLI Quick Configuration

To quickly enable graceful restart for OSPF, copy the following commands and paste them into the CLI.

```
[edit]
```

```
set interfaces fe-1/1/1 unit 0 family inet address 10.0.0.4
set interfaces fe-1/1/2 unit 0 family inet address 10.0.0.5
set protocols ospf area 0.0.0.0 interface fe-1/1/1
set protocols ospf area 0.0.0.0 interface fe-1/1/2
set routing-options graceful-restart
set protocols ospf graceful-restart restart-duration 190
set protocols ospf graceful-restart notify-duration 40
```

Step-by-Step Procedure

To enable graceful restart for OSPF:

1. Configure the interfaces.

   NOTE: For OSPFv3, use IPv6 addresses.

   ```
   [edit]
   user@host# set interfaces fe-1/1/1 unit 0 family inet address 10.0.0.4
   user@host# set interfaces fe-1/1/1 unit 0 family inet address 10.0.0.5
   ```

2. Configure OSPF on the interfaces.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# set protocols ospf area 0.0.0.0 interface fe-1/1/1
   user@host# set protocols ospf area 0.0.0.0 interface fe-1/1/2
   ```

3. Configure graceful restart globally

   ```
   [edit]
   user@host#edit routing-options graceful-restart
   ```

4. Configure OSPF graceful restart.

   ```
   [edit]
   user@host# edit protocols ospf graceful-restart
   ```

5. (Optional) Configure the restart duration time.

   ```
   [edit protocols ospf graceful-restart]
   user@host# set restart-duration 190
   ```

6. (Optional) Configure the notify duration time.

   ```
   [edit protocols ospf graceful-restart]
   user@host# set notify-duration 40
   ```

7. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols ospf graceful-restart]
   user@host# commit
   ```

Results Confirm your configuration by entering the **show interfaces** and **show protocols ospf** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show interfaces
fe-1/1/1 {
   unit 0 {
      family inet {
         address 10.0.0.4/32;
      }
   }
}
fe-1/1/2 {
   unit 0 {
      family inet {
         address 10.0.0.5/32;
      }
   }
}
user@host# show protocols ospf
graceful-restart {
   restart-duration 190;
   notify-duration 40;
}
area 0.0.0.0 {
   interface fe-1/1/1.0;
   interface fe-1/1/2.0;
}
```

To confirm an OSPFv3 configuration, enter the **show interfaces** and the **show protocols ospf3** commands.

Disabling Graceful Restart for OSPF

CLI Quick Configuration To quickly disable graceful restart for OSPF, copy the following command and paste it into the CLI.

```
[edit]
user@host# set protocols ospf graceful-restart disable
```

Step-by-Step Procedure To disable graceful restart for OSPF:

1. Disable graceful restart for the OSPF protocol only.

   This command does not affect the global graceful restart configuration setting.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# set protocols ospf graceful-restart disable
   ```

2. If you are done configuring the device, commit the configuration.

```
[edit]
user@host# commit
```

Results Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
graceful-restart disable;
```

To confirm an OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

- Verifying the OSPF Graceful Restart Configuration on page 3468
- Verifying Graceful Restart Status on page 3468

Verifying the OSPF Graceful Restart Configuration

Purpose Verify information about your OSPF graceful restart configuration.

Action From operational mode, enter the **show ospf overview** command for OSPFv2. Enter the **show ospf3 overview** command for OSPFv3.

Meaning The Restart field displays the status of graceful restart as either enabled or disabled. The Restart duration field displays how much time the restarted routing device requires to complete reacquisition of OSPF neighbors. The Restart grace period field displays how much time the neighbors should consider the restarted routing device as part of the topology.

Verifying Graceful Restart Status

Purpose Verify the status of graceful restart.

Action From operational mode, enter the **show route instance detail** command.

Meaning The Restart State field displays Pending if the restart has not been completed or Complete if the restart has finished. The Path selection timeout field indicates the amount of time remaining until graceful restart is declared complete. There is a more detailed Restart State field that displays a list of protocols that have or have not yet completed graceful restart for the specified routing table.

Example: Configuring the Helper Capability Mode for OSPFv2 Graceful Restart

This example shows how to disable and reenable the helper mode capability for OSPFv2 graceful restart.

- Requirements on page 3469
- Overview on page 3469

Requirements

Before you begin:

- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Control OSPF designated router election. See “Example: Controlling OSPF Designated Router Election” on page 3382
- Configure a single-area OSPF network. See “Example: Configuring a Single-Area OSPF Network” on page 3385.
- Configure a multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.

Overview

The OSPF graceful restart helper capability assists a neighboring routing device attempting a graceful restart. By default, the helper capability is globally enabled when you start the routing platform. This means that the helper capability is enabled when you start OSPF, even if graceful restart is not globally enabled or specifically enabled for OSPF. You can further modify your graceful restart configuration to disable the helper capability.

Beginning with Junos OS Release 11.4, you can configure restart signaling-based helper mode for OSPFv2 graceful restart configurations. Both the standard and restart signaling-based helper modes are enabled by default.

In the first example, interfaces **fe-1/1/1** and **fe-1/1/2** are in OSPFv2 area 0.0.0.0, and you configure those interfaces for graceful restart. You then disable the standard OSPFv2 graceful restart helper capability by including the **helper-disable standard** statement. This configuration is useful if you have an environment that contains other vendor equipment that is configured for restart signaling-based graceful restart.

NOTE: The **helper-disable** statement and the **no-strict-lsa-checking** statement cannot be configured at the same time. If you attempt to configure both statements at the same time, the routing device displays a warning message when you enter the **show protocols ospf** command.

The second example shows how to reenable the standard OSPFv2 restart helper capability that you disabled in the first example.

Configuration

Disabling Helper Mode for OSPFv2

CLI Quick Configuration

To quickly enable graceful restart for OSPFv2 with helper mode disabled, copy the following commands and paste them into the CLI.

```
[edit]
set interfaces fe-1/1/1 unit 0 family inet address 10.0.0.4
set interfaces fe-1/1/2 unit 0 family inet address 10.0.0.5
set protocols ospf area 0.0.0.0 interface fe-1/1/1
set protocols ospf area 0.0.0.0 interface fe-1/1/2
set protocols ospf graceful-restart helper-disable standard
```

Step-by-Step Procedure

To enable graceful restart for OSPFv2 with helper mode disabled:

1. Configure the interfaces.

   ```
   [edit]
   user@host# set interfaces fe-1/1/1 unit 0 family inet address 10.0.0.4
   user@host# set interfaces fe-1/1/1 unit 0 family inet address 10.0.0.5
   ```

2. Configure OSPFv2 on the interfaces

   ```
   [edit]
   user@host# set protocols ospf area 0.0.0.0 interface fe-1/1/1
   user@host# set protocols ospf area 0.0.0.0 interface fe-1/1/2
   ```

3. Disable the OSPFv2 graceful restart helper capability.
   If you disable the OSPFv2 graceful restart helper capability, you cannot disable strict LSA checking.

   ```
   [edit]
   user@host# set protocols ospf graceful-restart helper-disable standard
   ```

4. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show interfaces** and the **show protocols ospf** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show interfaces
fe-1/1/1 {
  unit 0 {
    family inet {
      address 10.0.0.4/32;
    }
  }
}
fe-1/1/2 {
  unit 0 {
    family inet {
      address 10.0.0.5/32;
    }
  }
}
```



```
user@host# show protocols ospf
graceful-restart {
   helper-disable {
      standard;
   }
}
area 0.0.0.0 {
   interface fe-1/1/1.0;
   interface fe-1/1/2.0;
}
```

Reenabling Helper Mode for OSPFv2

CLI Quick Configuration

To quickly reenable standard helper-mode for OSPFv2, copy the following command and paste it into the CLI.

```
[edit]
delete protocols ospf graceful-restart helper-disable standard
```

NOTE: To reenable restart signaling-based helper mode, include the **restart-signaling** statement. To reenable both standard and restart signaling-based helper mode, include the **both** statement.

Step-by-Step Procedure

To reenable standard helper mode for OSPFv2:

1. Delete the standard helper-mode statement from the OSPFv2 configuration.

   ```
   [edit]
   user@host# delete protocols ospf graceful-restart helper-disable standard
   ```

2. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

Results

After you reenable standard helper mode, the **show protocols ospf** command no longer displays the graceful restart configuration.

Verification

Confirm that the configuration is working properly.

- Verifying the OSPFv2 Graceful Restart Configuration on page 3471
- Verifying Graceful Restart Status on page 3472

Verifying the OSPFv2 Graceful Restart Configuration

Purpose

Verify information about your OSPFv2 graceful restart configuration. The Restart field displays the status of graceful restart as either enabled or disabled, the Graceful restart helper mode field displays the status of the standard helper mode capability as enabled or disabled, and the Restart-signaling helper mode field displays the status of the restart signaling-based helper mode as enabled or disabled. By default, both standard and restart signaling-based helper modes are enabled.

Action From operational mode, enter the **show ospf overview** command.

Verifying Graceful Restart Status

Purpose Verify the status of graceful restart. The Restart State field displays Pending if the restart has not completed, or Complete if the restart has finished. The Path selection timeout field indicates the amount of time remaining until graceful restart is declared complete. There is a more detailed Restart State field that displays a list of protocols that have completed graceful restart or have not yet completed graceful restart for the specified routing table.

Action From operational mode, enter the **show route instance detail** command.

Example: Configuring the Helper Capability Mode for OSPFv3 Graceful Restart

This example shows how to disable and reenable the helper mode capability for OSPFv3 graceful restart.

Requirements

Before you begin:

- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Control OSPF designated router election. See “Example: Controlling OSPF Designated Router Election” on page 3382
- Configure a single-area OSPF network. See “Example: Configuring a Single-Area OSPF Network” on page 3385.
- Configure a multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.

Overview

The OSPF graceful restart helper capability assists a neighboring routing device attempting a graceful restart. By default, the helper capability is globally enabled when you start the routing platform. This means that the helper capability is enabled when you start OSPF, even if graceful restart is not globally enabled or specifically enabled for OSPF. You can further modify your graceful restart configuration to disable the helper capability.

In the first example, interfaces **fe-1/1/1** and **fe-1/1/2** are in OSPFv3 area 0.0.0.0, and you configure those interfaces for graceful restart. You then disable the OSPFv3 graceful restart helper capability by including the **helper-disable** statement.

NOTE: The **helper-disable** statement and the **no-strict-lsa-checking** statement cannot be configured at the same time. If you attempt to configure both statements at the same time, the routing device displays a warning message when you enter the **show protocols ospf** command.

The second example shows how to reenable the OSPFv3 restart helper capability that you disabled in the first example.

Configuration

Disabling Helper Mode for OSPFv3

CLI Quick Configuration

To quickly enable graceful restart for OSPFv3 with helper mode disabled, copy the following commands and paste them into the CLI.

```
[edit]
set interfaces fe-1/1/1 unit 0 family inet6 address 2002:0a00:0004::
set interfaces fe-1/1/2 unit 0 family inet6 address 2002:0a00:0005::
set protocols ospf3 area 0.0.0.0 interface fe-1/1/1
set protocols ospf3 area 0.0.0.0 interface fe-1/1/2
set protocols ospf3 graceful-restart helper-disable
```

Step-by-Step Procedure

To enable graceful restart for OSPFv3 with helper mode disabled:

1. Configure the interfaces.

   ```
   [edit]
   user@host# set interfaces fe-1/1/1 unit 0 family inet6 address 2002:0a00:0004::
   user@host# set interfaces fe-1/1/1 unit 0 family inet address 2002:0a00:0005::
   ```

2. Configure OSPFv3 on the interfaces

   ```
   [edit]
   user@host# set protocols ospf3 area 0.0.0.0 interface fe-1/1/1
   user@host# set protocols ospf3 area 0.0.0.0 interface fe-1/1/2
   ```

3. Disable the OSPFv3 graceful restart helper capability.
   If you disable the OSPFv3 graceful restart helper capability, you cannot disable strict LSA checking.

   ```
   [edit]
   user@host# set protocols ospf3 graceful-restart helper-disable
   ```

4. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show interfaces** and the **show protocols ospf3** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show interfaces
fe-1/1/1 {
  unit 0 {
    family inet6 {
      address 2002:0a00:0004::/128;
    }
  }
}
fe-1/1/2 {
  unit 0 {
    family inet6 {
      address 2002:0a00:0005::/128;
    }
  }
}
user@host# show protocols ospf3
graceful-restart {
  helper-disable;
}
area 0.0.0.0 {
  interface fe-1/1/1.0;
  interface fe-1/1/2.0;
}
```

Reenabling Helper Mode for OSPFv3

CLI Quick Configuration

To quickly reenable helper-mode for OSPFv3, copy the following command and paste it into the CLI.

```
[edit]
delete protocols ospf3 graceful-restart helper-disable
```

Step-by-Step Procedure

To reenable helper mode for OSPFv3:

1. Delete the standard helper-mode statement from the OSPFv3 configuration.

   ```
   [edit]
   user@host# delete protocols ospf3 graceful-restart helper-disable
   ```

2. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

Results

After you reenable standard helper mode, the **show protocols ospfs** command no longer displays the graceful restart configuration.

Verification

Confirm that the configuration is working properly.

- Verifying the OSPFv3 Graceful Restart Configuration on page 3475
- Verifying Graceful Restart Status on page 3475

Verifying the OSPFv3 Graceful Restart Configuration

Purpose Verify information about your OSPFv3 graceful restart configuration. The Restart field displays the status of graceful restart as either enabled or disabled, and the Helper mode field displays the status of the helper mode capability as either enabled or disabled.

Action From operational mode, enter the **show ospf3 overview** command.

Verifying Graceful Restart Status

Purpose Verify the status of graceful restart. The Restart State field displays Pending if the restart has not completed, or Complete if the restart has finished. The Path selection timeout field indicates the amount of time remaining until graceful restart is declared complete. There is a more detailed Restart State field that displays a list of protocols that have completed graceful restart or have not yet completed graceful restart for the specified routing table.

Action From operational mode, enter the **show route instance detail** command.

Example: Disabling Strict LSA Checking for OSPF Graceful Restart

This example shows how to disable strict link-state advertisement (LSA) checking for OSPF graceful restart.

- Requirements on page 3475
- Overview on page 3476
- Configuration on page 3476
- Verification on page 3477

Requirements

Before you begin:

- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Control OSPF designated router election. See “Example: Controlling OSPF Designated Router Election” on page 3382
- Configure a single-area OSPF network. See “Example: Configuring a Single-Area OSPF Network” on page 3385.
- Configure a multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.

Overview

You can disable strict LSA checking to prevent the termination of graceful restart by a helping router. You might configure this option for interoperability with other vendor devices. The OSPF graceful restart helper capability must be enabled if you disable strict LSA checking. By default, LSA checking is enabled.

In this example, interfaces **fe-1/1/1** and **fe-1/1/2** are in OSPF area 0.0.0.0, and you configure those interfaces for graceful restart. You then disable strict LSA checking by including the **no-strict-lsa-checking** statement.

NOTE: The **helper-disable** statement and the **no-strict-lsa-checking** statement cannot be configured at the same time. If you attempt to configure both statements at the same time, the routing device displays a warning message when you enter the **show protocols ospf** command.

Configuration

CLI Quick Configuration

To quickly enable graceful restart for OSPF with strict LSA checking disabled, copy the following commands and paste them into the CLI.

```
[edit]
set interfaces fe-1/1/1 unit 0 family inet address 10.0.0.4
set interfaces fe-1/1/2 unit 0 family inet address 10.0.0.5
set protocols ospf area 0.0.0.0 interface fe-1/1/1
set protocols ospf area 0.0.0.0 interface fe-1/1/2
set protocols ospf graceful-restart no-strict-lsa-checking
```

Step-by-Step Procedure

To enable graceful restart for OSPF with strict LSA checking disabled:

1. Configure the interfaces.

   NOTE: For OSPFv3, use IPv6 addresses.

   ```
   [edit]
   user@host# set interfaces fe-1/1/1 unit 0 family inet address 10.0.0.4
   user@host# set interfaces fe-1/1/1 unit 0 family inet address 10.0.0.5
   ```

2. Configure OSPF on the interfaces

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# set protocols ospf area 0.0.0.0 interface fe-1/1/1
   user@host# set protocols ospf area 0.0.0.0 interface fe-1/1/2
   ```

3. Disable strict LSA checking.

If you disable the strict LSA checking, OSPF graceful restart helper capability must be enabled (which is the default behavior).

```
[edit]
user@host# set protocols ospf graceful-restart no-strict-lsa-checking
```

4. If you are done configuring the device, commit the configuration.

```
[edit ]
user@host# commit
```

Results Confirm your configuration by entering the **show interfaces** and the **show protocols ospf** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show interfaces
fe-1/1/1 {
  unit 0 {
    family inet {
      address 10.0.0.4/32;
    }
  }
}
fe-1/1/2 {
  unit 0 {
    family inet {
      address 10.0.0.5/32;
    }
  }
}
user@host# show protocols ospf
graceful-restart {
  no-strict-lsa-checking;
}
area 0.0.0.0 {
  interface fe-1/1/1.0;
  interface fe-1/1/2.0;
}
```

To confirm your OSPFv3 configuration, enter the **show interfaces** and the **show protocols ospf3** commands.

Verification

Confirm that the configuration is working properly.

- Verifying the OSPF Graceful Restart Configuration on page 3477
- Verifying Graceful Restart Status on page 3478

Verifying the OSPF Graceful Restart Configuration

Purpose Verify information about your OSPF graceful restart configuration. The Restart field displays the status of graceful restart as either enabled or disabled.

Action From operational mode, enter the **show ospf overview** command for OSPFv2, and enter the **show ospf3 overview** command for OSPFv3.

Verifying Graceful Restart Status

Purpose Verify the status of graceful restart. The Restart State field displays Pending if the restart has not completed, or Complete if the restart has finished. The Path selection timeout field indicates the amount of time remaining until graceful restart is declared complete. There is a more detailed Restart State field that displays a list of protocols that have completed graceful restart or have not yet completed graceful restart for the specified routing table.

Action From operational mode, enter the **show route instance detail** command.

Related Documentation

- OSPF Overview on page 3368
- *OSPF Configuration Overview*
- Graceful Restart Concepts on page 1735 in the *Junos OS High Availability Library for Routing Devices*

OSPF Traffic Engineering Configuration

Examples: Configuring OSPF Traffic Engineering

OSPF Support for Traffic Engineering

Traffic engineering allows you to control the path that data packets follow, bypassing the standard routing model, which uses routing tables. Traffic engineering moves flows from congested links to alternate links that would not be selected by the automatically computed destination-based shortest path.

To help provide traffic engineering and MPLS with information about network topology and loading, extensions have been added to the Junos OS implementation of OSPF. When traffic engineering is enabled on the routing device, you can enable OSPF traffic engineering support. When you enable traffic engineering for OSPF, the shortest-path-first (SPF) algorithm takes into account the various label-switched paths (LSPs) configured under MPLS and configures OSPF to generate opaque link-state advertisements (LSAs) that carry traffic engineering parameters. The parameters are used to populate the traffic engineering database. The traffic engineering database is used exclusively for calculating explicit paths for the placement of LSPs across the physical topology. The Constrained

Shortest Path First (CSPF) algorithm uses the traffic engineering database to compute the paths that MPLS LSPs take. RSVP uses this path information to set up LSPs and to reserve bandwidth for them.

By default, traffic engineering support is disabled. To enable traffic engineering, include the **traffic-engineering** statement. You can also configure the following OSPF traffic engineering extensions:

- **advertise-unnumbered-interfaces**—(OSPFv2 only) Advertises the link-local identifier in the link-local traffic engineering LSA packet. This statement must be included on both ends of an unnumbered link to allow an ingress LER to update the link in its traffic engineering database and use it for CSPF calculations. The link-local identifier is then used by RSVP to signal unnumbered interfaces as defined in RFC 3477, *Signalling Unnumbered Links in Resource Reservation Protocol - Traffic Engineering (RSVP-TE)*.
- **credibility-protocol-preference**—(OSPFv2 only) Assigns a credibility value to OSPF routes in the traffic engineering database. By default, Junos OS prefers IS-IS routes in the traffic engineering database over other interior gateway protocol (IGP) routes even if the routes of another IGP are configured with a lower, that is, more preferred, preference value. The traffic engineering database assigns a credibility value to each IGP and prefers the routes of the IGP with the highest credibility value. In Junos OS Release 9.4 and later, you can configure OSPF to take protocol preference into account to determine the traffic engineering database credibility value. When protocol preference is used to determine the credibility value, IS-IS routes are not automatically preferred by the traffic engineering database, depending on your configuration.
- **ignore-lsp-metrics**—Ignores RSVP LSP metrics in OSPF traffic engineering shortcut calculations or when you configure LDP over RSVP LSPs. This option avoids mutual dependency between OSPF and RSVP, eliminating the time period when the RSVP metric used for tunneling traffic is not up to date. In addition, If you are using RSVP for traffic engineering, you can run LDP simultaneously to eliminate the distribution of external routes in the core. The LSPs established by LDP are tunneled through the LSPs established by RSVP. LDP effectively treats the traffic-engineered LSPs as single hops.
- **multicast-rpf-routes**—(OSPFv2 only) Installs unicast IPv4 routes (not LSPs) in the multicast routing table (**inet.2**) for multicast reverse-path forwarding (RPF) checks. The **inet.2** routing table consists of unicast routes used for multicast RPF lookup. RPF is an antispoofing mechanism used to check if the packet is coming in on an interface that is also sending data back to the packet source.
- **no-topology**—(OSPFv2 only) To disable the dissemination of link-state topology information. If disabled, traffic engineering topology information is no longer distributed within the OSPF area.
- **shortcuts**—Configures OSPF to use MPLS LSPs as shortcut next hops. By default, shortcut routes calculated through OSPFv2 are installed in the **inet.3** routing table, and shortcut routes calculated through OSPFv3 are installed in the **inet6.3** routing table.

NOTE: Whenever possible, use OSPF IGP shortcuts configured at the **[edit protocols mpls traffic-engineering bgp-igp]** hierarchy level instead of traffic engineering shortcuts configured at the **[edit protocols (ospf | ospf3) traffic-engineering shortcuts]** hierarchy level.

If you configure OSPF IGP shortcuts, **inet.3** routes are moved into the **inet.0** routing table. In addition, you can verify the data path using **ping** or **traceroute** commands since the ping and traceroute packets get tunneled into the LSP. In case of a VPN enabled device, we recommend using **[edit protocols mpls traffic-engineering bgp-igp-both-ribs]** because BGP next-hop resolution for VPN prefixes relies on entries in the **inet.3** table.

If you configure traffic engineering shortcuts, OSPF treats the MPLS LSP as a candidate next hop and installs the routes in the **inet.3** (for OSPFv2) and **inet6.3** (for OSPFv3) routing tables. The only use for these tables is to allow BGP to perform next-hop resolution. In addition, you cannot verify the data path of these routes using **ping or traceroute** commands because the ping and traceroute packets get tunneled into the LSP.

- **lsp-metric-info-summary**—Advertises the LSP metric in summary LSAs to treat the LSP as a link. This configuration allows other routing devices in the network to use this LSP. To accomplish this, you need to configure MPLS and OSPF traffic engineering to advertise the LSP metric in summary LSAs.

When you enable traffic engineering on the routing device, you can also configure an OSPF metric that is used exclusively for traffic engineering. The traffic engineering metric is used for information injected into the traffic engineering database. Its value does not affect normal OSPF forwarding.

CAUTION: When the OSPF traffic engineering configuration is considerably modified, the routing table entries are deleted and the routing table is recreated. Changes to configuration that can cause this behavior include enabling or disabling:

- Traffic engineering shortcuts
- IGP shortcuts
- LDP tunneling
- Multiprotocol LSP
- Advertise summary metrics
- Multicast RPF routes

Example: Enabling OSPF Traffic Engineering Support

This example shows how to enable OSPF traffic engineering support to advertise the label-switched path (LSP) metric in summary link-state advertisements (LSAs).

- Requirements on page 3481
- Overview on page 3481
- Configuration on page 3482
- Verification on page 3485

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure BGP per your network requirements. See the *Junos OS Routing Protocols Library for Routing Devices*
- Configure MPLS per your network requirements. See the *Junos OS MPLS Applications Library for Routing Devices*.

Overview

You can configure OSPF to treat an LSP as a link and have other routing devices in the network use this LSP. To accomplish this, you configure MPLS and OSPF traffic engineering to advertise the LSP metric in summary LSAs.

In this example, there are four routing devices in area 0.0.0.0, and you want OSPF to treat the LSP named R1-to-R4 that goes from the ingress Device R1 to the egress Device R4 as a link.

For OSPF, you enable traffic engineering on all four routing devices in the area by including the **traffic-engineering** statement. This configuration ensures that the shortest-path-first (SPF) algorithm takes into account the LSPs configured under MPLS and configures OSPF to generate LSAs that carry traffic engineering parameters. You further ensure that OSPF uses the MPLS LSP as the next hop and advertises the LSP metric in summary LSAs, by including the optional **shortcuts lsp-metric-into-summary** statement on the ingress Device R1.

For MPLS, you enable traffic engineering so that MPLS performs traffic engineering on both BGP and IGP destinations by including the **traffic-engineering bgp-igp** statement, and you include the LSP named R1-to-R4 by including the **label-switched-path *lsp-path-name* to *address*** statement on the ingress Device R1. The address specified in the **to** statement on the ingress Device R1 must match the router ID of the egress Device R4 for the LSP to function as a direct link to the egress routing device and to be used as input to the OSPF SPF calculations. In this example, the router ID of the egress Device R4 is 10.0.0.4.

Configuration

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Modifying the Junos OS Configuration* in *CLI User Guide*.

CLI Quick Configuration

To quickly enable OSPF traffic engineering support to advertise the LSP metric in summary LSAs, copy the following commands and paste them into the CLI.

Configuration on R1:

```
[edit]
set routing-options router-id 10.0.0.1
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf traffic-engineering shortcuts lsp-metric-into-summary
set protocols mpls traffic-engineering bgp-igp
set protocols mpls label-switched-path R1-to-R4 to 10.0.0.4
```

Configuration on R2:

```
[edit]
set routing-options router-id 10.0.0.2
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf traffic-engineering
```

Configuration on R3:

```
[edit]
set routing-options router-id 10.0.0.3
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf traffic-engineering
```

Configuration on R4:

```
[edit]
set routing-options router-id 10.0.0.4
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf traffic-engineering
```

Step-by-Step Procedure

To enable OSPF traffic engineering support to advertise LSP metrics in summary LSAs:

1. Configure the router ID.

```
[edit]
user@R1# set routing-options router-id 10.0.0.1

[edit]
user@R2# set routing-options router-id 10.0.0.2

[edit]
user@R3# set routing-options router-id 10.0.0.3

[edit]
user@R4# set routing-options router-id 10.0.0.4
```


2. Configure the OSPF area and add the interfaces.

NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

```
[edit]
user@R1# set protocols ospf area 0.0.0.0 interface all
user@R1# set protocols ospf area 0.0.0.0 interface fxp0.0 disable
```

```
[edit]
user@R2# set protocols ospf area 0.0.0.0 interface all
user@R2# set protocols ospf area 0.0.0.0 interface fxp0.0 disable
```

```
[edit]
user@R3# set protocols ospf area 0.0.0.0 interface all
user@R3# set protocols ospf area 0.0.0.0 interface fxp0.0 disable
```

```
[edit]
user@R4# set protocols ospf area 0.0.0.0 interface all
user@R4# set protocols ospf area 0.0.0.0 interface fxp0.0 disable
```

3. Enable OSPF traffic engineering.

```
[edit]
user@R1 set protocols ospf traffic-engineering shortcuts lsp-metric-into-summary
```

```
[edit]
user@R2 set protocols ospf traffic-engineering
```

```
[edit]
user@R3 set protocols ospf traffic-engineering
```

```
[edit]
user@R4 set protocols ospf traffic-engineering
```

4. On Device R1, configure MPLS traffic engineering.

```
[edit ]
user@R1 set protocol mpls traffic-engineering bgp-igp
user@R1 set protocols mpls label-switched-path R1-to-R4 to 10.0.0.4
```

5. If you are done configuring the devices, commit the configuration.

```
[edit]
user@host# commit
```

Results Confirm your configuration by entering the **show routing-options**, **show protocols ospf**, and **show protocols mpls** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Output for R1:

```
user@host# show routing-options
router-id 10.0.0.1;
```

```
user@host# show protocols ospf
  traffic-engineering {
    shortcuts lsp-metric-into-summary;
```

```
    }
    area 0.0.0.0 {
        interface all;
        interface fxp0.0 {
            disable;
        }
    }
user@host# show protocols mpls
    traffic-engineering bgp-igp;
    label-switched-path R1-to-R4 {
        to 10.0.0.4;
}
```

Output for R2:

```
user@host# show routing-options
router-id 10.0.0.2;

user@host# show protocols ospf
    traffic-engineering;
    area 0.0.0.0 {
        interface all;
        interface fxp0.0 {
            disable;
        }
    }
```

Output for R3:

```
user@host# show routing-options
router-id 10.0.0.3;

user@host# show protocols ospf
    traffic-engineering;
    area 0.0.0.0 {
        interface all;
        interface fxp0.0 {
            disable;
        }
    }
```

Output for R4:

```
user@host# show routing-options
router-id 10.0.0.4;

user@host# show protocols ospf
    traffic-engineering;
    area 0.0.0.0 {
        interface all;
        interface fxp0.0 {
            disable;
        }
    }
```

To confirm your OSPFv3 configuration, enter the **show routing-options**, **show protocols ospf3**, and **show protocols mpls** commands.

Verification

Confirm that the configuration is working properly.

Verifying the Traffic Engineering Capability for OSPF

Purpose Verify that traffic engineering has been enabled for OSPF. By default, traffic engineering is disabled.

Action From operational mode, enter the **show ospf overview** command for OSPFv2, and enter the **show ospf3 overview** for OSPFv3.

Verifying OSPF Entries in the Traffic Engineering Database

Purpose Verify the OSPF information in the traffic engineering database. The Protocol field displays OSPF and the area from which the information was learned.

Action From operational mode, enter the **show ted database** command.

Verifying That the Traffic Engineering Database Is Learning Node Information from OSPF

Purpose Verify that OSPF is reporting node information. The Protocol name field displays OSPF and the area from which the information was learned.

Action From operational mode, enter the **show ted protocol** command.

Example: Configuring the Traffic Engineering Metric for a Specific OSPF Interface

This example shows how to configure the OSPF metric value used for traffic engineering.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure OSPF for traffic engineering. See "Example: Enabling OSPF Traffic Engineering Support" on page 3481

Overview

You can configure an OSPF metric that is used exclusively for traffic engineering. To modify the default value of the traffic engineering metric, include the **te-metric** statement. The OSPF traffic engineering metric does not affect normal OSPF forwarding. By default, the traffic engineering metric is the same value as the OSPF metric. The range is 1 through 65,535.

In this example, you configure the OSPF traffic engineering metric on OSPF interface **fe-0/1/1** in area 0.0.0.0.

Configuration

CLI Quick Configuration

To quickly configure the OSPF traffic engineering metric for a specific interface, copy the following command and paste it into the CLI.

```
[edit]
set protocols ospf area 0.0.0.0 interface fe-0/1/1 te-metric 10
```

Step-by-Step Procedure

To configure an OSPF traffic engineering metric for a specific interface used only for traffic engineering:

1. Create an OSPF area.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# edit protocols ospf area 0.0.0.0
   ```

2. Configure the traffic engineering metric of the OSPF network segments.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@host set interface fe-0/1/1 te-metric 10
   ```

3. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
area 0.0.0.0 {
  interface fe-0/1/1.0 {
    te-metric 10;
  }
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying the Configured Traffic Engineering Metric

Purpose Verify the traffic engineering metric value. Confirm that Metric field displays the configured traffic engineering metric.

Action From operational mode, enter the **show ted database extensive** command.

Related Documentation

- *OSPF Configuration Overview*
- *Junos OS MPLS Applications Library for Routing Devices*

Example: Configuring OSPF Passive Traffic Engineering Mode

OSPF Passive Traffic Engineering Mode

Ordinarily, interior routing protocols such as OSPF are not run on links between autonomous systems. However, for inter-AS traffic engineering to function properly, information about the inter-AS link—in particular, the address on the remote interface—must be made available inside the autonomous system (AS). This information is not normally included either in the external BGP (EBGP) reachability messages or in the OSPF routing advertisements.

To flood this link address information within the AS and make it available for traffic engineering calculations, you must configure OSPF passive mode for traffic engineering on each inter-AS interface. You must also supply the remote address for OSPF to distribute and include it in the traffic engineering database. OSPF traffic engineering mode allows MPLS label-switched paths (LSPs) to dynamically discover OSPF AS boundary routers and to allow routers to establish a traffic engineering LSP across multiple autonomous systems.

Example: Configuring OSPF Passive Traffic Engineering Mode

This example shows how to configure OSPF passive mode for traffic engineering on an inter-AS interface. The AS boundary router link between the EBGP peers must be a directly connected link and must be configured as a passive traffic engineering link.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure BGP per your network requirements. See the *Junos OS Routing Protocols Library for Routing Devices*.
- Configure the LSP per your network requirements. See the *Junos OS MPLS Applications Library for Routing Devices*.
- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.
- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382
- Configure a single-area OSPF network. See "Example: Configuring a Single-Area OSPF Network" on page 3385.
- Configure a multiarea OSPF network. See "Example: Configuring a Multiarea OSPF Network" on page 3387.

Overview

You can configure OSPF passive mode for traffic engineering on an inter-AS interface. The address used for the remote node of the OSPF passive traffic engineering link must be the same as the address used for the EBGP link. In this example, you configure interface **so-1/1/0** in area 0.0.0.1 as the inter-AS link to distribute traffic engineering information with OSPF within the AS and include the following settings:

- **passive**—Advertises the direct interface addresses on an interface without actually running OSPF on that interface. A passive interface is one for which the address information is advertised as an internal route in OSPF, but on which the protocol does not run.
- **traffic-engineering**—Configures an interface in OSPF passive traffic-engineering mode to enable dynamic discovery of OSPF AS boundary routers. By default, OSPF passive traffic-engineering mode is disabled.
- **remote-node-id**—Specifies the IP address at the far end of the inter-AS link. In this example, the remote IP address is 192.168.207.2.

Configuration

To quickly configure OSPF passive mode for traffic engineering, copy the following command, remove any line breaks, and paste it into the CLI.

```
[edit]
set protocols ospf area 0.0.0.1 interface so-1/1/0 passive traffic-engineering remote-node-id
  192.168.207.2
```

Step-by-Step Procedure

To configure OSPF passive traffic engineering mode:

1. Create an OSPF area.

NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

```
[edit]
user@host# set protocols ospf area 0.0.0.1
```

2. Configure interface **so-1/1/0** as a passive interface configured for traffic engineering, and specify the IP address at the far end of the inter-AS link.

```
[edit protocols ospf area 0.0.0.1]
user@host# set interface so-1/1/0 passive traffic-engineering remote-node-id
  192.168.207.2
```

3. If you are done configuring the device, commit the configuration.

```
[edit protocols ospf]
user@host# commit
```

Results Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
area 0.0.0.1 {
  interface so-1/1/0.0 {
    passive {
      traffic-engineering {
        remote-node-id 192.168.207.2;
      }
    }
  }
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying the Status of OSPF Interfaces

Purpose Verify the status of OSPF interfaces. If the interface is passive, the Adj count field is 0 because no adjacencies have been formed. Next to this field, you might also see the word Passive.

Action From operational mode, enter the **show ospf interface detail** command for OSPFv2, and enter the **show ospf3 interface detail** command for OSPFv3.

Related Documentation

- *OSPF Configuration Overview*
- About OSPF Interfaces on page 3408
- *Junos OS MPLS Applications Library for Routing Devices*

OSPF Database Protection Configuration

Example: Configuring OSPF Database Protection

OSPF Database Protection Overview

OSPF database protection allows you to limit the number of link-state advertisements (LSAs) not generated by the local router in a given OSPF routing instance, helping to protect the link-state database from being flooded with excessive LSAs. This feature is particularly useful if VPN routing and forwarding is configured on your provider edge and customer edge routers using OSPF as the routing protocol. An overrun link-state database on the customer edge router can exhaust resources on the provider edge router and impact the rest of the service provider network.

When you enable OSPF database protection, the maximum number of LSAs you specify includes all LSAs whose advertising router ID is not equal to the local router ID (nonself-generated LSAs). These might include external LSAs as well as LSAs with any scope such as the link, area, and autonomous system (AS).

Once the specified maximum LSA count is exceeded, the database typically enters into the ignore state. In this state, all neighbors are brought down, and nonself-generated LSAs are destroyed. In addition, the database sends out hellos but ignores all received packets. As a result, the database does not form any full neighbors, and therefore does not learn about new LSAs. However, if you have configured the **warning-only** option, only a warning is issued and the database does not enter the ignore state but continues to operate as before.

You can also configure one or more of the following options:

- A warning threshold for issuing a warning message before the LSA limit is reached.
- An ignore state time during which the database must remain in the ignore state and after which normal operations can be resumed.
- An ignore state count that limits the number of times the database can enter the ignore state, after which it must enter the isolate state. The isolate state is very similar to the ignore state, but has one important difference: once the database enters the isolate state, it must remain there until you issue a command to clear database protection before it can return to normal operations.
- A reset time during which the database must stay out of the ignore or isolate state before it is returned to a normal operating state.

Configuring OSPF Database Protection

By configuring OSPF database protection, you can help prevent your OSPF link-state database from being overrun with excessive LSAs that are not generated by the local router. You specify the maximum number of LSAs whose advertising router ID is not the same as the local router ID in an OSPF instance. This feature is particularly useful if your provider edge and customer edge routers are configured with VPN routing and forwarding using OSPF.

OSPF database protection is supported on:

- Logical systems
- All routing instances supported by OSPFv2 and OSPFv3
- OSPFv2 and OSPFv3 topologies
- OSPFv3 realms

To configure OSPF database protection:

1. Include the database-protection statement at one of the following hierarchy levels:
   - **[edit protocols ospf | ospf3]**
   - **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf |ospf3)]**
   - **[edit routing-instances *routing-instance-name* protocols (ospf |ospf3)]**
   - **[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-unicast | ipv6-multicast)]**
2. Include the **maximum-lsa *number*** statement.

   NOTE: The **maximum-lsa** statement is mandatory, and there is no default value for it. If you omit this statement, you cannot configure OSPF database protection.

3. (Optional) Include the following statements:
   - **ignore-count *number***—Specify the number of times the database can enter the ignore state before it goes into the isolate state.
   - **ignore-time *seconds***—Specify the time limit the database must remain in the ignore state before it resumes regular operations.
   - **reset-time *seconds***—Specify the time during which the database must operate without being in either the ignore or isolate state before it is reset to a normal operating state.
   - **warning-threshold *percent***—Specify the percent of the maximum LSA number that must be exceeded before a warning message is issued.

4. (Optional) Include the **warning-only** statement to prevent the database from entering the ignore state or isolate state when the maximum LSA count is exceeded.

NOTE: If you include the **warning-only** statement, values for the other optional statements at the same hierarchy level are not used when the maximum LSA number is exceeded.

5. Verify your configuration by checking the database protection fields in the output of the **show ospf overview** command.

Related Documentation

- OSPF Overview on page 3368
- *OSPF Configuration Overview*

OSPF Policy Configuration

Examples: Configuring OSPF Routing Policy

Understanding OSPF Routing Policy

Each routing policy is identified by a policy name. The name can contain letters, numbers, and hyphens (-) and can be up to 255 characters long. To include spaces in the name, enclose the entire name in double quotation marks. Each routing policy name must be unique within a configuration. Once a policy is created and named, it must be applied before it is active.

In the **import** statement, you list the name of the routing policy used to filter OSPF external routes from being installed into the routing tables of OSPF neighbors. You can filter the routes, but not link-state address (LSA) flooding. An external route is a route that is outside the OSPF Autonomous System (AS). The import policy does not impact the OSPF database. This means that the import policy has no impact on the link-state advertisements.

In the **export** statement, you list the name of the routing policy to be evaluated when routes are being exported from the routing table into OSPF.

By default, if a routing device has multiple OSPF areas, learned routes from other areas are automatically installed into area 0 of the routing table.

To specify more than one policy and create a policy chain, you list the policies using a space as a separator. If multiple policies are specified, the policies are evaluated in the order in which they are specified. As soon as an accept or reject action is executed, the policy chain evaluation ends.

This topic describes the following information:

Routing Policy Terms

Routing policies are made up of one or more terms. A term is a named structure in which match conditions and actions are defined. You can define one or more terms. The name can contain letters, numbers, and hyphens (-) and can be up to 255 characters long. To include spaces in the name, enclose the entire name in double quotation marks.

Each term contains a set of match conditions and a set of actions:

- Match conditions are criteria that a route must match before the actions can be applied. If a route matches all criteria, one or more actions are applied to the route.
- Actions specify whether to accept or reject the route, control how a series of policies are evaluated, and manipulate the characteristics associated with a route.

Routing Policy Match Conditions

A match condition defines the criteria that a route must match for an action to take place. You can define one or more match conditions for each term. If a route matches all of the match conditions for a particular term, the actions defined for that term are processed.

Each term can include two statements, **from** and **to**, that define the match conditions:

- In the **from** statement, you define the criteria that an incoming route must match. You can specify one or more match conditions. If you specify more than one, they all must match the route for a match to occur.

  The **from** statement is optional. If you omit the **from** and the **to** statements, all routes are considered to match.

  NOTE: In export policies, omitting the from statement from a routing policy term might lead to unexpected results. For more information, see the *Routing Policy Feature Guide for Routing Devices*.

- In the **to** statement, you define the criteria that an outgoing route must match. You can specify one or more match conditions. If you specify more than one, they all must match the route for a match to occur.

The order of the match conditions in a term is not important because a route must match all match conditions in a term for an action to be taken.

For a complete list of match conditions, see *Routing Policy Match Conditions* in the *Routing Policy Feature Guide for Routing Devices*.

Routing Policy Actions

An action defines what the routing device does with the route when the route matches all the match conditions in the **from** and **to** statements for a particular term. If a term does not have **from** and **to** statements, all routes are considered to match and the actions apply to all routes.

Each term can have one or more of the following types of actions. The actions are configured under the **then** statement.

- Flow control actions, which affect whether to accept or reject the route and whether to evaluate the next term or routing policy.
- Actions that manipulate route characteristics.
- Trace action, which logs route matches.

The **then** statement is optional. If you omit it, one of the following occurs:

- The next term in the routing policy, if one exists, is evaluated.
- If the routing policy has no more terms, the next routing policy, if one exists, is evaluated.
- If there are no more terms or routing policies, the **accept** or **reject** action specified by the default policy is executed.

For a complete list of routing policy actions, see *Actions in Routing Policy TermsRouting Policy Feature Guide for Routing Devices*

Example: Injecting OSPF Routes into the BGP Routing Table

This example shows how to create a policy that injects OSPF routes into the BGP routing table.

Requirements

Before you begin:

- Configure network interfaces.
- Configure external peer sessions. See “Example: Configuring External BGP Point-to-Point Peer Sessions” on page 2640.
- Configure interior gateway protocol (IGP) sessions between peers.

Overview

In this example, you create a routing policy called **injectpolicy1** and a routing term called **injectterm1**. The policy injects OSPF routes into the BGP routing table.

Configuration

- Configuring the Routing Policy on page 3495
- Configuring Tracing for the Routing Policy on page 3496

Configuring the Routing Policy

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set policy-options policy-statement injectpolicy1 term injectterm1 from protocol ospf
set policy-options policy-statement injectpolicy1 term injectterm1 from area 0.0.0.1
set policy-options policy-statement injectpolicy1 term injectterm1 then accept
set protocols bgp export injectpolicy1
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To inject OSPF routes into a BGP routing table:

1. Create the policy term.

   ```
   [edit policy-options policy-statement injectpolicy1]
   user@host# set term injectterm1
   ```

2. Specify OSPF as a match condition.

   ```
   [edit policy-options policy-statement injectpolicy1 term injectterm1]
   user@host# set from protocol ospf
   ```

3. Specify the routes from an OSPF area as a match condition.

   ```
   [edit policy-options policy-statement injectpolicy1 term injectterm1]
   user@host# set from area 0.0.0.1
   ```

4. Specify that the route is to be accepted if the previous conditions are matched.

   ```
   [edit policy-options policy-statement injectpolicy1 term injectterm1]
   user@host# set then accept
   ```

5. Apply the routing policy to BGP.

   ```
   [edit]
   user@host# set protocols bgp export injectpolicy1
   ```

Results

Confirm your configuration by entering the **show policy-options** and **show protocols bgp** commands from configuration mode. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show policy-options
policy-statement injectpolicy1 {
    term injectterm1 {
        from {
            protocol ospf;
            area 0.0.0.1;
        }
        then accept;
    }
}
```

```
user@host# show protocols bgp
export injectpolicy1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Tracing for the Routing Policy

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set policy-options policy-statement injectpolicy1 term injectterm1 then trace
set routing-options traceoptions file ospf-bgp-policy-log
set routing-options traceoptions file size 5m
set routing-options traceoptions file files 5
set routing-options traceoptions flag policy
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Include a trace action in the policy.

   ```
   [edit policy-options policy-statement injectpolicy1 term injectterm1]
   user@host# then trace
   ```

2. Configure the tracing file for the output.

   ```
   [edit routing-options traceoptions]
   user@host# set file ospf-bgp-policy-log
   user@host# set file size 5m
   user@host# set file files 5
   user@host# set flag policy
   ```

Results

Confirm your configuration by entering the **show policy-options** and **show routing-options** commands from configuration mode. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show policy-options
policy-statement injectpolicy1 {
    term injectterm1 {
        then {
            trace;
        }
```

```
    }
}
user@host# show routing-options
traceoptions {
    file ospf-bgp-policy-log size 5m files 5;
    flag policy;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying That the Expected BGP Routes Are Present

Purpose Verify the effect of the export policy.

Action From operational mode, enter the **show route** command.

Troubleshooting

Using the show log Command to Examine the Actions of the Routing Policy

Problem The routing table contains unexpected routes, or routes are missing from the routing table.

Solution If you configure policy tracing as shown in this example, you can run the **show log ospf-bgp-policy-log** command to diagnose problems with the routing policy. The **show log ospf-bgp-policy-log** command displays information about the routes that the **injectpolicy1** policy term analyzes and acts upon.

Example: Redistributing Static Routes into OSPF

This example shows how to create a policy that redistributes static routes into OSPF.

Requirements

Before you begin:

- Configure the device interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure static routes. See *Examples: Configuring Static Routes* in the *Junos OS Routing Protocols Library for Routing Devices*.

Overview

In this example, you create a routing policy called exportstatic1 and a routing term called exportstatic1. The policy injects static routes into OSPF. This example includes the following settings:

- **policy-statement**—Defines the routing policy. You specify the name of the policy and further define the elements of the policy. The policy name must be unique and can contain letters, numbers, and hyphens (-) and be up to 255 characters long.
- **term**—Defines the match condition and applicable actions for the routing policy. The term name can contain letters, numbers, and hyphens (-) and be up to 255 characters long. You specify the name of the term and define the criteria that an incoming route must match by including the **from** statement and the action to take if the route matches the conditions by including the **then** statement. In this example you specify the static protocol match condition and the accept action.
- **export**—Applies the export policy you created to be evaluated when routes are being exported from the routing table into OSPF.

Configuration

CLI Quick Configuration

To quickly create a policy that injects static routes into OSPF, copy the following commands and paste them into the CLI.

```
[edit]
set policy-options policy-statement exportstatic1 term exportstatic1 from protocol static
set policy-options policy-statement exportstatic1 term exportstatic1 then accept
set protocols ospf export exportstatic1
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Modifying the Junos OS Configuration* in *CLI User Guide*.

To inject static routes into OSPF:

1. Create the routing policy.

   ```
   [edit]
   user@host# edit policy-options policy-statement exportstatic1
   ```

2. Create the policy term.

   ```
   [edit policy-options policy-statement exportstatic1]
   user@host# set term exportstatic1
   ```

3. Specify static as a match condition.

   ```
   [edit policy-options policy-statement exportstatic1 term exportstatic1]
   user@host# set from protocol static
   ```

4. Specify that the route is to be accepted if the previous condition is matched.

   ```
   [edit policy-options policy-statement exportstatic1 term exportstatic1]
   user@host# set then accept
   ```

5. Apply the routing policy to OSPF.

NOTE: For OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

```
[edit]
user@host# set protocols ospf export exportstatic1
```

6. If you are done configuring the device, commit the configuration.

```
[edit]
user@host# commit
```

Results Confirm your configuration by entering the **show policy-options** and **show protocols ospf** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show policy-options
policy-statement exportstatic1 {
  term exportstatic1 {
    from protocol static;
    then accept;
  }
}

user@host# show protocols ospf
export exportstatic1;
```

To confirm your OSPFv3 configuration, enter the **show policy-options** and the **show protocols ospf3** commands.

Verification

Confirm that the configuration is working properly.

- Verifying That the Expected Static Routes Are Present on page 3499
- Verifying That AS External LSAs Are Added to the Routing Table on page 3499

Verifying That the Expected Static Routes Are Present

Purpose Verify the effect of the export policy.

Action From operational mode, enter the **show route** command.

Verifying That AS External LSAs Are Added to the Routing Table

Purpose On the routing device where you configured the export policy, verify that the routing device originates an AS external LSA for the static routes that are added to the routing table.

Action From operational mode, enter the **show ospf database** command for OSPFv2, and enter the **show ospf3 database** command for OSPFv3.

Example: Configuring an OSPF Import Policy

This example shows how to create an OSPF import policy. OSPF import policies apply to external routes only. An external route is a route that is outside the OSPF autonomous system (AS).

- Requirements on page 3500
- Overview on page 3500
- Configuration on page 3501
- Verification on page 3503

Requirements

Before you begin:

- Configure static routes. See *Examples: Configuring Static Routes* in the *Junos OS Routing Protocols Library for Routing Devices*.
- Configure the router identifiers for the devices in your OSPF network. See "Example: Configuring an OSPF Router Identifier" on page 3380.
- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382.
- Configure a single-area OSPF network. See "Example: Configuring a Single-Area OSPF Network" on page 3385 .

Overview

External routes are learned by AS boundary routers. External routes can be advertised throughout the OSPF domain if you configure the AS boundary router to redistribute the route into OSPF. An external route might be learned by the AS boundary router from a routing protocol other than OSPF, or the external route might be a static route that you configure on the AS boundary router.

For OSPFv3, the link-state advertisement (LSA) is referred to as the interarea prefix LSA and performs the same function as a network-summary LSA performs for OSPFv2. An area border router (ABR) originates an interarea prefix LSA for each IPv6 prefix that must be advertised into an area.

OSPF import policy allows you to prevent external routes from being added to the routing tables of OSPF neighbors. The import policy does not impact the OSPF database. This means that the import policy has no impact on the link-state advertisements. The filtering is done only on external routes in OSPF. The intra-area and interarea routes are not considered for filtering. The default action is to accept the route when the route does not match the policy.

This example includes the following OSPF policy settings:

- **policy-statement**—Defines the routing policy. You specify the name of the policy and further define the elements of the policy. The policy name must be unique and can contain letters, numbers, and hyphens (-) and be up to 255 characters long.

- **export**—Applies the export policy you created to be evaluated when network summary LSAs are flooded into an area. In this example, the export policy is named export_static.
- **import**—Applies the import policy you created to prevent external routes from being added to the routing table. In this example, the import policy is named filter_routes.

The devices you configure in this example represent the following functions:

- R1—Device R1 is in area 0.0.0.0 and has a direct connection to device R2. R1 has an OSPF export policy configured. The export policy redistributes static routes from R1's routing table into R1's OSPF database. Because the static route is in R1's OSPF database, the route is advertised in an LSA to R1's OSPF neighbor. R1's OSPF neighbor is device R2.
- R2—Device R2 is in area 0.0.0.0 and has a direct connection to device R1. R2 has an OSPF import policy configured that matches the static route to the 10.0.16.0/30 network and prevents the static route from being installed in R2's routing table. R2's OSPF neighbor is device R1.

Configuration

CLI Quick Configuration

To quickly configure an OSPF import policy, copy the following commands, removing any line breaks, and then paste the commands into the CLI.

Configuration on Device R1:

```
[edit]
set interfaces so-0/2/0 unit 0 family inet address 10.0.2.1/30
set protocols ospf export export_static
set protocols ospf area 0.0.0.0 interface so-0/2/0
set policy-options policy-statement export_static from protocol static
set policy-options policy-statement export_static then accept
```

Configuration on Device R2:

```
[edit]
set interfaces so-0/2/0 unit 0 family inet address 10.0.2.2/30
set protocols ospf import filter_routes
set protocols ospf area 0.0.0.0 interface so-0/2/0
set policy-options policy-statement filter_routes from route-filter 10.0.16.0/30 exact
set policy-options policy-statement filter_routes then reject
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Modifying the Junos OS Configuration* in *CLI User Guide*.

To configure an OSPF import policy:

1. Configure the interfaces.

   ```
   [edit]
   user@R1# set interfaces so-0/2/0 unit 0 family inet address 10.0.2.1/30
   ```

   ```
   [edit]
   user@R2# set interfaces so-0/2/0 unit 0 family inet address 10.0.2.2/30
   ```

2. Enable OSPF on the interfaces.

NOTE: For OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

```
[edit]
user@R1# set protocols ospf area 0.0.0.0 interface so-0/2/0

[edit]
user@R2# set protocols ospf area 0.0.0.0 interface so-0/2/0
```

3. On R1, redistribute the static route into OSPF.

```
[edit]
user@R1# set protocols ospf export export_static
user@R1# set policy-options policy-statement export_static from protocol static
user@R1# set policy-options policy-statement export_static then accept
```

4. On R2, configure the OSPF import policy.

```
[edit]
user@R2# set protocols ospf import filter_routes
user@R2# set policy-options policy-statement filter_routes from route-filter
  10.0.16.0/30 exact
user@R2# set policy-options policy-statement filter_routes then reject
```

5. If you are done configuring the devices, commit the configuration.

```
[edit]
user@host# commit
```

Results Confirm your configuration by entering the **show interfaces**, **show policy-options**, and **show protocols ospf** commands on the appropriate device. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Output for R1:

```
user@R1# show interfaces
so-0/2/0 {
  unit 0 {
    family inet {
      address 10.0.2.1/30;
    }
  }
}

user@R1# show policy-options
policy-statement export_static {
  from protocol static;
  then accept;
}

user@R1# show protocols ospf
export export_static;
area 0.0.0.0 {
```



```
    interface so-0/2/0.0;
}
```

Output for R2:

```
user@R2# show interfaces
so-0/2/0 {
    unit 0 {
        family inet {
            address 10.0.2.2/30;
        }
    }
}
user@R2# show policy-options
policy-statement filter_routes {
    from {
        route-filter 10.0.16.0/30 exact;
    }
    then reject;
}
user@R2# show protocols ospf
import filter_routes;
area 0.0.0.0 {
    interface so-0/2/0.0;
}
```

To confirm your OSPFv3 configuration, enter the **show interfaces**, **show policy-options**, **show routing-options**, and **show protocols ospf3** commands on the appropriate device.

Verification

Confirm that the configuration is working properly.

- Verifying the OSPF Database on page 3503
- Verifying the Routing Table on page 3503

Verifying the OSPF Database

Purpose Verify that OSPF is advertising the static route in the OSPF database.

Action From operational mode, enter the **show ospf database** for OSPFv2, and enter the **show ospf3 database** command for OSPFv3.

Verifying the Routing Table

Purpose Verify the entries in the routing table.

Action From operational mode, enter the **show route** command.

Example: Configuring a Route Filter Policy to Specify Priority for Prefixes Learned Through OSPF

This example shows how to create an OSPF import policy that prioritizes specific prefixes learned through OSPF.

Requirements

Before you begin:

- Configure the device interfaces.
- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Control OSPF designated router election. See “Example: Controlling OSPF Designated Router Election” on page 3382.
- Configure a single-area OSPF network. See “Example: Configuring a Single-Area OSPF Network” on page 3385.
- Configure a multiarea OSPF network. See “Example: Configuring a Multiarea OSPF Network” on page 3387.

Overview

In a network with a large number of OSPF routes, it can be useful to control the order in which routes are updated in response to a network topology change. In Junos OS Release 9.3 and later, you can specify a priority of high, medium, or low for prefixes included in an OSPF import policy. In the event of an OSPF topology change, high priority prefixes are updated in the routing table first, followed by medium and then low priority prefixes.

OSPF import policy can only be used to set priority or to filter OSPF external routes. If an OSPF import policy is applied that results in a **reject** terminating action for a nonexternal route, then the **reject** action is ignored and the route is accepted anyway. By default, such a route is now installed in the routing table with a priority of low. This behavior prevents traffic black holes, that is, silently discarded traffic, by ensuring consistent routing within the OSPF domain.

In general, OSPF routes that are not explicitly assigned a priority are treated as priority medium, except for the following:

- Summary discard routes have a default priority of low.
- Local routes that are not added to the routing table are assigned a priority of low.
- External routes that are rejected by import policy and thus not added to the routing table are assigned a priority of low.

Any available match criteria applicable to OSPF routes can be used to determine the priority. Two of the most commonly used match criteria for OSPF are the **route-filter** and **tag** statements.

In this example, the routing device is in area 0.0.0.0, with interfaces fe-0/1/0 and fe-1/1/0 connecting to neighboring devices. You configure an import routing policy named ospf-import to specify a priority for prefixes learned through OSPF. Routes associated with these prefixes are installed in the routing table in the order of the prefixes' specified priority. Routes matching **200.3.0.0/16 orlonger** are installed first because they have a priority of **high**. Routes matching **200.2.0.0/16 orlonger** are installed next because they have a priority of **medium**. Routes matching **200.1.0.0/16 orlonger** are installed last because they have a priority of **low**. You then apply the import policy to OSPF.

NOTE: The priority value takes effect when a new route is installed, or when there is a change to an existing route.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set interfaces fe-0/1/0 unit 0 family inet address 192.168.8.4/30
set interfaces fe-0/2/0 unit 0 family inet address 192.168.8.5/30
set policy-options policy-statement ospf-import term t1 from route-filter 200.1.0.0/16
  orlonger
set policy-options policy-statement ospf-import term t1 then priority low
set policy-options policy-statement ospf-import term t1 then accept
set policy-options policy-statement ospf-import term t2 from route-filter 200.2.0.0/16
  orlonger
set policy-options policy-statement ospf-import term t2 then priority medium
set policy-options policy-statement ospf-import term t2 then accept
set policy-options policy-statement ospf-import term t3 from route-filter 200.3.0.0/16
  orlonger
set policy-options policy-statement ospf-import term t3 then priority high
set policy-options policy-statement ospf-import term t3 then accept
set protocols ospf import ospf-import
set protocols ospf area 0.0.0.0 interface fe-0/1/0.0
set protocols ospf area 0.0.0.0 interface fe-0/2/0.0
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure an OSPF import policy that prioritizes specific prefixes:

1. Configure the device interfaces.

```
[edit interfaces]
user@host# set fe-0/1/0 unit 0 family inet address 192.168.8.4/30
```

user@host# **set fe-0/2/0 unit 0 family inet address 192.168.8.5/30**

2. Enable OSPF on the interfaces.

   NOTE: For OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@host# set interface fe-0/1/0.0
   user@host# set interface fe-0/2/0.0
   ```

3. Configure the policy to specify the priority for prefixes learned through OSPF.

   ```
   [edit policy-options policy-statement ospf-import]
   user@host# set term t1 from route-filter 200.1.0.0/16 orlonger
   user@host# set term t1 then priority low
   user@host# set term t1 then accept

   user@host# set term t2 from route-filter 200.2.0.0/16 orlonger
   user@host# set term t2 then priority medium
   user@host# set term t2 then accept

   user@host# set term t3 from route-filter 200.3.0.0/16 orlonger
   user@host# set term t3 then priority high
   user@host# set term t3 then accept
   ```

4. Apply the policy to OSPF.

   ```
   [edit protocols ospf]
   user@host# set import ospf-import
   ```

5. If you are done configuring the device, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols ospf**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show interfaces
fe-0/1/0 {
  unit 0 {
    family inet {
      address 192.168.8.4/30;
    }
  }
}
  fe-0/2/0 {
    unit 0 {
      family inet {
        address 192.168.8.5/30;
      }
```



```
    }
  }
user@host# show protocols ospf
import ospf-import;
area 0.0.0.0 {
  interface fe-0/1/0.0;
  interface fe-0/2/0.0;
}
user@host# show policy-options
policy-statement ospf-import {
  term t1 {
    from {
      route-filter 200.1.0.0/16 orlonger;
    }
    then {
      priority low;
      accept;
    }
  }
  term t2 {
    from {
      route-filter 200.2.0.0/16 orlonger;
    }
    then {
      priority medium;
      accept;
    }
  }
  term t3 {
    from {
      route-filter 200.3.0.0/16 orlonger;
    }
    then {
      priority high;
      accept;
    }
  }
}
```

To confirm your OSPFv3 configuration, enter the **show interfaces**, **show protocols ospf3**, and **show policy-options** commands.

Verification

Confirm that the configuration is working properly.

Verifying the Prefix Priority in the OSPF Routing Table

Purpose Verify the priority assigned to the prefix in the OSPF routing table.

Action From operational mode, enter the **show ospf route detail** for OSPFv2, and enter the **show ospf3 route detail** command for OSPFv3.

Related Documentation

- OSPF Overview on page 3368
- *OSPF Configuration Overview*
- *Routing Policy Match Conditions* in the *Routing Policy Feature Guide for Routing Devices*
- *Actions in Routing Policy Terms* in the *Routing Policy Feature Guide for Routing Devices*

Examples: Configuring Routing Policy for Network Summaries

Import and Export Policies for Network Summaries Overview

By default, OSPF uses network-summary link-state advertisements (LSAs) to transmit route information across area boundaries. Each area border router (ABR) floods network-summary LSAs to other routing devices in the same area. The ABR also controls which routes from the area are used to generate network-summary LSAs into other areas. Each ABR maintains a separate topological database for each area to which they are connected. In Junos OS Release 9.1 and later, you can configure export and import policies for OSPFv2 and OSPFv3 that enable you to control how network-summary LSAs, which contain information about interarea OSPF prefixes, are distributed and generated. For OSPFv3, the LSA is referred to as the interarea prefix LSA and performs the same function as a network-summary LSA performs for OSPFv2. An ABR originates an interarea prefix LSA for each IPv6 prefix that must be advertised into an area.

The export policy enables you to specify which summary LSAs are flooded into an area. The import policy enables you to control which routes learned from an area are used to generate summary LSAs into other areas. You define a routing policy at the **[edit policy-options policy-statement *policy-name*]** hierarchy level. As with all OSPF export policies, the default for network-summary LSA export policies is to reject everything. Similarly, as with all OSPF import policies, the default for network-summary LSA import policies is to accept all OSPF routes.

Example: Configuring an OSPF Export Policy for Network Summaries

This example shows how to create an OSPF export policy to control the network-summary (Type 3) LSAs that the ABR floods into an OSPF area.

Requirements

Before you begin:

- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.

- Control OSPF designated router election. See "Example: Controlling OSPF Designated Router Election" on page 3382

Overview

OSPF uses network-summary LSAs to transmit route information across area boundaries. Depending on your network environment, you might want to further filter the network-summary LSAs between OSPF areas. For example, if you create OSPF areas to define administrative boundaries, you might not want to advertise internal route information between those areas. To further improve the control of route distribution between multiple OSPF areas, you can configure network summary policies on the ABR for the area that you want to filter the advertisement of network-summary LSAs.

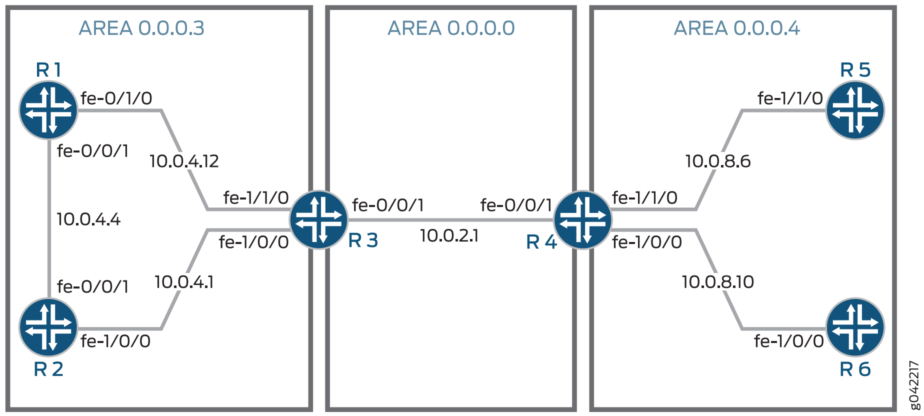
NOTE: **For OSPFv3, the LSA is referred to as the interarea prefix LSA and performs the same function as a network-summary LSA performs for OSPFv2. An ABR originates an interarea prefix LSA for each IPv6 prefix that must be advertised into an area. In this topic, the terms network summary policy and network-summary policy are used to describe both OSPFv2 and OSPFv3 functionality.**

The following guidelines apply to export network summary policies:

- You should have a thorough understanding of your network before configuring these policies. Incorrect network summary policy configuration might result in an unintended result such as suboptimal routing or dropped traffic.
- We recommend that you use the **route-filter** policy match condition for these types of policies.
- We recommend that you use the **accept** and **reject** routing policy terms for these types of policies.

Figure 94 on page 3510 shows a sample topology with three OSPF areas. R4 generates network summaries for the routes in area 4 and sends them out of area 4 to area 0. R3 generates network summaries for the routes in area 3 and sends them out of area 3 to area 0.

Figure 94: Sample Topology Used for an OSPF Export Network Summary Policy



In this example, you configure R4 with an export network summary policy named export-policy that only allows routes that match the 10.0.4.4 prefix from area 3 into area 4. The export policy controls the network-summary LSAs that R4 floods into area 4. This results in only the allowed interarea route to enter area 4, and all other interarea routes to be purged from the OSPF database and the routing table of the devices in area 4. You first define the policy and then apply it to the ABR by including the **network-summary-export** statement for OSPFv2 or the **inter-area-prefix-export** statement for OSPFv3.

The devices operate as follows:

- R1—Device R1 is an internal router in area 3. Interface **fe-0/1/0** has an IP address of 10.0.4.13/30 and connects to R3. Interface **fe-0/0/1** has an IP address of 10.0.4.5/30 and connects to R2.
- R2—Device R2 is an internal router in area 3. Interface **fe-0/0/1** has an IP address of 10.0.4.6/30 and connects to R1. Interface **fe-1/0/0** has an IP address of 10.0.4.1 and connects to R3.
- R3—Device R3 participates in area 3 and area 0. R3 is the ABR between area 3 and area 0, and passes network-summary LSAs between the areas. Interface **fe-1/0/0** has an IP address of 10.0.4.2/30 and connects to R2. Interface **fe-1/1/0** has an IP address of 10.0.4.14/30 and connects to R1. Interface **fe-0/0/1** has an IP address of 10.0.2.1/30 and connects to R4.
- R4—Device R4 participates in area 0 and area 4. R4 is the ABR between area 0 and area 4, and passes network-summary LSAs between the areas. Interface **fe-0/0/1** has an IP address of 10.0.2.4/30 and connects to R3. Interface **fe-1/1/0** has an IP address of 10.0.8.6/30 and connects to R5. Interface **fe-1/0/0** has an IP address of 10.0.8.9/30 and connects to R6.
- R5—Device R5 is an internal router in area 4. Interface **fe-1/1/0** has an IP address of 10.0.8.5/30 and connects to R4.
- R6—Device R6 is an internal router in area 4. Interface **fe-1/0/0** has an IP address of 10.0.8.10/30 and connects to R4.

Configuration

CLI Quick Configuration

To quickly configure an OSPF export policy for network summaries, copy the following commands, removing any line breaks, and then paste the commands into the CLI.

Configuration on Device R1:

```
[edit]
set interfaces fe-0/1/0 unit 0 family inet address 10.0.4.13/30
set interfaces fe-0/0/1 unit 0 family inet address 10.0.4.5/30
set protocols ospf area 0.0.0.3 interface fe-0/1/0
set protocols ospf area 0.0.0.3 interface fe-0/0/1
```

Configuration on Device R2:

```
[edit]
set interfaces fe-0/1/0 unit 0 family inet address 10.0.4.6/30
set interfaces fe-1/0/0 unit 0 family inet address 10.0.4.1/30
set protocols ospf area 0.0.0.3 interface fe-0/1/0
set protocols ospf area 0.0.0.3 interface fe-1/0/0
```

Configuration on Device R3:

```
[edit]
set interfaces fe-1/0/0 unit 0 family inet address 10.0.4.2/30
set interfaces fe-1/1/0 unit 0 family inet address 10.0.4.14/30
set interfaces fe-0/0/1 unit 0 family inet address 10.0.2.1/30
set protocols ospf area 0.0.0.3 interface fe-1/0/0
set protocols ospf area 0.0.0.3 interface fe-1/1/0
set protocols ospf area 0.0.0.0 interface fe-0/0/1
```

Configuration on Device R4:

```
[edit]
set interfaces fe-0/0/1 unit 0 family inet address 10.0.2.1/30
set interfaces fe-1/1/0 unit 0 family inet address 10.0.8.6/30
set interfaces fe-1/0/0 unit 0 family inet address 10.0.8.9/30
set policy-options policy-statement export-policy term term1 from route-filter 10.0.4.4/30
  prefix-length-range /30-/30
set policy-options policy-statement export-policy term term1 then accept
set protocols ospf area 0.0.0.0 interface fe-0/0/1
set protocols ospf area 0.0.0.4 interface fe-0/1/0
set protocols ospf area 0.0.0.4 interface fe-1/0/0
set protocols ospf area 0.0.0.4 network-summary-export export-policy
```

Configuration on Device R5:

```
[edit]
set interfaces fe-1/1/0 unit 0 family inet address 10.0.8.5/30
set protocols ospf area 0.0.0.4 interface fe-0/1/0
```

Configuration on Device R6:

```
[edit]
set interfaces fe-1/0/0 unit 0 family inet address 10.0.8.10/30
set protocols ospf area 0.0.0.4 interface fe-1/0/0
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Modifying the Junos OS Configuration* in *CLI User Guide*.

To configure an configure an OSPF export policy for network summaries:

1. Configure the interfaces.

   NOTE: For OSPFv3, use IPv6 addresses.

```
[edit]
user@R1# set interfaces fe-0/1/0 unit 0 family inet address 10.0.4.13/30
user@R1# set interfaces fe-0/0/1 unit 0 family inet address 10.0.4.5/30

[edit]
user@R2# set interfaces fe-0/1/0 unit 0 family inet address 10.0.4.6/30
user@R2# set interfaces fe-1/0/0 unit 0 family inet address 10.0.4.1/30

[edit]
user@R3# set interfaces fe-1/0/0 unit 0 family inet address 10.0.4.2/30
user@R3# set interfaces fe-1/1/0 unit 0 family inet address 10.0.4.14/30
user@R3#set interfaces fe-0/0/1 unit 0 family inet address 10.0.2.1/30

[edit]
user@R4# set interfaces fe-0/0/1 unit 0 family inet address 10.0.2.1/30
user@R4# set interfaces fe-1/1/0 unit 0 family inet address 10.0.8.6/30
user@R4# set interfaces fe-1/0/0 unit 0 family inet address 10.0.8.9/30

[edit]
user@R5# set interfaces fe-1/1/0 unit 0 family inet address 10.0.8.5/30

[edit]
user@R6# set interfaces fe-1/0/0 unit 0 family inet address 10.0.8.10/30
```

2. Enable OSPF on the interfaces.

   NOTE: For OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

```
[edit]
user@R1# set protocols ospf area 0.0.0.3 interface fe-0/1/0
user@R1# set protocols ospf area 0.0.0.3 interface fe-0/0/1

[edit]
user@R2# set protocols ospf area 0.0.0.3 interface fe-0/1/0
user@R2# set protocols ospf area 0.0.0.3 interface fe-1/0/0

[edit]
user@R3# set protocols ospf area 0.0.0.3 interface fe-1/0/0
user@R3# set protocols ospf area 0.0.0.3 interface fe-1/1/0
user@R3# set protocols ospf area 0.0.0.0 interface fe-0/0/1

[edit]
user@R4# set protocols ospf area 0.0.0.0 interface fe-0/0/1
```

```
user@R4# set protocols ospf area 0.0.0.4 interface fe-1/1/0
user@R4# set protocols ospf area 0.0.0.4 interface fe-1/0/0

[edit]
user@R5# set protocols ospf area 0.0.0.4 interface fe-1/1/0

[edit]
user@R6# set protocols ospf area 0.0.0.4 interface fe-1/0/0
```

3. On R4, configure the export network summary policy.

```
[edit ]
user@R4# set policy-options policy-statement export-policy term term1 from
  route-filter 10.0.4.4/30 prefix-length-range /30-/30
user@R4# set policy-options policy-statement export-policy term term1 then accept
```

4. On R4, apply the export network summary policy to OSPF.

NOTE: For OSPFv3, include the **inter-area-prefix-export** statement at the **[edit protocols ospf3 area *area-id*]** hierarchy level.

```
[edit]
user@R4# set protocols ospf area 0.0.0.4 network-summary-export export-policy
```

5. If you are done configuring the devices, commit the configuration.

```
[edit]
user@host# commit
```

Results Confirm your configuration by entering the **show interfaces**, **show policy-options**, and **show protocols ospf** commands on the appropriate device. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Output for R1:

```
user@R1# show interfaces
fe-0/0/1 {
  unit 0 {
    family inet {
      address 10.0.4.5/30;
    }
  }
}
fe-1/1/0 {
  unit 0 {
    family inet {
      address 10.0.4.13/30;
    }
  }
}

user@R1# show protocols ospf
area 0.0.0.3 {
  interface fe-0/1/0.0;
```

```
  interface fe-0/0/1.0;
}
```

Output for R2:

```
user@R2# show interfaces
fe-0/1/0 {
  unit 0 {
    family inet {
      address 10.0.4.6/30;
    }
  }
}
fe-1/0/0 {
  unit 0 {
    family inet {
      address 10.0.4.1/30;
    }
  }
}

user@R2# show protocols ospf
area 0.0.0.3 {
  interface fe-0/1/0.0;
  interface fe-1/0/0.0;
}
```

Output for R3:

```
user@R3# show interfaces
fe-0/0/1 {
  unit 0 {
    family inet {
      address 10.0.2.1/30;
    }
  }
}
fe-1/0/0 {
  unit 0 {
    family inet {
      address 10.0.4.2/30;
    }
  }
}
fe-1/1/0 {
  unit 0 {
    family inet {
      address 10.0.4.14/30;
    }
  }
}

user@R3# show protocols ospf
area 0.0.0.0 {
  interface fe-0/0/1.0;
}
  area 0.0.0.3 {
    interface fe-1/0/0.0;
```



```
        interface fe-1/1/0.0;
    }
```

Output for R4:

```
user@R4# show interfaces
fe-0/0/1 {
    unit 0 {
        family inet {
            address 10.0.2.1/30;
        }
    }
}
fe-1/0/0 {
    unit 0 {
        family inet {
            address 10.0.8.9/30;
        }
    }
}
fe-1/1/0 {
    unit 0 {
        family inet {
            address 10.0.8.6/30;
        }
    }
}
```

```
user@R4# show protocols ospf
area 0.0.0.0 {
    interface fe-0/0/1.0;
}
area 0.0.0.4 {
    network-summary-export export-policy;
    interface fe-1/0/0.0;
    interface fe-1/1/0.0;
}
```

```
user@R4# show policy-options
policy-statement export-policy {
    term term1 {
        from {
            route-filter 10.0.4.4/30 prefix-length-range /30-/30;
        }
        then accept;
    }
}
```

Output for R5:

```
user@R5# show interfaces
fe-1/1/0 {
    unit 0 {
        family inet {
            address 10.0.8.5/30;
        }
    }
}
```

```
user@R5# show protocols ospf
area 0.0.0.4 {
  interface fe-1/1/0.0;
}
```

Output for R6:

```
user@R6# show interfaces
fe-1/0/0 {
  unit 0 {
    family inet {
      address 10.0.8.10/30;
    }
  }
}
```

```
user@R6# show protocols ospf
area 0.0.0.4 {
  interface fe-1/0/0.0;
}
```

To confirm your OSPFv3 configuration, enter the **show interfaces**, **show policy-options**, and **show protocols ospf3** commands on the appropriate device.

Verification

Confirm that the configuration is working properly.

- Verifying the OSPF Database on page 3516
- Verifying the Routing Table on page 3516

Verifying the OSPF Database

Purpose Verify that the OSPF database for the devices in area 4 includes the interarea route that we permitted on the ABR R4. The other interarea routes that are not specified should age out or no longer be present in the OSPF database.

Action From operational mode, enter the **show ospf database netsummary area 0.0.0.4** command for OSPFv2, and enter the **show ospf3 database inter-area-prefix area 0.0.0.4** command for OSPFv3.

Verifying the Routing Table

Purpose Verify that the routes corresponding to the rejected network summaries are no longer present in R4's, R5's, or R6's routing table.

Action From operational mode, enter the **show route protocol ospf** command for both OSPFv2 and OSPFv3.

Example: Configuring an OSPF Import Policy for Network Summaries

This example shows how to create an OSPF import policy to control the network-summary (Type 3) LSAs that the ABR advertises out of an OSPF area.

Requirements

Before you begin:

- Configure the router identifiers for the devices in your OSPF network. See “Example: Configuring an OSPF Router Identifier” on page 3380.
- Control OSPF designated router election. See “Example: Controlling OSPF Designated Router Election” on page 3382.

Overview

OSPF uses network-summary LSAs to transmit route information across area boundaries. Depending on your network environment, you might want to further filter the network-summary LSAs between OSPF areas. For example, if you create OSPF areas to define administrative boundaries, you might not want to advertise internal route information between those areas. To further improve the control of route distribution between multiple OSPF areas, you can configure network summary policies on the ABR for the area that you want to filter the advertisement of network-summary LSAs.

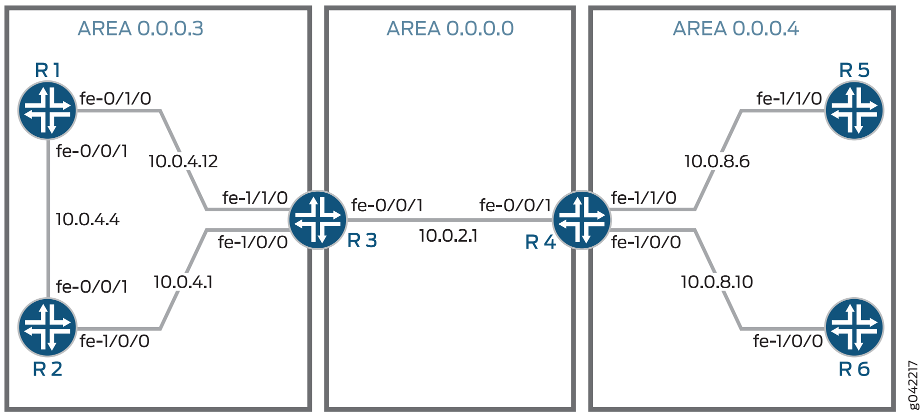
NOTE: For OSPFv3, the LSA is referred to as the interarea prefix LSA and performs the same function as a network-summary LSA performs for OSPFv2. An ABR originates an interarea prefix LSA for each IPv6 prefix that must be advertised into an area. In this topic, the terms network summary policy and network-summary policy are used to describe both OSPFv2 and OSPFv3 functionality.

The following guidelines apply to import network summary policies:

- You should have a thorough understanding of your network before configuring these policies. Incorrect network summary policy configuration might result in an unintended result such as suboptimal routing or dropped traffic.
- We recommend that you use the **route-filter** policy match condition for these types of policies.
- We recommend that you use the **accept** and **reject** routing policy terms for these types of policies.

Figure 95 on page 3518 shows a sample topology with three OSPF areas. R4 generates network summaries for the routes in area 4 and sends them out of area 4 to area 0. R3 generates network summaries for the routes in area 3 and sends them out of area 3 to area 0.

Figure 95: Sample Topology Used for an OSPF Import Network Summary Policy



In this example, you configure R3 with an import network summary policy named import-policy so R3 only generates network summaries for the route 10.0.4.12/30. The import policy controls the routes and therefore the network summaries that R3 advertises out of area 3, so applying this policy means that R3 only advertises route 10.0.4.12/30 out of area 3. This results in existing network summaries from other interarea routes getting purged from the OSPF database in area 0 and area 4, as well as the routing tables of the devices in areas 0 and area 4. You first define the policy and then apply it to the ABR by including the **network-summary-import** statement for OSPFv2 or the **inter-area-prefix-import** statement for OSPFv3.

The devices operate as follows:

- R1—Device R1 is an internal router in area 3. Interface **fe-0/1/0** has an IP address of 10.0.4.13/30 and connects to R3. Interface **fe-0/0/1** has an IP address of 10.0.4.5/30 and connects to R2.
- R2—Device R2 is an internal router in area 3. Interface **fe-0/0/1** has an IP address of 10.0.4.6/30 and connects to R1. Interface **fe-1/0/0** has an IP address of 10.0.4.1/30 and connects to R3.
- R3—Device R3 participates in area 3 and area 0. R3 is the ABR between area 3 and area 0, and passes network-summary LSAs between the areas. Interface **fe-1/0/0** has an IP address of 10.0.4.2/30 and connects to R2. Interface **fe-1/1/0** has an IP address of 10.0.4.14/30 and connects to R1. Interface **fe-0/0/1** has an IP address of 10.0.2.1/30 and connects to R4.
- R4—Device R4 participates in area 0 and area 4. R4 is the ABR between area 0 and area 4, and passes network-summary LSAs between the areas. Interface **fe-0/0/1** has an IP address of 10.0.2.1/30 and connects to R3. Interface **fe-1/1/0** has an IP address of 10.0.8.6/30 and connects to R5. Interface **fe-1/0/0** has an IP address of 10.0.8.9/30 and connects to R6.

- R5—Device R5 is an internal router in area 4. Interface **fe-1/1/0** has an IP address of 10.0.8.5/30 and connects to R4.
- R6—Device R6 is an internal router in area 4. Interface **fe-1/0/0** has an IP address of 10.0.8.10/30 and connects to R4.

Configuration

CLI Quick Configuration

To quickly configure an OSPF import policy for network summaries, copy the following commands, removing any line breaks, and then paste the commands into CLI.

Configuration on Device R1:

```
[edit]
set interfaces fe-0/1/0 unit 0 family inet address 10.0.4.13/30
set interfaces fe-0/0/1 unit 0 family inet address 10.0.4.5/30
set protocols ospf area 0.0.0.3 interface fe-0/1/0
set protocols ospf area 0.0.0.3 interface fe-0/0/1
```

Configuration on Device R2:

```
[edit]
set interfaces fe-0/1/0 unit 0 family inet address 10.0.4.6/30
set interfaces fe-1/0/0 unit 0 family inet address 10.0.4.1/30
set protocols ospf area 0.0.0.3 interface fe-0/1/0
set protocols ospf area 0.0.0.3 interface fe-1/0/0
```

Configuration on Device R3:

```
[edit]
set interfaces fe-1/0/0 unit 0 family inet address 10.0.4.2/30
set interfaces fe-1/1/0 unit 0 family inet address 10.0.4.14/30
set interfaces fe-0/0/1 unit 0 family inet address 10.0.2.1/30
set policy-options policy-statement import-policy term term1 from route-filter 10.0.4.12/30
  prefix-length-range /30-/30
set policy-options policy-statement import-policy term term1 then accept
set protocols ospf area 0.0.0.3 interface fe-1/0/0
set protocols ospf area 0.0.0.3 interface fe-1/1/0
set protocols ospf area 0.0.0.0 interface fe-0/0/1
set protocols ospf area 0.0.0.3 network-summary-import import-policy
```

Configuration on Device R4:

```
[edit]
set interfaces fe-0/0/1 unit 0 family inet address 10.0.2.1/30
set interfaces fe-1/1/0 unit 0 family inet address 10.0.8.6/30
set interfaces fe-1/0/0 unit 0 family inet address 10.0.8.9/30
set protocols ospf area 0.0.0.0 interface fe-0/0/1
set protocols ospf area 0.0.0.4 interface fe-1/1/0
set protocols ospf area 0.0.0.4 interface fe-1/0/0
```

Configuration on Device R5:

```
[edit]
set interfaces fe-1/1/0 unit 0 family inet address 10.0.8.5/30
set protocols ospf area 0.0.0.4 interface fe-1/1/0
```

Configuration on Device R6:

```
[edit]
set interfaces fe-1/0/0 unit 0 family inet address 10.0.8.10/30
set protocols ospf area 0.0.0.4 interface fe-1/0/0
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Modifying the Junos OS Configuration* in *CLI User Guide*.

To configure an configure an OSPF export policy for network summaries:

1. Configure the interfaces.

   NOTE: For OSPFv3, use IPv6 addresses.

   ```
   [edit]
   user@R1# set interfaces fe-0/1/0 unit 0 family inet address 10.0.4.13/30
   user@R1# set interfaces fe-0/0/1 unit 0 family inet address 10.0.4.5/30

   [edit]
   user@R2# set interfaces fe-0/1/0 unit 0 family inet address 10.0.4.6/30
   user@R2# set interfaces fe-1/0/0 unit 0 family inet address 10.0.4.1/30

   [edit]
   user@R3# set interfaces fe-1/0/0 unit 0 family inet address 10.0.4.2/30
   user@R3# set interfaces fe-1/1/0 unit 0 family inet address 10.0.4.14/30
   user@R3#set interfaces fe-0/0/1 unit 0 family inet address 10.0.2.1/30

   [edit]
   user@R4# set interfaces fe-0/0/1 unit 0 family inet address 10.0.2.1/30
   user@R4# set interfaces fe-1/1/0 unit 0 family inet address 10.0.8.6/30
   user@R4# set interfaces fe-1/0/0 unit 0 family inet address 10.0.8.9/30

   [edit]
   user@R5# set interfaces fe-1/1/0 unit 0 family inet address 10.0.8.5/30

   [edit]
   user@R6# set interfaces fe-1/0/0 unit 0 family inet address 10.0.8.10/30
   ```

2. Enable OSPF on the interfaces.

   NOTE: For OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@R1# set protocols ospf area 0.0.0.3 interface fe-0/1/0
   user@R1# set protocols ospf area 0.0.0.3 interface fe-0/0/1

   [edit]
   user@R2# set protocols ospf area 0.0.0.3 interface fe-0/1/0
   user@R2# set protocols ospf area 0.0.0.3 interface fe-1/0/0

   [edit]
   user@R3# set protocols ospf area 0.0.0.3 interface fe-1/0/0
   ```



```
user@R3# set protocols ospf area 0.0.0.3 interface fe-1/1/0
user@R3# set protocols ospf area 0.0.0.0 interface fe-0/0/1
```

```
[edit]
user@R4# set protocols ospf area 0.0.0.0 interface fe-0/0/1
user@R4# set protocols ospf area 0.0.0.4 interface fe-1/1/0
user@R4# set protocols ospf area 0.0.0.4 interface fe-1/0/0
```

```
[edit]
user@R5# set protocols ospf area 0.0.0.4 interface fe-1/1/0
```

```
[edit]
user@R6# set protocols ospf area 0.0.0.4 interface fe-1/0/0
```

3. On R3, configure the import network summary policy.

```
[edit ]
user@R3# set policy-options policy-statement import-policy term term1 from
  route-filter 10.0.4.12/30 prefix-length-range /30-/30
user@R3# set policy-options policy-statement export-policy term term1 then accept
```

4. On R3, apply the import network summary policy to OSPF.

> NOTE: For OSPFv3, include the **inter-area-prefix-export** statement at the **[edit protocols ospf3 area *area-id*]** hierarchy level.

```
[edit]
user@R3# set protocols ospf area 0.0.0.4 network-summary-import import-policy
```

5. If you are done configuring the devices, commit the configuration.

```
[edit]
user@host# commit
```

Results Confirm your configuration by entering the **show interfaces**, **show policy-options**, and **show protocols ospf** commands on the appropriate device. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Output for R1:

```
user@R1# show interfaces
fe-0/0/1 {
  unit 0 {
    family inet {
      address 10.0.4.5/30;
    }
  }
}
fe-0/1/0 {
  unit 0 {
    family inet {
      address 10.0.4.13/30;
    }
  }
```

```
}
user@R1# show protocols ospf
area 0.0.0.3 {
   interface fe-0/1/0.0;
   interface fe-0/0/1.0;
}
```

Output for R2:

```
user@R2# show interfaces
fe-0/1/0 {
   unit 0 {
      family inet {
         address 10.0.4.6/30;
      }
   }
}
fe-1/0/0 {
   unit 0 {
      family inet {
         address 10.0.4.1/30;
      }
   }
}
user@R2# show protocols ospf
area 0.0.0.3 {
   interface fe-0/1/0.0;
   interface fe-1/0/0.0;
}
```

Output for R3:

```
user@R3# show interfaces
fe-0/0/1 {
   unit 0 {
      family inet {
         address 10.0.2.1/30;
      }
   }
}
fe-1/0/0 {
   unit 0 {
      family inet {
         address 10.0.4.2/30;
      }
   }
}
fe-1/1/0 {
   unit 0 {
      family inet {
         address 10.0.4.14/30;
      }
   }
}
user@R3# show protocols ospf
```



```
area 0.0.0.0 {
  interface fe-0/0/1.0;
}
  area 0.0.0.3 {
    network-summary-export export-policy;
    interface fe-1/0/0.0;
    interface fe-1/1/0.0;
  }
```

```
user@R3# show policy-options
policy-statement export-policy {
  term term1 {
    from {
      route-filter 10.0.4.12/30 prefix-length-range /30-/30;
    }
    then accept;
  }
}
```

Output for R4:

```
user@R4# show interfaces
fe-0/0/1 {
  unit 0 {
    family inet {
      address 10.0.2.1/30;
    }
  }
}
fe-1/0/0 {
  unit 0 {
    family inet {
      address 10.0.8.9/30;
    }
  }
}
fe-1/1/0 {
  unit 0 {
    family inet {
      address 10.0.8.6/30;
    }
  }
}
```

```
user@R4# show protocols ospf
area 0.0.0.0 {
  interface fe-0/0/1.0;
}
area 0.0.0.4 {
  interface fe-0/1/0.0;
  interface fe-1/0/0.0;
}
```

Output for R5:

```
user@R5# show interfaces
fe-1/1/0 {
  unit 0 {
```

```
      family inet {
         address 10.0.8.5/30;
      }
   }
}
```

```
user@R5# show protocols ospf
area 0.0.0.4 {
   interface fe-1/1/0.0;
}
```

Output for R6:

```
user@R6# show interfaces
fe-1/0/0 {
   unit 0 {
      family inet {
         address 10.0.8.10/30;
      }
   }
}
```

```
user@R6# show protocols ospf
area 0.0.0.4 {
   interface fe-1/0/0.0;
}
```

To confirm your OSPFv3 configuration, enter the **show interfaces**, **show policy-options**, and **show protocols ospf3** commands on the appropriate device.

Verification

Confirm that the configuration is working properly.

- Verifying the OSPF Database on page 3524
- Verifying the Routing Table on page 3524

Verifying the OSPF Database

Purpose Verify that the OSPF database for the devices in area 4 includes the interarea route that we are advertising from R3. Any other routes from area 3 should not be advertised into area 4, so those entries should age out or no longer be present in the OSPF database.

Action From operational mode, enter the **show ospf database netsummary area 0.0.0.4** command for OSPFv2, and enter the **show ospf3 database inter-area-prefix area 0.0.0.4** command for OSPFv3.

Verifying the Routing Table

Purpose Verify that the specified route is included in R4's, R5's, or R6's routing table. Any other routes from area 3 should not be advertised into area 4.

Action From operational mode, enter the **show route protocol ospf** command for both OSPFv2 and OSPFv3.

Related Documentation

- OSPF Overview on page 3368
- *OSPF Configuration Overview*
- *Routing Policy Match Conditions* in the *Routing Policy Feature Guide for Routing Devices*
- *Actions in Routing Policy Terms* in the *Routing Policy Feature Guide for Routing Devices*

OSPF Monitoring Configuration

Example: Configuring OSPF Trace Options

Tracing OSPF Protocol Traffic

Tracing operations record detailed messages about the operation of OSPF. You can trace OSPF protocol traffic to help debug OSPF protocol issues. When you trace OSPF protocol traffic, you specify the name of the file and the type of information you want to trace.

You can specify the following OSPF protocol-specific trace options:

- **database-description**—All database description packets, which are used in synchronizing the OSPF topological database
- **error**—OSPF error packets
- **event**—OSPF state transitions
- **flooding**—Link-state flooding packets
- **graceful-restart**—Graceful-restart events
- **hello**—Hello packets, which are used to establish neighbor adjacencies and to determine whether neighbors are reachable
- **ldp-synchronization**—Synchronization events between OSPF and LDP
- **lsa-ack**—Link-state acknowledgment packets, which are used in synchronizing the OSPF topological database
- **lsa-analysis**—Link-state analysis. Specific to the Juniper Networks implementation of OSPF, Junos OS performs LSA analysis before running the shortest-path-first (SPF) algorithm. LSA analysis helps to speed the calculations performed by the SPF algorithm.
- **lsa-request**—Link-state request packets, which are used in synchronizing the OSPF topological database
- **lsa-update**—Link-state updates packets, which are used in synchronizing the OSPF topological database
- **nsr-synchronization**—Nonstop routing synchronization events
- **on-demand**—Trace demand circuit extensions

- **packet-dump**—Dump the contents of selected packet types
- **packets**—All OSPF packets
- **restart-signaling**—(OSPFv2 only) Restart-signaling graceful restart events
- **spf**—Shortest path first (SPF) calculations

You can optionally specify one or more of the following flag modifiers:

- **detail**—Detailed trace information
- **receive**—Packets being received
- **send**—Packets being transmitted

NOTE: Use the **detail** flag modifier with caution as it might cause the CPU to become very busy.

Global tracing options are inherited from the configuration set by the **traceoptions** statement at the **[edit routing-options]** hierarchy level. You can override the following global trace options for the OSPF protocol using the **traceoptions flag** statement included at the **[edit protocols ospf]** hierarchy level:

- **all**—All tracing operations
- **general**—All normal operations and routing table changes (a combination of the normal and route trace operations)
- **normal**—Normal events
- **policy**—Policy processing
- **route**—Routing information
- **state**—State transitions
- **task**—Routing protocol task processing
- **timer**—Routing protocol timer processing

NOTE: Use the trace flag **all** with caution as it might cause the CPU to become very busy.

Example: Tracing OSPF Protocol Traffic

This example shows how to trace OSPF protocol traffic.

Requirements

This example assumes that OSPF is properly configured and running in your network, and you want to trace OSPF protocol traffic for debugging purposes.

Overview

You can trace OSPF protocol traffic to help debug OSPF protocol issues. When you trace OSPF protocol traffic, you specify the name of the file and the type of information you want to trace. All files are placed in a directory on the routing device's hard disk. On M Series and T Series routers, trace files are stored in the /var/log directory.

This example shows a few configurations that might be useful when debugging OSPF protocol issues. The verification output displayed is specific to each configuration.

TIP: To keep track of your log files, create a meaningful and descriptive name so it is easy to remember the content of the trace file. We recommend that you place global routing protocol tracing output in the file **routing-log**, and OSPF tracing output in the file **ospf-log**.

In the first example, you globally enable tracing operations for all routing protocols that are actively running on your routing device to the file routing-log. With this configuration, you keep the default settings for the trace file size and the number of trace files. After enabling global tracing operations, you enable tracing operations to provide detailed information about OSPF packets, including link-state advertisements, requests, and updates, database description packets, and hello packets to the file ospf-log, and you configure the following options:

- **size**—Specifies the maximum size of each trace file, in KB, MB, or GB. In this example, you configure 10 KB as the maximum size. When the file reaches its maximum size, it is renamed with a .0 extension. When the file again reaches its maximum size, it is renamed with a .1 extension, and the newly created file is renamed with a .0 extension. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum file size, you must also specify a maximum number of trace files with the **files** option. You specify **k** for KB, **m** for MB, and **g** for GB. By default, the trace file size is 128 KB. The file size range is 10 KB through the maximum file size supported on your system.
- **files**—Specifies the maximum number of trace files. In this example, you configure a maximum of 5 trace files. When a trace file reaches its maximum size, it is renamed with a .0 extension, then a .1 extension, and so on until the maximum number of trace files is reached. When the maximum number of files is reached, the oldest trace file is overwritten. If you specify a maximum number of files, you must also specify a maximum file size with the **size** option. By default, there are 10 files. The range is 2 through 1000 files.

In the second example, you trace all SPF calculations to the file ospf-log by including the **spf** flag. You keep the default settings for the trace file size and the number of trace files.

In the third example, you trace the creation, receipt, and retransmission of all LSAs to the file ospf-log by including the **lsa-request**, **lsa-update**, and **lsa-ack** flags. You keep the default settings for the trace file size and the number of trace files.

Configuration

Configuring Global Tracing Operations and Tracing OSPF Packet Information

CLI Quick Configuration

To quickly enable global tracing operations for all routing protocols actively running on your routing device and to trace detailed information about OSPF packets, copy the following commands and paste them into the CLI.

```
[edit]
set routing-options traceoptions file routing-log
set protocols ospf traceoptions file ospf-log
set protocols ospf traceoptions file files 5 size 10k
set protocols ospf traceoptions flag lsa-ack
set protocols ospf traceoptions flag database-description
set protocols ospf traceoptions flag hello
set protocols ospf traceoptions flag lsa-update
set protocols ospf traceoptions flag lsa-request
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Modifying the Junos OS Configuration* in *CLI User Guide*.

To configure global routing tracing operations and tracing operations for OSPF packets:

1. Configure tracing at the routing options level to collect information about the active routing protocols on your routing device.

   ```
   [edit]
   user@host# edit routing-options traceoptions
   ```

2. Configure the filename for the global trace file.

   ```
   [edit routing-options traceoptions]
   user@host# set file routing-log
   ```

3. Configure the filename for the OSPF trace file.

   NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

   ```
   [edit]
   user@host# edit protocols ospf traceoptions
   user@host# set file ospf-log
   ```

4. Configure the maximum number of trace files.

```
[edit protocols ospf traceoptions]
user@host# set file files 5
```

5. Configure the maximum size of each trace file.

```
[edit protocols ospf traceoptions]
user@host# set file size 10k
```

6. Configure tracing flags.

```
[edit protocols ospf traceoptions]
user@host# set flag lsa-ack
user@host# set flag database-description
user@host# set flag hello
user@host# set flag lsa-update
user@host# set flag lsa-request
```

7. If you are done configuring the device, commit the configuration.

```
[edit protocols ospf traceoptions]
user@host# commit
```

Results Confirm your configuration by entering the **show routing-options** and the **show protocols ospf** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show routing-options
traceoptions {
  file routing-log;
}
```

```
user@host# show protocols ospf
traceoptions {
  file ospf-log size 10k files 5;
  flag lsa-ack;
  flag database-description;
  flag hello;
  flag lsa-update;
  flag lsa-request;
}
```

To confirm your OSPFv3 configuration, enter the **show routing-options** and the **show protocols ospf3** commands.

Tracing SPF Calculations

CLI Quick Configuration To quickly trace SPF calculations, copy the following commands and paste them into the CLI.

```
[edit]
set protocols ospf traceoptions file ospf-log
set protocols ospf traceoptions flag spf
```

Step-by-Step Procedure To configure SPF tracing operations for OSPF:

1. Configure the filename for the OSPF trace file.

NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

```
[edit]
user@host# edit protocols ospf traceoptions
user@host# set file ospf-log
```

2. Configure the SPF tracing flag.

```
[edit protocols ospf traceoptions]
user@host# set flag spf
```

3. If you are done configuring the device, commit the configuration.

```
[edit protocols ospf traceoptions]
user@host# commit
```

Results Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
traceoptions {
  file ospf-log ;
  flag spf;
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Tracing Link-State Advertisements

CLI Quick Configuration To quickly trace the creation, receipt, and retransmission of all LSAs, copy the following commands and paste them into the CLI.

```
[edit]
set protocols ospf traceoptions file ospf-log
set protocols ospf traceoptions flag lsa-request
set protocols ospf traceoptions flag lsa-update
set protocols ospf traceoptions flag lsa-ack
```

Step-by-Step Procedure To configure link-state advertisement tracing operations for OSPF:

1. Configure the filename for the OSPF trace file.

NOTE: To specify OSPFv3, include the **ospf3** statement at the **[edit protocols]** hierarchy level.

```
[edit]
user@host# edit protocols ospf traceoptions
user@host# set file ospf-log
```

2. Configure the link-state advertisement tracing flags.

   [edit protocols ospf traceoptions]
   user@host# **set flag lsa-request**
   user@host# **set flag lsa-update**
   user@host# **set flag lsa-ack**

3. If you are done configuring the device, commit the configuration.

   [edit protocols ospf traceoptions]
   user@host# **commit**

Results Confirm your configuration by entering the **show protocols ospf** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols ospf
traceoptions {
  file ospf-log;
  flag lsa-request;
  flag lsa-update;
  flag lsa-ack;
}
```

To confirm your OSPFv3 configuration, enter the **show protocols ospf3** command.

Verification

Confirm that the configuration is working properly.

Verifying Trace Operations

Purpose Verify that the Trace options field displays the configured trace operations, and verify that the Trace file field displays the location on the routing device where the file is saved, the name of the file to receive the output of the tracing operation, and the size of the file.

Action From operational mode, enter the **show ospf overview extensive** command for OSPFv2, and enter the **show ospf3 overview extensive** command for OSPFv3.

Related Documentation

- OSPF Overview on page 3368
- *OSPF Configuration Overview*
- *Junos OS Tracing and Logging Operations* in the *Junos OS Administration Library for Routing Devices*
- *Example: Tracing Global Routing Protocol Operations* in the *Junos OS Routing Protocols Library for Routing Devices*

Configuration Statements

area

Syntax

```
area area-id {
  interface interface-name {
    passive;
    topology (ipv4-multicast | name) {
      disable;
    }
  }
  virtual-link neighbor-id router-id transit-area area-id {
    topology (ipv4-multicast | name) {
      disable;
    }
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Specify the area identifier for this routing device to use when participating in OSPF routing. All routing devices in an area must use the same area identifier to establish adjacencies.

Specify multiple **area** statements to configure the routing device as an area border router. An area border router does not automatically summarize routes between areas. Use the **area-range** statement to configure route summarization. By definition, an area border router must be connected to the backbone area either through a physical link or through a virtual link. To create a virtual link, include the **virtual-link** statement.

To specify that the routing device is directly connected to the OSPF backbone, include the **area 0.0.0.0** statement.

All routing devices on the backbone must be contiguous. If they are not, use the **virtual-link** statement to create the appearance of connectivity to the backbone.

You can also configure any interface that belongs to one or more topologies to advertise the direct interface addresses without actually running OSPF on that interface. By default, OSPF must be configured on an interface in order for direct interface addresses to be advertised as interior routes.

NOTE: If you configure an interface with the passive statement, it applies to all the topologies to which the interface belongs. You cannot configure an interface as passive for only one specific topology and have it remain active for any other topologies to which it belongs.

Options

area-id—Area identifier. The identifier can be up to 32 bits. It is common to specify the area number as a simple integer or an IP address. Area number **0.0.0.0** is reserved for the OSPF backbone area.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- OSPF Areas and Router Functionality Overview on page 3373
- *Understanding Multiple Address Families for OSPFv3*
- *virtual-link*

area-range

Syntax
area-range *network/mask-length* <exact> <override-metric *metric*> <restrict>;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (ospf | ospf3) area *area-id*],
[edit logical-systems *logical-system-name* protocols (ospf | ospf3) area *area-id* nssa],
[edit logical-systems *logical-system-name* realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3) area *area-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3) area *area-id* nssa],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id*],
[edit protocols (ospf | ospf3) area *area-id*],
[edit protocols (ospf | ospf3) area *area-id* nssa],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id*],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3) area *area-id*],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3) area *area-id* nssa],
[edit routing-instances *routing-instance-name* realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id*]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description
(Area border routers only) For an area, summarize a range of IP addresses when sending summary link advertisements (within an area). To summarize multiple ranges, include multiple **area-range** statements.

For a not-so-stubby area (NSSA), summarize a range of IP addresses when sending NSSA link-state advertisements. The specified prefixes are used to aggregate external routes learned within the area when the routes are advertised to other areas. To specify multiple prefixes, include multiple **area-range** statements. All external routes learned within the area that do not fall into one of the prefixes are advertised individually to other areas.

Default
By default, area border routing devices do not summarize routes being sent from one area to other areas, but rather send all routes explicitly.

Options
exact—(Optional) Summarization of a route is advertised only when an exact match is made with the configured summary range.

mask-length—Number of significant bits in the network mask.

network—IP address. You can specify one or more IP addresses.

override-metric ***metric***—(Optional) Override the metric for the IP address range and configure a specific metric value.

restrict—(Optional) Do not advertise the configured summary. This hides all routes that are contained within the summary, effectively creating a route filter.

Range: 1 through 16,777,215

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Summarizing Ranges of Routes in OSPF Link-State Advertisements on page 3423

authentication (Protocols OSPF)

Syntax

```
authentication {
  md5 key-identifier {
    key key-value;
    start-time YYYY-MM-DD.hh:mm;
  }
  simple-password key;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols ospf area *area-id* interface *interface-name*],
[edit logical-systems *logical-system-name* protocols ospf area *area-id* virtual-link],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf area *area-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf area *area-id* virtual-link],
[edit protocols ospf area *area-id* interface *interface-name*],
[edit protocols ospf area *area-id* virtual-link],
[edit routing-instances *routing-instance-name* protocols ospf area *area-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols ospf area *area-id* virtual-link]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure an authentication key (password). Neighboring routers use the password to verify the authenticity of packets sent from this interface.

All routers that are connected to the same IP subnet must use the same authentication scheme and password.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Understanding OSPFv2 Authentication*
- *Example: Configuring MD5 Authentication for OSPFv2 Exchanges*
- *Example: Configuring a Transition of MD5 Keys on an OSPFv2 Interface*
- *Example: Configuring Simple Authentication for OSPFv2 Exchanges*

context-identifier (Protocols OSPF)

Syntax context-identifer *identifier*

Hierarchy Level [edit logical-systems *logical-system-name* protocols (ospf |ospf3) area *area-id*],
[edit protocols (ospf | ospf3) area *area-id*]

Release Information Statement introduced in Junos OS Release 10.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure OSPF context-identifier information.

Options *identifer*—IPv4 address that defines a protection pair. The context identifier is manually configured on both the primary and protector provider edge (PE) devices.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show ospf context-identifier on page 3586

bfd-liveness-detection (Protocols OSPF)

Syntax

```
bfd-liveness-detection {
  authentication {
    algorithm algorithm-name;
    key-chain key-chain-name;
    loose-check;
  }
  detection-time {
    threshold milliseconds;
  }
  full-neighbors-only
  minimum-interval milliseconds;
  minimum-receive-interval milliseconds;
  multiplier number;
  no-adaptation;
  transmit-interval {
    minimum-interval milliseconds;
    threshold milliseconds;
  }
  version (1 | automatic);
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (ospf | ospf3) area *area-id* interface *interface-name*],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3) area *area-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id* interface *interface-name*],
[edit protocols (ospf | ospf3) area *area-id* interface *interface-name*],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3) area *area-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id* interface *interface-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
detection-time threshold and **transmit-interval threshold** options added in Junos OS Release 8.2.
Support for logical systems introduced in Junos OS Release 8.3.
no-adaptation option introduced in Junos OS Release 9.0.
no-adaptation option introduced in Junos OS Release 9.0 for EX Series switches.
Support for OSPFv3 introduced in Junos OS Release 9.3.
Support for OSPFv3 introduced in Junos OS Release 9.3 for EX Series switches.
full-neighbors-only option introduced in Junos OS Release 9.5.
full-neighbors-only option introduced in Junos OS Release 9.5 for EX Series switches.

authentication algorithm, **authentication key-chain**, and **authentication loose-check** options introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure bidirectional failure detection timers and authentication for OSPF.

The remaining statements are explained separately.

Options

authentication algorithm *algorithm-name* —Configure the algorithm used to authenticate the specified BFD session: **simple-password**, **keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, or **meticulous-keyed-sha-1**.

authentication key-chain *key-chain-name*—Associate a security key with the specified BFD session using the name of the security keychain. The name you specify must match one of the keychains configured in the **authentication-key-chains key-chain** statement at the **[edit security]** hierarchy level.

authentication loose-check—(Optional) Configure loose authentication checking on the BFD session. Use only for transitional periods when authentication may not be configured at both ends of the BFD session.

detection-time threshold *milliseconds*—Configure a threshold for the adaptation of the BFD session detection time. When the detection time adapts to a value equal to or greater than the threshold, a single trap and a single system log message are sent.

full-neighbors-only—Establish BFD sessions only for OSPF neighbors in the full state. The default behavior is to establish BFD sessions for all OSPF neighbors.

minimum-interval *milliseconds*—Configure the minimum interval after which the local routing device transmits a hello packet and then expects to receive a reply from the neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum transmit and receive intervals separately using the **transmit-interval minimum-interval** and **minimum-receive-interval** statements.

Range: 1 through 255,000 milliseconds

minimum-receive-interval *milliseconds*—Configure the minimum interval after which the routing device expects to receive a reply from a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum receive interval using the **minimum-interval** statement.

Range: 1 through 255,000 milliseconds

multiplier *number*—Configure the number of hello packets not received by a neighbor that causes the originating interface to be declared down.

Range: 1 through 255

Default: 3

no-adaptation—Specify that BFD sessions should not adapt to changing network conditions. We recommend that you not disable BFD adaptation unless it is preferable not to have BFD adaptation enabled in your network.

transmit-interval threshold *milliseconds*—Configure the threshold for the adaptation of the BFD session transmit interval. When the transmit interval adapts to a value greater than the threshold, a single trap and a single system message are sent. The interval threshold must be greater than the minimum transmit interval.

Range: 0 through 4,294,967,295 ($2^{32} – 1$)

transmit-interval minimum-interval *milliseconds*—Configure the minimum interval at which the routing device transmits hello packets to a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum transmit interval using the **minimum-interval** statement.

Range: 1 through 255,000

version—Configure the BFD version to detect: **1** (BFD version 1) or **automatic** (autodetect the BFD version).

Default: **automatic**

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BFD for OSPF on page 3454
- Example: Configuring BFD Authentication for OSPF on page 3457

database-protection

Syntax

```
database-protection {
  ignore-count number;
  ignore-time seconds;
  maximum-lsa number;
  reset-time seconds;
  warning-only;
  warning-threshold percent;
}
```

Hierarchy Level

[edit protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-unicast | ipv6-multicast)]

Release Information

Statement introduced in Junos OS Release 10.2.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure the maximum number of link-state advertisements (LSAs) that are not generated by the router or switch in a given OSPF instance.

Default

By default, OSPF database protection is not enabled.

Options

ignore-count *number*—Configure the number of times the database can enter the ignore state. When the ignore count is exceeded, the database enters the isolate state.

Range: 1 through 32

Default: 5

ignore-time *seconds*—Configure the time the database must remain in the ignore state before it resumes regular operations (enters retry state).

Range: 30 through 3,600 seconds

Default: 300 seconds

maximum-lsa *number*—Configure the maximum number of LSAs whose advertising router ID is different from the local router ID in a given OSPF instance. This includes external LSAs as well as LSAs with any scope, such as the link, area, and autonomous system (AS). This value is mandatory.

Range: 1 through 1,000,000

Default: None

reset-time *seconds*—Configure the time period during which the database must operate without being in the ignore or isolate state before it is reset to a normal operating state.

Range: 60 through 86,400 seconds

Default: 600 seconds

warning-only—Specify that only a warning should be issued when the maximum LSA number is exceeded. If configured, no other action is taken against the database.

warning-threshold ***percent***—Configure the percentage of the maximum number of LSAs to be exceeded before a warning message is logged.

Range: 30 through 100 percent

Default: 75 percent

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- OSPF Database Protection Overview on page 3490
- Configuring OSPF Database Protection on page 3491

disable (OSPF)

Syntax disable;

Hierarchy Level [edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols (ospf | ospf3) area *area-id* interface *interface-name*],
[edit logical-systems *logical-system-name* protocols ospf area *area-id* peer-interface*interface-name*],
[edit logical-systems *logical-system-name* protocols (ospf | ospf3) virtual-link],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3) area *area-id* interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3) virtual-link],
[edit logical-systems *logical-system-name* routing-instances *routing-instances* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id* interface *interface-name*],
[edit protocols (ospf | ospf3)],
[edit protocols (ospf | ospf3) area *area-id* interface *interface-name*],
[edit protocols (ospf | ospf3) virtual-link],
[edit protocols ospf area *area-id* peer-interface *interface-name*],
[edit protocols ospf area *area-id* virtual-link neighbor-id *router-id* transit-area *area-id*],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3) area *area-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3) virtual-link],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id* interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Disable OSPF, an OSPF interface, or an OSPF virtual link.

By default, control packets sent to the remote end of a virtual link must be forwarded using the default topology. In addition, the transit area path consists only of links that are in the default topology. You can disable a virtual link for a configured topology, but not for a default topology. Include the **disable** statement at the **[edit protocols ospf area *area-id* virtual-link neighbor-id *router-id* transit-area *area-id* topology *name*]** hierarchy level.

NOTE: If you disable the virtual link by including the **disable** statement at the **[edit protocols ospf area *area-id* virtual-link neighbor-id *router-id* transit-area *area-id*]** hierarchy level, you disable the virtual link for all topologies, including the default topology. You cannot disable the virtual link only in the default topology.

Default The configured object is enabled (operational) unless explicitly disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *OSPF Configuration Overview*
- *Configuring RSVP and OSPF for LMP Peer Interfaces*

export (Protocols OSPF)

Syntax export [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Apply one or more policies to routes being exported from the routing table into OSPF.

Options ***policy-names***—Name of one or more policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding OSPF Routing Policy on page 3492
- Import and Export Policies for Network Summaries Overview on page 3508
- import on page 3551
- *Routing Policy Feature Guide for Routing Devices*

external-preference (Protocols OSPF)

Syntax external-preference *preference*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ip4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast } ipv4-multicast | ipv6-multicast)]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Set the route preference for OSPF external routes.

Options *preference*—Preference value.

Range: 0 through 4,294,967,295 (2^{32} – 1)

Default: 150

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Controlling OSPF Route Preferences on page 3439
- **preference on page 3558**

graceful-restart (Protocols OSPF)

Syntax

```
graceful-restart {
  disable;
  helper-disable (standard | restart-signaling | both);
  no-strict-lsa-checking;
  notify-duration seconds;
  restart-duration seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf]

Release Information

Statement introduced before Junos OS Release 7.4.
Support for the **no-strict-lsa-checking** statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the helper mode **standard**, **restart-signaling**, and **both** options introduced in Junos OS Release 11.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure graceful restart for OSPF.

Graceful restart allows a routing device to restart with minimal effects to the network, and is enabled for all routing protocols at the **[edit routing-options]** hierarchy level.

Options

disable—Disable graceful restart for OSPF.

helper-disable (standard | restart-signaling| both)—Disable helper mode for graceful restart. When helper mode is disabled, a device cannot help a neighboring device that is attempting to restart. Beginning with Junos OS Release 11.4, you can configure restart signaling-based helper mode for OSPFv2 graceful restart configurations. The **standard**, **restart-signaling**, and **both** options are only supported for OSPFv2. Specify **standard** to disable helper mode for standard graceful restart (based on RFC 3623). Specify **restart-signaling** to disable helper mode for restart signaling-based graceful restart (based on RFC 4811, RFC 4812, and RFC 4813). Specify **both** to disable helper mode for both standard and restart signaling-based graceful restart. The last committed statement takes precedence over the previously configured statement.

Default: Helper mode is enabled by default. For OSPFv2, both standard and restart-signaling based helper modes are enabled by default.

no-strict-lsa-checking—Disable strict OSPF link-state advertisement (LSA) checking to prevent the termination of graceful restart by a helping router. LSA checking is enabled by default.

NOTE: The **helper-disable** statement and the **no-strict-lsa-checking** statement cannot be configured at the same time. If you attempt to configure both statements at the same time, the routing device displays a warning message when you enter the **show protocols (ospf | ospf3)** command.

notify-duration ***seconds***—Estimated time needed to send out purged grace LSAs over all the interfaces.

Range: 1 through 3600 seconds

Default: 30 seconds

restart-duration ***seconds***—Estimated time needed to reacquire a full OSPF neighbor from each area.

Range: 1 through 3600 seconds

Default: 180 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Graceful Restart for OSPF on page 3464
- Example: Configuring the Helper Capability Mode for OSPFv2 Graceful Restart on page 3468
- Example: Configuring the Helper Capability Mode for OSPFv3 Graceful Restart on page 3472
- Example: Disabling Strict LSA Checking for OSPF Graceful Restart on page 3475

- *Configuring Graceful Restart for QFabric Systems*
- *Junos OS High Availability Library for Routing Devices*

import (Protocols OSPF)

Syntax import [*policy-names*];

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Filter OSPF routes from being added to the routing table.

Options *policy-names*—Name of one or more policies.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding OSPF Routing Policy on page 3492
- Import and Export Policies for Network Summaries Overview on page 3508
- **export on page 3547**

- *Routing Policy Feature Guide for Routing Devices*

interface (Protocols OSPF)

Syntax

```
interface interface-name {
  disable;
  authentication key <key-id identifier>;
  bfd-liveness-detection {
    authentication {
      algorithm algorithm-name;
      key-chain key-chain-name;
      loose-check;
    }
    detection-time {
      threshold milliseconds;
    }
    minimum-interval milliseconds;
    minimum-receive-interval milliseconds;
    transmit-interval {
      threshold milliseconds;
      minimum-interval milliseconds;
    }
    multiplier number;
  }
  dead-interval seconds;
  demand-circuit;
  hello-interval seconds;
  ipsec-sa name;
  interface-type type;
  ldp-synchronization {
    disable;
    hold-time seconds;
  }
  metric metric;
  neighbor address <eligible>;
  no-interface-state-traps;
  passive;
  poll-interval seconds;
  priority number;
  retransmit-interval seconds;
  te-metric metric;
  topology (ipv4-multicast | name) {
    metric metric;
  }
  transit-delay seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (ospf | ospf3) area *area-id*],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3) area *area-id*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id*],
[edit protocols (ospf | ospf3) area *area-id*],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast) area *area-id*],

[edit routing-instances *routing-instance-name* protocols (ospf | ospf3) area *area-id*],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast |
ipv4-multicast | ipv6-multicast) area *area-id*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **topology** statement introduced in Junos OS Release 9.0.
Support for the **topology** statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Support for the **no-interface-state-traps** statement introduced in Junos OS Release 10.3.
This statement is supported only for OSPFv2.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Enable OSPF routing on a routing device interface.

You must include at least one **interface** statement in the configuration to enable OSPF on the routing device.

Options

interface-name—Name of the interface. Specify the interface by IP address or interface name for OSPFv2, or only the interface name for OSPFv3. Using both the interface name and IP address of the same interface produces an invalid configuration. To configure all interfaces, you can specify **all**. Specifying a particular interface and **all** produces an invalid configuration.

NOTE: For nonbroadcast interfaces, specify the IP address of the nonbroadcast interface as *interface-name*.

The remaining statements are explained separately.

NOTE: You cannot run both OSPF and ethernet-tcc encapsulation between two Juniper Networks routing devices.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *OSPF Configuration Overview*
- *Example: Configuring Multitopology Routing Based on Applications*
- *Example: Configuring Multitopology Routing Based on a Multicast Source*
- *Example: Configuring Multiple Address Families for OSPFv3*
- *neighbor*

no-nssa-abr

Syntax

no-nssa-abr;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)]

Release Information

Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Disable exporting Type 7 link-state advertisements into not-so-stubby-areas (NSSAs) for an autonomous system boundary router (ASBR) or an area border router (ABR).

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring OSPF Not-So-Stubby Areas on page 3396

no-rfc-1583

Syntax no-rfc-1583;

Hierarchy Level [edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Disable compatibility with RFC 1583, *OSPF Version 2*. If the same external destination is advertised by AS boundary routers that belong to different OSPF areas, disabling compatibility with RFC 1583 can prevent routing loops.

Default Compatibility with RFC 1583 is enabled by default.

Required Privilege Level routing—To view this statement in the configuration.
routing-control-level—To add this statement to the configuration.

Related Documentation

- Example: Disabling OSPFv2 Compatibility with RFC 1583 on page 3406

ospf

Syntax

ospf { ... }

Hierarchy Level

[edit logical-systems *logical-system-name* protocols],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols],
[edit protocols],
[edit routing-instances *routing-instance-name* protocols]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Enable OSPF routing on the routing device.

You must include the **ospf** statement to enable OSPF on the routing device.

Default

OSPF is disabled on the routing device.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *OSPF Configuration Overview*
- *[edit protocols ospf] Hierarchy Level*

overload (Protocols OSPF)

Syntax

```
overload {
  timeout seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (oospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf topology (default | ipv4-multicast | *name*)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf topology (default | ipv4-multicast | *name*)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf topology (default | ipv4-multicast | *name*)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf topology (default | ipv4-multicast | *name*],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for Multitopology Routing introduced in Junos OS Release 9.0.
Support for Multitopology Routing introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure the local routing device so that it appears to be overloaded. You might do this when you want the routing device to participate in OSPF routing, but do not want it to be used for transit traffic.

NOTE: **Traffic destined to directly attached interfaces continues to reach the routing device.**

Options

timeout ***seconds***—(Optional) Number of seconds at which the overloading is reset. If no timeout interval is specified, the routing device remains in overload state until the **overload** statement is deleted or a timeout is set.

Range: 60 through 1800 seconds

Default: 0 seconds

NOTE: Multitopology Routing does not support the timeout option.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring OSPF to Make Routing Devices Appear Overloaded on page 3442
- *Example: Configuring Multitopology Routing Based on Applications*
- *Example: Configuring Multitopology Routing Based on a Multicast Source*

preference (Protocols OSPF)

Syntax
preference *preference*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description
Set the route preference for OSPF internal routes.

Options
preference—Preference value.

Range: 0 through 4,294,967,295 ($2^{32} – 1$)

Default: 10

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Controlling OSPF Route Preferences on page 3439
- **external-preference on page 3548**

prefix-export-limit (Protocols OSPF)

Syntax prefix-export-limit *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf topology (default | ipv4-multicast | *name*)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf topology (default | ipv4-multicast | *name*)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf topology (default | ipv4-multicast | *name*)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf topology (default | ipv4-multicast | *name*)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for Multitopology Routing introduced in Junos OS Release 9.0.
Support for Multitopology Routing introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure a limit to the number of prefixes exported into OSPF.

Options *number*—Prefix limit.

Range: 0 through 4,294,967,295 (2^{32} – 1)

Default: None

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Limiting the Number of Prefixes Exported to OSPF on page 3428
- *Example: Configuring Multitopology Routing Based on Applications*
- *Example: Configuring Multitopology Routing Based on a Multicast Source*

reference-bandwidth (Protocols OSPF)

Syntax reference-bandwidth *reference-bandwidth*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Set the reference bandwidth used in calculating the default interface cost. The cost is calculated using the following formula:

cost = ref-bandwidth/bandwidth

Options *reference-bandwidth*—Reference bandwidth, in bits per second.

Range: 9600 through 1,000,000,000,000 bits

Default: 100 Mbps (100,000,000 bits)

NOTE: The default behavior is to use the reference-bandwidth value to calculate the cost of OSPF interfaces. You can override this behavior for any OSPF interface by configuring a specific cost with the metric statement.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Controlling the Cost of Individual OSPF Network Segments on page 3433
- *metric*

rib-group (Protocols OSPF)

Syntax

rib-group *group-name*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Install routes learned from OSPF routing instances into routing tables in the OSPF routing table group.

Options

group-name—Name of the routing table group.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Exporting Specific Routes from One Routing Table Into Another Routing Table*
- *Example: Importing Direct and Static Routes Into a Routing Instance*
- *Understanding Multiprotocol BGP*
- interface-routes on page 2382
- rib-group on page 2421

topology (OSPF)

Syntax

```
topology (default | ipv4-multicast | name) {
  spf-options {
    delay milliseconds;
    holddown milliseconds;
    rapid-runs number;
  }
  topology-id number;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols ospf],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf],
[edit protocols ospf],
[edit routing-instances *routing-instance-name* protocols ospf]

Release Information

Statement introduced in Junos OS Release 9.0.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Enable a topology for OSPF multitopology routing. You must first configure one or more topologies under the **[edit routing-options]** hierarchy level.

Options

default—Name of the default topology. This topology is automatically created, and all routes that correspond to it are automatically added to the **inet.0** routing table. You can modify certain default parameters, such as for the SPF algorithm.

ipv4-multicast—Name of the topology for IPv4 multicast traffic.

name—Name of a topology you configured at the **[edit routing-options]** hierarchy level to create a topology for a specific type of traffic, such as voice or video.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Multitopology Routing Based on Applications*
- *Example: Configuring Multitopology Routing Based on a Multicast Source*

traceoptions (Protocols OSPF)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit protocols (ospf | ospf3)],
[edit protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)],
[edit routing-instances *routing-instance-name* protocols (ospf | ospf3)],
[edit routing-instances *routing-instance-name* protocols ospf3 realm (ipv4-unicast | ipv4-multicast | ipv6-multicast)]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the **realm** statement introduced in Junos OS Release 9.2.
Support for the **realm** statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure OSPF protocol-level tracing options.

To specify more than one tracing operation, include multiple **flag** statements.

NOTE: The traceoptions statement is not supported on QFabric systems.

Default

The default OSPF protocol-level tracing options are those inherited from the routing protocols **traceoptions** statement included at the **[edit routing-options]** hierarchy level.

Options

disable—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *filename*—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. We recommend that you place OSPF tracing output in the file **ospf-log**.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten.

If you specify a maximum number of files, you also must specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 10 files

flag ***flag***—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

OSPF Tracing Flags

- **database-description**—Database description packets, which are used in synchronizing the OSPF and OSPFv3 topological database.
- **error**—OSPF and OSPFv3 error packets.
- **event**—OSPF and OSPFv3 state transitions.
- **flooding**—Link-state flooding packets.
- **graceful-restart**—Graceful-restart events.
- **hello**—Hello packets, which are used to establish neighbor adjacencies and to determine whether neighbors are reachable.
- **ldp-synchronization**—Synchronization events between OSPF and LDP.
- **lsa-ack**—Link-state acknowledgment packets, which are used in synchronizing the OSPF topological database.
- **lsa-analysis**—Link-state analysis. Specific to the Juniper Networks implementation of OSPF, Junos OS performs LSA analysis before running the shortest-path-first (SPF) algorithm. LSA analysis helps to speed the calculations performed by the SPF algorithm.
- **lsa-request**—Link-state request packets, which are used in synchronizing the OSPF topological database.
- **lsa-update**—Link-state updates packets, which are used in synchronizing the OSPF topological database.
- **nsr-synchronization**—Nonstop routing synchronization events.
- **on-demand**—Trace demand circuit extensions.
- **packet-dump**—Content of selected packet types.
- **packets**—All OSPF packets.
- **restart-signaling**—(OSPFv2 only) Restart-signaling graceful restart events.
- **spf**—Shortest-path-first (SPF) calculations.

Global Tracing Flags

- **all**—All tracing operations.
- **general**—A combination of the **normal** and **route** trace operations.
- **normal**—All normal operations. If you do not specify this option, only unusual or abnormal operations are traced.
- **policy**—Policy operations and actions.
- **route**—Routing table changes.
- **state**—State transitions.
- **task**—Routing protocol task processing.
- **timer**—Routing protocol timer processing.

flag-modifier—(Optional) Modifier for the tracing flag. You can specify one or more of these modifiers:

- **detail**—Detailed trace information.
- **receive**—Packets being received.
- **send**—Packets being transmitted.

no-world-readable—(Optional) Prevent any user from reading the log file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten.
If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 128 KB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation

- Example: Tracing OSPF Protocol Traffic on page 3526

traffic-engineering (OSPF)

Syntax

```
traffic-engineering {
  <advertise-unnumbered-interfaces>;
  <credibility-protocol-preference>;
  ignore-lsp-metrics;
  multicast-rpf-routes;
  no-topology;
  shortcuts {
    lsp-metric-into-summary;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols (ospf | ospf3)],
[edit protocols (ospf | ospf3)]

Release Information

Statement introduced before Junos OS Release 7.4.
multicast-rpf-routes option introduced in Junos OS Release 7.5.
advertise-unnumbered-interfaces option introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for OSPFv3 (**ospf3**) introduced in Junos OS Release 9.4.
Support for OSPFv3 (**ospf3**) introduced in Junos OS Release 9.4 for EX Series switches.
credibility-protocol-preference statement introduced in Junos OS Release 9.4.
credibility-protocol-preference statement introduced in Junos OS Release 9.4 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Enable the OSPF traffic engineering features.

Default

Traffic engineering support is disabled.

Options

advertise-unnumbered-interfaces—(Optional) (OSPFv2 only) Include the link-local identifier in the link-local traffic-engineering link-state advertisement. This statement must be included on both ends of an unnumbered link to allow an ingress LER to update the link in its traffic engineering database and use it for CSPF calculations. The link-local identifier is then used by RSVP to signal unnumbered interfaces as defined in RFC 3477.

credibility-protocol-preference—(Optional) (OSPFv2 only) Use the configured preference value for OSPF routes to calculate the traffic engineering database credibility value used to select IGP routes. Use this statement to override the default behavior, in which the traffic engineering database prefers IS-IS routes even if OSPF routes are configured with a lower, that is, preferred, preference value. For example, OSPF routes have a default preference value of 10, whereas IS-IS Level 1 routes have a default preference value of 15. When protocol preference is enabled, the credibility value is determined by deducting the protocol preference value from a base value of 512. Using default protocol preference values, OSPF has a credibility value of 502, whereas IS-IS has a credibility value of 497. Because the traffic engineering database prefers IGP routes with the highest credibility value, OSPF routes are now preferred.

multicast-rpf-routes—(Optional) (OSPFv2 only) Install routes for multicast RPF checks into the **inet.2** routing table. The **inet.2** routing table consists of unicast routes used for multicast RPF lookup. RPF is an antispoofing mechanism used to check whether the packet is coming in on an interface that is also sending data back to the packet source.

NOTE: You must enable OSPF traffic engineering shortcuts to use the **multicast-rpf-routes** statement. You must not allow LSP advertisements into OSPF when configuring the **multicast-rpf-routes** statement.

no-topology—(Optional) (OSPFv2 only) Disable the dissemination of the link-state topology information.

The remaining statements are explained separately.

CAUTION: When the OSPF traffic engineering configuration is considerably modified, the routing table entries are deleted and the routing table is recreated. Changes to configuration that can cause this behavior include enabling or disabling:

- Traffic engineering shortcuts
- IGP shortcuts
- LDP tunneling
- Multiprotocol LSP
- Advertise summary metrics
- Multicast RPF routes

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Enabling OSPF Traffic Engineering Support on page 3481

CHAPTER 39

Administration

Routine Monitoring

Monitoring OSPF Routing Information

Purpose Use the monitoring functionality to monitor OSPF routing information on routing devices.

Action To view OSPF routing information in the CLI, enter the following CLI commands:

- **show ospf neighbor**
- **show ospf interface**
- **show ospf statistics**

Related Documentation

- **show (ospf | ospf3) interface on page 3596**
- **clear (ospf | ospf3) neighbor on page 3576**
- **show (ospf | ospf3) statistics on page 3624**

Operational Commands

- clear (ospf | ospf3) database
- clear (ospf | ospf3) database-protection
- clear (ospf | ospf3) io-statistics
- clear (ospf | ospf3) neighbor
- clear (ospf | ospf3) statistics
- clear (ospf | ospf3) overload
- show (ospf | ospf3) backup coverage
- show (ospf | ospf3) backup neighbor

- show ospf context-identifier
- show ospf database
- show (ospf | ospf3) interface
- show (ospf | ospf3) io-statistics
- show (ospf | ospf3) log
- show (ospf | ospf3) neighbor
- show (ospf | ospf3) overview
- show (ospf | ospf3) route
- show (ospf | ospf3) statistics

clear (ospf | ospf3) database

Syntax

clear (ospf | ospf3) database
<advertising-router (*router-id* | self)>
<area *area-id*>
<asbrsummary>
<external>
<instance *instance-name*>
<inter-area-prefix>
<inter-area-router>
<intra-area-prefix>
<link-local>
<logical-system (all | *logical-system-name*)>
<lsa-id *lsa-id*>
<netsummary>
<network>
<nssa>
<opaque-area>
<purge>
<realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)>
<router>

Syntax (EX Series Switch and QFX Series)

clear (ospf | ospf3) database
<advertising-router (*router-id* | self)>
<area *area-id*>
<asbrsummary>
<external>
<instance *instance-name*>
<inter-area-prefix>
<inter-area-router>
<intra-area-prefix>
<link-local>
<lsa-id *lsa-id*>
<netsummary>
<network>
<nssa>
<opaque-area>
<purge>
<router>

Release Information

Command introduced before Junos OS Release 7.4.
advertising-router *router-id*, **netsummary**, **network**, **nssa**, **opaque-area**, and **router** options added in Junos OS Release 8.3. You must use the **purge** command with these options.
area *area-id* option added in Junos OS Release 8.3.
Command introduced in Junos OS Release 9.0 for EX Series switches.
realm option added in Junos OS Release 9.2.
advertising-router (***router-id*** | **self**) option added in Junos OS Release 9.5.
advertising-router (***router-id*** | **self**) option introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

With the master Routing Engine, delete entries in the Open Shortest Path First (OSPF) link-state advertisement (LSA) database. With the backup Routing Engine, delete the

OSPF LSA database and sync the new database with the master Routing Engine. You can also use the **purge** command with any of the options to discard rather than delete the specified LSA entries.

CAUTION: **This command is useful only for testing. Use it with care, because it causes significant network disruption.**

Options

none—Delete all LSAs other than the system's own LSAs, which are regenerated. To resynchronize the database, the system destroys all adjacent neighbors that are in the state **EXSTART** or higher. The neighbors are then reacquired and the databases are synchronized.

advertising-router (*router-id* | self)—(Optional) Discard entries for the LSA entries advertised by the specified routing device or by this routing device.

area *area-id*—(Optional) Discard entries for the LSAs in the specified area.

asbrsummary—(Optional) Discard summary AS boundary router LSA entries.

external—(Optional) Discard external LSAs.

instance *instance-name*—(Optional) Delete or discard entries for the specified routing instance only.

inter-area-prefix—(OSPFv3 only) (Optional) Discard interarea prefix LSAs.

inter-area-router—(OSPFv3 only) (Optional) Discard interarea router LSAs.

intra-area-prefix—(OSPFv3 only) (Optional) Discard intra-area prefix LSAs.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

link-local—(Optional) Delete link-local LSAs.

lsa-id *lsa-id*—(Optional) Discard the LSA entries with the specified LSA identifier.

netsummary—(Optional) Discard summary network LSAs.

network—(Optional) Discard network LSAs.

nssa—(Optional) Discard not-so-stubby area (NSSA) LSAs.

opaque-area—(Optional) Discard opaque area-scope LSAs.

realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)—(OSPFv3 only) (Optional) Delete the entries for the specified OSPFv3 realm, or address family. Use the **realm** option to specify an address family for OSPFv3 other than IPv6 unicast, which is the default.

router—(Optional) Discard router LSAs.

purge—(Optional) Discard all entries in the link-state advertisement database. All link-state advertisements are set to **MAXAGE** and are flooded. The database is repopulated when the originators of the link-state advertisements receive the **MAXAGE** link-state advertisements and reissue them.

Required Privilege Level

clear

Related Documentation

- show ospf database on page 3588
- *show ospf3 database*

List of Sample Output

clear ospf database on page 3573

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear ospf database

```
user@host> clear ospf database
```

clear (ospf | ospf3) database-protection

Syntax

clear (ospf | ospf3) database-protection
<instance *instance-name*>

Release Information

Command introduced in Junos OS Release 10.2.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Clear the Open Shortest Path First (OSPF) link-state database from its isolated state. Reset the ignore count, ignore timer, and reset timer, and resume normal operations.

Options

instance ***instance-name***—(Optional) Clear the OSPF link-state database for the specified routing instance only.

Required Privilege Level

clear

Output Fields

This command produces no output.

Sample Output

clear ospf database-protection

```
user@host> clear ospf database-protection
```

clear (ospf | ospf3) io-statistics

Syntax clear (ospf | osfp3) io-statistics
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and QFX Series) clear (ospf | osfp3) io-statistics

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description Clear Open Shortest Path First (OSPF) input and output statistics.

Options **none**—Clear OSPF input and output statistics.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level clear

List of Sample Output clear ospf io-statistics on page 3575

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear ospf io-statistics

`user@host>` **clear ospf io-statistics**

clear (ospf | ospf3) neighbor

Syntax

clear (ospf | ospf3) neighbor
<area *area-id*>
<instance *instance-name*>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>
<neighbor>
<realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)>

Syntax (EX Series Switch and QFX Series)

clear (ospf | ospf3) neighbor
<area *area-id*>
<instance *instance-name*>
<interface *interface-name*>
<neighbor>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
realm option introduced in Junos OS Release 9.2.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Tear down Open Shortest Path First (OSPF) neighbor connections.

Options

none—Tear down OSPF connections with all neighbors for all routing instances.

area ***area-id***—(Optional) Tear down neighbor connections for the specified area only.

instance ***instance-name***—(Optional) Tear down neighbor connections for the specified routing instance only.

interface ***interface-name***—(Optional) Tear down neighbor connections for the specified interface only.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

neighbor—(Optional) Clear the state of the specified neighbor only.

realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)—(Optional) (OSPFv3 only) Clear the state of the specified OSPFv3 realm, or address family. Use the **realm** option to specify an address family for OSPFv3 other than IPv6 unicast, which is the default.

Required Privilege Level

clear

Related Documentation

- show (ospf | ospf3) neighbor on page 3607

List of Sample Output

clear ospf neighbor on page 3577

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear ospf neighbor

`user@host>` **clear ospf neighbor**

clear (ospf | ospf3) statistics

Syntax

clear (ospf | osfp3) statistics
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)>

Syntax (EX Series Switch and QFX Series)

clear (ospf | osfp3) statistics
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
realm option introduced in Junos OS Release 9.2.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Clear Open Shortest Path First (OSPF) statistics.

Options

none—Clear OSPF statistics.

instance ***instance-name***—(Optional) Clear statistics for the specified routing instance only.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)—(Optional) (OSPFv3 only) Clear statistics for the specified OSPFv3 realm, or address family. Use the **realm** option to specify an address family for OSPFv3 other than IPv6 unicast, which is the default.

Required Privilege Level

clear

Related Documentation

- show (ospf | ospf3) statistics on page 3624

List of Sample Output

clear ospf statistics on page 3578

Output Fields

See show (ospf | ospf3) statistics for an explanation of output fields.

Sample Output

clear ospf statistics

The following sample output displays OSPF statistics before and after the **clear ospf statistics** command is entered:

```
user@host> show ospf statistics

Packet type             Total                   Last 5 seconds
                     Sent        Received       Sent        Received
   Hello             3254            2268          3               1
     DbD               41              46          0               0
```



```
   LSReq             8             7           0             0
LSUpdate           212           154           0             0
   LSAck            65            98           0             0

DBDs retransmitted     :                     3, last 5 seconds :          0
LSAs flooded           :                    12, last 5 seconds :          0
LSAs flooded high-prio :                     0, last 5 seconds :          0
LSAs retransmitted     :                     0, last 5 seconds :          0
LSAs transmitted to nbr:                     3, last 5 seconds :          0
LSAs requested         :                     5, last 5 seconds :          0
LSAs acknowledged      :                    19, last 5 seconds :          0

Flood queue depth      :                0
Total rexmit entries   :                0
db summaries           :                0
lsreq entries          :                0

Receive errors:
  626 subnet mismatches
```

```
user@host> clear ospf statistics
```

```
user@host> show ospf statistics
Packet type            Total                  Last 5 seconds
                   Sent       Received        Sent       Received
   Hello             3             1           3             1
     DbD             0             0           0             0
   LSReq             0             0           0             0
LSUpdate             0             0           0             0
   LSAck             0             0           0             0

DBDs retransmitted     :                     0, last 5 seconds :          0
LSAs flooded           :                     0, last 5 seconds :          0
LSAs flooded high-prio :                     0, last 5 seconds :          0
LSAs retransmitted     :                     0, last 5 seconds :          0
LSAs transmitted to nbr:                     0, last 5 seconds :          0
LSAs requested         :                     0, last 5 seconds :          0
LSAs acknowledged      :                     0, last 5 seconds :          0

Flood queue depth      :                0
Total rexmit entries   :                0
db summaries           :                0
lsreq entries          :                0

Receive errors:
  None
```


clear (ospf | ospf3) overload

Syntax

clear (ospf | ospf3) overload
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

clear (ospf | ospf3) overload
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Clear the Open Shortest Path First (OSPF) overload bit and rebuild link-state advertisements (LSAs).

Options

none—Clear the overload bit and rebuild LSAs for all routing instances.

instance *instance-name*—(Optional) Clear the overload bit and rebuild LSAs for the specified routing instance only.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

clear

List of Sample Output

clear ospf overload on page 3580

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear ospf overload

user@host> **clear ospf overload**

show (ospf | ospf3) backup coverage

Syntax

show (ospf | ospf3) backup coverage
<instance *instance-name*>
< logical-system (all | *logical-system-name*)>
<realm (ipv4-unicast | ipv46-unicast>
<topology *topology-name*>

Syntax (QFX Series)

show (ospf | ospf3) backup coverage
<instance *instance-name*>
<topology *topology-name*>

Release Information

Command introduced in Junos OS Release 10.0.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display information about the level of backup coverage available for all the nodes and prefixes in the network.

Options

none—Display information about the level backup coverage for all OSPF routing instances in all logical systems.

logical-system (all | *logical-system-name*)—(Optional) Display information about the level of backup coverage for all logical systems or for a specific logical system.

instance *instance-name*—(Optional) Display information about the level of backup coverage for a specific OSPF routing instance.

realm (ipv4-unicast | ipv6-unicast)—(Optional) (OSPFv3 only) Display information about the level of backup coverage for the specific OSPFv3 realm, or address family.

topology (default | *topology-name*)—(Optional) (OSPFv2 only) Display information about the level of backup coverage for the specific OSPF topology.

Required Privilege Level

view

Related Documentation

- *show (ospf | ospf3) backup lsp*

List of Sample Output

show ospf backup coverage on page 3582
show ospf3 backup coverage on page 3582

Output Fields

Table 251 on page 3581 lists the output fields for the **show (ospf | ospf3) backup coverage** command. Output fields are listed in the approximate order in which they appear.

Table 251: show (ospf | ospf3) backup coverage Output Fields

Field Name	Field Description
Node Coverage	Information about backup coverage for each OSPF node.
Area	Area number. Area **0.0.0.0** is the backbone.

Table 251: show (ospf | ospf3) backup coverage Output Fields *(continued)*

Field Name	Field Description
Covered Nodes	Number of nodes for which backup coverage is available.
Total Nodes	Total number of OSPF nodes.
Route Coverage	Information about backup coverage for each type of OSPF route.
Path Type	Type of OSPF path: **Intra**, **Inter**, **Ext1**, **Ext2**, and **All**.
Covered Routes	For each path type, the number of routes for which backup coverage is available.
Total Routes	For each path type, the total number of configured routes.
Percent Covered	For all nodes and for each path type, the percentage for which backup coverage is available.

Sample Output

show ospf backup coverage

```
user@host> show ospf backup coverage
Topology default coverage:

Node Coverage:

Area                Covered  Total  Percent
                      Nodes  Nodes  Covered
0.0.0.0                   4      5   80.00%

Route Coverage:

Path Type  Covered   Total  Percent
            Routes  Routes  Covered
Intra            8      14   57.14%
Inter            0       0  100.00%
Ext1             0       0  100.00%
Ext2             1       1  100.00%
All              9      15   60.00%
```

show ospf3 backup coverage

```
user @host > show ospf3 backup coverage
show ospf3 backup coverage
Node Coverage:

Area                Covered  Total  Percent
                      Nodes  Nodes  Covered
0.0.0.0                   4      5   80.00%

Route Coverage:

Path Type  Covered   Total  Percent
            Routes  Routes  Covered
```

```
Intra           4       6   66.67%
Inter           0       0  100.00%
Ext1            0       0  100.00%
Ext2            1       1  100.00%
All             5       7   71.43%
```

show (ospf | ospf3) backup neighbor

Syntax

show (ospf | ospf3) backup neighbor
<**area** *area-id*>
<**instance (default |** *instance-name***)**>
<**logical-system (default | ipv4-multicast |** *logical-system-name***)**>
<**topology (default | ipv4-multicast |** *topology-name***)**>

Syntax (QFX Series)

show (ospf | ospf3) backup neighbor
<**area** *area-id*>
<**instance** *instance-name*>
<**topology (default | ipv4-multicast |** *topology-name***)**>

Release Information

Command introduced in Junos OS Release 10.0.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display the neighbors through which direct next hops for the backup paths are available.

Options

none—Display all neighbors that have direct next hops for backup paths.

area *area-id*—(Optional) Display the area information.

instance (default | *instance-name***)**—(Optional) Display information about the default routing instance or a particular routing instance.

logical-system (default | ipv4-multicast | *logical-system-name***)**—(Optional) Display information about the default logical system, IPv4 multicast logical system, or a particular logical system.

topology (default | ipv4-multicast | *topology-name***)**—(OSPFv2 only) (Optional) Display information about the default topology, IPv4 multicast topology, or a particular topology.

Required Privilege Level

view

Related Documentation

- *show (ospf | ospf3) backup spf*

List of Sample Output

show ospf backup neighbor on page 3585

Output Fields

Table 252 on page 3584 lists the output fields for the **show (ospf |ospf3) backup neighbor** command. Output fields are listed in the approximate order in which they appear.

Table 252: show (ospf |ospf3) backup neighbor Output Fields

Field Name	Field Description	Level of Output
Neighbor to Self Metric	Metric from the backup neighbor to the OSPF node.	All levels
Self to Neighbor Metric	Metric from the OSPF node to the backup neighbor.	All levels

Table 252: show (ospf |ospf3) backup neighbor Output Fields *(continued)*

Field Name	Field Description	Level of Output
Direct next-hop	Interface and address of the direct next hop.	All levels

Sample Output

show ospf backup neighbor

```
user@host> show ospf backup neighbor
Topology default backup neighbors:

Area 0.0.0.5 backup neighbors:

10.0.0.5
  Neighbor to Self Metric: 5
  Self to Neighbor Metric: 5
  Direct next-hop: ge-4/0/0.111 via 10.0.175.5

10.0.0.6
  Neighbor to Self Metric: 5
  Self to Neighbor Metric: 5
  Direct next-hop: ge-4/1/0.110 via 10.0.176.6
```


show ospf context-identifier

Syntax

show ospf context-identifier
<brief | detail>
<area *area-id*>
<context-id>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series)

show ospf context-identifier
<brief | detail>
<area *area-id*>
<context-id>
<instance *instance-name*>

Release Information

Command introduced in Junos OS Release 10.4.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display the context identifier information processed and advertised by Open Shortest Path First (OSPF) for egress protection.

Options

none—Display information about all context identifiers.

brief | detail—(Optional) Display the specified level of output.

area *area-id*—(Optional) Display information about the context identifier for the specified area.

context-id—(Optional) Display information about the specified context identifier.

instance *instance-name*—(Optional) Display information about the context identifier for the specified routing instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- *egress-protection (Layer 2 circuit)* in the *Junos OS VPNs Library for Routing Devices*
- *egress-protection (MPLS)* in the *Junos OS VPNs Library for Routing Devices*

List of Sample Output

show ospf context-identifier on page 3587
show ospf context-identifier detail on page 3587

Output Fields

Table 253 on page 3587 lists the output fields for the **show ospf context-identifier** command. Output fields are listed in the approximate order in which they appear.

Table 253: show ospf context-identifier Output Fields

Field Name	Field Description	Level of Output
Context	IPv4 address that defines a protection pair. The context is manually configured on both primary and protector provider edge (PE) devices.	All levels
Status	State of the path: **active** or **inactive**.	All levels
Metric	Advertised OSPF metric.	All levels
Area	OSPF area number.	All levels
Other Advertisements	Other advertisements received by the OSPF node: • **Advertising router**– Address of the device that sent the advertisement. • **Type**–Type of OSPF path: **inter-area** and **stub**. • **Metric**–Advertised OSPF metric. • **None**–No additional advertisements were received by the OSPF node.	**detail**

Sample Output

show ospf context-identifier

```
user@host> show ospf context-identifier
Context-id: 2.2.4.3
  Status: active, Metric: 65534, PE role: protector, Area: 0.0.0.0
```

show ospf context-identifier detail

```
user@host> show ospf context-identifier detail
Context-id: 88.24.13.1
                Status: inactive, Metric: 0, PE role: protector, Area: 0.0.0.13
                Other Advertisements:
                  Advertising router: 8.8.8.103
                    Type: stub link
                    Metric: 65534
```

show ospf database

Syntax

show ospf database
<brief | detail | extensive | summary>
<advertising-router (*address* | self)>
<area *area-id*>
<asbrsummary>
<external>
<instance *instance-name*>
<link-local>
<logical-system (all | *logical-system-name*)>
<lsa-id *lsa-id*>
<netsummary>
<network>
<nssa>
<opaque-area>
<router>

Syntax (EX Series Switches and QFX Series)

show ospf database
<brief | detail | extensive | summary>
<advertising-router (*address* | self)>
<area *area-id*>
<asbrsummary>
<external>
<instance *instance-name*>
<link-local>
<lsa-id *lsa-id*>
<netsummary>
<network>
<nssa>
<opaque-area>
<router>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
advertising-router self (***address*** | **self**) option introduced in Junos OS Release 9.5.
advertising-router self (***address*** | **self**) option introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display the entries in the OSPF version 2 (OSPFv2) link-state database, which contains data about link-state advertisement (LSA) packets.

Options

none—Display standard information about entries in the OSPFv2 link-state database for all routing instances.

brief | detail | extensive | summary—(Optional) Display the specified level of output.

advertising-router (*address* | self)—(Optional) Display the LSAs advertised either by a particular routing device or by this routing device.

area *area-id*—(Optional) Display the LSAs in a particular area.

asbrsummary—(Optional) Display summary AS boundary router LSA entries.

external—(Optional) Display external LSAs.

instance *instance-name*—(Optional) Display all OSPF database information under the named routing instance.

link-local—(Optional) Display information about link-local LSAs.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

lsa-id *lsa-id*—(Optional) Display the LSA with the specified LSA identifier.

netsummary—(Optional) Display summary network LSAs.

network—(Optional) Display information about network LSAs.

nssa—(Optional) Display information about not-so-stubby area (NSSA) LSAs.

opaque-area—(Optional) Display opaque area-scope LSAs.

router—(Optional) Display information about router LSAs.

Required Privilege Level view

Related Documentation

- clear (ospf | ospf3) database on page 3571

List of Sample Output

show ospf database on page 3591
show ospf database brief on page 3591
show ospf database detail on page 3591
show ospf database extensive on page 3593
show ospf database summary on page 3595

Output Fields Table 254 on page 3589 describes the output fields for the **show ospf database** command. Output fields are listed in the approximate order in which they appear.

Table 254: show ospf database Output Fields

Field Name	Field Description	Level of Output
area	Area number. Area **0.0.0.0** is the backbone area.	All levels
Type	Type of link advertisement: **ASBRSum**, **Extern**, **Network**, **NSSA**, **OpaqArea**, **Router**, or **Summary**.	All levels
ID	LSA identifier included in the advertisement. An asterisk preceding the identifier marks database entries that originated from the local routing device.	All levels
Adv Rtr	Address of the routing device that sent the advertisement.	All levels
Seq	Link sequence number of the advertisement.	All levels

Table 254: show ospf database Output Fields *(continued)*

Field Name	Field Description	Level of Output
Age	Time elapsed since the LSA was originated, in seconds.	All levels
Opt	Optional OSPF capabilities associated with the LSA.	All levels
Cksum	Checksum value of the LSA.	All levels
Len	Length of the advertisement, in bytes.	All levels
Router	Router link-state advertisement information: • **bits**—Flags describing the routing device that generated the LSP. • **link count**—Number of links in the advertisement. • **id**—ID of a routing device or subnet on the link. • **data**—For stub networks, the subnet mask. Otherwise, the IP address of the routing device that generated the LSP. • **type**—Type of link. It can be **PointToPoint**, **Transit**, **Stub**, or **Virtual**. • **TOS count**—Number of type-of-service (ToS) entries in the advertisement. • **TOS 0 metric**—Metric for ToS 0. • **TOS**—Type-of-service (ToS) value. • **metric**—Metric for the ToS.	**detail extensive**
Network	Network link-state advertisement information: • **mask**—Network mask. • **attached router**—ID of the attached neighbor.	**detail extensive**
Summary	Summary link-state advertisement information: • **mask**—Network mask. • **TOS**—Type-of-service (ToS) value. • **metric**—Metric for the ToS.	**detail extensive**
Gen timer	How long until the LSA is regenerated.	**extensive**
Aging timer	How long until the LSA expires.	**extensive**
Installed *hh:mm:ss* ago	How long ago the route was installed.	**extensive**
expires in *hh:mm:ss*	How long until the route expires.	**extensive**
sent *hh:mm:ss* ago	How long ago the LSA was sent.	**extensive**
Last changed *hh:mm:ss* ago	How long ago the route was changed.	**extensive**
Change count	Number of times the route has changed.	**extensive**

Table 254: show ospf database Output Fields *(continued)*

Field Name	Field Description	Level of Output
Ours	Indicates that this is a local advertisement.	extensive
Router LSAs	Number of router link-state advertisements in the link-state database.	summary
Network LSAs	Number of network link-state advertisements in the link-state database.	summary
Summary LSAs	Number of summary link-state advertisements in the link-state database.	summary
NSSA LSAs	Number of not-so-stubby area link-state advertisements in the link-state database.	summary

Sample Output

show ospf database

```
user@host> show ospf database
OSPF link state database, Area 0.0.0.1
 Type       ID               Adv Rtr           Seq      Age  Opt  Cksum  Len
Router   10.255.70.103    10.255.70.103    0x80000002   215  0x20 0x4112  48
Router  *10.255.71.242    10.255.71.242    0x80000002   214  0x20 0x11b1  48
Summary *23.1.1.0         10.255.71.242    0x80000002   172  0x20 0x6d72  28
Summary *24.1.1.0         10.255.71.242    0x80000002   177  0x20 0x607e  28
NSSA    *33.1.1.1         10.255.71.242    0x80000002   217  0x28 0x73bd  36

    OSPF link state database, Area 0.0.0.2
 Type       ID               Adv Rtr           Seq      Age  Opt  Cksum  Len
Router   10.255.71.52     10.255.71.52     0x80000004   174  0x20 0xd021  36
Router  *10.255.71.242    10.255.71.242    0x80000003   173  0x20 0xe191  36
Network *23.1.1.1         10.255.71.242    0x80000002   173  0x20 0x9c76  32
Summary *12.1.1.0         10.255.71.242    0x80000001   217  0x20 0xfeec  28
Summary *24.1.1.0         10.255.71.242    0x80000002   177  0x20 0x607e  28
NSSA    *33.1.1.1         10.255.71.242    0x80000001   222  0x28 0xe047  36

    OSPF link state database, Area 0.0.0.3
 Type       ID               Adv Rtr           Seq      Age  Opt  Cksum  Len
Router   10.255.71.238    10.255.71.238    0x80000003   179  0x20 0x3942  36
Router  *10.255.71.242    10.255.71.242    0x80000003   177  0x20 0xf37d  36
Network *24.1.1.1         10.255.71.242    0x80000002   177  0x20 0xc591  32
Summary *12.1.1.0         10.255.71.242    0x80000001   217  0x20 0xfeec  28
Summary *23.1.1.0         10.255.71.242    0x80000002   172  0x20 0x6d72  28
NSSA    *33.1.1.1         10.255.71.242    0x80000001   222  0x28 0xeb3b  36
```

show ospf database brief

The output for the **show ospf database brief** command is identical to that for the **show ospf database** command. For sample output, see show ospf database on page 3591.

show ospf database detail

```
user@host> show ospf database detail
    OSPF link state database, Area 0.0.0.1
 Type       ID               Adv Rtr           Seq      Age  Opt  Cksum  Len
Router   10.255.70.103    10.255.70.103    0x80000002   261  0x20 0x4112  48
```



```
  bits 0x0, link count 2
  id 10.255.71.242, data 12.1.1.1, Type PointToPoint (1)
  TOS count 0, TOS 0 metric 1
  id 12.1.1.0, data 255.255.255.0, Type Stub (3)
  TOS count 0, TOS 0 metric 1
Router  *10.255.71.242    10.255.71.242    0x80000002   260  0x20 0x11b1  48
  bits 0x3, link count 2
  id 10.255.70.103, data 12.1.1.2, Type PointToPoint (1)
  TOS count 0, TOS 0 metric 1
  id 12.1.1.0, data 255.255.255.0, Type Stub (3)
  TOS count 0, TOS 0 metric 1
Summary *23.1.1.0         10.255.71.242    0x80000002   218  0x20 0x6d72  28
  mask 255.255.255.0
  TOS 0x0, metric 1
Summary *24.1.1.0         10.255.71.242    0x80000002   223  0x20 0x607e  28
  mask 255.255.255.0
  TOS 0x0, metric 1
NSSA    *33.1.1.1         10.255.71.242    0x80000002   263  0x28 0x73bd  36
  mask 255.255.255.255
  Type 2, TOS 0x0, metric 0, fwd addr 12.1.1.2, tag 0.0.0.0

    OSPF link state database, Area 0.0.0.2
 Type       ID               Adv Rtr           Seq      Age  Opt  Cksum  Len
Router   10.255.71.52     10.255.71.52     0x80000004   220  0x20 0xd021  36
  bits 0x0, link count 1
  id 23.1.1.1, data 23.1.1.2, Type Transit (2)
  TOS count 0, TOS 0 metric 1
Router  *10.255.71.242    10.255.71.242    0x80000003   219  0x20 0xe191  36
  bits 0x3, link count 1
  id 23.1.1.1, data 23.1.1.1, Type Transit (2)
  TOS count 0, TOS 0 metric 1
Network *23.1.1.1         10.255.71.242    0x80000002   219  0x20 0x9c76  32
  mask 255.255.255.0
  attached router 10.255.71.242
  attached router 10.255.71.52
Summary *12.1.1.0         10.255.71.242    0x80000001   263  0x20 0xfeec  28
  mask 255.255.255.0
  TOS 0x0, metric 1
Summary *24.1.1.0         10.255.71.242    0x80000002   223  0x20 0x607e  28
  mask 255.255.255.0
  TOS 0x0, metric 1
NSSA    *33.1.1.1         10.255.71.242    0x80000001   268  0x28 0xe047  36
  mask 255.255.255.255
  Type 2, TOS 0x0, metric 0, fwd addr 23.1.1.1, tag 0.0.0.0

    OSPF link state database, Area 0.0.0.3
 Type       ID               Adv Rtr           Seq      Age  Opt  Cksum  Len
Router   10.255.71.238    10.255.71.238    0x80000003   225  0x20 0x3942  36
  bits 0x0, link count 1
  id 24.1.1.1, data 24.1.1.2, Type Transit (2)
  TOS count 0, TOS 0 metric 1
Router  *10.255.71.242    10.255.71.242    0x80000003   223  0x20 0xf37d  36
  bits 0x3, link count 1
  id 24.1.1.1, data 24.1.1.1, Type Transit (2)
  TOS count 0, TOS 0 metric 1
Network *24.1.1.1         10.255.71.242    0x80000002   223  0x20 0xc591  32
  mask 255.255.255.0
  attached router 10.255.71.242
  attached router 10.255.71.238
Summary *12.1.1.0         10.255.71.242    0x80000001   263  0x20 0xfeec  28
  mask 255.255.255.0
```



```
  TOS 0x0, metric 1
Summary *23.1.1.0        10.255.71.242    0x80000002   218  0x20 0x6d72  28
  mask 255.255.255.0
  TOS 0x0, metric 1
NSSA    *33.1.1.1        10.255.71.242    0x80000001   268  0x28 0xeb3b  36
  mask 255.255.255.255
  Type 2, TOS 0x0, metric 0, fwd addr 24.1.1.1, tag 0.0.0.0
```

show ospf database extensive

```
user@host> show ospf database extensive
    OSPF link state database, Area 0.0.0.1
 Type       ID               Adv Rtr           Seq      Age  Opt  Cksum  Len
Router   10.255.70.103    10.255.70.103    0x80000002   286  0x20 0x4112  48
  bits 0x0, link count 2
  id 10.255.71.242, data 12.1.1.1, Type PointToPoint (1)
  TOS count 0, TOS 0 metric 1
  id 12.1.1.0, data 255.255.255.0, Type Stub (3)
  TOS count 0, TOS 0 metric 1
  Aging timer 00:55:14
  Installed 00:04:43 ago, expires in 00:55:14
  Last changed 00:04:43 ago, Change count: 2
Router  *10.255.71.242    10.255.71.242    0x80000002   285  0x20 0x11b1  48
  bits 0x3, link count 2
  id 10.255.70.103, data 12.1.1.2, Type PointToPoint (1)
  TOS count 0, TOS 0 metric 1
  id 12.1.1.0, data 255.255.255.0, Type Stub (3)
  TOS count 0, TOS 0 metric 1
  Gen timer 00:45:15
  Aging timer 00:55:15
  Installed 00:04:45 ago, expires in 00:55:15, sent 00:04:43 ago
  Last changed 00:04:45 ago, Change count: 2, Ours
Summary *23.1.1.0        10.255.71.242    0x80000002   243  0x20 0x6d72  28
  mask 255.255.255.0
  TOS 0x0, metric 1
  Gen timer 00:45:57
  Aging timer 00:55:57
  Installed 00:04:03 ago, expires in 00:55:57, sent 00:04:01 ago
  Last changed 00:04:48 ago, Change count: 1, Ours
Summary *24.1.1.0        10.255.71.242    0x80000002   248  0x20 0x607e  28
  mask 255.255.255.0
  TOS 0x0, metric 1
  Gen timer 00:45:52
  Aging timer 00:55:52
  Installed 00:04:08 ago, expires in 00:55:52, sent 00:04:06 ago
  Last changed 00:04:48 ago, Change count: 1, Ours
NSSA    *33.1.1.1        10.255.71.242    0x80000002   288  0x28 0x73bd  36
  mask 255.255.255.255
  Type 2, TOS 0x0, metric 0, fwd addr 12.1.1.2, tag 0.0.0.0
  Gen timer 00:45:12
  Aging timer 00:55:12
  Installed 00:04:48 ago, expires in 00:55:12, sent 00:04:48 ago
  Last changed 00:04:48 ago, Change count: 2, Ours

    OSPF link state database, Area 0.0.0.2
 Type       ID               Adv Rtr           Seq      Age  Opt  Cksum  Len
Router   10.255.71.52     10.255.71.52     0x80000004   245  0x20 0xd021  36
  bits 0x0, link count 1
  id 23.1.1.1, data 23.1.1.2, Type Transit (2)
  TOS count 0, TOS 0 metric 1
  Aging timer 00:55:55
```

```
  Installed 00:04:02 ago, expires in 00:55:55
  Last changed 00:04:02 ago, Change count: 2
Router  *10.255.71.242    10.255.71.242    0x80000003   244  0x20 0xe191  36
  bits 0x3, link count 1
  id 23.1.1.1, data 23.1.1.1, Type Transit (2)
  TOS count 0, TOS 0 metric 1
  Gen timer 00:45:56
  Aging timer 00:55:56
  Installed 00:04:04 ago, expires in 00:55:56, sent 00:04:02 ago
  Last changed 00:04:04 ago, Change count: 2, Ours
Network *23.1.1.1         10.255.71.242    0x80000002   244  0x20 0x9c76  32
  mask 255.255.255.0
  attached router 10.255.71.242
  attached router 10.255.71.52
  Gen timer 00:45:56
  Aging timer 00:55:56
  Installed 00:04:04 ago, expires in 00:55:56, sent 00:04:02 ago
  Last changed 00:04:04 ago, Change count: 1, Ours
Summary *12.1.1.0         10.255.71.242    0x80000001   288  0x20 0xfeec  28
  mask 255.255.255.0
  TOS 0x0, metric 1
  Gen timer 00:45:12
  Aging timer 00:55:12
  Installed 00:04:48 ago, expires in 00:55:12, sent 00:04:04 ago
  Last changed 00:04:48 ago, Change count: 1, Ours
Summary *24.1.1.0         10.255.71.242    0x80000002   248  0x20 0x607e  28
  mask 255.255.255.0
  TOS 0x0, metric 1
  Gen timer 00:45:52
  Aging timer 00:55:52
  Installed 00:04:08 ago, expires in 00:55:52, sent 00:04:04 ago
  Last changed 00:04:48 ago, Change count: 1, Ours
NSSA    *33.1.1.1         10.255.71.242    0x80000001   293  0x28 0xe047  36
  mask 255.255.255.255
  Type 2, TOS 0x0, metric 0, fwd addr 23.1.1.1, tag 0.0.0.0
  Gen timer 00:45:07
  Aging timer 00:55:07
  Installed 00:04:53 ago, expires in 00:55:07, sent 00:04:04 ago
  Last changed 00:04:53 ago, Change count: 1, Ours

    OSPF link state database, Area 0.0.0.3
 Type       ID               Adv Rtr           Seq      Age  Opt  Cksum  Len
Router   10.255.71.238    10.255.71.238    0x80000003   250  0x20 0x3942  36
  bits 0x0, link count 1
  id 24.1.1.1, data 24.1.1.2, Type Transit (2)
  TOS count 0, TOS 0 metric 1
  Aging timer 00:55:50
  Installed 00:04:07 ago, expires in 00:55:50
  Last changed 00:04:07 ago, Change count: 2
Router  *10.255.71.242    10.255.71.242    0x80000003   248  0x20 0xf37d  36
  bits 0x3, link count 1
  id 24.1.1.1, data 24.1.1.1, Type Transit (2)
  TOS count 0, TOS 0 metric 1
  Gen timer 00:45:52
  Aging timer 00:55:52
  Installed 00:04:08 ago, expires in 00:55:52, sent 00:04:06 ago
  Last changed 00:04:08 ago, Change count: 2, Ours
Network *24.1.1.1         10.255.71.242    0x80000002   248  0x20 0xc591  32
  mask 255.255.255.0
  attached router 10.255.71.242
  attached router 10.255.71.238
```



```
  Gen timer 00:45:52
  Aging timer 00:55:52
  Installed 00:04:08 ago, expires in 00:55:52, sent 00:04:06 ago
  Last changed 00:04:08 ago, Change count: 1, Ours
Summary *12.1.1.0         10.255.71.242    0x80000001   288  0x20 0xfeec  28
  mask 255.255.255.0
  TOS 0x0, metric 1
  Gen timer 00:45:12
  Aging timer 00:55:12
  Installed 00:04:48 ago, expires in 00:55:12, sent 00:04:13 ago
  Last changed 00:04:48 ago, Change count: 1, Ours
Summary *23.1.1.0         10.255.71.242    0x80000002   243  0x20 0x6d72  28
  mask 255.255.255.0
  TOS 0x0, metric 1
  Gen timer 00:45:57
  Aging timer 00:55:57
  Installed 00:04:03 ago, expires in 00:55:57, sent 00:04:01 ago
  Last changed 00:04:48 ago, Change count: 1, Ours
NSSA    *33.1.1.1         10.255.71.242    0x80000001   293  0x28 0xeb3b  36
  mask 255.255.255.255
  Type 2, TOS 0x0, metric 0, fwd addr 24.1.1.1, tag 0.0.0.0
  Gen timer 00:45:07
  Aging timer 00:55:07
  Installed 00:04:53 ago, expires in 00:55:07, sent 00:04:13 ago
  Last changed 00:04:53 ago, Change count: 1, Ours
```

show ospf database summary

```
user@host> show ospf database summary
Area 0.0.0.1:
   2 Router LSAs
   2 Summary LSAs
   1 NSSA LSAs
Area 0.0.0.2:
   2 Router LSAs
   1 Network LSAs
   2 Summary LSAs
   1 NSSA LSAs
Area 0.0.0.3:
   2 Router LSAs
   1 Network LSAs
   2 Summary LSAs
   1 NSSA LSAs
Externals:
Interface fe-2/2/1.0:
Interface ge-0/3/2.0:
Interface so-0/1/2.0:
Interface so-0/1/2.0:
```

show (ospf | ospf3) interface

Syntax

show (ospf | ospf3) interface
<brief | detail | extensive>
<area *area-id*>
<*interface-name*>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<realm (ip4-multicast | ipv4-unicast | ipv6-multicast)>

Syntax (EX Series Switches and QFX Series)

show (ospf | ospf3) interface
<brief | detail | extensive>
<area *area-id*>
<*interface-name*>
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
area option introduced in Junos OS Release 9.2.
area option introduced in Junos OS Release 9.2 for EX Series switches.
realm option introduced in Junos OS Release 9.2.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display the status of OSPF interfaces.

Options

none—Display standard information about the status of all OSPF interfaces for all routing instances

brief | detail | extensive—(Optional) Display the specified level of output.

area ***area-id***—(Optional) Display information about the interfaces that belong to the specified area.

interface-name—(Optional) Display information for the specified interface.

instance ***instance-name***—(Optional) Display all OSPF interfaces under the named routing instance.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)—(OSPFv3 only) (Optional) Display information about the interfaces for the specified OSPFv3 realm, or address family. Use the **realm** option to specify an address family for OSPFv3 other than IPv6 unicast, which is the default.

Required Privilege Level

view

List of Sample Output

show ospf interface brief on page 3599
show ospf interface detail on page 3599
show ospf3 interface detail on page 3599

show ospf interface detail(When Multiarea Adjacency Is Configured) on page 3599
show ospf interface area area-id on page 3600
show ospf interface extensive (When Flooding Reduction Is Enabled) on page 3601
show ospf interface extensive (When LDP Synchronization Is Configured) on page 3601

Output Fields Table 255 on page 3597 lists the output fields for the **show (ospf | ospf3) interface** command. Output fields are listed in the approximate order in which they appear.

Table 255: show (ospf | ospf3) interface Output Fields

Field Name	Field Description	Level of Output
Interface	Name of the interface running OSPF version 2 or OSPF version 3.	All levels
State	State of the interface: **BDR**, **Down**, **DR**, **DRother**, **Loop**, **PtToPt**, or **Waiting**.	All levels
Area	Number of the area that the interface is in.	All levels
DR ID	Address of the area's designated router.	All levels
BDR ID	Backup designated router for a particular subnet.	All levels
Nbrs	Number of neighbors on this interface.	All levels
Type	Type of interface: **LAN**, **NBMA**, **P2MP**, **P2P**, or **Virtual**.	**detail extensive**
Address	IP address of the neighbor.	**detail extensive**
Mask	Netmask of the neighbor.	**detail extensive**
Prefix-length	(OSPFv3) IPv6 prefix length, in bits.	**detail extensive**
OSPF3-Intf-Index	(OSPFv3) OSPF version 3 interface index.	**detail extensive**
MTU	Interface maximum transmission unit (MTU).	**detail extensive**
Cost	Interface cost (metric).	**detail extensive**
DR addr	Address of the designated router.	**detail extensive**
BDR addr	Address of the backup designated router.	**detail extensive**
Adj count	Number of adjacent neighbors.	**detail extensive**
Secondary	Indicates that this interface is configured as a secondary interface for this area. This interface can belong to more than one area, but can be designated as a primary interface for only one area.	**detail extensive**
Flood Reduction	Indicates that this interface is configured with flooding reduction. All self-originated LSAs from this interface are initially sent with the **DoNotAge** bit set. As a result, LSAs are refreshed only when a change occurs.	**extensive**

Table 255: show (ospf | ospf3) interface Output Fields *(continued)*

Field Name	Field Description	Level of Output
Priority	Router priority used in designated router (DR) election on this interface.	**detail extensive**
Flood list	List of link-state advertisements (LSAs) that might be about to flood this interface.	**extensive**
Ack list	Acknowledgment list. List of pending acknowledgments on this interface.	**extensive**
Descriptor list	List of packet descriptors.	**extensive**
Hello	Configured value for the hello timer.	**detail extensive**
Dead	Configured value for the dead timer.	**detail extensive**
Auth type	(OSPFv2) Authentication mechanism for sending and receiving OSPF protocol packets: • **MD5**—The MD5 mechanism is configured in accordance with RFC 2328. • **None**—No authentication method is configured. • **Password**—A simple password (RFC 2328) is configured.	**detail extensive**
Topology	(Multiarea adjacency) Name of topology: **default** or ***name***.	
LDP sync state	(OSPFv2 and LDP synchronization) Current state of LDP synchronization: **in sync**, **in holddown**, and **not supported**.	**extensive**
reason	(OSPFv2 and LDP synchronization) Reason for the current state of LDP synchronization. The LDP session might be up or down, or adjacency might be up or down.	**extensive**
config holdtime	(OSPFv2 and LDP synchronization) Configured value of the hold timer. If the state is not synchronized, and the hold time is not infinity, the **remaining** field displays the number of seconds that remain until the configured hold timer expires.	**extensive**
IPSec SA name	(OSPFv2) Name of the IPSec security association name.	**detail extensive**
Active key ID	(OSPFv2 and MD5) Number from **0** to **255** that uniquely identifies an MD5 key.	**detail extensive**
Start time	(OSPFv2 and MD5) Time at which the routing device starts using an MD5 key to authenticate OSPF packets transmitted on the interface on which this key is configured. To authenticate received OSPF protocol packets, the key becomes effective immediately after the configuration is committed. If the start time option is not configured, the key is effective immediately for send and receive and is displayed as **Start time 1970 Jan 01 00:00:00 PST.**	**detail extensive**
ReXmit	Configured value for the Retransmit timer.	**detail extensive**
Stub, **Not Stub**, or **Stub NSSA**	Type of area.	**detail extensive**

Sample Output

show ospf interface brief

```
user@host> show ospf interface brief
Intf                State     Area            DR ID           BDR ID          Nbrs
at-5/1/0.0          PtToPt   0.0.0.0         0.0.0.0         0.0.0.0            1
ge-2/3/0.0          DR       0.0.0.0         192.168.4.16    192.168.4.15       1
lo0.0               DR       0.0.0.0         192.168.4.16    0.0.0.0            0
so-0/0/0.0          Down     0.0.0.0         0.0.0.0         0.0.0.0            0
so-6/0/1.0          PtToPt   0.0.0.0         0.0.0.0         0.0.0.0            1
so-6/0/2.0          Down     0.0.0.0         0.0.0.0         0.0.0.0            0
so-6/0/3.0          PtToPt   0.0.0.0         0.0.0.0         0.0.0.0            1
```

show ospf interface detail

```
user@host> show ospf interface detail
Interface              State     Area            DR ID           BDR ID Nbrs
fe-0/0/1.0             BDR      0.0.0.0         192.168.37.12   10.255.245.215 1
Type LAN, address 192.168.37.11, Mask 255.255.255.248, MTU 4460, Cost 40
DR addr 192.168.37.12, BDR addr 192.168.37.11, Adj count 1, Priority 128
Hello 10, Dead 40, ReXmit 5, Not Stub
t1-0/2/1.0             PtToPt   0.0.0.0         0.0.0.0         0.0.0.0 0
Type P2P, Address 0.0.0.0, Mask 0.0.0.0, MTU 1500, Cost 2604
  Adj count 0
Hello 10, Dead 40, ReXmit 5, Not Stub
Auth type: MD5, Active key ID 3, Start time 2002 Nov 19 10:00:00 PST
IPsec SA Name: sa
```

show ospf3 interface detail

```
user@host> show ospf3 interface so-0/0/3.0 detail
Interface              State     Area            DR-ID         BDR-ID      Nbrs
so-0/0/3.0             PtToPt   0.0.0.0         0.0.0.0       0.0.0.0         1
Address fe80::2a0:a5ff:fe28:1dfc, Prefix-length 64
OSPF3-Intf-index 1, Type P2P, MTU 4470, Cost 12, Adj-count 1
Hello 10, Dead 40, ReXmit 5, Not Stub
```

show ospf interface detail (When Multiarea Adjacency Is Configured)

```
user@host> show ospf interface detail
regress@router> show ospf interface detail
Interface           State    Area            DR ID           BDR ID           Nbrs
lo0.0               DR       0.0.0.0         10.255.245.2    0.0.0.0             0

  Type: LAN, Address: 127.0.0.1, Mask: 255.255.255.255, MTU: 65535, Cost: 0
  DR addr: 127.0.0.1, Adj count: 0, Priority: 128
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  Topology default (ID 0) -> Cost: 0
lo0.0               DR       0.0.0.0         10.255.245.2    0.0.0.0             0

  Type: LAN, Address: 10.255.245.2, Mask: 255.255.255.255, MTU: 65535, Cost: 0
  DR addr: 10.255.245.2, Adj count: 0, Priority: 128
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  Topology default (ID 0) -> Cost: 0
so-0/0/0.0          PtToPt   0.0.0.0         0.0.0.0         0.0.0.0             1

  Type: P2P, Address: 0.0.0.0, Mask: 0.0.0.0, MTU: 4470, Cost: 1
```

```
  Adj count: 1
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  Topology default (ID 0) -> Cost: 1
so-0/0/0.0          PtToPt  0.0.0.0        0.0.0.0        0.0.0.0            0

  Type: P2P, Address: 192.168.37.46, Mask: 255.255.255.254, MTU: 4470, Cost: 1
  Adj count: 0, , Passive
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  Topology default (ID 0) -> Passive, Cost: 1
so-1/0/0.0          PtToPt  0.0.0.0        0.0.0.0        0.0.0.0            1

  Type: P2P, Address: 0.0.0.0, Mask: 0.0.0.0, MTU: 4470, Cost: 1
  Adj count: 1
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  Topology default (ID 0) -> Cost: 1
so-1/0/0.0          PtToPt  0.0.0.0        0.0.0.0        0.0.0.0            0

  Type: P2P, Address: 192.168.37.54, Mask: 255.255.255.254, MTU: 4470, Cost: 1
  Adj count: 0, , Passive
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  Topology default (ID 0) -> Passive, Cost: 1
so-0/0/0.0          PtToPt  1.1.1.1        0.0.0.0        0.0.0.0            1

  Type: P2P, Address: 0.0.0.0, Mask: 0.0.0.0, MTU: 4470, Cost: 1
  Adj count: 1, Secondary
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  Topology default (ID 0) -> Cost: 1
so-1/0/0.0          PtToPt  1.1.1.1        0.0.0.0        0.0.0.0            1

  Type: P2P, Address: 0.0.0.0, Mask: 0.0.0.0, MTU: 4470, Cost: 1
  Adj count: 1, Secondary
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  Topology default (ID 0) -> Cost: 1
so-0/0/0.0          PtToPt  2.2.2.2        0.0.0.0        0.0.0.0            1

  Type: P2P, Address: 0.0.0.0, Mask: 0.0.0.0, MTU: 4470, Cost: 1
  Adj count: 1, Secondary
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  Topology default (ID 0) -> Cost: 1
so-1/0/0.0          PtToPt  2.2.2.2        0.0.0.0        0.0.0.0            1

  Type: P2P, Address: 0.0.0.0, Mask: 0.0.0.0, MTU: 4470, Cost: 1
  Adj count: 1, Secondary
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  Topology default (ID 0) -> Cost: 1
```

show ospf interface area area-id

```
user@host> show ospf interface area 1.1.1.1
Interface           State   Area           DR ID          BDR ID          Nbrs
so-0/0/0.0          PtToPt  1.1.1.1        0.0.0.0        0.0.0.0            1
so-1/0/0.0          PtToPt  1.1.1.1        0.0.0.0        0.0.0.0            1
```


show ospf interface extensive (When Flooding Reduction Is Enabled)

```
user@host> show ospf interface extensive
Interface           State   Area            DR ID           BDR ID          Nbrs
fe-0/0/0.0          PtToPt  0.0.0.0         0.0.0.0         0.0.0.0            0

  Type: P2P, Address: 10.10.10.1, Mask: 255.255.255.0, MTU: 1500, Cost: 1
  Adj count: 0
  Secondary, Flood Reduction
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  Topology default (ID 0) -> Cost: 1
```

show ospf interface extensive (When LDP Synchronization Is Configured)

```
user@host> show ospf interface extensive
Interface               State     Area            DR ID           BDR ID
Nbrs
so-1/0/3.0              Down     0.0.0.0         0.0.0.0         0.0.0.0
0
  Type: P2P, Address: 0.0.0.0, Mask: 0.0.0.0, MTU: 4470, Cost: 65535
  Adj count: 0
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: None
  LDP sync state: in holddown, for: 00:00:08, reason: LDP down during config
           config holdtime: 10 seconds, remaining: 1
```

show (ospf | ospf3) io-statistics

Syntax

show (ospf | ospf3) io-statistics
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and QFX Series)

show (ospf | ospf3) io-statistics

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display Open Shortest Path First (OSPF) input and output statistics.

Options

none—Display OSPF input and output statistics.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- clear (ospf | ospf3) statistics on page 3578

List of Sample Output

show ospf io-statistics on page 3602

Output Fields

Table 256 on page 3602 lists the output fields for the **show ospf io-statistics** command. Output fields are listed in the approximate order in which they appear.

Table 256: show (ospf | ospf3) io-statistics Output Fields

Field Name	Field Description
Packets read	Number of OSPF packets read since the last time the routing protocol was started.
average per run	Total number of packets divided by the total number of times the OSPF read operation is scheduled to run.
max run	Maximum number of packets for a given run among all scheduled runs.
Receive errors	Number of faulty packets received with errors.

Sample Output

show ospf io-statistics

```
user@host> show ospf io-statistics

Packets read: 7361, average per run: 1.00, max run: 1
```

```
Receive errors:
  None
```

show (ospf | ospf3) log

Syntax

show (ospf | osfp3) log
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)>
<topology *topology-name*>

Syntax (EX Series Switch and QFX Series)

show (ospf | osfp3) log
<instance *instance-name*>
<topology *topology-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
topology option introduced in Junos OS Release 9.0.
topology option introduced in Junos OS Release 9.0 for EX Series switches.
realm option introduced in Junos OS Release 9.2.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display the entries in the Open Shortest Path First (OSPF) log of SPF calculations.

Options

none—Display entries in the OSPF log of SPF calculations for all routing instances.

instance *instance-name*—(Optional) Display entries for the specified routing instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

topology *topology-name*—(Optional) (OSPFv2 only) Display entries for the specified topology.

realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)—(OSPFv3 only) (Optional) Display entries for the specified OSPFv3 realm, or address family. Use the **realm** option to specify an address family for OSPFv3 other than IPv6 unicast, which is the default.

Required Privilege Level

view

List of Sample Output

show ospf log on page 3605
show ospf log topology voice on page 3605

Output Fields

Table 257 on page 3604 lists the output fields for the **show (ospf | ospf3) log** command. Output fields are listed in the approximate order in which they appear.

Table 257: show (ospf | ospf3) log Output Fields

Field Name	Field Description
When	Time, in weeks (**w**) and days (**d**), since the SPF calculation was made.

Table 257: show (ospf | ospf3) log Output Fields *(continued)*

Field Name	Field Description
Type	Type of calculation: **Cleanup**, **External**, **Interarea**, **NSSA**, **Redist**, **SPF**, **Stub**, **Total**, or **Virtuallink**.
Elapsed	Amount of time, in seconds, that elapsed during the operation, or the time required to complete the SPF calculation. The start time is the time displayed in the **When** field.

Sample Output

show ospf log

```
user@host> show ospf log
When             Type            Elapsed

1w4d 17:25:58    Stub            0.000017
1w4d 17:25:58    SPF             0.000070
1w4d 17:25:58    Stub            0.000019
1w4d 17:25:58    Interarea       0.000054
1w4d 17:25:58    External        0.000005
1w4d 17:25:58    Cleanup         0.000203
1w4d 17:25:58      Total         0.000537
1w4d 17:24:48    SPF             0.000125
1w4d 17:24:48    Stub            0.000017
1w4d 17:24:48    SPF             0.000100
1w4d 17:24:48    Stub            0.000016
1w4d 17:24:48    Interarea       0.000056
1w4d 17:24:48    External        0.000005
1w4d 17:24:48    Cleanup         0.000238
1w4d 17:24:48      Total         0.000600
...
```

show ospf log topology voice

```
user@host> show ospf log topology voice
Topology voice SPF log:

   Last instance of each event type
When             Type            Elapsed
00:06:11         SPF             0.000116
00:06:11         Stub            0.000114
00:06:11         Interarea       0.000126
00:06:11         External        0.000067
00:06:11         NSSA            0.000037
00:06:11         Cleanup         0.000186

   Maximum length of each event type
When             Type            Elapsed
00:13:43         SPF             0.000140
00:13:33         Stub            0.000116
00:13:43         Interarea       0.000128
00:13:33         External        0.000075
00:13:38         NSSA            0.000039
00:13:53         Cleanup         0.000657

   Last 100 events
```

```
When            Type            Elapsed

00:13:53        SPF             0.000090
00:13:53        Stub            0.000041
00:13:53        Interarea       0.000123
00:13:53        External        0.000040
00:13:53        NSSA            0.000038
00:13:53        Cleanup         0.000657
00:13:53          Total         0.001252
.
.
00:06:11        SPF             0.000116
00:06:11        Stub            0.000114
00:06:11        Interarea       0.000126
00:06:11        External        0.000067
00:06:11        NSSA            0.000037
00:06:11        Cleanup         0.000186
00:06:11          Total         0.000818
```


show (ospf | ospf3) neighbor

Syntax

show (ospf | ospf3) neighbor
<brief | detail | extensive>
<area *area-id*>
<instance (all | *instance-name*)>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>
<*neighbor*>
<realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)>

Syntax (EX Series Switches and QFX Series)

show (ospf | ospf3) neighbor
<brief | detail | extensive>
<area *area-id*>
<instance (all | *instance-name*)>
<interface *interface-name*>
<*neighbor*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
instance all option introduced in Junos OS Release 9.1.
instance all option introduced in Junos OS Release 9.1 for EX Series switches.
area, **interface**, and **realm** options introduced in Junos OS Release 9.2.
area and **interface** options introduced in Junos OS Release 9.2 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display information about OSPF neighbors.

CPU utilization might increase while the device learns its OSPF neighbors. We recommend that you use the **show (ospf | ospf3) neighbor** command after the device learns and establishes OSPF neighbor adjacencies. Depending on the size of your network, this might take several minutes. If you receive a “timeout communicating with routing daemon” error when using the **show (ospf | ospf3) neighbor** command, wait several minutes before attempting to use the command again. This is not a critical system error, but you might experience a delay in using the CLI.

Options

none—Display standard information about all OSPF neighbors for all routing instances.

brief | detail | extensive—(Optional) Display the specified level of output.

area ***area-id***—(Optional) Display information about the OSPF neighbors for the specified area.

instance (all | ***instance-name*****)**—(Optional) Display all OSPF interfaces for all routing instances or under the named routing instance.

interface ***interface-name***—(Optional) Display information about OSPF neighbors for the specified logical interface.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

neighbor—(Optional) Display information about the specified OSPF neighbor.

realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)—(OSPFv3 only) (Optional) Display information about the OSPF neighbors for the specified OSPFv3 realm, or address family. Use the **realm** option to specify an address family for OSPFv3 other than IPv6 unicast, which is the default.

Required Privilege Level view

Related Documentation

- clear (ospf | ospf3) neighbor on page 3576

List of Sample Output

show ospf neighbor brief on page 3610
show ospf neighbor detail on page 3610
show ospf neighbor extensive on page 3611
show ospf3 neighbor detail on page 3612
show ospf neighbor area area-id on page 3612
show ospf neighbor interface interface-name on page 3612
show ospf3 neighbor instance all (OSPFv3 Multiple Family Address Support Enabled) on page 3612

Output Fields Table 258 on page 3608 lists the output fields for the **show (ospf | ospf3) neighbor** command. Output fields are listed in the approximate order in which they appear.

Table 258: show (ospf | ospf3) neighbor Output Fields

Field Name	Field Description	Level of Output
Address	Address of the neighbor.	All levels
Interface	Interface through which the neighbor is reachable.	All levels

Table 258: show (ospf | ospf3) neighbor Output Fields *(continued)*

Field Name	Field Description	Level of Output
State	State of the neighbor: • **Attempt**—Valid only for neighbors attached to nonbroadcast networks. It indicates that no recent information has been received from the neighbor, but that a more concerted effort must be made to contact the neighbor. • **Down**—Initial state of a neighbor conversation. It indicates that no recent information has been received from the neighbor. Hello packets might continue to be sent to neighbors in the **Down** state, although at a reduced frequency. • **Exchange**—Routing device is describing its entire link-state database by sending database description packets to the neighbor. Each packet has a sequence number and is explicitly acknowledged. • **ExStart**—First step in creating an adjacency between the two neighboring routing devices. The goal of this step is to determine which routing device is the master, and to determine the initial sequence number. • **Full**—Neighboring routing devices are fully adjacent. These adjacencies appear in router link and network link advertisements. • **Init**—A hello packet has recently been sent by the neighbor. However, bidirectional communication has not yet been established with the neighbor. This state might occur, for example, because the routing device itself did not appear in the neighbor's hello packet. • **Loading**—Link-state request packets are sent to the neighbor to acquire more recent advertisements that have been discovered (but not yet received) in the **Exchange** state. • **2Way**—Communication between the two routing devices is bidirectional. This state has been ensured by the operation of the Hello Protocol. This is the most advanced state short of beginning adjacency establishment. The (backup) designated router is selected from the set of neighbors in state **2Way** or greater.	All levels
ID	Router ID of the neighbor.	All levels
Pri	Priority of the neighbor to become the designated router.	All levels
Dead	Number of seconds until the neighbor becomes unreachable.	All levels
Link state acknowledgment list	Number of link-state acknowledgments received.	**extensive**
Link state retransmission list	Total number of link-state advertisements retransmitted. For **extensive** output only, the following information is also displayed: • **Type**—Type of link advertisement: **ASBR**, **Sum**, **Extern**, **Network**, **NSSA**, **OpaqArea**, **Router**, or **Summary**. • **LSA ID**—LSA identifier included in the advertisement. An asterisk preceding the identifier marks database entries that originated from the local routing device. • **Adv rtr**—Address of the routing device that sent the advertisement. • **Seq**—Link sequence number of the advertisement.	**detail extensive**

Table 258: show (ospf | ospf3) neighbor Output Fields *(continued)*

Field Name	Field Description	Level of Output
Neighbor-address	(OSPFv3 only) If the neighbor uses virtual links, the **Neighbor-address** is the site-local, local, or global address. If the neighbor uses a physical interface, the **Neighbor-address** is an IPv6 link-local address.	**detail extensive**
area	Area that the neighbor is in.	**detail extensive**
OSPF3-Intf-Index	(OSPFv3 only) Displays the OSPFv3 interface index.	**detail extensive**
opt	Option bits received in the hello packets from the neighbor.	**detail extensive**
DR or **DR-ID**	Address of the designated router.	**detail extensive**
BDR or **BDR-ID**	Address of the backup designated router.	**detail extensive**
Up	Length of time since the neighbor came up.	**detail extensive**
adjacent	Length of time since the adjacency with the neighbor was established.	**detail extensive**

Sample Output

show ospf neighbor brief

```
user@host> show ospf neighbor brief
  Address          Intf                State      ID              Pri  Dead
192.168.254.225  fxp3.0              2Way       10.250.240.32    128   36
192.168.254.230  fxp3.0              Full       10.250.240.8     128   38
192.168.254.229  fxp3.0              Full       10.250.240.35    128   33
10.1.1.129       fxp2.0              Full       10.250.240.12    128   37
10.1.1.131       fxp2.0              Full       10.250.240.11    128   38
10.1.2.1         fxp1.0              Full       10.250.240.9     128   32
10.1.2.81        fxp0.0              Full       10.250.240.10    128   33
```

show ospf neighbor detail

```
user@host> show ospf neighbor detail
  Address          Interface              State      ID               Pri  Dead
10.5.1.2         ge-1/2/0.1             Full       10.5.1.2         128   37
  area 0.0.0.1, opt 0x42, DR 10.5.1.2, BDR 10.5.1.1
  Up 06:09:28, adjacent 05:17:36
    Link state acknowledgment list:  3 entries

    Link state retransmission list:  9 entries

10.5.10.2        ge-1/2/0.10            ExStart    10.5.1.38        128   34
  area 0.0.0.1, opt 0x42, DR 10.5.10.2, BDR 10.5.10.1
  Up 06:09:28
    master, seq 0xac1530f8, rexmit DBD in 3 sec
    rexmit LSREQ in 0 sec
10.5.11.2        ge-1/2/0.11            Full       10.5.1.42        128   38
  area 0.0.0.1, opt 0x42, DR 10.5.11.2, BDR 10.5.11.1
  Up 06:09:28, adjacent 05:26:46
    Link state retransmission list:  1 entries
```



```
10.5.12.2        ge-1/2/0.12            ExStart   10.5.1.46        128   33
  area 0.0.0.1, opt 0x42, DR 10.5.12.2, BDR 10.5.12.1
  Up 06:09:28
    master, seq 0xac188a68, rexmit DBD in 2 sec
    rexmit LSREQ in 0 sec
```

show ospf neighbor extensive

```
user@host> show ospf neighbor extensive
  Address          Interface             State      ID               Pri  Dead
10.5.1.2         ge-1/2/0.1             Full      10.5.1.2         128   33
  area 0.0.0.1, opt 0x42, DR 10.5.1.2, BDR 10.5.1.1
  Up 06:09:42, adjacent 05:17:50
    Link state retransmission list:

      Type      LSA ID           Adv rtr          Seq

     Summary  10.8.56.0        172.25.27.82     0x8000004d

     Router   10.5.1.94        10.5.1.94        0x8000005c

     Network  10.5.24.2        10.5.1.94        0x80000036

     Summary  10.8.57.0        172.25.27.82     0x80000024

     Extern   1.10.90.0        10.8.1.2         0x80000041

     Extern   1.4.109.0        10.6.1.2         0x80000041

     Router   10.5.1.190       10.5.1.190       0x8000005f

     Network  10.5.48.2        10.5.1.190       0x8000003d

     Summary  10.8.58.0        172.25.27.82     0x8000004d

     Extern   1.10.91.0        10.8.1.2         0x80000041

     Extern   1.4.110.0        10.6.1.2         0x80000041

     Router   10.5.1.18        10.5.1.18        0x8000005f

     Network  10.5.5.2         10.5.1.18        0x80000033

     Summary  10.8.59.0        172.25.27.82     0x8000003a

     Summary  10.8.62.0        172.25.27.82     0x80000025

10.5.10.2        ge-1/2/0.10            ExStart   10.5.1.38        128   38
  area 0.0.0.1, opt 0x42, DR 10.5.10.2, BDR 10.5.10.1
  Up 06:09:42
    master, seq 0xac1530f8, rexmit DBD in 2 sec
    rexmit LSREQ in 0 sec
10.5.11.2        ge-1/2/0.11            Full      10.5.1.42        128   33
  area 0.0.0.1, opt 0x42, DR 10.5.11.2, BDR 10.5.11.1
  Up 06:09:42, adjacent 05:27:00
    Link state retransmission list:

      Type      LSA ID           Adv rtr          Seq

     Summary  10.8.58.0        172.25.27.82     0x8000004d
```

```
Extern    1.10.91.0        10.8.1.2         0x80000041

Extern    1.1.247.0        10.5.1.2         0x8000003f

Extern    1.4.110.0        10.6.1.2         0x80000041

Router    10.5.1.18        10.5.1.18        0x8000005f

Network   10.5.5.2         10.5.1.18        0x80000033

Summary   10.8.59.0        172.25.27.82     0x8000003a
```

show ospf3 neighbor detail

```
user@host> show ospf3 neighbor detail
ID               Interface              State     Pri   Dead
10.255.71.13     fe-0/0/2.0             Full      128   30
  Neighbor-address fe80::290:69ff:fe9b:e002
  area 0.0.0.0, opt 0x13, OSPF3-Intf-Index 2
  DR-ID 10.255.71.13, BDR-ID 10.255.71.12
  Up 02:51:43, adjacent 02:51:43
```

show ospf neighbor area area-id

```
user@host >show ospf neighbor area 1.1.1.1
Address          Interface              State     ID               Pri  Dead
192.168.37.47    so-0/0/0.0             Full      10.255.245.4     128    33
  Area 1.1.1.1
192.168.37.55    so-1/0/0.0             Full      10.255.245.5     128    37
  Area 1.1.1.1
```

show ospf neighbor interface interface-name

```
user@host >show ospf neighbor interface so-0/0/0.0
Address          Interface              State     ID               Pri  Dead
192.168.37.47    so-0/0/0.0             Full      10.255.245.4     128    37
  Area 0.0.0.0
192.168.37.47    so-0/0/0.0             Full      10.255.245.4     128    33
  Area 1.1.1.1
192.168.37.47    so-0/0/0.0             Full      10.255.245.4     128    32
  Area 2.2.2.2
```

show ospf3 neighbor instance all (OSPFv3 Multiple Family Address Support Enabled)

```
user @host > show ospf3 neighbor instance all
Instance: ina
    Realm: ipv6-unicast
    ID               Interface              State     Pri   Dead
   100.1.1.1        fe-0/0/2.0             Full      128     37
       Neighbor-address fe80::217:cb00:c87c:8c03
   Instance: inb
   Realm: ipv4-unicast
   ID               Interface              State     Pri   Dead
  100.1.2.1        fe-0/0/2.1             Full      128     33
      Neighbor-address fe80::217:cb00:c97c:8c03
```


show (ospf | ospf3) overview

Syntax

show (ospf | ospf3) overview
<brief | extensive>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)>

Syntax (EX Series Switch and QFX Series)

show (ospf | ospf3) overview
<brief | extensive>
<instance *instance-name*>

Release Information

Command introduced in Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
realm option introduced in Junos OS Release 9.2.
Database protection introduced in Junos 10.2.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display Open Shortest Path First (OSPF) overview information.

Options

none—Display standard information about all OSPF neighbors for all routing instances.

brief | extensive—(Optional) Display the specified level of output.

instance *instance-name*—(Optional) Display all OSPF interfaces under the named routing instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)—(Optional) (OSPFv3 only) Display information about the specified OSPFv3 realm, or address family. Use the **realm** option to specify an address family for OSPFv3 other than IPv6 unicast, which is the default.

Required Privilege Level

view

List of Sample Output

show ospf overview on page 3615
show ospf overview (With Database Protection) on page 3616
show ospf3 overview (With Database Protection) on page 3616
show ospf overview extensive on page 3616

Output Fields

Table 155 on page 1819 lists the output fields for the **show ospf overview** command. Output fields are listed in the approximate order in which they appear.

Table 259: show ospf overview Output Fields

Field name	Field Description	Level of Output
Instance	OSPF routing instance.	All levels

Table 259: show ospf overview Output Fields *(continued)*

Field name	Field Description	Level of Output
Router ID	Router ID of the routing device.	All levels
Route table index	Route table index.	All levels
Configured overload	Overload capability is enabled. If the overload timer is also configured, display the time that remains before it is set to expire. This field is not displayed after the timer expires.	All levels
Toplogy	Topology identifier.	All levels
Prefix export count	Number of prefixes exported into OSPF.	All levels
Full SPF runs	Number of complete Shortest Path First calculations.	All levels
SPF delay	Delay before performing consecutive Shortest Path First calculations.	All levels
SPF holddown	Delay before performing additional Shortest Path First (SPF) calculations after the maximum number of consecutive SPF calculations is reached.	All levels
SPF rapid runs	Maximum number of Shortest Path First calculations that can be performed in succession before the hold-down timer begins.	All levels
LSA refresh time	Refresh period for link-state advertisement (in minutes).	All levels
Database protection state	Current state of database protection.	All levels
Warning threshold	Threshold at which a warning message is logged (percentage of maximum LSA count).	All levels
Non self-generated LSAs	Number of LSAs whose router ID is not equal to the local router ID: **Current**, **Warning** (threshold), and **Allowed**.	All levels
Ignore time	How long the database has been in the ignore state.	All levels
Reset time	How long the database must stay out of the ignore or isolated state before it returns to normal operations.	All levels
Ignore count	Number of times the database has been in the ignore state: **Current** and **Allowed**.	All levels
Restart	Graceful restart capability: **enabled** or **disabled**.	All levels
Restart duration	Time period for complete reacquisition of OSPF neighbors.	All levels
Restart grace period	Time period for which the neighbors should consider the restarting routing device as part of the topology.	All levels

Table 259: show ospf overview Output Fields *(continued)*

Field name	Field Description	Level of Output
Graceful restart helper mode	(OSPFv2) Standard graceful restart helper capability (based on RFC 3623): **enabled** or **disabled**.	All levels
Restart-signaling helper mode	(OSPFv2) Restart signaling-based graceful restart helper capability (based on RFC 4811, RFC 4812, and RFC 4813): **enabled** or **disabled**.	All levels
Helper mode	(OSPFv3) Graceful restart helper capability: **enabled** or **disabled**.	All levels
Trace options	OSPF-specific trace options.	**extensive**
Trace file	Name of the file to receive the output of the tracing operation.	**extensive**
Area	Area number. Area 0.0.0.0 is the backbone area.	All levels
Stub type	Stub type of area: **Normal Stub**, **Not Stub**, or **Not so Stubby Stub**.	All levels
Authentication Type	Type of authentication: **None**, **Password**, or **MD5**. NOTE: The **Authentication Type** field refers to the authentication configured at the **[edit protocols ospf area *area-id*]** level. Any authentication configured for an interface in this area will not affect the value of this field.	All levels
Area border routers	Number of area border routers.	All levels
Neighbors	Number of autonomous system boundary routers.	All levels

Sample Output

show ospf overview

```
user@host> show ospf overview
Instance: master
    Router ID: 10.255.245.6
    Route table index: 0
   Configured overload, expires in 118 seconds
    LSA refresh time: 50 minutes
  Restart: Enabled
     Restart duration: 20 sec
     Restart grace period: 40 sec
     Helper mode: enabled
  Area: 0.0.0.0
      Stub type: Not Stub
      Authentication Type: None
      Area border routers: 0, AS boundary routers: 0
      Neighbors
        Up (in full state): 0
    Topology: default (ID 0)
      Prefix export count: 0
      Full SPF runs: 1
      SPF delay: 0.200000 sec, SPF holddown: 5 sec, SPF rapid runs: 3
```


show ospf overview (With Database Protection)

```
user@host> show ospf overview
Instance: master
  Router ID: 10.255.112.218
  Route table index: 0
  LSA refresh time: 50 minutes
  Traffic engineering
  Restart: Enabled
    Restart duration: 180 sec
    Restart grace period: 210 sec
    Graceful restart helper mode: Enabled
    Restart-signaling helper mode: Enabled
  Database protection state: Normal
    Warning threshold: 70 percent
    Non self-generated LSAs: Current 582, Warning 700, Allowed 1000
    Ignore time: 30, Reset time: 60
    Ignore count: Current 0, Allowed 1
  Area: 0.0.0.0
    Stub type: Not Stub
    Authentication Type: None
    Area border routers: 0, AS boundary routers: 0
    Neighbors
      Up (in full state): 160
  Topology: default (ID 0)
    Prefix export count: 0
    Full SPF runs: 70
    SPF delay: 0.200000 sec, SPF holddown: 5 sec, SPF rapid runs: 3
    Backup SPF: Not Needed
```

show ospf3 overview (With Database Protection)

```
user@host> show ospf3 overview
Instance: master
  Router ID: 10.255.112.128
  Route table index: 0
  LSA refresh time: 50 minutes
  Database protection state: Normal
    Warning threshold: 80 percent
    Non self-generated LSAs: Current 3, Warning 8, Allowed 10
    Ignore time: 30, Reset time: 60
    Ignore count: Current 0, Allowed 2
  Area: 0.0.0.0
    Stub type: Not Stub
    Area border routers: 0, AS boundary routers: 0
    Neighbors
      Up (in full state): 1
  Topology: default (ID 0)
    Prefix export count: 0
    Full SPF runs: 7
    SPF delay: 0.200000 sec, SPF holddown: 5 sec, SPF rapid runs: 3
    Backup SPF: Not Needed
```

show ospf overview extensive

```
user@host> show ospf overview extensive
Instance: master
  Router ID: 1.1.1.103
  Route table index: 0
  Full SPF runs: 13, SPF delay: 0.200000 sec
  LSA refresh time: 50 minutes
```



```
Restart: Disabled
Trace options: lsa
Trace file: /var/log/ospf size 131072 files 10
Area: 0.0.0.0
  Stub type: Not Stub
  Authentication Type: None
  Area border routers: 0, AS boundary routers: 0
  Neighbors
    Up (in full state): 1
```

show (ospf | ospf3) route

Syntax

show (ospf | ospf3) route
<brief | detail | extensive>
<abr | asbr | extern | inter | intra>
<*destination*>
<instance (default | ipv4-multicast | *instance-name*)>
<logical-system (default | ipv4-multicast | *logical-system-name*)>
<network>
<no-backup-coverage>
<realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)>
<router>
<topology (default | ipv4-multicast | *topology-name*)>
<transit>

Syntax (EX Series Switch and QFX Series)

show (ospf | ospf3) route
<brief | detail | extensive>
<abr | asbr | extern | inter | intra>
<*destination*>
<instance *instance-name*
<network>
<no-backup-coverage>
<router>
<topology (default | ipv4-multicast | *topology-name*)>
<transit>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
topology option introduced in Junos OS Release 9.0.
realm option introduced in Junos OS Release 9.2.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display the entries in the Open Shortest Path First (OSPF) routing table.

Options

none—Display standard information about all entries in the OSPF routing table for all routing instances and all topologies.

destination—Display routes to the specified IP address (with optional destination prefix length).

brief | detail | extensive—(Optional) Display the specified level of output.

abr—(Optional) Display routes to area border routers.

asbr—(Optional) Display routes to autonomous system border routers.

extern—(Optional) Display external routes.

inter—(Optional) Display interarea routes.

intra—(Optional) Display intra-area routes.

instance (default | ipv4-multicast | ***instance-name*****)**—(Optional) Display entries for the default routing instance, the IPv4 multicast routing instance, or for the specified routing instance.

logical-system (default | ipv4-multicast | ***logical-system-name*****)**—(Optional) Perform this operation on the default logical system, the IPv4 multicast logical system, or on a particular logical system.

network—(Optional) Display routes to networks.

no-backup-coverage—(Optional) Display routes with no backup coverage.

realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)—(OSPFv3 only) (Optional) Display entries in the routing table for the specified OSPFv3 realm, or address family. Use the **realm** option to specify an address family for OSPFv3 other than IPv6 unicast, which is the default.

router—(Optional) Display routes to all routers.

topology (default | ipv4-multicast | ***topology-name*****)**—(OSPFv2 only) (Optional) Display routes for the default OSPF topology, IPv4 multicast topology, or for a particular topology.

transit—(Optional) (OSPFv3 only) Display OSPFv3 routes to pseudonodes.

Required Privilege Level view

List of Sample Output

show ospf route on page 3621
show ospf route detail on page 3621
show ospf3 route on page 3621
show ospf3 route detail on page 3622
show ospf route topology voice on page 3622

Output Fields Table 260 on page 3619 list the output fields for the **show (ospf | ospf3) route** command. Output fields are listed in the approximate order in which they appear.

Table 260: show (ospf | ospf3) route Output Fields

Field Name	Field Description	Output Level
Topology	Name of the topology.	All levels
Prefix	Destination of the route.	All levels
Path type	How the route was learned: • **Inter**—Interarea route • **Ext1**—External type 1 route • **Ext2**—External type 2 route • **Intra**—Intra-area route	All levels

Table 260: show (ospf | ospf3) route Output Fields *(continued)*

Field Name	Field Description	Output Level
Route type	The type of routing device from which the route was learned: • **AS BR**—Route to AS border router. • **Area BR**—Route to area border router. • **Area/AS BR**—Route to router that is both an **Area BR** and **AS BR**. • **Network**—Network router. • **Router**—Route to a router that is neither an **Area BR** nor an **AS BR**. • **Transit**—(OSPFv3 only) Route to a pseudonode representing a transit network, LAN, or nonbroadcast multiaccess (NBMA) link. • **Discard**—Route to a summary discard.	All levels
NH Type	Next-hop type: **LSP** or **IP**.	All levels
Metric	Route's metric value.	All levels
NH-interface	(OSPFv3 only) Interface through which the route's next hop is reachable.	All levels
NH-addr	(OSPFv3 only) IPv6 address of the next hop.	All levels
NextHop Interface	(OSPFv2 only) Interface through which the route's next hop is reachable.	All levels
Nexthop addr/label	(OSPFv2 only) If the **NH Type** is **IP**, then it is the address of the next hop. If the **NH Type** is **LSP**, then it is the name of the label-switched path.	All levels
Area	Area ID of the route.	**detail**
Origin	Router from which the route was learned.	**detail**
Type 7	Route was learned through a not-so-stubby area (NSSA) link-state advertisement (LSA).	**detail**
P-bit	Route was learned through NSSA LSA and the propagate bit was set.	**detail**
Fwd NZ	Forwarding address is nonzero. **Fwd NZ** is only displayed if the route is learned through an NSSA LSA.	**detail**
optional-capability	Optional capabilities propagated in the router LSA. This field is in the output for intra-area router routes only (when **Route Type** is **Area BR**, **AS BR**, **Area/AS BR**, or **Router**), not for interarea router routes or network routes. Three bits in this field are defined as follows: • **0x4 (V)**—Routing device is at the end of a virtual active link. • **0x2 (E)**—Routing device is an autonomous system boundary router. • **0x1 (B)**—Routing device is an area border router.	**detail**

Table 260: show (ospf | ospf3) route Output Fields *(continued)*

Field Name	Field Description	Output Level
priority	The priority assigned to the prefix: • **high** • **medium** • **low** NOTE: The **priority** field applies only to routes of type **Network**.	detail

Sample Output

show ospf route

```
user@host> show ospf route
Prefix              Path   Route      NH   Metric  NextHop       Nexthop
                    Type   Type       Type         Interface     addr/label
10.255.71.12        Intra  Router     IP   1       fe-0/0/2.0    192.16.22.86
10.255.71.13/32     Intra  Network    IP   0       lo0.0
192.168.222.84/30   Intra  Network    LSP  1       fe-0/0/2.0    lsp-ab
```

show ospf route detail

```
user@host> show ospf route detail
Topology default Route Table:

Prefix              Path   Route      NH   Metric  NextHop       Nexthop
                    Type   Type       Type         Interface     addr/label
10.255.14.174       Inter  AS BR      IP      210  t1-3/0/1.0
   area 0.0.0.2, origin 10.255.14.185
10.255.14.178       Intra  Router     IP      200  t3-3/1/3.0
   area 0.0.0.2, origin 10.255.14.178, optional-capability 0x0
10.210.1.0/30       Intra  Network    IP       10  t3-3/1/2.0
   area 0.0.0.2, origin 10.255.14.172, priority medium
100.1.1.1/32        Inter  Network    IP      210  t1-3/0/1.0
   area 0.0.0.2, origin 10.255.14.185, priority low
112.3.1.0/24        Ext2   Network    IP        0  t1-3/0/1.0
   area 0.0.0.0, origin 10.255.14.174, priority high
200.3.3.0/30        Inter  Network    IP      220  t1-3/0/1.0
   area 0.0.0.2, origin 10.255.14.185, priority high
```

show ospf3 route

```
user@host> show ospf3 route
Prefix              Path   Route      NH   Metric  NextHop       Nexthop

                    Type   Type       Type         Interface     addr/label
10.255.71.13        Intra  Router     IP        1
  NH-interface fe-0/0/2.0, NH-addr fe80::290:69ff:fe9b:e002
10.255.71.13;0.0.0.2
10.255.245.1        Intra  Router     IP      40   fxp1.1        192.168.36.17

  area 0.0.0.0, origin 10.255.245.1 optional-capability 0x0,
10.255.245.3        Intra  AS BR      IP       1   fxp2.3        192.168.36.34

  area 0.0.0.0, origin 10.255.245.3 optional-capability 0x0,
10.255.245.1/32     Intra  Network    IP      40   fxp1.1        192.168.36.17
```



```
  area 0.0.0.0, origin 10.255.245.1, priority high
10.255.245.2/32      Intra  Network     IP       0  lo0.0
  area 0.0.0.0, origin 10.255.245.2, priority medium
10.255.245.3/32      Intra  Network     IP       1  fxp2.3       192.168.36.34

  area 0.0.0.0, origin 10.255.245.3, priority low
                     Intra  Transit     IP       1
  NH-interface fe-0/0/2.0
192::168:222:84/126  Intra  Network     IP       1
  NH-interface fe-0/0/2.0
abcd::71:12/128      Intra  Network     IP       0
  NH-interface lo0.0
abcd::71:13/128      Intra  Network     LSP      1
  NH-interface fe-0/0/2.0, NH-addr lsp-cd
```

show ospf3 route detail

```
user@host> show ospf3 route detail
Prefix                                      Path   Route       NH    Metric
                                            type   type        type
10.255.14.174                               Intra  Area/AS BR  IP    110
   NH-interface so-1/2/2.0
   Area 0.0.0.0, Origin 10.255.14.174, Optional-capability 0x3
10.255.14.178                               Intra  Router      IP    200
   NH-interface t3-3/1/3.0
   Area 0.0.0.0, Origin 10.255.14.178, Optional-capability 0x0
10.255.14.185;0.0.0.2                       Intra  Transit     IP    200
   NH-interface t1-3/0/1.0
   NH-interface so-1/2/2.0
   Area 0.0.0.0, Origin 10.255.14.185
1000:1:1::1/128                             Inter  Network     IP    110
   NH-interface so-1/2/2.0
   Area 0.0.0.0, Origin 10.255.14.174, Priority low
1001:2:1::/48                               Ext1   Network     IP    110
   NH-interface so-1/2/2.0
   Area 0.0.0.0, Origin 10.255.14.174, Fwd NZ, Priority medium
1002:1:7::/48                               Ext2   Network     IP    0
   NH-interface so-1/2/2.0
   Area 0.0.0.0, Origin 10.255.14.174, Fwd NZ, Priority low
1002:3:4::/48                               Ext2   Network     IP    0
   NH-interface so-1/2/2.0
   Area 0.0.0.0, Origin 10.255.14.174, Fwd NZ, Priority high
abcd::10:255:14:172/128                     Intra  Network     IP    0
   NH-interface lo0.0
   Area 0.0.0.0, Origin 10.255.14.172, Priority low
```

show ospf route topology voice

```
user@host show ospf route topology voice
Topology voice Route Table:
Prefix             Path   Route       NH    Metric  NextHop       Nexthop
                   Type   Type        Type          Interface     addr/label
10.255.8.2         Intra  Router      IP         1  so-0/2/0.0
10.255.8.3         Intra  Router      IP         2  so-0/2/0.0
10.255.8.1/32      Intra  Network     IP         0  lo0.0
10.255.8.2/32      Intra  Network     IP         1  so-0/2/0.0
10.255.8.3/32      Intra  Network     IP         2  so-0/2/0.0
192.168.8.0/29     Intra  Network     IP         2  so-0/2/0.0
192.168.8.44/30    Intra  Network     IP         2  so-0/2/0.0
192.168.8.46/32    Intra  Network     IP         1  so-0/2/0.0
```

```
192.168.8.48/30    Intra  Network     IP         1  so-0/2/1.0
192.168.8.52/30    Intra  Network     IP         2  so-0/2/0.0
192.168.9.44/30    Intra  Network     IP         1  so-0/2/0.0
192.168.9.45/32    Intra  Network     IP         2  so-0/2/0.0
```


show (ospf | ospf3) statistics

Syntax

show (ospf | ospf3) statistics
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)>

Syntax (EX Series Switch and QFX Series)

show (ospf | ospf3) statistics
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
realm option introduced in Junos OS Release 9.2.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display OSPF statistics.

Options

none—Display OSPF statistics for all routing instances.

instance ***instance-name***—(Optional) Display all statistics for the specified routing instance.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

realm (ipv4-multicast | ipv4-unicast | ipv6-multicast)—(Optional) (OSPFv3 only) Display all statistics for the specified OSPFv3 realm, or address family. Use the **realm** option to specify an address family for OSPFv3 other than IPv6 unicast, which is the default.

Required Privilege Level

view

Related Documentation

- clear (ospf | ospf3) statistics on page 3578

List of Sample Output

show ospf statistics on page 3626
show ospf statistics logical-system all on page 3626
show ospf3 statistics on page 3627

Output Fields

Table 261 on page 3624 lists the output fields for the **show (ospf | ospf3) statistics** command. Output fields are listed in the approximate order in which they appear.

Table 261: show (ospf | ospf3) statistics Output Fields

Field Name	Field Description
Packet type	Type of OSPF packet.
Total Sent/Total Received	Total number of packets sent and received.
Last 5 seconds Sent/Last 5 seconds Received	Total number of packets sent and received in the last 5 seconds.

Table 261: show (ospf | ospf3) statistics Output Fields *(continued)*

Field Name	Field Description
DBDs retransmitted	Total number of database description packets retransmitted, and number retransmitted in the last 5 seconds.
LSAs flooded	Total number of link-state advertisements flooded, and number flooded in the last 5 seconds.
LSAs flooded high-prio	Total number of high priority link-state advertisements flooded, and number flooded in the last 5 seconds. A link-state advertisement is deemed a high priority if it has changed since it was last sent.
LSAs retransmitted	Total number of link-state advertisements retransmitted, and number retransmitted in the last 5 seconds.
LSAs transmitted to nbr	Total number of link-state advertisements transmitted to a neighbor, and number transmitted in the last 5 seconds.
LSAs requested	Total number of link-state advertisements requested by neighboring devices, and number requested in the last 5 seconds.
LSAs acknowledged	Total number of link-state advertisements acknowledged, and number acknowledged in the last 5 seconds.
Flood queue depth	Total number of entries in the extended queue.
Total rexmit entries	Total number of retransmission entries waiting to be sent from the OSPF routing instance.
db summaries	Total number of database description summaries waiting to be sent from the OSPF routing instance.
lsreq entries	Total number of link-state request entries waiting to be sent from the OSPF routing instance.
Receive errors	Number and type of receive errors. Some sample receive errors include: • **mtu mismatches** • **no interface found** • **no virtual link found** • **nssa mismatches** • **stub area mismatches** • **subnet mismatches** If there are no receive errors, the output displays **none**.

Sample Output

show ospf statistics

```
user@host> show ospf statistics
Packet type              Total                  Last 5 seconds
                   Sent       Received         Sent       Received
   Hello             31             14            2              2
     DbD              9             10            0              0
   LSReq              2              2            0              0
LSUpdate              8             16            0              0
   LSAck              9              9            0              0

DBDs retransmitted     :                 3, last 5 seconds :          0
LSAs flooded           :                12, last 5 seconds :          0
LSAs flooded high-prio :                 0, last 5 seconds :          0
LSAs retransmitted     :                 0, last 5 seconds :          0
LSAs transmitted to nbr:                 3, last 5 seconds :          0
LSAs requested         :                 5, last 5 seconds :          0
LSAs acknowledged      :                19, last 5 seconds :          0

Flood queue depth      :               0
Total rexmit entries   :               0
db summaries           :               0
lsreq entries          :               0

Receive errors:
  862 no interface found
  115923 no virtual link found
```

show ospf statistics logical-system all

```
user@host> show ospf statistics logical-system all
logical-system: C
OSPF instance is not running
-----

logical-system: B

Packet type              Total                  Last 5 seconds
                   Sent       Received         Sent       Received
   Hello         313740         313653            1              0
     DbD              3              2            0              0
   LSReq              1              1            0              0
LSUpdate           2752           1825            0              0
   LSAck           1821           2747            0              0

DBDs retransmitted     :                 0, last 5 seconds :          0
LSAs flooded           :              2741, last 5 seconds :          0
LSAs flooded high-prio :                10, last 5 seconds :          0
LSAs retransmitted     :                 0, last 5 seconds :          0
LSAs transmitted to nbr:                 2, last 5 seconds :          0
LSAs requested         :                 1, last 5 seconds :          0
LSAs acknowledged      :              1831, last 5 seconds :          0

Flood queue depth      :               0
Total rexmit entries   :               0
db summaries           :               0
lsreq entries          :               0

Receive errors:
```



```
  None
-----

logical-system: A

Packet type             Total                  Last 5 seconds
                   Sent        Received        Sent        Received
   Hello         313698          313695           0               0
     DbD              2               3           0               0
   LSReq              1               1           0               0
LSUpdate           1825            2752           0               0
   LSAck           2747            1821           0               0

DBDs retransmitted     :                  0, last 5 seconds :          0
LSAs flooded           :               1825, last 5 seconds :          0
LSAs flooded high-prio :                 10, last 5 seconds :          0
LSAs retransmitted     :                  0, last 5 seconds :          0
LSAs transmitted to nbr:                  1, last 5 seconds :          0
LSAs requested         :                  2, last 5 seconds :          0
LSAs acknowledged      :               2748, last 5 seconds :          0

Flood queue depth      :               0
Total rexmit entries   :               0
db summaries           :               0
lsreq entries          :               0

Receive errors:
  None
-----
```

show ospf3 statistics

```
user@host> show ospf3 statistics
Packet type             Total                  Last 5 seconds
                   Sent        Received        Sent        Received
   Hello              0               0           0               0
     DbD              0               0           0               0
   LSReq              0               0           0               0
LSUpdate              0               0           0               0
   LSAck              0               0           0               0

DBDs retransmitted     :                  0, last 5 seconds :          0
LSAs flooded           :                  0, last 5 seconds :          0
LSAs flooded high-prio :                  0, last 5 seconds :          0
LSAs retransmitted     :                  0, last 5 seconds :          0
LSAs transmitted to nbr:                  0, last 5 seconds :          0
LSAs requested         :                  0, last 5 seconds :          0
LSAs acknowledged      :                  0, last 5 seconds :          0

Flood queue depth      :               0
Total rexmit entries   :               0
db summaries           :               0
lsreq entries          :               0

Receive errors:
  None
```

PART 13

Routing Information Protocol

CHAPTER 40

Overview

RIP Overview

RIP Overview

RIP is an interior gateway protocol (IGP) that uses a distance-vector algorithm to determine the best route to a destination, using the hop count as the metric.

In a RIP network, each router's forwarding table is distributed among the nodes through the flooding of routing table information. Because topology changes are flooded throughout the network, every node maintains the same list of destinations. Packets are then routed to these destinations based on path-cost calculations done at each node in the network.

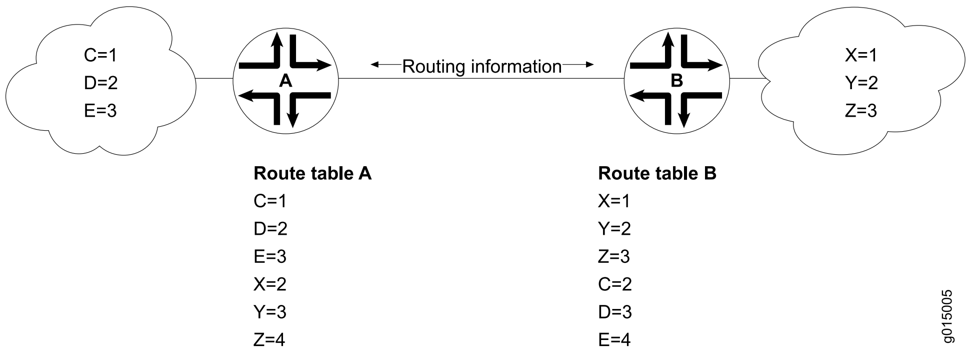
NOTE: In general, the term *RIP* refers to RIP version 1 and RIP version 2.

This topic contains the following sections:

Distance-Vector Routing Protocols

Distance-vector routing protocols transmit routing information that includes a distance vector, typically expressed as the number of hops to the destination. This information is flooded out all protocol-enabled interfaces at regular intervals (every 30 seconds in the case of RIP) to create a network map that is stored in each node's local topology database. Figure 96 on page 3632 shows how distance-vector routing works.

Figure 96: Distance-Vector Protocol



In Figure 96 on page 3632, Routers A and B have RIP enabled on adjacent interfaces. Router A has known RIP neighbors Routers C, D, and E, which are 1, 2, and 3 hops away, respectively. Router B has known RIP neighbors Routers X, Y, and Z, which are 1, 2, and 3 hops away, respectively. Every 30 seconds, each router floods its entire routing table information out all RIP-enabled interfaces. In this case, flooding exchanges routing table information across the RIP link.

When Router A receives routing information from Router B, it adds 1 to the hop count to determine the new hop count. For example, Router X has a hop count of 1, but when Router A imports the route to X, the new hop count is 2. The imported route also includes information about where the route was learned, so that the original route is imported as a route to Router X through Router B with a hop count of 2.

When multiple routes to the same host are received, RIP uses the distance-vector algorithm to determine which path to import into the forwarding table. The route with the smallest hop count is imported. If there are multiple routes with the same hop count, all are imported into the forwarding table, and traffic is sent along the paths in round-robin fashion.

RIP Protocol Overview

The RIP IGP uses the Bellman-Ford, or *distance-vector*, algorithm to determine the best route to a destination. RIP uses the hop count as the metric. RIP enables hosts and routers to exchange information for computing routes through an IP-based network. RIP is intended to be used as an IGP in reasonably homogeneous networks of moderate size.

The Junos® operating system (Junos OS) supports RIP versions 1 and 2.

NOTE: **RIP is not supported for multipoint interfaces.**

RIP version 1 packets contain the minimal information necessary to route packets through a network. However, this version of RIP does not support authentication or subnetting.

RIP uses User Datagram Protocol (UDP) port 520.

RIP has the following architectural limitations:

- The longest network path cannot exceed 15 hops (assuming that each network, or hop, has a cost of 1).
- RIP depends on counting to infinity to resolve certain unusual situations—When the network consists of several hundred routers, and when a routing loop has formed, the amount of time and network bandwidth required to resolve a next hop might be great.
- RIP uses only a fixed metric to select a route. Other IGPs use additional parameters, such as measured delay, reliability, and load.

RIP Packets

RIP packets contain the following fields:

- Command—Indicates whether the packet is a request or response message. Request messages seek information for the router's routing table. Response messages are sent periodically and also when a request message is received. Periodic response messages are called *update messages*. Update messages contain the command and version fields and 25 destinations (by default), each of which includes the destination IP address and the metric to reach that destination.

  NOTE: **Beginning with Junos OS Release 11.1, three additional command field types are available to support RIP demand circuits. When you configure an interface for RIP demand circuits, the command field indicates whether the packet is an update request, update response, or update acknowledge message. Neighbor interfaces send updates on demand, not periodically. These command field types are only valid on interfaces configured for RIP demand circuits. For more detailed information, see *RIP Demand Circuits Overview*.**

- Version number—Version of RIP that the originating router is running.
- Address family identifier—Address family used by the originating router. The family is always IP.
- Address—IP address included in the packet.
- Metric—Value of the metric advertised for the address.
- Mask—Mask associated with the IP address (RIP version 2 only).
- Next hop—IP address of the next-hop router (RIP version 2 only).

Routing information is exchanged in a RIP network by RIP request and RIP response packets. A router that has just booted can broadcast a RIP request on all RIP-enabled interfaces. Any routers running RIP on those links receive the request and respond by sending a RIP response packet immediately to the router. The response packet contains the routing table information required to build the local copy of the network topology map.

In the absence of RIP request packets, all RIP routers broadcast a RIP response packet every 30 seconds on all RIP-enabled interfaces. The RIP broadcast is the primary way in which topology information is flooded throughout the network.

Once a router learns about a particular destination through RIP, it starts a timer. Every time it receives a new response packet with information about the destination, the router resets the timer to zero. However, if the router receives no updates about a particular destination for 180 seconds, it removes the destination from its RIP routing table.

In addition to the regular transmission of RIP packets every 30 seconds, if a router detects a new neighbor or detects that an interface is unavailable, it generates a triggered update. The new routing information is immediately broadcast out all RIP-enabled interfaces, and the change is reflected in all subsequent RIP response packets.

Maximizing Hop Count

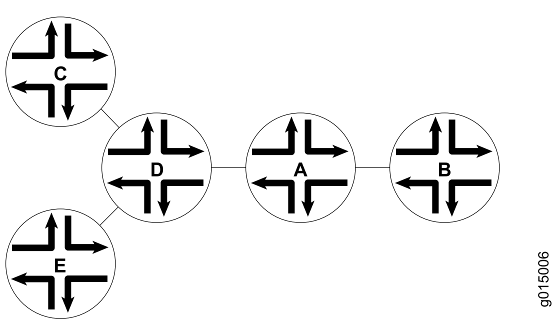
The successful routing of traffic across a RIP network requires that every node in the network maintain the same view of the topology. Topology information is broadcast between RIP neighbors every 30 seconds. If Router A is many hops away from a new host, Router B, the route to B might take significant time to propagate through the network and be imported into Router A's routing table. If the two routers are 5 hops away from each other, Router A cannot import the route to Router B until 2.5 minutes after Router B is online (30 seconds per hop). For large numbers of hops, the delay becomes prohibitive. To help prevent this delay from growing arbitrarily large, RIP enforces a maximum hop count of 15 hops. Any prefix that is more than 15 hops away is treated as unreachable and assigned a hop count equal to infinity. This maximum hop count is called the *network diameter*.

Split Horizon and Poison Reverse Efficiency Techniques

Because RIP functions by periodically flooding the entire routing table out to the network, it generates a lot of traffic. The split horizon and poison reverse techniques can help reduce the amount of network traffic originated by RIP hosts and make the transmission of routing information more efficient.

If a router receives a set of route advertisements on a particular interface, RIP determines that those advertisements do not need to be retransmitted out the same interface. This technique, known as *split horizon*, helps limit the amount of RIP routing traffic by eliminating information that other neighbors on that interface have already learned. Figure 97 on page 3634 shows an example of the split horizon technique.

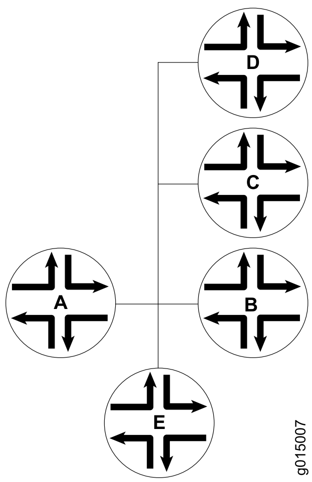
Figure 97: Split Horizon Example



In Figure 97 on page 3634, Router A advertises routes to Routers C, D, and E to Router B. In this example, Router A can reach Router C in 2 hops. When Router A advertises the route to Router B, Router B imports it as a route to Router C through Router A in 3 hops. If Router B then readvertised this route to Router A, Router A would import it as a route to Router C through Router B in 4 hops. However, the advertisement from Router B to Router A is unnecessary, because Router A can already reach the route in 2 hops. The split horizon technique helps reduce extra traffic by eliminating this type of route advertisement.

Similarly, the poison reverse technique helps to optimize the transmission of routing information and improve the time to reach network convergence. If Router A learns about unreachable routes through one of its interfaces, it advertises those routes as unreachable (hop count of 16) out the same interface. Figure 98 on page 3635 shows an example of the poison reverse technique.

Figure 98: Poison Reverse Example

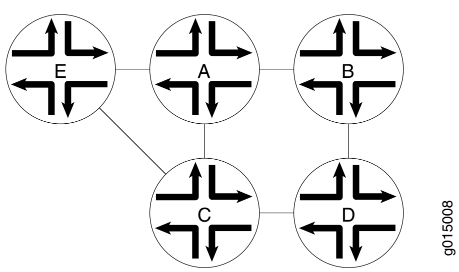


In Figure 98 on page 3635, Router A learns through one of its interfaces that routes to Routers C, D, and E are unreachable. Router A readvertises those routes out the same interface as unreachable. The advertisement informs Router B that Routers C, D, and E are definitely not reachable through Router A.

Limitations of Unidirectional Connectivity

Because RIP processes routing information based solely on the receipt of routing table updates, it cannot ensure bidirectional connectivity. As Figure 99 on page 3635 shows, RIP networks are limited by their unidirectional connectivity.

Figure 99: Limitations of Unidirectional Connectivity



In Figure 99 on page 3635, Routers A and D flood their routing table information to Router B. Because the path to Router E has the fewest hops when routed through Router A, that route is imported into Router B's forwarding table. However, suppose that Router A can transmit traffic but is not receiving traffic from Router B because of an unavailable link or invalid routing policy. If the only route to Router E is through Router A, any traffic destined for Router A is lost, because bidirectional connectivity was never established.

OSPF establishes bidirectional connectivity with a three-way handshake.

Related Documentation

- *Junos OS Feature Support Reference for SRX Series and J Series Devices*
- *RIP Configuration Overview*
- Example: Configuring RIP on page 3637

CHAPTER 41

Configuration

RIP Configuration Tasks

Example: Configuring RIP

Understanding Basic RIP Routing

RIP is an interior gateway protocol (IGP) that routes packets within a single autonomous system (AS). By default, RIP does not advertise the subnets that are directly connected through the device's interfaces. For traffic to pass through a RIP network, you must create a routing policy to export these routes. Advertising only the direct routes propagates the routes to the immediately adjacent RIP-enabled router only. To propagate all routes through the entire RIP network, you must configure the routing policy to export the routes learned through RIP.

Example: Configuring a Basic RIP Network

This example shows how to configure a basic RIP network.

- Requirements on page 3638
- Overview on page 3638
- Configuration on page 3638
- Verification on page 3641

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

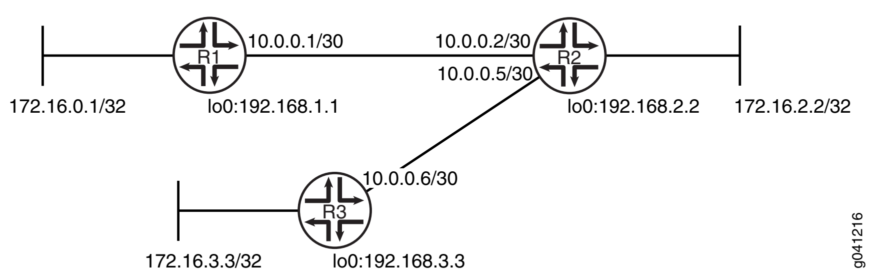
In this example, you configure a basic RIP network, create a RIP group called **rip-group**, and add the directly connected interfaces to the RIP group. Then you configure a routing policy to advertise direct routes using policy statement **advertise-routes-through-rip**.

By default, Junos OS does not advertise RIP routes, not even routes that are learned through RIP. To advertise RIP routes, you must configure and apply an export routing policy that advertises RIP-learned and direct routes.

In Junos OS, you do not need to configure the RIP version. RIP version 2 is used by default.

To use RIP on the device, you must configure RIP on all of the RIP interfaces within the network. Figure 100 on page 3638 shows the topology used in this example.

Figure 100: Sample RIP Network Topology



"CLI Quick Configuration" on page 3638 shows the configuration for all of the devices in Figure 100 on page 3638. The section "Step-by-Step Procedure" on page 3639 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set interfaces lo0 unit 1 family inet address 172.16.0.1/32
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
```



```
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.1
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 5 family inet address 10.0.0.5/30
set interfaces lo0 unit 2 family inet address 192.168.2.2/32
set interfaces lo0 unit 2 family inet address 172.16.2.2/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.2
set protocols rip group rip-group neighbor fe-1/2/1.5
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R3

```
set interfaces fe-1/2/0 unit 6 family inet address 10.0.0.6/30
set interfaces lo0 unit 3 family inet address 192.168.3.3/32
set interfaces lo0 unit 3 family inet address 172.16.3.3/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.6
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure a basic RIP network:

1. Configure the network interfaces.

   This example shows multiple loopback interface addresses to simulate attached networks.

   ```
   [edit interfaces]
   user@R1# set fe-1/2/0 unit 1 family inet address 10.0.0.1/30

   user@R1# set lo0 unit 1 family inet address 172.16.0.1/32
   user@R1# set lo0 unit 1 family inet address 192.168.1.1/32
   ```

2. Create the RIP group and add the interface.

   To configure RIP in Junos OS, you must configure a group that contains the interfaces on which RIP is enabled. You do not need to enable RIP on the loopback interface.

   ```
   [edit protocols rip group rip-group]
   user@R1# set neighbor fe-1/2/0.1
   ```

3. Create the routing policy to advertise both direct and RIP-learned routes.

```
[edit policy-options policy-statement advertise-routes-through-rip term 1]
user@R1# set from protocol direct
user@R1# set from protocol rip
user@R1# set then accept
```

4. Apply the routing policy.

   In Junos OS, you can only apply RIP export policies at the group level.

```
[edit protocols rip group rip-group]
user@R1# set export advertise-routes-through-rip
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R1# show interfaces
fe-1/2/0 {
  unit 1 {
    family inet {
      address 10.0.0.1/30;
    }
  }
}
lo0 {
  unit 1 {
    family inet {
      address 172.16.0.1/32;
      address 192.168.1.1/32;
    }
  }
}
```

```
user@R1# show protocols
rip {
  group rip-group {
    export advertise-routes-through-rip;
    neighbor fe-1/2/0.1;
  }
}
```

```
user@R1# show policy-options
policy-statement advertise-routes-through-rip {
  term 1 {
    from protocol [ direct rip ];
    then accept;
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Checking the Routing Table

Purpose Verify that the routing table is populated with the expected routes..

Action From operational mode, enter the **show route protocol rip** command.

```
user@R1> show route protocol rip
inet.0: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.4/30        *[RIP/100] 00:59:15, metric 2, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
172.16.2.2/32      *[RIP/100] 02:52:48, metric 2, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
172.16.3.3/32      *[RIP/100] 00:45:05, metric 3, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
192.168.2.2/32     *[RIP/100] 02:52:48, metric 2, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
192.168.3.3/32     *[RIP/100] 00:45:05, metric 3, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
224.0.0.9/32       *[RIP/100] 00:45:09, metric 1
                         MultiRecv
```

Meaning The output shows that the routes have been learned from Device R2 and Device R3.

If you were to delete the **from protocol rip** condition in the routing policy on Device R2, the remote routes from Device R3 would not be learned on Device R1.

Looking at the Routes That Device R1 Is Advertising to Device R2

Purpose Verify that Device R1 is sending the expected routes.

Action From operational mode, enter the **show route advertising-protocol rip** command.

```
user@R1> show route advertising-protocol rip 10.0.0.1
inet.0: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.0.1/32      *[Direct/0] 05:18:26
                    >     via lo0.1
192.168.1.1/32     *[Direct/0] 05:18:25
                    >     via lo0.1
```

Meaning Device R1 is sending routes to its directly connected networks.

Looking at the Routes That Device R1 Is Receiving from Device R2

Purpose Verify that Device R1 is receiving the expected routes.

Action From operational mode, enter the **show route receive-protocol rip** command.

```
user@R1> show route receive-protocol rip 10.0.0.2
inet.0: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.4/30        *[RIP/100] 02:31:22, metric 2, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
172.16.2.2/32      *[RIP/100] 04:24:55, metric 2, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
172.16.3.3/32      *[RIP/100] 02:17:12, metric 3, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
192.168.2.2/32     *[RIP/100] 04:24:55, metric 2, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
192.168.3.3/32     *[RIP/100] 02:17:12, metric 3, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
```

Meaning Device R1 is receiving from Device R2 all of Device R2's directly connected networks. Device R1 is also receiving from Device R2 all of Device R3's directly connected networks, which Device R2 learned from Device R3 through RIP.

Verifying the RIP-Enabled Interfaces

Purpose Verify that all RIP-enabled Interfaces are available and active.

Action From operational mode, enter the **show rip neighbor** command.

```
user@R1> show rip neighbor
                  Local  Source         Destination     Send   Receive   In
Neighbor          State  Address        Address         Mode   Mode      Met
--------          -----  -------        -----------     ----   -------   ---
fe-1/2/0.1           Up 10.0.0.1       224.0.0.9       mcast  both      1
```

Meaning The output shows that the RIP-enabled interface on Device R1 is operational.

In general for this command, the output shows a list of the RIP neighbors that are configured on the device. Verify the following information:

- Each configured interface is present. Interfaces are listed in alphabetical order.
- Each configured interface is up. The state of the interface is listed in the **Local State** column. A state of **Up** indicates that the link is passing RIP traffic. A state of **Dn** indicates that the link is not passing RIP traffic. In a point-to-point link, this state generally means that either the end point is not configured for RIP or the link is unavailable.

Verifying the Exchange of RIP Messages

Purpose Verify that RIP messages are being sent and received on all RIP-enabled interfaces.

Action From operational mode, enter the **show rip statistics** command.

```
user@R1> show rip statistics
RIPv2 info: port 520; holddown 120s.
    rts learned  rts held down  rqsts dropped  resps dropped
              5              0              0              0

fe-1/2/0.1:  5 routes learned; 2 routes advertised; timeout 180s; update interval
 30s
Counter                          Total   Last 5 min  Last minute
-------                    -----------  -----------  -----------
Updates Sent                      2669           10            2
Triggered Updates Sent               2            0            0
Responses Sent                       0            0            0
Bad Messages                         0            0            0
RIPv1 Updates Received               0            0            0
RIPv1 Bad Route Entries              0            0            0
RIPv1 Updates Ignored                0            0            0
RIPv2 Updates Received            2675           11            2
RIPv2 Bad Route Entries              0            0            0
RIPv2 Updates Ignored                0            0            0
Authentication Failures              0            0            0
RIP Requests Received                0            0            0
RIP Requests Ignored                 0            0            0
none                                 0            0            0
```

Meaning The output shows the number of RIP routes learned. It also shows the number of RIP updates sent and received on the RIP-enabled interfaces. Verify the following information:

- The number of RIP routes learned matches the number of expected routes learned. Subnets learned by direct connectivity through an outgoing interface are not listed as RIP routes.
- RIP updates are being sent on each RIP-enabled interface. If no updates are being sent, the routing policy might not be configured to export routes.
- RIP updates are being received on each RIP-enabled interface. If no updates are being received, the routing policy might not be configured to export routes on the host connected to that subnet. The lack of updates might also indicate an authentication error.

Verifying Reachability of All Hosts in the RIP Network

Purpose Use the **traceroute** command on each loopback address in the network to verify that all hosts in the RIP network are reachable from each Juniper Networks device.

Action From operational mode, enter the **traceroute** command.

```
user@R1> traceroute 192.168.3.3
traceroute to 192.168.3.3 (192.168.3.3), 30 hops max, 40 byte packets
 1  10.0.0.2 (10.0.0.2)  1.094 ms  1.028 ms  0.957 ms
 2  192.168.3.3 (192.168.3.3)  1.344 ms  2.245 ms  2.125 ms
```

Meaning Each numbered row in the output indicates a routing hop in the path to the host. The three-time increments indicate the round-trip time (RTT) between the device and the hop for each traceroute packet.

To ensure that the RIP network is healthy, verify the following information:

- The final hop in the list is the host you want to reach.
- The number of expected hops to the host matches the number of hops in the traceroute output. The appearance of more hops than expected in the output indicates that a network segment is probably unreachable. It might also indicate that the incoming or outgoing metric on one or more hosts has been set unexpectedly.

Related Documentation

- *Example: Configuring Point-to-Multipoint RIP Networks*

Example: Configuring Authentication for RIP Routes

Understanding RIP Authentication

RIPv2 provides authentication support so that RIP links can require authentication keys (passwords) before they become active. Authentication provides an additional layer of security on the network beyond the other security features. By default, this authentication is disabled.

Authentication keys can be specified in either plain-text or MD5 form. Authentication requires all routers within the RIP network or subnetwork to have the same authentication type and key (password) configured.

This type of authentication is not supported on RIPv1 networks.

Example: Configuring Route Authentication for RIP

This example shows how to configure authentication for a RIP network.

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

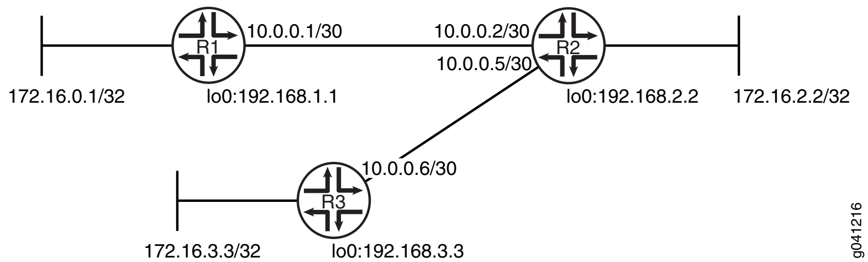
You can configure the router to authenticate RIP route queries. By default, authentication is disabled. You can use one of the following authentication methods:

- Simple authentication—Uses a text password that is included in the transmitted packet. The receiving router uses an authentication key (password) to verify the packet.
- MD5 authentication—Creates an encoded checksum that is included in the transmitted packet. The receiving router uses an authentication key (password) to verify the packet's MD5 checksum.

This example shows MD5 authentication.

Figure 101 on page 3645 shows the topology used in this example.

Figure 101: RIP Authentication Network Topology



"CLI Quick Configuration" on page 3645 shows the configuration for all of the devices in Figure 101 on page 3645. The section "Step-by-Step Procedure" on page 3646 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set interfaces lo0 unit 1 family inet address 172.16.0.1/32
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.1
set protocols rip authentication-type md5
set protocols rip authentication-key "$9$ONLRBhreK87dsM8i.5FAtM8XxNb"
set protocols rip traceoptions file rip-authentication-messages
set protocols rip traceoptions flag auth
set protocols rip traceoptions flag packets
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 5 family inet address 10.0.0.5/30
set interfaces lo0 unit 2 family inet address 192.168.2.2/32
set interfaces lo0 unit 2 family inet address 172.16.2.2/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.2
```

```
set protocols rip group rip-group neighbor fe-1/2/1.5
set protocols rip authentication-type md5
set protocols rip authentication-key "$9$Lf1Xds2gJDHmoJCu1hKvoJGUjq"
set protocols rip traceoptions file rip-authentication-messages
set protocols rip traceoptions flag auth
set protocols rip traceoptions flag packets
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R3

```
set interfaces fe-1/2/0 unit 6 family inet address 10.0.0.6/30
set interfaces lo0 unit 3 family inet address 192.168.3.3/32
set interfaces lo0 unit 3 family inet address 172.16.3.3/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.6
set protocols rip authentication-type md5
set protocols rip authentication-key "$9$G.UkP5T39tOz3K87V4oz36/Cu"
set protocols rip traceoptions file rip-authentication-messages
set protocols rip traceoptions flag auth
set protocols rip traceoptions flag packets
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure RIP authentication:

1. Configure the network interfaces.

   This example shows multiple loopback interface addresses to simulate attached networks.

   ```
   [edit interfaces]
   user@R1# set fe-1/2/0 unit 1 family inet address 10.0.0.1/30

   user@R1# set lo0 unit 1 family inet address 172.16.0.1/32
   user@R1# set lo0 unit 1 family inet address 192.168.1.1/32
   ```

2. Create the RIP group and add the interface.

   To configure RIP in Junos OS, you must configure a group that contains the interfaces on which RIP is enabled. You do not need to enable RIP on the loopback interface.

   ```
   [edit protocols rip group rip-group]
   user@R1# set neighbor fe-1/2/0.1
   ```

3. Create the routing policy to advertise both direct and RIP-learned routes.

   ```
   [edit policy-options policy-statement advertise-routes-through-rip term 1]
   user@R1# set from protocol direct
   ```

```
user@R1# set from protocol rip
user@R1# set then accept
```

4. Apply the routing policy.

   In Junos OS, you can only apply RIP export policies at the group level.

   ```
   [edit protocols rip group rip-group]
   user@R1# set export advertise-routes-through-rip
   ```

5. Require MD5 authentication for RIP route queries received on an interface.

   The passwords must match on neighboring RIP routers. If the password does not match, the packet is rejected. The password can be from 1 through 16 contiguous characters long and can include any ASCII strings.

   Do not enter the password as shown here. The password shown here is the encrypted password that is displayed in the configuration after the actual password is already configured.

   ```
   [edit protocols rip]
   user@R1# set authentication-type md5
   user@R1# set authentication-key "$9$ONLRBhreK87dsM8i.5FAtM8XxNb"
   ```

6. Configure tracing operations to track authentication.

   ```
   [edit protocols rip traceoptions]
   user@R1# set file rip-authentication-messages
   user@R1# set flag auth
   user@R1# set flag packets
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R1# show interfaces
fe-1/2/0 {
  unit 1 {
    family inet {
      address 10.0.0.1/30;
    }
  }
}
lo0 {
  unit 1 {
    family inet {
      address 172.16.0.1/32;
      address 192.168.1.1/32;
    }
  }
}
```

```
user@R1# show protocols
rip {
  traceoptions {
    file rip-authentication-messages;
    flag auth;
```

```
      flag packets;
    }
    authentication-type md5;
    authentication-key "$9$ONLRBhreK87dsM8i.5FAtM8XxNb"; ## SECRET-DATA
    group rip-group {
      export advertise-routes-through-rip;
      neighbor fe-1/2/0.1;
    }
  }
```

```
user@R1# show policy-options
policy-statement advertise-routes-through-rip {
  term 1 {
    from protocol [ direct rip ];
    then accept;
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking for Authentication Failures on page 3648
- Verifying That MD5 Authentication Is Enabled in RIP Update Packets on page 3649

Checking for Authentication Failures

Purpose Verify that there are no authentication failures.

Action From operational mode, enter the **show rip statistics** command.

```
user@R1> show rip statistics
RIPv2 info: port 520; holddown 120s.
    rts learned  rts held down  rqsts dropped  resps dropped
              5              0              0              0

fe-1/2/0.1:  5 routes learned; 2 routes advertised; timeout 180s; update interval
 30s
Counter                          Total   Last 5 min  Last minute
-------                    -----------  -----------  -----------
Updates Sent                      2669           10            2
Triggered Updates Sent               2            0            0
Responses Sent                       0            0            0
Bad Messages                         0            0            0
RIPv1 Updates Received               0            0            0
RIPv1 Bad Route Entries              0            0            0
RIPv1 Updates Ignored                0            0            0
RIPv2 Updates Received            2675           11            2
RIPv2 Bad Route Entries              0            0            0
RIPv2 Updates Ignored                0            0            0
Authentication Failures          0            0            0
RIP Requests Received                0            0            0
RIP Requests Ignored                 0            0            0
none                                 0            0            0
```

Meaning The output shows that there are no authentication failures.

Verifying That MD5 Authentication Is Enabled in RIP Update Packets

Purpose Use tracing operations to verify that MD5 authentication is enabled in RIP updates.

Action From operational mode, enter the **show log** command.

```
user@R1> show log rip-authentication-messages | match md5
Feb 15 15:45:13.969462          sending msg 0xb9a8c04, 3 rtes (needs MD5)
Feb 15 15:45:43.229867          sending msg 0xb9a8c04, 3 rtes (needs MD5)
Feb 15 15:46:13.174410          sending msg 0xb9a8c04, 3 rtes (needs MD5)
Feb 15 15:46:42.716566          sending msg 0xb9a8c04, 3 rtes (needs MD5)
Feb 15 15:47:11.425076          sending msg 0xb9a8c04, 3 rtes (needs MD5)
...
```

Meaning The **(needs MD5)** output shows that all route updates require MD5 authentication.

Enabling Authentication with Plain-Text Passwords (CLI Procedure)

To configure authentication that requires a plain-text password to be included in the transmitted packet, enable simple authentication by performing these steps on all RIP devices in the network:

1. Navigate to the top of the configuration hierarchy.
2. Perform the configuration tasks described in Table 262 on page 3649.
3. If you are finished configuring the router, commit the configuration.

Table 262: Configuring Simple RIP Authentication

Task	CLI Configuration Editor
Navigate to **Rip** level in the configuration hierarchy.	From the **[edit]** hierarchy level, enter **edit protocols rip**
Set the authentication type to **simple**.	Set the authentication type to **simple**: **set authentication-type simple**
Set the authentication key to a simple-text password. The password can be from 1 through 16 contiguous characters long and can include any ASCII strings.	Set the authentication key to a simple-text password: **set authentication-key *password***

Enabling Authentication with MD5 Authentication (CLI Procedure)

To configure authentication that requires an MD5 password to be included in the transmitted packet, enable MD5 authentication by performing these steps on all RIP devices in the network:

1. Navigate to the top of the configuration hierarchy.
2. Perform the configuration tasks described in Table 263 on page 3650.
3. If you are finished configuring the router, commit the configuration.

Table 263: Configuring MD5 RIP Authentication

Task	CLI Configuration Editor
Navigate to **Rip** level in the configuration hierarchy.	From the **[edit]** hierarchy level, enter **edit protocols rip**
Set the authentication type to **MD5**.	Set the authentication type to **md5**: **set authentication-type md5**
Set the MD5 authentication key (password). The key can be from 1 through 16 contiguous characters long and can include any ASCII strings.	Set the MD5 authentication key: **set authentication-key *password***

Related Documentation

- Example: Configuring RIP on page 3637

Example: Configuring BFD for RIP

Understanding BFD for RIP

The Bidirectional Forwarding Detection (BFD) Protocol is a simple hello mechanism that detects failures in a network. Hello packets are sent at a specified, regular interval. A neighbor failure is detected when the routing device stops receiving a reply after a specified interval. BFD works with a wide variety of network environments and topologies. BFD failure detection times are shorter than RIP detection times, providing faster reaction times to various kinds of failures in the network. Instead of waiting for the routing protocol neighbor timeout, BFD provides rapid detection of link failures. BFD timers are adaptive and can be adjusted to be more or less aggressive. For example, a timer can adapt to a higher value if the adjacency fails, or a neighbor can negotiate a higher value for a timer than the one configured.

BFD enables quick failover between a primary and a secondary routed path. The protocol tests the operational status of the interface multiple times per second. BFD provides for configuration timers and thresholds for failure detection. For example, if the minimum interval is set for 50 milliseconds and the threshold uses the default value of three missed messages, a failure is detected on an interface within 200 milliseconds of the failure.

Intervening devices (for example, an Ethernet LAN switch) hide link-layer failures from routing protocol peers, such as when two routers are connected by way of a LAN switch, where the local interface status remains up even when a physical fault happens on the remote link. Link-layer failure detection times vary, depending on the physical media and the Layer 2 encapsulation. BFD can provide fast failure detection times for all media types, encapsulations, topologies, and routing protocols.

To enable BFD for RIP, both sides of the connection must receive an update message from the peer. By default, RIP does not export any routes. Therefore, you must enable update messages to be sent by configuring an export policy for routes before a BFD session is triggered.

Example: Configuring BFD for RIP

This example shows how to configure Bidirectional Forwarding Detection (BFD) for a RIP network.

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

To enable failure detection, include the **bfd-liveness-detection** statement:

```
bfd-liveness-detection {
  detection-time {
    threshold milliseconds;
  }
  minimum-interval milliseconds;
  minimum-receive-interval milliseconds;
  multiplier number;
  no-adaptation;
  transmit-interval {
    threshold milliseconds;
    minimum-interval milliseconds;
  }
  version (1 | automatic);
}
```

Optionally, you can specify the threshold for the adaptation of the detection time by including the **threshold** statement. When the BFD session detection time adapts to a value equal to or greater than the threshold, a single trap and a system log message are sent.

To specify the minimum transmit and receive interval for failure detection, include the **minimum-interval** statement. This value represents the minimum interval at which the local routing device transmits hello packets as well as the minimum interval at which the routing device expects to receive a reply from a neighbor with which it has established a BFD session. You can configure a value in the range from 1 through 255,000 milliseconds. This examples sets a minimum interval of 600 milliseconds.

NOTE: BFD is an intensive protocol that consumes system resources. Specifying a minimum interval for BFD of less than 100 ms for Routing Engine-based sessions and 10 ms for distributed BFD sessions can cause undesired BFD flapping.

Depending on your network environment, these additional recommendations might apply:

- For large-scale network deployments with a large number of BFD sessions, specify a minimum interval of 300 ms for Routing Engine-based sessions and 100 ms for distributed BFD sessions.
- For very large-scale network deployments with a large number of BFD sessions, contact Juniper Networks customer support for more information.
- For BFD sessions to remain up during a Routing Engine switchover event when nonstop active routing (NSR) is configured, specify a minimum interval of 2500 ms for Routing Engine-based sessions. For distributed BFD sessions with nonstop active routing configured, the minimum interval recommendations are unchanged and depend only on your network deployment.

You can optionally specify the minimum transmit and receive intervals separately.

To specify only the minimum receive interval for failure detection, include the **minimum-receive-interval** statement. This value represents the minimum interval at which the local routing device expects to receive a reply from a neighbor with which it has established a BFD session. You can configure a value in the range from 1 through 255,00 milliseconds.

To specify only the minimum transmit interval for failure detection, include the **transmit-interval minimum-interval** statement. This value represents the minimum interval at which the local routing device transmits hello packets to the neighbor with which it has established a BFD session. You can configure a value in the range from 1 through 255,000 milliseconds.

To specify the number of hello packets not received by a neighbor that causes the originating interface to be declared down, include the **multiplier** statement. The default is 3, and you can configure a value in the range from 1 through 255.

To specify the threshold for detecting the adaptation of the transmit interval, include the **transmit-interval threshold** statement. The threshold value must be greater than the transmit interval.

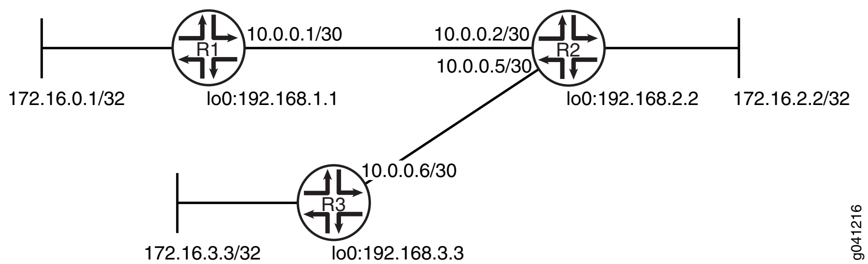
To specify the BFD version used for detection, include the **version** statement. The default is to have the version detected automatically.

You can trace BFD operations by including the **traceoptions** statement at the **[edit protocols bfd]** hierarchy level.

In Junos OS Release 9.0 and later, you can configure BFD sessions not to adapt to changing network conditions. To disable BFD adaptation, include the **no-adaptation** statement. We recommend that you not disable BFD adaptation unless it is preferable not to have BFD adaptation enabled in your network.

Figure 102 on page 3653 shows the topology used in this example.

Figure 102: RIP BFD Network Topology



“CLI Quick Configuration” on page 3653 shows the configuration for all of the devices in Figure 102 on page 3653. The section “Step-by-Step Procedure” on page 3654 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set protocols bfd traceoptions file bfd-trace
set protocols bfd traceoptions flag all
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.1
set protocols rip group rip-group bfd-liveness-detection minimum-interval 600
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 5 family inet address 10.0.0.5/30
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.2
set protocols rip group rip-group neighbor fe-1/2/1.5
set protocols rip group rip-group bfd-liveness-detection minimum-interval 600
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R3

```
set interfaces fe-1/2/0 unit 6 family inet address 10.0.0.6/30
set protocols rip group rip-group export advertise-routes-through-rip
```

set protocols rip group rip-group neighbor fe-1/2/0.6
set protocols rip group rip-group bfd-liveness-detection minimum-interval 600
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure a BFD for a RIP network:

1. Configure the network interfaces.

   [edit interfaces]
   user@R1# **set fe-1/2/0 unit 1 family inet address 10.0.0.1/30**

2. Create the RIP group and add the interface.

   To configure RIP in Junos OS, you must configure a group that contains the interfaces on which RIP is enabled. You do not need to enable RIP on the loopback interface.

   [edit protocols rip group rip-group]
   user@R1# **set neighbor fe-1/2/0.1**

3. Create the routing policy to advertise both direct and RIP-learned routes.

   [edit policy-options policy-statement advertise-routes-through-rip term 1]
   user@R1# **set from protocol direct**
   user@R1# **set from protocol rip**
   user@R1# **set then accept**

4. Apply the routing policy.

   In Junos OS, you can only apply RIP export policies at the group level.

   [edit protocols rip group rip-group]
   user@R1# **set export advertise-routes-through-rip**

5. Enable BFD.

   [edit protocols rip group rip-group]
   user@R1# **set bfd-liveness-detection minimum-interval 600**

6. Configure tracing operations to track BFD messages.

   [edit protocols bfd traceoptions]
   user@R1# **set file bfd-trace**
   user@R1# **set flag all**

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

user@R1# **show interfaces**
fe-1/2/0 {

```
  unit 1 {
    family inet {
      address 10.0.0.1/30;
    }
  }
}
```

```
user@R1# show protocols
bfd {
  traceoptions {
    file bfd-trace;
    flag all;
  }
}
rip {
  group rip-group {
    export advertise-routes-through-rip;
    bfd-liveness-detection {
      minimum-interval 600;
    }
    neighbor fe-1/2/0.1;
  }
}
```

```
user@R1# show policy-options
policy-statement advertise-routes-through-rip {
  term 1 {
    from protocol [ direct rip ];
    then accept;
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying That the BFD Sessions Are Up on page 3655
- Checking the BFD Trace File on page 3656

Verifying That the BFD Sessions Are Up

Purpose Make sure that the BFD sessions are operating.

Action From operational mode, enter the **show bfd session** command.

```
user@R1>  show bfd session
                                                  Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
10.0.0.2                 Up        fe-1/2/0.1     1.800     0.600       3

1 sessions, 1 clients
Cumulative transmit rate 1.7 pps, cumulative receive rate 1.7 pps
```

Meaning The output shows that there are no authentication failures.

Checking the BFD Trace File

Purpose Use tracing operations to verify that BFD packets are being exchanged.

Action From operational mode, enter the **show log** command.

```
user@R1> show log bfd-trace
Feb 16 10:26:32 PPM Trace: BFD periodic xmit to 10.0.0.2 (IFL 124, rtbl 53,
single-hop port)
Feb 16 10:26:32 Received Downstream TraceMsg (24) len 86:
Feb 16 10:26:32    IfIndex (3) len 4: 0
Feb 16 10:26:32    Protocol (1) len 1: BFD
Feb 16 10:26:32    Data (9) len 61: (hex) 42 46 44 20 70 61 63 6b 65 74 20 66 72
 6f 6d 20 31 30 2e
Feb 16 10:26:32 PPM Trace: BFD packet from 10.0.0.1 (IFL 73, rtbl 56, ttl 255)
absorbed
Feb 16 10:26:32 Received Downstream TraceMsg (24) len 60:
Feb 16 10:26:32    IfIndex (3) len 4: 0
Feb 16 10:26:32    Protocol (1) len 1: BFD
Feb 16 10:26:32    Data (9) len 35: (hex) 42 46 44 20 70 65 72 69 6f 64 69 63 20
 78 6d 69 74 20 6f
...
```

Meaning The output shows the normal functioning of BFD.

Related Documentation

- Example: Configuring RIP on page 3637
- Example: Configuring Authentication for RIP Routes on page 3644

- *Example: Configuring Point-to-Multipoint RIP Networks*

Example: Configuring BFD Authentication for RIP

Understanding BFD Authentication for RIP

BFD enables rapid detection of communication failures between adjacent systems. By default, authentication for BFD sessions is disabled. However, when running BFD over Network Layer protocols, the risk of service attacks can be significant. We strongly recommend using authentication if you are running BFD over multiple hops or through insecure tunnels. Beginning with Junos OS Release 9.6, Junos OS supports authentication for BFD sessions running over RIP. BFD authentication is only supported in the domestic image and is not available in the export image.

You authenticate BFD sessions by specifying an authentication algorithm and keychain, and then associating that configuration information with a security authentication keychain using the keychain name.

The following sections describe the supported authentication algorithms, security keychains, and the level of authentication that can be configured:

- BFD Authentication Algorithms on page 3657
- Security Authentication Keychains on page 3657
- Strict Versus Loose Authentication on page 3658

BFD Authentication Algorithms

Junos OS supports the following algorithms for BFD authentication:

- **simple-password**—Plain-text password. One to 16 bytes of plain text are used to authenticate the BFD session. One or more passwords can be configured. This method is the least secure and should be used only when BFD sessions are not subject to packet interception.
- **keyed-md5**—Keyed Message Digest 5 hash algorithm for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed MD5 uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than or equal to the last sequence number received. Although more secure than a simple password, this method is vulnerable to replay attacks. Increasing the rate at which the sequence number is updated can reduce this risk.
- **meticulous-keyed-md5**—Meticulous keyed Message Digest 5 hash algorithm. This method works in the same manner as keyed MD5, but the sequence number is updated with every packet. Although more secure than keyed MD5 and simple passwords, this method might take additional time to authenticate the session.
- **keyed-sha-1**—Keyed Secure Hash Algorithm I for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed SHA uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. The key is not carried within the packets. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than the last sequence number received.
- **meticulous-keyed-sha-1**—Meticulous keyed Secure Hash Algorithm I. This method works in the same manner as keyed SHA, but the sequence number is updated with every packet. Although more secure than keyed SHA and simple passwords, this method might take additional time to authenticate the session.

NOTE: Nonstop active routing is not supported with meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.

Security Authentication Keychains

The security authentication keychain defines the authentication attributes used for authentication key updates. When the security authentication keychain is configured and associated with a protocol through the keychain name, authentication key updates can occur without interrupting routing and signaling protocols.

The authentication keychain contains one or more keychains. Each keychain contains one or more keys. Each key holds the secret data and the time at which the key becomes valid. The algorithm and keychain must be configured on both ends of the BFD session, and they must match. Any mismatch in configuration prevents the BFD session from being created.

BFD allows multiple clients per session, and each client can have its own keychain and algorithm defined. To avoid confusion, we recommend specifying only one security authentication keychain.

Strict Versus Loose Authentication

By default, strict authentication is enabled and authentication is checked at both ends of each BFD session. Optionally, to smooth migration from nonauthenticated sessions to authenticated sessions, you can configure *loose checking*. When loose checking is configured, packets are accepted without authentication being checked at each end of the session. This feature is intended for transitional periods only.

Example: Configuring BFD Authentication for RIP

This example shows how to configure Bidirectional Forwarding Detection (BFD) authentication for a RIP network.

Requirements

No special configuration beyond device initialization is required before configuring this example.

The devices must be running Junos OS Release 9.6 or later.

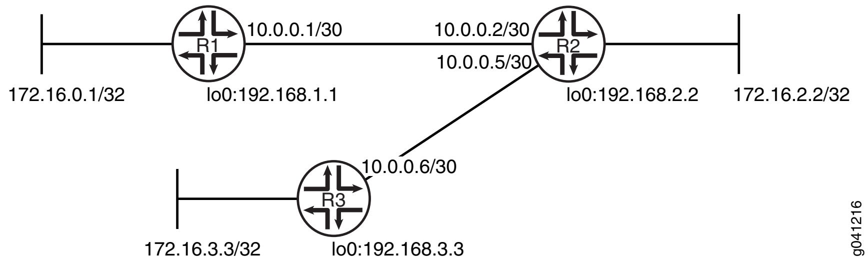
Overview

Only three steps are needed to configure authentication on a BFD session:

1. Specify the BFD authentication algorithm for the RIP protocol.
2. Associate the authentication keychain with the RIP protocol.
3. Configure the related security authentication keychain.

Figure 103 on page 3659 shows the topology used in this example.

Figure 103: RIP BFD Authentication Network Topology



"CLI Quick Configuration" on page 3659 shows the configuration for all of the devices in Figure 103 on page 3659. The section "Step-by-Step Procedure" on page 3660 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set protocols bfd traceoptions file bfd-trace
set protocols bfd traceoptions flag all
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.1
set protocols rip group rip-group bfd-liveness-detection minimum-interval 600
set protocols rip group rip-group bfd-liveness-detection authentication key-chain bfd-rip
set protocols rip group rip-group bfd-liveness-detection authentication algorithm
  keyed-md5
set protocols rip group rip-group bfd-liveness-detection authentication loose-check
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
set security authentication-key-chains key-chain bfd-rip key 53 secret
  "$9$d1V2aZGi.fzDiORSeXxDikqmT"
set security authentication-key-chains key-chain bfd-rip key 53 start-time
  "2012-2-16.12:00:00 -0800"
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 5 family inet address 10.0.0.5/30
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.2
set protocols rip group rip-group neighbor fe-1/2/1.5
set protocols rip group rip-group bfd-liveness-detection minimum-interval 600
set protocols rip group rip-group bfd-liveness-detection authentication key-chain bfd-rip
set protocols rip group rip-group bfd-liveness-detection authentication algorithm
  keyed-md5
set protocols rip group rip-group bfd-liveness-detection authentication loose-check
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
```



```
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
set security authentication-key-chains key-chain bfd-rip key 53 secret
  "$9$d1V2aZGi.fzDiORSeXxDikqmT"
set security authentication-key-chains key-chain bfd-rip key 53 start-time
  "2012-2-16.12:00:00 -0800"
```

Device R3

```
set interfaces fe-1/2/0 unit 6 family inet address 10.0.0.6/30
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.6
set protocols rip group rip-group bfd-liveness-detection minimum-interval 600
set protocols rip group rip-group bfd-liveness-detection authentication key-chain bfd-rip
set protocols rip group rip-group bfd-liveness-detection authentication algorithm
  keyed-md5
set protocols rip group rip-group bfd-liveness-detection authentication loose-check
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
set security authentication-key-chains key-chain bfd-rip key 53 secret
  "$9$d1V2aZGi.fzDiORSeXxDikqmT"
set security authentication-key-chains key-chain bfd-rip key 53 start-time
  "2012-2-16.12:00:00 -0800"
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure a BFD authentication:

1. Configure the network interfaces.

   ```
   [edit interfaces]
   user@R1# set fe-1/2/0 unit 1 family inet address 10.0.0.1/30
   ```

2. Create the RIP group and add the interface.

   To configure RIP in Junos OS, you must configure a group that contains the interfaces on which RIP is enabled. You do not need to enable RIP on the loopback interface.

   ```
   [edit protocols rip group rip-group]
   user@R1# set neighbor fe-1/2/0.1
   ```

3. Create the routing policy to advertise both direct and RIP-learned routes.

   ```
   [edit policy-options policy-statement advertise-routes-through-rip term 1]
   user@R1# set from protocol direct
   user@R1# set from protocol rip
   user@R1# set then accept
   ```

4. Apply the routing policy.

   In Junos OS, you can only apply RIP export policies at the group level.

   ```
   [edit protocols rip group rip-group]
   user@R1# set export advertise-routes-through-rip
   ```

5. Enable BFD.

   [edit protocols rip group rip-group]
   user@R1# **set bfd-liveness-detection minimum-interval 600**

6. Specify the algorithm (**keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**, or **simple-password**) to use.

   NOTE: Nonstop active routing is not supported with meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.

   [edit protocols rip group rip-group]
   user@R1# **set bfd-liveness-detection authentication algorithm keyed-md5**

7. Specify the keychain to be used to associate BFD sessions on RIP with the unique security authentication keychain attributes.

   The keychain you specify must match a keychain name configured at the **[edit security authentication key-chains]** hierarchy level.

   The algorithm and keychain must be configured on both ends of the BFD session, and they must match. Any mismatch in configuration prevents the BFD session from being created.

   [edit protocols rip group rip-group]
   user@R1# **set bfd-liveness-detection authentication key-chain bfd-rip**

8. (Optional) Specify loose authentication checking if you are transitioning from nonauthenticated sessions to authenticated sessions.

   [edit protocols rip group rip-group]
   user@R1# **set bfd-liveness-detection authentication loose-check**

9. Specify the unique security authentication information for BFD sessions:

   - The matching keychain name as specified in Step 7.
   - At least one key, a unique integer between **0** and **63**. Creating multiple keys allows multiple clients to use the BFD session.
   - The secret data used to allow access to the session.
   - The time at which the authentication key becomes active, in the format *yyyy-mm-dd.hh:mm:ss*.

   [edit security authentication-key-chains key-chain bfd-rip]
   user@R1# **set key 53 secret "9d1V2aZGi.fzDiORSeXxDikqmT"**
   user@R1# **set key 53 start-time "2012-2-16.12:00:00 -0800"**

10. Configure tracing operations to track BFD authentication.

    [edit protocols bfd traceoptions]
    user@R1# **set file bfd-trace**
    user@R1# **set flag all**

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show security** commands. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R1# show interfaces
fe-1/2/0 {
  unit 1 {
    family inet {
      address 10.0.0.1/30;
    }
  }
}
```

```
user@R1# show protocols
bfd {
  traceoptions {
    file bfd-trace;
    flag all;
  }
}
rip {
  group rip-group {
    export advertise-routes-through-rip;
    bfd-liveness-detection {
      minimum-interval 600;
    }
    neighbor fe-1/2/0.1;
  }
}
```

```
user@R1# show policy-options
policy-statement advertise-routes-through-rip {
  term 1 {
    from protocol [ direct rip ];
    then accept;
  }
}
```

```
user@R1# show security
authentication-key-chains {
  key-chain bfd-rip {
    key 53 {
      secret "$9$d1V2aZGi.fzDiORSeXxDikqmT"; ## SECRET-DATA
      start-time "2012-2-16.12:00:00 -0800";
    }
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying That the BFD Sessions Are Authenticated on page 3663
- Viewing Extensive Information About the BFD Authentication on page 3663
- Checking the BFD Trace File on page 3664

Verifying That the BFD Sessions Are Authenticated

Purpose Make sure that the BFD sessions are authenticated.

Action From operational mode, enter the **show bfd session detail** command.

```
user@R1> show bfd session detail
                                                  Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
10.0.0.2                 Up        fe-1/2/0.1     1.800     0.600       3
 Client RIP, TX interval 0.600, RX interval 0.600, Authenticate
 Session up time 01:39:34
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 Logical system 6, routing table index 53

1 sessions, 1 clients
Cumulative transmit rate 1.7 pps, cumulative receive rate 1.7 pps
```

Meaning **Authenticate** is displayed to indicate that BFD authentication is configured.

Viewing Extensive Information About the BFD Authentication

Purpose View the keychain name, the authentication algorithm and mode for each client in the session, and the BFD authentication configuration status.

Action From operational mode, enter the **show bfd session extensive** command.

```
user@R1> show bfd session extensive
                                                  Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
10.0.0.2                 Up        fe-1/2/0.1     1.800     0.600       3
 Client RIP, TX interval 0.600, RX interval 0.600, Authenticate
        keychain bfd-rip, algo keyed-md5, mode loose
 Session up time 01:46:29
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 Logical system 6, routing table index 53
 Min async interval 0.600, min slow interval 1.000
 Adaptive async TX interval 0.600, RX interval 0.600
 Local min TX interval 0.600, minimum RX interval 0.600, multiplier 3
 Remote min TX interval 0.600, min RX interval 0.600, multiplier 3
 Local discriminator 225, remote discriminator 226
 Echo mode disabled/inactive
 Authentication enabled/active, keychain bfd-rip, algo keyed-md5, mode loose
  Session ID: 0x300501

1 sessions, 1 clients
Cumulative transmit rate 1.7 pps, cumulative receive rate 1.7 pps
```

Meaning The output shows the keychain name, the authentication algorithm and mode for the client in the session, and the BFD authentication configuration status.

Checking the BFD Trace File

Purpose Use tracing operations to verify that BFD packets are being exchanged.

Action From operational mode, enter the **show log** command.

```
user@R1> show log bfd-trace
Feb 16 10:26:32 PPM Trace: BFD periodic xmit to 10.0.0.2 (IFL 124, rtbl 53,
single-hop port)
Feb 16 10:26:32 Received Downstream TraceMsg (24) len 86:
Feb 16 10:26:32    IfIndex (3) len 4: 0
Feb 16 10:26:32    Protocol (1) len 1: BFD
Feb 16 10:26:32    Data (9) len 61: (hex) 42 46 44 20 70 61 63 6b 65 74 20 66 72
 6f 6d 20 31 30 2e
Feb 16 10:26:32 PPM Trace: BFD packet from 10.0.0.1 (IFL 73, rtbl 56, ttl 255)
absorbed
Feb 16 10:26:32 Received Downstream TraceMsg (24) len 60:
Feb 16 10:26:32    IfIndex (3) len 4: 0
Feb 16 10:26:32    Protocol (1) len 1: BFD
Feb 16 10:26:32    Data (9) len 35: (hex) 42 46 44 20 70 65 72 69 6f 64 69 63 20
 78 6d 69 74 20 6f
...
```

Meaning The output shows the normal functioning of BFD.

Related Documentation

- Example: Configuring BFD for RIP on page 3650
- Example: Configuring Authentication for RIP Routes on page 3644
- Example: Configuring RIP on page 3637

Example: Applying Policies to RIP Routes Imported from Neighbors

- Understanding RIP Import Policy on page 3664
- Example: Applying Policies to RIP Routes Imported from Neighbors on page 3664

Understanding RIP Import Policy

The default RIP import policy is to accept all received RIP routes that pass a sanity check. To filter routes being imported by the local routing device from its neighbors, include the **import** statement, and list the names of one or more policies to be evaluated. If you specify more than one policy, they are evaluated in order (first to last) and the first matching policy is applied to the route. If no match is found, the local routing device does not import any routes.

Example: Applying Policies to RIP Routes Imported from Neighbors

This example shows how to configure an import policy in a RIP network.

- Requirements on page 3665
- Overview on page 3665

- Configuration on page 3665
- Verification on page 3668

Requirements

No special configuration beyond device initialization is required before configuring this example.

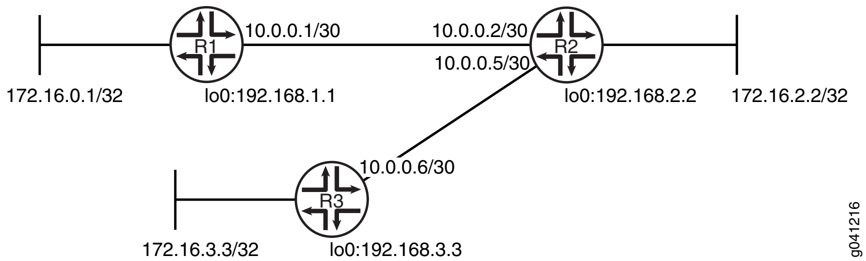
Overview

In this example, Device R1 has an import policy that accepts the 10/8 and 192.168/16 RIP routes and rejects all other RIP routes. This means that the 172.16/16 RIP routes are excluded from Device R1's routing table.

An export policy is also shown because an export policy is required as part of the minimum configuration for RIP.

Figure 104 on page 3665 shows the topology used in this example.

Figure 104: RIP Import Policy Network Topology



"CLI Quick Configuration" on page 3665 shows the configuration for all of the devices in Figure 104 on page 3665. The section "Step-by-Step Procedure" on page 3666 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set interfaces lo0 unit 1 family inet address 172.16.0.1/32
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols rip import rip-import
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.1
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
set policy-options policy-statement rip-import term 1 from protocol rip
set policy-options policy-statement rip-import term 1 from route-filter 10.0.0.0/8 orlonger
set policy-options policy-statement rip-import term 1 from route-filter 192.168.0.0/16
  orlonger
```

```
set policy-options policy-statement rip-import term 1 then accept
set policy-options policy-statement rip-import term 2 then reject
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 5 family inet address 10.0.0.5/30
set interfaces lo0 unit 2 family inet address 192.168.2.2/32
set interfaces lo0 unit 2 family inet address 172.16.2.2/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.2
set protocols rip group rip-group neighbor fe-1/2/1.5
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R3

```
set interfaces fe-1/2/0 unit 6 family inet address 10.0.0.6/30
set interfaces lo0 unit 3 family inet address 192.168.3.3/32
set interfaces lo0 unit 3 family inet address 172.16.3.3/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.6
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure a RIP import policy:

1. Configure the network interfaces.

   This example shows multiple loopback interface addresses to simulate attached networks.

   ```
   [edit interfaces]
   user@R1# set fe-1/2/0 unit 1 family inet address 10.0.0.1/30

   user@R1# set lo0 unit 1 family inet address 172.16.0.1/32
   user@R1# set lo0 unit 1 family inet address 192.168.1.1/32
   ```

2. Create the RIP group and add the interface.

   To configure RIP in Junos OS, you must configure a group that contains the interfaces on which RIP is enabled.

   You do not need to enable RIP on the loopback interface.

   ```
   [edit protocols rip group rip-group]
   user@R1# set neighbor fe-1/2/0.1
   ```

3. Create the routing policy to advertise both direct and RIP-learned routes.

   ```
   [edit policy-options policy-statement advertise-routes-through-rip term 1]
   ```

```
user@R1# set from protocol direct
user@R1# set from protocol rip
user@R1# set then accept
```

4. Apply the routing policy.

   In Junos OS, you can only apply RIP export policies at the group level.

   ```
   [edit protocols rip group rip-group]
   user@R1# set export advertise-routes-through-rip
   ```

5. Configure the import policy.

   ```
   [edit policy-options policy-statement rip-import]
   user@R1# set term 1 from protocol rip
   user@R1# set term 1 from route-filter 10.0.0.0/8 orlonger
   user@R1# set term 1 from route-filter 192.168.0.0/16 orlonger
   user@R1# set term 1 then accept
   user@R1# set term 2 then reject
   ```

6. Apply the import policy.

   ```
   [edit protocols rip]
   user@R1# set import rip-import
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R1# show interfaces
fe-1/2/0 {
    unit 1 {
        family inet {
            address 10.0.0.1/30;
        }
    }
}
lo0 {
    unit 1 {
        family inet {
            address 172.16.0.1/32;
            address 192.168.1.1/32;
        }
    }
}
```

```
user@R1# show protocols
rip {
    import rip-import;
    group rip-group {
        export advertise-routes-through-rip;
        neighbor fe-1/2/0.1;
    }
}
```

```
user@R1# show policy-options
policy-statement advertise-routes-through-rip {
```

```
    term 1 {
      from protocol [ direct rip ];
      then accept;
    }
  }
  policy-statement rip-import {
    term 1 {
      from {
        protocol rip;
        route-filter 10.0.0.0/8 orlonger;
        route-filter 192.168.0.0/16 orlonger;
      }
      then accept;
    }
    term 2 {
      then reject;
    }
  }
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Looking at the Routes That Device R2 Is Advertising to Device R1

Purpose Verify that Device R2 is sending the expected routes.

Action From operational mode, enter the **show route advertising-protocol rip** command.

```
user@R2> show route advertising-protocol rip 10.0.0.2

inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.4/30        *[Direct/0] 2d 01:17:44
                    >    via fe-1/2/0.5
172.16.2.2/32      *[Direct/0] 2d 04:09:52
                    >    via lo0.2
172.16.3.3/32      *[RIP/100] 23:40:02, metric 2, tag 0
                    > to 10.0.0.6 via fe-1/2/0.5
192.168.2.2/32     *[Direct/0] 2d 04:09:52
                    >    via lo0.2
192.168.3.3/32     *[RIP/100] 23:40:02, metric 2, tag 0
                    > to 10.0.0.6 via fe-1/2/0.5
```

Meaning Device R2 is sending 172.16/16 routes to Device R1.

Looking at the Routes That Device R1 Is Receiving from Device R2

Purpose Verify that Device R1 is receiving the expected routes.

Action From operational mode, enter the **show route receive-protocol rip** command.

```
user@R1> show route receive-protocol rip 10.0.0.2
inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.4/30        *[RIP/100] 01:06:03, metric 2, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
192.168.2.2/32     *[RIP/100] 01:06:03, metric 2, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
192.168.3.3/32     *[RIP/100] 01:06:03, metric 3, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
```

Meaning The output shows that the 172.16/16 routes are excluded.

Checking the Routing Table

Purpose Verify that the routing table is populated with the expected routes.

Action From operational mode, enter the **show route protocol rip** command.

```
user@R1> show route protocol rip

inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.4/30        *[RIP/100] 00:54:34, metric 2, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
192.168.2.2/32     *[RIP/100] 00:54:34, metric 2, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
192.168.3.3/32     *[RIP/100] 00:54:34, metric 3, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
224.0.0.9/32       *[RIP/100] 00:49:00, metric 1
                         MultiRecv
```

Meaning The output shows that the routes have been learned from Device R2 and Device R3.

If you delete or deactivate the import policy, the routing table contains the 172.16/16 routes.

Testing the Import Policy

Purpose By using the **test policy** command, monitor the number of rejected prefixes.

Action From operational mode, enter the **test policy rip-import 172.16/16** command.

```
user@R1> test policy rip-import 172.16/16
Policy rip-import: 0 prefix accepted, 1 prefix rejected
```

Meaning The output shows that the policy rejected one prefix.

Related Documentation

- Example: Configuring RIP on page 3637

Examples: Controlling Traffic with Metrics in a RIP Network

Understanding Traffic Control with Metrics in a RIP Network

To tune a RIP network and to control traffic flowing through the network, you increase or decrease the cost of the paths through the network. RIP provides two ways to modify the path cost: an incoming metric and an outgoing metric, which are each set to 1 by default. In other words, by default, the metric of routes that RIP imports from a neighbor or exports to a neighbor is incremented by 1. These routes include those learned from RIP as well as those learned from other protocols. The metrics are attributes that specify the cost of any route advertised through a host. By increasing or decreasing the metrics—and thus the cost—of links throughout the network, you can control packet transmission across the network.

The incoming metric modifies the cost of an individual segment when a route across the segment is imported into the routing table. For example, if you set the incoming metric on the segment to **3**, the individual segment cost along the link is changed from **1** to **3**. The increased cost affects all route calculations through that link. Other routes that were previously excluded because of a high hop count might now be included in the router's forwarding table.

The outgoing metric modifies the path cost for all the routes advertised out of a particular interface. Unlike the incoming metric, the outgoing metric modifies the routes that other routers are learning and thereby controls the way they send traffic.

If an exported route was learned from a member of the same RIP group, the metric associated with that route is the normal RIP metric. For example, a RIP route with a metric of 5 learned from a neighbor configured with an incoming metric of 2 is advertised with a combined metric of 7 when advertised to neighbors in the same group. However, if this route was learned from a RIP neighbor in a different group or from a different protocol, the route is advertised with the metric value configured in the outgoing metric for that group.

You might want to increase the metric of routes to decrease the likelihood that a particular route is selected and installed in the routing table. This process is sometimes referred to as *route poisoning*. Some reasons that you might want to poison a route are that the route is relatively expensive to use, or it has relatively low bandwidth.

A route with a higher metric than another route becomes the active route only when the lower-metric route becomes unavailable. In this way, the higher-metric route serves as a backup path.

One way to increase the metric of imported routes is to configure an import policy. Another way is to include the **metric-in** statement in the RIP neighbor configuration. One way to increase the metric of export routes is to configure an export policy. Another way is to include the **metric-out** statement in the RIP neighbor configuration.

Example: Controlling Traffic in a RIP Network with an Incoming Metric

This example shows how to control traffic with an incoming metric.

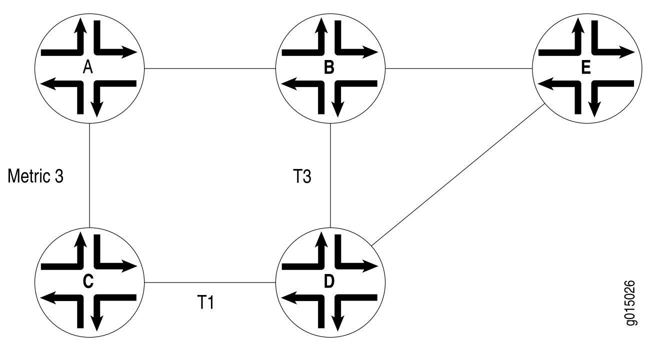
Requirements

Before you begin, define RIP groups, and add interfaces to the groups. Then configure a routing policy to export directly connected routes and routes learned through the RIP routing exchanges. See "Example: Configuring a Basic RIP Network" on page 3638.

Overview

In this example, routes to Router D are received by Router A across both of its RIP-enabled interfaces as shown in Figure 105 on page 3671. Because the route through Router B and the route through Router C have the same number of hops, both routes are imported into the forwarding table. However, because the T3 link from Router B to Router D has a higher bandwidth than the T1 link from Router C to Router D, you want traffic to flow from Router A through Router B to Router D.

Figure 105: Controlling Traffic in a RIP Network with the Incoming Metric



To force this flow, you can modify the route metrics as they are imported into Router A's routing table. By setting the incoming metric on the interface from Router A to Router C, you modify the metric on all routes received through that interface. Setting the incoming route metric on Router A changes only the routes in Router A's routing table, and affects only how Router A sends traffic to Router D. Router D's route selection is based on its own routing table, which, by default, includes no adjusted metric values.

In the example, Router C receives a route advertisement from Router D and readvertises the route to Router A. When Router A receives the route, it applies the incoming metric on the interface. Instead of incrementing the metric by 1 (the default), Router A increments it by 3 (the configured incoming metric), giving the route from Router A to Router D through Router C a total path metric of 4. Because the route through Router B has a metric of 2, it becomes the preferred route for all traffic from Router A to Router D.

This example uses a RIP group called **alpha 1** on interface **g3–0/0/0**.

Configuration

Step-by-Step Procedure

To control traffic with an incoming metric:

1. Enable RIP on the interface.

```
[edit protocols rip]
user@host# set group alpha1 neighbor ge-0/0/0
```

2. Set the incoming metric.

```
[edit protocols rip]
user@host# set metric-in 3
```

3. If you are done configuring the device, commit the configuration.

```
[edit]
user@host# commit
```

Verification

To verify that the configuration is working properly, enter the **show route protocols rip** command.

Example: Controlling Traffic in a RIP Network with an Outgoing Metric

This example shows how to control traffic with an outgoing metric.

Requirements

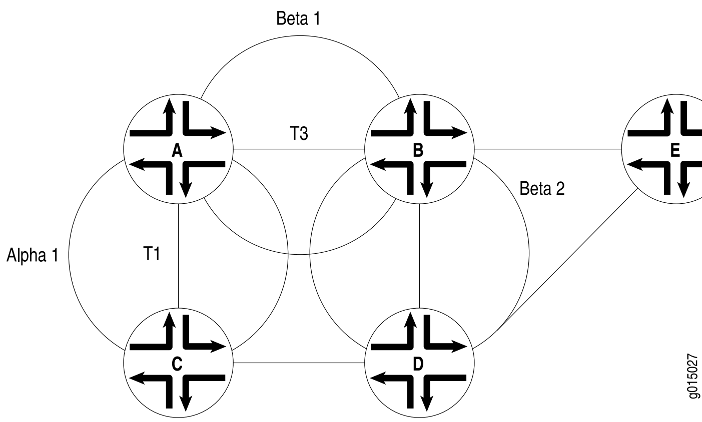
Before you begin:

- Define RIP groups, and add interfaces to the groups. Then configure a routing policy to export directly connected routes and routes learned through RIP routing exchanges. See “Example: Configuring a Basic RIP Network” on page 3638.
- Control traffic with an incoming metric. See “Example: Controlling Traffic in a RIP Network with an Incoming Metric” on page 3671.

Overview

In this example, each route from Router A to Router D has two hops as shown in Figure 106 on page 3673. However, because the link from Router A to Router B in the RIP group has a higher bandwidth than the link from Router A to Router C in RIP group Alpha 1, you want traffic from Router D to Router A to flow through Router B. To control the way Router D sends traffic to Router A, you can alter the routes that Router D receives by configuring the outgoing metric on Router A's interfaces in the Alpha 1 RIP group.

Figure 106: Controlling Traffic in a RIP Network with the Outgoing Metric



If the outgoing metric for the Alpha 1 RIP group—the A-to-C link—is changed to 3, Router D calculates the total path metric from Router A through Router C as 4. In contrast, the unchanged default total path metric to Router A through Router B in the RIP group is 2. The fact that Router A's interfaces belong to two different RIP groups allows you to configure two different outgoing metrics on its interfaces, because you configure path metrics at the group level.

By configuring the outgoing metric, you control the way Router A sends traffic to Router D. By configuring the outgoing metric on the same router, you control the way Router D sends traffic to Router A.

This example uses an outgoing metric of **3**.

Configuration

Step-by-Step Procedure

To control traffic with an outgoing metric:

1. Set the outgoing metric.

   [edit protocols rip group alpha1]
   user@host# **set metric-out 3**

2. If you are done configuring the device, commit the configuration.

   [edit]
   user@host# **commit**

Verification

To verify that the configuration is working properly, enter the **show protocols rip** command.

Example: Configuring the Metric Value Added to Imported RIP Routes

This example shows how to change the default metric to be added to incoming routes to control the route selection process.

Requirements

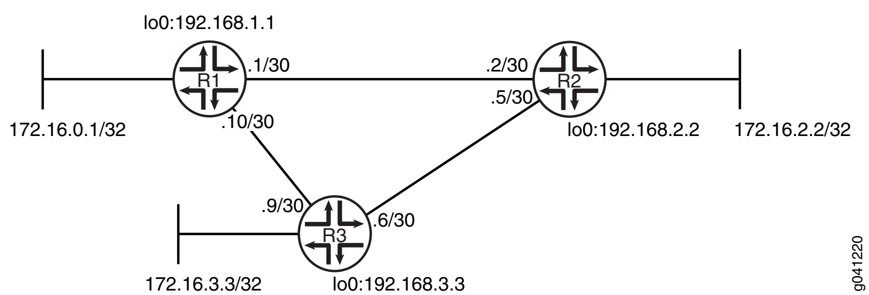
No special configuration beyond device initialization is required before configuring this example.

Overview

Normally, when multiple routes are available, RIP selects the route with the lowest hop count. Changing the default metric enables you to control the route selection process such that a route with a higher hop count can be preferred over of a route with a lower hop count.

Figure 107 on page 3674 shows the topology used in this example.

Figure 107: RIP Incoming Metrics Network Topology



Device R1 has two potential paths to reach 172.16.2.2/32. The default behavior is to send traffic out the 0.1/30 interface facing Device R2. Suppose, though, that the path through Device R3 is less expensive to use or has higher bandwidth links. This example shows how to use the **metric-in** statement to ensure that Device R1 uses the path through Device R3 to reach 172.16.2.2/32. "CLI Quick Configuration" on page 3674 shows the configuration for all of the devices in Figure 107 on page 3674. The section "Step-by-Step Procedure" on page 3675 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 description to-R2
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set interfaces ge-1/2/1 unit 10 description to-R3
```



```
set interfaces ge-1/2/1 unit 10 family inet address 10.0.0.10/30
set interfaces lo0 unit 1 family inet address 172.16.0.1/32
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols rip group primary export advertise-routes-through-rip
set protocols rip group primary neighbor ge-1/2/1.10
set protocols rip group secondary export advertise-routes-through-rip
set protocols rip group secondary neighbor fe-1/2/0.1 metric-in 4
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces ge-1/2/1 unit 5 family inet address 10.0.0.5/30
set interfaces lo0 unit 2 family inet address 192.168.2.2/32
set interfaces lo0 unit 2 family inet address 172.16.2.2/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.2
set protocols rip group rip-group neighbor ge-1/2/1.5
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R3

```
set interfaces fe-1/2/0 unit 6 family inet address 10.0.0.6/30
set interfaces ge-1/2/1 unit 9 family inet address 10.0.0.9/30
set interfaces lo0 unit 3 family inet address 192.168.3.3/32
set interfaces lo0 unit 3 family inet address 172.16.3.3/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.6
set protocols rip group rip-group neighbor ge-1/2/1.9
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure a RIP metrics:

1. Configure the network interfaces.

```
[edit interfaces]
user@R1# set fe-1/2/0 unit 1 description to-R2
user@R1# set fe-1/2/0 unit 1 family inet address 10.0.0.1/30

user@R1# set ge-1/2/1 unit 10 description to-R3
user@R1# set ge-1/2/1 unit 10 family inet address 10.0.0.10/30

user@R1# set lo0 unit 1 family inet address 172.16.0.1/32
```

```
user@R1# set lo0 unit 1 family inet address 192.168.1.1/32
```

2. Create the RIP groups and add the interfaces.

   To configure RIP in Junos OS, you must configure one or more groups that contain the interfaces on which RIP is enabled. You do not need to enable RIP on the loopback interface.

   For the interface that is facing Device R2, the **metric-in 4** setting causes this route to be less likely to be chosen as the active route.

   ```
   [edit protocols rip]
   user@R1# set group primary neighbor ge-1/2/1.10
   user@R1# set group secondary neighbor fe-1/2/0.1 metric-in 4
   ```

3. Create the routing policy to advertise both direct and RIP-learned routes.

   ```
   [edit policy-options policy-statement advertise-routes-through-rip term 1]
   user@R1# set from protocol direct
   user@R1# set from protocol rip
   user@R1# set then accept
   ```

4. Apply the routing policy.

   In Junos OS, you can only apply RIP export policies at the group level.

   ```
   [edit protocols rip]
   user@R1# set group primary export advertise-routes-through-rip
   user@R1# set group secondary export advertise-routes-through-rip
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 1 {
      description to-R2;
      family inet {
         address 10.0.0.1/30;
      }
   }
}
ge-1/2/1 {
   unit 10 {
      description to-R3;
      family inet {
         address 10.0.0.10/30;
      }
   }
}
lo0 {
   unit 1 {
      family inet {
         address 172.16.0.1/32;
         address 192.168.1.1/32;
      }
```



```
    }
  }
  user@R1# show protocols
  rip {
    group primary {
      export advertise-routes-through-rip;
      neighbor ge-1/2/1.10;
    }
    group secondary {
      export advertise-routes-through-rip;
      neighbor fe-1/2/0.1 {
        metric-in 4;
      }
    }
  }
  user@R1# show policy-options
  policy-statement advertise-routes-through-rip {
    term 1 {
      from protocol [ direct rip ];
      then accept;
    }
  }
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying That the Expected Route Is Active on page 3677
- Removing the metric-in Statement on page 3677

Verifying That the Expected Route Is Active

Purpose Make sure that to reach 172.16.2.2/32, Device R1 uses the path through Device R3.

Action From operational mode, enter the **show route 172.16.2.2** command.

```
user@R1> show route 172.16.2.2
inet.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.2.2/32      *[RIP/100] 00:15:46, metric 3, tag 0
                    > to 10.0.0.9 via ge-1/2/1.10
```

Meaning The **to 10.0.0.9 via ge-1/2/1.10** output shows that Device R1 uses the path through Device R3 to reach 172.16.2.2/32. The metric for this route is 3.

Removing the metric-in Statement

Purpose Delete or deactivate the **metric-in** statement to see what happens to the 172.16.2.2/32 route.

Action 1. From configuration mode, deactivate the **metric-in** statement.

```
[edit protocols rip group secondary neighbor fe-1/2/0.1]
user@R1# deactivate metric-in
user@R1# commit
```

2. From operational mode, enter the **show route 172.16.2.2** command.

```
user@R1> show route 172.16.2.2
inet.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.2.2/32      *[RIP/100] 00:00:06, metric 2, tag 0
                    > to 10.0.0.2 via fe-1/2/0.1
```

Meaning The **to 10.0.0.2 via fe-1/2/0.1** output shows that Device R1 uses the path through Device R2 to reach 172.16.2.2/32. The metric for this route is 2.

Related Documentation

- Example: Applying Policies to RIP Routes Imported from Neighbors on page 3664

Example: Configuring the Sending and Receiving of RIPv1 and RIPv2 Packets

Understanding the Sending and Receiving of RIPv1 and RIPv2 Packets

RIP version 1 (RIPv1) and RIP version 2 (RIPv2) can run simultaneously. This might make sense when you are migrating a RIPv1 network to a RIPv2 network. This also allows interoperation with a device that supports RIPv1 but not RIPv2.

By default, when RIP is enabled on an interface, Junos OS receives both RIPv1 and RIPv2 packets and sends only RIPv2 packets. You can configure this behavior by including the send and receive statements in the RIP configuration.

Example: Configuring the Sending and Receiving of RIPv1 and RIPv2 Packets

This example shows how to configure whether the RIP update messages conform to RIP version 1 (RIPv1) only, to RIP version 2 (RIPv2) only, or to both versions. You can also disable the sending or receiving of update messages.

Requirements

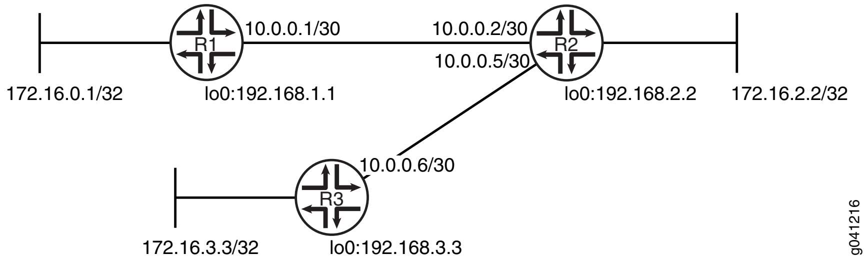
No special configuration beyond device initialization is required before configuring this example.

Overview

By default, when RIP is enabled on an interface, Junos OS receives both RIPv1 and RIPv2 packets and sends only RIPv2 packets.

Figure 108 on page 3679 shows the topology used in this example.

Figure 108: Sending and Receiving RIPv1 and RIPv2 Packets Network Topology



In this example, Device R1 is configured to receive only RIPv2 packets.

“CLI Quick Configuration” on page 3679 shows the configuration for all of the devices in Figure 108 on page 3679. The section “Step-by-Step Procedure” on page 3680 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set interfaces lo0 unit 1 family inet address 172.16.0.1/32
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.1 receive version-2
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 5 family inet address 10.0.0.5/30
set interfaces lo0 unit 2 family inet address 192.168.2.2/32
set interfaces lo0 unit 2 family inet address 172.16.2.2/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.2
set protocols rip group rip-group neighbor fe-1/2/1.5
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R3

```
set interfaces fe-1/2/0 unit 6 family inet address 10.0.0.6/30
set interfaces lo0 unit 3 family inet address 192.168.3.3/32
set interfaces lo0 unit 3 family inet address 172.16.3.3/32
set protocols rip group rip-group export advertise-routes-through-rip
```

```
set protocols rip group rip-group neighbor fe-1/2/0.6
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure a RIP packet versions that can be received:

1. Configure the network interfaces.

   ```
   [edit interfaces]
   user@R1# set fe-1/2/0 unit 1 family inet address 10.0.0.1/30


   user@R1# set lo0 unit 1 family inet address 172.16.0.1/32
   user@R1# set lo0 unit 1 family inet address 192.168.1.1/32
   ```

2. Create the RIP groups and add the interfaces.

   To configure RIP in Junos OS, you must configure one or more groups that contain the interfaces on which RIP is enabled. You do not need to enable RIP on the loopback interface.

   For the interface that is facing Device R2, the **receive version-2** setting causes this interface to accept only RIPv2 packets.

   ```
   [edit protocols rip group rip-group]
   user@R1# set neighbor fe-1/2/0.1 receive version-2
   ```

3. Create the routing policy to advertise both direct and RIP-learned routes.

   ```
   [edit policy-options policy-statement advertise-routes-through-rip term 1]
   user@R1# set from protocol direct
   user@R1# set from protocol rip
   user@R1# set then accept
   ```

4. Apply the routing policy.

   In Junos OS, you can only apply RIP export policies at the group level.

   ```
   [edit protocols rip group rip-group]
   user@R1# set export advertise-routes-through-rip
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R1# show interfaces
fe-1/2/0 {
  unit 1 {
    family inet {
      address 10.0.0.1/30;
```



```
        }
    }
}
lo0 {
    unit 1 {
        family inet {
            address 172.16.0.1/32;
            address 192.168.1.1/32;
        }
    }
}
```

```
user@R1# show protocols
rip {
    group rip-group {
        export advertise-routes-through-rip;
        neighbor fe-1/2/0.1 {
            receive version-2;
        }
    }
}
```

```
user@R1# show policy-options
policy-statement advertise-routes-through-rip {
    term 1 {
        from protocol [ direct rip ];
        then accept;
    }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying That the Receive Mode Is Set to RIPv2 Only

Purpose Make sure that the interfacing Device R2 is configured to receive only RIPv2 packets, instead of both RIPv1 and RIPv2 packets.

Action From operational mode, enter the **show rip neighbor** command.

```
user@R1> show rip neighbor

                      Local  Source          Destination     Send   Receive   In
Neighbor              State  Address         Address         Mode   Mode      Met
--------              -----  -------         -----------     ----   -------   ---
fe-1/2/0.1               Up 10.0.0.1        224.0.0.9       mcast  v2 only    1
```

Meaning In the output, the **Receive Mode** field displays **v2 only**. The default **Receive Mode** is **both**.

Related Documentation

- Example: Configuring RIP on page 3637

Example: Redistributing Routes Among RIP Instances

Understanding Route Redistribution Among RIP instances

You can redistribute routes among RIP processes. Another way to say this is to export RIP routes from one RIP instance to other RIP instances.

In Junos OS, route redistribution among routing instances is accomplished by using routing table groups, also called RIB groups. Routing table groups allow you to import and export routes from a protocol within one routing table into another routing table.

NOTE: In contrast, the policy-based import and export functions allow you import and export routes between different protocols within the same routing table.

Consider the following partial example:

```
protocols {
  rip {
    rib-group inet-to-voice;
  }
}
routing-instances {
  voice {
    protocols {
      rip {
        rib-group voice-to-inet;
      }
    }
  }
}
routing-options {
  rib-groups {
    inet-to-voice {
      import-rib [ inet.0 voice.inet.0 ];
    }
    voice-to-inet {
      import-rib [ voice.inet.0 inet.0 ];
    }
  }
}
```

The way to read the **import-rib** statement is as follows. Take the routes from the protocol (RIP, in this case), and import them into the primary (or local) routing table and also into any other routing tables listed after this. The primary routing table is the routing table where the routing table group is being used. That would be either **inet.0** if used in the main routing instance or **voice.inet.0** if used within the routing instance. In the **inet-to-voice** routing table group, **inet.0** is listed first because this routing table group is used in the main routing instance. In the **voice-to-inet** routing table group, **voice.inet.0** is listed first because this routing table group is used in the voice routing instance.

Example: Redistributing Routes Between Two RIP Instances

This example shows how to configure a RIP routing instance and control the redistribution of RIP routes between the routing instance and the master instance.

- Requirements on page 3683
- Overview on page 3683
- Configuration on page 3683
- Verification on page 3687

Requirements

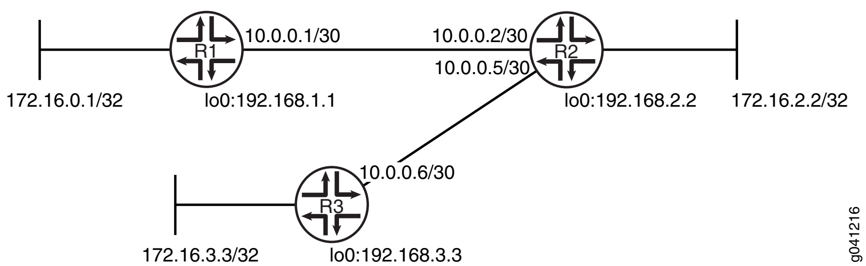
No special configuration beyond device initialization is required before configuring this example.

Overview

When you create a routing instance called voice, Junos OS creates a routing table called **voice.inet.0**. The example shows how to install routes learned through the master RIP instance into the **voice.inet.0** routing table. The example also shows how to install routes learned through the voice routing instance into **inet.0**. This is done by configuring routing table groups. RIP routes are installed into each routing table that belongs to a routing table group.

Figure 109 on page 3683 shows the topology used in this example.

Figure 109: Redistributing Routes Between RIP Instances Network Topology



"CLI Quick Configuration" on page 3683 shows the configuration for all of the devices in Figure 109 on page 3683. The section "Step-by-Step Procedure" on page 3684 describes the steps on Device R2.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set interfaces lo0 unit 1 family inet address 172.16.0.1/32
```

```
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols rip group to-R2 export advertise-routes-through-rip
set protocols rip group to-R2 neighbor fe-1/2/0.1
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 5 family inet address 10.0.0.5/30
set interfaces lo0 unit 2 family inet address 192.168.2.2/32
set interfaces lo0 unit 2 family inet address 172.16.2.2/32
set protocols rip rib-group inet-to-voice
set protocols rip group to-R3 export advertise-routes-through-rip
set protocols rip group to-R3 neighbor fe-1/2/1.5
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
set routing-instances voice protocols rip group to-R1 export advertise-routes-through-rip
set routing-instances voice interface fe-1/2/0.2
set routing-instances voice protocols rip rib-group voice-to-inet
set routing-instances voice protocols rip group to-R1 neighbor fe-1/2/0.2
set routing-options rib-groups inet-to-voice import-rib inet.0
set routing-options rib-groups inet-to-voice import-rib voice.inet.0
set routing-options rib-groups voice-to-inet import-rib voice.inet.0
set routing-options rib-groups voice-to-inet import-rib inet.0
```

Device R3

```
set interfaces fe-1/2/0 unit 6 family inet address 10.0.0.6/30
set interfaces lo0 unit 3 family inet address 192.168.3.3/32
set interfaces lo0 unit 3 family inet address 172.16.3.3/32
set protocols rip group to-R2 export advertise-routes-through-rip
set protocols rip group to-R2 neighbor fe-1/2/0.6
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To redistribute RIP routes between routing instances:

1. Configure the network interfaces.

```
[edit interfaces]
user@R2# set fe-1/2/0 unit 2 family inet address 10.0.0.2/30

user@R2# set fe-1/2/1 unit 5 family inet address 10.0.0.5/30

user@R2# set lo0 unit 2 family inet address 192.168.2.2/32
```


user@R2# **set lo0 unit 2 family inet address 172.16.2.2/32**

2. Create the routing instance, and add one or more interfaces to the routing instance.

   [edit routing-instances voice]
   user@R2# **set interface fe-1/2/0.2**

3. Create the RIP groups and add the interfaces.

   [edit protocols rip group to-R3]
   user@R2# **set neighbor fe-1/2/1.5**

   [edit routing-instances voice protocols rip group to-R1]
   user@R2# **set neighbor fe-1/2/0.2**

4. Create the routing table groups.

   [edit routing-options rib-groups]
   user@R2# **set inet-to-voice import-rib inet.0**
   user@R2# **set inet-to-voice import-rib voice.inet.0**

   user@R2# **set voice-to-inet import-rib voice.inet.0**
   user@R2# **set voice-to-inet import-rib inet.0**

5. Apply the routing table groups.

   [edit protocols rip]
   user@R2# **set** rib-group **inet-to-voice**

   [edit routing-instances voice protocols rip]
   user@R2# **set rib-group voice-to-inet**

6. Create the routing policy to advertise both direct and RIP-learned routes.

   [edit policy-options policy-statement advertise-routes-through-rip term 1]
   user@R2# **set from protocol direct**
   user@R2# **set from protocol rip**
   user@R2# **set then accept**

7. Apply the routing policy.

   In Junos OS, you can only apply RIP export policies at the group level.

   [edit protocols rip group to-R3]
   user@R2# **set export advertise-routes-through-rip**

   [edit routing-instances voice protocols rip group to-R1]
   user@R2# **set export advertise-routes-through-rip**

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, **show routing-instances**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R2# show interfaces
fe-1/2/0 {
  unit 2 {
    family inet {
```

```
            address 10.0.0.2/30;
        }
    }
}
fe-1/2/1 {
    unit 5 {
        family inet {
            address 10.0.0.5/30;
        }
    }
}
lo0 {
    unit 2 {
        family inet {
            address 192.168.2.2/32;
            address 172.16.2.2/32;
        }
    }
}
```

```
user@R2# show protocols
rip {
    rib-group inet-to-voice;
    group to-R3 {
        export advertise-routes-through-rip;
        neighbor fe-1/2/1.5;
    }
}
```

```
user@R2# show policy-options
policy-statement advertise-routes-through-rip {
    term 1 {
        from protocol [ direct rip ];
        then accept;
    }
}
```

```
user@R2# show routing-instances
voice {
    interface fe-1/2/0.2;
    protocols {
        rip {
            rib-group voice-to-inet;
            group to-R1 {
                export advertise-routes-through-rip;
                neighbor fe-1/2/0.2;
            }
        }
    }
}
```

```
user@R2# show routing-options
rib-groups {
    inet-to-voice {
        import-rib [ inet.0 voice.inet.0 ];
    }
    voice-to-inet {
```



```
        import-rib [ voice.inet.0 inet.0 ];
      }
    }
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Checking the Routing Tables

Purpose Make sure that the routing tables contain the expected routes.

Action From operational mode, enter the **show route protocol rip** command.

```
user@R2> show route protocol rip
inet.0: 9 destinations, 9 routes (9 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.0.1/32      *[RIP/100] 01:58:14, metric 2, tag 0
                    > to 10.0.0.1 via fe-1/2/0.2
172.16.3.3/32      *[RIP/100] 02:06:03, metric 2, tag 0
                    > to 10.0.0.6 via fe-1/2/0.5
192.168.1.1/32     *[RIP/100] 01:58:14, metric 2, tag 0
                    > to 10.0.0.1 via fe-1/2/0.2
192.168.3.3/32     *[RIP/100] 02:06:03, metric 2, tag 0
                    > to 10.0.0.6 via fe-1/2/0.5
224.0.0.9/32       *[RIP/100] 01:44:13, metric 1
                          MultiRecv

voice.inet.0: 7 destinations, 7 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.0.1/32      *[RIP/100] 02:06:03, metric 2, tag 0
                    > to 10.0.0.1 via fe-1/2/0.2
172.16.3.3/32      *[RIP/100] 01:58:14, metric 2, tag 0
                    > to 10.0.0.6 via fe-1/2/0.5
192.168.1.1/32     *[RIP/100] 02:06:03, metric 2, tag 0
                    > to 10.0.0.1 via fe-1/2/0.2
192.168.3.3/32     *[RIP/100] 01:58:14, metric 2, tag 0
                    > to 10.0.0.6 via fe-1/2/0.5
224.0.0.9/32       *[RIP/100] 01:44:13, metric 1
                          MultiRecv
```

Meaning The output shows that both routing tables contain all of the RIP routes.

Related Documentation

- Example: Configuring RIP on page 3637
- Example: Applying Policies to RIP Routes Imported from Neighbors on page 3664

Example: Configuring RIP Timers

Understanding RIP Timers

RIP uses several timers to regulate its operation.

The update interval is the interval at which routes that are learned by RIP are advertised to neighbors. This timer controls the interval between routing updates. The update interval is set to 30 seconds, by default, with a small random amount of time added when the timer is reset. This added time prevents congestion that can occur if all routing devices update their neighbors simultaneously.

To configure the update time interval, include the **update-interval** statement:

update-interval *seconds*;

seconds can be a value from 10 through 60.

You can set a route timeout interval. If a route is not refreshed after being installed in the routing table by the specified time interval, the route is marked as invalid and is removed from the routing table after the hold-down period expires.

To configure the route timeout for RIP, include the **route-timeout** statement:

route-timeout *seconds*;

seconds can be a value from 30 through 360. The default value is 180 seconds.

RIP routes expire when either a route timeout limit is met or a route metric reaches infinity, and the route is no longer valid. However, the expired route is retained in the routing table for a specified period so that neighbors can be notified that the route has been dropped. This time period is set by configuring the hold-down timer. Upon expiration of the hold-down timer, the route is removed from the routing table.

To configure the hold-down timer for RIP, include the **holddown** statement:

holddown *seconds*;

seconds can be a value from 10 through 180. The default value is 120 seconds.

NOTE: **In Junos OS Release 11.1 and later, a retransmission timer is available for RIP demand circuits.**

Generally, we recommend against changing the RIP timers, unless the effects of a change are well understood. The route timeout should be at least three times the update interval. Normally, the default values are best left in effect for standard operations.

Example: Configuring RIP Timers

This example shows how to configure the RIP update interval and how to monitor the impact of the change.

- Requirements on page 3689
- Overview on page 3689

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

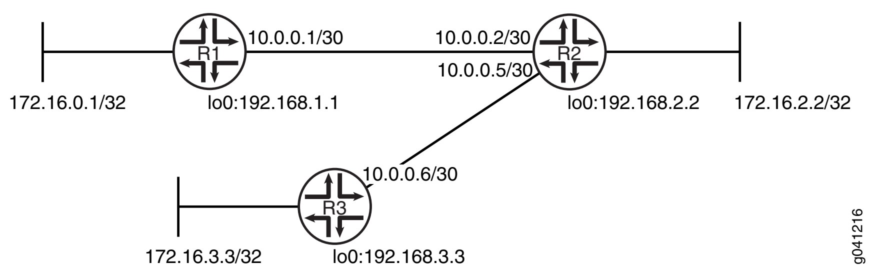
In this example, Device R2 has an update interval of 60 seconds for its neighbor, Device R1, and an update interval of 10 seconds for its neighbor, Device R3.

This example is not necessarily practical, but it is shown for demonstration purposes. Generally, we recommend against changing the RIP timers, unless the effects of a change are well understood. Normally, the default values are best left in effect for standard operations.

An export policy is also shown because an export policy is required as part of the minimum configuration for RIP.

Figure 110 on page 3689 shows the topology used in this example.

Figure 110: RIP Timers Network Topology



"CLI Quick Configuration" on page 3689 shows the configuration for all of the devices in Figure 110 on page 3689. The section "Step-by-Step Procedure" on page 3690 describes the steps on Device R2.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set interfaces lo0 unit 1 family inet address 172.16.0.1/32
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.1
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 5 family inet address 10.0.0.5/30
set interfaces lo0 unit 2 family inet address 192.168.2.2/32
set interfaces lo0 unit 2 family inet address 172.16.2.2/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.2 update-interval 60
set protocols rip group rip-group neighbor fe-1/2/1.5 update-interval 10
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R3

```
set interfaces fe-1/2/0 unit 6 family inet address 10.0.0.6/30
set interfaces lo0 unit 3 family inet address 192.168.3.3/32
set interfaces lo0 unit 3 family inet address 172.16.3.3/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.6
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the RIP update interval:

1. Configure the network interfaces.

   This example shows multiple loopback interface addresses to simulate attached networks.

   ```
   [edit interfaces]
   user@R2# set fe-1/2/0 unit 2 family inet address 10.0.0.2/30

   user@R2# set fe-1/2/1 unit 5 family inet address 10.0.0.5/30

   user@R2# set lo0 unit 2 family inet address 192.168.2.2/32
   user@R2# set lo0 unit 2 family inet address 172.16.2.2/32
   ```

2. Configure different update intervals for the two RIP neighbors.

   To configure RIP in Junos OS, you must configure a group that contains the interfaces on which RIP is enabled. You do not need to enable RIP on the loopback interface.

   ```
   [edit protocols rip group rip-group]
   user@R2# set neighbor fe-1/2/0.2 update-interval 60
   user@R2# set neighbor fe-1/2/1.5 update-interval 10
   ```

3. Create the routing policy to advertise both direct and RIP-learned routes.

   ```
   [edit policy-options policy-statement advertise-routes-through-rip term 1]
   user@R2# set from protocol direct
   user@R2# set from protocol rip
   ```



```
user@R2# set then accept
```

4. Apply the routing policy.

   In Junos OS, you can only apply RIP export policies at the group level.

```
[edit protocols rip group rip-group]
user@R2# set export advertise-routes-through-rip
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R2# show interfaces
fe-1/2/0 {
  unit 2 {
    family inet {
      address 10.0.0.2/30;
    }
  }
}
fe-1/2/1 {
  unit 5 {
    family inet {
      address 10.0.0.5/30;
    }
  }
}
lo0 {
  unit 2 {
    family inet {
      address 192.168.2.2/32;
      address 172.16.2.2/32;
    }
  }
}
```

```
user@R2# show protocols
rip {
  group rip-group {
    export advertise-routes-through-rip;
    neighbor fe-1/2/0.2 {
      update-interval 60;
    }
    neighbor fe-1/2/1.5 {
      update-interval 10;
    }
  }
}
```

```
user@R2# show policy-options
policy-statement advertise-routes-through-rip {
  term 1 {
    from protocol [ direct rip ];
    then accept;
  }
```

```
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the RIP Updates Sent by Device R2 on page 3692
- Checking the RIP Updates Received by Device R2 on page 3693
- Checking the RIP Updates Received by Device R3 on page 3693

Checking the RIP Updates Sent by Device R2

Purpose Make sure that the RIP update packets are sent at the expected interval.

Action From operational mode, enter the **show rip statistics** command.

```
user@R2> show rip statistics
RIPv2 info: port 520; holddown 120s.
    rts learned  rts held down  rqsts dropped  resps dropped
              4              2              0              0

fe-1/2/0.2:  2 routes learned; 5 routes advertised; timeout 180s; update interval
60s
Counter                          Total   Last 5 min  Last minute
-------                    -----------  -----------  -----------
Updates Sent                       123            5            1
Triggered Updates Sent               0            0            0
Responses Sent                       0            0            0
Bad Messages                         0            0            0
RIPv1 Updates Received               0            0            0
RIPv1 Bad Route Entries              0            0            0
RIPv1 Updates Ignored                0            0            0
RIPv2 Updates Received             244           10            2
RIPv2 Bad Route Entries              0            0            0
RIPv2 Updates Ignored                0            0            0
Authentication Failures              0            0            0
RIP Requests Received                0            0            0
RIP Requests Ignored                 0            0            0
none                                 0            0            0

fe-1/2/1.5:  2 routes learned; 5 routes advertised; timeout 180s; update interval
10s
Counter                          Total   Last 5 min  Last minute
-------                    -----------  -----------  -----------
Updates Sent                       734           32            6
Triggered Updates Sent               0            0            0
Responses Sent                       0            0            0
Bad Messages                         0            0            0
RIPv1 Updates Received               0            0            0
RIPv1 Bad Route Entries              0            0            0
RIPv1 Updates Ignored                0            0            0
RIPv2 Updates Received             245           11            2
RIPv2 Bad Route Entries              0            0            0
RIPv2 Updates Ignored                0            0            0
Authentication Failures              0            0            0
RIP Requests Received                0            0            0
```



```
RIP Requests Ignored                0            0            0
none                                0            0            0
```

Meaning The **update interval** field shows that the interval is 60 seconds for Neighbor R1 and 10 seconds for Neighbor R3. The **Updates Sent** field shows that Device R2 is sending updates to Device R1 at roughly 1/6 of the rate that it is sending updates to Device R3.

Checking the RIP Updates Received by Device R2

Purpose Make sure that the RIP update packets are sent at the expected interval.

Action From operational mode, enter the **show rip statistics** command.

```
user@R1> show rip statistics
RIPv2 info: port 520; holddown 120s.
    rts learned  rts held down  rqsts dropped  resps dropped
              5              0              0              0

fe-1/2/0.1:  5 routes learned; 2 routes advertised; timeout 180s; update interval
 30s
Counter                          Total   Last 5 min  Last minute
-------                    -----------  -----------  -----------
Updates Sent                       312           10            2
Triggered Updates Sent               2            0            0
Responses Sent                       0            0            0
Bad Messages                         0            0            0
RIPv1 Updates Received               0            0            0
RIPv1 Bad Route Entries              0            0            0
RIPv1 Updates Ignored                0            0            0
RIPv2 Updates Received             181            5            1
RIPv2 Bad Route Entries              0            0            0
RIPv2 Updates Ignored                0            0            0
Authentication Failures              0            0            0
RIP Requests Received                1            0            0
RIP Requests Ignored                 0            0            0
none                                 0            0            0
```

Meaning The **RIPv2 Updates Received** field shows the number of updates received from Device R2.

Checking the RIP Updates Received by Device R3

Purpose Make sure that the RIP update packets are sent at the expected interval.

Action From operational mode, enter the **show rip statistics** command.

```
user@R3> show rip statistics
RIPv2 info: port 520; holddown 120s.
    rts learned  rts held down  rqsts dropped  resps dropped
              5              0              0              0

fe-1/2/0.6:  5 routes learned; 2 routes advertised; timeout 180s; update interval
 30s
Counter                          Total   Last 5 min  Last minute
-------                    -----------  -----------  -----------
Updates Sent                       314           11            2
Triggered Updates Sent               1            0            0
Responses Sent                       0            0            0
```

```
Bad Messages                    0            0            0
RIPv1 Updates Received          0            0            0
RIPv1 Bad Route Entries         0            0            0
RIPv1 Updates Ignored           0            0            0
RIPv2 Updates Received        827           31            6
RIPv2 Bad Route Entries         0            0            0
RIPv2 Updates Ignored           0            0            0
Authentication Failures         0            0            0
RIP Requests Received           0            0            0
RIP Requests Ignored            0            0            0
none                            0            0            0
```

Meaning The **RIPv2 Updates Received** field shows the number of updates received from Device R2.

Related Documentation

- Example: Configuring RIP on page 3637
- *Example: Configuring RIP Demand Circuits*

Example: Tracing RIP Protocol Traffic

- Understanding RIP Trace Operations on page 3694
- Example: Tracing RIP Protocol Traffic on page 3695

Understanding RIP Trace Operations

You can trace various types of RIP protocol traffic to help debug RIP protocol issues.

To trace RIP protocol traffic, include the **traceoptions** statement at the **[edit protocols rip]** hierarchy level:

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

You can specify the following RIP protocol-specific trace options using the **flag** statement:

- **auth**—RIP authentication
- **error**—RIP error packets
- **expiration**—RIP route expiration processing
- **holddown**—RIP hold-down processing
- **nsr-synchronization**—Nonstop active routing synchronization events
- **packets**—All RIP packets
- **request**—RIP information packets
- **trigger**—RIP triggered updates
- **update**—RIP update packets

You can optionally specify one or more of the following flag modifiers:

- **detail**—Detailed trace information
- **receive**—Packets being received
- **send**—Packets being transmitted

NOTE: Use the **detail** flag modifier with caution as this may cause the CPU to become very busy.

Global tracing options are inherited from the configuration set by the **traceoptions** statement at the **[edit routing-options]** hierarchy level. You can override the following global trace options for the RIP protocol using the **traceoptions flag** statement included at the **[edit protocols rip]** hierarchy level:

- **all**—All tracing operations
- **general**—All normal operations and routing table changes (a combination of the normal and route trace operations)
- **normal**—Normal events
- **policy**—Policy processing
- **route**—Routing information
- **state**—State transitions
- **task**—Routing protocol task processing
- **timer**—Routing protocol timer processing

NOTE: Use the trace flag **all** with caution because this may cause the CPU to become very busy.

Example: Tracing RIP Protocol Traffic

This example shows how to trace RIP protocol operations.

Requirements

No special configuration beyond device initialization is required before configuring this example.

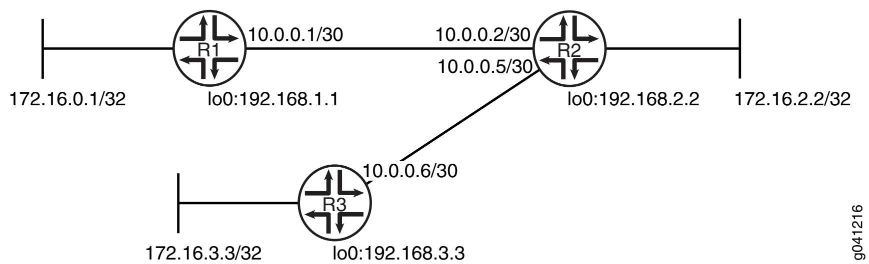
Overview

In this example, Device R1 is set to trace routing information updates.

An export policy is also shown because an export policy is required as part of the minimum configuration for RIP.

Figure 111 on page 3696 shows the topology used in this example.

Figure 111: RIP Trace Operations Network Topology



"CLI Quick Configuration" on page 3696 shows the configuration for all of the devices in Figure 111 on page 3696. The section "Step-by-Step Procedure" on page 3697 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set interfaces lo0 unit 1 family inet address 172.16.0.1/32
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols rip traceoptions file rip-trace-file
set protocols rip traceoptions flag route
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.1
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 5 family inet address 10.0.0.5/30
set interfaces lo0 unit 2 family inet address 192.168.2.2/32
set interfaces lo0 unit 2 family inet address 172.16.2.2/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.2
set protocols rip group rip-group neighbor fe-1/2/1.5
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
  rip
```

```
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Device R3

```
set interfaces fe-1/2/0 unit 6 family inet address 10.0.0.6/30
set interfaces lo0 unit 3 family inet address 192.168.3.3/32
set interfaces lo0 unit 3 family inet address 172.16.3.3/32
set protocols rip group rip-group export advertise-routes-through-rip
set protocols rip group rip-group neighbor fe-1/2/0.6
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
   direct
set policy-options policy-statement advertise-routes-through-rip term 1 from protocol
   rip
set policy-options policy-statement advertise-routes-through-rip term 1 then accept
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the RIP update interval:

1. Configure the network interfaces.

   This example shows multiple loopback interface addresses to simulate attached networks.

   ```
   [edit interfaces]
   user@R1# set fe-1/2/0 unit 1 family inet address 10.0.0.1/30

   user@R1# set lo0 unit 1 family inet address 172.16.0.1/32
   user@R1# set lo0 unit 1 family inet address 192.168.1.1/32
   ```

2. Configure the RIP group, and add the interface to the group.

   To configure RIP in Junos OS, you must configure a group that contains the interfaces on which RIP is enabled. You do not need to enable RIP on the loopback interface.

   ```
   [edit protocols rip group rip-group]
   user@R1# set neighbor fe-1/2/0.1
   ```

3. Configure RIP tracing operations.

   ```
   [edit protocols rip traceoptions]
   user@R1# set file rip-trace-file
   user@R1# set flag route
   ```

4. Create the routing policy to advertise both direct and RIP-learned routes.

   ```
   [edit policy-options policy-statement advertise-routes-through-rip term 1]
   user@R1# set from protocol direct
   user@R1# set from protocol rip
   user@R1# set then accept
   ```

5. Apply the routing policy.

   In Junos OS, you can only apply RIP export policies at the group level.

   ```
   [edit protocols rip group rip-group]
   user@R1# set export advertise-routes-through-rip
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 1 {
      family inet {
         address 10.0.0.1/30;
      }
   }
}
lo0 {
   unit 1 {
      family inet {
         address 172.16.0.1/32;
         address 192.168.1.1/32;
      }
   }
}
```

```
user@R1# show protocols
rip {
   traceoptions {
      file rip-trace-file;
      flag route;
   }
   group rip-group {
      export advertise-routes-through-rip;
      neighbor fe-1/2/0.1;
   }
}
```

```
user@R1# show policy-options
policy-statement advertise-routes-through-rip {
   term 1 {
      from protocol [ direct rip ];
      then accept;
   }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Checking the Log File

Purpose Make sure that the RIP route updates are logged in the configured log file.

Action

1. Deactivate the extra loopback interface address on Device R3.

   ```
   [edit interfaces lo0 unit 3 family inet]
   user@R3# deactivate address 172.16.3.3/32
   user@R3# commit
   ```


2. From operational mode on Device R1, enter the **show log rip-trace-file** command with the **| match 172.16.3.3** option.

```
user@R1> show log rip-trace-file | match 172.16.3.3
Mar  1 11:39:53.975192 Setting RIPv2 rtbit on route 172.16.3.3/32, tsi =
0xbb69228
Mar  1 11:39:59.847118  172.16.3.3/32: metric-in: 16, change: 3 -> 16; # gw:
1, pkt_upd_src 10.0.0.2, inx: 0, rte_upd_src 10.0.0.2
Mar  1 11:39:59.847568 CHANGE   172.16.3.3/32       nhid 591 gw 10.0.0.2
   RIP      pref 100/0 metric 3/0 fe-1/2/0.1 <Delete Int>
Mar  1 11:39:59.847629 Best route to 172.16.3.3/32 got deleted. Doing route calculation
 on the stored rte-info
```

Meaning The output shows that the route to 172.16.3.3/32 was deleted.

Related Documentation

- Example: Configuring RIP on page 3637

RIP Configuration Statements

any-sender

Syntax any-sender;

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information Statement introduced in Junos OS Release 8.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Disable strict sender address checks.

If the sender of a RIP message does not belong to the subnet of the interface, the message is discarded. This situation might cause problems with dropped packets when RIP is running on point-to-point interfaces, or when the addresses on the interfaces do not fall in the same subnet. You can resolve this by disabling strict address checks on the RIP traffic.

NOTE: The **any-sender** statement is supported only for peer-to-peer interfaces.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring RIP on page 3637

authentication-key (Protocols RIP)

Syntax authentication-key *password*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Require authentication for RIP route queries received on an interface.

Options *password*—Authentication password. If the password does not match, the packet is rejected. The password can be from 1 through 16 contiguous characters long and can include any ASCII strings.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Configuring Route Authentication for RIP on page 3644

authentication-type (Protocols RIP)

Syntax authentication-type *type*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the type of authentication for RIP route queries received on an interface.

Default If you do not include this statement and the **authentication-key** statement, RIP authentication is disabled.

Options *type*—Authentication type:

- **md5**—Use the MD5 algorithm to create an encoded checksum of the packet. The encoded checksum is included in the transmitted packet. The receiving routing device uses the authentication key to verify the packet, discarding it if the digest does not match. This algorithm provides a more secure authentication scheme.
- **none**—Disable authentication. If **none** is configured, the configured authentication key is ignored.
- **simple**—Use a simple password. The password is included in the transmitted packet, which makes this method of authentication relatively insecure. The password can be from 1 through 16 contiguous letters or digits long.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Route Authentication for RIP on page 3644
- **authentication-key on page 3701**

bfd-liveness-detection (Protocols RIP)

Syntax

```
bfd-liveness-detection {
  authentication {
    algorithm algorithm-name;
    key-chain key-chain-name;
    loose-check;
  }
  detection-time {
    threshold milliseconds;
  }
  minimum-interval milliseconds;
  minimum-receive-interval milliseconds;
  multiplier number;
  no-adaptation;
  transmit-interval {
    minimum-interval milliseconds;
    threshold milliseconds;
  }
  version (1 | automatic);
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols rip group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip group *group-name*],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information

Statement introduced in Junos OS Release 8.0.
Options **detection-time threshold** and **transmit-interval threshold** introduced in Junos OS Release 8.2.
Support for logical systems introduced in Junos OS Release 8.3.
Option **no-adaptation** introduced in Junos OS Release 9.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Options **authentication algorithm**, **authentication key-chain**, and **authentication loose-check** introduced in Junos OS Release 9.6.
Options **authentication algorithm**, **authentication key-chain**, and **authentication loose-check** introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure bidirectional failure detection timers and authentication.

Options

authentication algorithm *algorithm-name* —Configure the algorithm used to authenticate the specified BFD session: **simple-password**, **keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, or **meticulous-keyed-sha-1**.

authentication key-chain *key-chain-name*—Associate a security key with the specified BFD session using the name of the security keychain. The name you specify must match one of the keychains configured in the **authentication-key-chains key-chain** statement at the **[edit security]** hierarchy level.

authentication loose-check—(Optional) Configure loose authentication checking on the BFD session. Use only for transitional periods when authentication is not configured at both ends of the BFD session.

detection-time threshold ***milliseconds***—Configure a threshold for the adaptation of the BFD session detection time. When the detection time adapts to a value equal to or greater than the threshold, a single trap and a single system log message are sent.

minimum-interval ***milliseconds***—Configure the minimum interval after which the local routing device transmits a hello packet and then expects to receive a reply from the neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can specify the minimum transmit and receive intervals separately using the **transmit-interval minimum-interval** and **minimum-receive-interval** statements.

Range: 1 through 255,000 milliseconds

minimum-receive-interval ***milliseconds***—Configure the minimum interval after which the local routing device expects to receive a reply from a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum receive interval using the **minimum-interval** statement.

Range: 1 through 255,000 milliseconds

multiplier ***number***—Configure the number of hello packets not received by a neighbor that causes the originating interface to be declared down.

Range: 1 through 255

Default: 3

no-adaptation—Configure BFD sessions not to adapt to changing network conditions. We recommend that you not disable BFD adaptation unless it is preferable not to have BFD adaptation enabled in your network.

transmit-interval threshold ***milliseconds***—Configure the threshold for the adaptation of the BFD session transmit interval. When the transmit interval adapts to a value greater than the threshold, a single trap and a single system message are sent. The interval threshold must be greater than the minimum transmit interval.

Range: 0 through 4,294,967,295 (2^{32} – 1)

transmit-interval minimum-interval ***milliseconds***—Configure a minimum interval after which the local routing device transmits hello packets to a neighbor. Optionally, instead of using this statement, you can configure the minimum transmit interval using the **minimum-interval** statement.

Range: 1 through 255,000

version—Configure the BFD version to detect: **1** (BFD version 1) or **automatic** (autodetect the BFD version).

Default: **automatic**

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BFD for RIP on page 3651
- Example: Configuring BFD Authentication for RIP on page 3658

check-zero

Syntax

(check-zero | no-check-zero);

Hierarchy Level

[edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Some of the reserved fields in RIP version 1 packets must be zero, whereas in RIP version 2 packets, most of these reserved fields can contain nonzero values. By default, RIP discards version 1 packets that have nonzero values in the reserved fields and version 2 packets that have nonzero values in the fields that must be zero. This default behavior implements the RIP version 1 and version 2 specifications.

If you find that you are receiving RIP version 1 packets with nonzero values in the reserved fields or RIP version 2 packets with nonzero values in the fields that must be zero, you can configure RIP to receive these packets even though they are being sent in violation of the specifications in RFC 1058 and RFC 2453.

Check whether the reserved fields in a RIP packet are zero:

- **check-zero**—Discard version 1 packets that have nonzero values in the reserved fields and version 2 packets that have nonzero values in the fields that must be zero. This default behavior implements the RIP version 1 and version 2 specifications.
- **no-check-zero**—Receive RIP version 1 packets with nonzero values in the reserved fields or RIP version 2 packets with nonzero values in the fields that must be zero. This is in spite of the fact that they are being sent in violation of the specifications in RFC 1058 and RFC 2453.

Default

check-zero

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring RIP on page 3637

export (Protocols RIP)

Syntax
export [*policy-names*];

Hierarchy Level
[edit logical-systems *logical-system-name* protocols rip group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name*],
[edit protocols rip group *group-name*],
[edit routing-instances *routing-instance-name* protocols rip group *group-name*]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description
Apply a policy to routes being exported to the neighbors.

By default, RIP does not export routes it has learned to its neighbors. To enable RIP to export routes, apply one or more export policies.

If no routes match the policies, the local routing device does not export any routes to its neighbors. Export policies override any metric values determined through calculations involving the values configured with the **metric-in** and **metric-out** statements.

NOTE: The export policy on RIP does not support manipulating routing information of the next hop.

Options
policy-names—Name of one or more policies.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Configuring RIP on page 3637
- import on page 3711

group (Protocols RIP)

Syntax

```
group group-name {
  bfd-liveness-detection {
    authentication {
      algorithm algorithm-name;
      key-chain key-chain-name;
      loose-check;
    }
    detection-time {
      threshold milliseconds;
    }
    minimum-interval milliseconds;
    minimum-receive-interval milliseconds;
    transmit-interval {
      threshold milliseconds;
      minimum-interval milliseconds;
    }
    multiplier number;
    version (0 | 1 | automatic);
  }
  demand-circuit;
  export policy;
  max-retrans-time  seconds;
  metric-out metric;
  preference number;
  route-timeout seconds;
  update-interval seconds;
  neighbor neighbor-name {
    authentication-key password;
    authentication-type type;
    bfd-liveness-detection {
      authentication {
        algorithm algorithm-name;
        key-chain key-chain-name;
        loose-check;
      }
      detection-time {
        threshold milliseconds;
      }
      minimum-interval milliseconds;
      minimum-receive-interval milliseconds;
      transmit-interval {
        threshold milliseconds;
        minimum-interval milliseconds;
      }
      multiplier number;
      version (0 | 1 | automatic);
    }
    (check-zero | no-check-zero);
    demand-circuit;
    import policy-name;
    max-retrans-time seconds;
    message-size number;
```



```
        metric-in metric;
        metric-out metric;
        receive receive-options;
        route-timeout seconds;
        send send-options;
        update-interval seconds;
    }
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit protocols rip],
[edit routing-instances *routing-instance-name* protocols rip]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure a set of RIP neighbors that share an export policy and metric. The export policy and metric govern what routes to advertise to neighbors in a given group. Each group must contain at least one neighbor. You should create a group for every export policy.

Options ***group-name***—Name of a group, up to 16 characters long.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring RIP on page 3637

holddown (Protocols RIP)

Syntax

holddown *seconds*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit protocols rip],
[edit routing-instances *routing-instance-name* protocols rip]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure how long the expired route is retained in the routing table before being removed.

When the hold-down timer runs on RIP demand circuits, routes are advertised as unreachable on other interfaces. When the hold-down timer expires, the route is removed from the routing table if all destinations detect that the route is unreachable or the remaining destinations are down.

Options

seconds—Estimated time to wait before making updates to the routing table.

Range: 10 through 180 seconds

Default: 120 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring RIP Timers on page 3688
- *RIP Demand Circuits Overview*

import (Protocols RIP)

Syntax import [*policy-names*];

Hierarchy Level
[edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Apply one or more policies to routes being imported by the local routing device from neighbors.

Options ***policy-names***—Name of one or more policies.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Applying Policies to RIP Routes Imported from Neighbors on page 3664
- *Routing Policy Feature Guide for Routing Devices*
- export on page 3707

message-size

Syntax message-size *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement for SRX Series devices introduced in Junos OS Release 9.5.
Statement for J Series platform introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the number of route entries to be included in every RIP update message.

TIP: To ensure interoperability with other vendors' equipment, use the standard of 25 route entries per message. Do not change the default number of route entries in a RIP update message.

Options *number*—Number of route entries per update message.

Range: 25 through 255 entries

Default: 25 entries

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring RIP on page 3637

metric-in (Protocols RIP)

Syntax metric-in *metric*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the metric to add to incoming routes when the routing device advertises into RIP routes that were learned from other protocols. Use this statement to configure the routing device to prefer RIP routes learned through a specific neighbor.

Options *metric*—Metric value.

Range: 1 through 16

Default: 1

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring the Metric Value Added to Imported RIP Routes on page 3674

metric-out (Protocols RIP)

Syntax metric-out *metric*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify the metric value to add to routes transmitted to the neighbor. Use this statement to control how other routing devices prefer RIP routes sent from this neighbor.

If you have included the **export** statement, RIP exports routes it has learned to the neighbors configured by including the **neighbor** statement.

The metric associated with a RIP route (unless modified by an export policy) is the normal RIP metric. For example, a RIP route with a metric of 5 learned from a neighbor configured with a **metric-in** value of 2 is advertised with a combined metric of 7 when advertised to RIP neighbors in the same group. However, if this route was learned from a RIP neighbor in a different group or from a different protocol, the route is advertised with the metric value configured for that group with the **metric-out** statement.

The metric for a route can be modified with an export policy. That metric is seen when the route is exported to the next hop.

To increase the metric for routes advertised outside a group, include the **metric-out** statement.

Options *metric*—Metric value.

Range: 1 through 16

Default: 1

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Examples: Controlling Traffic with Metrics in a RIP Network on page 367050

neighbor (Protocols RIP)

Syntax

```
neighbor neighbor-name {
  authentication-key password;
  authentication-type type;
  bfd-liveness-detection {
    authentication {
      algorithm algorithm-name;
      key-chain key-chain-name;
      loose-check;
    }
    detection-time {
      threshold milliseconds;
    }
    minimum-interval milliseconds;
    minimum-receive-interval milliseconds;
    transmit-interval {
      threshold milliseconds;
      minimum-interval milliseconds;
    }
    multiplier number;
    version (0 | 1 | automatic);
  }
  (check-zero | no-check-zero);
  demand-circuit;
  import policy-name;
  max-retrans-time seconds;
  message-size number;
  metric-in metric;
  metric-out metric;
  receive receive-options;
  route-timeout seconds;
  send send-options;
  update-interval seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols rip group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name*],
[edit protocols rip group *group-name*],
[edit routing-instances *routing-instance-name* protocols rip group *group-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description

Configure neighbor-specific RIP parameters, thereby overriding the defaults set for the routing device.

Options

neighbor-name—Name of an interface over which a routing device communicates to its neighbors.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Configuring RIP on page 3637

preference (Protocols RIP)

Syntax preference *preference*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name*],
[edit protocols rip group *group-name*],
[edit routing-instances *routing-instance-name* protocols rip group *group-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description Specify the preference of external routes learned by RIP as compared to those learned from other routing protocols.

By default, Junos OS assigns a preference of 100 to routes that originate from RIP. When Junos OS determines a route's preference to become the active route, the software selects the route with the lowest preference and installs this route into the forwarding table.

Options *preference*—Preference value. A lower value indicates a more preferred route.

Range: 0 through 4,294,967,295 (2^{32} – 1)

Default: 100

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Route Preferences Overview*

receive (Protocols RIP)

Syntax

receive *receive-options*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure RIP receive options.

Options

receive-options—One of the following:

- **both**—Accept both RIP version 1 and version 2 packets.
- **none**—Do not receive RIP packets.
- **version-1**—Accept only RIP version 1 packets.
- **version-2**—Accept only RIP version 2 packets.

Default: both

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring the Sending and Receiving of RIPv1 and RIPv2 Packets on page 3678
- send on page 3720

rib-group (Protocols RIP)

Syntax rib-group *group-name*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit protocols rip],
[edit routing-instances *routing-instance-name* protocols rip]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Install RIP routes into multiple routing tables by configuring a routing table group.

Options *group-name*—Name of the routing table group.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Redistributing Routes Between Two RIP Instances on page 3683

rip

Syntax rip {...}

Hierarchy Level [edit logical-systems *logical-system-name* protocols],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols],
[edit protocols],
[edit routing-instances *routing-instance-name* protocols]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable RIP routing on the routing device.

Default RIP is disabled on the routing device.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring RIP on page 3637

route-timeout (Protocols RIP)

Syntax route-timeout *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit logical-systems *logical-system-name* protocols rip group *group-name*],
[edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip],
[edit protocols rip group *group-name*],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip],
[edit routing-instances *routing-instance-name* protocols rip group *group-name*],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the route timeout interval for RIP. If a route is not refreshed after being installed in the routing table by the specified timeout interval, the route is marked as invalid and is removed from the routing table after the hold-down period expires.

Options *seconds*—Estimated time to wait before making updates to the routing table.

Range: 30 through 360 seconds

Default: 180 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring RIP Timers on page 3688
- *RIP Demand Circuits Overview*

send (Protocols RIP)

Syntax send *send-options*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure RIP send options.

Options *send-options*—One of the following:

- **broadcast**—Broadcast RIP version 2 packets (RIP version 1 compatible).
- **multicast**—Multicast RIP version 2 packets. This is the default.
- **none**—Do not send RIP updates.
- **version-1**—Broadcast RIP version 1 packets.

Default: multicast

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring the Sending and Receiving of RIPv1 and RIPv2 Packets on page 3678
- receive on page 3717

traceoptions (Protocols RIP)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit protocols rip],
[edit routing-instances *routing-instance-name* protocols rip]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Set RIP protocol-level tracing options.

NOTE: **The traceoptions statement is not supported on QFabric systems.**

Default

The default RIP protocol-level trace options are inherited from the global **traceoptions** statement.

Options

disable—(Optional) Disable the tracing operation. One use of this option is to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *filename*—Name of the file to receive the output of the tracing operation. Enclose the name in quotation marks. We recommend that you place RIP tracing output in the file **/var/log/rip-log**.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 10 files

flag *flag*—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

RIP Tracing Options

- **auth**—RIP authentication
- **error**—RIP error packets

- **expiration**—RIP route expiration processing
- **holddown**—RIP hold-down processing
- **nsr-synchronization**—Nonstop routing synchronization events
- **packets**—All RIP packets
- **request**—RIP information packets such as request, poll, and poll entry packets
- **trigger**—RIP triggered updates
- **update**—RIP update packets

Global Tracing Options

- **all**—All tracing operations
- **general**—A combination of the **normal** and **route** trace operations
- **normal**—All normal operations

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **policy**—Policy operations and actions
- **route**—Routing table changes
- **state**—State transitions
- **task**—Routing protocol task processing
- **timer**—Routing protocol timer processing

flag-modifier—(Optional) Modifier for the tracing flag. You can specify one or more of these modifiers:

- **detail**—Provide detailed trace information.
- **receive**—Trace the packets being received.
- **receive-detail**—Provide detailed trace information for packets being received.
- **send**—Trace the packets being transmitted.
- **send-detail**—Provide detailed trace information for packets being transmitted.

no-world-readable—(Optional) Prevent any user from reading the log file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB) or megabytes (MB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum file size, you must also specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 128 KB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Tracing RIP Protocol Traffic on page 3695

update-interval (Protocols RIP)

Syntax update-interval *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols rip],
[edit logical-systems *logical-system-name* protocols rip group *group-name*],
[edit logical-systems *logical-system-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*],
[edit protocols rip],
[edit protocols rip group *group-name*],
[edit protocols rip group *group-name* neighbor *neighbor-name*],
[edit routing-instances *routing-instance-name* protocols rip],
[edit routing-instances *routing-instance-name* protocols rip group *group-name*],
[edit routing-instances *routing-instance-name* protocols rip group *group-name* neighbor *neighbor-name*]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the interval at which routes learned by RIP are sent to neighbors. This timer controls the interval between routing updates. This timer is set to 30 seconds, by default, with a small random amount of time added when the timer is reset. This added time prevents congestion that can happen if all routing devices update their neighbors simultaneously.

Options *seconds*—Estimated time to wait before making updates to the routing table.

Range: 10 through 60 seconds

Default: 30 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring RIP Timers on page 3688

CHAPTER 42

Administration

Routine Monitoring

Monitoring RIP Routing Information

Purpose Use the monitoring functionality to monitor RIP routing on routing devices.

Action To view RIP routing information in the CLI, enter the following CLI commands:

- **show rip statistics**
- **show rip neighbor**

Related Documentation

- show rip neighbor on page 3730
- show rip statistics on page 3732

RIP Operational Commands

clear rip general-statistics

Syntax clear rip general-statistics
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series) clear rip general-statistics

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description Clear RIP general statistics.

Options **none**—Clear RIP general statistics.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level clear

Related Documentation

- show rip general-statistics on page 3728

List of Sample Output clear rip general-statistics on page 3726

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear rip general-statistics

```
user@host> clear rip general-statistics
```


clear rip statistics

Syntax

clear rip statistics
<instance (all | *instance-name*)>
<logical-system (all | *logical-system-name*)>
<*neighbor*>
<peer (all | *address*)>

Syntax (EX Series Switches and QFX Series)

clear rip statistics
<instance (all | *instance-name*)>
<*neighbor*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Clear RIP statistics.

Options

none—Reset RIP counters for all neighbors for all routing instances.

instance (all | ***instance-name*****)**—(Optional) Clear RIP statistics for all instances or for the specified routing instance only.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

neighbor—(Optional) Clear RIP statistics for the specified neighbor only.

peer (all | ***address*****)**—(Optional) Clear RIP statistics for a single peer or all peers.

Required Privilege Level

clear

Related Documentation

- show rip statistics on page 3732

List of Sample Output

clear rip statistics on page 3727

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear rip statistics

```
user@host> clear rip statistics
```

show rip general-statistics

Syntax

show rip general-statistics
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and QFX Series)

show rip general-statistics

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display brief RIP statistics.

Options

none—Display brief RIP statistics.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- clear rip general-statistics on page 3726

List of Sample Output

show rip general-statistics on page 3728

Output Fields

Table 264 on page 3728 lists the output fields for the **show rip general-statistics** command. Output fields are listed in the approximate order in which they appear.

Table 264: show rip general-statistics Output Fields

Field Name	Field Description
bad msgs	Number of invalid messages received.
no recv intf	Number of packets received with no matching interface.
curr memory	Amount of memory currently used by RIP.
max memory	Most memory used by RIP.

Sample Output

show rip general-statistics

```
user@host> show rip general-statistics
RIPv2 I/O info:
     bad msgs      :         0
     no recv intf  :         0
     curr memory   :         0
     max memory    :         0
```

show rip neighbor

Syntax

show rip neighbor
<instance (all | *instance-name*)>
<logical-system (all | *logical-system-name*)>
<*name*>

Syntax (EX Series Switches and QFX Series)

show rip neighbor
<instance (all | *instance-name*)>
<*name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display information about RIP neighbors.

Options

none—Display information about all RIP neighbors for all instances.

instance (all | ***instance-name*****)**—(Optional) Display RIP neighbor information for all instances or for only the specified routing instance.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

name—(Optional) Display detailed information about only the specified RIP neighbor.

Required Privilege Level

view

List of Sample Output

show rip neighbor on page 3731
show rip neighbor (With Demand Circuits Configured) on page 3731

Output Fields

Table 265 on page 3730 lists the output fields for the **show rip neighbor** command. Output fields are listed in the approximate order in which they appear.

Table 265: show rip neighbor Output Fields

Field Name	Field Description
Neighbor	Name of the RIP neighbor. NOTE: Beginning with Junos OS Release 11.1, when you configure demand circuits, the output displays a demand circuit (DC) flag next to neighbor interfaces configured for demand circuits. If you configure demand circuits at the **[edit protocols rip group** ***group-name*** **neighbor** ***neighbor-name*****]** hierarchy level, the output shows only the neighboring interface that you specifically configured as a demand circuit. If you configure demand circuits at the **[edit protocols rip group** ***group-name*****]** hierarchy level, all of the interfaces in the group are configured as demand circuits. Therefore, the output shows all of the interfaces in that group as demand circuits.

Table 265: show rip neighbor Output Fields *(continued)*

Field Name	Field Description
State	State of the connection: **Up** or **Dn** (Down).
Source Address	Address of the port on the local router.
Destination Address	Address of the port on the remote router.
Send Mode	Send options: **broadcast**, **multicast**, **none**, or **version 1**.
Receive Mode	Type of packets to accept: **both**, **none**, **version 1**, or **version 2**.
In Met	Metric added to incoming routes when advertising into RIP routes that were learned from other protocols.

Sample Output

show rip neighbor

```
user@host> show rip neighbor
                  Local  Source          Destination     Send   Receive   In
Neighbor          State  Address         Address         Mode   Mode      Met
--------          -----  -------         -----------     ----   -------   ---
ge-2/3/0.0           Up  192.168.9.105   192.168.9.107   bcast  both        1
at-5/1/1.42          Dn  (null)          (null)          mcast  v2 only     3
at-5/1/0.42          Dn  (null)          (null)          mcast  both        3
at-5/1/0.0           Up  20.0.0.1        224.0.0.9       mcast  both        3
so-0/0/0.0           Up  192.168.9.97    224.0.0.9       mcast  both        3
```

show rip neighbor (With Demand Circuits Configured)

```
user@host> show rip neighbor
                  Local  Source          Destination     Send   Receive  In
Neighbor          State  Address         Address         Mode   Mode     Met
--------          -----  -------         -----------     ----   -------  ---
so-0/1/0.0(DC)       Up  10.10.10.2      224.0.0.9       mcast  both       1
so-0/2/0.0(DC)       Up  13.13.13.2      224.0.0.9       mcast  both       1
```

show rip statistics

Syntax

show rip statistics
<instance (all | *instance-name*)>
<logical-system (all | *logical-system-name*)>
<*name*>
<peer (all | *address*)>

Syntax (EX Series Switches and QFX Series)

show rip statistics
<instance (all | *instance-name*)>
<*name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display RIP statistics about messages sent and received on an interface, as well as information received from advertisements from other routing devices.

Options

none—Display RIP statistics for all routing instances.

instance (all | *instance-name*)—(Optional) Display RIP statistics for all instances or for only the specified routing instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

name—(Optional) Display detailed information about only the specified RIP neighbor.

peer (all | *address*)—(Optional) Display RIP statistics for a single peer or all peers.

Required Privilege Level

view

Related Documentation

- clear rip statistics on page 3727

List of Sample Output

show rip statistics on page 3733

Output Fields

Table 266 on page 3733 lists the output fields for the **show rip statistics** command. Output fields are listed in the approximate order in which they appear.

Table 266: show rip statistics Output Fields

Field Name	Field Description
RIP info	Information about RIP on the specified interface: • **port**—UDP port number used for RIP. • **update interval**—Interval between routing table updates, in seconds. • **holddown**—Hold-down interval, in seconds. • **timeout**—Timeout interval, in seconds. • **restart in progress**—Graceful restart status. Displayed when RIP is or has been in the process of graceful restart. • **restart time**—Estimated time for the graceful restart to finish, in seconds. • **restart will complete in**—Remaining time for the graceful restart to finish, in seconds. • **rts learned**—Number of routes learned through RIP. • **rts held down**—Number of routes held down by RIP. • **rqsts dropped**—Number of received request packets that were dropped. • **resps dropped**—Number of received response packets that were dropped.
logical-interface	Name of the logical interface and its statistics: • **routes learned**—Number of routes learned on the logical interface. • **routes advertised**—Number of routes advertised by the logical interface.
Counter	List of counter types: • **Updates Sent**—Number of update messages sent. • **Triggered Updates Sent**—Number of triggered update messages sent. • **Responses Sent**—Number of response messages sent. • **Bad Messages**—Number of invalid messages received. • **RIPv1 Updates Received**—Number of RIPv1 update messages received. • **RIPv1 Bad Route Entries**—Number of RIPv1 invalid route entry messages received. • **RIPv1 Updates Ignored**—Number of RIPv1 update messages ignored. • **RIPv2 Updates Received**—Number of RIPv2 update messages received. • **RIPv2 Bad Route Entries**—Number of RIPv2 invalid route entry messages received. • **RIPv2 Updates Ignored**—Number of RIPv2 update messages ignored. • **Authentication Failures**—Number of received update messages that failed authentication. • **RIP Requests Received**—Number of RIP request messages received. • **RIP Requests Ignored**—Number of RIP request messages ignored.
Total	Total number of packets for the selected counter.
Last 5 min	Number of packets for the selected counter in the most recent 5-minute period.
Last minute	Number of packets for the selected counter in the most recent 1-minute period.

Sample Output

show rip statistics

`user@host>` **show rip statistics so-0/0/0.0**

```
RIP info: port 520; update interval: 30s; holddown 180s; timeout 120s
restart in progress: restart time 60s; restart will complete in 55s
    rts learned  rts held down  rqsts dropped  resps dropped
              0              0              0              0
so-0/0/0.0:  0 routes learned; 501 routes advertised
Counter                         Total   Last 5 min  Last minute
-------                   -----------  -----------  -----------
Updates Sent                        0            0            0
Triggered Updates Sent              0            0            0
Responses Sent                      0            0            0
Bad Messages                        0            0            0
RIPv1 Updates Received              0            0            0
RIPv1 Bad Route Entries             0            0            0
RIPv1 Updates Ignored               0            0            0
RIPv2 Updates Received              0            0            0
RIPv2 Bad Route Entries             0            0            0
RIPv2 Updates Ignored               0            0            0
Authentication Failures             0            0            0
RIP Requests Received               0            0            0
RIP Requests Ignored                0            0            0
```

PART 14

MPLS Applications

CHAPTER 43

Overview

MPLS Overview

MPLS on the QFX Series Overview

You can configure Multiprotocol Label Switching (MPLS) on QFX Series devices to increase transport efficiency in the network. MPLS services can be used to connect various sites to a backbone network and to ensure better performance for low-latency applications such as voice over IP (VoIP) and other business-critical functions.

MPLS has the following advantages over conventional packet forwarding:

- Packets arriving on different ports can be assigned different labels.
- A packet arriving at a particular provider edge (PE) switch can be assigned a label that is different from that of the same packet entering the network at a different PE switch. As a result, forwarding decisions that depend on the ingress PE switch can be easily made.
- Sometimes it is desirable to force a packet to follow a particular route that is explicitly chosen at or before the time the packet enters the network, rather than letting it follow the route chosen by the normal dynamic routing algorithm as the packet travels through the network. In MPLS, a label can be used to represent the route so that the packet need not carry the identity of the explicit route.

Related Documentation

- MPLS Feature Support on the QFX Series Overview on page 3748
- Understanding MPLS Components for the QFX Series on page 3738
- Understanding MPLS Label Operations on the QFX Series on page 3741

- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- *Junos OS MPLS Applications Library for Routing Devices*

Understanding MPLS Components for the QFX Series

MPLS for QFX Series devices includes a number of components. While some components are required for all MPLS applications, others might not be, depending on the specific application.

This topic includes:

Provider Edge Switches

To implement MPLS on a network, you must configure two provider edge (PE) switches—that is, an ingress PE switch and an egress PE switch. In addition, you must configure one or more provider switches as transit switches within the network to support the forwarding of MPLS packets.

The ingress PE switch (the entry point to the MPLS tunnel) receives a packet, analyzes it, and pushes an MPLS label onto it. This label places the packet in a forwarding equivalence class (FEC) and determines its handling and destination through the MPLS tunnel. The egress PE switch (the exit point from the MPLS tunnel) pops the MPLS label off the outgoing packet.

Within an MPLS tunnel, the network traffic is bidirectional. Therefore, each PE switch can be configured to be both an ingress switch and an egress switch, depending on the direction of the traffic.

The following MPLS components are configured on the PE switches but not on the provider switches:

MPLS Protocol and Label-Switched Paths

Each PE switch must be configured to support the MPLS protocol. You must also configure label-switched paths (LSPs) at the **[edit protocols mpls]** hierarchy level.

IP Over MPLS for Customer Edge Interfaces

You can configure the customer edge interfaces of the PE switches for IP over MPLS using a Layer 3 interface and a static route from the ingress PE switch to the egress PE switch. See "Configuring MPLS on Provider Edge Switches" on page 3772.

BGP Layer 3 VPN Configuration

If you are implementing a Layer 3 virtual private network (VPN), you must configure the BGP routing protocol on the PE switches.

Routing Instances for Layer 3 VPN

If you are implementing a Layer 3 VPN, you must configure a routing instance. A routing instance is a collection of routing tables, interfaces, and routing protocol parameters. The set of interfaces belongs to the routing tables, and the routing protocol parameters control the information in the routing tables.

QFX Series devices support VPN routing and forwarding (VRF) routing instances for Layer 3 VPNs.

Each routing instance has a unique name and a corresponding IP unicast table. For example, if you configure a routing instance with the name **my-instance**, its corresponding IP unicast table will be **my-instance.inet.0**. All routes for **my-instance** are installed in **my-instance.inet.0**.

Provider Switch

You must configure one or more provider switches as transit switches within the network to support the forwarding of MPLS packets. You can add provider switches without changing the configuration of the PE switches.

A provider switch does not analyze packets. It refers to an MPLS label forwarding table and swaps one label for another. The new label determines the next hop along the MPLS tunnel. A provider switch cannot perform push or pop operations.

Components Required for All Switches in the MPLS Network

The following MPLS components are configured on both the PE switches and the provider switches:

- Interior Gateway Protocol on page 3739
- MPLS Protocol on page 3740
- RSVP on page 3740
- Family mpls on page 3740

Interior Gateway Protocol

MPLS works in coordination with OSPF as the interior gateway protocol (IGP). Therefore, you must configure OSPF as the IGP on the loopback interface and core interfaces of both the PE switches and the provider switches.

The core interfaces can be either Gigabit Ethernet or 10-Gigabit Ethernet interfaces, and they can be configured as either individual interfaces or as aggregated Ethernet interfaces.

NOTE: The core interfaces cannot be configured with VLAN tagging or a VLAN ID. When you configure them to belong to **family mpls**, they are removed from the default VLAN if they were members of that VLAN. They operate as an exclusive tunnel for MPLS traffic.

MPLS Protocol

You must enable the MPLS protocol on all switches that participate in the MPLS network and apply it to the core interfaces of both the PE and provider switches. You do not need to apply it to the loopback interface because the MPLS protocol uses the framework established by the RSVP signaling protocol to create LSPs. On the PE switches, the configuration of the MPLS protocol must also include the definition of an LSP.

RSVP

RSVP is a signaling protocol that allocates and distributes labels throughout an MPLS network. RSVP sets up unidirectional paths between the ingress PE switch and the egress PE switch. RSVP makes the LSPs dynamic; it can detect topology changes and outages and establish new LSPs to allow traffic to move around a failure.

You must enable RSVP and apply it to the loopback interface and the core interface of both the PE and provider switches. The path message contains the configured information about the resources required for the LSP to be established.

When the egress PE switch receives the path message, it sends a reservation message back to the ingress PE switch. This reservation message is passed along from switch to switch along the same path as the original path message. Once the ingress PE switch receives this reservation message, an RSVP path is established.

The established LSP stays active as long as the RSVP session remains active. RSVP continues activity through the transmissions and responses to RSVP path and reservation messages. If the messages stop for three minutes, the RSVP session terminates and the LSP is lost.

RSVP runs as a separate software process in Junos OS and is not in the packet-forwarding path.

Family mpls

You must configure the core interfaces used for MPLS traffic to belong to **family mpls**.

NOTE: You can enable **family mpls** on either individual interfaces or on aggregated Ethernet interfaces. You cannot enable it on tagged VLAN interfaces.

Related Documentation

- MPLS Feature Support on the QFX Series Overview on page 3748
- Understanding Using MPLS-Based Layer 3 VPNs on the QFX Series on page 3747
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744

- *Junos OS MPLS Applications Library for Routing Devices*
- *Junos OS VPNs Library for Routing Devices*

Understanding MPLS Label Operations on the QFX Series

In the traditional packet-forwarding paradigm, as a packet travels from one switch to the next, an independent forwarding decision is made at each hop. The IP network header is analyzed and the next hop is chosen based on this analysis and on the information in the routing table. In an MPLS environment, the analysis of the packet header is made only once, when a packet enters the MPLS tunnel (that is, the path used for MPLS traffic).

When an IP packet enters a label-switched path (LSP), the ingress provider edge (PE) switch examines the packet and assigns it a label based on its destination, placing the label in the packet's header. The label transforms the packet from one that is forwarded based on its IP routing information to one that is forwarded based on information associated with the label. The packet is then forwarded to the next provider switch in the LSP. This switch and all subsequent switches in the LSP do not examine any of the IP routing information in the labeled packet. Rather, they use the label to look up information in their label forwarding table. They then replace the old label with a new label and forward the packet to the next switch in the path. When the packet reaches the egress PE switch, the label is removed, and the packet again becomes a native IP packet and is forwarded based on its IP routing information.

This topic describes:

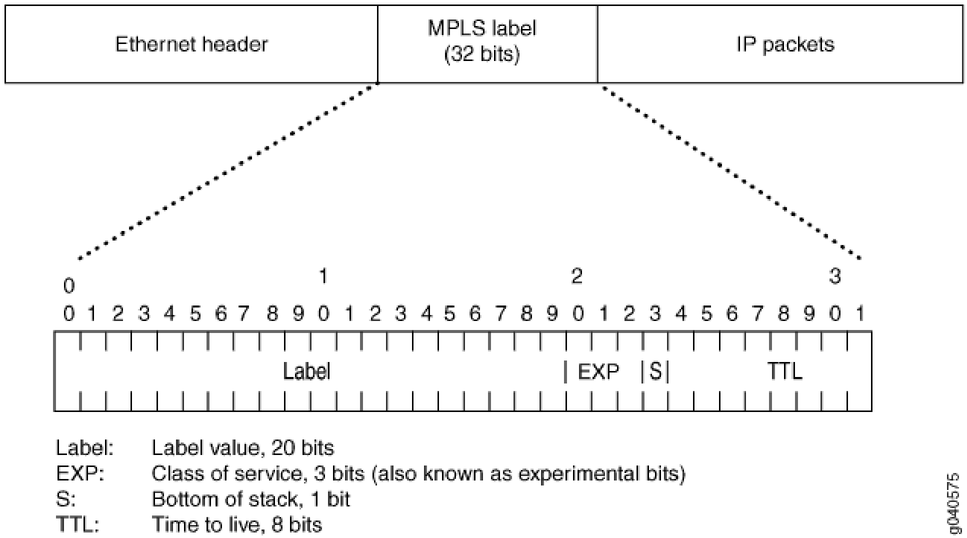
MPLS Label-Switched Paths and MPLS Labels

When a packet enters the MPLS network, it is assigned to an LSP. Each LSP is identified by a label, which is a short (20-bit), fixed-length value at the front of the MPLS label (32 bits). Labels are used as lookup indexes for the label forwarding table. For each label, this table stores forwarding information. Because no additional parsing or lookup is done on the encapsulated packet, MPLS supports the transmission of any other protocols within the packet payload.

NOTE: The implementation of MPLS on QFX Series devices supports packets with as many as two labels.

Figure 112 on page 3742 shows the encoding of a single label. The encoding appears after data link layer headers, but before any network layer header.

Figure 112: Label Encoding



Reserved Labels

Labels range from 0 through 1,048,575. Labels 0 through 999,999 are for internal use.

Some of the reserved labels (in the range 0 through 15) have well-defined meanings. The following reserved labels are used by QFX Series devices:

- 0, IPv4 Explicit Null label—This value is valid only when it is the sole label entry (no label stacking). It indicates that the label must be popped on receipt. Forwarding continues based on the IP version 4 (IPv4) packet.
- 1, Router Alert label—When a packet is received with a top label value of 1, it is delivered to the local software module for processing.
- 3, Implicit Null label—This label is used in the signaling protocol (RSVP) only to request label popping by the downstream switch. It never actually appears in the encapsulation. Labels with a value of 3 must not be used in the data packet as real labels. No payload type (IPv4 or IPv6) is implied with this label.

MPLS Label Operations

QFX Series devices support the following MPLS label operations:

- Push
- Pop
- Swap

The push operation affixes a new label to the top of the IP packet. For IPv4 packets, the new label is the first label. The time to live (TTL) field value in the packet header is derived from the IP packet header. The push operation cannot be applied to a packet that already has an MPLS label.

The pop operation removes a label from the beginning of the packet. Once the label is removed, the TTL is copied from the label into the IP packet header, and the underlying IP packet is forwarded as a native IP packet

The swap operation removes an existing MPLS label from an IP packet and replaces it with a new MPLS label, based on the following:

- Incoming interface
- Label
- Label forwarding table

Figure 113 on page 3743 shows an IP packet without a label arriving on the customer edge interface (ge-0/0/1) of the ingress PE switch. The ingress PE switch examines the packet and identifies that packet's destination as the egress PE switch. The ingress PE switch applies label 100 to the packet and sends the MPLS packet to its outgoing MPLS core interface (ge-0/0/5). The MPLS packet is transmitted on the MPLS tunnel through the provider switch, where it arrives at interface ge-0/0/5 with label 100. The provider switch swaps label 100 with label 200 and forwards the MPLS packet through its core interface (ge-0/0/7) to the next hop on the tunnel, which is the egress PE switch. The egress PE switch receives the MPLS packet through its core interface (ge-0/0/7), removes the MPLS label, and sends the IP packet out of its customer edge interface (ge-0/0/1) to a destination that is beyond the tunnel.

Figure 113: MPLS Label Swapping

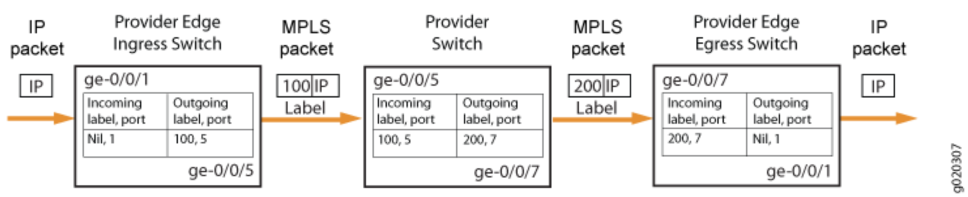


Figure 113 on page 3743 shows the path of a packet as it passes in one direction from the ingress PE switch to the egress PE switch. However, the MPLS configuration also allows traffic to travel in the reverse direction. Thus, each PE switch operates as both an ingress switch and an egress switch.

Penultimate-Hop Popping and Ultimate-Hop Popping

The switches enable penultimate-hop popping (PHP) by default with IP over MPLS configurations. With PHP, the penultimate provider switch is responsible for popping the MPLS label and forwarding the traffic to the egress PE switch. The egress PE switch then performs an IP route lookup and forwards the traffic. This reduces the processing load on the egress PE switch, because it is not responsible for popping the MPLS label.

- The default advertised label is label 3 (Implicit Null label). If label 3 is advertised, the penultimate-hop switch removes the label and sends the packet to the egress PE switch.

- If ultimate-hop popping is enabled, label 0 (IPv4 Explicit Null label) is advertised and the egress PE switch of the LSP removes the label.

Related Documentation

- Understanding MPLS Components for the QFX Series on page 3738
- Configuring MPLS on Provider Edge Switches on page 3772
- Configuring MPLS on Provider Switches on page 3775

- *Junos OS MPLS Applications Library for Routing Devices*
- *Junos OS VPNs Library for Routing Devices*

Understanding CoS MPLS EXP Classifiers and Rewrite Rules

You can use class of service (CoS) within MPLS networks to prioritize certain types of traffic during periods of congestion by applying packet classifiers and rewrite rules to the MPLS traffic. (For information about DSCP and IEEE 802.1p classifiers and general information about classifiers, see "Understanding CoS Classifiers" on page 5334. For information about DSCP and IEEE 802.1p rewrite rules, see "Understanding CoS Rewrite Rules" on page 5414.)

When a packet enters a customer-edge interface on the ingress provider edge (PE) switch, the switch associates the packet with a particular CoS servicing level before placing the packet onto the label-switched path (LSP). The switches within the LSP utilize the CoS value set at the ingress PE switch. The CoS value that was embedded in the classifier is translated and encoded in the MPLS header by means of the experimental (EXP) bits.

EXP classifiers map incoming MPLS packets to a forwarding class and a loss priority, and assign MPLS packets to output queues based on the forwarding class mapping. EXP classifiers are behavior aggregate (BA) classifiers.

EXP rewrite rules change (rewrite) the CoS value of the EXP bits in outgoing packets on the egress queues of the switch so that the new (rewritten) value matches the policies of a targeted peer. Policy matching allows the downstream routing platform or switch in a neighboring network to classify each packet into the appropriate service group.

NOTE: There is no default EXP classifier. There is no default EXP rewrite rule. If you want to classify incoming MPLS packets using the EXP bits, you must configure a global EXP classifier. If you want to rewrite the EXP bit value at the egress interface, you must configure EXP rewrite rules and apply them to logical interfaces.

This topic includes:

- EXP Classifiers on page 3745
- EXP Rewrite Rules on page 3745
- Schedulers on page 3746

EXP Classifiers

Unlike DSCP and IEEE 802.1p BA classifiers, EXP classifiers are global to the switch and apply to all switch interfaces. When you configure and apply an EXP classifier, MPLS traffic on all interfaces uses the EXP classifier, even on interfaces that also have a fixed classifier. If an interface has both an EXP classifier and a fixed classifier, the EXP classifier is applied to MPLS traffic and the fixed classifier is applied to all other traffic.

Also unlike DSCP and IEEE 802.1p BA classifiers, there is no default EXP classifier. If you want to classify MPLS traffic based on the EXP bits, you must explicitly configure an EXP classifier and apply it the switch interfaces. Each EXP classifier has eight entries that correspond to the eight EXP CoS values (0 through 7, which correspond to bits 000 through 111).

You can configure as many EXP classifiers as you want. However, the switch uses only one MPLS EXP classifier as a global classifier on all interfaces. After you configure an MPLS EXP classifier, you can configure it as the global EXP classifier by including the EXP classifier in the **[edit class-of-service system-defaults classifiers exp]** hierarchy. All switch interfaces use the global EXP classifier to classify MPLS traffic.

Only one EXP classifier can be configured as the global EXP classifier at any time. If you want to change the global EXP classifier, delete the global EXP classifier configuration (use the **user@switch# delete class-of-service system-defaults classifiers exp** configuration statement), then configure the new global EXP classifier.

If an EXP classifier is not configured, then if a fixed classifier is applied to the interface, the MPLS traffic uses the fixed classifier. If no EXP classifier and no fixed classifier is applied to the interface, MPLS traffic is treated as best-effort traffic. DSCP classifiers are not applied to MPLS traffic.

Because the EXP classifier is global, you cannot configure some ports to use a fixed IEEE 802.1p classifier for MPLS traffic on some interfaces and the global EXP classifier for MPLS traffic on other interfaces. When you configure a global EXP classifier, all MPLS traffic on all interfaces uses the EXP classifier.

NOTE: The switch uses only the outermost label of incoming EXP packets for classification.

NOTE: MPLS packets with 802.1Q tags are not supported.

EXP Rewrite Rules

As MPLS packets enter or exit a network, edge switches might be required to alter the class-of-service (CoS) settings of the packets. EXP rewrite rules set the value of the EXP CoS bits within the header of the outgoing MPLS packet. Each rewrite rule reads the current forwarding class and loss priority associated with the packet, locates the chosen

CoS value from a table, and writes that CoS value into the packet header, replacing the old CoS value. EXP rewrite rules apply only to MPLS traffic.

EXP rewrite rules apply only to logical interfaces. You cannot apply EXP rewrite rules to physical interfaces.

There are no default EXP rewrite rules. If you want to rewrite the EXP value in MPLS packets, you must configure EXP rewrite rules and apply them to logical interfaces. If no rewrite rules are applied, all MPLS labels that are pushed have a value of zero (0). The EXP value remains unchanged on MPLS labels that are swapped.

You can configure as many EXP rewrite rules as you want, but you can only apply 16 EXP rewrite rules at any time on the switch. On a given logical interface, all pushed MPLS labels have the same EXP rewrite rule applied to them. You can apply different EXP rewrite rules to different logical interfaces on the same physical interface.

You can apply an EXP rewrite rule to an interface that has a DSCP, DSCP IPv6, or IEEE 802.1p rewrite rule. Only MPLS traffic uses the EXP rewrite rule. MPLS traffic does not use DSCP or DSCP IPv6 rewrite rules.

If the switch is performing penultimate hop popping (PHP), EXP rewrite rules do not take effect. If both an EXP classifier and an EXP rewrite rule are configured on the switch, then the EXP value from the last popped label is copied into the inner label. If either an EXP classifier or an EXP rewrite rule (but not both) is configured on the switch, then the inner label EXP value is sent unchanged.

NOTE: **On each physical interface, either all forwarding classes that are being used on the interface must have rewrite rules configured or no forwarding classes that are being used on the interface can have rewrite rules configured. On any physical port, do not mix forwarding classes with rewrite rules and forwarding classes without rewrite rules.**

Schedulers

The schedulers for using CoS with MPLS are the same as for the other CoS configurations on the QFX Series. Default schedulers are provided only for the best-effort, fcoe, no-loss, and network-control forwarding classes. If you configure a custom forwarding class for MPLS traffic, you need to configure a scheduler to support that forwarding class and provide bandwidth to that forwarding class. See "Understanding CoS Output Queue Schedulers" on page 5371 and "Example: Configuring Queue Schedulers" on page 5511 for more information.

Related Documentation

- Understanding CoS Classifiers on page 5334
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344
- Configuring a Global MPLS EXP Classifier on page 3782
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Configuring CoS Bits for an MPLS Network on page 3781

Understanding Using MPLS-Based Layer 3 VPNs on the QFX Series

On the QFX Series, you can use MPLS-based Layer 3 virtual private networks (VPNs) to securely connect geographically diverse sites across an MPLS network. MPLS services can be used to connect various sites to a backbone network and to ensure better performance for low-latency applications such as voice over IP (VoIP) and other business-critical functions.

A VPN uses a public telecommunications infrastructure, such as the Internet, to provide remote offices or individual users with secure access to their organization's network. VPNs are designed to provide the same level of performance and security as privately owned or leased networks but without the attendant costs.

This topic describes:

MPLS-Based Layer 3 VPNs

In Junos OS, Layer 3 VPNs are based on RFC 4364, *BGP/MPLS IP Virtual Private Networks*. RFC 4364 defines a mechanism by which service providers can use their IP backbones to provide VPN services to their customers. A Layer 3 VPN is a set of sites that share common routing information and whose connectivity is controlled by a collection of policies. The sites that make up a Layer 3 VPN are connected over a provider's existing public Internet backbone.

Customer networks, because they are private, can use either public or private addresses, as defined in RFC 1918, *Address Allocation for Private Internets*. When customer networks that use private addresses connect to the public Internet infrastructure, the private addresses might overlap with the same private addresses used by other network users. BGP/MPLS VPNs solve this problem by adding a VPN identifier prefix to each address from a particular VPN site, thereby creating an address that is unique both within the VPN and on the public Internet. In addition, each VPN has its own VPN-specific routing table that contains the routing information for that VPN only. Two different VPNs can use overlapping addresses. Each route within a VPN is assigned an MPLS label (for example, MPLS-ARCH, MPLS-BGP, or MPLS-ENCAPS). When BGP distributes a VPN route, it also distributes an MPLS label for that route. Before a customer data packet travels across the service provider's backbone, it is encapsulated along with the MPLS label that corresponds to the route within the customer's VPN that is the best match based on the packet's destination address. This MPLS packet is further encapsulated with another MPLS label or with an IP, so that it gets tunneled across the backbone to the egress provider edge (PE) switch. Thus, the backbone core switches do not need to know the VPN routes.

Related Documentation

- Understanding MPLS Label Operations on the QFX Series on page 3741
- Understanding MPLS Components for the QFX Series on page 3738

- *Junos OS VPNs Library for Routing Devices*
- *Junos OS MPLS Applications Library for Routing Devices*

MPLS Features

MPLS Feature Support on the QFX Series Overview

This topic describes the major MPLS features that are supported and not supported on the QFX Series.

NOTE: The command-line interface (CLI) on QFX Series devices displays even the MPLS related configuration statements that are not supported. However, configuring the unsupported statements on a device will have no effect on the operation of the device. See the following topics for the list of supported MPLS related configuration statements on QFX Series devices:

- "[edit protocols mpls] Hierarchy Level" on page 3798 for the list of supported configuration statements at the **[edit protocols mpls]** hierarchy level
- "[edit protocols rsvp] Hierarchy Level" on page 3802 for the list of supported configuration statements at the **[edit protocols rsvp]** hierarchy level

Supported MPLS Features

Table 267 on page 3748 lists the major MPLS features that are supported on the QFX Series and the Juniper Networks Junos operating system (Junos OS) release in which they were introduced.

Table 267: MPLS Features

Feature	Supported Junos Release
QFX standalone switch as an MPLS provider edge (PE) switch or provider switch	Junos OS 12.2X50-D10
QFX standalone switch as a route reflector for BGP labeled routes	Junos OS 12.2X50-D10
RSVP as a signaling protocol for MPLS	Junos OS 12.2X50-D10
OSPF version 2 (OSPFv2) as an interior gateway protocol (IGP) for MPLS	Junos OS 12.2X50-D10
Graceful restart for OSPF and RSVP protocols	Junos OS 12.2X50-D10
IP over MPLS label-switched paths (LSPs)	Junos OS 12.2X50-D10
Static LSPs	Junos OS 12.2X50-D10

Table 267: MPLS Features *(continued)*

Feature	Supported Junos Release
BGP labeled unicast	Junos OS 12.2X50-D10
MPLS firewall filters	Junos OS 12.2X50-D10
SNMP MIB support	Junos OS 12.2X50-D10
Class of service (CoS) for MPLS traffic	Junos OS 12.3X50-D10
MPLS-based Layer 3 virtual private networks (VPNs)	Junos OS 12.3X50-D10
Automatic bandwidth allocation for LSPs	Junos OS 12.3X50-D10
MPLS OAM-LSP ping and traceroute	Junos OS 12.3X50-D10
Maximum transmission unit (MTU) discovery for MPLS paths	Junos OS 12.3X50-D10
LDP tunneling (LDP over RSVP)	Junos OS 12.3X50-D10
IPv6 tunneling for MPLS to tunnel IPv6 traffic over an MPLS-based IPv4 network	Junos OS 12.3X50-D10

Unsupported MPLS Features

The following major MPLS features are not supported on the QFX Series:

- MPLS-based Layer 2 virtual private networks (VPNs)
- Virtual Private LAN Service (VPLS)
- IS-IS as an interior gateway protocol (IGP) for MPLS
- Inter BGP autonomous system (AS) MPLS traffic. Only a single BGP AS is supported.
- LSP signaling across multiple OSPF areas. Only a single OSPF area is supported.
- IPv6 over MPLS LSPs
- Link coloring using administrative groups
- MPLS traffic engineering
- MPLS-based circuit cross-connects (CCC)
- Node protection, link protection, and egress protection
- Configuring LSP priority and preemption
- Bidirectional Forwarding Detection (BFD) for MPLS LSPs
- Point-to-multipoint LSP support
- Fast reroute
- Classifiers for MPLS firewall filters

- MPLS over routed VLAN interfaces (RVIs) and Layer 3 subinterfaces
- Port mirroring on MPLS interfaces

Related Documentation

- MPLS Configuration Guidelines on page 3753
- Supported MPLS and ECMP Scaling Values on page 3750
- Issues and Limitations in Operation of MPLS Features on the QFX Series on page 3933
- Understanding MPLS Components for the QFX Series on page 3738
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744

- *Junos OS MPLS Applications Library for Routing Devices*

Supported MPLS and ECMP Scaling Values

This topic lists the MPLS and Equal Cost Multi Path (ECMP) scaling values supported on Juniper QFX switches.

Table 268 on page 3750 lists the MPLS scaling values supported on Juniper QFX switches.

Table 268: MPLS Scaling Values

Feature	Scaling Value
Maximum number of MPLS labels in a packet's label stack	3
Maximum number of tunnel (combination of routes and LSPs) initiations	1000
Maximum number of MPLS labels on provider switches	4000
Maximum number of unique next-hops on egress provider edge (PE) switches	512
Maximum number of MPLS firewall filters	768

Table 269 on page 3750 lists the ECMP scaling values supported on Juniper QFX switches deployed as ingress PE switches.

Table 269: ECMP Scaling Values on QFX Switches Deployed as Ingress PE Switches

Feature	Scaling Value
Maximum number of BGP prefixes (Maximum number of ECMP groups is 128)	128
Maximum number of LSPs with respect to BGP prefixes	8 LSPs with 128 BGP prefixes, 16 LSPs with 64 BGP prefixes, and so on

Related Documentation

- MPLS Feature Support on the QFX Series Overview on page 3748
- MPLS Configuration Guidelines on page 3753

CHAPTER 44

Configuration

Configuration Guidelines

MPLS Configuration Guidelines

When configuring MPLS on QFX Series devices, keep the following in mind:

- QFX3500 and QFX3600 standalone switches support up to 8000 external IP prefixes only. Therefore, we recommend the following:
  - If your ingress provider edge (PE) switch needs to support more than 8000 external IP prefixes, use a larger capacity device as an ingress PE switch.
  - If you use a QFX3500 or QFX3600 switch as a route reflector for BGP labeled routes, use it as a dedicated route reflector (that is, the switch must not participate in managing data traffic).
  - If you use a QFX3500 or QFX3600 switch as a PE switch or as a route reflector for BGP labeled routes, configure routing policies on the PE switch and the route reflector to filter external IP routes from the routing table.

    The configuration example for a routing policy named fib_policy (at the **[edit policy-options** and **[edit routing-options** hierarchy levels) to filter BGP labeled routes from the inet.0 routing table is given below:

    ```
    user@switch# show policy-options
    policy-statement fib_policy {
      from {
        protocol bgp;
        rib inet.0;
      }
      then reject;
    }
    ```

    ```
    user@switch# show routing-options
    ```

```
forwarding-table {
  export fib_policy;
}
```

- MPLS traffic engineering is not supported on QFX Series devices. Therefore, you must disable constrained-path LSP computation on PE switches by configuring the **no-cspf** statement at the **[edit protocols mpls]** hierarchy level.
- Packet fragmentation using the **allow-fragmentation** statement at the **[edit protocols mpls path-mtu]** hierarchy level is not supported on QFX Series devices. Therefore, you must ensure that the maximum transmission unit (MTU) values configured on every MPLS interface is sufficient to handle MPLS packets. The packets whose size exceeds the MTU value of an interface will be dropped.

Related Documentation

- Configuring MPLS on Provider Edge Switches on page 3772
- Configuring MPLS on Provider Switches on page 3775
- Configuring a Global MPLS EXP Classifier on page 3782
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- MPLS Feature Support on the QFX Series Overview on page 3748

Configuration Examples

Example: Configuring MPLS-Based Layer 3 VPNs

You can implement an MPLS-based Layer 3 virtual private network (VPN) on QFX3500 switches to interconnect sites for customers who want the service provider to handle all the Layer 3 routing functions. To support an MPLS-based Layer 3 VPN, you need to add components of the Layer 3 VPN to the configuration of the two provider edge (PE) switches. You do not need to change the configuration of the provider switches.

This example shows how to configure an MPLS-based Layer 3 VPN spanning two corporate sites:

Requirements

This example uses the following software and hardware components:

- Junos OS Release 12.3 or later for the QFX Series
- Three QFX3500 switches

Before you configure the Layer 3 VPN components, you must configure the basic components for an MPLS network:

- Configure two PE switches. See “Configuring MPLS on Provider Edge Switches” on page 3772.
- Configure one or more provider switches. See “Configuring MPLS on Provider Switches” on page 3775.

Overview and Topology

Layer 3 VPNs allow customers to leverage the service provider’s technical expertise to ensure efficient site-to-site routing. The customer’s customer edge (CE) switch uses a routing protocol such as BGP or OSPF to communicate with the service provider’s provider edge (PE) switch to carry IP prefixes across the network. MPLS-based Layer 3 VPNs use only IP over MPLS; other protocol packets are not supported. This example includes two PE switches, PE1 and PE2.

In the basic MPLS configuration of the PE switches using IP over MPLS, the PE switches were configured to use OSPF as the routing protocol between the MPLS switches and RSVP as the signaling protocol. Traffic engineering was enabled. A label-switched path (LSP) was configured.

The following components must be added to the PE switches for an MPLS-based Layer 3 VPN:

- BGP group with **family inet-vpn unicast**
- Routing instance with instance type **vrf**

Figure 114 on page 3755 illustrates the topology of this MPLS-based Layer 3 VPN.

Figure 114: MPLS-Based Layer 3 VPN

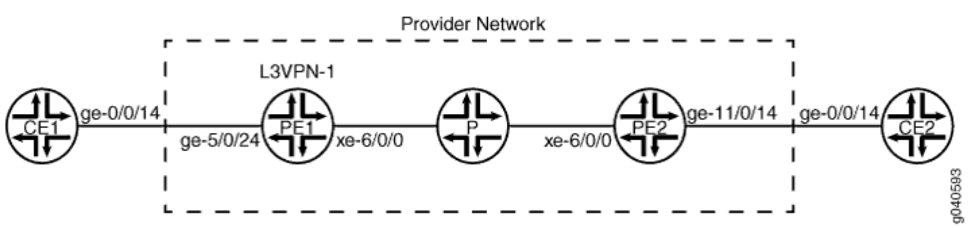


Table 270 on page 3756 shows the settings of the customer edge interface on the local CE switch.

Table 270: Local CE Switch in the MPLS-Based Layer 3 VPN Topology

Property	Settings	Description
Local CE switch hardware	QFX3500 switch	CE1
Customer edge interface	**ge-0/0/14 unit 0** **family inet** **address 51.51.0.14/16**	Interface that connects CE1 to PE1.

Table 271 on page 3756 shows the settings of the customer edge interface on the remote CE switch.

Table 271: Remote CE Switch in the MPLS-Based Layer 3 VPN Topology

Property	Settings	Description
Remote CE switch hardware	QFX3500 switch	CE2
Customer edge interface	**ge-0/0/14 unit 0** **family inet** **address 11.22.26.1/16**	Interface that connects CE2 to PE2.

Table 272 on page 3756 shows the Layer 3 VPN components of the local PE switch.

Table 272: Layer 3 VPN Components of the Local PE Switch

Property	Settings	Description
Local PE switch hardware	QFX3500 switch	PE1
Customer edge interface	**ge-0/0/14 unit 0** **family inet** **address 51.51.0.1/16**	Connects PE1 to CE1. NOTE: The **family inet** configuration should already have been completed as part of the basic MPLS configuration of the PE switch for IP over MPLS. It is included here to show what was specified for that portion of the configuration.
Core interface	**xe-0/0/6 unit 0** **family inet address 60.0.0.60/16** **family mpls**	Connects PE1 to P. NOTE: This portion of the configuration should already have been completed as part of the basic MPLS configuration. It is included here to show what was specified for that portion of the configuration.

Table 272: Layer 3 VPN Components of the Local PE Switch *(continued)*

Property	Settings	Description
Loopback interface	**lo0 unit 0** **family inet address 21.21.21.21/32**	NOTE: This portion of the configuration should already have been completed as part of the basic MPLS configuration. It is included here to show what was specified for that portion of the configuration.
BGP	**bgp**	Added for the Layer 3 VPN configuration.
Routing instance	**L3VPN-1**	Added for the Layer 3 VPN configuration.

Table 273 on page 3757 shows the Layer 3 VPN components of the remote PE switch.

Table 273: Layer 3 VPN Components of the Remote PE Switch

Property	Settings	Description
Remote PE switch hardware	QFX3500 switch	PE2
Customer edge interface	**ge-0/0/14 unit 0** **family inet** **address 11.22.26.14/16** **family mpls**	Connects PE2 to CE2. For the Layer 3 VPN configuration, added **family mpls**. NOTE: The **family inet** configuration should already have been completed as part of the basic MPLS configuration of the PE switch for IP over MPLS. It is included here to show what was specified for that portion of the configuration.
Core interface	**xe-0/0/6 unit 0** **family inet address 60.2.0.60/16** **family mpls**	Connects PE1 to P. NOTE: This portion of the configuration should already have been completed as part of the basic MPLS configuration. It is included here to show what was specified for that portion of the configuration.
Loopback interface	**lo0 unit 0** **family inet address 22.22.22.22/32**	NOTE: This portion of the configuration should already have been completed as part of the basic MPLS configuration. It is included here to show what was specified for that portion of the configuration.
BGP	**bgp**	Added for the Layer 3 VPN configuration.
Routing instances	**L3VPN-1**	Added for the Layer 3 VPN configuration.

Configuring the Local PE Switch

CLI Quick Configuration

To quickly configure the Layer 3 VPN components on the local PE switch, copy the following commands and paste them into the switch terminal window of PE1:

```
[edit]
set protocols bgp local-address 21.21.21.21 family inet-vpn unicast
set protocols bgp group PE1-PE2 type internal
set protocols bgp neighbor 22.22.22.22
set routing-instances L3VPN-1 instance-type vrf
set routing-instances L3VPN-1 description "BETWEEN PE1 AND PE2"
set routing-instances L3VPN-1 interface ge-0/0/14.0
set routing-instances L3VPN-1 route-distinguisher 21:21
set routing-instances L3VPN-1 vrf-target target:21:21
set routing-instances L3VPN-1 vrf-table-label
set routing-options router-id 21.21.21.21
set routing-options autonomous-system 10
```

Step-by-Step Procedure

To configure the Layer 3 VPN components on the local PE switch:

1. Configure BGP, specifying the loopback address as the local address and specifying **family inet-vpn unicast**:

   ```
   [edit protocols bgp]
   user@switchPE1# set local-address 21.21.21.21 family inet-vpn unicast
   ```
2. Configure the BGP group, specifying the group name and type:

   ```
   [edit protocols bgp]
   user@switchPE1# set group PE1-PE2 type internal
   ```
3. Configure the BGP neighbor, specifying the loopback address of the remote PE switch as the neighbor’s address:

   ```
   [edit protocols bgp]
   user@switchPE1# set neighbor 22.22.22.22
   ```
4. Configure the routing instance, specifying the routing-instance name and using **vrf** as the instance type:

   ```
   [edit routing-instances]
   user@switchPE1# set L3VPN-1 instance-type vrf
   ```
5. Configure a description for this routing instance:

   ```
   [edit routing-instances]
   user@switchPE1# set L3VPN-1 description "BETWEEN PE1 AND PE2"
   ```
6. Configure the routing instance to use a route distinguisher:

   ```
   [edit routing-instances]
   user@switchPE1# set L3VPN-1 route-distinguisher 21:21
   ```

   NOTE: Each routing instance that you configure on a PE switch must have a unique route distinguisher associated with it. VPN routing instances require a route distinguisher to allow BGP to distinguish between potentially identical network layer reachability information (NLRI) messages received from different VPNs. If you configure different VPN routing instances with the same route distinguisher, the commit fails.

7. Configure the VPN routing and forwarding (VRF) target of the routing instance:

   `[edit routing-instances]`
   `user@switchPE1#` **set L3VPN-1 vrf-target target:21:21**

   NOTE: You can create more complex policies by explicitly configuring VRF import and export policies using the import and export options. See the *Junos OS VPNs Library for Routing Devices*.

8. Configure this routing instance with **vrf-table-label**, which maps the inner label of a packet to a specific VPN routing and forwarding (VRF) table and allows the examination of the encapsulated IP header:

   `[edit routing-instances]`
   `user@switchPE1#` **set L3VPN-1 vrf-table-label**

9. Configure the router ID and autonomous system (AS):

   NOTE: We recommend that you explicitly configure the router identifier under the **[edit routing-options]** hierarchy level to avoid unpredictable behavior if the interface address on a loopback interface changes.

   `[edit routing-options]`
   `user@switchPE1#` **set** router-id **21.21.21.21** autonomous-system **10**

Results Display the results of the configuration:

`user@switchPE1>` **show configuration**

```
interfaces {
    ge-0/0/14 {
        unit 0 {
            family inet {
                address 51.51.0.1/16;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 21.21.21.21/32;
            }
        }
    }
    xe-0/0/6 {
        unit 0 {
            family inet {
                address 60.0.0.60/16;
            }
            family mpls;
        }
    }
```

```
protocols {
   mpls {
      label-switched-path 21-22 {
         from 21.21.21.21;
         to 22.22.22.22;
         no-cspf;
      }
      interface xe-0/0/6.0;
      interface lo0.0;
   bgp {
      local-address 21.21.21.21;
      family inet-vpn {
         unicast;
      }
      group PE1-PE2 {
         type internal;
         neighbor 22.22.22.22;
      }
   }
   ospf {
      traffic-engineering;
      area 0.0.0.0 {
         interface ge-0/0/14.0;
         interface lo0.0;
         interface xe-0/0/6.0;
      }
   }
}
routing-instances {
   L3VPN-1 {
      instance-type vrf;
      description "BETWEEN PE1 AND PE2";
      route-distinguisher 21:21;
      vrf-target target:21:21;
      vrf-table-label;
   }
routing-options {
   router-id 21.21.21.21;
   autonomous-system 10;
```

Configuring the Remote PE Switch

CLI Quick Configuration

To quickly configure the Layer 3 VPN components on the remote PE switch, copy the following commands and paste them into the switch terminal window of PE2:

```
[edit]
set protocols bgp local-address 22.22.22.22 family inet-vpn unicast
set protocols bgp group PE1-PE2 type internal
set protocols bgp neighbor 21.21.21.21
set routing-instances L3VPN-1 instance-type vrf
set routing-instances L3VPN-1 description "BETWEEN PE1 AND PE2"
set routing-instances L3VPN-1 interface ge-0/0/14.0
set routing-instances L3VPN-1 route-distinguisher 21:21
set routing-instances L3VPN-1 vrf-target target:21:21
set routing-instances L3VPN-1 vrf-table-label;
set routing-options router-id 22.22.22.22
```


set routing-options autonomous-system 10

Step-by-Step Procedure

To configure Layer 3 VPN components on the remote PE switch:

1. Configure BGP, specifying the loopback address as the local address and specifying **family inet-vpn unicast**:

   ```
   [edit protocols bgp]
   user@switchPE2# set local-address 22.22.22.22 family inet-vpn unicast
   ```
2. Configure the BGP group, specifying the group name and type:

   ```
   [edit protocols bgp]
   user@switchPE2# set group PE1-PE2 type internal
   ```
3. Configure the BGP neighbor, specifying the loopback address of the remote PE switch as the neighbor's address:

   ```
   [edit protocols bgp]
   user@switchPE2# set neighbor 21.21.21.21
   ```
4. Configure the routing instance, specifying the routing-instance name and using **vrf** as the instance type:

   ```
   [edit routing-instances]
   user@switchPE2# set L3VPN-1 instance-type vrf
   ```
5. Configure a description for this routing instance:

   ```
   [edit routing-instances]
   user@switchPE1# set L3VPN-1 description "BETWEEN PE1 AND PE2"
   ```
6. Configure the routing instance to apply to the customer edge interface:

   ```
   [edit routing-instances]
   user@switchPE2# set L3VPN-1 interface ge-0/0/14.0
   ```
7. Configure the routing instance to use a route distinguisher, using the format *ip-address:number*:

   ```
   [edit routing-instances]
   user@switchPE2# set L3VPN-1 route-distinguisher 21:21
   ```
8. Configure the VPN routing and forwarding (VRF) target of the routing instance:

   ```
   [edit routing-instances]
   user@switchPE2# set L3VPN-1 vrf-target target:21:21
   ```
9. Configure this routing instance with **vrf-table-label**, which maps the inner label of a packet to a specific VPN routing and forwarding (VRF) table and allows the examination of the encapsulated IP header.

   ```
   [edit routing-instances]
   user@switchPE2# set L3VPN-1 vrf-tabel-label
   ```
10. Configure the router ID and autonomous system (AS):

    ```
    [edit routing-options]
    user@switchPE2# set router-id 22.22.22.22 autonomous-system 10
    ```

Results

Display the results of the configuration:

```
user@switchPE2> show configuration
```

```
interfaces {
  ge-0/0/14 {
    unit 0 {
      family inet {
        address 11.22.26.14/16;
      }
```

```
    }
}
lo0 {
    unit 0 {
        family inet {
            address 22.22.22.22/32;
        }
    }
}
xe-0/0/6 {
    unit 0 {
        family inet {
            address 60.2.0.60/16;
        }
        family mpls;
    }
}
protocols {
    mpls {
        label-switched-path 22-21 {
            from 22.22.22.22;
            to 21.21.21.21;
            no-cspf;
        }
        interface xe-0/0/6.0;
        interface lo0.0;
    bgp {
        local-address 22.22.22.22;
        family inet-vpn {
            unicast;
        }
        group PE1-PE2 {
            type internal;
            neighbor 21.21.21.21;
        }
    }
    ospf {
        traffic-engineering;
        area 0.0.0.0 {
            interface ge-0/0/14.0;
            interface lo0.0;
            interface xe-0/0/6.0;
        }
    }
}
routing-instances {
    L3VPN-1 {
        instance-type vrf;
        description"BETWEEN PE1 AND PE2";
        route-distinguisher 21:21;
        vrf-target target:21:21;
        vrf-table-label;
    }
routing-options {
    router-id 22.22.22.22;
    autonomous-system 10;
```


Related Documentation

- Configuring MPLS on Provider Edge Switches on page 3772
- Configuring MPLS on Provider Switches on page 3775

Example: Tunneling IPv6 Traffic over MPLS IPv4 Networks

This example shows how to configure Junos OS to tunnel IPv6 over an MPLS-based IPv4 network. External BGP (EBGP) is used between the customer edge (CE) and provider edge (PE) devices. The remote CE devices have different AS numbers for loop detection.

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

Detailed information about the Juniper Networks implementation of IPv6 over MPLS is described in the following Internet drafts:

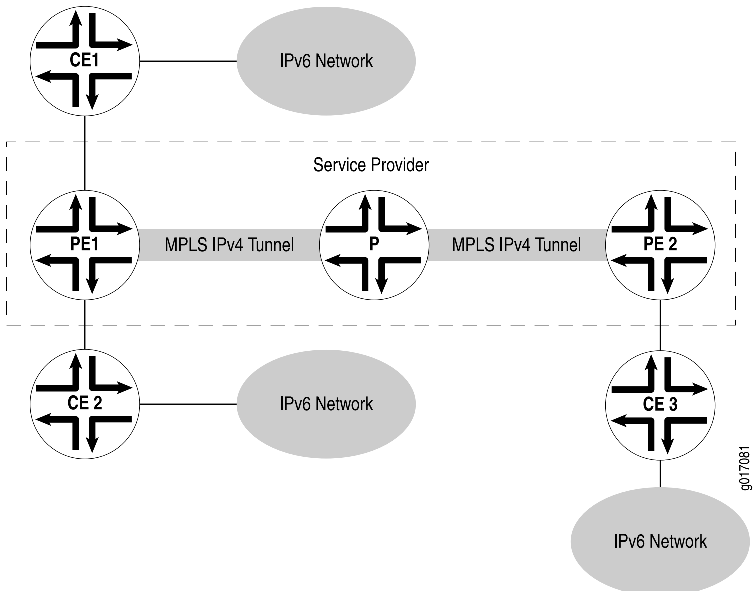
- Internet draft draft-ietf-l3vpn-bgp-ipv6-07.txt, *BGP-MPLS IP VPN extension for IPv6 VPN* (expires January 2006)
- Internet draft draft-ooms-v6ops-bgp-tunnel-06.txt, *Connecting IPv6 Islands over IPv4 MPLS using IPv6 Provider Edge Routers* (expires July 2006)

These Internet drafts are available on the IETF website at **http://www.ietf.org/**.

This example shows you how to interconnect a two IPv6 networks over an IPv4-based network core, giving you the ability to provide IPv6 service without having to upgrade the routers in your core network. Multiprotocol Border Gateway Protocol (MP-BGP) is configured to exchange routes between the IPv6 networks, and data is tunneled between these IPv6 networks by means of IPv4-based MPLS.

In Figure 115 on page 3764, PE1 and PE2 are dual-stack BGP routers or switches, meaning they have both IPv4 and IPv6 stacks. The PE devices link the IPv6 networks through the customer edge (CE) routers or switches to the IPv4 core network. The CE devices and the PE devices connect through a link layer that can carry IPv6 traffic. The PE devices use IPv6 on the CE router-facing interfaces and use IPv4 and MPLS on the core-facing interfaces. Note that one of the connected IPv6 networks could be the global IPv6 Internet.

Figure 115: IPv6 Networks Linked by MPLS IPv4 Tunnels



The two PE devices are linked through an MP-BGP session using IPv4 addresses. They use the session to exchange IPv6 routes with an IPv6 (value 2) address family indicator (AFI) and a subsequent AFI (SAFI) (value 4). Each PE router sets the next hop for the IPv6 routes advertised on this session to its own IPv4 address. Because MP-BGP requires the BGP next hop to correspond to the same address family as the network layer reachability information (NLRI), this IPv4 address needs to be embedded within an IPv6 format.

The PE devices can learn the IPv6 routes from the CE devices connected to them using MP-BGP or through static configuration. Note that if BGP is used as the PE-router-to-CE-router protocol, the MP-BGP session between the PE device and CE device could occur over an IPv4 or IPv6 Transmission Control Protocol (TCP) session. Also, the BGP routes exchanged on that session would have SAFI unicast. You must configure an export policy to pass routes between IBGP and EBGP, and between BGP and any other protocol.

The PE routers have MPLS LSPs routed to each others' IPv4 addresses. IPv4 provides signaling for the LSPs by means of RSVP. These LSPs are used to resolve the next-hop addresses of the IPv6 routes learned from MP-BGP. The next hops use IPv4-mapped IPv6 addresses, while the LSPs use IPv4 addresses.

The PE devices always advertise IPv6 routes to each other using a label value of 2, the explicit null label for IPv6 as defined in RFC 3032, *MPLS Label Stack Encoding*. As a consequence, each of the forwarding next hops for the IPv6 routes learned from remote PE routers normally push two labels. The inner label is 2 (this label could be different if the advertising PE device is not a Juniper Networks routing or switching platform), and the outer label is the LSP label. If the LSP is a single-hop LSP, then only Label 2 is pushed.

It is also possible for the PE devices to exchange plain IPv6 routes using SAFI unicast. However, there is one major advantage in exchanging labeled IPv6 routes. The penultimate-hop router for an MPLS LSP can pop the outer label and then send the packet with the inner label as an MPLS packet. Without the inner label, the penultimate-hop router would need to discover whether the packet is an IPv4 or IPv6 packet to set the protocol field in the Layer 2 header correctly.

When the PE1 device in Figure 115 on page 3764 receives an IPv6 packet from the CE1 device, it performs a lookup in the IPv6 forwarding table. If the destination matches a prefix learned from the CE2 device, then no labels need to be pushed and the packet is simply sent to the CE2 device. If the destination matches a prefix that was learned from the PE2 device, then the PE1 router pushes two labels onto the packet and sends it to the Provider router. The inner label is 2 and the outer label is the LSP label for the PE2 router.

Each provider router in the service provider's network handles the packet as it would any MPLS packet, swapping labels as it passes from provider router to provider router. The penultimate-hop provider router for the LSP pops the outer label and sends the packet to the PE2 router. When the PE2 router receives the packet, it recognizes the IPv6 explicit null label on the packet (Label 2). It pops this label and treats it as an IPv6 packet, performing a lookup in the IPv6 forwarding table and forwarding the packet to the CE3 router.

This example includes the following settings:

- In addition to configuring the **family inet6** statement on all the CE router–facing interfaces, you must also configure the statement on all the core-facing interfaces running MPLS. Both configurations are necessary because the router must be able to process any IPv6 packets it receives on these interfaces. You should not see any regular IPv6 traffic arrive on these interfaces, but you will receive MPLS packets tagged with Label 2. Even though Label 2 MPLS packets are sent in IPv4, these packets are treated as native IPv6 packets.
- You enable IPv6 tunneling by including the **ipv6-tunneling** statement in the configuration for the PE routers. This statement allows IPv6 routes to be resolved over an MPLS network by converting all routes stored in the inet.3 routing table to IPv4-mapped IPv6 addresses and then copying them into the inet6.3 routing table. This routing table can be used to resolve next hops for both inet6 and inet6-vpn routes.

  NOTE: BGP automatically runs its import policy even when copying routes from a primary routing table group to a secondary routing table group. If IPv4 labeled routes arrive from a BGP session (for example, when you have configured the **labeled-unicast** statement at the **[edit protocols bgp family inet]** hierarchy level on the PE router), the BGP neighbor's import policy also accepts IPv6 routes, since the neighbor's import policy is run while doing the copy operation to the inet6.3 routing table.

- When you configure MP-BGP to carry IPv6 traffic, the IPv4 MPLS label is removed at the destination PE router. The remaining IPv6 packet without a label can then be forwarded to the IPv6 network. To enable this, include the **explicit-null** statement in the BGP configuration.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device PE1

```
set interfaces xe-0/0/5 unit 2 family inet6 address ::10.1.1.2/126
set interfaces xe-0/0/5 unit 2 family mpls
set interfaces xe-0/0/6 unit 5 family inet address 10.1.1.5/30
set interfaces xe-0/0/6 unit 5 family inet6
set interfaces xe-0/0/6 unit 5 family mpls
set interfaces lo0 unit 2 family inet address 1.1.1.2/32
set protocols mpls ipv6-tunneling
set protocols mpls interface xe-0/0/5.2
set protocols mpls interface xe-0/0/6.5
set protocols bgp group toCE1 type external
set protocols bgp group toCE1 local-address ::10.1.1.2
set protocols bgp group toCE1 family inet6 unicast
set protocols bgp group toCE1 export send-bgp6
set protocols bgp group toCE1 peer-as 1
set protocols bgp group toCE1 neighbor ::10.1.1.1
set protocols bgp group toPE2 type internal
set protocols bgp group toPE2 local-address 1.1.1.2
set protocols bgp group toPE2 family inet6 labeled-unicast explicit-null
set protocols bgp group toPE2 export next-hop-self
set protocols bgp group toPE2 export send-v6
set protocols bgp group toPE2 neighbor 1.1.1.4
set protocols ospf area 0.0.0.0 interface xe-0/0/6.5
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols rsvp interface xe-0/0/6.5
set policy-options policy-statement next-hop-self then next-hop self
set policy-options policy-statement send-bgp6 from family inet6
set policy-options policy-statement send-bgp6 from protocol bgp
set policy-options policy-statement send-bgp6 then accept
set policy-options policy-statement send-v6 from family inet6
set policy-options policy-statement send-v6 from protocol bgp
set policy-options policy-statement send-v6 from protocol direct
set policy-options policy-statement send-v6 then accept
set routing-options router-id 1.1.1.2
set routing-options autonomous-system 2
```

Device PE2

```
set interfaces xe-0/0/5 unit 10 family inet address 10.1.1.10/30
set interfaces xe-0/0/5 unit 10 family inet6
set interfaces xe-0/0/5 unit 10 family mpls
set interfaces xe-0/0/6 unit 13 family inet6 address ::10.1.1.13/126
set interfaces xe-0/0/6 unit 13 family mpls
set interfaces lo0 unit 4 family inet address 1.1.1.4/32
set protocols mpls ipv6-tunneling
set protocols mpls interface xe-0/0/5.10
set protocols mpls interface xe-0/0/6.13
set protocols bgp group toPE1 type internal
set protocols bgp group toPE1 local-address 1.1.1.4
set protocols bgp group toPE1 family inet6 labeled-unicast explicit-null
set protocols bgp group toPE1 export next-hop-self
```

```
set protocols bgp group toPE1 export send-v6
set protocols bgp group toPE1 neighbor 1.1.1.2
set protocols bgp group toCE3 type external
set protocols bgp group toCE3 local-address ::10.1.1.13
set protocols bgp group toCE3 family inet6 unicast
set protocols bgp group toCE3 export send-bgp6
set protocols bgp group toCE3 peer-as 3
set protocols bgp group toCE3 neighbor ::10.1.1.14
set protocols ospf area 0.0.0.0 interface xe-0/0/5.10
set protocols ospf area 0.0.0.0 interface lo0.4 passive
set protocols rsvp interface xe-0/0/5.10
set policy-options policy-statement next-hop-self then next-hop self
set policy-options policy-statement send-bgp6 from family inet6
set policy-options policy-statement send-bgp6 from protocol bgp
set policy-options policy-statement send-bgp6 then accept
set policy-options policy-statement send-v6 from family inet6
set policy-options policy-statement send-v6 from protocol bgp
set policy-options policy-statement send-v6 from protocol direct
set policy-options policy-statement send-v6 then accept
set routing-options router-id 1.1.1.4
set routing-options autonomous-system 2
```

Device P

```
set interfaces xe-0/0/5 unit 6 family inet address 10.1.1.6/30
set interfaces xe-0/0/5 unit 6 family inet6
set interfaces xe-0/0/5 unit 6 family mpls
set interfaces xe-0/0/6 unit 9 family inet address 10.1.1.9/30
set interfaces xe-0/0/6 unit 9 family inet6
set interfaces xe-0/0/6 unit 9 family mpls
set interfaces lo0 unit 3 family inet address 1.1.1.3/32
set protocols mpls interface xe-0/0/5.6
set protocols mpls interface xe-0/0/6.9
set protocols ospf area 0.0.0.0 interface xe-0/0/5.6
set protocols ospf area 0.0.0.0 interface xe-0/0/6.9
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols rsvp interface xe-0/0/5.6
set protocols rsvp interface xe-0/0/6.9
set routing-options router-id 1.1.1.3
set routing-options autonomous-system 2
```

Device CE1

```
set interfaces xe-0/0/5 unit 1 family inet6 address ::10.1.1.1/126
set interfaces xe-0/0/5 unit 1 family mpls
set interfaces lo0 unit 1 family inet6 address ::1.1.1.1/128
set protocols bgp group toPE1 type external
set protocols bgp group toPE1 local-address ::10.1.1.1
set protocols bgp group toPE1 family inet6 unicast
set protocols bgp group toPE1 export send-v6
set protocols bgp group toPE1 peer-as 2
set protocols bgp group toPE1 neighbor ::10.1.1.2
set policy-options policy-statement send-v6 from family inet6
set policy-options policy-statement send-v6 from protocol direct
set policy-options policy-statement send-v6 then accept
set routing-options router-id 1.1.1.1
set routing-options autonomous-system 1
```

Device CE3

```
set interfaces xe-0/0/5 unit 14 family inet6 address ::10.1.1.14/126
```

```
set interfaces xe-0/0/5 unit 14 family mpls
set interfaces lo0 unit 5 family inet6 address ::1.1.1.5/128
set protocols bgp group toPE2 type external
set protocols bgp group toPE2 local-address ::10.1.1.14
set protocols bgp group toPE2 family inet6 unicast
set protocols bgp group toPE2 export send-v6
set protocols bgp group toPE2 peer-as 2
set protocols bgp group toPE2 neighbor ::10.1.1.13
set policy-options policy-statement send-v6 from family inet6
set policy-options policy-statement send-v6 from protocol direct
set policy-options policy-statement send-v6 then accept
set routing-options router-id 1.1.1.5
set routing-options autonomous-system 3
```

Configuring Device PE1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE1:

1. Configure the interfaces.

```
[edit interfaces]
user@PE1# set xe-0/0/5 unit 2 family inet6 address ::10.1.1.2/126
user@PE1# set xe-0/0/5 unit 2 family mpls

user@PE1# set xe-0/0/6 unit 5 family inet address 10.1.1.5/30
user@PE1# set xe-0/0/6 unit 5 family inet6
user@PE1# set xe-0/0/6 unit 5 family mpls

user@PE1# set lo0 unit 2 family inet address 1.1.1.2/32
```

2. Configure MPLS on the interfaces.

```
[edit protocols mpls]
user@PE1# set ipv6-tunneling
user@PE1# set interface xe-0/0/5.2
user@PE1# set interface xe-0/0/6.5
```

3. Configure BGP.

```
[edit protocols bgp]
user@PE1# set group toCE1 type external
user@PE1# set group toCE1 local-address ::10.1.1.2
user@PE1# set group toCE1 family inet6 unicast
user@PE1# set group toCE1 export send-bgp6
user@PE1# set group toCE1 peer-as 1
user@PE1# set group toCE1 neighbor ::10.1.1.1

user@PE1# set group toPE2 type internal
user@PE1# set group toPE2 local-address 1.1.1.2
user@PE1# set group toPE2 family inet6 labeled-unicast explicit-null
user@PE1# set group toPE2 export next-hop-self
user@PE1# set group toPE2 export send-v6
```



```
user@PE1# set group toPE2 neighbor 1.1.1.4
```

4. Configure OSPF

```
[edit protocols ospf area 0.0.0.0]
user@PE1# set interface xe-0/0/6.5
user@PE1# set interface lo0.2 passive
```

5. Configure a signaling protocol.

```
[edit protocols]
user@PE1# set rsvp interface xe-0/0/6.5
```

6. Configure the routing policies.

```
[edit policy-options]
user@PE1# set policy-statement next-hop-self then next-hop self

user@PE1# set policy-statement send-bgp6 from family inet6
user@PE1# set policy-statement send-bgp6 from protocol bgp
user@PE1# set policy-statement send-bgp6 then accept

user@PE1# set policy-statement send-v6 from family inet6
user@PE1# set policy-statement send-v6 from protocol bgp
user@PE1# set policy-statement send-v6 from protocol direct
user@PE1# set policy-statement send-v6 then accept
```

7. Configure the router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@PE1# set router-id 1.1.1.2
user@PE1# set autonomous-system 2
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
xe-0/0/5 {
  unit 2 {
    family inet6 {
      address ::10.1.1.2/126;
    }
    family mpls;
  }
}
xe-0/0/6 {
  unit 5 {
    family inet {
      address 10.1.1.5/30;
    }
    family inet6;
    family mpls;
  }
}
lo0 {
```

```
    unit 2 {
        family inet {
            address 1.1.1.2/32;
        }
    }
}
```

user@R1# **show policy-options**

```
policy-statement next-hop-self {
    then {
        next-hop self;
    }
}
policy-statement send-bgp6 {
    from {
        family inet6;
        protocol bgp;
    }
    then accept;
}
policy-statement send-v6 {
    from {
        family inet6;
        protocol [ bgp direct ];
    }
    then accept;
}
```

user@R1# **show protocols**

```
mpls {
    ipv6-tunneling;
    interface xe-0/0/5.2;
    interface xe-0/0/6.5;
}
bgp {
    group toCE1 {
        type external;
        local-address ::10.1.1.2;
        family inet6 {
            unicast;
        }
        export send-bgp6;
        peer-as 1;
        neighbor ::10.1.1.1;
    }
    group toPE2 {
        type internal;
        local-address 1.1.1.2;
        family inet6 {
            labeled-unicast {
                explicit-null;
            }
        }
        export [ next-hop-self send-v6 ];
        neighbor 1.1.1.4;
    }
}
```



```
ospf {
   area 0.0.0.0 {
      interface xe-0/0/6.5;
      interface lo0.2 {
         passive;
      }
   }
}
rsvp {
   interface xe-0/0/6.5;
}
```

```
user@R1# show routing-options
router-id 1.1.1.2;
autonomous-system 2;
```

If you are done configuring the device, enter **commit** from configuration mode.
Configure the other devices in the topology, as shown in "CLI Quick Configuration" on page 3766.

Verification

Confirm that the configuration is working properly.

Verifying That the CE Devices Have Connectivity

Purpose Make sure that the tunnel is operating.

Action From operational mode, enter the **ping** command.

```
user@CE1> ping ::10.1.1.14
PING6(56=40+8+8 bytes) ::10.1.1.1 --> ::10.1.1.14
16 bytes from ::10.1.1.14, icmp_seq=0 hlim=61 time=10.687 ms
16 bytes from ::10.1.1.14, icmp_seq=1 hlim=61 time=9.239 ms
16 bytes from ::10.1.1.14, icmp_seq=2 hlim=61 time=1.842 ms

user@CE3> ping ::10.1.1.1
PING6(56=40+8+8 bytes) ::10.1.1.14 --> ::10.1.1.1
16 bytes from ::10.1.1.1, icmp_seq=0 hlim=61 time=1.484 ms
16 bytes from ::10.1.1.1, icmp_seq=1 hlim=61 time=1.338 ms
16 bytes from ::10.1.1.1, icmp_seq=2 hlim=61 time=1.351 ms
```

Meaning The IPv6 CE devices can communicate over the core IPv4 network.

Related Documentation

Configuration Tasks

Configuring MPLS on Provider Edge Switches

To implement MPLS, you must configure two provider edge (PE) switches—an ingress PE switch and an egress PE switch—and at least one provider switch. You can configure the customer edge (CE) interfaces on the PE switches of the MPLS network using IP over MPLS.

This topic describes how to configure an ingress PE switch and an egress PE switch using IP over MPLS:

Configuring the Ingress PE Switch

To configure the ingress PE switch:

1. Configure an IP address for the loopback interface and the core interfaces:

   ```
   [edit interfaces]
   user@switch# set lo0 unit 0 family inet address 192.168.10.1/32
   user@switch# set xe-0/0/5 unit 0 family inet address 10.1.5.1/24
   user@switch# set xe-0/0/6 unit 0 family inet address 10.1.6.1/24
   ```

   NOTE: You cannot use routed VLAN interfaces (RVIs) or Layer 3 subinterfaces as core interfaces.

2. Configure OSPF on the loopback interface and the core interfaces:

   NOTE: You can use the switch address as an alternative to the loopback interface.

   ```
   [edit protocols ospf]
   user@switch# set area 0.0.0.0 interface lo0.0
   user@switch# set area 0.0.0.0 interface xe-0/0/5.0
   user@switch# set area 0.0.0.0 interface xe-0/0/6.0
   ```

3. Configure RSVP on the loopback interface and the core interfaces:

   ```
   [edit protocols rsvp]
   user@switch# set interface lo0.0
   user@switch# set interface xe-0/0/5.0
   user@switch# set interface xe-0/0/6.0
   ```


4. Configure MPLS on the core interfaces:

```
[edit protocols mpls]
user@switch# set interface xe-0/0/5.0
user@switch# set interface xe-0/0/6.0
```

5. Configure **family mpls** on the logical units of the core interfaces, thereby identifying the interfaces that will be used for forwarding MPLS packets:

```
[edit interfaces]
user@switch# set xe-0/0/5 unit 0 family mpls
user@switch# set xe-0/0/6 unit 0 family mpls
```

6. Configure a customer edge interface as a Layer 3 routed interface, specifying an IP address:

```
[edit interfaces]
user@switch# set xe-0/0/3 unit 0 family inet address 121.100.10.1/16
```

7. Configure this Layer 3 customer edge interface for the routing protocol:

```
[edit]
user@switch# set protocols ospf area 0.0.0 interface xe-0/0/3.0
```

8. Configure an LSP on the ingress PE switch (192.168.10.1) to send IP packets over MPLS to the egress PE switch (192.168.12.1):

```
[edit protocols mpls]
user@switch# set label-switched-path lsp_1 to 192.168.12.1
```

9. Disable constrained-path LSP computation for this LSP:

```
[edit protocols mpls]
user@switch# set label-switched-path lsp_1 no-cspf
```

NOTE: We recommend disabling constrained-path LSP computation because MPLS traffic engineering is not supported on QFX Series devices.

10. Configure a static route from the ingress PE switch to the egress PE switch, thereby indicating to the routing protocol that the packets will be forwarded over the MPLS LSP that has been set up to that destination:

```
[edit routing-options]
user@switch# set static route 2.2.2.0/24 next-hop 192.168.10.1
user@switch# set static route 2.2.2.0/24 resolve
```

Configuring the Egress PE Switch

To configure the egress PE switch:

1. Configure an IP address for the loopback interface and the core interfaces:

```
[edit interfaces]
user@switch# set lo0 unit 0 family inet address 192.168.12.1/32
user@switch# set xe-0/0/5 unit 0 family inet address 10.1.20.1/24
user@switch# set xe-0/0/6 unit 0 family inet address 10.1.21.1/24
```

NOTE: You cannot use routed VLAN interfaces (RVIs) or Layer 3 subinterfaces as core interfaces.

2. Configure OSPF on the loopback interface and the core interfaces:

NOTE: You can use the switch address as an alternative to the loopback interface.

```
[edit protocols ospf]
user@switch# set area 0.0.0.0 interface lo0.0
user@switch# set area 0.0.0.0 interface xe-0/0/5.0
user@switch# set area 0.0.0.0 interface xe-0/0/6.0
```

3. Configure RSVP on the loopback interface and the core interfaces:

```
[edit protocols rsvp]
user@switch# set rsvp interface lo0.0
user@switch# set rsvp interface xe-0/0/5.0
user@switch# set rsvp interface xe-0/0/6.0
```

4. Configure MPLS on the core interfaces:

```
[edit protocols mpls]
user@switch# set interface xe-0/0/5.0
user@switch# set interface xe-0/0/6.0
```

5. Configure **family mpls** on the logical units of the core interfaces, thereby identifying the interfaces that will be used for forwarding MPLS packets:

```
[edit interfaces]
user@switch# set xe-0/0/5 unit 0 family mpls
user@switch# set xe-0/0/6 unit 0 family mpls
```

6. Configure a customer edge interface as a Layer 3 routed interface, specifying an IP address:

```
[edit interfaces]
user@switch# set xe-0/0/3 unit 0 family inet address 2.2.2.1/16
```

7. Configure this Layer 3 customer edge interface for the routing protocol:

```
[edit]
user@switch# set protocols ospf area 0.0.0 interface xe-0/0/3
```

8. Configure an LSP on the egress PE switch (192.168.12.1) to send IP packets over MPLS to the ingress PE switch (192.168.10.1):

```
[edit protocols mpls]
user@switch# set label-switched-path lsp_2 to 192.168.10.1
```

9. Disable constrained-path LSP computation for this LSP:

```
[edit protocols mpls]
user@switch# set label-switched-path lsp_2 no-cspf
```

NOTE: We recommend disabling constrained-path LSP computation because MPLS traffic engineering is not supported on QFX Series devices.

10. Configure a static route from the ingress PE switch to the egress PE switch, thereby indicating to the routing protocol that the packets will be forwarded over the MPLS LSP that has been set up to that destination:

```
[edit routing-options]
user@switch# set static route 121.121.121.0/24 next-hop 192.168.12.1
user@switch# set static route 121.121.121.0/24 resolve
```

Related Documentation

- MPLS Configuration Guidelines on page 3753
- Configuring MPLS on Provider Switches on page 3775
- MPLS Feature Support on the QFX Series Overview on page 3748
- Understanding MPLS Components for the QFX Series on page 3738
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744

Configuring MPLS on Provider Switches

To implement MPLS, you must configure at least one provider switch as a transit switch for the MPLS packets.

MPLS requires the configuration of an interior gateway protocol (OSPF) and a signaling protocol (RSVP) on the core interfaces and the loopback interface of all the switches. This procedure includes the configuration of OSPF on the provider switch.

To configure the provider switch, complete the following tasks:

1. Configure OSPF on the loopback and core interfaces:

   NOTE: You can use the switch address as an alternative to the loopback interface.

   ```
   [edit protocols ospf]
   user@switch# set area 0.0.0.0 interface lo0.0
   user@switch# set area 0.0.0.0 interface xe-0/0/5.0
   user@switch# set area 0.0.0.0 interface xe-0/0/6.0
   user@switch# set area 0.0.0.0 interface ae0
   ```

   NOTE: You cannot use routed VLAN interfaces (RVIs) or Layer 3 subinterfaces as core interfaces.

2. Configure MPLS on the core interfaces:

   ```
   [edit protocols mpls]
   user@switch# set interface xe-0/0/5.0
   user@switch# set interface xe-0/0/6.0
   user@switch# set interface ae0
   ```

3. Configure RSVP on the loopback interface and the core interfaces:

   ```
   [edit protocols rsvp]
   user@switch# set interface lo0.0
   user@switch# set interface xe-0/0/5.0
   user@switch# set interface xe-0/0/6.0
   user@switch# set interface ae0
   ```

4. Configure an IP address for the loopback interface and the core interfaces:

   ```
   [edit interfaces]
   user@switch# set lo0 unit 0 family inet address 127.1.1.1/32
   user@switch# set xe-0/0/5 unit 0 family inet address 10.1.5.1/24
   user@switch# set xe-0/0/6 unit 0 family inet address 10.1.6.1/24
   ```

```
user@switch# set ae0 unit 0 family inet address 10.1.9.2/24
```

5. Configure **family mpls** on the logical units of the core interfaces, thereby identifying the interfaces that will be used for forwarding MPLS packets:

```
[edit interfaces]
user@switch# set xe-0/0/5 unit 0 family mpls
user@switch# set xe-0/0/6 unit 0 family mpls
user@switch# set ae0 unit 0 family mpls
```

NOTE: You can configure **family mpls** on either individual interfaces or aggregated Ethernet interfaces. You cannot configure it on tagged VLAN interfaces.

Related Documentation

- Configuring MPLS on Provider Edge Switches on page 3772
- MPLS Configuration Guidelines on page 3753
- MPLS Feature Support on the QFX Series Overview on page 3748
- Understanding MPLS Components for the QFX Series on page 3738
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744

Configuring Static Label Switched Paths for MPLS

Configuring static label-switched paths (LSPs) for MPLS is similar to configuring static routes on individual switches. As with static routes, there is no error reporting, liveliness detection, or statistics reporting.

To configure static LSPs, configure the ingress PE switch and each provider switch along the path up to and including the egress PE switch.

For the ingress PE switch, configure which packets to tag (based on the packet's destination IP address), configure the next switch in the LSP, and the tag to apply to the packet. Manually assigned labels can have values from 0 through 1,048,575.

For the transit switches in the path, configure the next switch in the path and the tag to apply to the packet. Manually assigned labels can have values from 1,000,000 through 1,048,575.

The egress PE switch removes the label and forwards the packet to the IP destination. However, if the previous switch removed the label, the egress switch examines the packet's IP header and forwards the packet toward its IP destination.

Before you configure a static LSP, you must configure the basic components for an MPLS network:

- Configure two PE switches. See "Configuring MPLS on Provider Edge Switches" on page 3772.

NOTE: Do not configure LSPs at the **[edit protocols mpls label-switched-path]** hierarchy level on the PE switches.

- Configure one or more provider switches. See “Configuring MPLS on Provider Switches” on page 3775.

This topic describes how to configure an ingress PE switch, one or more provider switches, and an egress PE switch for static LSP:

Configuring the Ingress PE Switch

To configure the ingress PE switch:

1. Configure an IP address for every core interface:

   ```
   [edit interfaces]
   user@switch# set interface-name unit logical-unit-number family inet address address
   ```

   NOTE: You cannot use routed VLAN interfaces (RVIs) or Layer 3 subinterfaces as core interfaces.

2. Configure the name associated with the static LSP:

   ```
   [edit protocols mpls]
   user@switch# set static-label-switched-path lsp-name
   ```
3. Configure the next hop switch for the LSP:

   ```
   [edit protocols mpls]
   user@switch# set static-label-switched-path lsp-name ingress next-hop address-of-next-hop
   ```
4. Specify the address of the egress switch for the LSP:

   ```
   [edit protocols mpls]
   user@switch# set static-label-switched-path lsp-name ingress to address-of-egress-switch
   ```
5. Configure the new label that you want to add to the top of the label stack:

   ```
   [edit protocols mpls]
   user@switch# set static-label-switched-path lsp-name ingress push out-label
   ```

Configuring the Provider and the Egress PE Switch

To configure a static LSP for MPLS on the provider and egress PE switch:

1. Configure a transit static LSP:

   ```
   [edit protocols mpls]
   user@switch# set static-label-switched-path lsp-name transit incoming-label
   ```
2. Configure the next hop switch for the LSP:

   ```
   [edit protocols mpls]
   user@switch# set static-label-switched-path lsp-name transit incoming-label next-hop
   address-of-next-hop
   ```


3. Only for provider switches, remove the label at the top of the label stack and replace it with the specified label:

   ```
   [edit protocols mpls]
   user@switch# set static-label-switched-path lsp-name transit incoming-label swap out-label
   ```

4. Only for the egress PE switch, remove the label at the top of the label stack:

   NOTE: If there is another label in the stack, that label becomes the label at the top of the label stack. Otherwise, the packet is forwarded as a native protocol packet (typically, as an IP packet).

   ```
   [edit protocols mpls]
   user@switch# set static-label-switched-path lsp-name transit incoming-label pop
   ```

Related Documentation

- Configuring MPLS on Provider Edge Switches on page 3772
- Configuring MPLS on Provider Switches on page 3775
- Understanding MPLS Label Operations on the QFX Series on page 3741

Configuring MPLS Firewall Filters

You can configure firewall filters to filter MPLS traffic. To use an MPLS firewall filter, you must first configure the filter and then apply it to an interface you have configured for forwarding MPLS traffic.

NOTE: You can configure ingress MPLS firewall filters only. Egress MPLS firewall filters are not supported.

When you configure an MPLS firewall filter, you define filtering criteria (terms, with match conditions) for the packets and an action (action, or action modifier) for the switch to take if the packets match the filtering criteria.

- Table 274 on page 3779 describes the match conditions you can configure for MPLS firewall filters at the **[edit firewall family mpls filter *filter-name* term *term-name* from]** hierarchy level.

  NOTE: If a packet has multiple MPLS labels, the filter applies the match conditions to only the bottom label in the label stack.

Table 274: Supported Match Conditions for MPLS Firewall Filters

Match Condition	Description
exp *number*	Experimental (EXP) bit number or range of bit numbers in the MPLS header of a packet. For *number*, you can specify one or more values from 0 through 7 in binary, decimal or hexadecimal format, as given below: • A single EXP bit—for example, **exp 3** • Several EXP bits—for example, **exp 0,4** • A range of EXP bits—for example, **exp [0-5]**
label *number*	MPLS label value or range of label values in the MPLS header of a packet. For *number*, you can specify one or more values from 0 through 1048575 in decimal or hexadecimal format, as given below: • A single label—for example, **label 3** • Several labels—for example, **label 0,4** • A range of labels—for example, **label [0-5]**

- Table 275 on page 3779 describes the actions you can configure for MPLS firewall filters at the **[edit firewall family mpls filter *filter-name* term *term-name* then]** hierarchy level.

Table 275: Supported Actions for MPLS Firewall Filters

Action	Description
accept	Accept a packet
count *counter-name*	Count the number of packets that pass this filter or term. NOTE: We recommend that you configure a counter for each term in a firewall filter, so that you can monitor the number of packets that match the conditions specified in each filter term.
discard	Discard a packet silently without sending an Internet Control Message Protocol (ICMP) message

- Configuring an MPLS Firewall Filter on page 3779
- Applying an MPLS Firewall Filter to an MPLS Interface on page 3780

Configuring an MPLS Firewall Filter

To configure an MPLS firewall filter:

1. Configure the filter name, term name, and at least one match condition—for example, match on MPLS packets with EXP bits set to either 0 or 4:

```
[edit firewall family mpls]
user@switch# set filter ingress-exp-filter term term-one from exp 0,4
```

2. In each firewall filter term, specify the actions to take if the packet matches all the conditions in that term—for example, count MPLS packets with EXP bits set to either 0 or 4:

   [edit firewall family mpls filter ingress-exp-filter term term-one then]
   user@switch# **set count counter0**
   user@switch# **set accept**

Applying an MPLS Firewall Filter to an MPLS Interface

To apply the MPLS firewall filter to an interface you have configured for forwarding MPLS traffic (using the **family mpls** statement at the **[edit interfaces *interface-name* unit *unit-number*]** hierarchy level):

NOTE: You can apply firewall filters only to filter MPLS packets that enter an interface.

1. Apply the firewall filter to an MPLS interface—for example, apply the firewall filter to interface xe-0/0/5:

   [edit interfaces]
   user@switch# **set xe-0/0/5 unit 0 family mpls filter input ingress-exp-filter**

2. Review your configuration and issue the **commit** command:

   [edit interfaces]
   user@switch# **commit**
   commit complete

Related Documentation

- MPLS Feature Support on the QFX Series Overview on page 3748
- Supported MPLS and ECMP Scaling Values on page 3750

Configuring CoS Bits for an MPLS Network

When traffic enters a labeled-switch path (LSP) tunnel, the CoS bits in the MPLS header are set in one of two ways:

- The number of the output queue into which the packet was buffered and the packet loss priority (PLP) bit are written into the MPLS header and are used as the packet's CoS value. This behavior is the default, and no configuration is required. The *Junos OS Class of Service Library for Routing Devices* explains the IP CoS values, and summarizes how the CoS bits are treated.
- You set a fixed CoS value on all packets entering the LSP tunnel. A fixed CoS value means that all packets entering the LSP receive the same class of service.

To set a fixed CoS value on all packets entering the LSP:

1. Specify a class of service value for the LSP:

   NOTE: The CoS value set using the **class-of-service** statement at the **[edit protocols mpls]** hierarchy level supersedes the CoS value set at the **[edit class-of-service]** hierarchy level for an interface. Effectively, the CoS value configured for an LSP overrides the CoS value set for an interface.

   ```
   [edit protocols mpls]
   user@switch# set class-of-service cos-value
   ```

Related Documentation

- Understanding CoS Classifiers on page 5334
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Configuring a Global MPLS EXP Classifier on page 3782
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Defining CoS Rewrite Rules on page 5693

Configuring a Global MPLS EXP Classifier

EXP packet classification associates incoming packets with a particular MPLS CoS servicing level. EXP behavior aggregate (BA) classifiers examine the MPLS EXP value in the packet header to determine the CoS settings applied to the packet. EXP BA classifiers allow you to set the forwarding class and loss priority of an MPLS packet based on the incoming CoS value.

You can configure as many EXP classifiers as you want, however, the switch uses only one MPLS EXP classifier as a global classifier on all interfaces. All switch interfaces use the global EXP classifier to classify MPLS traffic.

If an EXP classifier is configured, MPLS traffic uses the EXP classifier. If an EXP classifier is not configured, then if a fixed classifier is applied to the interface, the MPLS traffic uses the fixed classifier. If no EXP classifier and no fixed classifier is applied to the interface, MPLS traffic is treated as best-effort traffic. DSCP classifiers are not applied to MPLS traffic.

NOTE: There is no default MPLS EXP classifier. If you want to use an MPLS EXP classifier, you must configure it. The MPLS EXP classifier is global and applies to all interfaces on the switch that transport MPLS traffic. You can configure as many MPLS EXP classifiers as you want, but you can only use one MPLS EXP classifier on switch interfaces at any time.

To configure a unicast MPLS EXP classifier using the CLI:

1. Create an EXP classifier and associate it with a forwarding class, a loss priority, and a code point:

   `[edit class-of-service classifiers]`
   `user@switch#` **set (dscp | ieee-802.1 | exp)** ***classifier-name*** **forwarding-class** ***forwarding-class-name*** **loss-priority** ***level*** **code-points [*aliases*] [*bit-patterns*]**
2. Apply the EXP classifier to the switch interfaces:

   `[edit class-of-service]`
   `user@switch#` **set system-defaults classifiers exp** ***classifier-name***

Related Documentation

- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344
- Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 5673
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783

Configuring Rewrite Rules for MPLS EXP Classifiers

You configure EXP rewrite rules to alter CoS values in outgoing MPLS packets on the outbound interfaces of a switch to match the policies of a targeted peer. Policy matching allows the downstream routing platform or switch in a neighboring network to classify each packet into the appropriate service group.

To configure an EXP CoS rewrite rule, create the rule by giving it a name and associating it with a forwarding class, loss priority, and code point. This creates a rewrite table. After the rewrite rule is created, enable it on a logical interface. EXP rewrite rules can only be enabled on logical interfaces, not on physical interfaces. You can also apply an existing EXP rewrite rule on a logical interface.

NOTE: There are no default rewrite rules.

You can configure as many EXP rewrite rules as you want, but you can only use 16 EXP rewrite rules at any time on the switch. On a given logical interface, all pushed MPLS labels have the same EXP rewrite rule applied to them. You can apply different EXP rewrite rules to different logical interfaces on the same physical interface.

NOTE: On each physical interface, either all forwarding classes that are being used on the interface must have rewrite rules configured, or no forwarding classes that are being used on the interface can have rewrite rules configured. On any physical port, do not mix forwarding classes with rewrite rules and forwarding classes without rewrite rules.

NOTE: To replace an existing rewrite rule on the interface with a new rewrite rule of the same type, first explicitly remove the existing rewrite rule and then apply the new rule.

To create an EXP rewrite rule for MPLS traffic and enable it on a logical interface:

1. Create an EXP rewrite rule:

   `user@switch#` **set class-of-service rewrite-rules exp *rewrite-rule-name* forwarding-class *forwarding-class-name* loss-priority *level* code-points [*aliases*] [*bit-patterns*]**

   For example, to configure an EXP rewrite rule named **exp-rr-1** for a forwarding class named **mpls-1** with a loss priority of **low** that rewrites the EXP code point value to **001**:

   `user@switch#` **set class-of-service rewrite-rules exp exp-rr-1 forwarding-class mpls-1 loss-priority low code-points 001**

2. Apply the rewrite rule to a logical interface:

   `user@switch #` **set class-of-service interfaces *interface-name* unit *logical-unit* rewrite-rules exp *rewrite-rule-name***

   For example, to apply a rewrite rule named **exp-rr-1** to logical interface **xe-0/0/10.0**:

```
user@switch# set class-of-service interfaces xe-0/0/10 unit 0 rewrite-rules exp exp-rr-1
```

NOTE: In this example, all forwarding classes assigned to port xe-0/0/10 must have rewrite rules. Do not mix forwarding classes that have rewrite rules with forwarding classes that do not have rewrite rules on the same interface.

Related Documentation

- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344
- Monitoring CoS Rewrite Rules on page 5812
- Defining CoS Rewrite Rules on page 5693
- Configuring a Global MPLS EXP Classifier on page 3782

Configuring MPLS to Gather Statistics

You can configure MPLS so that it periodically gathers traffic statistics about all MPLS sessions, including transit sessions, by configuring the **statistics** statement. You must configure the **statistics** statement if you want to collect MPLS traffic statistics using SNMP polling of MPLS Management Information Bases (MIBs).

To enable MPLS statistics collection, include the **statistics** statement:

```
statistics {
  auto-bandwidth;
  file filename <files number> <size size> <world-readable | no-world-readable>;
  interval seconds;
  no-transit-statistics;
}
```

You can configure these statements at the following hierarchy levels:

- **[edit protocols mpls]**
- **[edit logical-systems *logical-system-name* protocols mpls]**

The default interval is 300 seconds.

If you configure the **file** option, the statistics are placed in a file, with one entry per LSP. During the specified interval, the following information is recorded in this file:

- The number of packets, number of bytes, packets per second, and bytes per second transmitted by each LSP. Feature parity for the display of packet and byte statistics for sub-LSPs of a point-to-multipoint LSP on the Junos Trio chipset is supported in Junos OS Releases 11.1R2, 11.2R2, and 11.4.
- The percent of bandwidth transmitted over a given LSP in relation to the bandwidth percentage configured for that LSP. If no bandwidth is configured for an LSP, 0 percent is recorded in the percentage column.

At the end of each periodic report, a summary shows the current time, total number of sessions, number of sessions read, number of sessions ignored, and read errors, if any. Ignored sessions are typically those not in the up state or those with a reserved (0 through 15) incoming label (typically the egress point of an LSP). The reason for a read error appears on the same line as the entry for the LSP on which the error occurred. Gathering statistics is an unreliable process; occasional read errors might affect their accuracy. Sample output follows:

```
lsp6                    0 pkt              0 Byte      0 pps         0 Bps    0
lsp5                    0 pkt              0 Byte      0 pps         0 Bps    0
lsp6.1              34845 pkt        2926980 Byte   1049 pps     88179 Bps  132
lsp5.1                  0 pkt              0 Byte      0 pps         0 Bps    0
lsp4                    0 pkt              0 Byte      0 pps         0 Bps    0
Dec  7 17:28:38 Total 6 sessions: 5 success, 0 fail, 1 ignored
```

Related Documentation

- Configuring Automatic Bandwidth Allocation for LSPs on page 3785

Configuring Automatic Bandwidth Allocation for LSPs

Automatic bandwidth allocation allows an MPLS tunnel to automatically adjust its bandwidth allocation based on the volume of traffic flowing through the tunnel. You can configure an LSP with minimal bandwidth, and this feature can dynamically adjust the LSP's bandwidth allocation based on current traffic patterns. The bandwidth adjustments do not interrupt traffic flow through the tunnel.

At the end of the automatic bandwidth allocation time interval, the current maximum average bandwidth usage is compared with the allocated bandwidth for the LSP. If the LSP needs more bandwidth, an attempt is made to set up a new path where bandwidth is equal to the current maximum average usage. If the attempt is successful, the LSP's traffic is routed through the new path and the old path is removed. If the attempt fails, the LSP continues to use its current path.

If you have configured link and node protection for the LSP and traffic has been switched to the bypass LSP, the automatic bandwidth allocation feature continues to operate and take bandwidth samples from the bypass LSP. For the first bandwidth adjustment cycle, the maximum average bandwidth usage taken from the original link and node-protected LSP is used to resignal the bypass LSP if more bandwidth is needed.

If you have configured fast-reroute for the LSP, you might not be able to use this feature to adjust the bandwidth. Because the LSPs use a fixed filter (FF) reservation style, when a new path is signaled, the bandwidth might be double-counted. Double-counting can prevent a fast-reroute LSP from ever adjusting its bandwidth when automatic bandwidth allocation is enabled.

To configure automatic bandwidth allocation, complete the steps in the following sections:

- Configuring Automatic Bandwidth Allocation on LSPs on page 3786
- Requesting Automatic Bandwidth Allocation Adjustment on page 3791

Configuring Automatic Bandwidth Allocation on LSPs

To enable automatic bandwidth allocation on an LSP, include the **auto-bandwidth** statement:

```
auto-bandwidth {
  adjust-interval seconds;
  adjust-threshold percent;
  adjust-threshold-overflow-limit number;
  adjust-threshold-underflow-limit number;
  maximum-bandwidth bps;
  minimum-bandwidth bps;
  minimum-bandwidth-adjust-interval
  minimum-bandwidth-adjust-threshold-change
  minimum-bandwidth-adjust-threshold-value
  monitor-bandwidth;
}
```

You can include this statement at the following hierarchy levels:

- **[edit protocols mpls label-switched-path *lsp-name*]**
- **[edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name*]**

If an LSP has an automatic bandwidth configuration, you can disable automatic bandwidth adjustments on a particular path (either primary or secondary) by configuring a static bandwidth value and by disabling the CSPF computation (using the **no-cspf** statement).

For example:

```
user@host> show protocols mpls
label-switched-path primary-path {
  to 192.168.0.1;
  ldp-tunneling;
  optimize-timer 3571;
  least-fill;
  link-protection;
  adaptive;
  auto-bandwidth {
    adjust-interval 7177;
    adjust-threshold 5;
    minimum-bandwidth 1m;
    maximum-bandwidth 2500000000;
    adjust-threshold-overflow-limit 2;
    resignal-minimum-bandwidth;
  }
  primary primary-path;
  secondary secondary-path {
    bandwidth 0;
    no-cspf;
    priority 0 0;
  }
}
```


The statements configured at the **[edit protocols mpls label-switched-path** ***label-switched-path-name*** **auto-bandwidth]** hierarchy level are optional and explained in the following sections:

- Configuring the Automatic Bandwidth Allocation Interval on page 3787
- Configuring the Maximum and Minimum Bounds of the LSP's Bandwidth on page 3787
- Configuring the Automatic Bandwidth Adjustment Threshold on page 3788
- Configuring a Limit on Bandwidth Overflow and Underflow Samples on page 3788
- Configuring Passive Bandwidth Utilization Monitoring on page 3790

Configuring the Automatic Bandwidth Allocation Interval

At the end of the automatic bandwidth allocation interval, the automatic bandwidth computation and new path setup process is triggered.

NOTE: To prevent unnecessary resignaling of LSPs, it is best to configure an LSP adjustment interval that is at least three times longer than the MPLS automatic bandwidth statistics interval. For example, if you configure a value of 30 seconds for the MPLS automatic bandwidth statistics interval (**interval** statement at the **[edit protocols mpls statistics]** hierarchy level), you should configure a value of at least 90 seconds for the LSP adjustment interval (**adjust-interval** statement at the **[edit protocols mpls label-switched-path** ***label-switched-path-name*** **auto-bandwidth]** hierarchy level). See also "Configuring Reporting of Automatic Bandwidth Allocation Statistics" on page 3792.

To specify the bandwidth reallocation interval in seconds for a specific LSP, include the **adjust-interval** statement:

```
adjust-interval seconds;
```

You can include this statement at the following hierarchy levels:

- **[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]**
- **[edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth]**

Configuring the Maximum and Minimum Bounds of the LSP's Bandwidth

You can maintain the LSP's bandwidth between minimum and maximum bounds by specifying values for the **minimum-bandwidth** and **maximum-bandwidth** statements.

To specify the minimum amount of bandwidth allocated for a specific LSP, include the **minimum-bandwidth** statement:

```
minimum-bandwidth bps;
```

You can include this statement at the following hierarchy levels:

- **[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]**

- **[edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth]**

To specify the maximum amount of bandwidth allocated for a specific LSP, include the **maximum-bandwidth** statement:

maximum-bandwidth *bps*;

You can include this statement at the following hierarchy levels:

- **[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]**
- **[edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth]**

Configuring the Automatic Bandwidth Adjustment Threshold

Use the **adjust-threshold** statement to specify the sensitivity of the automatic bandwidth adjustment of an LSP to changes in bandwidth utilization. You can set the threshold for when to trigger automatic bandwidth adjustments. When configured, bandwidth demand for the current interval is determined and compared to the LSP's current bandwidth allocation. If the percentage difference in bandwidth is greater than or equal to the specified **adjust-threshold** percentage, the LSP's bandwidth is adjusted to the current bandwidth demand.

For example, assume that the current bandwidth allocation is 100 megabits per second (Mbps) and that the percentage configured for the **adjust-threshold** statement is 15 percent. If the bandwidth demand increases to 110 Mbps, the bandwidth allocation is not adjusted. However, if the bandwidth demand increases to 120 Mbps (20 percent over the current allocation) or decreases to 80 Mbps (20 percent under the current allocation), the bandwidth allocation is increased to 120 Mbps or decreased to 80 Mbps, respectively.

To configure the threshold for automatic bandwidth adjustment, include the **adjust-threshold** statement:

adjust-threshold *percent*;

You can include this statement at the following hierarchy levels:

- **[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]**
- **[edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth]**

Configuring a Limit on Bandwidth Overflow and Underflow Samples

The automatic bandwidth adjustment timer is a periodic timer which is triggered every adjust interval to determine whether any bandwidth adjustments are required on the LSP's active path. This interval is typically configured as a long period of time, usually hours. If, at the end of adjust interval, the change in bandwidth is above a certain adjust threshold, the LSP is resignaled with the new bandwidth.

During the automatic bandwidth adjustment interval, the router might receive a steady increase in traffic (increasing bandwidth utilization) on an LSP, potentially causing congestion or packet loss. To prevent this, you can define a second trigger to prematurely expire the automatic bandwidth adjustment timer before the end of the current adjustment interval.

Every statistics interval, the router samples the average bandwidth utilization of an LSP and if this has exceeded the current maximum average bandwidth utilization, the maximum average bandwidth utilization is updated.

During each sample period, the following conditions are also checked:

- Is the current average bandwidth utilization above the active bandwidth of the path?
- Has the difference between the average bandwidth utilization and the active bandwidth exceeded the adjust threshold (bandwidth utilization has changed significantly)?

If these conditions are true, it is considered to be one bandwidth overflow sample. Using the **adjust-threshold-overflow-limit** statement, you can define a limit on the number of bandwidth overflow samples such that when the limit is reached, the current automatic bandwidth adjustment timer is expired and a bandwidth adjustment is triggered. Once this adjustment is complete, the normal automatic bandwidth adjustment timer is reset to expire after the periodic adjustment interval.

To specify a limit on the number of bandwidth overflow samples before triggering an automatic bandwidth allocation adjustment, configure the **adjust-threshold-overflow-limit** statement:

adjust-threshold-overflow-limit *number*;

Similarly, if the current average bandwidth utilization is below the active bandwidth of the path by the configured adjusted threshold (meaning that bandwidth utilization has gone down significantly), the sample is considered to be an underflow sample. The adjusted (new signaling) bandwidth after an adjustment due to underflow is the maximum average bandwidth among the underflow samples. You can specify a limit on the number of bandwidth underflow samples before triggering an automatic bandwidth allocation adjustment by configuring the **adjust threshold-underflow-limit** statement:

adjust-threshold-underflow-limit *number*;

These statements can be configured at the following hierarchy levels:

- **[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]**
- **[edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth]**

You must configure the **adjust-threshold** and **minimum-bandwidth** statements whenever you configure the **adjust-threshold-underflow-limit** statement. You must configure the **adjust-threshold** and **maximum-bandwidth** statements whenever you configure the **adjust-threshold-overflow-limit** statement

- You must configure a nonzero value for the **adjust-threshold** statement if you configure the **adjust-threshold-overflow-limit** or **adjust-threshold-underflow-limit** statement.

- Any bandwidth increase or decrease below the value configured for the **adjust-threshold** statement does not constitute an overflow or underflow condition.
- To prevent unlimited increases in LSP bandwidth (to limit overflow beyond a certain bandwidth), you must also configure the **maximum-bandwidth** statement when you configure the **adjust-threshold-overflow-limit** statement.

The following describes the other aspects of the **adjust-threshold-overflow-limit** statement:

- It only applies to bandwidth overflows. If the bandwidth is decreasing, the normal automatic bandwidth adjustment interval is used.
- It does not affect manually triggered automatic bandwidth adjustment.
- It applies to single-class DiffServ-TE LSPs.
- Because the **adjust-threshold-overflow-limit** statement can trigger a bandwidth adjustment, it cannot be enabled at the same time as the **monitor-bandwidth** statement (for information about that statement, see "Configuring Passive Bandwidth Utilization Monitoring" on page 3790).
- You cannot configure automatic bandwidth adjustments to occur more often than every 300 seconds. The **adjust-threshold-overflow-limit** statement is subject to the same minimum value with regard to the minimum frequency of adjustment allowed. Overflow condition based adjustments can occur no sooner than 300 seconds from the start of the overflow condition. Therefore it is required that:

  sample interval x adjust-threshold-overflow-limit >= 300s

  These values are checked during the commit operation. An error is returned if the value is less than 300 seconds.
- If you change the value of the **adjust-threshold-overflow-limit** statement on a working router, you can expect the following behavior:
  - If you increase the current value of the **adjust-threshold-overflow-limit** statement, the old value is replaced with the new one.
  - If you decrease the current value of the **adjust-threshold-overflow-limit** statement and the current bandwidth overflow count is less than the new value, the old value is replaced with the new one.
  - If you decrease the current value of the **adjust-threshold-overflow-limit** statement and the current bandwidth overflow count is greater than the new value, the adjustment timer is immediately expired and a bandwidth adjustment is initiated.

Configuring Passive Bandwidth Utilization Monitoring

Use the **monitor-bandwidth** statement to switch to a passive bandwidth utilization monitoring mode. In this mode, no automatic bandwidth adjustments are made, but the maximum average bandwidth utilization is continuously monitored and recorded.

To configure passive bandwidth utilization monitoring, include the **monitor-bandwidth** statement:

monitor-bandwidth;

You can include this statement at the following hierarchy levels:

- **[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]**
- **[edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth]**

If you have configured an LSP with primary and secondary paths, the automatic bandwidth allocation statistics are carried over to the secondary path if the primary path fails. For example, consider a primary path whose adjustment interval is half complete and whose maximum average bandwidth usage is currently calculated as 50 Mbps. If the primary path suddenly fails, the time remaining for the next adjustment and the maximum average bandwidth usage are carried over to the secondary path.

Requesting Automatic Bandwidth Allocation Adjustment

For MPLS LSP automatic bandwidth allocation adjustment, the minimum value for the adjustment interval is 5 minutes (300 seconds). You might find it necessary to trigger a bandwidth allocation adjustment manually, for example in the following circumstances:

- When you are testing automatic bandwidth allocation in a network lab.
- When the LSP is configured for automatic bandwidth allocation in monitor mode (the **monitor-bandwidth** statement is included in the configuration as described in "Configuring Passive Bandwidth Utilization Monitoring" on page 3790), and want to initiate an immediate bandwidth adjustment.

To use the **request mpls lsp adjust-autobandwidth** command, the following must be true:

- Automatic bandwidth allocation must be enabled on the LSP.
- The criteria required to trigger a bandwidth adjustment have been met (the difference between the adjust bandwidth and the current LSP path bandwidth is greater than the threshold limit).

A manually triggered bandwidth adjustment operates only on the active LSP path. Also, if you have enabled periodic automatic bandwidth adjustment, the periodic automatic bandwidth adjustment parameters (the adjustment interval and the maximum average bandwidth) are not reset after a manual adjustment.

For example, suppose the periodic adjust interval is 10 hours and there are currently 5 hours remaining before an automatic bandwidth adjustment is triggered. If you initiate a manual adjustment with the **request mpls lsp adjust-autobandwidth** command, the adjust timer is not reset and still has 5 hours remaining.

To manually trigger a bandwidth allocation adjustment, you need to use the **request mpls lsp adjust-autobandwidth** command. You can trigger the command for all affected LSPs on the router, or you can specify a particular LSP:

`user@host>` **request mpls lsp adjust-autobandwidth**

Once you execute this command, the automatic bandwidth adjustment validation process is triggered. If all the criteria for adjustment are met, the LSP's active path bandwidth is adjusted to the adjusted bandwidth value determined during the validation process.

Related Documentation

- Configuring MPLS to Gather Statistics on page 3784
- Configuring Reporting of Automatic Bandwidth Allocation Statistics on page 3792
- **request mpls lsp adjust-autobandwidth on page 3840**
- **show mpls lsp on page 3870**

Configuring Reporting of Automatic Bandwidth Allocation Statistics

Automatic bandwidth allocation allows an MPLS tunnel to automatically adjust its bandwidth allocation based on the volume of traffic flowing through the tunnel. You can configure the device to collect statistics related to automatic bandwidth allocation by completing the following steps:

1. To collect statistics related to automatic bandwidth allocation, configure the **auto-bandwidth** option for the **statistics** statement at the **[edit protocols mpls]** hierarchy level. These settings apply to all LSPs configured on the router on which you have also configured the **auto-bandwidth** statement at the **[edit protocols mpls label-switched-path *label-switched-path-name*]** hierarchy level.

   ```
   statistics {
     auto-bandwidth;
     file filename <files number> <size size> <world-readable | no-world-readable>;
     interval seconds;
     no-transit-statistics;
   }
   ```

2. Specify the ***filename*** for the files used to store the MPLS trace operation output using the **file** option. All files are placed in the directory **/var/log**. We recommend that you place MPLS tracing output in the file **mpls-log**.

3. Specify the maximum number of trace files using the **files *number*** option. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

4. Specify the interval for calculating the average bandwidth usage by configuring a time in seconds using the **interval** option. You can also set the adjustment interval on a specific LSP by configuring the **interval** option at the **[edit protocols mpls label-switch-path *label-switched-path-name* statistics]** hierarchy level.

NOTE: To prevent unnecessary resignaling of LSPs, it is best to configure an LSP adjustment interval that is at least three times longer than the MPLS automatic bandwidth statistics interval. For example, if you configure a value of 30 seconds for the MPLS automatic bandwidth statistics interval (**interval** statement at the **[edit protocols mpls statistics]** hierarchy level), you should configure a value of at least 90 seconds for the LSP adjustment interval (**adjust-interval** statement at the **[edit protocols mpls label-switched-path *label-switched-path-name* auto-bandwidth]** hierarchy level).

5. To trace automatic bandwidth allocation, include the **autobw-state flag** for the MPLS **traceoptions** statement at the **[edit protocols mpls]** hierarchy level.

   The following configuration enables the MPLS traceoptions for automatic bandwidth allocation. The trace records are stored in a file called **auto-band-trace** (the filename is user configurable):

   ```
   [edit protocols mpls]
   traceoptions {
     file auto-band-trace size 10k files 10 world-readable;
     flag autobw-state;
   }
   ```

6. Using the **show log** command, you can display the automatic bandwidth allocation statistics file generated when you configure the *auto-bandwidth* statement. The following shows sample log file output taken from an MPLS statistics file named **auto-band-stats** on a router configured with an LSP named **E-D**. The log file shows that LSP **E-D** is operating over its reserved bandwidth limit initially. Before **Oct 30 17:14:57**, the router triggered an automatic bandwidth adjustment (you might see two sessions for an LSP undergoing an automatic bandwidth adjustment). By **Oct 29 17:16:57**, the LSP has been reestablished at a higher bandwidth and is now shown using less than 100 percent of its **Reserved Bw** (reserved bandwidth).

```
user@host> show log auto-band-stats
E-D          (LSP ID 5, Tunnel ID 6741)         209 pkt         17094 Byte
     1 pps       90 Bps Util 240.01% Reserved Bw       37 Bps
decr nh 0x952c224, type 4, flags 0x0, n_gw 1, nhid 0 to refcount 1Oct 30
17:13:57 Total 1 sessions: 1 success, 0 fail, 0 ignored
E-D          (LSP ID 5, Tunnel ID 6741)         241 pkt         19737 Byte
     1 pps       88 Bps Util 234.67% Reserved Bw       37 Bps
decr nh 0x952c224, type 4, flags 0x0, n_gw 1, nhid 0 to refcount 1Oct 30
17:14:27 Total 1 sessions: 1 success, 0 fail, 0 ignored
E-D          (LSP ID 5, Tunnel ID 6741)         276 pkt         22607 Byte
     1 pps       95 Bps Util 253.34% Reserved Bw       37 Bps
decr nh 0x952c224, type 4, flags 0x0, n_gw 1, nhid 0 to refcount 1Oct 30
17:14:57 Total 1 sessions: 1 success, 0 fail, 0 ignored
E-D          (LSP ID 5, Tunnel ID 6741)           0 pkt             0 Byte
     0 pps        0 Bps Util  0.00% Reserved Bw       37 Bps
E-D          (LSP ID 6, Tunnel ID 6741)           0 pkt             0 Byte
     0 pps        0 Bps Util  0.00% Reserved Bw      101 Bps
decr nh 0x952c224, type 4, flags 0x0, n_gw 1, nhid 0 to refcount 1decr nh
0x952c308, type 4, flags 0x0, n_gw 1, nhid 0 to refcount 1Oct 30 17:15:27 Total
 2 sessions: 2 success, 0 fail, 0 ignored
```

```
E-D          (LSP ID 5, Tunnel ID 6741)           0 pkt              0 Byte
     0 pps        0 Bps Util  0.00% Reserved Bw      37 Bps
E-D          (LSP ID 6, Tunnel ID 6741)          33 pkt           2695 Byte
     1 pps       89 Bps Util 87.69% Reserved Bw     101 Bps
decr nh 0x952c224, type 4, flags 0x0, n_gw 1, nhid 0 to refcount 1decr nh
0x952c308, type 4, flags 0x0, n_gw 1, nhid 0 to refcount 1Oct 30 17:15:57 Total
 2 sessions: 2 success, 0 fail, 0 ignored
E-D          (LSP ID 5, Tunnel ID 6741)           0 pkt              0 Byte
     0 pps        0 Bps Util  0.00% Reserved Bw      37 Bps
E-D          (LSP ID 6, Tunnel ID 6741)          65 pkt           5338 Byte
     1 pps       88 Bps Util 86.70% Reserved Bw     101 Bps
decr nh 0x952c224, type 4, flags 0x0, n_gw 1, nhid 0 to refcount 1decr nh
0x952c308, type 4, flags 0x0, n_gw 1, nhid 0 to refcount 1Oct 30 17:16:27 Total
 2 sessions: 2 success, 0 fail, 0 ignored
E-D          (LSP ID 6, Tunnel ID 6741)          97 pkt           7981 Byte
     1 pps       88 Bps Util 86.70% Reserved Bw     101 Bps
decr nh 0x952c308, type 4, flags 0x0, n_gw 1, nhid 0 to refcount 1Oct 30
17:16:57 Total 1 sessions: 1 success, 0 fail, 0 ignored
```

7. Issue the show mpls lsp autobandwidth command to display current information about automatic bandwidth allocation. The following shows sample output from the **show mpls lsp autobandwidth** command taken at about the same time as the log file shown previously:

```
user@host> show mpls lsp autobandwidth
Lspname               Last         Requested    Reserved     Highwater
AdjustTime LastAdjust
                      BW           BW           BW           mark         Left
 (sec)
E-D                   300bps      812.005bps   812bps      1.56801kbps 294 sec
    Wed Oct 30 17:15:26 2013
```

8. Issue the **file show** command to display the MPLS trace file. You need to specify the file location and file name (the file is located in **/var/log/**. The following shows sample trace file output is taken from an MPLS trace file named **auto-band-trace.0.gz** on a router configured with an LSP named **E-D**. The trace file shows that LSP **E-D** is operating over its reserved bandwidth limit initially. At **Oct 30 17:15:26**, the router triggers an automatic bandwidth adjustment (you might see two sessions for an LSP undergoing an automatic bandwidth adjustment). By **Oct 29 17:15:57**, the LSP has been reestablished at a higher bandwidth and is now shown using less than 100 percent of its **Reserved Bw** (reserved bandwidth).

```
user@host> file show /var/log/auto-band-trace.0.gz
Oct 30 17:13:57 trace_on: Tracing to "/var/log/E/auto-band-trace" started
Oct 30 17:13:57.466825 LSP E-D (id 5) new bytes arrived          2714 in 29
sec
Oct 30 17:14:27.466713 E-D          (LSP ID 5, Tunnel ID 6741)          241
pkt          19737 Byte      1 pps       88 Bps Util 234.67% Reserved Bw
  37 Bps
Oct 30 17:14:27.466962 LSP E-D (id 5, old id 5); sampled bytes      19737 >
bytes recorded      17094
Oct 30 17:14:27.467035 LSP E-D (id 5) new bytes arrived          2643 in 29
sec
Oct 30 17:14:57.466599 E-D          (LSP ID 5, Tunnel ID 6741)          276
pkt          22607 Byte      1 pps       95 Bps Util 253.34% Reserved Bw
  37 Bps
Oct 30 17:14:57.466758 LSP E-D (id 5, old id 5); sampled bytes      22607 >
bytes recorded      19737
Oct 30 17:14:57.466825 LSP E-D (id 5) new bytes arrived          2870 in 29
```



```
sec
Oct 30 17:15:26.265816 Adjust Autobw: LSP E-D (id 5) curr adj bw 300bps updated
 with 812.005bps
Oct 30 17:15:26.266064 mpls LSP E-D Autobw change 512.005bps >= threshold 75bps
Oct 30 17:15:26.363372 Autobw Success: LSP E-D ()  (old id 5 new id 6) update
 prev active bw 300 bps with 812 bps
Oct 30 17:15:26.363686 RPD_MPLS_PATH_BANDWIDTH_CHANGE: MPLS path  (lsp E-D)
bandwidth changed, path bandwidth 812 bps
Oct 30 17:15:27.364751 RPD_MPLS_LSP_BANDWIDTH_CHANGE: MPLS LSP E-D bandwidth
changed, lsp bandwidth 812 bps
Oct 30 17:15:27.466849 E-D          (LSP ID 5, Tunnel ID 6741)            0
pkt                0 Byte      0 pps        0 Bps Util  0.00% Reserved Bw
 37 Bps
Oct 30 17:15:27.467050 E-D          (LSP ID 6, Tunnel ID 6741)            0
pkt                0 Byte      0 pps        0 Bps Util  0.00% Reserved Bw
101 Bps
Oct 30 17:15:57.466858 E-D          (LSP ID 5, Tunnel ID 6741)            0
pkt                0 Byte      0 pps        0 Bps Util  0.00% Reserved Bw
 37 Bps
Oct 30 17:15:57.467106 E-D          (LSP ID 6, Tunnel ID 6741)           33
pkt             2695 Byte      1 pps       89 Bps Util 87.69% Reserved Bw
101 Bps
Oct 30 17:15:57.467201 LSP E-D (id 6, old id 5); LSP up after autobw adjustment
 and active for 30 sec
Oct 30 17:15:57.467398 LSP E-D (id 6) psb bytes          2695 < bytes recorded
          22607 total bytes           2695 in 30 sec
Oct 30 17:15:57.467461 First sample of the adjust interval after automatic bw
 adjustment
Oct 30 17:15:57.467594 Update curr max avg bw 0bps of LSP E-D with new bw
716.225bps
Oct 30 17:16:27.466830 E-D          (LSP ID 5, Tunnel ID 6741)            0
pkt                0 Byte      0 pps        0 Bps Util  0.00% Reserved Bw
 37 Bps
Oct 30 17:16:27.467079 E-D          (LSP ID 6, Tunnel ID 6741)           65
pkt             5338 Byte      1 pps       88 Bps Util 86.70% Reserved Bw
101 Bps
Oct 30 17:16:27.467171 LSP E-D (id 6, old id 6); sampled bytes       5338 >
bytes recorded       2695
Oct 30 17:16:27.467237 LSP E-D (id 6) new bytes arrived          2643 in 29
sec
Oct 30 17:16:57.466712 E-D          (LSP ID 6, Tunnel ID 6741)           97
pkt             7981 Byte      1 pps       88 Bps Util 86.70% Reserved Bw
101 Bps
Oct 30 17:16:57.466870 LSP E-D (id 6, old id 6); sampled bytes       7981 >
bytes recorded       5338
```

Related Documentation

- Configuring Automatic Bandwidth Allocation for LSPs on page 3785
- **show mpls lsp autobandwidth on page 3884**

Configuring MPLS Firewall Filters and Policers

You can configure an MPLS firewall filter to count packets based on the EXP bits for the top-level MPLS label in a packet. You can also configure policers for MPLS LSPs.

The following sections discuss MPLS firewall filters and policers:

Configuring MPLS Firewall Filters

You can configure an MPLS firewall filter to count packets based on the EXP bits for the top-level MPLS label in a packet. You can then apply this filter to a specific interface on input or output. You can also configure a policer for the MPLS filter to police (that is, rate-limit) the traffic on the interface to which the filter is attached. You cannot apply MPLS firewall filters to loopback interfaces.

You can configure the following match conditions for MPLS filters at the **[edit firewall family mpls filter *filter-name* term *term-name* from]** hierarchy level:

- **exp**
- **label**

These **exp** match condition can accept EXP bits in the range 0 through 7. You can configure the following choices:

- A single EXP bit—for example, **exp 3;**
- Several EXP bits—for example, **exp 0, 4;**
- A range of EXP bits—for example, **exp [0-5];**

The **label** match condition can accept a range of values from 0 to 1048575.

If you do not specify a match criterion (that is, you do not configure the **from** statement and use only the **then** statement with the **count** action keyword), all the MPLS packets passing through the interface on which the filter is applied will be counted.

You also can configure any of the following action keywords at the **[edit firewall family mpls filter *filter-name* term *term-name* then]** hierarchy level:

- **accept**
- **count**
- **discard**
- **policer**
- **three-color-policer**

Examples: Configuring MPLS Firewall Filters

The following examples illustrate how you might configure an MPLS firewall filter and then apply the filter to an interface. This filter is configured to count MPLS packets with EXP bits set to either 0 or 4.

The following shows a configuration for an MPLS firewall filter:

```
[edit firewall]
family mpls {
   filter expf {
      term expt0 {
         from {
            exp 0,4;
         }
         then {
            count counter0;
            accept;
         }
      }
   }
}
```

Configuring Policers for LSPs

MPLS LSP policing allows you to control the amount of traffic forwarded through a particular LSP. Policing helps to ensure that the amount of traffic forwarded through an LSP never exceeds the requested bandwidth allocation. LSP policing is supported on regular LSPs, LSPs configured with DiffServ-aware traffic engineering, and multiclass LSPs. You can configure multiple policers for each multiclass LSP. For regular LSPs, each LSP policer is applied to all of the traffic traversing the LSP. The policer's bandwidth limitations become effective as soon as the total sum of traffic traversing the LSP exceeds the configured limit.

You configure the multiclass LSP and DiffServ-aware traffic engineering LSP policers in a filter. The filter can be configured to distinguish between the different class types and apply the relevant policer to each class type. The policers distinguish between class types based on the EXP bits.

You configure LSP policers under the **family any** filter. The **family any** filter is used because the policer is applied to traffic entering the LSP. This traffic might be from different families: IPv6, MPLS, and so on. You do not need to know what sort of traffic is entering the LSP, as long as the match conditions apply to all types of traffic.

LSP Policer Limitations

When configuring MPLS LSP policers, be aware of the following limitations:

- LSP policers are supported for packet LSPs only.
- LSP policers are supported for unicast next hops only. Multicast next hops are not supported.
- LSP policers are not supported on aggregated interfaces.
- The LSP policer runs before any output filters.
- Traffic sourced from the Routing Engine (for example, ping traffic) does not take the same forwarding path as transit traffic. This type of traffic cannot be policed.

Related Documentation

- Overview of Policers on page 4441

Configuration Statements

[edit protocols mpls] Hierarchy Level

This topic lists the supported configuration statements at the **[edit protocols mpls]** hierarchy level on the QFX Series. For more information about these statements, see the *Junos OS MPLS Applications Library for Routing Devices*.

NOTE: The command-line interface (CLI) on QFX Series devices displays even the MPLS related configuration statements that are not supported. However, configuring the unsupported statements on a device will have no effect on the operation of the device.

```
protocols {
  mpls {
    admin-down;
    advertisement-hold-time seconds;
    class-of-service cos-value;
    diffserv-te{
      bandwidth-model {
        extended-mam;
        mam;
        rdm;
      }
      te-class-matrix {
        tenumber {
```



```
            priority priority;
            traffic-class {
                ctnumber priority priority;
            }
        }
    }
}
disable;
exclude-srlg;
explicit-null;
hop-limit number;
interface (interface-name | all) {
    disable;
}
ipv6-tunneling;
label-switched-path lsp-name {
    adaptive;
    admin-down;
    associate-backup-pe-groups;
    associate-lsp lsp-name {
        from from-ip-address;
    }
    auto-bandwidth {
        adjust-interval seconds;
        adjust-threshold percentage;
        maximum-bandwidth bps;
        minimum-bandwidth bps;
        monitor-bandwidth;
    }
    backup;
    bandwidth bps {
        ct0 bps;
        ct1 bps;
        ct2 bps;
        ct3 bps;
    }
    class-of-service cos-value;
    corouted-bidirectional;
    corouted-bidirectional-passive;
    description text;
    disable;
    exclude-srlg;
    from address;
    hop-limit number;
    install {
        destination-prefix/prefix-length <active>;
    }
    inter-domain;
    ldp-tunneling;
    lsp-attributes {
        encoding-type (ethernet | packet | pdh | sonet-sdh);
        gpid (ethernet | hdlc | ipv4 | pos-scrambling-crc-16 | pos-no-scrambling-crc-16 |
            pos-scrambling-crc-32 | pos-no-scrambling-crc-32 | ppp);
        signal-bandwidth type;
        switching-type (fiber | lambda | psc-1 | tdm);
    }
```

```
metric metric;
no-cspf;
no-decrement-ttl;
no-install-to-address;
no-record;
oam{
   lsp-ping-interval seconds;
   mpls-tp-mode seconds;
   traceoptions {
      file filename <files number> <size maximum-file-size> <world-readable |
         no-world-readable>;
      flag flag;
      no-remote-trace;
   }
}
optimize-hold-dead-delay seconds;
optimize-timer seconds;
p2mp lsp-name;
policing {
   filter filter-name;
   no-auto-policing;
}
preference preference;
primary path-name {
   adaptive;
   class-of-service cos-value;
   hop-limit number;
   no-cspf;
   no-decrement-ttl;
   optimize-timer seconds;
   preference preference;
   (record | no-record);
   select (manual | unconditional);
   standby;
}
(record | no-record);
retry-limit number;
retry-timer seconds;
revert-timer seconds;
secondary path-name {
   adaptive;
   bandwidth bps {
      ct0 bps;
      ct1 bps;
      ct2 bps;
      ct3 bps;
   }
   class-of-service cos-value;
   hop-limit number;
   no-cspf;
   no-decrement-ttl;
   optimize-timer seconds;
   preference preference;
   (record | no-record);
   select (manual | unconditional);
   standby;
```



```
  }
  standby;
  jtemplate;
  to address;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
}
log-updown {
  no-trap {
    mpls-lsp-traps;
    rfc3812-traps;
  }
  (syslog | no-syslog);
  trap;
  trap-path-down;
  trap-path-up;
}
mib-mpls-show-p2mp;
no-cspf;
no-decrement-ttl;
no-propagate-ttl;
no-record;
oam{
  lsp-ping-interval seconds;
  mpls-tp-mode seconds;
  traceoptions {
    file filename <files number> <size maximum-file-size> <world-readable |
      no-world-readable>;
    flag flag;
    no-remote-trace;
  }
}
optimize-aggressive;
optimize-hold-dead-delay;
optimize-switchover-delay;
optimize-timer;
path path-name {
  (address | hostname) <loose | strict>;
}
path-mtu {
  rsvp {
    mtu-signaling;
  }
}
preference;
record;
revert-timer;
rsvp-error-hold-time;
smart-optimize-timer;
standby;
static-label-switched-path lsp-name {
  bypass bypass-name {
    description string;
    next-hop (address | interface-name | address/interface-name);
```

```
            push out-label;
            to address;
          }
          ingress {
            class-of-service cos-value;
            description string;
            install {
              destination-prefix <active>;
            }
            metric metric;
            next-hop (address | interface-name | address/interface-name);
            no-install-to-address;
            policing {
              filter filter-name;
              no-auto-policing;
            }
            preference preference;
            push out-label;
            to address;
          }
          transit incoming-label {
            description string;
            next-hop (address | interface-name | address/interface-name);
            pop;
            swap out-label;
          }
        statistics {
          auto-bandwidth;
          file filename <files number> <size maximum-file-size> <world-readable |
            no-world-readable>;
          interval seconds;
        }
        traceoptions {
          file filename <files number> <size maximum-file-size> <world-readable |
            no-world-readable>;
          flag flag;
        }
        transit-lsp-association transit-association-lsp-group-name {
          from-1 address-of-associated-lsp-1;
          from-2 address-of-associated-lsp-2;
          lsp-name-1 name-of-associated-lsp-1;
          lsp-name-2 name-of-associated-lsp-2;
        }
      }
    }
```

Related Documentation

- *Junos OS MPLS Applications Library for Routing Devices*

[edit protocols rsvp] Hierarchy Level

This topic lists the supported configuration statements at the **[edit protocols rsvp]** hierarchy level on the QFX Series. For more information about these statements, see the *Junos OS MPLS Applications Library for Routing Devices*.

NOTE: The command-line interface (CLI) on QFX Series devices displays even the RSVP related configuration statements that are not supported. However, configuring the unsupported statements on a device will have no effect on the operation of the device.

```
protocols {
  rsvp {
    disable;
    graceful-deletion-timeout seconds;
    graceful-restart {
      disable;
      helper-disable;
      maximum-helper-recovery-time seconds;
      maximum-helper-restart-time seconds;
    }
    hello-acknowledgements;
    interface interface-name {
      (aggregate | no-aggregate);
      authentication-key key;
      bandwidth bps;
      disable;
      hello-interval seconds;
      (reliable | no-reliable);
      subscription {
        percentage;
        ct0 percentage;
        ct1 percentage;
        ct2 percentage;
        ct3 percentage;
      }
      update-threshold percentage;
    }
    keep-multiplier number;
    load-balance bandwidth;
    no-interface-hello;
    no-node-id-subobject;
    no-p2mp-sublsp;
    node-hello
    preemption {
      (aggressive | disabled | normal);
      soft-preemption cleanup-timer seconds;
    }
    refresh-time seconds;
    setup-protection;
    traceoptions {
      file filename <files number> <size maximum-file-size> <world-readable |
        no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
    tunnel-services {
      devices device-names;
    }
  }
```

```
}
```

Related Documentation
- *Junos OS MPLS Applications Library for Routing Devices*

auto-bandwidth

Syntax

```
auto-bandwidth {
  adjust-interval seconds;
  adjust-threshold percent;
  adjust-threshold-overflow-limit number;
  adjust-threshold-underflow-limit number;
  maximum-bandwidth bps;
  minimum-bandwidth bps;
  minimum-bandwidth-adjust-interval
  minimum-bandwidth-adjust-threshold-change
  minimum-bandwidth-adjust-threshold-value
  monitor-bandwidth;
}
```

Hierarchy Level [edit protocols mpls label-switched-path *lsp-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Allow an MPLS tunnel to automatically adjust its bandwidth allocation based on the volume of traffic flowing through the tunnel.

Options The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring Automatic Bandwidth Allocation for LSPs on page 3785
- request mpls lsp adjust-autobandwidth on page 3840

adjust-interval

Syntax adjust-interval *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth],
[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Specify the bandwidth reallocation interval.

Options *seconds*—Bandwidth reallocation interval, in seconds.

Range: 300 through 315,360,000 seconds

Default: 86,400 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Automatic Bandwidth Allocation Interval on page 3787

adjust-threshold

Syntax adjust-threshold *percent*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth],
[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Specify how sensitive the automatic bandwidth adjustment for a label-switched path (LSP) is to changes in bandwidth utilization.

Options *percent*—Bandwidth demand for the current bandwidth adjustment interval is determined and compared to the LSP's current bandwidth allocation. If the percentage difference in bandwidth is greater than or equal to the percentage specified by this statement, the LSP's bandwidth is adjusted to the current bandwidth demand.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Automatic Bandwidth Adjustment Threshold on page 3788

adjust-threshold-overflow-limit

Syntax adjust-threshold-overflow-limit *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth],
[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]

Release Information Statement introduced in Junos OS Release 7.5.
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Specify the number of consecutive bandwidth overflow samples before triggering a bandwidth adjustment.

Options *number*—Number of consecutive bandwidth overflow samples.

Range: 1 through 65,535

Default: This feature is disabled by default.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring a Limit on Bandwidth Overflow and Underflow Samples on page 3788

adjust-threshold-underflow-limit

Syntax adjust-threshold-underflow-limit *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth],
[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]

Release Information Statement introduced in Junos OS Release 11.3.
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Specify the number of consecutive bandwidth underflow samples before triggering a bandwidth adjustment.

Options *number*—Number of consecutive bandwidth underflow samples.

Range: 1 through 65,535

Default: This feature is disabled by default.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring a Limit on Bandwidth Overflow and Underflow Samples on page 3788

exp

Syntax

```
exp classifier-name {
  import (classifier-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-points [ aliases ] [ bit-patterns ];
    }
  }
}
```

Rewrite Rule Configuration

```
exp rewrite-name {
  import (rewrite-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-point [ aliases ] [ bit-patterns ];
    }
  }
}
```

Global Classifier Association with Interfaces

exp *classifier-name*;

Hierarchy Level

[edit class-of-service classifiers],
[edit class-of-service rewrite-rules]
[edit class-of-service system-defaults classifiers]

Release Information

Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description

Define the EXP code point mapping that is applied to MPLS packets. EXP classifiers are not applied to any traffic except MPLS traffic.

You can configure as many EXP classifiers as you want. However, the switch uses only one EXP classifier as a global MPLS classifier on all interfaces. You specify the global EXP classifier in the **[edit class-of-service system-defaults]** hierarchy.

Options

classifier-name—Name of the EXP classifier.

Required Privilege Level

interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring a Global MPLS EXP Classifier on page 3782
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

maximum-bandwidth (Protocols MPLS)

Syntax maximum-bandwidth *bps*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth],
[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Specify the maximum amount of bandwidth in bits per second (bps).

Options *bps*—Maximum amount of bandwidth.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Maximum and Minimum Bounds of the LSP's Bandwidth on page 3787

minimum-bandwidth

Syntax minimum-bandwidth *bps*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth],
[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Set the minimum bandwidth in bps for an LSP with automatic bandwidth allocation enabled.

Options *bps*—Miniminum bandwidth for the LSP.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Maximum and Minimum Bounds of the LSP's Bandwidth on page 3787

minimum-bandwidth-adjust-interval

Syntax minimum-bandwidth-adjust-interval *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth],
[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]

Release Information Statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Specify the duration (in seconds) for which minimum bandwidth is frozen.

Options ***seconds***—Minimum bandwidth reallocation interval, in seconds.

Range: 300 through 31,536,000 seconds.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Maximum and Minimum Bounds of the LSP's Bandwidth on page 3787

minimum-bandwidth-adjust-threshold-change

Syntax minimum-bandwidth-adjust-threshold-change *percentage*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth],
[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]

Release Information Statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Specify the percentage change in maximum average bandwidth to freeze the minimum bandwidth.

Options ***percentage***—Percentage change in maximum average bandwidth.

Range: Range: 0 through 100 percent.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Maximum and Minimum Bounds of the LSP's Bandwidth on page 3787

minimum-bandwidth-adjust-threshold-value

Syntax minimum-bandwidth-adjust-threshold-value *bps*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth],
[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]

Release Information Statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Specify the value in bits per second (bps) to freeze the minimum bandwidth if the maximum average bandwidth falls below this value.

Options *bps*—Threshold value for minimum bandwidth if the maximum average bandwidth falls below the specified value.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Maximum and Minimum Bounds of the LSP's Bandwidth on page 3787

monitor-bandwidth

Syntax monitor-bandwidth;

Hierarchy Level [edit logical-systems *logical-system-name* protocols mpls label-switched-path *lsp-name* auto-bandwidth],
[edit protocols mpls label-switched-path *lsp-name* auto-bandwidth]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description Do not automatically adjust bandwidth allocation. However, the maximum average bandwidth utilization is monitored on the LSP, and the information is recorded in the MPLS statistics file.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Passive Bandwidth Utilization Monitoring on page 3790

system-defaults

Syntax

```
system-defaults {
  classifiers exp classifier-name;
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure the global EXP classifier used on all interfaces to classify MPLS traffic.

Although you can configure as many EXP classifiers as you want, the switch uses only one EXP classifier as a global MPLS classifier on all interfaces. All switch interfaces use the EXP classifier specified as the system default to classify MPLS traffic.

Options The statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring a Global MPLS EXP Classifier on page 3782
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

CHAPTER 45

Administration

Routine Monitoring

Verifying That MPLS Is Working Correctly

To verify that MPLS is working correctly, perform the following tasks:

Verifying the Physical Layer on the Switches

Purpose Verify that the interfaces are up. Perform this verification task on each of the switches.

Action `user@switch>` **show interfaces xe-* terse**

```
Interface               Admin Link Proto    Local                 Remote
xe-0/0/0                up    up
xe-0/0/0.0              up    up
xe-0/0/1.0              up    up
xe-0/0/2.0              up    up
xe-0/0/3.0              up    up   inet       2.2.2.1/16
xe-0/0/4.0              up    up
xe-0/0/5.0              up    up   inet      10.1.5.1/24
                                   mpls
xe-0/0/6.0              up    up   inet      10.1.6.1/24
                                   mpls
```

Meaning The **show interfaces terse** command displays status information about the 10-Gigabit Ethernet interfaces on the switch. This output verifies that the interfaces are **up**. The output for the protocol family (Proto column) of the core interfaces (xe-0/0/5.0 and xe-0/0/6.0), shows that these interfaces are configured as both **inet** and **mpls**. The **Local** column for the core interfaces shows the IP address configured for these interfaces.

Verifying the Routing Protocol

Purpose Verify the state of the configured routing protocol. You should perform this verification task on each of the switches. The state should be **Full**. If you have configured OSPF as the routing protocol, use the **show ospf neighbor** command to verify that the routing protocol is communicating with the switch neighbors.

Action `user@switch>` **show ospf neighbor**

```
Address          Interface              State     ID               Pri  Dead
127.1.1.1        xe-0/0/5               Full      10.10.10.10      128    39
```

Meaning The **show ospf neighbor** command displays the status of the routing protocol that has been configured on this switch. The output shows that the state is **Full**, meaning that the routing protocol is operating correctly—that is, hello packets are being exchanged between directly connected neighbors. For additional information on checking and monitoring routing protocols, see the *Junos OS Routing Protocols and Policies Command Reference* .

Verifying the Core Interfaces Being Used for the MPLS Traffic

Purpose Verify that the state of the MPLS interface is **Up**. You should perform this verification task on each of the switches.

Action `user@switch>` **show mpls interface**

```
Interface        State       Administrative groups
ge-0/0/5            Up          <none>
ge-0/0/6            Up          <none>
```

Meaning The **show mpls interface** command displays the status of the core interfaces that have been configured to belong to **family mpls**. This output shows that the interface configured to belong to **family mpls** is up.

Verifying RSVP

Purpose Verify the state of the RSVP session. You should perform this verification task on each of the switches.

Action

```
user@switch> show rsvp session

Ingress RSVP: 1 sessions
To              From            State   Rt Style Labelin Labelout LSPname
127.1.1.3       127.1.1.1         Up       0  1 FF       -    300064 lsp_to_pe2_ge1
Total 1 displayed, Up 1, Down 0

Egress RSVP: 1 sessions
To              From            State   Rt Style Labelin Labelout LSPname
127.1.1.1       127.1.1.3         Up       0  1 FF   299968        - lsp_to_pe1_ge1
Total 1 displayed, Up 1, Down 0

Transit RSVP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

Meaning This output confirms that the RSVP sessions are up.

Related Documentation

- Configuring MPLS on Provider Edge Switches on page 3772
- Configuring MPLS on Provider Switches on page 3775

Operational Mode Commands

- clear mpls lsp
- clear rsvp session
- clear rsvp statistics
- ping mpls bgp
- ping mpls l2circuit
- ping mpls l3vpn
- ping mpls ldp
- ping mpls lsp-end-point
- ping mpls rsvp
- request mpls lsp adjust-autobandwidth
- show link-management
- show link-management peer
- show link-management routing
- show link-management statistics
- show link-management te-link
- show mpls call-admission-control
- show mpls cspf
- show mpls diffserv-te
- show route forwarding-table
- show mpls interface

- show mpls lsp
- show mpls lsp autobandwidth
- show mpls path
- show mpls static-lsp
- show rsvp interface
- show rsvp neighbor
- show rsvp session
- show rsvp statistics
- show rsvp version
- show ted database
- show ted link
- show ted protocol
- traceroute mpls ldp
- traceroute mpls rsvp

clear mpls lsp

Syntax

clear mpls lsp
<autobandwidth>
<logical-system (all | *logical-system-name*)>
<name *name*>
<optimize | optimize-aggressive>
<path *regular-expression*>
<statistics>

Syntax (EX and QFX Series Switches)

clear mpls lsp
<autobandwidth>
<name *name*>
<optimize | optimize-aggressive>
<path *regular-expression*>
<statistics>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description

Release the routes and states associated with MPLS label-switched paths (LSPs), and start new LSPs.

CAUTION: This command disconnects existing Resource Reservation Protocol (RSVP) sessions on the ingress routing device. If there is a time lag between the old path being torn down and the new path being set up, this command might impact traffic traveling along the LSPs.

Options

none—Reset and restart all LSPs that originated from this routing device; that is, all LSPs for which this routing device is the ingress routing device. Depending on the number of LSPs involved, it might take a while to restart all the LSPs.

autobandwidth—(Optional) Clear LSP autobandwidth counters.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

name *name*—(Optional) Reset and restart the specified LSP or group of LSPs. You can include wildcard characters in the interface name, as described in the *Junos Network Interfaces Configuration Guide*.

optimize | optimize-aggressive—(Optional) Run nonpreemptive optimization or aggressive optimization computation now.

path *regular-expression*—(Optional) Clear the specific LSP path matching the specified regular expression.

statistics—(Optional) Clear LSP statistics. You cannot clear the MPLS LSP statistics using a regular expression (**name** and **path** options) on transit routers.

Required Privilege Level

clear

Related Documentation

- show mpls lsp on page 3870
- show rsvp session on page 3901

List of Sample Output

clear mpls lsp on page 3818

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear mpls lsp

```
user@host> clear mpls lsp
```

clear rsvp session

Syntax

clear rsvp session
<connection-destination *address*>
<connection-source *address*>
<gracefully>
<logical-system (all | *logical-system-name*)>
<lsp-id *identifier*>
<name *name*>
<optimize-fast-reroute>
<tunnel-id *identifier*>

Syntax (EX and QFX Series Switches)

clear rsvp session
<connection-destination *address*>
<connection-source *address*>
<gracefully>
<lsp-id *identifier*>
<name *name*>
<optimize-fast-reroute>
<tunnel-id *identifier*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description

Reset and restart Resource Reservation Protocol (RSVP) sessions.

Options

none—Reset and restart all RSVP sessions for which this routing device is the ingress, transit, or egress routing device.

connection-source *address*—(Optional) Source address for GMPLS and MPLS LSPs from the RSVP sender template.

connection-destination *address*—(Optional) Destination address for GMPLS and MPLS LSPs from the RSVP sender template.

gracefully—(Optional) Gracefully reset an RSVP session for a nonpacket LSP in two passes. In the first pass, the Admin-Status object is signaled along the path to the other endpoint of the RSVP session. In the second pass, the path used by the RSVP session is torn down. This option can only be used on the ingress or egress routing device of the RSVP session and is only valid for nonpacket LSPs.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

lsp-id *identifier*—(Optional) LSP identifier (source port) for the RSVP sender template.

name *name*—(Optional) Reset and restart the specified RSVP session.

optimize-fast-reroute—(Optional) Begin fast reroute optimization.

tunnel-id *identifier*—(Optional) Tunnel identifier (destination port) for the RSVP session.

Required Privilege Level clear

Related Documentation

- clear mpls lsp on page 3817
- show rsvp session on page 3901

List of Sample Output clear rsvp session on page 3820

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear rsvp session

```
user@host> clear rsvp session
```


clear rsvp statistics

Syntax clear rsvp statistics
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches) clear rsvp statistics

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description Clear Resource Reservation Protocol (RSVP) packet and error statistics.

Options **none**—Clear RSVP packet and error statistics.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level clear

Related Documentation

- show rsvp statistics on page 3910

List of Sample Output clear rsvp statistics on page 3821

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear rsvp statistics

```
user@host> clear rsvp statistics
```

ping mpls bgp

Syntax

ping mpls bgp *fec*
<bottom-label-ttl>
<count *count*>
<destination *address*>
<detail>
<exp *forwarding-class*>
<instance *routing-instance-name*>
<logical-system (all | *logical-system-name*)>
<size *bytes*>
<source *source-address*>
<sweep>

Release Information

Command introduced in Junos OS Release 11.1.

Description

Check the operability of MPLS BGP-signaled label-switched path (LSP) connections. Press Ctrl+c to interrupt a **ping mpls bgp** command.

Options

bottom-label-ttl—(Optional) Time-to-live (TTL) value for the bottom label in the label stack. The range of values is 1 through 255. The default value is **255**.

count ***count***—(Optional) Number of ping requests to send. If **count** is not specified, five ping requests are sent. The range of values is 1 through 1,000,000. The default value is 5.

destination ***address***—(Optional) Specify an address other than the default (127.0.0.1/32) for the ping echo requests. The address can be anything within the 127/8 subnet.

detail—(Optional) Display detailed information about the echo requests sent and received.

exp ***forwarding-class***—(Optional) Value of the forwarding class for the MPLS ping packets.

fec—Ping a BGP-signaled LSP using the forwarding equivalence class (FEC) prefix and length.

instance ***routing-instance-name***—(Optional) Allows you to ping a combination of the routing instance and forwarding equivalence class (FEC) associated with an LSP.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on the specified logical system.

size ***bytes***—(Optional) Size of the LSP ping request packet (88 through 65468 bytes). Packets are 4-byte aligned. For example, If you enter a size of 89, 90, 91, or 92, the router or switch uses a size value of 92 bytes. If you enter a packet size that is smaller than the minimum size, an error message is displayed reminding you of the 88-byte minimum.

source ***source-address***—(Optional) IP address of the outgoing interface. This address is sent in the IP source address field of the ping request. If this option is not specified, the default address is usually the loopback interface (**lo.0**).

sweep—(Optional) Automatically determine the size of the maximum transmission unit (MTU).

Additional Information

If the LSP changes, the label and interface information displayed when you issued the **ping** command continues to be used. You must configure MPLS at the **[edit protocols mpls]** hierarchy level on the remote router or switch to ping an LSP terminating there. You must configure MPLS even if you intend to ping only BGP forwarding equivalence classes (FECs).

In asymmetric MTU scenarios, the echo response might be dropped. For example, if the MTU from System A to System B is 1000 bytes, the MTU from System B to System A is 500 bytes, and the ping request packet size is 1000 bytes, the echo response is dropped because the PAD TLV is included in the echo response, making it too large.

Required Privilege Level

network

List of Sample Output

ping mpls bgp fec count on page 3823

Output Fields

When you enter this command, you are provided feedback on the status of your request. An exclamation point (**!**) indicates that an echo reply was received. A period (**.**) indicates that an echo reply was not received within the timeout period. An **x** indicates that an echo reply was received with an error code. Packets with error codes are not counted in the received packets count. They are accounted for separately. To display the error codes, use the **detail** option (for example, **ping mpls bgp 10.255.245.222 detail**).

Sample Output

ping mpls bgp fec count

```
user@host> ping mpls bgp 10.255.245.222 count 10
!!!xxx...x--- lsping statistics ---10 packets transmitted, 3 packets received,
70% packet loss 4 packets received with error status, not counted as received.
```

ping mpls l2circuit

Syntax

ping mpls l2circuit (interface *interface-name* | virtual-circuit *virtual-circuit-id* neighbor *address*)
<count *count*>
<destination *address*>
<detail>
<exp *forwarding-class*>
<logical-system (all | *logical-system-name*)>
reply-mode (application-level-control-channel | ip-udp | no-reply)
<size *bytes*>
<source *source-address*>
<sweep>
<v1>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
The **size** and **sweep** options were introduced in Junos OS Release 9.6.
The **reply-mode** option and its suboptions are introduced in Junos OS Release 10.4R1.

Description

Check the operability of the MPLS Layer 2 circuit connections. Type Ctrl+c to interrupt a **ping mpls l2circuit** command. You can also issue this command within logical systems.

Options

count ***count***—(Optional) Number of ping requests to send. If **count** is not specified, five ping requests are sent. The range of values is 1 through 1,000,000. The default value is 5.

destination ***address***—(Optional) Specify an address other than the default (127.0.0.1/32) for the ping echo requests. The address can be anything within the 127/8 subnet.

detail—(Optional) Display detailed information about the echo requests sent and received.

exp ***forwarding-class***—(Optional) Value of the forwarding class for the MPLS ping packets.

interface ***interface-name***—Ping an interface configured for the Layer 2 circuit on the egress provider edge (PE) router.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on the specified logical system.

reply-mode—(Optional) Reply mode for the ping request. This option has the following suboptions:

- **application-level-control-channel**—Reply using an application level control channel.
- **ip-udp**—Reply using an IPv4 or IPv6 UDP packet.
- **no-reply**—Do not reply to the ping request.

NOTE: The **reply-mode** option and its suboptions **application-level-control-channel**, **ip-udp**, and **no-reply** are also available in Junos OS Release 10.2R4 and 10.3R2.

size *bytes*—(Optional) Size of the label-switched path (LSP) ping request packet (96 through 65468 bytes). Packets are 4-byte aligned. For example, If you enter a size of 97, 98, 99, or 100, the router or switch uses a size value of 100 bytes. If you enter a packet size that is smaller than the minimum size, an error message is displayed reminding you of the 96-byte minimum.

source *source-address*—(Optional) IP address of the outgoing interface. This address is sent in the IP source address field of the ping request. If this option is not specified, the default address is usually the loopback interface (lo.0).

sweep—(Optional) Automatically determine the size of the maximum transmission unit (MTU).

v1—(Optional) Use the type 9 Layer 2 circuit type, length, and value (TLV).

virtual-circuit *virtual-circuit-id* neighbor *address*—Ping the virtual circuit identifier on the egress PE router or switch and the specified neighbor, testing the integrity of the Layer 2 circuit between the ingress and egress PE routers or switches.

Additional Information You must configure MPLS at the **[edit protocols mpls]** hierarchy level on the egress PE router or switch (the router or switch receiving the MPLS echo packets) to ping a Layer 2 circuit.

In asymmetric MTU scenarios, the echo response may be dropped. For example, if the MTU from System A to System B is 1000 bytes, the MTU from System B to System A is 500 bytes, and the ping request packet size is 1000 bytes, the echo response is dropped because the PAD TLV is included in the echo response, making it too large.

Required Privilege Level network

List of Sample Output
ping mpls l2circuit interface on page 3825
ping mpls l2circuit virtual-circuit detail on page 3825
ping mpls l2circuit interface <interface-name> reply-mode on page 3826

Output Fields When you enter this command, you are provided feedback on the status of your request. An exclamation point (**!**) indicates that an echo reply was received. A period (**.**) indicates that an echo reply was not received within the timeout period. An **x** indicates that an echo reply was received with an error code. Packets with an error code are not counted in the received packets count. They are accounted for separately.

Sample Output

ping mpls l2circuit interface

```
user@host> ping mpls l2circuit interface so-1/0/0.1
Request for seq 1, to interface 69, labels <100000, 100208>, packet size 100
Reply for seq 1, return code: Egress-ok, time: 0.439 ms
```

ping mpls l2circuit virtual-circuit detail

```
user@host> ping mpls l2circuit virtual-circuit 200 neighbor 10.255.245.122/32 detail
```



```
Request for seq 1, to interface 68, labels <100048, 100128>, packet size 100

Reply for seq 1, return code: Egress-ok time: 0.539 ms
```

ping mpls l2circuit interface <interface-name> reply-mode

```
user@host> ping mpls l2circuit interface lt-1/2/0.21 reply-mode application-level-control-channel
!!!!!
--- lsping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
```

ping mpls l3vpn

Syntax

ping mpls l3vpn prefix *prefix-name*
<*l3vpn-name*>
<bottom-label-ttl>
<count *count*>
<destination *address*>
<detail>
<exp *forwarding-class*>
<logical-system (all | *logical-system-name*)>
<size *bytes*>
<source *source-address*>
<sweep>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
The **size** and **sweep** options were introduced in Junos OS Release 9.6.

Description

Check the operability of a MPLS Layer 3 virtual private network (VPN) connection. Type Ctrl+c to interrupt a **ping mpls l3vpn** command.

Options

bottom-label-ttl—(Optional) Display the time-to-live value for the bottom label in the label stack.

count ***count***—(Optional) Number of ping requests to send. If **count** is not specified, five ping requests are sent. The range of values is **1** through **1,000,000**. The default value is **5**.

destination ***address***—(Optional) Specify an address other than the default (**127.0.0.1/32**) for the ping echo requests. The address can be anything within the **127/8** subnet.

detail—(Optional) Display detailed information about the echo requests sent and received.

exp ***forwarding-class***—(Optional) Value of the forwarding class for the MPLS ping packets.

l3vpn-name—(Optional) Layer 3 VPN name.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on the specified logical system.

prefix ***prefix-name***—Ping to test whether a prefix is present in a provider edge (PE) router's or switch's VPN routing and forwarding (VRF) table, by means of a Layer 3 VPN destination prefix. This option does not test the connection between a PE router or switch and a customer edge (CE) router or switch.

size ***bytes***—(Optional) Size of the label-switched path (LSP) ping request packet (**96** through **65468** bytes). Packets are 4-byte aligned. For example, If you enter a size of 97, 98, 99, or 100, the router or switch uses a size value of 100 bytes. If you enter a packet size that is smaller than the minimum size, an error message is displayed reminding you of the 96-byte minimum.

source ***source-address***—(Optional) IP address of the outgoing interface. This address is sent in the IP source address field of the ping request. If this option is not specified, the default address is usually the loopback interface (**lo.0**).

sweep—(Optional) Automatically determine the size of the maximum transmission unit (MTU).

Additional Information

You must configure MPLS at the **[edit protocols mpls]** hierarchy level on the egress PE router or switch (the router or switch receiving the MPLS echo packets) to ping a Layer 2 circuit.

In asymmetric MTU scenarios, the echo response may be dropped. For example, if the MTU from System A to System B is 1000 bytes, the MTU from System B to System A is 500 bytes, and the ping request packet size is 1000 bytes, the echo response is dropped because the PAD TLV is included in the echo response, making it too large.

If the Layer 3 VPN traffic transits a route reflector within the network, the **ping mpls l3vpn** command does not work.

Required Privilege Level

network

List of Sample Output

ping mpls l3vpn on page 3828
ping mpls l3vpn detail on page 3828

Output Fields

When you enter this command, you are provided feedback on the status of your request. An exclamation point (**!**) indicates that an echo reply was received. A period (**.**) indicates that an echo reply was not received within the timeout period. An **x** indicates that an echo reply was received with an error code. When an echo reply is received with an error code, the packets are not counted in the received packets count, and are counted seperately..

Sample Output

ping mpls l3vpn

```
user@host> ping mpls l3vpn vpn1 prefix 10.255.245.122/32
!!!!!
--- lsping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
```

ping mpls l3vpn detail

```
user@host> ping mpls l3vpn vpn1 prefix 10.255.245.122/32 detail
Request for seq 1, to interface 68, labels <100128, 100112>
Reply for seq 1, return code: Egress-ok
Request for seq 2, to interface 68, labels <100128, 100112>
Reply for seq 2, return code: Egress-ok
Request for seq 3, to interface 68, labels <100128, 100112>
Reply for seq 3, return code: Egress-ok
Request for seq 4, to interface 68, labels <100128, 100112>
Reply for seq 4, return code: Egress-ok
Request for seq 5, to interface 68, labels <100128, 100112>
Reply for seq 5, return code: Egress-ok
```

```
--- lsping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
```

ping mpls ldp

Syntax

ping mpls ldp *fec*
<count *count*>
<destination *address*>
<detail>
<exp *forwarding-class*>
<instance *routing-instance-name*>
<logical-system (all | *logical-system-name*)>
<p2mp root-addr *ip-address* lsp-id *identifier*>
<size *bytes*>
<source *source-address*>
<sweep>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
size and **sweep** options introduced in Junos OS Release 9.6.
instance option introduced in Junos OS Release 10.0.
p2mp, **root-address**, and **lsp-id** options introduced in Junos OS Release 11.2.

Description

Check the operability of MPLS LDP-signaled label-switched path (LSP) connections. Type Ctrl+c to interrupt a **ping mpls** command.

Options

count ***count***—(Optional) Number of ping requests to send. If **count** is not specified, five ping requests are sent. The range of values is **1** through **1,000,000**. The default value is **5**.

destination ***address***—(Optional) Specify an address other than the default (**127.0.0.1/32**) for the ping echo requests. The address can be anything within the **127/8** subnet.

detail—(Optional) Display detailed information about the echo requests sent and received.

exp ***forwarding-class***—(Optional) Value of the forwarding class for the MPLS ping packets.

fec—Ping an LDP-signaled LSP using the forwarding equivalence class (FEC) prefix and length.

instance ***routing-instance-name***—(Optional) Allows you to ping a combination of the routing instance and forwarding equivalence class (FEC) associated with an LSP.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on the specified logical system.

p2mp root-addr ***ip-address*** **lsp-id** ***identifier***—(Optional) Ping the end points of a point-to-multipoint LSP. Enter the IP address of the point-to-multipoint LSP root and the ID number of the point-to-multipoint LSP.

size ***bytes***—(Optional) Size of the LSP ping request packet (**88** through **65468** bytes). Packets are 4-byte aligned. For example, If you enter a size of 89, 90, 91, or 92, the router or switch uses a size value of 92 bytes. If you enter a packet size that is smaller than the minimum size, an error message is displayed reminding you of the 88-byte minimum.

source ***source-address***—(Optional) IP address of the outgoing interface. This address is sent in the IP source address field of the ping request. If this option is not specified, the default address is usually the loopback interface (**lo.0**).

sweep—(Optional) Automatically determine the size of the maximum transmission unit (MTU).

Additional Information

If the LSP changes, the label and interface information displayed when you issued the **ping** command continues to be used. You must configure MPLS at the **[edit protocols mpls]** hierarchy level on the remote router or switch to ping an LSP terminating there. You must configure MPLS even if you intend to ping only LDP forwarding equivalence classes (FECs).

You can configure the ping interval for the **ping mpls ldp** command by specifying a new time in seconds using the **lsp-ping-interval** statement at the **[edit protocols ldp oam]** hierarchy level. For more information, see the *Junos OS MPLS Applications Library for Routing Devices*.

In asymmetric MTU scenarios, the echo response may be dropped. For example, if the MTU from System A to System B is 1000 bytes, the MTU from System B to System A is 500 bytes, and the ping request packet size is 1000 bytes, the echo response is dropped because the PAD TLV is included in the echo response, making it too large.

Required Privilege Level

network

List of Sample Output

ping mpls ldp fec count on page 3831
ping mpls ldp p2mp root-addr lsp-id on page 3831

Output Fields

When you enter this command, you are provided feedback on the status of your request. An exclamation point (**!**) indicates that an echo reply was received. A period (**.**) indicates that an echo reply was not received within the timeout period. An **x** indicates that an echo reply was received with an error code. Packets with error codes are not counted in the received packets count. They are accounted for separately.

Sample Output

ping mpls ldp fec count

```
user@host> ping mpls ldp 10.255.245.222 count 10
!!!xxx...x--- lsping statistics ---10 packets transmitted, 3 packets received,
70% packet loss 4 packets received with error status, not counted as received.
```

ping mpls ldp p2mp root-addr lsp-id

```
user@host>ping mpls ldp p2mp root-addr 10.1.1.1/32 lsp-id 1 count 1
Request for seq 1, to interface 71, no label stack.
Request for seq 1, to interface 70, label 299786
Reply for seq 1, egress 10.1.1.3, return code: Egress-ok, time: 18.936 ms
        Local transmit time: 2009-01-12 03:50:03 PST 407.281 ms
        Remote receive time: 2009-01-12 03:50:03 PST 426.217 ms
Reply for seq 1, egress 10.1.1.4, return code: Egress-ok, time: 18.936 ms
        Local transmit time: 2009-01-12 03:50:03 PST 407.281 ms
        Remote receive time: 2009-01-12 03:50:03 PST 426.217 ms
```



```
Reply for seq 1, egress 10.1.1.5, return code: Egress-ok, time: 18.936 ms
        Local transmit time: 2009-01-12 03:50:03 PST 407.281 ms
        Remote receive time: 2009-01-12 03:50:03 PST 426.217 ms
```


ping mpls lsp-end-point

Syntax

ping mpls lsp-end-point *prefix-name*
<count *count*>
<destination *address*>
<detail>
<exp *forwarding-class*>
<instance *routing-instance-name*>
<logical-system (all | *logical-system-name*)>
<size *bytes*>
<source *source-address*>
<sweep>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
The **size** and **sweep** options were introduced in Junos OS Release 9.6.
The **instance** option was introduced in Junos OS Release 10.0.

Description

Check the operability of MPLS label-switched path (LSP) endpoint connections. Type Ctrl+c to interrupt a **ping mpls** command.

Options

count ***count***—(Optional) Number of ping requests to send. If **count** is not specified, five ping requests are sent. The range of values is **1** through **1,000,000**. The default value is **5**.

destination ***address***—(Optional) Specify an address other than the default (**127.0.0.1/32**) for the ping echo requests. The address can be anything within the **127/8** subnet.

detail—(Optional) Display detailed information about the echo requests sent and received.

exp ***forwarding-class***—(Optional) Value of the forwarding class for the MPLS ping packets.

instance ***routing-instance-name***—(Optional) Ping a combination of the routing instance and forwarding equivalence class (FEC) associated with an LSP connection.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on the specified logical system.

prefix-name—LDP forwarding equivalence class (FEC) prefix or RSVP LSP endpoint address.

size ***bytes***—(Optional) Size of the LSP ping request packet. If the endpoint is LDP-based, the minimum size of the packet is **88** bytes. If the endpoint is RSVP-based, the minimum size of the packet is **100** bytes. The maximum size in either case is **65468** bytes.

source ***source-address***—(Optional) IP address of the outgoing interface. This address is sent in the IP source address field of the ping request. If this option is not specified, the default address is usually the loopback interface (**lo.0**).

sweep—(Optional) Automatically determine the size of the maximum transmission unit (MTU).

Additional Information

If the LSP changes, the label and interface information displayed when you issued the **ping** command continues to be used. You must configure MPLS at the **[edit protocols mpls]** hierarchy level on the remote router or switch to ping an LSP terminating there. You must configure MPLS even if you intend to ping only LDP forwarding equivalence classes (FECs).

In asymmetric MTU scenarios, the echo response may be dropped. For example, if the MTU from System A to System B is 1000 bytes, the MTU from System B to System A is 500 bytes, and the ping request packet size is 1000 bytes, the echo response is dropped because the PAD TLV is included in the echo response, making it too large.

Required Privilege Level

network

List of Sample Output

ping mpls lsp-end-point detail on page 3834

Output Fields

When you enter this command, you are provided feedback on the status of your request. An exclamation point (**!**) indicates that an echo reply was received. A period (**.**) indicates that an echo reply was not received within the timeout period. An **x** indicates that an echo reply was received with an error code. Packets with an error code are not counted in the received packets count. They are accounted for separately.

Sample Output

ping mpls lsp-end-point detail

```
user@host> ping mpls lsp-end-point 10.255.245.119 detail
Route to end point address is via LDP FEC
Request for seq 1, to interface 67, label 100032
Reply for seq 1, return code: Egress-ok
Request for seq 2, to interface 67, label 100032
Reply for seq 2, return code: Egress-ok
Request for seq 3, to interface 67, label 100032
Reply for seq 3, return code: Egress-ok
Request for seq 4, to interface 67, label 100032
Reply for seq 4, return code: Egress-ok
Request for seq 5, to interface 67, label 100032
Reply for seq 5, return code: Egress-ok
--- lsping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
```

ping mpls rsvp

Syntax

ping mpls rsvp
<*lsp-name*>
<count *count*>
<destination *address*>
<detail>
<dynamic-bypass>
<egress *egress-address*>
<exp *forwarding-class*>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>
<manual-bypass>
<multipoint>
<size *bytes*>
<source *source-address*>
<standby *standby-path-name*>
<sweep>

Release Information

Command introduced before Junos OS Release 7.4.
The **egress** and **multipoint** options were introduced in Junos OS Release 9.2.
The **size** and **sweep** options were introduced in Junos OS Release 9.6.
The **dynamic-bypass** and **manual-bypass** options were introduced in Junos OS Release 10.2.

Description

Check the operability of MPLS RSVP-signaled label-switched path (LSP) connections. Type Ctrl+c to interrupt a **ping mpls** command.

Options

count ***count***—(Optional) Number of ping requests to send. If **count** is not specified, five ping requests are sent. The range of values is **1** through **1,000,000**. The default value is **5**.

destination ***address***—(Optional) Specify an address other than the default (**127.0.0.1/32**) for the ping echo requests. The address can be anything within the **127/8** subnet.

detail—(Optional) Display detailed information about the echo requests sent and received.

> NOTE: When using the **detail** option, the reported time is based on the system time configured on the local and remote routers. Differences in these system times can result in inaccurate one way ping trip times being reported.
>
> In practice, it is difficult to synchronize the system times of independent Juniper Networks routers with sufficient accuracy to provide a meaningful time value for the **detail** option (even when synchronized using NTP).

dynamic-bypass—(Optional) Ping dynamically generated bypass LSPs, used for protecting other LSPs.

egress ***egress-address***—(Optional) Only the specified egress router or switch responds to the ping request.

exp ***forwarding-class***—(Optional) Value of the forwarding class for the MPLS ping packets.

interface—(Optional) Specify the name of the interface protected by the manual bypass LSP. This option is only available when you have also used the **manual-bypass** option.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on the specified logical system.

lsp-name—Ping an RSVP-signaled LSP using an LSP name.

manual-bypass—(Optional) Ping manually configured bypass LSPs, used for protecting other LSPs. For this option, you must also specify the interface protected by the manual bypass LSP using the **interface** option.

multipoint—(Optional) Send ping requests to each of the egress routers or switches participating in a point-to-multipoint LSP. You can also include the **egress** option to ping a specific egress router or switch participating in a point-to-multipoint LSP.

size ***bytes***—(Optional) Size of the LSP ping request packet (**100** through **65468** bytes). Packets are 4-byte aligned. For example, if you enter a size of 101, 102, 103, or 104, the router or switch uses a size value of 104 bytes. If you enter a packet size that is smaller than the minimum size, an error message is displayed reminding you of the 100-byte minimum.

source ***source-address***—(Optional) IP address of the outgoing interface. This address is sent in the IP source address field of the ping request. If this option is not specified, the default address is usually the loopback interface.

standby ***standby-path-name***—(Optional) Name of the standby path.

sweep —(Optional) Automatically determine the size of the maximum transmission unit (MTU).

Additional Information

If the LSP changes, the label and interface information displayed when you issued the **ping** command continues to be used. You must configure MPLS at the **[edit protocols mpls]** hierarchy level on the remote router or switch to ping an LSP terminating there. You must configure MPLS even if you intend to ping only LDP forwarding equivalence classes (FECs).

In asymmetric MTU scenarios, the echo response may be dropped. For example, if the MTU from System A to System B is 1000 bytes, the MTU from System B to System A is 500 bytes, and the ping request packet size is 1000 bytes, the echo response is dropped because the PAD TLV is included in the echo response, making it too large.

Required Privilege Level

network

List of Sample Output

ping mpls rsvp (Echo Reply Received) on page 3837
ping mpls rsvp (Echo Reply with Error Code) on page 3837

ping mpls rsvp detail on page 3837
ping mpls rsvp multipoint egress detail count on page 3837
ping mpls rsvp multipoint detail count on page 3837
ping mpls rsvp destination detail count size on page 3838
ping mpls rsvp destination detail sweep size on page 3838

Output Fields When you enter this command, you are provided feedback on the status of your request. An exclamation point (**!**) indicates that an echo reply was received. A period (**.**) indicates that an echo reply was not received within the timeout period. An **x** indicates that an echo reply was received with an error code. Packets with an error code are not counted in the received packets count. They are accounted for separately.

Sample Output

ping mpls rsvp (Echo Reply Received)

```
user@host> ping mpls rsvp test1
!!!!!--- lsping statistics ---5 packets transmitted, 5 packets received, 0% packet
 loss
```

ping mpls rsvp (Echo Reply with Error Code)

```
user@host> ping mpls rsvp test2
!!xxx--- lsping statistics ---5 packets transmitted, 2 packets received, 60%
packet loss3 packets received with error status, not counted as received.
```

ping mpls rsvp detail

```
user@host> ping mpls rsvp to-green detail
Request for seq 1, to interface 67, labels <100095, 0, 0>
Reply for seq 1, return code: Egress-ok
Request for seq 2, to interface 67, labels <100095, 0, 0>
Reply for seq 2, return code: Egress-ok
```

ping mpls rsvp multipoint egress detail count

```
user@host>ping mpls rsvp sample-lsp multipoint egress 192.168.1.3 detail count 1
Request for seq 1, to interface 70, label 299952
Request for seq 1, to interface 70, no label stack.
Request for seq 1, to interface 67, no label stack.

Reply for seq 1, egress 192.168.1.3, return code: Egress-ok, time: 0.242 ms
 Local transmit time: 1205310695s 215737us
 Remote receive time: 1205310695s 215979us

--- lsping, egress 192.168.1.3 statistics ---
1 packets transmitted, 1 packets received, 0% packet loss
```

ping mpls rsvp multipoint detail count

```
user@host>ping mpls rsvp sample-lsp multipoint detail count 1
Request for seq 1, to interface 70, label 299952
Request for seq 1, to interface 70, no label stack.
Request for seq 1, to interface 67, no label stack.

Reply for seq 1, return code: Unknown TLV, time: 9.877 ms
 Local transmit time: 1205310615s 347317us
 Remote receive time: 1205310615s 357194us
Reply for seq 1, egress 192.168.1.3, return code: Egress-ok, time: 0.351 ms
```



```
 Local transmit time: 1205310615s 347262us
 Remote receive time: 1205310615s 347613us
Reply for seq 1, egress 192.168.1.13, return code: Egress-ok, time: 0.301 ms
 Local transmit time: 1205310615s 347167us
 Remote receive time: 1205310615s 347468us
Timeout for seq 1, egress 192.168.1.1
Timeout for seq 1, egress 192.168.1.4
Timeout for seq 1, egress 192.168.1.14

--- lsping, egress 192.168.1.1 statistics ---
1 packets transmitted, 0 packets received, 100% packet loss

--- lsping, egress 192.168.1.3 statistics ---
1 packets transmitted, 1 packets received, 0% packet loss

--- lsping, egress 192.168.1.4 statistics ---
1 packets transmitted, 0 packets received, 100% packet loss

--- lsping, egress 192.168.1.13 statistics ---
1 packets transmitted, 1 packets received, 0% packet loss

--- lsping, egress 192.168.1.14 statistics ---
1 packets transmitted, 0 packets received, 100% packet loss
```

ping mpls rsvp destination detail count size

```
user@host>ping mpls rsvp chaser-access destination 192.168.0.1 detail count 1 size 4468

Request for seq 1, to interface 88, label 299984, packet size 4468
Reply for seq 1, return code: Egress-ok, time: 44.804 ms
        Local transmit time: 2009-03-30 22:05:02 CEST 408.629 ms
        Remote receive time: 2009-03-30 22:05:02 CEST 453.433 ms

--- lsping statistics ---
1 packets transmitted, 1 packets received, 0% packet loss
```

ping mpls rsvp destination detail sweep size

```
user@router> ping mpls rsvp chaser-access destination 192.168.0.1 detail sweep size 4500
Request for seq 1, to interface 86, no label stack., packet size 100
Reply for seq 1, return code: Egress-ok, time: -39.264 ms
        Local transmit time: 2009-04-24 14:05:40 CEST 541.423 ms
        Remote receive time: 2009-04-24 14:05:40 CEST 502.159 ms
Request for seq 2, to interface 86, no label stack., packet size 2300
Reply for seq 2, return code: Egress-ok, time: -38.179 ms
        Local transmit time: 2009-04-24 14:05:41 CEST 544.240 ms
        Remote receive time: 2009-04-24 14:05:41 CEST 506.061 ms
Request for seq 3, to interface 86, no label stack., packet size 4500
Timeout for seq 3
Request for seq 4, to interface 86, no label stack., packet size 3400
Reply for seq 4, return code: Egress-ok, time: -37.545 ms
        Local transmit time: 2009-04-24 14:05:45 CEST 549.953 ms
        Remote receive time: 2009-04-24 14:05:45 CEST 512.408 ms
Request for seq 5, to interface 86, no label stack., packet size 3952
Reply for seq 5, return code: Egress-ok, time: -37.176 ms
        Local transmit time: 2009-04-24 14:05:46 CEST 555.881 ms
        Remote receive time: 2009-04-24 14:05:46 CEST 518.705 ms
Request for seq 6, to interface 86, no label stack., packet size 4228
Reply for seq 6, return code: Egress-ok, time: -36.962 ms
        Local transmit time: 2009-04-24 14:05:47 CEST 561.809 ms
        Remote receive time: 2009-04-24 14:05:47 CEST 524.847 ms
```

```
Request for seq 7, to interface 86, no label stack., packet size 4368
Reply for seq 7, return code: Egress-ok, time: -36.922 ms
        Local transmit time: 2009-04-24 14:05:48 CEST 568.738 ms
        Remote receive time: 2009-04-24 14:05:48 CEST 531.816 ms
Request for seq 8, to interface 86, no label stack., packet size 4440
Reply for seq 8, return code: Egress-ok, time: -36.855 ms
        Local transmit time: 2009-04-24 14:05:49 CEST 575.669 ms
        Remote receive time: 2009-04-24 14:05:49 CEST 538.814 ms
Request for seq 9, to interface 86, no label stack., packet size 4476
Timeout for seq 9
Request for seq 10, to interface 86, no label stack., packet size 4460
Reply for seq 10, return code: Egress-ok, time: -36.906 ms
        Local transmit time: 2009-04-24 14:05:53 CEST 584.382 ms
        Remote receive time: 2009-04-24 14:05:53 CEST 547.476 ms
Request for seq 11, to interface 86, no label stack., packet size 4480
Timeout for seq 11
Request for seq 12, to interface 86, no label stack., packet size 4472
Timeout for seq 12
Request for seq 13, to interface 86, no label stack., packet size 4468
Reply for seq 13, return code: Egress-ok, time: -36.943 ms
        Local transmit time: 2009-04-24 14:06:00 CEST 594.884 ms
        Remote receive time: 2009-04-24 14:06:00 CEST 557.941 ms
Request for seq 14, to interface 86, no label stack., packet size 4476
Timeout for seq 14
Request for seq 15, to interface 86, no label stack., packet size 4472
Timeout for seq 15

--- lsp ping sweep result---
Maximum Transmission Unit (MTU) is 4468 bytes
```

request mpls lsp adjust-autobandwidth

Syntax

request mpls lsp adjust-autobandwidth
<logical-system (all | *logical-system-name*)>
<name *lsp-name*>

Syntax (EX and QFX Series Switches)

request mpls lsp adjust-autobandwidth
<name *lsp-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description

Manually trigger a bandwidth allocation adjustment for active label-switched paths (LSPs).

Without running this command, the bandwidth adjustment is recomputed at a configurable interval. The default interval is 5 minutes. If you do not want to wait for the periodic adjustment (for example, during a software demonstration), this command is useful.

During bandwidth allocation adjustment, the LSP stays up to enable the bandwidth to be changed without dropping any traffic. This functionality is often referred to as *make-before-break*.

Options

none—Manually trigger a bandwidth allocation adjustment for all active LSP paths.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

name *lsp-name*—(Optional) Manually trigger a bandwidth allocation adjustment on the specified LSP only.

Additional Information

For this command to work properly, the following conditions must exist:

- Automatic bandwidth allocation must be enabled on the LSP. The parameters for adjustment interval and maximum average bandwidth are not reset after you issue the **request mpls lsp adjust-autobandwidth** command.
- The difference between the adjusted bandwidth and the current LSP path bandwidth must be greater than the threshold limit.

Required Privilege Level

maintenance

Related Documentation

- auto-bandwidth on page 3804
- Configuring Automatic Bandwidth Allocation for LSPs on page 3785

List of Sample Output

request mpls lsp adjust-auto-bandwidth on page 3841

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

request mpls lsp adjust-auto-bandwidth

```
user@host> request mpls lsp adjust-auto-bandwidth
```

show link-management

Syntax show link-management

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description Display Multiprotocol Label Switching (MPLS) peer and traffic engineering link information.

Options This command has no options.

Required Privilege Level view

Related Documentation

- show link-management peer on page 3846
- show link-management routing on page 3848
- show link-management statistics on page 3851
- show link-management te-link on page 3853

List of Sample Output show link-management on page 3845

Output Fields Table 276 on page 3842 describes the output fields for the **show link-management** command. Output fields are listed in the approximate order in which they appear.

Table 276: show link-management Output Fields

Field Name	Field Description
Peer Name	Name of the peer.
System identifier	Internal identifier for the peer. The range of values is **0** through **64,000**.
State	State of the peer: **Up** or **Down**.
Control address	Address to which a control channel is established.
CC local ID	Identifier assigned to the control channel by the local peer. The range of values is 1 through **4,294,967,296**.
CC remote ID	Identifier assigned to the control channel by the remote peer. The range of values is 1 through **4,294,967,296**.
State	State of the control channel: **Up** or **Down**.
TxSeqNum	Sequence number of the hello message being sent to the peer. The range of values is 1 through **4,294,967,295**.
RcvSeqNum	Sequence number of the last hello message received from the peer. The range of values is **0** through **4,294,967,295.**

Table 276: show link-management Output Fields *(continued)*

Field Name	Field Description
Flags	Code that provides information about the control channel. Currently supports only code value **R**, which indicates that the control channel is restarting after a failure in the control plane, as when the Link Management Protocol (LMP) process starts or restarts.
TE links	Traffic-engineered links that are managed by their peer.
TE link name	Name of the traffic-engineered link.
State	State of the traffic-engineered link: **Up**, **Down**, or **Init**.
Local identifier	Identifier of the local side of the link.
Remote identifier	Identifier of the remote side of the link.
Local address	Address of the local side of the link.
Remote address	Address of the remote side of the link.
Encoding	Physical layer media type determined by the interfaces contained in the traffic-engineered link. Typical values include **SDH/SONET, Ethernet**, **Packet**, and **PDH**.
Switching	Type of switching that can be performed on the traffic-engineered link. Supported values are **PSC-1** and **Packet**.
Minimum bandwidth	Smallest single allocation of bandwidth possible on the traffic-engineered link. This number is equal to the smallest bandwidth interface that is a member of the traffic-engineered link (in bps).
Maximum bandwidth	Largest single allocation of bandwidth possible on the traffic-engineered link. This number is equal to the largest bandwidth interface that is a member of the link (in bps).
Total bandwidth	Sum of the bandwidth, in bits per second (bps) and megabits per second (Mbps), of all interfaces that are members of the link.
Available bandwidth	Sum of the bandwidths of all interfaces that are members of the link and that are not yet allocated (in bps).
Name	Name of the interface.
State	State of the interface: **Up** or **Down**.
Local ID	Identifier of the local side of the interface.
Remote ID	Identifier of the remote side of the interface.
Bandwidth	Bandwidth, in bps or Mbps, of the member interface.
Used	Whether the resource is allocated to an LSP: **Yes** or **No**.

Table 276: show link-management Output Fields *(continued)*

Field Name	Field Description
LSP-name	LSP name.

Sample Output

show link-management

```
user@host> show link-management
Peer name: PEER-A, System identifier: 11973
 State: Up, Control address: 10.255.245.4
   CC local ID CC remote ID State       TxSeqNum  RcvSeqNum Flags
         24547        24547 Up              1027       1026
  TE links:
   pro4-ba

 TE link name: pro4-ba, State: Init
  Local identifier: 2662, Remote identifier: 0, Encoding: SDH/SONET, Switching:
  PSC-1,
  Minimum bandwidth: 155.52Mbps, Maximum bandwidth: 155.52Mbps, Total bandwidth:

  155.52Mbps,
  Available bandwidth: 155.52Mbps
    Name        State Local ID  Remote ID      Bandwidth Used  LSP-name
    so-1/0/2    Up       21271          0     155.52Mbps   No
```


show link-management peer

Syntax

show link-management peer
<name *peer-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display Multiprotocol Label Switching (MPLS) peer link information.

Options

none—Display all peer link information.

name ***peer-name***—(Optional) Display information for the specified peer only.

Required Privilege Level

view

Related Documentation

- show link-management on page 3842
- show link-management routing on page 3848
- show link-management statistics on page 3851
- show link-management te-link on page 3853

List of Sample Output

show link-management peer on page 3847

Output Fields

Table 277 on page 3846 describes the output fields for the **show link-management peer** command. Output fields are listed in the approximate order in which they appear.

Table 277: show link-management peer Output Fields

Field Name	Field Description
Peer Name	Name of the peer.
System identifier	Internal identifier for the peer. The range of values is **0** through **64,000**.
State	State of the peer: **Up** or **Down**.
Control address	Address to which a control channel is established.
Hello interval	How often the routing device sends Link Management Protocol (LMP) hello packets.
Hello dead interval	How long LMP waits before declaring the control channel to be dead. This is an interval during which the routing device receives no LMP hello packets from the neighbor on a control that is active or up.
CC local ID	Identifier assigned to the control channel by the local peer. The range of values is **1** through **4,294,967,296**.
CC remote ID	Identifier assigned to the control channel by the remote peer. The range of values is **1** through **4,294,967,296**.

Table 277: show link-management peer Output Fields *(continued)*

Field Name	Field Description
State	State of the control channel: **Up** or **Down**.
TxSeqNum	Sequence number of the hello message being sent to the peer. The range of values is 1 through **4,294,967,295**.
RcvSeqNum	Sequence number of the last hello message received from the peer. The range of values is **0** through **4,294,967,295.**
Flags	Code that provides information about the control channel. Currently supports only code value **R**, which indicates that the control channel is restarting after a failure in the control plane, as when the Link Management Protocol (LMP) process starts or restarts.
TE links	Traffic-engineered links that are managed by their peer.

Sample Output

show link-management peer

```
user@host> show link-management peer
Peer name: sonet, System identifier: 41448
  State: Up, Control address: 70.70.70.70
  Hello interval: 10000, Hello dead interval: 30000
    CC local ID CC remote ID State       TxSeqNum  RcvSeqNum Flags
           3265            0 ConfSnd            1          0 R
   TE links:
    to-sonet
```

show link-management routing

Syntax

show link-management routing
<peer <name *name*> | te-link <name *name*>>
<resource <name *name*>>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display Multiprotocol Label Switching (MPLS) peer or traffic engineering link information from the routing process.

Options

none—Display all peer and traffic-engineered link information.

peer <name *name*>—(Optional) Display information for all peers or for the specified peer only.

resource <name *name*>—(Optional) Display information for all resources or for the specified resource only.

te-link <name *name*>—(Optional) Display information for all traffic-engineered forwarding paths or for the specified path only.

Required Privilege Level

view

Related Documentation

- show link-management on page 3842
- show link-management peer on page 3846
- show link-management statistics on page 3851
- show link-management te-link on page 3853

List of Sample Output

show link-management routing on page 3850

Output Fields

Table 278 on page 3848 describes the output fields for the **show link-management routing** command. Output fields are listed in the approximate order in which they appear.

Table 278: show link-management routing Output Fields

Field Name	Field Description
Peer Name	Name of the peer.
System identifier	Internal identifier for the peer. The range of values is **0** through **64,000**.
State	State of the peer: **Up** or **Down**.
Control address	Address to which a control channel is established.
Control channel	Interface over which control packets are sent.

Table 278: show link-management routing Output Fields *(continued)*

Field Name	Field Description
State	State of the control channel.
TE link name	Traffic-engineered link name.
State	State of the traffic-engineered link: **Up** or **Down**.
Local identifier	Identifier of the local side of the link.
Remote identifier	Identifier of the remote side of the link.
Local address	Address of the local side of the link.
Remote address	Address of the remote side of the link.
Encoding	Physical layer media type determined by the interfaces contained in the traffic-engineered link. Typical values include **SDH/SONET**, **Ethernet**, and **Packet**.
Minimum bandwidth	Smallest single allocation of bandwidth, in bits per second (bps) or megabits per second (Mbps), possible on the traffic-engineered link. This number is equal to the smallest bandwidth interface that is a member of the traffic-engineered link.
Maximum bandwidth	Largest single allocation of bandwidth, in bps or Mbps, possible on the traffic-engineered link. This number is equal to the largest bandwidth interface that is a member of the link (in bps).
Total bandwidth	Sum of the bandwidth, in bps or Mbps, of all interfaces that are members of the link.
Available bandwidth	Sum of the bandwidth, in bps or Mbps, of all interfaces that are members of the link and that are not yet allocated.
Resource	Forwarding adjacency LSP information.
Type	Type of resource. The type is always a forwarding adjacency LSP.
State	State of the LSP: **Up** or **Down**.
System Identifier	Internal identifier for the peer. The range of values is **0** through **64,000**.
Total bandwidth	Bandwidth resource, in bps or Mbps, on the TE-link learned from the routing process.
Traffic parameters	• **Encoding**—Physical layer media type determined by the interfaces contained in the traffic-engineered link. Typical values include **SDH/SONET**, **Ethernet**, and **Packet**. • **Switching**—Type of switching that can be performed on the traffic-engineered link: **PSC-1** and **Packet**. • **Granularity**—Layer 2 data for switching Layer 2 LSPs for this resource. Not supported. This value is always **unknown**.

Sample Output

show link-management routing

```
user@host> show link-management routing
Peer name: __rpd:fe-0/1/0.0, System identifier: 2147483649
 State: Up, Control address: (null)
   Control-channel                  State
   fe-0/1/0.0                       Active

Peer name: __rpd:fe-0/1/2.0, System identifier: 2147483650
 State: Up, Control address: (null)
   Control-channel                  State
   fe-0/1/2.0                       Active

Peer name: __rpd:so-0/2/0.0, System identifier: 2147483651
 State: Down, Control address: (null)
   Control-channel                  State
   so-0/2/0.0

Peer name: __rpd:so-0/2/1.0, System identifier: 2147483652
 State: Down, Control address: (null)
   Control-channel                  State
   so-0/2/1.0

...

 TE link name: __rpd:fe-0/1/0.0, State: Up
  Local identifier: 2147483649, Remote identifier: 0,
  Local address: 192.168.37.66, Remote address: 192.168.37.66,
  Encoding: Ethernet, Minimum bandwidth: 0bps, Maximum bandwidth: 100Mbps,
  Total bandwidth: 100Mbps, Available bandwidth: 100Mbps

 TE link name: __rpd:fe-0/1/2.0, State: Up
  Local identifier: 2147483650, Remote identifier: 0,
  Local address: 192.168.37.73, Remote address: 192.168.37.73,
  Encoding: Ethernet, Minimum bandwidth: 0bps, Maximum bandwidth: 100Mbps,
  Total bandwidth: 100Mbps, Available bandwidth: 100Mbps

 TE link name: __rpd:so-0/2/0.0, State: Down
  Local identifier: 2147483651, Remote identifier: 0,
  Local address: 192.168.37.82, Remote address: 192.168.37.95,
  Encoding: Ethernet, Minimum bandwidth: 0bps, Maximum bandwidth: 155.52Mbps,
  Total bandwidth: 155.52Mbps, Available bandwidth: 155.52Mbps

...

Resource: falsp-bd, Type: LSP, State: Dn  System identifier: 2147483652,
Total bandwidth: 0bps,  Traffic parameters: Encoding: Packet, Switching: Packet,
 Granularity: Unknown

Resource: falsp-be, Type: LSP, State: Up  System identifier: 2147483654,
Total bandwidth: bw[1]=10Mbps,  Traffic parameters: Encoding: Packet,
Switching: Packet, Granularity: Unknown
```

show link-management statistics

Syntax

show link-management statistics
<peer <name *name*>>

Release Information

Command introduced in Junos OS Release 8.0.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display statistical information for Link Management Protocol (LMP) packets.

Options

none—Display information for all peers.

peer <name ***name*****>**—(Optional) Display information for all peers or for the specified peer only.

Required Privilege Level

view

Related Documentation

- show link-management on page 3842
- show link-management peer on page 3846
- show link-management routing on page 3848
- show link-management te-link on page 3853

List of Sample Output

show link-management statistics on page 3852

Output Fields

Table 279 on page 3851 describes the output fields for the **show link-management statistics** command. Output fields are listed in the approximate order in which they appear.

Table 279: show link-management statistics Output Fields

Field Name	Field Description
Received packets	Number of received packets by message type. If the count for a message type is zero, that message type is not displayed. If the count for all message types is zero, this field is not displayed.
Received bad packets	Number of received bad packets by message type. If the count for a message type is zero, that message type is not displayed. If the count for all message types is zero, this field is not displayed.
Small packets	Number of packets that are too small.
Wrong protocol version	Number of packets specifying the wrong LMP version.
Messages for unknown peer	Number of packets destined for an unknown peer.
Messages for bad state	Number of packets indicating a state that does not match the recipient.
Stale acknowledgments	Number of **configAck** and **LinkSummaryAck** packets received that have a stale message ID.

Table 279: show link-management statistics Output Fields *(continued)*

Field Name	Field Description
Stale negative acknowledgments	Number of **configNack** and **LinkSummaryNack** packets received that have a stale message ID.
Sent packets	Number of sent packets by message type. If the count for a message type is zero, that message type is not displayed. If the count for all message types is zero, this field is not displayed.
Retransmitted packets	Number of retransmitted packets by message type. If the count for a message type is zero, that message type is not displayed. If the count for all message types is zero, this field is not displayed.
Dropped packets	Number of packets sent, by message type, that have been dropped by the receiver after the LMP retransmission interval has been exceeded. If the count for a message type is zero, that message type is not displayed. If the count for all message types is zero, this field is not displayed.

Sample Output

show link-management statistics

```
user@host> show link-management statistics peer pro4-a
Statistics for peer pro4-a
    Received packets
        Config: 1
        Hello: 2572
    Small packets: 0
    Wrong protocol version: 0
    Messages for unknown peer: 0
    Messages for bad state: 0
    Stale acknowledgments: 0
    Stale negative acknowledgments: 0
    Sent packets
        Config: 2
        ConfigAck: 1
        Hello: 2572
    Retransmitted packets
        Config: 1
```


show link-management te-link

Syntax

show link-management te-link
<brief | detail>
<name *name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display the resources used to set up Multiprotocol Label Switching (MPLS) traffic-engineered forwarding paths.

Options

none—Display information for all traffic-engineered links.

brief | detail—(Optional) Display the specified level of output.

name ***name***—(Optional) Display information for the specified traffic-engineered link only.

Required Privilege Level

view

Related Documentation

- show link-management on page 3842
- show link-management peer on page 3846
- show link-management routing on page 3848
- show link-management statistics on page 3851

List of Sample Output

show link-management te-link on page 3854

Output Fields

Table 280 on page 3853 describes the output fields for the **show link-management te-link** command. Output fields are listed in the approximate order in which they appear.

Table 280: show link-management te-link Output Fields

Field Name	Field Description
TE link name	Traffic-engineered link name.
State	State of the traffic-engineered link: **Up** or **Down.**
Local identifier	Identifier of the local side of the link.
Remote identifier	Identifier of the remote side of the link.
Local address	Address of the local side of the link.
Remote address	Address of the remote side of the link.
Encoding	Physical layer media type determined by the interfaces contained in the traffic-engineered link. Typical values include **SDH/SONET**, **Ethernet**, **Packet**, and **PDH**.

Table 280: show link-management te-link Output Fields *(continued)*

Field Name	Field Description
Switching	Type of switching that can be performed on the traffic-engineered link. Supported values are **PSC-1** and **Packet**.
Minimum bandwidth	Smallest single allocation of bandwidth, in bits per second (bps) or megabits per second (Mbps), possible on the traffic-engineered link. This number is equal to the smallest bandwidth interface that is a member of the traffic-engineered link.
Maximum bandwidth	Largest single allocation of bandwidth, in bps or Mbps, possible on the traffic-engineered link. This number is equal to the largest bandwidth interface that is a member of the link.
Total bandwidth	Sum of the bandwidth, in bps or Mbps, of all interfaces that are members of the link (in bps).
Available Bandwidth	Sum of the bandwidth, in bps or Mbps, of all interfaces that are members of the link and that are not yet allocated.
Name	Name of the interface.
State	State of the interface: **Up** or **Down**.
Local ID	Identifier of the local side of the interface.
Remote ID	Identifier of the remote side of the interface.
Bandwidth	Bandwidth, in bps or Mbps, of the member interface.
Used	Whether the resource is allocated to an LSP: **Yes** or **No**.
LSP-name	LSP name.

Sample Output

show link-management te-link

```
user@host> show link-management te-link
TE link name: FA-bd, State: Up
  Local identifier: 4144, Remote identifier: 0, Local address: 2.2.2.1,
  Remote address: 2.2.2.2, Encoding: Ethernet, Switching: Packet,
  Minimum bandwidth: 0bps, Maximum bandwidth: 0bps, Total bandwidth: 0bps,
Available bandwidth: 0bps
    Name        State Local ID  Remote ID      Bandwidth Used  LSP-name
    falsp-bd    Dn       43077          0           0bps No

 TE link name: FA-be, State: Up
  Local identifier: 4145, Remote identifier: 0, Local address: 1.1.1.1,
   Remote address: 1.1.1.2, Encoding: Ethernet, Switching: Packet,
  Minimum bandwidth: 0bps, Maximum bandwidth: 10Mbps, Total bandwidth: 10Mbps,
 Available bandwidth: 8Mbps
    Name        State Local ID  Remote ID      Bandwidth Used  LSP-name
    falsp-be    Up       43076          0         10Mbps  Yes  e2elsp-bf
```


show mpls call-admission-control

Syntax

show mpls call-admission-control
<logical-system (all | *logical-system-name*)>
<*lsp-name*>

Syntax (EX Series Switches)

show mpls call-admission-control
<*lsp-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display Multiprotocol Label Switching (MPLS) label-switched path (LSP) call admission control (CAC) information.

Options

none—Display CAC information for all LSPs.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

lsp-name—(Optional) Display CAC information for the specified LSP only.

Additional Information

The available bandwidth on an LSP path at a particular class type is the total path bandwidth at that class type minus the total bandwidth reserved by any Layer 2 connection at that class type.

Required Privilege Level

view

List of Sample Output

show mpls call-admission-control on page 3856

Output Fields

Table 281 on page 3855 describes the output fields for the **show mpls call-admission-control** command. Output fields are listed in the approximate order in which they appear.

Table 281: show mpls call-admission-control Output Fields

Field Name	Field Description
Available bandwidth	Current available bandwidth on each LSP path. Depending on whether the LSP is an E-LSP or a regular LSP, either per-class bandwidth or a single bandwidth value (corresponding to best-effort bandwidth at **ct0**) is displayed. The available bandwidth on an LSP path at a particular class type is the total path bandwidth at that class type minus the total bandwidth reserved by some Layer 2 connections at that class type.
Layer2 connections	Different Layer 2 connections that had some bandwidth requirement and were admitted into an LSP path.
LSP name	LSP pathname.
Neighbor address	Neighbor address from which CAC and bandwidth booking are configured for Layer 2 circuits.
Circuit	Interface name and circuit information.

Table 281: show mpls call-admission-control Output Fields *(continued)*

Field Name	Field Description
Primary	LSP's primary standby path.
Standby	LSP's secondary standby path.
VC bandwidth	Bandwidth constraints associated with a Layer 2 circuit route.

Sample Output

show mpls call-admission-control

```
user@host# show mpls call-admission-control

LSP name: pro1-be
 *Primary
  Available bandwidth: 0bps

LSP name: pro1-be-1
 *Primary
  Available bandwidth: 60kbps

LSP name: pro1-be-gold
 *Primary
  Available bandwidth: <ct0 50kbps> <ct1 20kbps> <ct2 30kbps> <ct3 0bps>
    Layer2 connections:
    Neighbor address: 10.255.245.215, Circuit: so-0/3/0.0(vc 5)
    VC bandwidth: <ct0 50kbps> <ct1 40kbps> <ct2 40kbps>

LSP name: pro1-be-gold-2
 *Primary
  Available bandwidth: <ct0 0bps> <ct1 40kbps> <ct2 40kbps> <ct3 0bps>

LSP name: pro1-be-silver
 *Primary   prim1
  Available bandwidth: <ct0 10kbps> <ct1 20kbps> <ct2 0bps> <ct3 40kbps>
    Layer2 connections:
    Neighbor address: 10.255.245.215, Circuit: so-0/3/0.1(vc 3)
    VC bandwidth: <ct0 20kbps> <ct1 20kbps>
  Standby   sec1
  Available bandwidth: <ct0 10kbps> <ct1 10kbps> <ct2 20kbps> <ct3 0bps>
    Layer2 connections:
    Neighbor address: 10.255.245.215, Circuit: so-0/3/0.1(vc 3)
    VC bandwidth: <ct0 20kbps> <ct1 20kbps>
```


show mpls cspf

Syntax
show mpls cspf
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)
show mpls cspf

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description
Display Multiprotocol Label Switching (MPLS) Constrained Shortest Path First (CSPF) statistics.

Options
none—Display MPLS CSFP statistics.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level
view

List of Sample Output
show mpls cspf on page 3858

Output Fields
Table 282 on page 3857 describes the output fields for the **show mpls cspf** command. Output fields are listed in the approximate order in which they appear.

Table 282: show mpls cspf Output Fields

Field Name	Field Description
Queue length	Number of LSPs queued for automatic path computation.
current	Current queue length.
maximum	Maximum queue length (high-water mark).
dequeued	Number of aborted computation attempts.
Paths	Counters for label-switched path computations.
total	Sum of the next four fields.
successful	Number of path computations that were successfully completed.
no route	Number of path computations that failed because the destination is unreachable.
Sys Error	Number of path computations that failed because of lack of memory.

Table 282: show mpls cspf Output Fields *(continued)*

Field Name	Field Description
CSPFs	Total number of CSPF computations. A single path might require multiple CSPF computations.
Time	Time, in seconds, required to perform the label-switched path computation.
Total	Total amount of time consumed by the CSPF path computation algorithm.
CSPFs	Total number of CSPF computations.
Avg per CSPF	Average amount of time required for each CSPF computation.
% of rpd	Percentage of routing process CPU used in the CSPF computation.

Sample Output

show mpls cspf

```
user@host> show mpls cspf
CSPF statistics
Queue length   current       maximum      dequeued
                     0             0             0
Paths            total    successful      no route     sys error         CSPFs
                     0             0             0             0             0
Time (secs)      total         CSPFs  avg per CSPF      % of rpd
              0.000000      0.000000      0.000000        0.0000
```


show mpls diffserv-te

Syntax show mpls diffserve-te
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches) show mpls diffserve-te

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description Display Multiprotocol Label Switching (MPLS) label-switched path (LSP) Differentiated Services (DiffServ) class and preemption priority information.

Options **none**—Display DiffServ classes and priorities used by MPLS LSPs.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level view

List of Sample Output show mpls diffserv-te on page 3860

Output Fields Table 283 on page 3859 describes the output fields for the **show mpls diffserv-te** command. Output fields are listed in the approximate order in which they appear.

Table 283: show mpls diffserv-te Output Fields

Field Name	Field Description
Bandwidth model	Bandwidth constraint model supported. The maximum allocation model (MAM) for EXP-inferred LSPs (E-LSPs) is currently supported.
TE class	DiffServ traffic engineering class.
Traffic class	MPLS class type that corresponds to the DiffServ traffic engineering class: • **ct0**—Best effort • **ct1**—Assured forwarding • **ct2**—Expedited forwarding • **ct3**—Network control
Priority	MPLS preemption priority for this class type, a value from **0** through **7**. Interior gateway protocols (IGPs) distribute information about the available bandwidth for each traffic engineering class.

Sample Output

show mpls diffserv-te

```
user@host> show mpls diffserv-te
Bandwidth model: Maximum Allocation Model with support for E-LSPs.
TE class     Traffic class       Priority
te0          ct0                 3
te1          ct1                 2
```

show route forwarding-table

Syntax

show route forwarding-table
<detail | extensive | summary>
<ccc *ccc-interface-name*>
<*destination*>
<family *family-name*>
<label *label*>
<matching *ip_prefix*>
<multicast>
<vpn *vpn*>

Release Information

Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display the Routing Engine's forwarding table, including the network-layer prefixes and their next hops. This command is used to help verify that the routing protocol process has relayed the correction information to the forwarding table. The Routing Engine constructs and maintains one or more routing tables. From the routing tables, the Routing Engine derives a table of active routes, called the forwarding table.

Options

none—Display the routes in the forwarding table.

detail | extensive | summary—(Optional) Display the specified level of output.

ccc—(Optional) Display the specified circuit cross-connect interface name for entries to match.

destination —(Optional) Display the destination prefix.

family *family-name* —(Optional) Display routing table entries for the specified family: **ethernet-switching**, **inet**, **inet6**, **iso**, **mpls**, **vlan classification**.

label *label* —(Optional) Display route entries for the specified label name.

matching *ip_prefix* —(Optional) Display route entries for the specified IP prefix.

multicast—(Optional) Display route entries for multicast routes.

vpn *vpn* —(Optional) Display route entries for the specified VPN.

Required Privilege Level

view

Related Documentation

- *Example: Configuring MPLS on EX Series Switches*
- *Configuring MPLS on Provider Switches (CLI Procedure)*

List of Sample Output

show route forwarding-table on page 3863
show route forwarding-table summary on page 3864
show route forwarding-table extensive on page 3864
show route forwarding-table ccc on page 3866
show route forwarding-table family on page 3866

show route forwarding-table label on page 3866
show route forwarding-table matching on page 3867
show route forwarding-table multicast on page 3867

Output Fields Table 219 on page 2529 lists the output fields for the **show route forwarding-table** command. Output fields are listed in the approximate order in which they appear. Field names might be abbreviated (as shown in parentheses) when no level of output is specified or when the **detail** keyword is used instead of the **extensive** keyword.

Table 284: show route forwarding-table Output Fields

Field Name	Field Description	Level of Output
Routing table	Name of the routing table (for example, **inet**, **inet6**, **mpls**).	All levels
Address family	Address family (for example, **IP**, **IPv6**, **ISO**, **MPLS**).	All levels
Destination	Destination of the route.	**detail, extensive**
Route Type (Type)	How the route was placed into the forwarding table. When the **detail** keyword is used, the route type might be abbreviated (as shown in parentheses): • **cloned** (**clon**)—(TCP or multicast only) Cloned route. • **destination** (**dest**)—Remote addresses directly reachable through an interface. • **destination down** (**iddn**)—Destination route for which the interface is unreachable. • **interface cloned** (**ifcl**)—Cloned route for which the interface is unreachable. • **route down** (**ifdn**)—Interface route for which the interface is unreachable. • **ignore** (**ignr**)—Ignore this route. • **interface** (**intf**)—Installed as a result of configuring an interface. • **permanent** (**perm**)—Routes installed by the kernel when the routing table is initialized. • **user**—Routes installed by the routing protocol process or as a result of the configuration.	All levels
Route reference (RtRef)	Number of routes to reference.	**detail, extensive**
Flags	Route type flags: • **none**—No flags are enabled. • **accounting**—Route has accounting enabled. • **cached**—Cache route. • **incoming-iface** ***interface-number*** —Check against incoming interface. • **prefix load balance**—Load balancing is enabled for this prefix. • **sent to PFE**—Route has been sent to the Packet Forwarding Engine. • **static**—Static route.	**extensive**
Nexthop	IP address of the next hop to the destination.	**detail, extensive**

Table 284: show route forwarding-table Output Fields *(continued)*

Field Name	Field Description	Level of Output
Next hop type (Type)	Next-hop type. When the **detail** keyword is used, the next-hop type might be abbreviated (as indicated in parentheses): • **broadcast (bcst)**—Broadcast. • **deny**—Deny. • **hold**—Next hop is waiting to be resolved into a unicast or multicast type. • **indexed (idxd)**—Indexed next hop. • **indirect (indr)**—Indirect next hop. • **local (locl)**—Local address on an interface. • **routed multicast (mcrt)**—Regular multicast next hop • **multicast (mcst)**—Wire multicast next hop (limited to the LAN). • **multicast discard (mdsc)**—Multicast discard. • **multicast group (mgrp)** —Multicast group member. • **receive (recv)**—Receive. • **reject (rjct)** Discard. An ICMP unreachable message was sent. • **resolve (rslv)**—Resolving the next hop. • **unicast (ucst)**—Unicast. • **unilist (ulst)**—List of unicast next hops. A packet sent to this next hop goes to any next hop in the list.	**detail, extensive**
Index	Software index of the next hop that is used to route the traffic for a given prefix.	**detail, extensive** none
Route interface-index	Logical interface index from which the route is learned. For example, for interface routes, this is the logical interface index of the route itself. For static routes, this field is zero. For routes learned through routing protocols, this is the logical interface index from which the route is learned.	**extensive**
Reference (NhRef)	Number of routes that refer to this next hop.	none **detail, extensive**
Next-hop interface (Netif)	Interface used to reach the next hop.	none **detail, extensive**
Alternate forward nh index	Index number of the alternate next hop interface. Seen with **multicast** option only.	**extensive**
Next-hop L3 Interface	The next hop layer 3 interface. This option can be expressed as a VLAN name and is only seen with the **multicast** option.	**extensive**
Next-hop L2 Interfaces	The next hop layer 2 interfaces. Seen with **multicast** option only.	**extensive**

Sample Output

show route forwarding-table

```
user@switch> show route forwarding-table

Routing table: default.inet
```

```
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            user     2 0:12:f2:21:cf:0    ucst   333     5 me0.0
default            perm     0                    rjct    36     2
0.0.0.0/32         perm     0                    dscd    34     1
2.2.2.0/24         intf     0                    rslv  1309     1 ae0.0
2.2.2.0/32         dest     0 2.2.2.0            recv  1307     1 ae0.0
2.2.2.1/32         dest     0 0:21:59:cc:89:c0   ucst  1320     1 ae0.0
2.2.2.2/32         intf     0 2.2.2.2            locl  1308     2
2.2.2.2/32         dest     0 2.2.2.2            locl  1308     2
2.2.2.255/32       dest     0 2.2.2.255          bcst  1306     1 ae0.0
3.3.3.0/24         intf     0                    rslv  1313     1 ae1.0
3.3.3.0/32         dest     0 3.3.3.0            recv  1311     1 ae1.0
3.3.3.1/32         intf     0 3.3.3.1            locl  1312     2
3.3.3.1/32         dest     0 3.3.3.1            locl  1312     2
3.3.3.2/32         dest     0 0:21:59:cc:89:c1   ucst  1321    24 ae1.0
3.3.3.255/32       dest     0 3.3.3.255          bcst  1310     1 ae1.0
4.4.4.0/24         user     0 3.3.3.2            ucst  1321    24 ae1.0
8.8.8.8/32         user     0 3.3.3.2            ucst  1321    24 ae1.0
9.9.9.9/32         intf     0 9.9.9.9            locl  1280     1
10.10.10.10/32     user     0 3.3.3.2            ucst  1321    24 ae1.0
10.93.8.0/21       intf     0                    rslv   323     1 me0.0
10.93.8.0/32       dest     0 10.93.8.0          recv   321     1 me0.0
10.93.13.238/32    intf     0 10.93.13.238       locl   322     2
10.93.13.238/32    dest     0 10.93.13.238       locl   322     2
10.93.15.254/32    dest     0 0:12:f2:21:cf:0    ucst   333     5 me0.0
10.93.15.255/32    dest     0 10.93.15.255       bcst   320     1 me0.0
14.14.14.0/24      ifdn     0                    rslv  1319     1 ge-0/0/25.0
14.14.14.0/32      iddn     0 14.14.14.0         recv  1317     1 ge-0/0/25.0
14.14.14.2/32      user     0                    rjct    36     2
14.14.14.2/32      intf     0 14.14.14.2         locl  1318     2
14.14.14.2/32      iddn     0 14.14.14.2         locl  1318     2
14.14.14.255/32    iddn     0 14.14.14.255       bcst  1316     1 ge-0/0/25.0
224.0.0.0/4        perm     1                    mdsc    35     1
224.0.0.1/32       perm     0 224.0.0.1          mcst    31     3
224.0.0.5/32       user     1 224.0.0.5          mcst    31     3
255.255.255.255/32 perm     0                    bcst    32     1
```

show route forwarding-table summary

user@switch> **show route forwarding-table summary**

```
Routing table: default.inet
Internet:
         user:          6 routes
         perm:          5 routes
         intf:          8 routes
         dest:         12 routes
         ifdn:          1 routes
         iddn:          3 routes
```

show route forwarding-table extensive

user@switch> **show route forwarding-table summary**

```
Routing table: default.inet [Index 0]
Internet:

Destination:  default
  Route type: user
  Route reference: 2                   Route interface-index: 0
```



```
  Flags: sent to PFE, rt nh decoupled
  Nexthop: 0:12:f2:21:cf:0
  Next-hop type: unicast             Index: 333      Reference: 5
  Next-hop interface: me0.0

Destination:  default
  Route type: permanent
  Route reference: 0                 Route interface-index: 0
  Flags: none
  Next-hop type: reject              Index: 36       Reference: 2

Destination:  0.0.0.0/32
  Route type: permanent
  Route reference: 0                 Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: discard             Index: 34       Reference: 1

Destination:  2.2.2.0/24
  Route type: interface
  Route reference: 0                 Route interface-index: 66
  Flags: sent to PFE
  Next-hop type: resolve             Index: 1309     Reference: 1
  Next-hop interface: ae0.0

Destination:  2.2.2.0/32
  Route type: destination
  Route reference: 0                 Route interface-index: 66
  Flags: sent to PFE
  Nexthop: 2.2.2.0
  Next-hop type: receive             Index: 1307     Reference: 1
  Next-hop interface: ae0.0

Destination:  2.2.2.1/32
  Route type: destination
  Route reference: 0                 Route interface-index: 66
  Flags: sent to PFE
  Nexthop: 0:21:59:cc:89:c0
  Next-hop type: unicast             Index: 1320     Reference: 1
  Next-hop interface: ae0.0

Destination:  2.2.2.2/32
  Route type: interface
  Route reference: 0                 Route interface-index: 0
  Flags: sent to PFE
  Nexthop: 2.2.2.2
  Next-hop type: local               Index: 1308     Reference: 2

Destination:  2.2.2.2/32
  Route type: destination
  Route reference: 0                 Route interface-index: 66
  Flags: none
  Nexthop: 2.2.2.2
  Next-hop type: local               Index: 1308     Reference: 2

Destination:  2.2.2.255/32
  Route type: destination
  Route reference: 0                 Route interface-index: 66
  Flags: sent to PFE
  Nexthop: 2.2.2.255
  Next-hop type: broadcast           Index: 1306     Reference: 1
  Next-hop interface: ae0.0
```

show route forwarding-table ccc

```
user@switch> show route forwarding-table ccc ge-0/0/0.10
Routing table: default.mpls
MPLS:
Destination         Type RtRef Next hop           Type Index NhRef Netif
ge-0/0/0.10  (CCC) user     0 3.3.3.2           Push 300112  1343     2 ae1.0
```

show route forwarding-table family

```
user@switch> show route forwarding-table family mpls

Routing table: default.mpls
MPLS:
Destination         Type RtRef Next hop           Type Index NhRef Netif
default             perm     0                     dscd    50     1
0                   user     0                     recv    49     3
1                   user     0                     recv    49     3
2                   user     0                     recv    49     3
299776              user     0                    Pop     1334     2 ge-0/0/0.10
299792              user     0                    Pop     1339     2 ge-0/0/0.14
299808              user     0                    Pop     1341     2 ge-0/0/0.2
299824              user     0                    Pop     1344     2 ge-0/0/0.11
299840              user     0                    Pop     1345     2 ge-0/0/0.13
299856              user     0                    Pop     1346     2 ge-0/0/0.18
299872              user     0                    Pop     1347     2 ge-0/0/0.16
299888              user     0                    Pop     1348     2 ge-0/0/0.7
299904              user     0                    Pop     1349     2 ge-0/0/0.20
299920              user     0                    Pop     1350     2 ge-0/0/0.19
299936              user     0                    Pop     1351     2 ge-0/0/0.17
299952              user     0                    Pop     1352     2 ge-0/0/0.9
299968              user     0                    Pop     1353     2 ge-0/0/0.1
299984              user     0                    Pop     1354     2 ge-0/0/0.12
300000              user     0                    Pop     1355     2 ge-0/0/0.8
300016              user     0                    Pop     1356     2 ge-0/0/0.4
300032              user     0                    Pop     1357     2 ge-0/0/0.5
300048              user     0                    Pop     1358     2 ge-0/0/0.3
300064              user     0                    Pop     1359     2 ge-0/0/0.15
ge-0/0/0.1  (CCC)   user     0 3.3.3.2            Push 300064  1340     2 ae1.0
ge-0/0/0.2  (CCC)   user     0 3.3.3.2            Push 299872  1328     2 ae1.0
ge-0/0/0.3  (CCC)   user     0 3.3.3.2            Push 299792  1323     2 ae1.0
ge-0/0/0.4  (CCC)   user     0 3.3.3.2            Push 300016  1337     2 ae1.0
ge-0/0/0.5  (CCC)   user     0 3.3.3.2            Push 299824  1325     2 ae1.0
ge-0/0/0.7  (CCC)   user     0 3.3.3.2            Push 299920  1331     2 ae1.0
ge-0/0/0.8  (CCC)   user     0 3.3.3.2            Push 299840  1326     2 ae1.0
ge-0/0/0.9  (CCC)   user     0 3.3.3.2            Push 299888  1329     2 ae1.0
ge-0/0/0.10  (CCC)  user     0 3.3.3.2            Push 300112  1343     2 ae1.0
ge-0/0/0.11  (CCC)  user     0 3.3.3.2            Push 299776  1322     2 ae1.0
ge-0/0/0.12  (CCC)  user     0 3.3.3.2            Push 299952  1333     2 ae1.0
ge-0/0/0.13  (CCC)  user     0 3.3.3.2            Push 300096  1342     2 ae1.0
ge-0/0/0.14  (CCC)  user     0 3.3.3.2            Push 299984  1335     2 ae1.0
ge-0/0/0.15  (CCC)  user     0 3.3.3.2            Push 299936  1332     2 ae1.0
ge-0/0/0.16  (CCC)  user     0 3.3.3.2            Push 299808  1324     2 ae1.0
ge-0/0/0.17  (CCC)  user     0 3.3.3.2            Push 300000  1336     2 ae1.0
ge-0/0/0.18  (CCC)  user     0 3.3.3.2            Push 300032  1338     2 ae1.0
ge-0/0/0.19  (CCC)  user     0 3.3.3.2            Push 299904  1330     2 ae1.0
ge-0/0/0.20  (CCC)  user     0 3.3.3.2            Push 299856  1327     2 ae1.0
```

show route forwarding-table label

```
user@switch> show route forwarding-table label 29976
```



```
Routing table: default.mpls
MPLS:
Destination        Type RtRef Next hop           Type Index NhRef Netif
299776             user     0                   Pop    1334     2 ge-0/0/0.10
```

show route forwarding-table matching

user@switch> **show route forwarding-table matching 3**

```
Routing table: default.inet
Internet:
```

show route forwarding-table multicast

user@switch> **show route forwarding-table multicast**

```
Routing table: default.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
224.0.0.0/4        perm     1                    mdsc    35     1
224.0.0.1/32       perm     0 224.0.0.1          mcst    31     3
224.0.0.5/32       user     1 224.0.0.5          mcst    31     3

Routing table: __master.anon__.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
224.0.0.0/4        perm     0                    mdsc  1289     1
224.0.0.1/32       perm     0 224.0.0.1          mcst  1285     1

Routing table: default.inet6
Internet6:
Destination        Type RtRef Next hop           Type Index NhRef Netif
ff00::/8           perm     0                    mdsc    43     1
ff02::1/128        perm     0 ff02::1            mcst    39     1
```


show mpls interface

Syntax

show mpls interface
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show mpls interface

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display information about Multiprotocol Label Switching (MPLS)-enabled interfaces.

Options

none—Display information about MPLS-enabled interfaces.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Additional Information

MPLS is enabled on an interface when the interface is configured with both the **set protocol mpls interface *interface-name*** and **set interface *interface-name* unit 0 family mpls** statements.

Required Privilege Level

view

List of Sample Output

show mpls interface on page 3869

Output Fields

Table 285 on page 3868 describes the output fields for the **show mpls interface** command. Output fields are listed in the approximate order in which they appear.

Table 285: show mpls interface Output Fields

Field Name	Field Description
Interface	Name of the interface.
State	State of the interface: **Up** or **Dn** (down).
Administrative groups	Administratively assigned colors of the link.
Maximum labels	Maximum number of MPLS labels upon which MPLS can operate on a logical interface. This is configured using the **maximum-labels** statement at the **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family mpls]** or the **[edit interfaces *interface-name* unit *logical-unit-number* family mpls]** hierarchy levels.
Static protection revert time	Time (in seconds) that a static LSP must wait before traffic reverts from the bypass path to the original path. This is configured using the **protection-revert-time** statement at the **[edit logical-systems *logical-system-name* protocols mpls interface *interface-name* static]** or the **[edit protocols mpls interface *interface-name* static]** hierarchy levels.

Table 285: show mpls interface Output Fields *(continued)*

Field Name	Field Description
Always mark connection protection tlv	**Enabled** or **Disabled**: **Enabled** indicates that the **always-mark-connection-protection-tlv** statement is configured at the **[edit logical-systems *logical-system-name* protocols mpls interface *interface-name* static]** or the **[edit protocols mpls interface *interface-name* static]** hierarchy levels. When this statement is configured, it marks all OAM traffic transiting this interface in preparation for switching the traffic to an alternate path based on the OAM functionality. To switch traffic to the bypass LSP, the **switch-away-lsps** statement must be configured.
Switch away lsps	**Enabled** or **Disabled**: **Enabled** indicates that the **switch-away-lsps** statement is configured at the **[edit logical-systems *logical-system-name* protocols mpls interface *interface-name* static]** or the **[edit protocols mpls interface *interface-name* static]** hierarchy levels. This enables you to switch an LSP away from a network node using a bypass LSP. This feature can be used in maintenance of active networks when a network device needs to be replaced without interrupting traffic passing through the network. The LSPs can be either static or dynamic.

Sample Output

show mpls interface

```
user@host> show mpls interface

Interface: ge-0/2/1.57
  State: Up
  Administrative group: <none>
  Maximum labels: 5
  Static protection revert time: 5 seconds
  Always mark connection protection tlv: Disabled
  Switch away lsps : Disabled
```

show mpls lsp

Syntax

```
show mpls lsp
<brief | detail | extensive | terse>
<autobandwidth>
<bidirectional | unidirectional>
<bypass>
<count-active-routes>
<defaults>
<descriptions>
<down | up>
<logical-system (all | logical-system-name)>
<lsp-type>
<name name>
<p2mp>
<statistics>
<transit>
```

Syntax (EX Series Switches)

```
show mpls lsp
<brief | detail | extensive | terse>
<bidirectional | unidirectional>
<bypass>
<descriptions>
<down | up>
<lsp-type>
<name name>
<p2mp>
<statistics>
<transit>
```

Release Information

Command introduced before Junos OS Release 7.4.
defaults option added in Junos OS Release 8.5.
Command introduced in Junos OS Release 9.5 for EX Series switches.
autobandwidth option added in Junos OS Release 11.4.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description

Display information about configured and active dynamic Multiprotocol Label Switching (MPLS) label-switched paths (LSPs).

Options

none—Display standard information about all configured and active dynamic MPLS LSPs.

brief | detail | extensive | terse—(Optional) Display the specified level of output. The extensive option displays the same information as the detail option, but covers the most recent 50 events.

autobandwidth—(Optional) Display automatic bandwidth information. This option is explained separately (see show mpls lsp autobandwidth).

bidirectional | unidirectional—(Optional) Display bidirectional or unidirectional LSP information, respectively.

bypass—(Optional) Display LSPs used for protecting other LSPs.

count-active-routes—(Optional) Display active routes for LSPs.

defaults—(Optional) Display the MPLS LSP default settings.

descriptions—(Optional) Display the MPLS label-switched path (LSP) descriptions. To view this information, you must configure the description statement at the **[edit protocol mpls lsp]** hierarchy level. Only LSPs with a description are displayed. This command is only valid for the ingress routing device, because the description is not propagated in RSVP messages.

down | up—(Optional) Display only LSPs that are inactive or active, respectively.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

lsp-type—(Optional) Display information about a particular LSP type:

- **bypass**—Sessions for bypass LSPs.
- **egress**—Sessions that terminate on this routing device.
- **ingress**—Sessions that originate from this routing device.
- **transit**—Sessions that pass through this routing device.

name *name*—(Optional) Display information about the specified LSP or group of LSPs.

p2mp—(Optional) Display information about point-to-multipoint LSPs.

statistics—(Optional) (Ingress and transit routers only) Display accounting information about LSPs. Statistics are not available for LSPs on the egress routing device, because the penultimate routing device in the LSP sets the label to 0. Also, as the packet arrives at the egress routing device, the hardware removes its MPLS header and the packet reverts to being an IPv4 packet. Therefore, it is counted as an IPv4 packet, not an MPLS packet.

NOTE: If a bypass LSP is configured for the primary static LSP, display cumulative statistics of packets traversing through the protected LSP and bypass LSP when traffic is re-optimized when the protected LSP link is restored.

When used with the **bypass** option (**show mpls lsp bypass statistics**), display statistics for the traffic that flows only through the bypass LSP.

transit—(Optional) Display LSPs transiting this routing device.

Required Privilege Level

view

Related Documentation

- clear mpls lsp on page 3817

• show mpls lsp autobandwidth on page 3884

List of Sample Output

Output Fields Table 286 on page 3872 describes the output fields for the **show mpls lsp** command. Output fields are listed in the approximate order in which they appear.

Table 286: show mpls lsp Output Fields

Field Name	Field Description	Level of Output
Ingress LSP	Information about LSPs on the ingress routing device. Each session has one line of output.	All levels
Egress LSP	Information about the LSPs on the egress routing device. MPLS learns this information by querying RSVP, which holds all the transit and egress session information. Each session has one line of output.	All levels
Transit LSP	Number of LSPs on the transit routing devices and the state of these paths. MPLS learns this information by querying RSVP, which holds all the transit and egress session information.	All levels
P2MP name	Name of the point-to-multipoint LSP. Dynamically generated P2MP LSPs used for VPLS flooding use dynamically generated P2MP LSP names. The name uses the format ***identifier*:vpls:*router-id*:*routing-instance-name***. The ***identifier*** is automatically generated by Junos OS.	All levels
P2MP branch count	Number of destination LSPs the point-to-multipoint LSP is transmitting to.	All levels
P	An asterisk (*) under this heading indicates that the LSP is a primary path.	All levels
address	(**detail** and **extensive**) Destination (egress routing device) of the LSP.	**detail extensive**
To	Destination (egress routing device) of the session.	**brief**
From	Source (ingress routing device) of the session.	**brief detail**
State	State of the LSP handled by this RSVP session: **Up**, **Dn** (down), or **Restart**.	**brief detail**
Active Route	Number of active routes (prefixes) installed in the forwarding table. For ingress LSPs, the forwarding table is the primary IPv4 table (**inet.0**). For transit and egress RSVP sessions, the forwarding table is the primary MPLS table (**mpls.0**).	**detail extensive**

Table 286: show mpls lsp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Rt	Number of active routes (prefixes) installed in the routing table. For ingress RSVP sessions, the routing table is the primary IPv4 table (**inet.0**). For transit and egress RSVP sessions, the routing table is the primary MPLS table (mpls.0).	**brief**
P	Path. An asterisk (*****) underneath this column indicates that the LSP is a primary path.	**brief**
ActivePath	(Ingress LSP) Name of the active path: **Primary** or **Secondary**.	**detail extensive**
LSPname	Name of the LSP.	**brief detail**
Statistics	Displays the number of packets and the number of bytes transmitted over the LSP. These counters are reset to zero whenever the LSP path is optimized (for example, during an automatic bandwidth allocation).	**extensive**
Aggregate statistics	Displays the number of packets and the number of bytes transmitted over the LSP. These counters continue to iterate even if the LSP path is optimized. You can reset these counters to zero using the **clear mpls lsp statistics** command.	**extensive**
Packets	Displays the number of packets transmitted over the LSP.	**brief extensive**
Bytes	Displays the number of bytes transmitted over the LSP.	**brief extensive**
DiffServeInfo	Type of LSP: multiclass LSP **(multiclass diffServ-TE LSP)** or Differentiated-Services-aware traffic engineering LSP **(diffServ-TE LSP)**.	**detail**
LSPtype	Type of LSP: static **Static configured** or dynamic **Dynamic configured**. Also indicates if the LSP is a **Penultimate hop popping** LSP or an **Ultimate hop popping** LSP.	**detail extensive**
Bypass	(Bypass LSP) Destination address (egress routing device) for the bypass LSP.	All levels
LSPpath	Indicates whether the RSVP session is for the primary or secondary LSP path. **LSPpath** can be either **primary** or **secondary** and can be displayed on the ingress, egress, and transit routing devices.	**detail**
Bidir	(GMPLS) The LSP allows data to travel in both directions between GMPLS devices.	All levels
Bidirectional	(GMPLS) The LSP allows data to travel both ways between GMPLS devices.	All levels
FastReroute desired	Fast reroute has been requested by the ingress routing device.	**detail**
Link protection desired	Link protection has been requested by the ingress routing device.	**detail**
LoadBalance	(Ingress LSP) CSPF load-balancing rule that was configured to select the LSP's path among equal-cost paths: **Most-fill**, **Least-fill**, or **Random**.	**detail extensive**

Table 286: show mpls lsp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Signal type	Signal type for GMPLS LSPs. The signal type determines the peak data rate for the LSP: **DS0**, **DS3**, **STS-1**, **STM-1**, or **STM-4**.	All levels
Encoding type	LSP encoding type: **Packet**, **Ethernet**, **PDH**, **SDH/SONET**, **Lambda**, or **Fiber**.	All levels
Switching type	Type of switching on the links needed for the LSP: **Fiber**, **Lamda**, **Packet**, **TDM**, or **PSC-1**.	All levels
GPID	Generalized Payload Identifier (identifier of the payload carried by an LSP): **HDLC**, **Ethernet**, **IPv4**, **PPP**, or **Unknown**.	All levels
Protection	Configured protection capability desired for the LSP: **Extra**, **Enhanced**, **none**, **One plus one**, **One to one**, or **Shared**.	All levels
Upstream label in	(Bidirectional LSPs) Incoming label for reverse direction traffic for this LSP.	All levels
Upstream label out	(Bidirectional LSPs) Outgoing label for reverse direction traffic for this LSP.	All levels
Suggested label received	(Bidirectional LSPs) Label the upstream node suggests to use in the Resv message that is sent.	All levels
Suggested label sent	(Bidirectional LSPs) Label the downstream node suggests to use in the Resv message that is returned.	All levels
Autobandwidth	(Ingress LSP) The LSP is performing autobandwidth allocation.	**detail extensive**
MinBW	(Ingress LSP) Configured minimum value of the LSP, in bps.	**detail extensive**
MaxBW	(Ingress LSP) Configured maximum value of the LSP, in bps.	**detail extensive**
Dynamic MinBW	(Ingress LSP) Displays the current dynamically specified minimum bandwidth allocation for the LSP, in bps.	**detail extensive**
Adjustment Timer	(Ingress LSP) Configured value for the **adjust-timer** statement, indicating the total amount of time allowed before bandwidth adjustment will take place, in seconds.	**detail extensive**
Adjustment Threshold	(Ingress LSP) Configured value for the **adjust-threshold** statement. Specifies how sensitive the automatic bandwidth adjustment for an LSP is to changes in bandwidth utilization.	**detail extensive**
Time for Next Adjustment	(Ingress LSP) Time in seconds until the next automatic bandwidth adjustment sample is taken.	**detail extensive**
Time of Last Adjustment	(Ingress LSP) Date and time since the last automatic bandwidth adjustment was completed.	**detail extensive**
Max AvgBW util	(Ingress LSP) Current value of the actual maximum average bandwidth utilization, in bps.	**detail extensive**

Table 286: show mpls lsp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Overflow limit	(Ingress LSP) Configured value of the threshold overflow limit.	**detail extensive**
Overflow sample count	(Ingress LSP) Current value for the overflow sample count.	**detail extensive**
Bandwidth Adjustment in *nnn* second(s)	(Ingress LSP) Current value of the bandwidth adjustment timer, indicating the amount of time remaining until the bandwidth adjustment will take place, in seconds.	**detail extensive**
Underflow limit	(Ingress LSP) Configured value of the threshold underflow limit.	**detail extensive**
Underflow sample count	(Ingress LSP) Current value for the underflow sample count.	**detail extensive**
Underflow Max AvgBW	(Ingress LSP) The highest sample bandwidth among the underflow samples recorded currently. This is the signaling bandwidth if an adjustment occurs because of an underflow.	**detail extensive**
Active path indicator	(Ingress LSP) A value of ***** indicates that the path is active. The absence of ***** indicates that the path is not active. In the following example, "long" is the active path. ***Primary long** **Standby short**	**detail extensive**
Primary	(Ingress LSP) Name of the primary path.	**detail extensive**
Secondary	(Ingress LSP) Name of the secondary path.	**detail extensive**
Standby	(Ingress LSP) Name of the path in standby mode.	**detail extensive**
State	(Ingress LSP) State of the path: **Up** or **Dn** (down).	**detail extensive**
COS	(Ingress LSP) Class-of-service value.	**detail extensive**
Bandwidth per class	(Ingress LSP) Active bandwidth for the LSP path for each MPLS class type, in bps.	**detail extensive**
Priorities	(Ingress LSP) Configured value of the setup priority and the hold priority respecitively (the setup priority is displayed first), where 0 is the highest priority and 7 is the lowest priority. If you have not explicitly configured these values, the default values are displayed (7 for the setup priority and 0 for the hold priority).	**detail extensive**
OptimizeTimer	(Ingress LSP) Configured value of the optimize timer, indicating the total amount of time allowed before path reoptimization, in seconds.	**detail extensive**
SmartOptimizeTimer	(Ingress LSP) Configured value of the smart optimize timer, indicating the total amount of time allowed before path reoptimization, in seconds.	**detail extensive**

Table 286: show mpls lsp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Reoptimization in xxx seconds	(Ingress LSP) Current value of the optimize timer, indicating the amount of time remaining until the path will be reoptimized, in seconds.	**detail extensive**
Computed ERO (S [L] denotes strict [loose] hops)	(Ingress LSP) Computed explicit route. A series of hops, each with an address followed by a hop indicator. The value of the hop indicator can be strict (**S**) or loose (**L**).	**detail extensive**
CSPF metric	(Ingress LSP) Constrained Shortest Path First metric for this path.	**detail extensive**
Received RRO	(Ingress LSP) Received record route. A series of hops, each with an address followed by a flag. (In most cases, the received record route is the same as the computed explicit route. If **Received RRO** is different from **Computed ERO**, there is a topology change in the network, and the route is taking a detour.) The following flags identify the protection capability and status of the downstream node: • **0x01**—Local protection available. The link downstream from this node is protected by a local repair mechanism. This flag can be set only if the Local protection flag was set in the **SESSION_ATTRIBUTE** object of the corresponding Path message. • **0x02**—Local protection in use. A local repair mechanism is in use to maintain this tunnel (usually because of an outage of the link it was routed over previously). • **0x03**—Combination of **0x01** and **0x02**. • **0x04**—Bandwidth protection. The downstream routing device has a backup path providing the same bandwidth guarantee as the protected LSP for the protected section. • **0x08**—Node protection. The downstream routing device has a backup path providing protection against link and node failure on the corresponding path section. If the downstream routing device can set up only a link-protection backup path, the **Local protection available** bit is set but the **Node protection** bit is cleared. • **0x09**—Detour is established. Combination of **0x01** and **0x08**. • **0x10**—Preemption pending. The preempting node sets this flag if a pending preemption is in progress for the traffic engine LSP. This flag indicates to the ingress legacy edge router (LER) of this LSP that it should be rerouted. • **0x20**—Node ID. Indicates that the address specified in the RRO's IPv4 or IPv6 sub-object is a node ID address, which refers to the router address or router ID. Nodes must use the same address consistently. • **0xb**—Detour is in use. Combination of **0x01**, **0x02**, and **0x08**.	**detail extensive**
Index number	(Ingress LSP) Log entry number of each LSP path event. The numbers are in chronological descending order, with a maximum of 50 index numbers displayed.	**extensive**
Date	(Ingress LSP) Date of the LSP event.	**extensive**
Time	(Ingress LSP) Time of the LSP event.	**extensive**
Event	(Ingress LSP) Description of the LSP event.	**extensive**
Created	(Ingress LSP) Date and time the LSP was created.	**extensive**

Table 286: show mpls lsp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Resv style	(Bypass) RSVP reservation style. This field consists of two parts. The first is the number of active reservations. The second is the reservation style, which can be **FF** (fixed filter), **SE** (shared explicit), or **WF** (wildcard filter).	**brief detail extensive**
Labelin	Incoming label for this LSP.	**brief detail**
Labelout	Outgoing label for this LSP.	**brief detail**
LSPname	Name of the LSP.	**brief detail**
Time left	Number of seconds remaining in the lifetime of the reservation.	**detail**
Since	Date and time when the RSVP session was initiated.	**detail**
Tspec	Sender's traffic specification, which describes the sender's traffic parameters.	**detail**
Port number	Protocol ID and sender or receiver port used in this RSVP session.	**detail**
PATH rcvfrom	Address of the previous-hop (upstream) routing device or client, interface the neighbor used to reach this router, and number of packets received from the upstream neighbor.	**detail**
PATH sentto	Address of the next-hop (downstream) routing device or client, interface used to reach this neighbor, and number of packets sent to the downstream routing device.	**detail**
RESV rcvfrom	Address of the previous-hop (upstream) routing device or client, interface the neighbor used to reach this routing device, and number of packets received from the upstream neighbor. The output in this field, which is consistent with that in the **PATH rcvfrom** field, indicates that the RSVP negotiation is complete.	**detail**
Record route	Recorded route for the session, taken from the record route object.	**detail**
Soft preempt	Number of soft preemptions that occurred on a path and when the last soft preemption occurred. Only successful soft preemptions are counted (those that actually resulted in a new path being used).	**detail**
Soft preemption pending	Path is in the process of being soft preempted. This display is removed once the ingress router has calculated a new path.	**detail**

Table 286: show mpls lsp Output Fields *(continued)*

Field Name	Field Description	Level of Output
MPLS-TE LSP Defaults	Default settings for MPLS traffic engineered LSPs: • **LSP Holding Priority**—Determines the degree to which an LSP holds on to its session reservation after the LSP has been set up successfully. • **LSP Setup Priority**—Determines whether a new LSP that preempts an existing LSP can be established. • **Hop Limit**—Specifies the maximum number of routers the LSP can traverse (including the ingress and egress). • **Bandwidth**—Specifies the bandwidth in bits per second for the LSP. • **LSP Retry Timer**—Length of time in seconds that the ingress router waits between attempts to establish the primary path.	**defaults**

The XML tag name of the **bandwidth** tag under the **auto-bandwidth** tag has been updated to **maximum-average-bandwidth** . You can see the new tag when you issue the **show mpls lsp extensive** command with the **| display xml** pipe option. If you have any scripts that use the **bandwidth** tag, ensure that they are updated to **maximum-average-bandwidth**.

Sample Output

show mpls lsp defaults

```
user@host> show mpls lsp defaults
   MPLS-TE LSP Defaults
      LSP Holding Priority      0
      LSP Setup Priority        7
      Hop Limit                 255
      Bandwidth                 0
      LSP Retry Timer           30 seconds
```

show mpls lsp descriptions

```
user@host> show mpls lsp descriptions
Ingress LSP: 3 sessions
To              LSP name                             Description
10.0.0.195      to-sanjose                           to-sanjose-desc
10.0.0.195      to-sanjose-other-desc                other-desc
Total 2 displayed, Up 2, Down 0
```

show mpls lsp detail

```
user@host> show mpls lsp detail
Ingress LSP: 1 sessions

192.168.0.4
  From: 192.168.0.5, State: Up, ActiveRoute: 0, LSPname: E-D
  ActivePath:  (primary)
  LSPtype: Static Configured, Penultimate hop popping
  LoadBalance: Random
  Encoding type: Packet, Switching type: Packet, GPID: IPv4
 *Primary                   State: Up
    Priorities: 7 0
    SmartOptimizeTimer: 180
    Computed ERO (S [L] denotes strict [loose] hops): (CSPF metric: 30)
 10.0.0.18 S 10.0.0.22 S
```



```
   Received RRO (ProtectionFlag 1=Available 2=InUse 4=B/W 8=Node 10=SoftPreempt
 20=Node-ID):
          10.0.0.18 10.0.0.22
Total 1 displayed, Up 1, Down 0

Egress LSP: 1 sessions

192.168.0.5
  From: 192.168.0.4, LSPstate: Up, ActiveRoute: 0
  LSPname: E-D, LSPpath: Primary
  Suggested label received: -, Suggested label sent: -
  Recovery label received: -, Recovery label sent: -
  Resv style: 1 FF, Label in: 3, Label out: -
  Time left:  157, Since: Wed Jul 18 17:55:12 2012
  Tspec: rate 0bps size 0bps peak Infbps m 20 M 1500
  Port number: sender 1 receiver 46128 protocol 0
  PATH rcvfrom: 10.0.0.18 (lt-1/2/0.17) 3 pkts
  Adspec: received MTU 1500
  PATH sentto: localclient
  RESV rcvfrom: localclient
  Record route: 10.0.0.22 10.0.0.18 <self>
Total 1 displayed, Up 1, Down 0

Transit LSP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

show mpls lsp extensive

```
user@host> show mpls lsp extensive
Ingress LSP: 1 sessions

192.168.0.4
  From: 192.168.0.5, State: Up, ActiveRoute: 0, LSPname: E-D
  ActivePath:  (primary)
  LSPtype: Static Configured, Ultimate hop popping
  LoadBalance: Random
  Encoding type: Packet, Switching type: Packet, GPID: IPv4
 *Primary                    State: Up
    Priorities: 7 0
    SmartOptimizeTimer: 180
    Computed ERO (S [L] denotes strict [loose] hops): (CSPF metric: 30)
 10.0.0.18 S 10.0.0.22 S
   Received RRO (ProtectionFlag 1=Available 2=InUse 4=B/W 8=Node 10=SoftPreempt
 20=Node-ID):
          10.0.0.18 10.0.0.22
   11 Sep 20 15:54:35.032 Make-before-break: Switched to new instance
   10 Sep 20 15:54:34.029 Record Route:  10.0.0.18 10.0.0.22
    9 Sep 20 15:54:34.029 Up
    8 Sep 20 15:54:20.271 Originate make-before-break call
    7 Sep 20 15:54:20.271 CSPF: computation result accepted  10.0.0.18 10.0.0.22

    6 Sep 20 15:52:10.247 Selected as active path
    5 Sep 20 15:52:10.246 Record Route:  10.0.0.18 10.0.0.22
    4 Sep 20 15:52:10.243 Up
    3 Sep 20 15:52:09.745 Originate Call
    2 Sep 20 15:52:09.745 CSPF: computation result accepted  10.0.0.18 10.0.0.22

    1 Sep 20 15:51:39.903 CSPF failed: no route toward 192.168.0.4
  Created: Thu Sep 20 15:51:08 2012
Total 1 displayed, Up 1, Down 0
```

```
Egress LSP: 1 sessions

192.168.0.5
  From: 192.168.0.4, LSPstate: Up, ActiveRoute: 0
  LSPname: E-D, LSPpath: Primary
  Suggested label received: -, Suggested label sent: -
  Recovery label received: -, Recovery label sent: -
  Resv style: 1 FF, Label in: 3, Label out: -
  Time left:  148, Since: Thu Sep 20 15:52:10 2012
  Tspec: rate 0bps size 0bps peak Infbps m 20 M 1500
  Port number: sender 1 receiver 49601 protocol 0
  PATH rcvfrom: 10.0.0.18 (lt-1/2/0.17) 27 pkts
  Adspec: received MTU 1500
  PATH sentto: localclient
  RESV rcvfrom: localclient
  Record route: 10.0.0.22 10.0.0.18 <self>
Total 1 displayed, Up 1, Down 0

Transit LSP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

show mpls lsp ingress extensive

```
user@host> show mpls lsp ingress extensive
Ingress LSP: 1 sessions

50.0.0.1
  From: 10.0.0.1, State: Up, ActiveRoute: 0, LSPname: test
  ActivePath:  (primary)
  LSPtype: Static Configured
  LoadBalance: Random
  Encoding type: Packet, Switching type: Packet, GPID: IPv4
 *Primary                    State: Up
    Priorities: 7 0
    OptimizeTimer: 300
    SmartOptimizeTimer: 180
    Reoptimization in 240 second(s).
    Computed ERO (S [L] denotes strict [loose] hops): (CSPF metric: 3)
 1.1.1.2 S 4.4.4.1 S 5.5.5.2 S
    Received RRO (ProtectionFlag 1=Available 2=InUse 4=B/W 8=Node 10=SoftPreempt
 20=Node-ID):
          1.1.1.2 4.4.4.1 5.5.5.2
   17 Aug  3 13:17:33.601 CSPF: computation result ignored, new path less avail
bw[3 times]
   16 Aug  3 13:02:51.283 CSPF: computation result ignored, new path no benefit[2
 times]
   15 Aug  3 12:54:36.678 Selected as active path
   14 Aug  3 12:54:36.676 Record Route:  1.1.1.2 4.4.4.1 5.5.5.2
   13 Aug  3 12:54:36.676 Up
   12 Aug  3 12:54:33.924 Deselected as active
   11 Aug  3 12:54:33.924 Originate Call
   10 Aug  3 12:54:33.923 Clear Call
    9 Aug  3 12:54:33.923 CSPF: computation result accepted  1.1.1.2 4.4.4.1
5.5.5.2
    8 Aug  3 12:54:33.922 2.2.2.2: No Route toward dest
    7 Aug  3 12:54:28.177 CSPF: computation result ignored, new path no benefit[4
 times]
    6 Aug  3 12:35:03.830 Selected as active path
    5 Aug  3 12:35:03.828 Record Route:  2.2.2.2 3.3.3.2
    4 Aug  3 12:35:03.827 Up
    3 Aug  3 12:35:03.814 Originate Call
```

```
    2 Aug  3 12:35:03.814 CSPF: computation result accepted  2.2.2.2 3.3.3.2
    1 Aug  3 12:34:34.921 CSPF failed: no route toward 50.0.0.1
  Created: Tue Aug  3 12:34:35 2010
Total 1 displayed, Up 1, Down 0
```

show mpls lsp extensive (automatic bandwidth adjustment enabled)

```
user@host> show mpls lsp extensive
Ingress LSP: 1 sessions

192.168.0.4
  From: 192.168.0.5, State: Up, ActiveRoute: 0, LSPname: E-D
  ActivePath:  (primary)
  Node/Link protection desired
  LSPtype: Static Configured, Penultimate hop popping
  LoadBalance: Random
  Autobandwidth
  MinBW: 300bps, MaxBW: 1000bps, Dynamic MinBW: 1000bps
  Adjustment Timer: 300 secs AdjustThreshold: 25%
  Max AvgBW util: 963.739bps, Bandwidth Adjustment in 0 second(s).
  Min BW Adjust Interval: 1000, MinBW Adjust Threshold (in %): 50
  Overflow limit: 0, Overflow sample count: 0
  Underflow limit: 0, Underflow sample count: 9, Underflow Max AvgBW: 614.421bps

  Encoding type: Packet, Switching type: Packet, GPID: IPv4
 *Primary                    State: Up
    Priorities: 7 0
    Bandwidth: 1000bps
    SmartOptimizeTimer: 180
    Computed ERO (S [L] denotes strict [loose] hops): (CSPF metric: 30)
 10.0.0.18 S 10.0.0.22 S
    Received RRO (ProtectionFlag 1=Available 2=InUse 4=B/W 8=Node 10=SoftPreempt
 20=Node-ID):
          192.168.0.6(flag=0x20) 10.0.0.18(Label=299792) 192.168.0.4(flag=0x20)
10.0.0.22(Label=3)
   12 Apr 30 10:25:17.024 Make-before-break: Switched to new instance
   11 Apr 30 10:25:16.023 Record Route:  192.168.0.6(flag=0x20)
10.0.0.18(Label=299792) 192.168.0.4(flag=0x20) 10.0.0.22(Label=3)
   10 Apr 30 10:25:16.023 Up
    9 Apr 30 10:25:16.023 Automatic Autobw adjustment succeeded: BW changes from
 300 bps to 1000 bps
    8 Apr 30 10:25:15.946 Originate make-before-break call
    7 Apr 30 10:25:15.946 CSPF: computation result accepted  10.0.0.18 10.0.0.22

    6 Apr 30 10:16:42.891 Selected as active path
    5 Apr 30 10:16:42.891 Record Route:  192.168.0.6(flag=0x20)
10.0.0.18(Label=299776) 192.168.0.4(flag=0x20) 10.0.0.22(Label=3)
    4 Apr 30 10:16:42.890 Up
    3 Apr 30 10:16:42.828 Originate Call
    2 Apr 30 10:16:42.828 CSPF: computation result accepted  10.0.0.18 10.0.0.22

    1 Apr 30 10:16:14.064 CSPF: could not determine self[2 times]
  Created: Tue Apr 30 10:15:16 2013
Total 1 displayed, Up 1, Down 0

Egress LSP: 0 sessions
Total 0 displayed, Up 0, Down 0

Transit LSP: 0 sessions
Total 0 displayed, Up 0, Down 0
```


show mpls lsp p2mp

```
user@host> show mpls lsp p2mp
Ingress LSP: 2 sessions
P2MP name: p2mp-lsp1, P2MP branch count: 1
To              From            State Rt P ActivePath       LSPname
10.255.245.51   10.255.245.50   Up     0 * path1            p2mp-branch-1
P2MP name: p2mp-lsp2, P2MP branch count: 1
To              From            State Rt P ActivePath       LSPname
10.255.245.51   10.255.245.50   Up     0 * path1            p2mp-st-br1
Total 2 displayed, Up 2, Down 0

Egress LSP: 0 sessions
Total 0 displayed, Up 0, Down 0

Transit LSP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

show mpls lsp p2mp detail

```
user@host> show mpls lsp p2mp detail
Ingress LSP: 2 sessions
P2MP name: p2mp-lsp1, P2MP branch count: 1

10.255.245.51
  From: 10.255.245.50, State: Up, ActiveRoute: 0, LSPname: p2mp-branch-1
  ActivePath: path1 (primary)
  P2MP name: p2mp-lsp1
  LoadBalance: Random
  Encoding type: Packet, Switching type: Packet, GPID: IPv4
 *Primary   path1           State: Up
    Computed ERO (S [L] denotes strict [loose] hops): (CSPF metric: 25)
 192.168.208.17 S
   Received RRO (ProtectionFlag 1=Available 2=InUse 4=B/W 8=Node 10=SoftPreempt):

          192.168.208.17
P2MP name: p2mp-lsp2, P2MP branch count: 1

10.255.245.51
  From: 10.255.245.50, State: Up, ActiveRoute: 0, LSPname: p2mp-st-br1
  ActivePath: path1 (primary)
  P2MP name: p2mp-lsp2
  LoadBalance: Random
  Encoding type: Packet, Switching type: Packet, GPID: IPv4
 *Primary   path1           State: Up
    Computed ERO (S [L] denotes strict [loose] hops): (CSPF metric: 25)
 192.168.208.17 S
   Received RRO (ProtectionFlag 1=Available 2=InUse 4=B/W 8=Node 10=SoftPreempt):

          192.168.208.17
Total 2 displayed, Up 2, Down 0
```

show mpls lsp detail count-active-routes

```
user@host> show mpls lsp detail count-active-routes
Ingress LSP: 1 sessions

213.119.192.2
  From: 156.154.162.128, State: Up, ActiveRoute: 1, LSPname: to-lahore
  ActivePath:  (primary)
  LSPtype: Static Configured
```



```
  LoadBalance: Random
  Autobandwidth
  MinBW: 5Mbps MaxBW: 250Mbps
  Adjustment Timer: 300 secs
  Max AvgBW util: 60.2599Mbps, Bandwidth Adjustment in 0 second(s).
  Overflow limit: 0, Overflow sample count: 0
  Encoding type: Packet, Switching type: Packet, GPID: IPv4
 *Primary                    State: Up
    Priorities: 7 0
    Bandwidth: 5Mbps
    SmartOptimizeTimer: 180
    Computed ERO (S [L] denotes strict [loose] hops): (CSPF metric: 4)
 10.252.0.177 S
    Received RRO (ProtectionFlag 1=Available 2=InUse 4=B/W 8=Node 10=SoftPreempt
 20=Node-ID):
          10.252.0.177
Total 1 displayed, Up 1, Down 0

Egress LSP: 0 sessions
Total 0 displayed, Up 0, Down 0

Transit LSP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

show mpls lsp statistics extensive

```
user@host> show mpls lsp statistics extensive
Ingress LSP: 1 sessions

192.168.0.4
  From: 192.168.0.5, State: Up, ActiveRoute: 0, LSPname: E-D
  Statistics: Packets 302, Bytes 28992
  Aggregate statistics: Packets 302, Bytes 28992
  ActivePath:  (primary)
  LSPtype: Static Configured, Penultimate hop popping
  LoadBalance: Random
  Encoding type: Packet, Switching type: Packet, GPID: IPv4
 *Primary                    State: Up
    Priorities: 7 0
    SmartOptimizeTimer: 180
    Computed ERO (S [L] denotes strict [loose] hops): (CSPF metric: 30)
 10.0.0.18 S 10.0.0.22 S
    Received RRO (ProtectionFlag 1=Available 2=InUse 4=B/W 8=Node 10=SoftPreempt
 20=Node-ID):
          10.0.0.18 10.0.0.22
    6 Oct  3 11:18:28.281 Selected as active path
    5 Oct  3 11:18:28.281 Record Route:  10.0.0.18 10.0.0.22
    4 Oct  3 11:18:28.280 Up
    3 Oct  3 11:18:27.995 Originate Call
    2 Oct  3 11:18:27.995 CSPF: computation result accepted  10.0.0.18 10.0.0.22

    1 Oct  3 11:17:59.118 CSPF failed: no route toward 192.168.0.4[2 times]
  Created: Wed Oct  3 11:17:01 2012
Total 1 displayed, Up 1, Down 0
```

show mpls lsp autobandwidth

Syntax

show mpls lsp autobandwidth
<brief | detail | extensive>
<logical-system (all | *logical-system-name*)>

Release Information

Command introduced in Junos OS Release 11.4.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description

Display automatic bandwidth information for the LSP(s).

Options

brief | detail | extensive —(Optional) Display the specified level of output. The extensive option displays the same information as the detail option, but covers the most recent 50 events.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- show mpls lsp on page 3870

List of Sample Output

show mpls lsp autobandwidth on page 3885

Output Fields

Table 287 on page 3884 describes the output fields for the **show mpls lsp autobandwidth** command. Output fields are listed in the approximate order in which they appear.

Table 287: show mpls lsp autobandwidth Output Fields

Field Name	Field Description	Level of Output
To	Destination (egress routing device) of the session.	All Levels
From	Source (ingress routing device) of the session.	All Levels
LSPname	Name of the LSP.	All Levels
Min BW	(Ingress LSP) Configured minimum value of the LSP, in bps.	**detail extensive**
Max BW	(Ingress LSP) Configured maximum value of the LSP, in bps.	**detail extensive**
Max AvgBW util	(Ingress LSP) Current value of the actual maximum average bandwidth utilization, in bps.	**detail extensive**
Overflow limit	(Ingress LSP) Configured value of the threshold overflow limit.	**detail extensive**
Overflow sample count	(Ingress LSP) Current value for the overflow sample count.	**detail extensive**
Underflow limit	(Ingress LSP) Configured value of the threshold underflow limit.	**detail extensive**

Table 287: show mpls lsp autobandwidth Output Fields *(continued)*

Field Name	Field Description	Level of Output
Underflow sample count	(Ingress LSP) Current value for the underflow sample count.	**detail extensive**
Adjustment Timer	(Ingress LSP) Configured value for the adjust-timer statement, indicating the total amount of time allowed before bandwidth adjustment will take place, in seconds.	**detail extensive**
Adjustment Threshold	(Ingress LSP) Configured value for the adjust-threshold statement. Specifies how sensitive the automatic bandwidth adjustment for an LSP is to changes in bandwidth utilization.	**detail extensive**
Time for Next Adjustment	(Ingress LSP) Time in seconds until the next automatic bandwidth adjustment sample is taken.	**detail extensive**
Time of Last Adjustment	(Ingress LSP) Date and time since the last automatic bandwidth adjustment was completed.	**detail extensive**
Last BW	Previous active bandwidth of the LSP.	**detail extensive**
Last Requested BW	Bandwidth requested in the previous automatic bandwidth adjustment.	**detail extensive**
Last Signaled BW	Bandwidth signaled in the previous automatic bandwidth adjustment.	**detail extensive**
Highest Watermark BW	Maximum bandwidth used by the LSP.	**detail extensive**
Total AutoBw Adjustments	Total number of attempts to adjust automatic bandwidth including failed and successful adjustments.	**detail extensive**
Successful Adjustments	Number of successful automatic bandwidth adjustments.	**detail extensive**
Failed Adjustments	Number of failed automatic bandwidth adjustments.	**detail extensive**

Sample Output

show mpls lsp autobandwidth

```
user@host> show mpls lsp autobandwidth extensive
To: 10.255.106.133,
From: 10.255.106.135, LSPname: r0-r1
Min BW: 100kbps, Max BW: 0bps, Max AvgBW util: 2.33249Mbps
Overflow limit: 0, Overflow sample count: 0
Underflow limit: 0, Underflow sample count: 0
Adjustment Timer: 300 sec, Adjustment Threshold: 0
Time for Next Adjustment: 23 sec, Time of Last Adjustment: Fri Jun  3 21:05:37
2011
Last BW: 100kbps, Last Requested BW: 2.2169Mbps, Last Signaled BW: 2.2169Mbps,
Highest Watermark BW: 2.33249Mbps
Total AutoBw Adjustments: 1, Successful Adjustments: 1, Failed Adjustments: 0
```


show mpls path

Syntax

show mpls path
<logical-system (all | *logical-system-name*)>
<*path-name*>

Syntax (EX Series Switches)

show mpls path
<*path-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display dynamic Multiprotocol Label Switching (MPLS) label-switched paths (LSPs).

Options

none—Display standard information about all MPLS LSPs.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

path-name—(Optional) Display information about the specified LSP only.

Required Privilege Level

view

List of Sample Output

show mpls path on page 3887

Output Fields

Table 288 on page 3887 describes the output fields for the **show mpls path** command. Output fields are listed in the approximate order in which they appear.

Table 288: show mpls path Output Fields

Field Name	Field Description
Path name	Information about ingress LSPs. Each path has one line of output.
Address	Addresses of the routing devices that form the LSP.
Strict/loose address	Whether the address is a configured as a strict or loose address.

Sample Output

show mpls path

```
user@host> show mpls path
Path name        Address         Strict/loose address
p1               123.456.55.6    Strict
                 123.456.1.6     Loose
p2               191.456.1.4     Strict
```

show mpls static-lsp

Syntax

show mpls static-lsp
<brief | detail | extensive | terse>
<bypass>
<descriptions>
<down | up>
<ingress>
<logical-system (all | *logical-system-name*)>
<*lsp-type*>
<name *name*>
<statistics>
<transit>

Release Information

Command introduced in Junos OS Release 10.1.

Description

Display information about configured and active static Multiprotocol Label Switching (MPLS) label-switched paths (LSPs).

Options

none—Display standard information about all configured and active static MPLS LSPs.

brief | detail | extensive | terse—(Optional) Display the specified level of output. The **extensive** option displays the same information as the **detail** option, but covers the most recent 50 events.

bypass—(Optional) Display LSPs used for protecting other static LSPs.

descriptions—(Optional) Display the MPLS static LSP descriptions. To view this information, you must configure the description statement at the **[edit protocols mpls static-label-switched-path *path-name* bypass]**, **[edit protocols mpls static-label-switched-path *path-name* ingress]**, or **[edit protocols mpls static-label-switched-path *path-name* transit *incoming-label*]** hierarchy levels. Only static LSPs with a description are displayed.

down | up—(Optional) Display only static LSPs that are inactive or active, respectively.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

lsp-type—(Optional) Display information about a particular LSP type:

- **bypass**—Sessions for bypass LSPs.
- **ingress**—Sessions that originate from this routing device.
- **transit**—Sessions that pass through this routing device.

name *name*—(Optional) Display information about the specified static LSP or group of LSPs.

statistics—(Optional) Display accounting information about static LSPs.

transit—(Optional) Display static LSPs transiting this routing device.

Required Privilege Level view

List of Sample Output show mpls static-lsp extensive on page 3890
show mpls static-lsp statistics ingress on page 3890

Output Fields Table 289 on page 3889 describes the output fields for the **show mpls static-lsp** command. Output fields are listed in the approximate order in which they appear.

Table 289: show mpls static-lsp Output Fields

Field Name	Field Description	Level of Output
Ingress LSPs	Information about the static LSPs on the ingress routing device. Each session has one line of output.	All levels
Transit LSPs	Number of static LSPs on the transit routing devices and the state of these paths. MPLS learns this information by querying RSVP, which holds all the transit and egress session information.	All levels
Bypass LSPs	Information about the bypass LSPs configured on the routing device. Each session has one line of output.	All levels
LSPname	Name of the static LSP.	All levels
To	Destination (egress routing device) of the session.	All levels
State	State of the static LSP handled by this RSVP session: **Up**, **Dn** (down), or **Restart**.	All levels
Packets	Number of packet transiting the static LSP (**statistics** option only).	All levels
Bytes	Number of bytes transiting the static LSP (**statistics** option only).	All levels
Nexthop	IP address for the next-hop router for the static LSP.	**detail**, **extensive**
Bypass	(Bypass LSP) Destination address (egress routing device) for the bypass LSP.	All levels
Link protection desired	Link protection has been requested by the ingress routing device.	**detail**, **extensive**
LabelOperation	Label operation to perform: **Push**, **Pop**, **Swap**.	**detail**, **extensive**
Outgoing-label	Outgoing label to use for the MPLS packet in either push or swap label operations.	**detail**, **extensive**
Created	(Ingress LSP) Date and time the static LSP was created.	**extensive**
Bandwidth	Bandwidth configured for the static LSP.	**detail**, **extensive**
Resv style	(Bypass) RSVP reservation style. This field consists of two parts: the number of active reservations and the reservation style, which can be **FF** (fixed filter), **SE** (shared explicit), or **WF** (wildcard filter).	All levels

Sample Output

show mpls static-lsp extensive

```
user@host> show mpls static-lsp extensive
Ingress LSPs:
LSPname: alpha-to-beta, To: 192.168.14.1
  State: Dn
  Nexthop: 192.168.10.1
  LabelOperation: Push, Outgoing-label: 1000001
  Created: Thu Jan 14 16:44:43 2010
  Bandwidth: 0 bps
Total 1, displayed 1, Up 0, Down 1

Transit LSPs:
Total 0, displayed 0, Up 0, Down 0

Bypass LSPs:
Total 0, displayed 0, Up 0, Down 0
```

show mpls static-lsp statistics ingress

```
user@host> show mpls static-lsp statistics ingress
Ingress LSPs:
LSPname                      To              State      Packets            Bytes
alpha-to-beta                192.168.14.1    Dn              NA               NA
Total 1, displayed 1, Up 0, Down 1
```

show rsvp interface

Syntax

show rsvp interface
<brief | detail | extensive>
<link-management>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show rsvp interface
<brief | detail | extensive>
<link-management>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display the status of Resource Reservation Protocol (RSVP)-enabled interfaces and packet statistics.

Options

none—Display standard information about the status of RSVP-enabled interfaces and packet statistics.

brief | detail | extensive | link-management—(Optional) Display the specified level of output.

link-management—(Optional) Use the link-management option to display the control peers and corresponding TE-link information created by the Link Management Protocol (LMP).

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show rsvp interface brief on page 3894
show rsvp interface detail on page 3894
show rsvp interface extensive on page 3894
show rsvp interface link-management on page 3895

Output Fields

Table 290 on page 3891 lists the output fields for the **show rsvp interface** command. Output fields are listed in the approximate order in which they appear.

Table 290: show rsvp interface Output Fields

Field Name	Field Description	Level of Output
RSVP interface	Number of interfaces on which RSVP is active. Each interface has one line of output.	All levels
Interface	Name of the interface.	All levels
Index	Index of the interface.	**detail**

Table 290: show rsvp interface Output Fields *(continued)*

Field Name	Field Description	Level of Output
State	State of the interface. • **Disabled**—No traffic engineering information is displayed. • **Down**—Interface is not operational. • **Enabled**—Displays traffic engineering information. • **Up**—Interface is operational.	All levels
NoAuthentication	Interface does not support RSVP authentication.	**detail**
NoAggregate	Interface does not support refresh reduction.	**detail**
NoReliable	Interface does not support refresh reduction message ID extension.	**detail**
NoLinkProtection	Interface does not support link protection.	**detail**
HelloInterval	Frequency at which RSVP hellos are sent on this interface (in seconds).	**detail**
Address	IP address of the local interface.	**detail**
Active control channel	Next-hop link address to transmit messages.	None specified
TElink	Traffic-engineered links that are managed by the peer they are associated with.	None specified
Active resv	Number of reservations that are actively reserving bandwidth on the interface.	All levels
PreemptionCnt	Number of times an RSVP session was preempted on this interface.	**detail**
Update threshold	Percentage change in reserved bandwidth to trigger an IGP update.	**detail**
Subscription	User-configured subscription factor.	All levels
bc *number*	Bandwidth allocated for the specified bandwidth constraint.	**extensive**
ct *number*	Bandwidth allocated for the specified class type.	**extensive**
Static BW	Total interface bandwidth, in bps.	All levels
Available BW	Amount of bandwidth that RSVP is allowed to reserve, in bps. It is equal to (static bandwidth * subscription factor).	al levels
Reserved BW	Currently reserved bandwidth, in bps.	All levels
SoftPreemptionCnt	Number of times a soft preemption occurred on this interface. This number is not included in the **PreemptionCnt** value.	**detail**
Overbooked BW	Currently overbooked bandwidth, in bps, by class type (**ct0** through **ct3**).	**detail**

Table 290: show rsvp interface Output Fields *(continued)*

Field Name	Field Description	Level of Output
Highwater mark	Highest bandwidth that has ever been reserved on this interface, in bps.	**brief**
PacketType	Type of RSVP packet.	**detail**
Total Sent	Total number of packets sent.	**detail**
Total Received	Total number of packets received since RSVP was enabled.	**detail**
Last 5 seconds Sent	Number of packets sent in the last 5 seconds.	**detail**
Last 5 seconds Received	Number of packets received in the last 5 seconds.	**detail**
Path	Statistics about Path messages, which are sent from the RSVP sender along the data paths and store path state information in each node along the path.	**detail**
PathErr	Statistics about PathErr messages, which are advisory messages that are sent upstream to the sender.	**detail**
PathTear	Statistics about PathTear messages, which remove path states and dependent reservation states in any routers along a path.	**detail**
Resv	Statistics about Resv messages, which are sent from the RSVP receiver along the data paths and store reservation state information in each node along the path.	**detail**
ResvErr	Statistics about ResvErr messages, which are advisory messages that are sent when an attempt to establish a reservation fails.	**detail**
ResvTear	Statistics about ResvTear messages, which remove reservation states along a path.	**detail**
Hello	Number of RSVP hello packets that have been sent to and received from the neighbor.	**detail**
Ack	Acknowledge message for refresh reductions.	**detail**
Srefresh	Summary refresh messages.	**detail**
EndtoEnd RSVP	Statistics for the number of end-to-end RSVP messages sent.	**detail**
Queue	CoS transmit queue number and its associated forwarding class designation.	**extensive**
TxRate	Configured bandwidth in Mbps and configured bandwidth as a percentage of the specified queue.	**extensive**
Priority	Weight of the queue relative to other configured queues, in percentage.	**extensive**

Table 290: show rsvp interface Output Fields *(continued)*

Field Name	Field Description	Level of Output
queue-priority-value	**Low**, **High**, **None**, or **Exact**. **None** indicates no rate limiting. **Exact** indicates the queue transmits at the configured rate only.	**extensive**

Sample Output

show rsvp interface brief

```
user@host> show rsvp interface brief
RSVP interface: 1 active
                  Active Subscr- Static      Available   Reserved    Highwater
Interface    State resv   iption  BW          BW          BW          mark
de0.0      Up          1     23%     10Mbps      989.992kbps 1.31Mbps    1.31Mbps
```

show rsvp interface detail

```
user@host> show rsvp interface detail
so-0/1/1.0  Index 6, State: Ena/Up
  NoAuthentication, NoAggregate, NoReliable, NoLinkProtection
  HelloInterval 3(second)
  Address 192.168.207.29, 10.255.245.194
  ActiveResv 0, PreemptionCnt 0, Update threshold 10%
  Subscription 100%, StaticBW 155.52Mbps, AvailableBW 155.52Mbps
ReservedBW [0] 155Mbps[1] 0bps[2] 0bps[3] 0bps[4] 0bps[5] 0bps[6] 0bps[7] 0bps
SoftPreemptionCnt1
OverbookedBW [0] 0bps[1] 0bps[2] 0bps[3] 0bps[4] 155Mbps[5] 0bps[6] 0bps[7] 0bps
PacketType              Total                    Last 5 seconds
                   Sent       Received          Sent       Received
  Path               16              0             1              0
  PathErr             0              0             0              0
  PathTear            1              0             0              0
  Resv                0             11             0              1
  ResvErr             0              0             0              0
  ResvTear            0              0             0              0
  Hello              66             67             1              1
  Ack                 0              0             0              0
  Srefresh            0              0             0              0
  EndtoEnd RSVP       0              0             0              0
...
```

show rsvp interface extensive

```
user@host> show rsvp interface extensive
so-1/0/0.0 Index 72, State Ena/Up
  NoAuthentication, NoAggregate, NoReliable, NoLinkProtection
  HelloInterval 9(second)
  Address 192.168.213.22, 10.255.240.175
  ActiveResv 1, PreemptionCnt 0, Update threshold 10%
  Subscription 100%,
  bc0 = (ct0+ct1+ct2+ct3), StaticBW 622.08Mbps
  bc1 = (ct1+ct2+ct3), StaticBW 466.56Mbps
  bc2 = (ct2+ct3), StaticBW 311.04Mbps
  bc3 = ct3, StaticBW 155.52Mbps
  ct0: StaticBW 155.52Mbps, AvailableBW 522.08Mbps
  ReservedBW [0] 0bps[1] 0bps[2] 0bps[3] 0bps[4] 0bps[5] 0bps[6] 0bps[7] 0bps
  ct1: StaticBW 155.52Mbps, AvailableBW 366.56Mbps
  ReservedBW [0] 100Mbps[1] 0bps[2] 0bps[3] 0bps[4] 0bps[5] 0bps[6] 0bps[7] 0bps
```



```
ct2: StaticBW 155.52Mbps, AvailableBW 311.04Mbps
ReservedBW [0] 0bps[1] 0bps[2] 0bps[3] 0bps[4] 0bps[5] 0bps[6] 0bps[7] 0bps
ct3: StaticBW 155.52Mbps, AvailableBW 155.52Mbps
ReservedBW [0] 0bps[1] 0bps[2] 0bps[3] 0bps[4] 0bps[5] 0bps[6] 0bps[7] 0bps
Queue          TxRate             Priority Exact
  0            155.52Mbps         25%      Low
  1            155.52Mbps         25%      Low
  2            155.52Mbps         25%      Low
  3            155.52Mbps         25%      Low
```

show rsvp interface link-management

```
user@host> show rsvp interface link-management
RSVP interface: 2 active
PEER-C  State: Up
Active Control Channel: so-0/1/0.0

  TElink: TElnk1, Link ID: 37811
  ActiveResv 0, PreemptionCnt 0
  StaticBW 155.52Mbps, ReservedBW: 0bps, AvailableBW: 155.52Mbps

  TElink: TElnk2, Link ID: 37808
  ActiveResv 1, PreemptionCnt 0
  StaticBW 155.52Mbps, ReservedBW: 0bps, AvailableBW: 155.52Mbps

PEER-B  State: Up
Active Control Channel: so-1/0/0.0

  TElink: TElnkAB1, Link ID: 1598
  ActiveResv 0, PreemptionCnt 0
  StaticBW 622.08Mbps, ReservedBW: 0bps, AvailableBW: 622.08Mbps

  TElink: TElnkAB2, Link ID: 1597
  ActiveResv 0, PreemptionCnt 0
  StaticBW 622.08Mbps, ReservedBW: 0bps, AvailableBW: 622.08Mbps
```


show rsvp neighbor

Syntax

show rsvp neighbor
<brief | detail>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show rsvp neighbor
<brief | detail>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display Resource Reservation Protocol (RSVP) neighbors that were discovered dynamically during the exchange of RSVP packets.

Options

none—Display standard information about RSVP neighbors.

brief | detail—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show rsvp neighbor on page 3900
show rsvp neighbor detail on page 3900

Output Fields

Table 291 on page 3896 lists the output fields for the **show rsvp neighbor** command. Output fields are listed in the approximate order in which they appear.

Table 291: show rsvp neighbor Output Fields

Field Name	Field Description	Level of Output
RSVP neighbor	Number of neighbors that the routing device has learned of. Each neighbor has one line of output.	All levels
via	Name of the interface where the neighbor has been detected. In the case of generalized MPLS (GMPLS) LSPs, the name of the peer where the neighbor has been detected.	**detail**
Address	Address of a learned neighbor.	All levels
Idle	Length of time the neighbor has been idle, in seconds.	All levels
Up/Dn	Number of neighbor up or down transitions detected by RSVP hello packets. If the up count is 1 greater than the down count, the neighbor is currently up. Otherwise, the neighbor is down. Neighbors that do not support RSVP hello packets, such as routers running Junos OS Release 3.2 or earlier, are not reported as up or down.	All levels

Table 291: show rsvp neighbor Output Fields *(continued)*

Field Name	Field Description	Level of Output
Up cnt and Down cnt	Number of neighbor up or down transitions detected by RSVP hello packets. If the up count is 1 greater than the down count, the neighbor is currently up. Otherwise, the neighbor is down. Neighbors that do not support RSVP hello packets, such as routers running Junos OS Release 3.2 or earlier, are not reported as up or down.	**detail**

status	State of the RSVP neighbor:
	• **Up**—Routing device can detect RSVP Hello messages from the neighbor.
	• **Down**—Routing device has received one of the following indications:
	  ◦ Communication failure from the neighbor.
	  ◦ Communication from IGP that the neighbor is unavailable.
	  ◦ Change in the sequence numbers in the RSVP Hello messages sent by the neighbor.
	• **Restarting**—RSVP neighbor is unavailable and might be restarting. The neighbor remains in this state until it has restarted or is declared dead. This state is possible only when graceful restart is enabled.
	• **Restarted**—RSVP neighbor has restarted and is undergoing state recovery (graceful restart) procedures.
	• **Dead**—Routing device has lost all communication with the RSVP neighbor. Any RSVP sessions with that neighbor are torn down.
		detail

LastChange	Time elapsed since the neighbor state changed either from up to down or from down to up. The format is ***hh:mm:ss***.	All levels
Last changed time	Time elapsed since the neighbor state changed either from up to down or from down to up.	**detail**
HelloInt	Frequency at which RSVP hellos are sent on this interface (in seconds).	All levels
HelloTx/Rx	Number of hello packets sent to and received from the neighbor.	All levels
Hello	Number of RSVP hello packets that have been sent to and received from the neighbor.	**detail**
Message received	Number of Path and Resv messages that this routing device has received from the neighbor.	**detail**
Remote Instance	Identification provided by the remote routing device during Hello message exchange.	**detail**
Local Instance	Identification sent to the remote routing device during Hello message exchange.	**detail**

Table 291: show rsvp neighbor Output Fields *(continued)*

Field Name	Field Description	Level of Output
Refresh reduction	Measure of processing overhead requests of refresh messages. Refresh reduction extensions improve routing device performance by reducing the process overhead, thus increasing the number of LSPs a routing device can support. **Refresh reduction** can have the following values: • **operational**—All four RSVP refresh reduction extensions—message ack, bundling, summary refresh, and staged refresh timer—are functional between the two neighboring routing devices. For a detailed explanation of these extensions, see RFC 2961. • **incomplete**—Some RSVP refresh reduction extensions are functional between the two neighboring routing devices. • **no operational**—Either the refresh reduction feature has been turned off, or the remote routing device cannot support the refresh reduction extensions.	**detail**
Remote end	Neighboring routing device's status with regard to refresh reduction: • **enabled**—Remote routing device has requested refresh reduction during RSVP message exchanges. • **disabled**—Remote routing device does not require refresh reduction.	**detail**
Ack-extension	An RSVP refresh reduction extension: • **enabled**—Both local and remote routing devices support the ack-extension (RFC 2961). • **disabled**—Remote routing device does not support the ack-extension.	**detail**
Link protection	Status of the MPLS fast reroute mechanism that protects traffic from link failure: • **enabled**—Link protection feature has been turned on, protecting the neighbor with a bypass LSP. • **disabled**—No link protection feature has been enabled for this neighbor.	**detail**
LSP name	Name of the bypass LSP.	**detail**
Bypass LSP	Status of the bypass LSP. It can have the following values: • **does not exist**—Bypass LSP is not available. • **connecting**—Routing device is in the process of establishing a bypass LSP, and the LSP is not available for link protection at the moment. • **operational**—Bypass LSP is up and running. • **down**—Bypass LSP has gone down, with the most probable cause a node or a link failure on the bypass path.	**detail**
Backup routes	Number of user LSPs (or routes) that are being protected by a bypass LSP (before link failure).	**detail**
Backup LSPs	Number of LSPs that have been temporarily established to maintain traffic by refreshing the downstream LSPs during link failure (not a one-to-one correspondence).	**detail**
Bypass explicit route	Explicit route object's (ERO) path that is taken by the bypass LSP.	**detail**

Table 291: show rsvp neighbor Output Fields *(continued)*

Field Name	Field Description	Level of Output
Restart time	Length of time a neighbor waits to receive a Hello from the restarting node before declaring the node dead and deleting the states (in milliseconds).	**detail**
Recovery time	Length of time during which the restarting node attempts to recover its lost states with help from its neighbors (in milliseconds). Recovery time is advertised by the restarting node to its neighbors, and applies to nodal faults. The restarting node considers its graceful restart complete after this time has elapsed.	**detail**

Sample Output

show rsvp neighbor

```
user@host> show rsvp neighbor
RSVP neighbor: 2 learned
Address            Idle Up/Dn LastChange HelloInt HelloTx/Rx
192.168.207.203       0  3/2       13:01        3   366/349
192.168.207.207       0  1/0       22:49        3   448/448
```

show rsvp neighbor detail

```
user@host> show rsvp neighbor detail
RSVP neighbor: 2 learned
Address: 192.168.207.203   via: ecstasyl status: Up
   Last changed time: 28:47, Idle: 0 sec, Up cnt: 3, Down cnt: 2
   Message received: 632
   Hello: sent 673, received 656, interval 3 sec
   Remote instance: 0x6432838a, Local instance: 0x74b72e36
   Refresh reduction:  operational
     Remote end: enabled,  Ack-extension: enabled
   Link protection:  enabled
     LSP name: Bypass_to_192.168.207.203
     Bypass LSP: operational,  Backup routes: 1,  Backup LSPs: 0
     Bypass explicit route: 192.168.207.207 192.168.207.224
  Restart time: 60000 msec, Recovery time: 0 msec
```

show rsvp session

Syntax

show rsvp session
<brief | detail | extensive | terse>
<bidirectional | unidirectional>
<bypass>
<down | up>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>
<*lsp-type*>
<name *session-name*>
<p2mp>
<*session-type*>
<statistics>
<te-link *te-link*>

Syntax (EX and QFX Series Switches)

show rsvp session
<brief | detail | extensive | terse>
<bidirectional | unidirectional>
<bypass>
<down | up>
<interface *interface-name*>
<*lsp-type*>
<name *session-name*>
<p2mp>
<*session-type*>
<statistics>
<te-link *te-link*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.

Description

Display information about Resource Reservation Protocol (RSVP) sessions.

Options

none—Display standard information about all RSVP sessions.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

bidirectional | unidirectional—(Optional) Display information about bidirectional or unidirectional RSVP sessions only, respectively.

bypass—(Optional) Display RSVP sessions for bypass LSPs.

down | up—(Optional) Display only LSPs that are inactive or active, respectively.

interface *interface-name*—(Optional) Display RSVP sessions for the specified interface only.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

lsp-type—(Optional) Display information about RSVP sessions with regard to LSPs:

- **bypass**—Sessions used for bypass LSPs.
- **lsp**—Sessions used to set up LSPs.
- **nolsp**—Sessions not used to set up LSPs.

name ***session-name***—(Optional) Display information about the named session.

p2mp—(Optional) Display point-to-multipoint information.

session-type—(Optional) Display information about a particular session type:

- **egress**—Sessions that terminate on this routing device.
- **ingress**—Sessions that originate from this routing device.
- **transit**—Sessions that transit through this routing device.

statistics—(Optional) Display packet statistics.

te-link ***te-link***—(Optional) Display sessions with reservations on the specified TE link.

Required Privilege Level

view

Related Documentation

- clear rsvp session on page 3819

List of Sample Output

show rsvp session on page 3906
show rsvp session statistics on page 3906
show rsvp session detail on page 3906
show rsvp session detail (Path MTU Output Field) on page 3907
show rsvp session detail (GMPLS) on page 3907
show rsvp session extensive on page 3908
show rsvp session p2mp (Ingress Router) on page 3908
show rsvp session p2mp (Transit Router) on page 3909

Output Fields

Table 292 on page 3902 describes the output fields for the **show rsvp session** command. Output fields are listed in the approximate order in which they appear.

Table 292: show rsvp session Output Fields

Field Name	Field Description	Level of Output
Ingress RSVP	Information about ingress RSVP sessions.	**detail**
Ingress RSVP	Information about ingress RSVP sessions. Each session has one line of output.	All levels
Egress RSVP	Information about egress RSVP sessions.	All levels
Transit RSVP	Information about the transit RSVP sessions.	All levels
P2MP name	(Appears only when the **p2mp** option is specified). Name of the point-to-multipoint LSP path.	All levels

Table 292: show rsvp session Output Fields *(continued)*

Field Name	Field Description	Level of Output
P2MP branch count	(Appears only when the **p2mp** option is specified). Number of LSPs receiving packets from the point-to-multipoint LSP.	All levels
To	Destination (egress routing device) of the session.	All levels
From	Source (ingress routing device) of the session.	All levels
State	State of the path: **Up**, **Down**, or **AdminDn**. **AdminDn** indicates that the LSP is being taken down gracefully.	All levels
Address	Destination (egress routing device) of the LSP.	**detail**
From	Source (ingress routing device) of the session.	**detail**
LSPstate	State of the LSP that is being handled by this RSVP session. It can be either **Up**, **Dn** (down), or **AdminDn**. **AdminDn** indicates that the LSP is being taken down gracefully.	**brief detail**
Rt	Number of active routes (prefixes) that have been installed in the routing table. For ingress RSVP sessions, the routing table is the primary IPv4 table (**inet.0**). For transit and egress RSVP sessions, the routing table is the primary MPLS table **mpls.0**).	**brief**
Active Route	Number of active routes (prefixes) that have been installed in the forwarding table. For ingress RSVP sessions, the forwarding table is the primary IPv4 table (**inet.0**). For transit and egress RSVP sessions, the forwarding table is the primary MPLS table (**mpls.0**).	**detail**
LSPname	Name of the LSP.	**brief detail**
LSPpath	Indicates whether the RSVP session is for the primary or secondary LSP path. **LSPpath** can be either **primary** or **secondary** and can be displayed on the ingress, egress, and transit routing devices. **LSPpath** can also indicate when a graceful LSP deletion has been triggered.	**detail**
Bypass	(Egress routing device) Destination address for the bypass LSP.	**detail**
Bidir	(When LSP is bidirectional) LSP will allow data to travel in both directions between GMPLS devices.	**detail**
Bidirectional	(When LSP is bidirectional) LSP will allow data to travel both ways between GMPLS devices.	**detail**
Upstream label in	(When LSP is bidirectional) Incoming label for reverse direction traffic for this LSP.	**detail**
Upstream label out	(When LSP is bidirectional) Outgoing label for reverse direction traffic for this LSP.	**detail**

Table 292: show rsvp session Output Fields *(continued)*

Field Name	Field Description	Level of Output
Recovery label received	(When LSP is bidirectional) Label the upstream node suggests for use in the Resv message that is sent.	**detail**
Recovery label sent	(When LSP is bidirectional) Label the downstream node suggests for use in its Resv messages that is returned.	**detail**
Suggested label received	(When LSP is bidirectional) Label the upstream node suggests for use in the Resv message that is sent.	**detail**
Suggested label sent	(When LSP is bidirectional) Label the downstream node suggests for use in its Resv message that is returned.	**detail**
Resv style or **Style**	RSVP reservation style. This field consists of two parts. The first is the number of active reservations. The second is the reservation style, which can be **FF** (fixed filter), **SE** (shared explicit), or **WF** (wildcard filter).	**brief detail**
Label in	Incoming label for this LSP.	**brief detail**
Label out	Outgoing label for this LSP.	**brief detail**
Time left	Number of seconds remaining in the lifetime of the reservation.	**brief detail**
Since	Date and time when the RSVP session was initiated.	**detail**
Tspec	Sender's traffic specification, which describes the sender's traffic parameters.	**detail**
DiffServ info	Indicates whether the LSP is a multiclass LSP (**multiclass diffServ-TE LSP**) or a Differentiated-Services-aware traffic engineering LSP (**diffServ-TE LSP**).	**detail**
bandwidth	Bandwidth for each class type (**ct0**, **ct1**, **ct2**, or **ct3**).	**detail**
Port number	Protocol ID and sender/receiver port used in this RSVP session.	**detail**
Attrib flags	**Non-PHP** indicates that ultimate hop popping has been requested by the LSP using this RSVP session	extensive
FastReroute desired	Fast reroute has been requested by the ingress routing device.	**detail**
Soft preemption desired	Soft preemption has been requested by the ingress routing device.	**detail**
FastReroute desired	(Data [not a bypass or backup] LSP when the protection scheme has been requested) Fast reroute (one-to-one backup) has been requested by the ingress routing device.	**detail extensive**
Link protection desired	(Data [not a bypass or backup] LSP when the protection scheme has been requested) Link protection (many-to-one backup) has been requested by the ingress routing device.	**detail extensive**

Table 292: show rsvp session Output Fields *(continued)*

Field Name	Field Description	Level of Output
Node/Link protection desired	(Data [not a bypass or backup] LSP when the protection scheme has been requested) Node and link protection (many-to-one backup) has been requested by the ingress routing device.	**detail extensive**
Type	LSP type: • **Link protected LSP**—LSP has been protected by link protection at the outgoing interface. The name of the bypass used is also listed here (**extensive**). • **Node/Link protected LSP**—LSP has been protected by node and link protection at the outgoing interface. The name of the bypass used is also listed here (**extensive**). • **Protection down**—LSP is not currently protected. • **Bypass LSP**—LSP that is used to protected one or more user LSPs in case of link failure. • **Backup LSP at Point-of-Local-Repair (PLR)**—LSP that has been temporarily established to protected a user LSP at the ingress of a failed link. • **Backup LSP at Merge Point (MP)**—LSP that has been temporarily established to protected a user LSP at the egress of a failed link.	**detail extensive**
New bypass	New bypass (the bypass name is also displayed) has been activated to protect the LSP.	**extensive**
Link protection up, using *bypass-name*	Link protection (the bypass name is also displayed) has been activated for the LSP.	**extensive**
Creating backup LSP, link down	A **link down** event occurred, and traffic is being switched over to the bypass LSP.	**extensive**
Deleting backup LSP, protected LSP restored	Link has come back up and the LSP has been restored. Because the backup LSP is no longer needed, it is deleted.	**extensive**
Path mtu	Displays the value of the path MTU received from the network (through signaling) and the value used for forwarding. This value is only displayed on ingress routing devices with the **allow-fragmentation** statement configured at the **[edit protocols mpls path-mtu]** hierarchy level. If there is a detour LSP, the path MTU for the detour is also displayed.	**detail**
PATH rcvfrom	Address of the previous-hop (upstream) routing device or client, interface the neighbor used to reach this routing device, and number of packets received from the upstream neighbor.	**detail**
Adspec	MTU signaled from the ingress routing device to the egress routing device by means of the adspec object.	**detail**
PATH sentto	Address of the next-hop (downstream) routing device or client, interface used to reach this neighbor (or peer-name in the GMPLS LSP case), and number of packets sent to the downstream routing device.	**detail**

Table 292: show rsvp session Output Fields *(continued)*

Field Name	Field Description	Level of Output
Explct route	Explicit route for the session. Normally this value will be the same as that of record route. Differences indicate that path rerouting has occurred, typically during fast reroute.	**detail**
Record route	Recorded route for the session, taken from the record route object. Normally this value will be the same as that of explct route. Differences indicate that path rerouting has occurred, typically during fast reroute.	**detail**

Sample Output

show rsvp session

```
user@host> show rsvp session
Ingress RSVP: 1 sessions
To              From            State   Rt Style Labelin Labelout LSPname
10.255.245.214  10.255.245.212  AdminDn  0  1 FF       -    22293 LSP Bidir
Total 1 displayed, Up 1, Down 0

Egress RSVP: 2 sessions
To              From            State Rt Style Labelin Labelout LSPname
10.255.245.194  10.255.245.195  Up     0  1 FF   39811        - Gpro3-ba Bidir
10.255.245.194  10.255.245.195  Up     0  1 FF       3        - pro3-ba
Total 2 displayed, Up 2, Down 0

Transit RSVP: 1 sessions
To              From            State Rt Style Labelin Labelout LSPname
10.255.245.198  10.255.245.197  Up     0  1 SE  100000        3 pro3-de
Total 1 displayed, Up 1, Down 0
```

show rsvp session statistics

```
user@host> show rsvp session statistics
Ingress RSVP: 2 sessions
To             From           State   Packets      Bytes     LSPname
10.255.245.24  10.255.245.22   Up          0        0        pro3-bd
10.255.245.24  10.255.245.22   Up      44868    2333136   pro3-bd-2
Total 2 displayed, Up 2, Down 0
Egress RSVP: 2 sessions
To             From           State   Packets      Bytes     LSPname
10.255.245.22  10.255.245.24   Up          0          0      pro3-db
10.255.245.22  10.255.245.24   Up          0          0   pro3-db-2
Total 2 displayed, Up 2, Down 0
Transit RSVP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

show rsvp session detail

```
user@host> show rsvp session detail
Ingress RSVP: 1 sessions
1.1.1.1
  From: 2.2.2.2, LSPstate: Up, ActiveRoute: 0
  LSPname: to-a, LSPpath: Primary
  Suggested label received: -, Suggested label sent: -
  Recovery label received: -, Recovery label sent: 3
  Resv style: 1 FF, Label in: -, Label out: 3
```

```
  Time left:    -, Since: Fri Mar 26 18:42:42 2004
  Tspec: rate 300kbps size 300kbps peak Infbps m 20 M 1500
  DiffServ info: diffServ-TE LSP, bandwidth: <ct1 300kbps>
  Port number: sender 1 receiver 15876 protocol 0
  PATH rcvfrom: localclient
  Adspec: sent MTU 1500
  PATH sentto: 192.168.37.16 (t1-0/2/1.0) 1 pkt
```

show rsvp session detail (Path MTU Output Field)

```
user@host> show rsvp session detail
Ingress RSVP: 1 sessions
10.255.245.3
  From: 10.255.245.5, LSPstate: Up, ActiveRoute: 3
  LSPname: to-c, LSPpath: Primary
  Suggested label received: -, Suggested label sent: -
  Recovery label received: -, Recovery label sent: 100432
  Resv style: 1 FF, Label in: -, Label out: 100432
  Time left:    -, Since: Mon Aug 16 17:54:40 2006
  Tspec: rate 0bps size 0bps peak Infbps m 20 M 9192
  Port number: sender 1 receiver 57843 protocol 0
  FastReroute desired
  PATH rcvfrom: localclient
  Adspec: sent MTU 4470
  Path mtu: received 4470, using 4458 for forwarding
  PATH sentto: 192.168.37.89 (so-0/2/3.0) 11 pkts
  RESV rcvfrom: 192.168.37.89 (so-0/2/3.0) 10 pkts
  Explct route: 192.168.37.89
  Record route: <self> 192.168.37.89 192.168.37.87
    Detour is Up
    Detour Tspec: rate 0bps size 0bps peak Infbps m 20 M 9192
    Detour adspec: sent MTU 1512
    Path mtu: received 1512, using 1500 for forwarding
```

show rsvp session detail (GMPLS)

```
user@host> show rsvp session detail
Ingress RSVP: 1 sessions
192.168.4.1
  From: 192.168.1.1, LSPstate: Dn, ActiveRoute: 0
  LSPname: gmpls-r1-to-r3, LSPpath: Primary
  Bidirectional, Upstream label in: 21253, Upstream label out: –
  Suggested label received: -, Suggested label sent: 21253
  Recovery label received: -, Recovery label sent: –
  Resv style: 0 –, Label in: -, Label out: –
  Time left:    -, Since: Mon Aug 16 17:54:40 2006
  Tspec: rate 0bps size 0bps peak 155.52Mbps m 20 M 1500
  Port number: sender 2 receiver 46115 protocol 0
  PATH rcvfrom: localclient
  Adspec: sent MTU 1500
  PATH MTU: received 0
  PATH sentto: 10.35.1.5 (so-0/2/3.0) 11 pkts
  Explct route: 100.100.100.100 93.93.93.93
  Record route: <self> 100.100.100.100 93.93.93.93
  Total 1 displayed, Up 0, Down 1
  Egress RSVP: 0 sessions
  Total 0 displayed, Up 0, Down 0
  Transit RSVP: 0 sessions
  Total 0 displayed, Up 0, Down 0
```


show rsvp session extensive

```
user@host> show rsvp session extensive
Ingress RSVP: 1 sessions

192.168.0.4
  From: 192.168.0.5, LSPstate: Up, ActiveRoute: 0
  LSPname: E-D, LSPpath: Primary
  LSPtype: Static Configured
  Suggested label received: -, Suggested label sent: -
  Recovery label received: -, Recovery label sent: 299808
  Resv style: 1 FF, Label in: -, Label out: 299808
  Time left:    -, Since: Thu Sep 20 15:54:20 2012
  Tspec: rate 0bps size 0bps peak Infbps m 20 M 1500
  Port number: sender 2 receiver 61576 protocol 0
  Attrib flags: Non-PHP
  PATH rcvfrom: localclient
  Adspec: sent MTU 1500
  Path MTU: received 1500
  PATH sentto: 10.0.0.18 (lt-1/2/0.17) 41 pkts
  RESV rcvfrom: 10.0.0.18 (lt-1/2/0.17) 40 pkts
  Explct route: 10.0.0.18 10.0.0.22
  Record route: <self> 10.0.0.18 10.0.0.22
Total 1 displayed, Up 1, Down 0

Egress RSVP: 1 sessions

192.168.0.5
  From: 192.168.0.4, LSPstate: Up, ActiveRoute: 0
  LSPname: E-D, LSPpath: Primary
  Suggested label received: -, Suggested label sent: -
  Recovery label received: -, Recovery label sent: -
  Resv style: 1 FF, Label in: 3, Label out: -
  Time left:  140, Since: Thu Sep 20 15:52:10 2012
  Tspec: rate 0bps size 0bps peak Infbps m 20 M 1500
  Port number: sender 1 receiver 49601 protocol 0
  PATH rcvfrom: 10.0.0.18 (lt-1/2/0.17) 44 pkts
  Adspec: received MTU 1500
  PATH sentto: localclient
  RESV rcvfrom: localclient
  Record route: 10.0.0.22 10.0.0.18 <self>
Total 1 displayed, Up 1, Down 0

Transit RSVP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

show rsvp session p2mp (Ingress Router)

```
user@host> show rsvp session p2mp
Ingress RSVP: 3 sessions
P2MP name: test, P2MP branch count: 1
To              From            State   Rt Style Labelin Labelout LSPname
10.255.10.95    10.255.10.2     Up       0  1 SE    -           3 to-pe1
P2MP name: test2, P2MP branch count: 2
To              From            State   Rt Style Labelin Labelout LSPname
10.255.10.23    10.255.10.2     Up       0  1 SE    -      299776 to-pe3
10.255.10.16    10.255.10.2     Up       0  1 SE    -      299776 to-pe4
Total 3 displayed, Up 3, Down 0

Egress RSVP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

```
Transit RSVP: 0 sessions
Total 0 displayed, Up 0, Down 0
```

show rsvp session p2mp (Transit Router)

```
user@host> show rsvp session p2mp
Ingress RSVP: 1 sessions
P2MP name: test, P2MP branch count: 1
To              From            State   Rt Style Labelin  Labelout LSPname
10.255.10.23    10.255.10.95    Up       0  1 SE    -       299792 to-pe2
Total 1 displayed, Up 1, Down 0

Egress RSVP: 1 sessions
P2MP name: test, P2MP branch count: 1
To              From            State   Rt Style Labelin Labelout  LSPname
10.255.10.95    10.255.10.2     Up       0  1 SE    3         -     to-pe1
Total 1 displayed, Up 1, Down 0

Transit RSVP: 2 sessions
P2MP name: test2, P2MP branch count: 2
To              From            State   Rt Style Labelin Labelout  LSPname
10.255.10.23    10.255.10.2     Up       0  1 SE   299776   299808  to-pe3
10.255.10.16    10.255.10.2     Up       0  1 SE   299776   299856  to-pe4
Total 2 displayed, Up 2, Down 0
```

show rsvp statistics

Syntax

show rsvp statistics
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show rsvp statistics

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display Resource Reservation Protocol (RSVP) packet and error statistics.

Options

none—Display RSVP packet and error statistics.

logical-system (all |*logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- clear rsvp statistics on page 3821

List of Sample Output

show rsvp statistics on page 3912

Output Fields

Table 293 on page 3910 describes the output fields for the **show rsvp statistics** command. Output fields are listed in the approximate order in which they appear.

Table 293: show rsvp statistics Output Fields

Field Name	Field Description
Packet Type	Statistics about different RSVP messages.
Total Sent	Total number of packets sent since RSVP was enabled.
Total Received	Total number of packets received since RSVP was enabled.
Last 5 seconds Sent	Total number of packets sent in the last 5 seconds.
Last 5 seconds Received	Number of packets received in the last 5 seconds.
Path	Statistics about Path messages, which are sent from the RSVP sender along the data paths and which store path state information in each node along the path.
PathErr	Statistics about PathErr messages, which are advisory messages that are sent upstream to the sender.
PathTear	Statistics about PathTear messages, which remove path states and dependent reservation states in any routing devices along a path.

Table 293: show rsvp statistics Output Fields *(continued)*

Field Name	Field Description
Resv FF	Statistics about fixed-filter reservation style messages, which consist of distinct reservations among explicit senders.
Resv WF	Statistics about wildcard-filter reservation style messages, which consist of shared reservations among wildcard senders.
Res SE	Statistics about shared-explicit reservation style messages, which consist of shared reservations among explicit senders.
ResvErr	Statistics about ResvErr messages, which are advisory messages that are sent when an attempt to establish a reservation fails.
ResvTear	Statistics about ResvTear messages, which remove reservation states along a path.
ResvConf	Statistics about ResvConfirm messages, which are responses to confirm a reservation request.
Ack	Acknowledge message for refresh reductions.
SRefresh	Summary refresh messages.
Hello	Number of RSVP hello packets that have been sent to and received from the neighbor.
EndtoEnd RSVP	Statistics for the number of End-to-end RSVP messages.
Errors	Statistics about errored RSVP packets.
Rcv pkt bad length	The packet was not processed because its length is inappropriate.
Rcv pkt unknown type	The packet is not one of the well-known RSVP types, as defined in RFC 2205, *Resource ReSerVation Protocol (RSVP)*.
Rcv pkt bad version	The packet is not an RSVP version 1 packet.
Rcv pkt auth fail	The packet failed authentication checks.
Rcv pkt bad checksum	The RSVP checksum check failed.
Rcv pkt bad format	General packet processing failed because the packet was badly formed.
Memory allocation fail	An internal resource failure occurred.
No path information	A reservation was received, but no sender is active.
Resv style conflict	The same session contains inconsistent reservation styles.
Port conflict	There were inconsistent port numbers for the same session.
Resv no interface	An interface for the receive reservation packets cannot be located.

Table 293: show rsvp statistics Output Fields *(continued)*

Field Name	Field Description
PathErr to client	Number of PathErr packets delivered to the local client.
ResvErr to client	Number of ResvErr packets delivered to the local client.
Path timeout	Number of times the sender timed out because the path was removed.
Resv timeout	Number of times the receiver timed out because the reservation was removed.
Message out-of-order	Records the number of RSVP incoming messages that are considered out of order. This is detected from the message ID object's sequence number.
Unknown ack msg	A neighboring routing device replies with an ACK object that contains an unknown message ID. This can indicate a message ID handshake problem. For example, a router receives an ACK for message IDs 1, 2, and 3. However, it only has state for message IDs 1 and 3. The router increments the unknown ack counter by 1.
Recv nack	If a neighboring router receives an unknown message ID in an RSVP refresh message, the router sends a Resv nack message back to the sender. This can happen if that neighbor has been rebooted. For this case, the router sends a regular RSVP refresh message to recover the state and start the message-ID handshake process again.
Recv duplicated msg-id	Number of times the same message ID is used by two different RSVP messages. This duplication is usually caused when a neighboring routing device restarts.
No TE-link to recv Hop	Counter of packets discarded because a TE link was not found.
Rcv pkt disabled interface	Number of RSVP packets received on an interface that is not enabled for RSVP.
Transmit buffer full	Number of times the buffer for assembling an outgoing RSVP message was not large enough.
Transmit failure	Number of times the RSVP task failed to send out a packet.
Receive failure	Number of times the RSVP task failed to read an incoming packet.
P2MP RESV discarded by appl	Number of Resv messages discarded because the MPLS label is not valid for the P2MP LSP application.
Rate limit	Number of RSVP packets dropped due to rate limiting.
Err msg loop detected	Number of RSVP error messages that have looped back to their originator. This is detected by checking the error node address in the ERROR_SPEC object.

Sample Output

show rsvp statistics

`user@host>` **show rsvp statistics**

```
PacketType              Total                 Last 5 seconds
                 Sent      Received        Sent      Received
Path              355           408           0             0
PathErr             2            13           0             0
PathTear          101           139           0             0
Resv FF             0             0           0             0
Resv WF             0             0           0             0
Resv SE           419           225           0             0
ResvErr             0             0           0             0
ResvTear            0            13           0             0
ResvConf            0             0           0             0
Ack               682          1414           0             0
SRefresh       395198        236030           5             2
Hello          578809        578221           4             4
EndtoEnd RSVP       0             0           0             0

Errors                          Total              Last 5 seconds
Rcv pkt bad length                0                          0
Rcv pkt unknown type              0                          0
Rcv pkt bad version               0                          0
Rcv pkt auth fail                 0                          0
Rcv pkt bad checksum              0                          0
Rcv pkt bad format                0                          0
Memory allocation fail            0                          0
No path information              10                          0
Resv style conflict               0                          0
Port conflict                     0                          0
Resv no interface                 0                          0
PathErr to client                38                          0
ResvErr to client                 0                          0
Path timeout                      8                          0
Resv timeout                     57                          0
Message out-of-order              0                          0
Unknown ack msg                2978                          0
Recv nack                        86                          0
Recv duplicated msg-id            5                          0
No TE-link to recv Hop            0                          0
Rcv pkt disabled interface        0                          0
Transmit buffer full              0                          0
Transmit failure                  0                          0
Receive failure                   0                          0
P2MP RESV discarded by appl       0                          0
Rate limit                      306                          0
Err msg loop detected             0                          0
```

show rsvp version

Syntax

show rsvp version
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show rsvp version

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display information about the Resource Reservation Protocol (RSVP) protocol settings, such as the version of the RSVP software, the refresh timer and keep multiplier, and local RSVP graceful restart capabilities on a routing device.

Options

none—Display RSVP protocol settings.

logical-system (all |*logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show rsvp version on page 3915

Output Fields

Table 294 on page 3914 describes the output fields for the **show rsvp version** command. Output fields are listed in the approximate order in which they appear.

Table 294: show rsvp version Output Fields

Field Name	Field Description
Resource ReSerVation Protocol, version	RSVP software version.
RSVP protocol	Status of RSVP: **Enabled** or **Disabled**.
R(refresh timer)	Configured time interval used to generate periodic RSVP messages.
K(keep multiplier)	Number of RSVP messages that can be lost before an RSVP state is declared stale.
Preemption	Currently configured preemption capability: **Aggressive**, **Disabled**, or **Normal**. The default is **Normal**.
Soft-preemption cleanup	Time, in seconds, that an LSP is kept after it has been soft preempted. This is a global property of the RSVP protocol.
Graceful deleting timeout	Currently configured value for the **graceful-deletion-timeout** statement. The router that initiates the graceful deletion procedure for an RSVP session waits for the graceful deletion timeout interval to ensure that all routers along the path (especially the ingress and egress routers) have prepared for the LSP to be taken down.

Table 294: show rsvp version Output Fields *(continued)*

Field Name	Field Description
NSR Mode	Status of the nonstop active routing feature for RSVP on the restarting device: **Disabled**, **Enabled/Master**, or **Enabled/Standby**.
NSR State	State of the nonstop active routing feature for RSVP on the restarting device. Possible values are: • **Idle** • **TE-link sync complete** • **Neighbor sync complete** • **Path state sync complete** • **Resv state sync complete** • **Bypass sync complete** • **Init sync complete**
Setup protection	Status of point-to-point and point-to-multipoint LSP setup protection configuration on the device: **Enabled** or **Disabled**
Graceful restart	Status of the graceful restart feature for RSVP on the restarting routing device: **Enabled** or **Disabled**.
Restart helper mode	Status of the helper mode feature: **Enabled** or **Disabled**. When this feature is enabled, the restarting routing device can help the neighbor with its RSVP restart procedures.
Maximum helper restart time	Number of milliseconds (ms) configured for the maximum helper restart time. The maximum helper restart time is the length of time the routing device waits before declaring that an RSVP neighbor attempting to restart gracefully is down.
Maximum helper recovery time	Number of milliseconds configured for the maximum helper recovery time. The maximum helper recovery time is the amount of time the routing device maintains the state of an RSVP neighbor attempting to restart gracefully.
Restart time	Number of milliseconds that a neighbor waits to receive a Hello message from the restarting node before declaring the node dead and deleting the states.
Recovery time	Number of milliseconds during which the restarting node attempts to recover its lost states with help from its neighbors. Recovery time is advertised by the restarting node to its neighbors, and applies to nodal faults. The restarting node considers its graceful restart complete after this time has elapsed.
P2p transit LSP nexthop mode	Point-to-point transit LSP nexthop mode on PTX Series devices. The possible values are **Chained** or **Unchained**
P2mp transit LSP nexthop mode	Point-to-multipoint transit LSP nexthop mode on PTX Series devices. The possible values are **Chained** or **Unchained**

Sample Output

show rsvp version

`user@host>` **show rsvp version**

```
Resource ReSerVation Protocol, version 1. rfc2205
   RSVP protocol:                Enabled
   R(refresh timer):             30 seconds
   K(keep multiplier):           3
   Preemption:                   Normal
   Soft-preemption cleanup:      30 seconds
   Graceful deletion timeout:    30 seconds
   NSR mode:                     Enabled/Master
   NSR state:                    Init sync complete
   Setup protection:             Disabled
   Graceful restart:             Disabled
   Restart helper mode:          Enabled
   Maximum helper restart time:  20000 msec
   Maximum helper recovery time: 180000 msec
   Restart time:                 0 msec
   P2p transit LSP nexthop mode: Unchained
   P2mp transit LSP nexthop mode: Unchained
```

show ted database

Syntax

show ted database
<brief | detail | extensive>
<logical-system (all | *logical-system-name*)>
<*system-name*>

Syntax (EX Series Switches)

show ted database
<brief | detail | extensive>
<*system-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display the entries in the Multiprotocol Label Switching (MPLS) traffic engineering database.

Options

none—Display standard information about all entries in the traffic engineering database.

brief | detail | extensive—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

system-name—(Optional) Display traffic engineering database information for a particular system.

Required Privilege Level

view

List of Sample Output

show ted database brief on page 3919
show ted database detail system-name on page 3920
show ted database extensive on page 3920

Output Fields

Table 295 on page 3917 describes the output fields for the **show ted database** command. Output fields are listed in the approximate order in which they appear.

Table 295: show ted database Output Fields

Field Name	Field Description	Level of Output
TED database	Number of nodes and pseudonodes participating in IS-IS and OSPF domain routing.	All levels
ID	Hostname and address of the node that the link is coming from. An address of **.00** indicates that the node is the routing device itself. An address in the range **0.01** through **0.FF** indicates that the node is a pseudonode. If the node contains a router ID, it is displayed in parentheses.	**brief**
NodeID	Hostname and address of the node that the link is coming from. An address of **.00** indicates that the node is the routing device itself. An address in the range **0.01** through **0.FF** indicates that the node is a pseudonode.	**extensive**

Table 295: show ted database Output Fields *(continued)*

Field Name	Field Description	Level of Output
Type	Type of node. It can be either **Rtr** (router) or **Net** (pseudonode).	All levels
Age(s)	How long since the node was last refreshed, in seconds.	All levels
LnkIn	Number of nodes pointing toward this node.	All levels
LnkOut	Number of nodes to which this node points.	All levels
Protocol	Protocol that reported the node information: • **IS-IS(1)**—IS-IS Level 1. • **IS-IS(2)**—IS-IS Level 2. • **OSPF (area-number)**—OSPF from the specified area.	All levels
To	Address on the far end of a link.	**detail extensive**
Local	Address of the local interface being used to reach the remote node.	**detail extensive**
Remote	Address of the interface on the remote node.	**detail extensive**
Metric	Configured traffic engineering metric.	**extensive**
Static BW	Total interface bandwidth in bps.	**extensive**
Reservable bandwidth	Subscription factor for the interface, which is the percentage of the link bandwidth that can be used for the RSVP reservation process. You configure this by including the **subscription** statement when configuring RSVP.	**extensive**
Available BW [priority]	(Must include **diffserv-te** statement when configuring LSPs) Amount of bandwidth actually reserved by RSVP for each priority level. The bandwidth shown is for the entire interface, not for each individual LSP.	**extensive**
Diffserv-TE BW Model	Bandwidth constraint model used by the LSPs.	**extensive**
Available BW [TE-class]	(Must include the **diffserv-te** statement when configuring LSPs) Amount of bandwidth actually reserved by RSVP for each traffic engineering class.	**extensive**
Static BW [CT-class]	Total interface bandwidth used by an MPLS traffic class, in bps.	**extensive**

Table 295: show ted database Output Fields *(continued)*

Field Name	Field Description	Level of Output

Interface Switching Capability Descriptor (*n*)	Information about the interface switching capability descriptor, which is a subtype length value (TLV) of the link TLV. ***n*** is the index number.
	• **Switching type**—Type of switching to be performed on a particular link:
	  ◦ **PSC-1**—Packet switch-capable 1
	  ◦ **PSC-2**—Packet switch-capable 2
	  ◦ **PSC-3**—Packet switch-capable 3
	  ◦ **PSC-4**—Packet switch-capable 4
	  ◦ **L2SC**—Layer-2-switch-capable
	  ◦ **TDM**—Time-division-multiplexing-capable
	  ◦ **LSC**—Lambda switch-capable
	  ◦ **FSC**—Fiber switch-capable
	• **Encoding type**—Encoding of the LSP being requested:
	  ◦ **Packet**
	  ◦ **Ethernet**
	  ◦ **ANSI/ETSI PDH**
	  ◦ **Reserved**
	  ◦ **SDH /SONET**
	  ◦ **Digital Wrapper**
	  ◦ **Lambda (photonic)**
	  ◦ **Fiber**
	  ◦ **FiberSDH/SONET**
	• **Maximum LSP BW [priority] bps**—Maximum LSP bandwidth information. Amount of bandwidth actually reserved for each priority level. The bandwidth shown is for the entire interface.
	  ◦ **[*n*]**—Priority level. The range is from **0** (high) through **7** (low).
	  ◦ ***n* Mbps**—Amount of the maximum bandwidth.
	• **Minimum LSP BW**—Minimum LSP bandwidth in Mbps. Amount of bandwidth actually reserved for each priority level. The bandwidth shown is for the entire interface. **Minimum LSP BW** is displayed only when **switching type** is **PSC-1** or **TDM**.
	• **Interface MTU**—Displayed only when **switching type** is **TDM**.
	• **Interface supports standard SONET/SDH**—Displayed only when **switching type** is **TDM**.
		extensive

Sample Output

show ted database brief

```
user@host> show ted database brief
TED database: 6 ISIS nodes 6 INET nodes
ID                            Type Age(s) LnkIn LnkOut Protocol
cheviot.00(123.456.1.10)      Rtr    383      1      1 IS-IS(2) IS-IS(1)
corriedale.00(123.456.1.11)   Rtr     36      2      0 IS-IS(2) IS-IS(1)
wolff.00(123.456.1.12)        Rtr    399      0      0 IS-IS(2) IS-IS(1)
perendale.00(123.456.1.13)    Rtr    385      2      0 IS-IS(2) IS-IS(1)
```

```
merino.00(123.456.1.14)       Rtr    379      1       3 IS-IS(2) IS-IS(1)
romney.00(123.456.1.15)       Rtr    427      0       2 IS-IS(2) IS-IS(1)
```

show ted database detail system-name

```
user@host> show ted database detail merino
TED database: 6 ISIS nodes 6 INET nodes
NodeID: merino.00(123.456.1.14)
  Type: Rtr, Age: 507 secs, LinkIn: 1, LinkOut: 3
  Protocol: IS-IS(2)
    To: corriedale.00(123.456.1.11), Local: 123.456.8.206, Remote: 123.456.8.207

    To: perendale.00(123.456.1.13), Local: 123.456.8.204, Remote: 123.456.8.205
    To: cheviot.00(123.456.1.10), Local: 123.456.10.65, Remote: 123.456.10.66
  Protocol: IS-IS(1)
    To: corriedale.00(123.456.1.11), Local: 123.456.8.206, Remote: 123.456.8.207

    To: perendale.00(123.456.1.13), Local: 123.456.8.204, Remote: 123.456.8.205
    To: cheviot.00(123.456.1.10), Local: 123.456.10.65, Remote: 123.456.10.66
```

show ted database extensive

```
user@host> show ted database extensive
TED database: 0 ISIS nodes 2 INET nodes
NodeID: 10.255.245.196
  Type: Rtr, Age: 46 secs, LinkIn: 1, LinkOut: 1
  Protocol: OSPF(0.0.0.0)
    To: 10.255.245.24, Local: 4.4.4.4, Remote: 5.5.5.5
      Metric: 1
      Static BW: 155.52Mbps
      Reservable BW: 155.52Mbps
      Available BW [TE-class] bps:
       [te0] 155.52Mbps   [te1] 155.52Mbps   [te2] 155.52Mbps   [te3] 155.52Mbps

       [te4] 155.52Mbps   [te5] 155.52Mbps   [te6] 155.52Mbps   [te7] 155.52Mbps

    Diffserv-TE BW model: Maximum allocation model
      Static BW [CT-class] bps:
       [ct0] 155.52Mbps   [ct1] 155.52Mbps   [ct2] 155.52Mbps   [ct3] 155.52Mbps

      Interface Switching Capability Descriptor(1):
        Switching type: PSC-1
        Encoding type: SDH/SONET
        Maximum LSP BW [priority] bps:
         [0] 155.52Mbps    [1] 155.52Mbps    [2] 155.52Mbps    [3] 155.52Mbps
         [4] 155.52Mbps    [5] 155.52Mbps    [6] 155.52Mbps    [7] 155.52Mbps
        Minimum LSP BW: 155.52Mbps
        Interface MTU: 1285
      Interface Switching Capability Descriptor(2):
        Switching type: TDM
        Encoding type: SDH/SONET
        Maximum LSP BW [priority] bps:
         [0] 155.52Mbps    [1] 155.52Mbps    [2] 155.52Mbps    [3] 155.52Mbps
         [4] 155.52Mbps    [5] 155.52Mbps    [6] 155.52Mbps    [7] 155.52Mbps
        Minimum LSP BW: 155.52Mbps
        Interface supports standard SONET/SDH
```

show ted link

Syntax

show ted link
<brief | detail>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show ted link
<brief | detail>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display Multiprotocol Label Switching (MPLS) traffic engineering database link information.

Options

none—Display standard information about traffic engineering database link information.

brief | detail—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show ted link brief on page 3922
show ted link detail on page 3922

Output Fields

Table 296 on page 3921 describes the output fields for the **show ted link** command. Output fields are listed in the approximate order in which they appear.

Table 296: show ted link Output Fields

Field Name	Field Description	Level of Output
ID	Hostname and address of the node that the link is coming from. An address of **.00** indicates that the node is the routing device itself. An address in the range **0.01** through **0.FF** indicates that the node is a pseudonode.	**brief**
-->ID	Hostname and address of the node that the link is going to. An address of **.00** indicates that the node is the routing device itself. An address in the range **0.01** through **0.FF** indicates that the node is a pseudonode.	**brief**
hostname	Hostname and address of the node that the link is coming from. An address of **.00** indicates that the node is the routing device itself. An address in the range **0.01** through **0.FF** indicates that the node is a pseudonode.	**detail**
hostname	Hostname and address of the node that the link is going to. An address of **.00** indicates that the node is the routing device itself. An address in the range **0.01** through **0.FF** indicates that the node is a pseudonode.	**detail**
Local Path	Number of paths CSPF on the local routing device has placed on the link.	All levels

Table 296: show ted link Output Fields *(continued)*

Field Name	Field Description	Level of Output
Local BW	Amount of bandwidth the local routing device has placed on the link.	All levels

Sample Output

show ted link brief

```
user@host> show ted link brief
TED link:
ID                           ->ID                           LocalPath LocalBW
cheviot.00(123.456.1.10)      merino.00(123.456.1.14)               0 0bps
merino.00(123.456.1.14)       corriedale.00(123.456.1.11)           0 0bps
merino.00(123.456.1.14)       perendale.00(123.456.1.13)            0 0bps
merino.00(123.456.1.14)       cheviot.00(123.456.1.10)              0 0bps
romney.00(123.456.1.15)       corriedale.00(123.456.1.11)           0 0bps
romney.00(123.456.1.15)       perendale.00(123.456.1.13)            0 0bps
```

show ted link detail

```
user@host> show ted link detail
TED link:
cheviot.00(123.456.1.10)->merino.00(123.456.1.14), LocalPath 0
  localBW [0] 0bps       [1] 0bps      [2] 0bps       [3] 0bps
  localBW [4] 0bps       [5] 0bps      [6] 0bps       [7] 0bps
merino.00(123.456.1.14)->corriedale.00(123.456.1.11), LocalPath 0
  localBW [0] 0bps       [1] 0bps      [2] 0bps       [3] 0bps
  localBW [4] 0bps       [5] 0bps      [6] 0bps       [7] 0bps
merino.00(123.456.1.14)->perendale.00(123.456.1.13), LocalPath 0
  localBW [0] 0bps       [1] 0bps      [2] 0bps       [3] 0bps
  localBW [4] 0bps       [5] 0bps      [6] 0bps       [7] 0bps
merino.00(123.456.1.14)->cheviot.00(123.456.1.10), LocalPath 0
  localBW [0] 0bps       [1] 0bps      [2] 0bps       [3] 0bps
  localBW [4] 0bps       [5] 0bps      [6] 0bps       [7] 0bps
romney.00(123.456.1.15)->corriedale.00(123.456.1.11), LocalPath 0
  localBW [0] 0bps       [1] 0bps      [2] 0bps       [3] 0bps
  localBW [4] 0bps       [5] 0bps      [6] 0bps       [7] 0bps
romney.00(123.456.1.15)->perendale.00(123.456.1.13), LocalPath 0
  localBW [0] 0bps       [1] 0bps      [2] 0bps       [3] 0bps
  localBW [4] 0bps       [5] 0bps      [6] 0bps       [7] 0bps
```


show ted protocol

Syntax

show ted protocol
<brief | detail>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

show ted protocol
<brief | detail>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.5 for EX Series switches.

Description

Display information about the protocols from which the Multiprotocol Label Switching (MPLS) traffic engineering database learned about its nodes.

Options

none—Display standard information about the protocols from which the traffic engineering database learned about its nodes.

brief | detail—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show ted protocol on page 3923

Output Fields

Table 297 on page 3923 describes the output fields for the **show ted protocol** command. Output fields are listed in the approximate order in which they appear.

Table 297: show ted protocol Output Fields

Field Name	Field Description
Protocol name	Protocol that reported the node information: • **IS-IS(1)**—IS-IS Level 1. • **IS-IS(2)**—IS-IS Level 2. • **OSPF** (***area-number***)—OSPF from the specified area.
Credibility	If the protocols provide conflicting information about a node, the protocol with the highest credibility value is the one that the traffic engineering database uses.
Self node	Address the protocol uses as the local address.

Sample Output

show ted protocol

```
user@host> show ted protocol
```

```
Protocol name       Credibility  Self node
IS-IS(2)            2  (highest) corriedale.00(123.456.1.11)
IS-IS(1)            1            corriedale.00(123.456.1.11)
```


traceroute mpls ldp

Syntax

traceroute mpls <ldp> *fec*
<destination>
<detail>
<exp>
<fanout>
<logical-system>
<no-resolve>
<paths>
<retries>
<routing-instance>
<source>
<ttl>
<update>
<wait>

Release Information Command introduced in Junos OS Release 8.4.

Description Trace route to a remote host for an MPLS label-switched path signaled by the LDP. Use **traceroute mpls ldp** as a debugging tool to locate MPLS label-switched path forwarding issues in a network. (Currently supported for IPv4 packets only.)

Options

fec—Specify the IP address and optional prefix of the forwarding equivalence class (FEC).

destination—(Optional) Specify the destination address to use when sending probes.

detail—(Optional) Display detailed output.

exp—(Optional) Specify the class-of-service to use when sending probes. The range of values is **0** through **7**. The default value is **7**.

fanout—(Optional) Specify the maximum number of nexthops to search per node. The range of values is **1** through **16**. The default value is **16**.

logical-system—(Optional) Specify the name of the logical system for the traceroute attempt.

no-resolve—(Optional) Specify not to resolve the hostname that corresponds to the IP address.

paths—(Optional) Specify the number of paths to search. The range of values is **1** through **255**. The default value is **16**.

retries—(Optional) Specify the number of times to resend probe. values. The range of values is **1** through **9**. The default value is **3**.

routing-instance ***routing-instance-name***—(Optional) Specify the name of the routing instance for the traceroute attempt.

source ***source-address***—(Optional) Specify the source address of the outgoing traceroute packets.

ttl ***value***—(Optional) Specify the maximum time-to-live value to include in the traceroute request, in seconds. The range of values is **1** through **125** and the default value is **64**.

wait ***seconds***—(Optional) Specify the number of seconds to wait before resending a probe. The range of values is **5** through **15** and the default value is **10** seconds.

Required Privilege Level

network

List of Sample Output

traceroute mpls ldp on page 3927
traceroute mpls ldp detail on page 3927

Output Fields

Table 298 on page 3926 describes the output fields for the **traceroute mpls ldp** ***fec*** command and the **traceroute mpls ldp** ***fec*** **detail** commands. Output fields are listed in the approximate order in which they appear.

Table 298: traceroute mpls ldp Output Fields

Field Name	Field Description	Level of Output
Probe options	Probe options specified in the **traceroute mpls ldp** ***fec*** command.	all levels
ttl	Time to live value of the labeled packet.	none specified
Label	Outgoing label used for forwarding the packet along the label-switched paths.	none specified
Protocol	Signaling protocol used. For this command, it is LDP.	none specified
Address	Address of the next hop.	none specified
Previous Hop	Address of the previous hop. Previous hop address of the first hop is **null**.	none specified
Probe status	Forwarding status from the first hop to the last-hop label-switching router (egress point in the label-switched paths).	none specified
Hop	Address of the hops in the label-switched path from the first hop to the last hop. Depth indicates the level of the hop.	**detail**
Parent	Address of the previous hop. Parent value for the first hop is **null**.	**detail**
Return Code	Return code for reporting the result of processing the echo request by the receiver.	**detail**
Response time	Time for the echo request to reach the receiver.	**detail**
Multipath type	Labels or addresses used by the specified multipath type. If multipaths are not used, the value is **none**.	**detail**

Table 298: traceroute mpls ldp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Label Stack	Label stack used to forward the packet.	**detail**

Sample Output

traceroute mpls ldp

user@router> **traceroute mpls ldp 4.4.4.4**

```
  Probe options: ttl 64, retries 3, wait 10, paths 16, exp 7, fanout 16
  ttl     Label  Protocol     Address          Previous Hop     Probe Status
    1    100016  LDP          24.24.24.1       (null)           Success
    2    100000  LDP          20.20.20.2       24.24.24.1       Success
    3         3  LDP          22.22.22.4       20.20.20.2       Egress

Path 1 via fe-0/3/3.101 destination 127.0.0.64
```

traceroute mpls ldp detail

user@router> **traceroute mpls ldp 4.4.4.4 detail**

```
  Probe Options: ttl 64, retries 3, wait 10, paths 3, exp 7
  Hop 24.24.24.1 Depth 1
    Parent (null)
    Return code: Label switched at stack-depth 1
    Response time 165.93 msec
    Multipath type: IP bitmask
      Address Range 1: 127.0.0.0 ~ 127.0.3.255
    Label Stack:
      Label 1 Value 100032 Protocol LDP

  Hop 20.20.20.2 Depth 2
    Parent 24.24.24.1
    Return code: Upstream interface index unknown label-switched at stack-depth
1
    Response time 19.05 msec
    Multipath type: IP bitmask
      Address Range 1: 127.0.0.0 ~ 127.0.3.255
    Label Stack:
      Label 1 Value 100000 Protocol LDP

  Hop 22.22.22.4 Depth 3
    Parent 20.20.20.2
    Return code: Egress-ok at stack-depth 1
    Response time 0.79 msec
    Multipath type: None
    Label Stack:
      Label 1 Value 3 Protocol LDP
```


traceroute mpls rsvp

Syntax

traceroute mpls <rsvp> *lsp-name*
<detail>
<egress>
<exp>
<logical-system>
<multipoint>
<no-resolve>
<retries>
<source *source-address*>
<ttl>

Release Information

Command introduced in Junos OS Release 9.2.
egress, **multipoint**, and **ttl** options added in Junos OS Release 11.2.

Description

Trace route to a remote host for an MPLS LSP signaled by RSVP. Use **traceroute mpls rsvp** as a debugging tool to locate MPLS label-switched path (LSP) forwarding issues in a network. (Currently supported for IPv4 packets only.)

Options

lsp-name—Specify the name of the LSP to be traced.

detail—(Optional) Display detailed output.

egress—(Optional) Request that a specific point-to-multipoint egress node reply to the trace route. The trace route would follow the associated sub-LSP to the egress node.

exp—(Optional) Specify the class of service to use when sending probes. The range of values is 0 through 7. The default value is 7.

logical-system—(Optional) Specify the name of the logical system for the traceroute attempt.

multipoint—(Optional) Perform a trace route on a point-to-multipoint LSP.

no-resolve—(Optional) Specify not to resolve the hostname that corresponds to the IP address.

retries—(Optional) Specify the number of times to resend probe. The range of values is 1 through 9. The default value is 3.

source ***source-address***—(Optional) Specify the source address of the outgoing traceroute packets.

ttl—(Optional) Specify the number of hops to follow before forcing the trace route to quit.

Required Privilege Level

network

List of Sample Output

traceroute mpls rsvp on page 3930
traceroute mpls rsvp detail on page 3930

traceroute mpls rsvp multipoint (branch node for sub-LSPs) on page 3931
traceroute mpls rsvp multipoint (single-hop sub-LSPs) on page 3931

Output Fields

Table 299 on page 3929 describes the output fields for the **traceroute mpls rsvp** ***lsp-name*** and **traceroute mpls rsvp** ***lsp-name*** **detail** commands. Output fields are listed in the approximate order in which they appear.

Table 299: traceroute mpls rsvp Output Fields

Field Name	Field Description	Level of Output
Probe options	Probe options specified in the **traceroute mpls rsvp** ***lsp-name*** command.	all levels
ttl	Time-to-live value of the labeled packet.	none specified
Label	MPLS label used to forward the packets along the LSP.	none specified
Protocol	Signaling protocol used. For this command, it is RSVP-TE.	none specified
Address	Address of the next hop.	none specified
Previous Hop	Address of the previous hop. Previous hop address of the first hop is null.	none specified
Probe status	Forwarding status from the first hop to the last-hop label-switching router (egress point in the label-switched paths). Displays **Success** if the trace to a hop is successful or **Egress** if the trace has reached the last router on the path.	none specified
Hop	Address of the hops in the label-switched path from the first hop to the last hop. Depth indicates the level of the hop.	**detail**
Parent	Address of the previous hop. Parent value for the first hop is null.	**detail**
Return Code	Return code for reporting the result of processing the echo request by the receiver.	**detail**
Sender timestamp	Displays the timestamp when the MPLS echo request is sent to the next hop.	**detail**
Receiver timestamp	Timestamp when the echo request from the previous hop is received and acknowledged with an echo response by the next hop.	**detail**
Response time	Time for the echo request to reach the receiver.	**detail**
MTU	Size of the largest packet that includes the label stack forwarded to the next hop.	**detail**

Table 299: traceroute mpls rsvp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Multipath type	Labels or addresses used by the specified multipath type. If multipaths are not used, the value is none.	**detail**
Label stack	Label stack used to forward the packet.	**detail**
Path	Displays the sub-lsp path number for this traceroute, the interface used, and the destination address.	all levels

Sample Output

traceroute mpls rsvp

```
user@host> traceroute mpls rsvp lsp-chicago-atlanta

     Probe options: retries 3, exp 7

     ttl    Label  Protocol    Address          Previous Hop     Probe Status
       1   299792  RSVP-TE        192.168.1.2      (null)           Success
       2   299803  RSVP-TE        192.168.2.3      192.168.1.2      Success
       3        3  RSVP-TE        192.168.3.4      192.168.2.3      Egress

     Path 1 via ge-0/0/0.1 destination 127.0.0.64
```

traceroute mpls rsvp detail

```
user@host> traceroute mpls rsvp lsp-chicago-atlanta detail
Probe options: retries 3, exp 7

   Hop 192.168.1.2 Depth 1
     Probe status: Success
     Parent: (null)
     Return code: Label-switched at stack-depth 1
     Sender timestamp: 2008-04-17 09:35:27 EDT 400.88 msec
     Receiver timestamp: 2008-04-17 09:35:27 EDT 427.87 msec
     Response time: 26.99 msec
     MTU: Unknown
     Multipath type: IP bitmask
       Address Range 1: 127.0.0.64 ~ 127.0.0.127
     Label Stack:
       Label 1 Value 299792 Protocol RSVP-TE

Hop 192.168.2.3 Depth 2
     Probe status: Success
     Parent: 192.168.1.2
     Return code: Upstream interface index unknown label-switched at stack-depth
 1
     Sender timestamp: 2008-04-17 09:35:27 EDT 522.13 msec
     Receiver timestamp: 2008-04-17 09:35:27 EDT 548.69 msec
     Response time: 26.55 msec
     MTU: 1518
     Multipath type: IP bitmask
       Address Range 1: 127.0.0.64 ~ 127.0.0.127
     Label Stack:
       Label 1 Value 299803 Protocol RSVP-TE
```


traceroute mpls rsvp multipoint (branch node for sub-LSPs)

The following traceroute output is for a point-to-multipoint LSP where the penultimate node is a branch node for the sub-LSPs.

```
user@host> traceroute mpls rsvp multipoint p2mplsp
  Probe options: retries 3, exp 7

  ttl    Label  Protocol    Address          Previous Hop     Probe Status
    1   300000  RSVP-TE     81.1.2.2         (null)           Success
    2   299968  RSVP-TE     81.2.3.3         81.1.2.2         Success
    3   299952  RSVP-TE     81.3.4.4         81.2.3.3         Success
    4   299920  RSVP-TE     81.4.6.6         81.3.4.4         Egress

  Path 1 via lt-1/2/0.102 destination 127.0.0.64

  ttl    Label  Protocol    Address          Previous Hop     Probe Status
    4   299920  RSVP-TE     81.4.5.5         81.3.4.4         Egress

  Path 2 via lt-1/2/0.102 destination 127.0.0.64
```

traceroute mpls rsvp multipoint (single-hop sub-LSPs)

The following traceroute output is for a point-to-multipoint LSP with multiple single-hop sub-LSPs.

```
user@host> traceroute mpls rsvp multipoint p2mplsp
  Probe options: retries 3, exp 7

   ttl    Label  Protocol    Address          Previous Hop     Probe Status
     1        0  RSVP-TE     81.1.2.2         (null)           Egress

   Path 1 via lt-1/2/0.102 destination 127.0.0.64

   ttl    Label  Protocol    Address          Previous Hop     Probe Status
     1        0  RSVP-TE     81.1.8.8         (null)           Egress

   Path 2 via lt-1/2/0.108 destination 127.0.0.64

   ttl    Label  Protocol    Address          Previous Hop     Probe Status
     1        0  RSVP-TE     81.1.9.9         (null)           Egress

   Path 3 via lt-1/2/0.109 destination 127.0.0.64
```


CHAPTER 46

Troubleshooting

Troubleshooting Procedures

Issues and Limitations in Operation of MPLS Features on the QFX Series

The following issues exist in the operation of MPLS features on QFX Series devices. In each case, the described behavior is the expected behavior.

- Configuring an MPLS firewall filter on a switch that is deployed as an egress provider edge (PE) switch has no effect.
- Configuring the **revert-timer** statement at the **[edit protocols mpls]** hierarchy level has no effect.
- If you configure the BGP labeled unicast address family (using the **labeled-unicast** statement at the **[edit protocols bgp family inet]** hierarchy level) on a QFX switch deployed as a route reflector for BGP labeled routes, path selection will occur at the route reflector, and a single best path will be advertised. This will result in loss of BGP multipath information.

Related Documentation

• MPLS Feature Support on the QFX Series Overview on page 3748

PART 15

Multicast

CHAPTER 47

Overview

Introduction to PIM Basics

PIM Overview

The predominant multicast routing protocol in use on the Internet today is Protocol Independent Multicast, or PIM. The type of PIM used on the Internet is PIM sparse mode. PIM sparse mode is so accepted that when the simple term “PIM” is used in an Internet context, some form of sparse mode operation is assumed.

PIM emerged as an algorithm to overcome the limitations of dense-mode protocols such as the Distance Vector Multicast Routing Protocol (DVMRP), which was efficient for dense clusters of multicast receivers, but did not scale well for the larger, sparser, groups encountered on the Internet. The Core Based Trees (CBT) Protocol was intended to support sparse mode as well, but CBT, with its all-powerful core approach, made placement of the core critical, and large conference-type applications (many-to-many) resulted in bottlenecks in the core. PIM was designed to avoid the dense-mode scaling issues of DVMRP and the potential performance issues of CBT at the same time.

PIM is one of the most rapidly evolving specifications on the Internet today. Since its introduction in 1995, PIM has already seen two major revisions to its packet structure (PIM version 1 [PIMv1] and PIM version 2 [PIMv2]), two major RFCs (RFC 2362 obsoleted RFC 2117), and numerous drafts describing major components of PIM, such as many-to-many trees and source-specific multicast (SSM). Long-lasting RFCs are not a feature of PIM, and virtually all of PIM must be researched, understood, and implemented directly from Internet drafts. In fact, no current RFC describes PIMv1 at all. The drafts have all expired, and PIMv1 was never issued as an official RFC.

PIM itself is not nonstandard or unstable, however. PIM has been a promising multicast routing protocol since its inception, especially PIM sparse mode, the first real sparse-mode multicast routing protocol. Work continues on PIM in a number of areas, from bidirectional trees to network management, and the rapid pace of development makes drafts essential for PIM.

PIMv1 and PIMv2 can coexist on the same routing device and even on the same interface. The main difference between PIMv1 and PIMv2 is the packet format. PIMv1 messages use Internet Group Management Protocol (IGMP) packets, whereas PIMv2 has its own IP protocol number (103) and packet structure. All routing devices connecting to an IP subnet such as a LAN must use the same PIM version. Some PIM implementations can recognize PIMv1 packets and automatically switch the routing device interface to PIMv1. Because the difference between PIMv1 and PIMv2 involves the message format, but not the meaning of the message or how the routing device processes the PIM message, a routing device can easily mix PIMv1 and PIMv2 interfaces.

PIM is used for efficient routing to multicast groups that might span wide-area and interdomain internetworks. It is called "protocol independent" because it does not depend on a particular unicast routing protocol. Junos OS supports bidirectional mode, sparse mode, dense mode, and sparse-dense mode.

PIM operates in several modes: bidirectional mode, sparse mode, dense mode, and sparse-dense mode. In sparse-dense mode, some multicast groups are configured as dense mode (flood-and-prune, [S,G] state) and others are configured as sparse mode (explicit join to rendezvous point [RP], [*,G] state).

PIM drafts also establish a mode known as PIM source-specific mode, or PIM SSM. In PIM SSM there is only one specific source for the content of a multicast group within a given domain.

Because the PIM mode you choose determines the PIM configuration properties, you first must decide whether PIM operates in bidirectional, sparse, dense, or sparse-dense mode in your network. Each mode has distinct operating advantages in different network environments.

- In sparse mode, routing devices must join and leave multicast groups explicitly. Upstream routing devices do not forward multicast traffic to a downstream routing device unless the downstream routing device has sent an explicit request (by means of a join message) to the rendezvous point (RP) routing device to receive this traffic. The RP serves as the root of the shared multicast delivery tree and is responsible for forwarding multicast data from different sources to the receivers.

  Sparse mode is well suited to the Internet, where frequent interdomain join messages and prune messages are common.

- Bidirectional PIM is similar to sparse mode, and is especially suited to applications that must scale to support a large number of dispersed sources and receivers. In bidirectional PIM, routing devices build shared bidirectional trees and do not switch to a source-based tree. Bidirectional PIM scales well because it needs no source-specific (S,G) state. Instead, it builds only group-specific (*,G) state.

- Unlike sparse mode and bidirectional mode, in which data is forwarded only to routing devices sending an explicit PIM join request, dense mode implements a *flood-and-prune* mechanism, similar to the Distance Vector Multicast Routing Protocol (DVMRP). In dense mode, a routing device receives the multicast data on the incoming interface, then forwards the traffic to the outgoing interface list. Flooding occurs periodically and is used to refresh state information, such as the source IP address and multicast group pair. If the routing device has no interested receivers for the data, and the outgoing interface list becomes empty, the routing device sends a PIM prune message upstream.

  Dense mode works best in networks where few or no prunes occur. In such instances, dense mode is actually more efficient than sparse mode.

- Sparse-dense mode, as the name implies, allows the interface to operate on a per-group basis in either sparse or dense mode. A group specified as “dense” is not mapped to an RP. Instead, data packets destined for that group are forwarded by means of PIM dense mode rules. A group specified as “sparse” is mapped to an RP, and data packets are forwarded by means of PIM sparse-mode rules. Sparse-dense mode is useful in networks implementing auto-RP for PIM sparse mode.

Basic PIM Network Components

PIM dense mode requires only a multicast source and series of multicast-enabled routing devices running PIM dense mode to allow receivers to obtain multicast content. Dense mode makes sure that all multicast traffic gets everywhere by periodically flooding the network with multicast traffic, and relies on prune messages to make sure that subnets where all receivers are uninterested in that particular multicast group stop receiving packets.

PIM sparse mode is more complicated and requires the establishment of special routing devices called *rendezvous points* (*RPs*) in the network core. These routing devices are where upstream join messages from interested receivers meet downstream traffic from the source of the multicast group content. A network can have many RPs, but PIM sparse mode allows only one RP to be active for any multicast group.

If there is only one RP in a routing domain, the RP and adjacent links might become congested and form a single point of failure for all multicast traffic. Thus, multiple RPs are the rule, but the issue then becomes how other multicast routing devices find the RP that is the source of the multicast group the receiver is trying to join. This RP-to-group mapping is controlled by a special *bootstrap router* (*BSR*) running the PIM BSR mechanism. There can be more than one bootstrap router as well, also for single-point-of-failure reasons.

The bootstrap router does not have to be an RP itself, although this is a common implementation. The bootstrap router's main function is to manage the collection of RPs and allow interested receivers to find the source of their group's multicast traffic. PIM bootstrap messages are sourced from the loopback address, which is always up. The loopback address must be routable. If it is not routable, then the bootstrap router is unable to send bootstrap messages to update the RP domain members. The **show pim bootstrap** command displays only those bootstrap routers that have routable loopback addresses.

PIM SSM can be seen as a subset of a special case of PIM sparse mode and requires no specialized equipment other than that used for PIM sparse mode (and IGMP version 3).

Bidirectional PIM RPs, unlike RPs for PIM sparse mode, do not need to perform PIM Register tunneling or other specific protocol action. Bidirectional PIM RPs implement no specific functionality. RP addresses are simply a location in the network to rendezvous toward. In fact, for bidirectional PIM, RP addresses need not be loopback interface addresses or even be addresses configured on any routing device, as long as they are covered by a subnet that is connected to a bidirectional PIM-capable routing device and advertised to the network.

Related Documentation

- *Supported IP Multicast Protocol Standards* in the *Multicast Protocols Feature Guide for Routing Devices*

PIM on Aggregated Interfaces

If you configure PIM on an aggregated (**ae-** or **as-**) interface, each of the interfaces in the aggregate is included in the multicast output interface list and carries the single stream of replicated packets in a load-sharing fashion. The multicast aggregate interface is “expanded” into its constituent interfaces in the next-hop database.

Related Documentation

- PIM Overview on page 3937
- **interface on page 4139**

Introduction to PIM Sparse Mode

Understanding PIM Sparse Mode

A Protocol Independent Multicast (PIM) sparse-mode domain uses reverse-path forwarding (RPF) to create a path from a data source to the receiver requesting the data. When a receiver issues an explicit join request, an RPF check is triggered. A (*,G) PIM join message is sent toward the RP from the receiver's designated router (DR). (By definition, this message is actually called a join/prune message, but for clarity in this description, it is called either join or prune, depending on its context.) The join message is multicast hop by hop upstream to the ALL-PIM-ROUTERS group (224.0.0.13) by means of each router's RPF interface until it reaches the RP. The RP router receives the (*,G) PIM join message and adds the interface on which it was received to the outgoing interface list (OIL) of the rendezvous-point tree (RPT) forwarding state entry. This builds the RPT connecting the receiver with the RP. The RPT remains in effect, even if no active sources generate traffic.

NOTE: **State—the (*,G) or (S,G) entries—is the information used for forwarding unicast or multicast packets. S is the source IP address, G is the multicast group address, and * represents any source sending to group G. Routers keep track of the multicast forwarding state for the incoming and outgoing interfaces for each group.**

When a source becomes active, the source DR encapsulates multicast data packets into a PIM register message and sends them by means of unicast to the RP router.

If the RP router has interested receivers in the PIM sparse-mode domain, it sends a PIM join message toward the source to build a shortest-path tree (SPT) back to the source. The source sends multicast packets out on the LAN, and the source DR encapsulates the packets in a PIM register message and forwards the message toward the RP router by means of unicast. The RP router receives PIM register messages back from the source, and thus adds a new source to the distribution tree, keeping track of sources in a PIM table. Once an RP router receives packets natively (with S,G), it sends a register stop message to stop receiving the register messages by means of unicast.

In actual application, many receivers with multiple SPTs are involved in a multicast traffic flow. To illustrate the process, we track the multicast traffic from the RP router to one receiver. In such a case, the RP router begins sending multicast packets down the RPT toward the receiver's DR for delivery to the interested receivers. When the receiver's DR receives the first packet from the RPT, the DR sends a PIM join message toward the source DR to start building an SPT back to the source. When the source DR receives the PIM join message from the receiver's DR, it starts sending traffic down all SPTs. When the first multicast packet is received by the receiver's DR, the receiver's DR sends a PIM prune message to the RP router to stop duplicate packets from being sent through the RPT. In turn, the RP router stops sending multicast packets to the receiver's DR, and sends a PIM prune message for this source over the RPT toward the source DR to halt multicast packet delivery to the RP router from that particular source.

If the RP router receives a PIM register message from an active source but has no interested receivers in the PIM sparse-mode domain, it still adds the active source into the PIM table. However, after adding the active source into the PIM table, the RP router sends a register stop message. The RP router discovers the active source's existence and no longer needs to receive advertisement of the source (which utilizes resources).

NOTE: If the number of PIM join messages exceeds the configured MTU, the messages are fragmented in IPv6 PIM sparse mode. To avoid the fragmentation of PIM join messages, the multicast traffic receives the interface MTU instead of the path MTU.

The major characteristics of PIM sparse mode are as follows:

- Routers with downstream receivers join a PIM sparse-mode tree through an explicit join message.
- PIM sparse-mode RPs are the routers where receivers meet sources.
- Senders announce their existence to one or more RPs, and receivers query RPs to find multicast sessions.
- Once receivers get content from sources through the RP, the last-hop router (the router closest to the receiver) can optionally remove the RP from the shared distribution tree (*,G) if the new source-based tree (S,G) is shorter. Receivers can then get content directly from the source.

  The transitional aspect of PIM sparse mode from shared to source-based tree is one of the major features of PIM, because it prevents overloading the RP or surrounding core links.

There are related issues regarding source, RPs, and receivers when sparse mode multicast is used:

- Sources must be able to send to all RPs.
- RPs must all know one another.
- Receivers must send explicit join messages to a known RP.
- Receivers initially need to know only one RP (they later learn about others).
- Receivers can explicitly prune themselves from a tree.
- Receivers that never transition to a source-based tree are effectively running Core Based Trees (CBT)`.

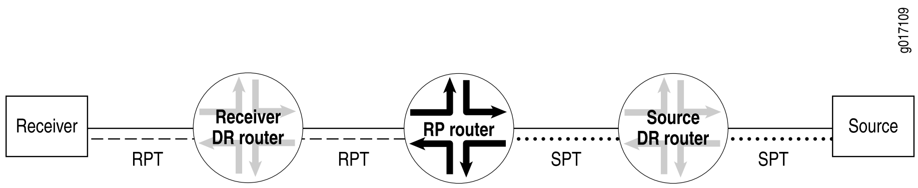
PIM sparse mode has standard features for all of these issues.

Rendezvous Point

The RP router serves as the information exchange point for the other routers. All routers in a PIM domain must provide mapping to an RP router. It is the only router that needs to know the active sources for a domain—the other routers just need to know how to reach the RP. In this way, the RP matches receivers with sources.

The RP router is downstream from the source and forms one end of the shortest-path tree. As shown in Figure 116 on page 3943, the RP router is upstream from the receiver and thus forms one end of the rendezvous-point tree.

Figure 116: Rendezvous Point as Part of the RPT and SPT



The benefit of using the RP as the information exchange point is that it reduces the amount of state in non-RP routers. No network flooding is required to provide non-RP routers information about active sources.

RP Mapping Options

RPs can be learned by one of the following mechanisms:

- Static configuration
- Anycast RP
- Auto-RP
- Bootstrap router

We recommend a static RP mapping with anycast RP and a bootstrap router (BSR) with auto-RP configuration, because static mapping provides all the benefits of a bootstrap router and auto-RP without the complexity of the full BSR and auto-RP mechanisms.

Related Documentation

- Understanding Static RP on page 3944
- Understanding RP Mapping with Anycast RP on page 3945
- Understanding the PIM Bootstrap Router on page 3945
- *Understanding PIM Auto-RP*

Designated Router

In a PIM sparse mode (PIM-SM) domain, there are two types of designated routers to consider:

- The receiver DR sends PIM join and PIM prune messages from the receiver network toward the RP.
- The source DR sends PIM register messages from the source network to the RP.

Neighboring PIM routers multicast periodic PIM hello messages to each other every 30 seconds (the default). The PIM hello message usually includes a holdtime value for the neighbor to use, but this is not a requirement. If the PIM hello message does not include a holdtime value, a default timeout value (in Junos OS, 105 seconds) is used. On receipt of a PIM hello message, a router stores the IP address and priority for that neighbor. If the DR priorities match, the router with the highest IP address is selected as the DR.

If a DR fails, a new one is selected using the same process of comparing IP addresses.

NOTE: In PIM dense mode (PIM-DM), a DR is elected by the same process that PIM-SM uses. However, the only time that a DR has any effect in PIM-DM is when IGMPv1 is used on the interface. (IGMPv2 is the default.) In this case, the DR also functions as the IGMP Query Router because IGMPv1 does not have a Query Router election mechanism.

Introduction to Static RP

Understanding Static RP

Protocol Independent Multicast (PIM) sparse mode is the most common multicast protocol used on the Internet. PIM sparse mode is the default mode whenever PIM is configured on any interface of the device. However, because PIM must not be configured on the network management interface, you must disable it on that interface.

Each any-source multicast (ASM) group has a shared tree through which receivers learn about new multicast sources and new receivers learn about all multicast sources. The rendezvous point (RP) router is the root of this shared tree and receives the multicast traffic from the source. To receive multicast traffic from the groups served by the RP, the device must determine the IP address of the RP for the source.

You can configure a static rendezvous point (RP) configuration that is similar to static routes. A static configuration has the benefit of operating in PIM version 1 or version 2. When you configure the static RP, the RP address that you select for a particular group must be consistent across all routers in a multicast domain.

One common way for the device to locate RPs is by static configuration of the IP address of the RP. A static configuration is simple and convenient. However, if the statically defined RP router becomes unreachable, there is no automatic failover to another RP router. To remedy this problem, you can use anycast RP.

Related Documentation

- Configuring Local PIM RPs on page 3995
- Configuring the Static PIM RP Address on the Non-RP Routing Device on page 3997

Introduction to Anycast RP

Understanding RP Mapping with Anycast RP

Having a single active rendezvous point (RP) per multicast group is much the same as having a single server providing any service. All traffic converges on this single point, although other servers are sitting idle, and convergence is slow when the resource fails. In multicast specifically, there might be closer RPs on the shared tree, so the use of a single RP is suboptimal.

For the purposes of load balancing and redundancy, you can configure anycast RP. You can use anycast RP within a domain to provide redundancy and RP load sharing. When an RP fails, sources and receivers are taken to a new RP by means of unicast routing. When you configure anycast RP, you bypass the restriction of having one active RP per multicast group, and instead deploy multiple RPs for the same group range. The RP routers share one unicast IP address. Sources from one RP are known to other RPs that use the Multicast Source Discovery Protocol (MSDP). Sources and receivers use the closest RP, as determined by the interior gateway protocol (IGP).

Anycast means that multiple RP routers share the same unicast IP address. Anycast addresses are advertised by the routing protocols. Packets sent to the anycast address are sent to the nearest RP with this address. Anycast addressing is a generic concept and is used in PIM sparse mode to add load balancing and service reliability to RPs.

Anycast RP is defined in Internet draft draft-ietf-mboned-anycast-rp-08.txt, *Anycast RP Mechanism Using PIM and MSDP*. To access Internet RFCs and drafts, go to the IETF website at http://www.ietf.org .

Related Documentation

- Configuring the Static PIM RP Address on the Non-RP Routing Device on page 3997
- Example: Configuring Multiple RPs in a Domain with Anycast RP on page 4005
- Example: Configuring PIM Anycast With or Without MSDP on page 3999

Introduction to PIM Bootstrap Router

Understanding the PIM Bootstrap Router

To determine which router is the rendezvous point (RP), all routers within a PIM sparse-mode domain collect bootstrap messages. A PIM sparse-mode domain is a group of routers that all share the same RP router. The domain bootstrap router initiates bootstrap messages, which are sent hop by hop within the domain. The routers use bootstrap messages to distribute RP information dynamically and to elect a bootstrap router when necessary.

Related Documentation

- *Configuring PIM Bootstrap Properties for IPv4 or IPv6*

Introduction to PIM Filtering

Understanding Multicast Message Filters

Multicast sources and routers generate a considerable number of control messages, especially when using PIM sparse mode. These messages form distribution trees, locate rendezvous points (RPs) and designated routers (DRs), and transition from one type of tree to another. In most cases, this multicast messaging system operates transparently and efficiently. However, in some configurations, more control over the sending and receiving of multicast control messages is necessary.

You can configure multicast filtering to control the sending and receiving of multicast control messages.

To prevent unauthorized groups and sources from registering with an RP router, you can define a routing policy to reject PIM register messages from specific groups and sources and configure the policy on the designated router or the RP router.

- If you configure the reject policy on an RP router, it rejects incoming PIM register messages from the specified groups and sources. The RP router also sends a register stop message by means of unicast to the designated router. On receiving the register stop message, the designated router sends periodic null register messages for the specified groups and sources to the RP router.
- If you configure the reject policy on a designated router, it stops sending PIM register messages for the specified groups and sources to the RP router.

NOTE: If you have configured the reject policy on an RP router, we recommend that you configure the same policy on all the RP routers in your multicast network.

NOTE: If you delete a group and source address from the reject policy configured on an RP router and commit the configuration, the RP router will register the group and source only when the designated router sends a null register message.

Related Documentation

- Filtering MAC Addresses on page 3947
- Filtering RP and DR Register Messages on page 3947
- Filtering MSDP SA Messages on page 3969

Filtering MAC Addresses

When a router is exclusively configured with multicast protocols on an interface, multicast sets the interface media access control (MAC) filter to multicast promiscuous mode, and the number of multicast groups is unlimited. However, when the router is not exclusively used for multicasting and other protocols such as OSPF, Routing Information Protocol version 2 (RIPv2), or Network Time Protocol (NTP) are configured on an interface, each of these protocols individually requests that the interface program the MAC filter to pick up its respective multicast group only. In this case, without multicast configured on the interface, the maximum number of multicast MAC filters is limited to 20. For example, the maximum number of interface MAC filters for protocols such as OSPF (multicast group 224.0.0.5) is 20, unless a multicast protocol is also configured on the interface.

No configuration is necessary for MAC filters.

Filtering RP and DR Register Messages

You can filter Protocol Independent Multicast (PIM) register messages sent from the designated router (DR) or to the rendezvous point (RP). The PIM RP keeps track of all active sources in a single PIM sparse mode domain. In some cases, more control over which sources an RP discovers, or which sources a DR notifies other RPs about, is desired. A high degree of control over PIM register messages is provided by RP and DR register message filtering. Message filtering also prevents unauthorized groups and sources from registering with an RP router.

Register messages that are filtered at a DR are not sent to the RP, but the sources are available to local users. Register messages that are filtered at an RP arrive from source DRs, but are ignored by the router. Sources on multicast group traffic can be limited or directed by using RP or DR register message filtering alone or together.

If the action of the register filter policy is to discard the register message, the router needs to send a register-stop message to the DR. Register-stop messages are throttled to prevent malicious users from triggering them on purpose to disrupt the routing process.

Multicast group and source information is encapsulated inside unicast IP packets. This feature allows the router to inspect the multicast group and source information before sending or accepting the PIM register message.

Incoming register messages to an RP are passed through the configured register message filtering policy before any further processing. If the register message is rejected, the RP router sends a register-stop message to the DR. When the DR receives the register-stop message, the DR stops sending register messages for the filtered groups and sources to the RP. Two fields are used for register message filtering:

- Group multicast address
- Source address

The syntax of the existing policy statements is used to configure the filtering on these two fields. The **route-filter** statement is useful for multicast group address filtering, and the **source-address-filter** statement is useful for source address filtering. In most cases, the action is to **reject** the register messages, but more complex filtering policies are possible.

Filtering cannot be performed on other header fields, such as DR address, protocol, or port. In some configurations, an RP might not send register-stop messages when the policy action is to discard the register messages. This has no effect on the operation of the feature, but the router will continue to receive register messages.

When anycast RP is configured, register messages can be sent or received by the RP. All the RPs in the anycast RP set need to be configured with the same RP register message filtering policies. Otherwise, it might be possible to circumvent the filtering policy.

Related Documentation

- Understanding RP Mapping with Anycast RP on page 3945
- Configuring Register Message Filters on a PIM RP and DR on page 4013

Introduction to PIM RPT and SPT Cutover

Understanding Multicast Rendezvous Points, Shared Trees, and Rendezvous-Point Trees

In a shared tree, the root of the distribution tree is a router, not a host, and is located somewhere in the core of the network. In the primary sparse mode multicast routing protocol, Protocol Independent Multicast sparse mode (PIM SM), the core router at the root of the shared tree is the rendezvous point (RP). Packets from the upstream source and join messages from the downstream routers “rendezvous” at this core router.

In the RP model, other routers do not need to know the addresses of the sources for every multicast group. All they need to know is the IP address of the RP router. The RP router discovers the sources for all multicast groups.

The RP model shifts the burden of finding sources of multicast content from each router (the (S,G) notation) to the network (the (*,G) notation knows only the RP). Exactly how the RP finds the unicast IP address of the source varies, but there must be some method to determine the proper source for multicast content for a particular group.

Consider a set of multicast routers without any active multicast traffic for a certain group. When a router learns that an interested receiver for that group is on one of its directly connected subnets, the router attempts to join the distribution tree for that group back to the RP, not to the actual source of the content.

To join the shared tree, or *rendezvous-point tree* (*RPT*) as it is called in PIM sparse mode, the router must do the following:

- Determine the IP address of the RP for that group. Determining the address can be as simple as static configuration in the router, or as complex as a set of nested protocols.
- Build the shared tree for that group. The router executes an RPF check on the RP address in its routing table, which produces the interface closest to the RP. The router now detects that multicast packets from this RP for this group need to flow into the router on this RPF interface.
- Send a join message out on this interface using the proper multicast protocol (probably PIM sparse mode) to inform the upstream router that it wants to join the shared tree for that group. This message is a (*,G) join message because S is not known. Only the RP is known, and the RP is not actually the source of the multicast packets. The router receiving the (*,G) join message adds the interface on which the message was received to its outgoing interface list (OIL) for the group and also performs an RPF check on the RP address. The upstream router then sends a (*,G) join message out from the RPF interface toward the source, informing the upstream router that it also wants to join the group.

Each upstream router repeats this process, propagating join messages from the RPF interface, building the shared tree as it goes. The process stops when the join message reaches one of the following:

- The RP for the group that is being joined
- A router along the RPT that already has a multicast forwarding state for the group that is being joined

In either case, the branch is created, and packets can flow from the source to the RP and from the RP to the receiver. Note that there is no guarantee that the shared tree (RPT) is the shortest path tree to the source. Most likely it is not. However, there are ways to "migrate" a shared tree to an SPT once the flow of packets begins. In other words, the forwarding state can transition from (*,G) to (S,G). The formation of both types of tree depends heavily on the operation of the RPF check and the RPF table.

Related Documentation

- *Understanding Multicast Reverse Path Forwarding*

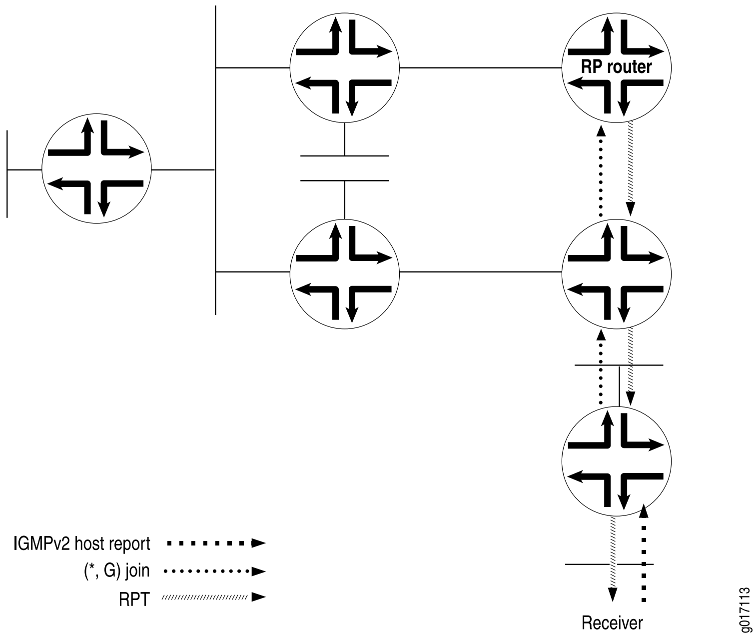
Building an RPT Between the RP and Receivers

The RPT is the path between the RP and receivers (hosts) in a multicast group (see Figure 117 on page 3950). The RPT is built by means of a PIM join message from a receiver's DR:

1. A receiver sends a request to join group (G) in an Internet Group Management Protocol (IGMP) host membership report. A PIM sparse-mode router, the receiver's DR, receives the report on a directly attached subnet and creates an RPT branch for the multicast group of interest.
2. The receiver's DR sends a PIM join message to its RPF neighbor, the next-hop address in the RPF table, or the unicast routing table.

3. The PIM join message travels up the tree and is multicast to the ALL-PIM-ROUTERS group (224.0.0.13). Each router in the tree finds its RPF neighbor by using either the RPF table or the unicast routing table. This is done until the message reaches the RP and forms the RPT. Routers along the path set up the multicast forwarding state to forward requested multicast traffic back down the RPT to the receiver.

Figure 117: Building an RPT Between the RP and the Receiver



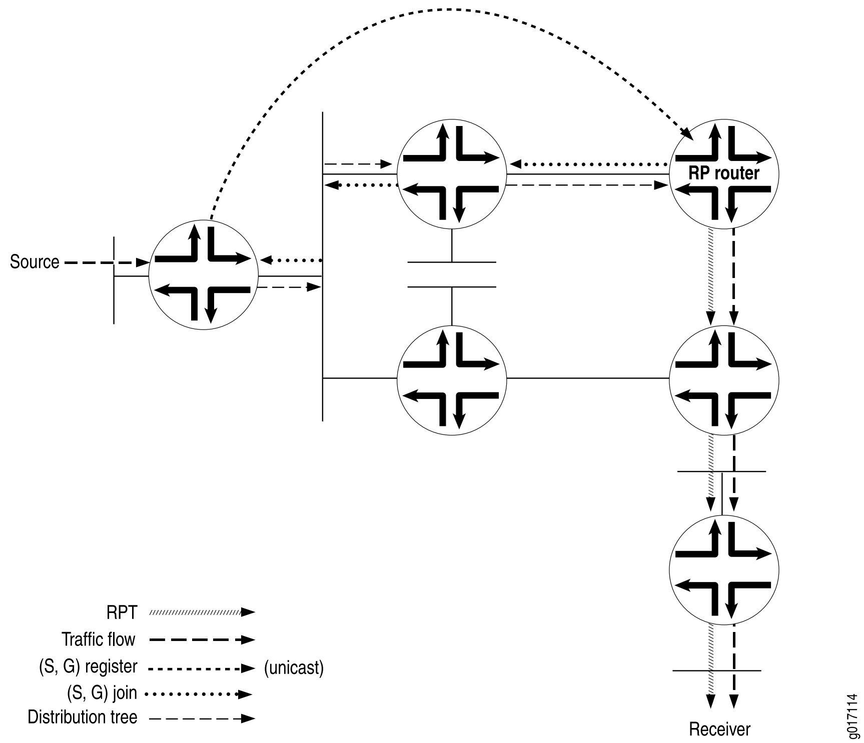
PIM Sparse Mode Source Registration

The RPT is a unidirectional tree, permitting traffic to flow down from the RP to the receiver in one direction. For multicast traffic to reach the receiver from the source, another branch of the distribution tree, called the shortest-path tree, needs to be built from the source's DR to the RP.

The shortest-path tree is created in the following way:

1. The source becomes active, sending out multicast packets on the LAN to which it is attached. The source's DR receives the packets and encapsulates them in a PIM register message, which it sends to the RP router (see Figure 118 on page 3951).
2. When the RP router receives the PIM register message from the source, it sends a PIM join message back to the source.

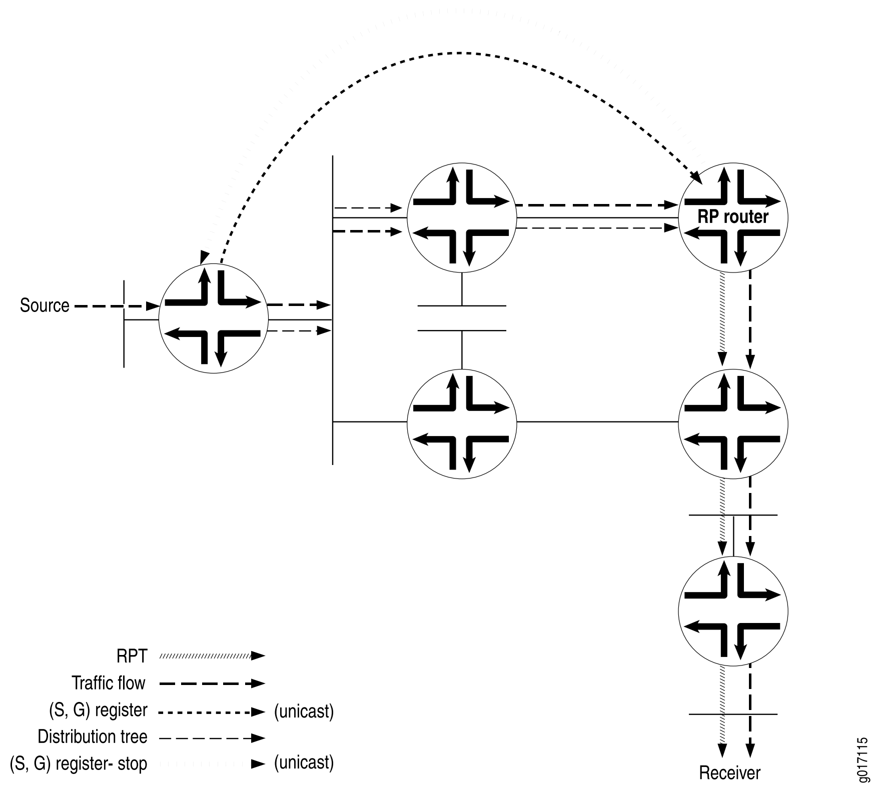
Figure 118: PIM Register Message and PIM Join Message Exchanged



3. The source's DR receives the PIM join message and begins sending traffic down the SPT toward the RP router (see Figure 119 on page 3952).

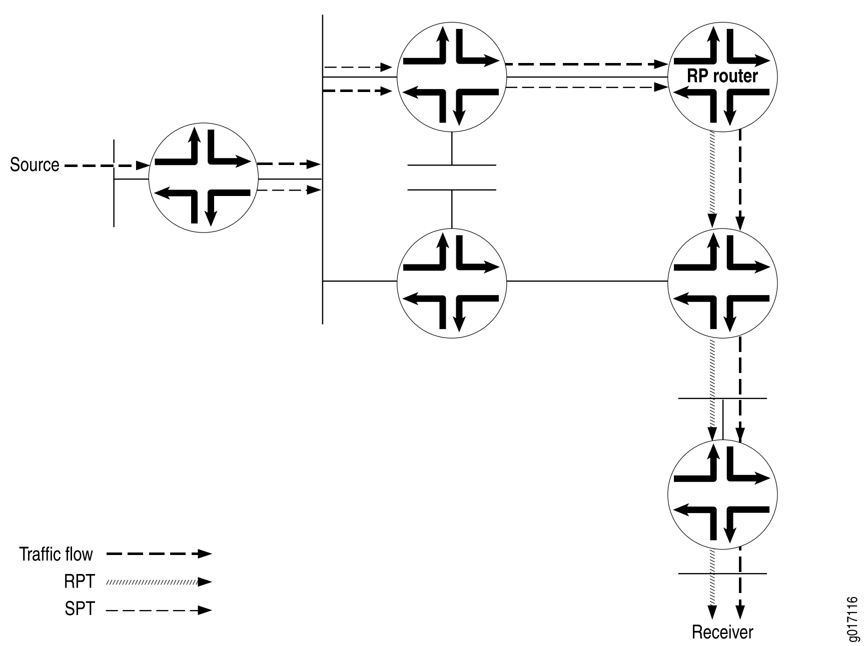
4. Once traffic is received by the RP router, it sends a register stop message to the source's DR to stop the register process.

Figure 119: Traffic Sent from the Source to the RP Router



5. The RP router sends the multicast traffic down the RPT toward the receiver (see Figure 120 on page 3952).

Figure 120: Traffic Sent from the RP Router Toward the Receiver



Multicast Shortest-Path Tree

The distribution tree used for multicast is rooted at the source and is the shortest-path tree (SPT) as well. Consider a set of multicast routers without any active multicast traffic for a certain group (that is, they have no multicast forwarding state for that group). When a router learns that an interested receiver for that group is on one of its directly connected subnets, the router attempts to join the tree for that group.

To join the distribution tree, the router determines the unicast IP address of the source for that group. This address can be a simple static configuration on the router, or as complex as a set of protocols.

To build the SPT for that group, the router executes an a reverse path forwarding (RPF) check on the source address in its routing table. The RPF check produces the interface closest to the source, which is where multicast packets from this source for this group need to flow into the router.

The router next sends a join message out on this interface using the proper multicast protocol to inform the upstream router that it wants to join the distribution tree for that group. This message is an (S,G) join message because both S and G are known. The router receiving the (S,G) join message adds the interface on which the message was received to its output interface list (OIL) for the group and also performs an RPF check on the source address. The upstream router then sends an (S,G) join message out on the RPF interface toward the source, informing the upstream router that it also wants to join the group.

Each upstream router repeats this process, propagating joins out on the RPF interface, building the SPT as it goes. The process stops when the join message does one of two things:

- Reaches the router directly connected to the host that is the source.
- Reaches a router that already has multicast forwarding state for this source-group pair.

In either case, the branch is created, each of the routers has multicast forwarding state for the source-group pair, and packets can flow down the distribution tree from source to receiver. The RPF check at each router makes sure that the tree is an SPT.

SPTs are always the shortest path, but they are not necessarily short. That is, sources and receivers tend to be on the periphery of a router network, not on the backbone, and multicast distribution trees have a tendency to sprawl across almost every router in the network. Because multicast traffic can overwhelm a slow interface, and one packet can easily become a hundred or a thousand on the opposite side of the backbone, it makes sense to provide a shared tree as a distribution tree so that the multicast source can be located more centrally in the network, on the backbone. This sharing of distribution trees with roots in the core network is accomplished by a multicast rendezvous point.

Related Documentation

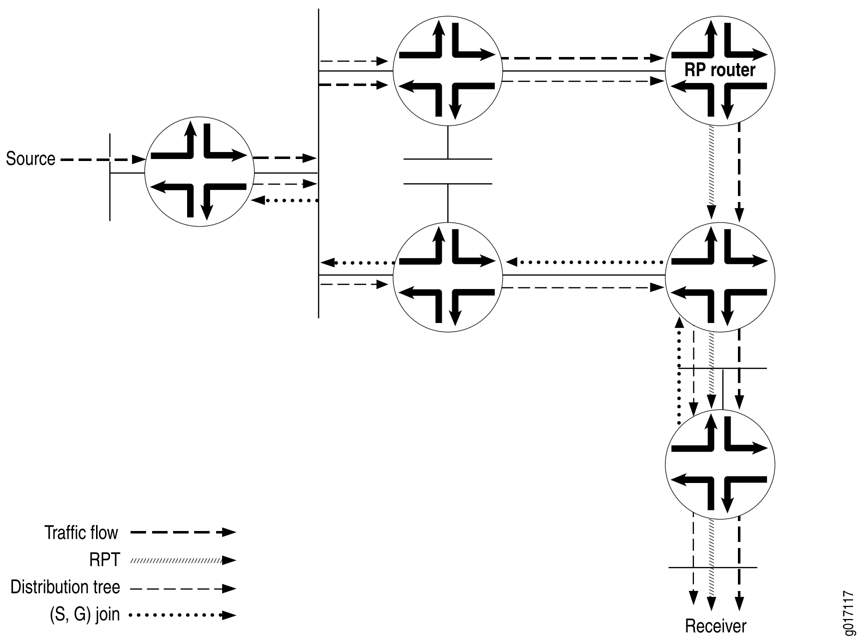
- Understanding Multicast Rendezvous Points, Shared Trees, and Rendezvous-Point Trees on page 3948

SPT Cutover

Instead of continuing to use the SPT to the RP and the RPT toward the receiver, a direct SPT is created between the source and the receiver in the following way:

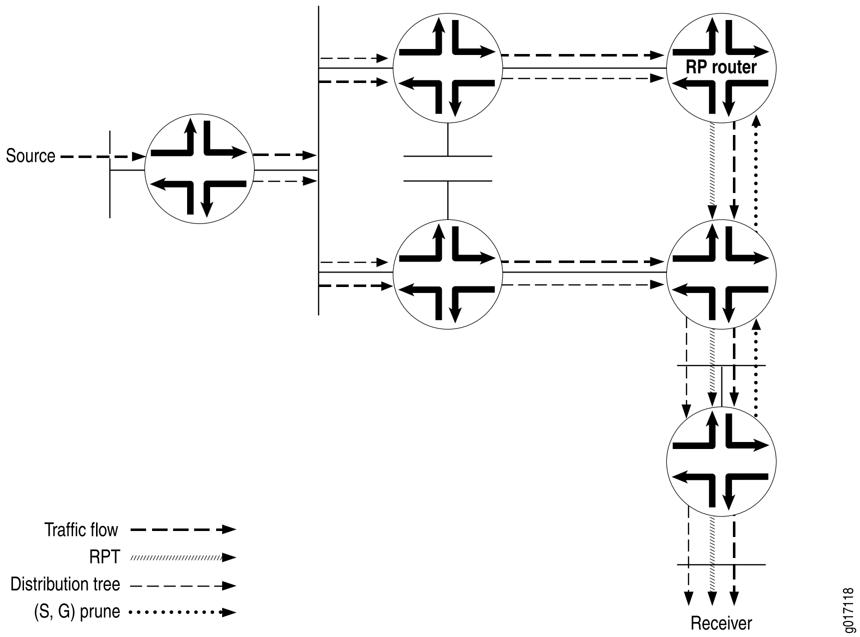
1. Once the receiver's DR receives the first multicast packet from the source, the DR sends a PIM join message to its RPF neighbor (see Figure 121 on page 3954).
2. The source's DR receives the PIM join message, and an additional (S,G) state is created to form the SPT.
3. Multicast packets from that particular source begin coming from the source's DR and flowing down the new SPT to the receiver's DR. The receiver's DR is now receiving two copies of each multicast packet sent by the source—one from the RPT and one from the new SPT.

Figure 121: Receiver DR Sends a PIM Join Message to the Source



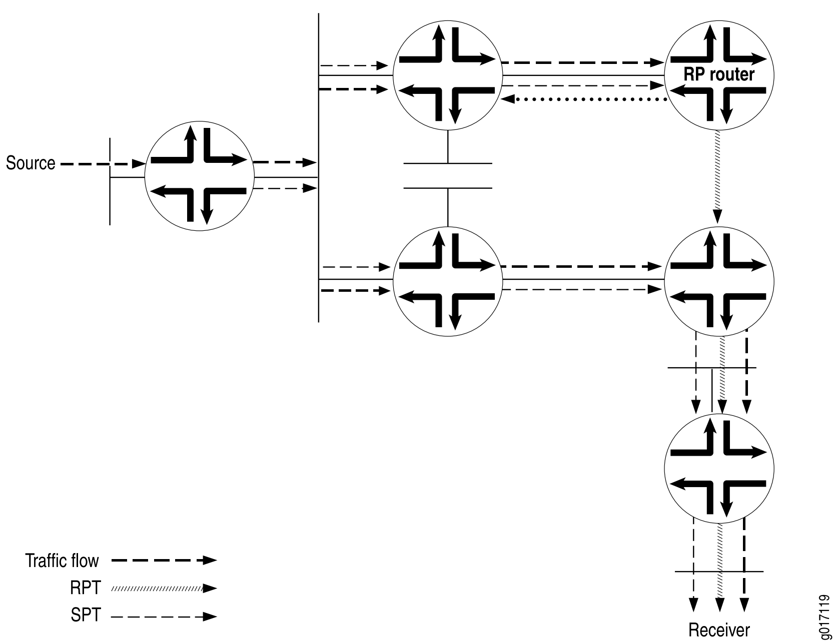
4. To stop duplicate multicast packets, the receiver's DR sends a PIM prune message toward the RP router, letting it know that the multicast packets from this particular source coming in from the RPT are no longer needed (see Figure 122 on page 3955).

Figure 122: PIM Prune Message Is Sent from the Receiver’s DR Toward the RP Router



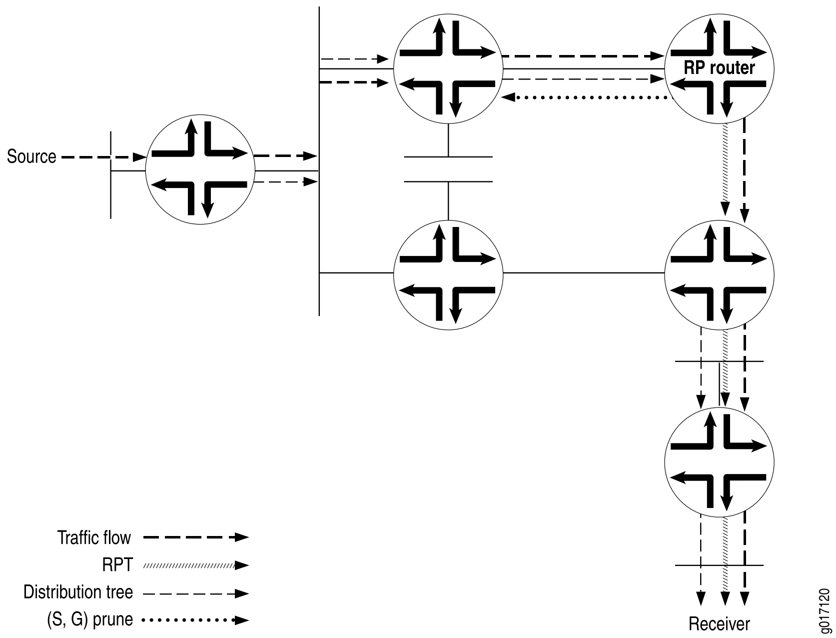
5. The PIM prune message is received by the RP router, and it stops sending multicast packets down to the receiver’s DR. The receiver’s DR is getting multicast packets only for this particular source over the new SPT. However, multicast packets from the source are still arriving from the source’s DR toward the RP router (see Figure 123 on page 3955).

Figure 123: RP Router Receives PIM Prune Message



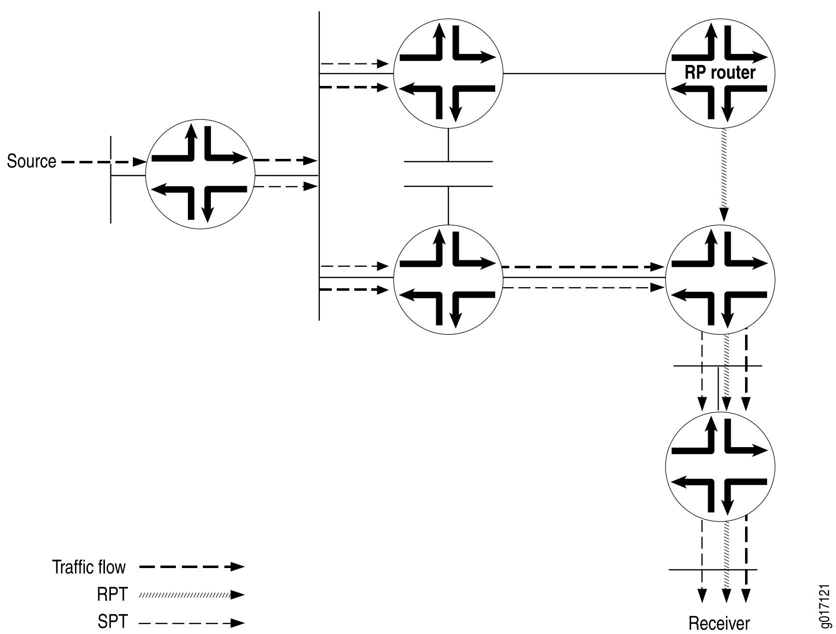
6. To stop the unneeded multicast packets from this particular source, the RP router sends a PIM prune message to the source's DR (see Figure 124 on page 3956).

Figure 124: RP Router Sends a PIM Prune Message to the Source DR



7. The receiver's DR now receives multicast packets only for the particular source from the SPT (see Figure 125 on page 3956).

Figure 125: Source's DR Stops Sending Duplicate Multicast Packets Toward the RP Router



SPT Cutover Control

In some cases, the last-hop router needs to stay on the shared tree to the RP and not transition to a direct SPT to the source. You might not want the last-hop router to transition when, for example, a low-bandwidth multicast stream is forwarded from the RP to a last-hop router. All routers between last hop and source must maintain and refresh the SPT state. This can become a resource-intensive activity that does not add much to the network efficiency for a particular pair of source and multicast group addresses.

In these cases, you configure an SPT threshold policy on the last-hop router to control the transition to a direct SPT. An SPT cutover threshold of infinity applied to a source-group address pair means the last-hop router will never transition to a direct SPT. For all other source-group address pairs, the last-hop router transitions immediately to a direct SPT rooted at the source DR.

Introduction to IGMP

Understanding Group Membership Protocols

There is a big difference between the multicast protocols used between host and router and between the multicast routers themselves. Hosts on a given subnetwork need to inform their router only whether or not they are interested in receiving packets from a certain multicast group. The source host needs to inform its routers only that it is the source of traffic for a particular multicast group. In other words, no detailed knowledge of the distribution tree is needed by any hosts; only a group membership protocol is needed to inform routers of their participation in a multicast group. Between adjacent routers, on the other hand, the multicast routing protocols must avoid loops as they build a detailed sense of the network topology and distribution tree from source to leaf. So, different multicast protocols are used for the host-router portion and the router-router portion of the multicast network.

Multicast group membership protocols enable a router to detect when a host on a directly attached subnet, typically a LAN, wants to receive traffic from a certain multicast group. Even if more than one host on the LAN wants to receive traffic for that multicast group, the router sends only one copy of each packet for that multicast group out on that interface, because of the inherent broadcast nature of LANs. When the multicast group membership protocol informs the router that there are no interested hosts on the subnet, the packets are withheld and that leaf is pruned from the distribution tree.

The Internet Group Management Protocol (IGMP) and the Multicast Listener Discovery (MLD) Protocol are the standard IP multicast group membership protocols: IGMP and MLD have several versions that are supported by hosts and routers:

- IGMPv1—The original protocol defined in RFC 1112. An explicit join message is sent to the router, but a timeout is used to determine when hosts leave a group. This process wastes processing cycles on the router, especially on older or smaller routers.
- IGMPv2—Defined in RFC 2236. Among other features, IGMPv2 adds an explicit leave message to the join message so that routers can more easily determine when a group has no interested listeners on a LAN.
- IGMPv3—Defined in RFC 3376. Among other features, IGMPv3 optimizes support for a single source of content for a multicast group, or *source-specific multicast* (*SSM*).
- MLDv1—Defined in RFC 2710. MLDv1 is similar to IGMPv2.
- MLDv2—Defined in RFC 3810. MLDv2 similar to IGMPv3.

The various versions of IGMP and MLD are backward compatible. It is common for a router to run multiple versions of IGMP and MLD on LAN interfaces. Backward compatibility is achieved by dropping back to the most basic of all versions run on a LAN. For example, if one host is running IGMPv1, any router attached to the LAN running IGMPv2 can drop back to IGMPv1 operation, effectively eliminating the IGMPv2 advantages. Running multiple IGMP versions ensures that both IGMPv1 and IGMPv2 hosts find peers for their versions on the router.

Related Documentation

- Examples: Configuring MLD on page 4059

Understanding IGMP

The IPv4 address scheme assigns class D addresses for IP multicast. IGMP is the protocol that uses these addresses, which can be in the range 224.0.0.0 to 239.255.255.255. The following addresses have specific functions or are unavailable:

- 224.0.0.0 is reserved—you cannot assign it to a group.
- 224.0.0.1 is the all-hosts address—a packet sent to this address reaches all hosts on a subnet.
- 224.0.0.2 is the all-routers address—a packet sent to this address reaches all routers on a subnet.

This implementation of IGMP complies with IGMP versions 1, 2, and 3. IGMPv3 supports source-specific join and leave messages and is backward compatible with IGMPv1 and IGMPv2.

IGMPv2 mode interfaces exchange the following types of messages between routers and hosts:

- Group membership queries
- Group membership reports
- Leave group membership messages

IGMPv3 mode interfaces exchange the following types of messages with IGMPv3 hosts:

- Group membership queries
- IGMPv3 group membership reports

IGMP manages the membership of hosts and routers in multicast groups. IP hosts use IGMP to report their multicast group memberships to any immediately neighboring multicast routers. Multicast routers use IGMP to learn, for each of their attached physical networks, which groups have members.

A router receives explicit join and prune messages from those neighboring routers that have downstream group members. When PIM is the multicast protocol in use, IGMP begins the process as follows:

1. To join a multicast group, G, a host conveys its membership information through IGMP.
2. The router then forwards data packets addressed to a multicast group to only those interfaces on which explicit join messages have been received.
3. A designated router (DR) sends periodic join and prune messages toward a group-specific rendezvous point (RP) for each group for which it has active members. One or more routers are automatically or statically designated as the RP, and all routers must explicitly join through the RP.
4. Each router along the path toward the RP builds a wild card (any-source) state for the group and sends join and prune messages toward the RP.

The term *route entry* is used to refer to the state maintained in a router to represent the distribution tree.

A route entry can include such fields as:

- source address
- group address
- incoming interface from which packets are accepted
- list of outgoing interfaces to which packets are sent
- timers
- flag bits

The wild card route entry's incoming interface points toward the RP.

The outgoing interfaces point to the neighboring downstream routers that have sent join and prune messages toward the RP as well as the directly connected hosts that have requested membership to group G.

5. This state creates a shared, RP-centered, distribution tree that reaches all group members.

IGMP is also used as the transport for several related multicast protocols (for example, Distance Vector Multicast Routing Protocol [DVMRP] and Protocol Independent Multicast version 1 [PIMv1]).

A router receives explicit join and prune messages from those neighboring routers that have downstream group members. When PIM is the multicast protocol in use, IGMP begins the process as follows:

1. To join a multicast group, G, a host conveys its membership information through IGMP.
2. The router then forwards data packets addressed to a multicast group G to only those interfaces on which explicit join messages have been received.
3. A designated router (DR) sends periodic join and prune messages toward a group-specific rendezvous point (RP) for each group for which it has active members. One or more routers are automatically or statically designated as the RP, and all routers must explicitly join through the RP.
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   A route entry can include such fields as:

   - source address
   - group address
   - incoming interface from which packets are accepted
   - list of outgoing interfaces to which packets are sent

- timers
- flag bits

The wild card route entry's incoming interface points toward the RP.

The outgoing interfaces point to the neighboring downstream routers that have sent join and prune messages toward the RP as well as the directly connected hosts that have requested membership to group G.

5. This state creates a shared, RP-centered, distribution tree that reaches all group members.

IGMP is an integral part of IP and must be enabled on all routers and hosts that need to receive IP multicast traffic.

For each attached network, a multicast router can be either a querier or a nonquerier. The querier router periodically sends general query messages to solicit group membership information. Hosts on the network that are members of a multicast group send report messages. When a host leaves a group, it sends a leave group message.

IGMP version 3 (IGMPv3) supports inclusion and exclusion lists. Inclusion lists enable you to specify which sources can send to a multicast group. This type of multicast group is called a source-specific multicast (SSM) group, and its multicast address is 232/8.

IGMPv3 provides support for source filtering. For example, a router can specify particular routers from which it accepts or rejects traffic. With IGMPv3, a multicast router can learn which sources are of interest to neighboring routers.

Exclusion mode works the opposite of an inclusion list. It allows any source but the ones listed to send to the SSM group.

IGMPv3 interoperates with versions 1 and 2 of the protocol. However, to remain compatible with older IGMP hosts and routers, IGMPv3 routers must also implement versions 1 and 2 of the protocol. IGMPv3 supports the following membership-report record types: mode is allowed, allow new sources, and block old sources.

Related Documentation

- *Supported IP Multicast Protocol Standards*

Introduction to IGMP Snooping

IGMP Snooping Overview

With IGMP snooping enabled, a switch monitors the IGMP (Internet Group Management Protocol) traffic between hosts and multicast routers and uses what it learns to forward multicast traffic to only the downstream interfaces that are connected to interested receivers. This conserves bandwidth by allowing the switch to send multicast traffic to only those interfaces that are connected to devices that want to receive the traffic (instead of flooding the traffic to all the downstream VLAN interfaces).

This IGMP snooping topic includes:

How IGMP Snooping Works

A switch usually learns unicast MAC addresses by checking the source address field of the frames it receives and then sends any traffic for that unicast address only to the appropriate interface. However, a multicast MAC address can never be the source address for a packet. As a result, when a switch receives traffic for a multicast destination address, it floods the traffic on the relevant VLAN, which can cause a significant amount of traffic to be sent unnecessarily.

IGMP snooping prevents this flooding. When you enable IGMP snooping, the switch monitors IGMP packets between receivers and multicast routers and uses the content of the packets to build a multicast cache table—a database of multicast groups and the interfaces that are connected to members of the groups. When the switch receives multicast packets, it uses the cache table to selectively forward the traffic to only the interfaces that are connected to members of the appropriate multicast groups.

NOTE: **IGMP snooping is enabled by default on the default VLAN only. With versions of Junos OS for the QFX Series previous to 13.2, IGMP snooping is enabled by default on all VLANs.**

NOTE: **You cannot configure IGMP snooping on a secondary (private) VLAN.**

How IGMP Snooping Works with Routed VLAN Interfaces

A switch can use a routed VLAN interface (RVI) to forward traffic between VLANs that connect to it. IGMP snooping works with Layer 2 interfaces and RVIs to forward multicast traffic in a switched network.

When a switch receives a multicast packet, its Packet Forwarding Engines perform a multicast lookup on the packet to determine how to forward the packet to its local interfaces. From the results of the lookup, each Packet Forwarding Engine extracts a list of Layer 3 interfaces that have ports local to the Packet Forwarding Engine. If the list includes an RVI, the switch provides a bridge multicast group ID for the RVI to the Packet Forwarding Engine.

For VLANs that include multicast receivers, the bridge multicast ID includes a sub-next-hop ID, which identifies the Layer 2 interfaces in the VLAN that are interested in receiving the multicast stream. The Packet Forwarding Engine then forwards multicast traffic to bridge multicast IDs that have multicast receivers for a given multicast group.

How Hosts Join and Leave Multicast Groups

Hosts can join multicast groups in two ways:

- By sending an unsolicited IGMP join message to a multicast router that specifies the IP multicast group that the host is attempting to join.
- By sending an IGMP join message in response to a general query from a multicast router.

A multicast router continues to forward multicast traffic to a VLAN provided that at least one host on that VLAN responds to the periodic general IGMP queries. For a host to remain a member of a multicast group, therefore, it must continue to respond to the periodic general IGMP queries.

To leave a multicast group, either a host cannot respond to the periodic general IGMP queries, which results in a “silent leave” (the only leave option for IGMPv1), or a host can send a group-specific IGMPv2 leave message.

IGMP Snooping and Forwarding Interfaces

To determine how to forward multicast traffic, a switch with IGMP snooping enabled maintains information about the following interfaces in its multicast forwarding table:

- Multicast-router interfaces—These interfaces lead toward multicast routers or IGMP queriers.
- Group-member interfaces—These interfaces lead toward hosts that are members of multicast groups.

The switch learns about these interfaces by monitoring IGMP traffic. If an interface receives IGMP queries or Protocol Independent Multicast (PIM) updates, the switch adds the interface to its multicast forwarding table as a multicast-router interface. If an interface receives membership reports for a multicast group, the switch adds the interface to its multicast forwarding table as a group-member interface.

Table entries for interfaces that the switch learns about are subject to aging. For example, if a learned multicast-router interface does not receive IGMP queries or PIM hellos within a certain interval, the switch removes the entry for that interface from its multicast forwarding table.

NOTE: For a switch to learn multicast-router interfaces and group-member interfaces, an IGMP querier must exist in the network. This is often a multicast router, but if there is no multicast router on the local network, you can configure the switch itself to be an IGMP querier.

You can statically configure an interface to be a multicast-router interface or a group-member interface. The switch adds a static interface to its multicast forwarding table without having to learn about the interface, and the entry in the table is not subject to aging. You can have a mix of statically configured and dynamically learned interfaces on a switch.

General Forwarding Rules

Multicast traffic received on a switch interface in a VLAN on which IGMP snooping is enabled is forwarded according to the following rules.

IGMP traffic is forwarded as follows:

- IGMP general queries received on a multicast-router interface are forwarded to all other interfaces in the VLAN.
- IGMP group-specific queries received on a multicast-router interface are forwarded to only those interfaces in the VLAN that are members of the group.
- IGMP reports received on a host interface are forwarded to multicast-router interfaces in the same VLAN, but not to the other host interfaces in the VLAN.

Multicast traffic that is not IGMP traffic is forwarded as follows:

- A multicast packet with a destination address of 224.0.0.0/24 is flooded to all other interfaces on the VLAN.
- An unregistered multicast packet—that is, a packet for a group that has no current members—is forwarded to all multicast-router interfaces in the VLAN.
- A registered multicast packet is forwarded only to those host interfaces in the VLAN that are members of the multicast group and to all multicast-router interfaces in the VLAN.

Using a Switch as an IGMP Querier

If IGMP snooping is enabled on a pure Layer 2 a local network (that is, Layer 3 is not enabled on the network), and there is not multicast router in the network, multicast traffic might not be properly forwarded through the network. This problem occurs if the local network is configured such that multicast traffic must be forwarded between switches in order to reach a multicast receiver. In this case, an upstream switch does not forward multicast traffic to a downstream switch (and therefore to the multicast receivers attached to the downstream switch) because the downstream switch does not forward IGMP reports to the upstream switch. You can solve this problem by configuring one of the switches to be an IGMP querier. This switch sends periodic general query packets to all the switches in the network, which ensures that the snooping membership tables are updated and prevents any multicast traffic loss.

If you configure multiple switches to be IGMP queriers, the switch with the highest (greatest) IGMP querier source address takes precedence and acts as the querier. Switches with lower IGMP querier source addresses stop sending IGMP queries unless they do not receive IGMP queries for 255 seconds. If a switch with a lower IGMP querier source address does not receive any IGMP queries during that period, it starts sending queries again.

To configure a switch to act as an IGMP querier, enter the following:

```
[edit protocols]
user@switch# set igmp-snooping vlan vlan-name igmp-querier source-address source address
```

NOTE: The **igmp-querier** statement is not supported on QFabric systems.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048
- Changing the IGMP Snooping Group Timeout Value on page 4051
- Monitoring IGMP Snooping on page 4257
- Configuring IGMP on page 4026

- RFC 3171, *IANA Guidelines for IPv4 Multicast Address Assignments*
- IGMPv1—See RFC 1112, *Host extensions for IP multicasting*.
- IGMPv2—See RFC 2236, *Internet Group Management Protocol, Version 2*.
- IGMPv3—See RFC 3376, *Internet Group Management Protocol, Version 3*.

Introduction to MLD

- Understanding MLD on page 3965

Understanding MLD

The Multicast Listener Discovery (MLD) Protocol manages the membership of hosts and routers in multicast groups. IP version 6 (IPv6) multicast routers use MLD to learn, for each of their attached physical networks, which groups have interested listeners. Each routing device maintains a list of host multicast addresses that have listeners for each subnetwork, as well as a timer for each address. However, the routing device does not need to know the address of each listener—just the address of each host. The routing device provides addresses to the multicast routing protocol it uses, which ensures that multicast packets are delivered to all subnetworks where there are interested listeners. In this way, MLD is used as the transport for the Protocol Independent Multicast (PIM) Protocol.

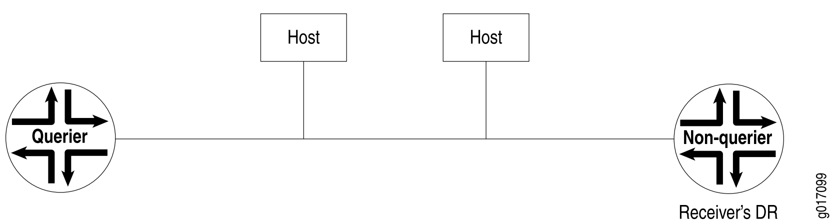
MLD is an integral part of IPv6 and must be enabled on all IPv6 routing devices and hosts that need to receive IP multicast traffic. The Junos OS supports MLD versions 1 and 2. Version 2 is supported for source-specific multicast (SSM) include and exclude modes.

In include mode, the receiver specifies the source or sources it is interested in receiving the multicast group traffic from. Exclude mode works the opposite of include mode. It allows the receiver to specify the source or sources it is not interested in receiving the multicast group traffic from.

For each attached network, a multicast routing device can be either a querier or a nonquerier. A querier routing device, usually one per subnet, solicits group membership information by transmitting MLD queries. When a host reports to the querier routing device that it has interested listeners, the querier routing device forwards the membership information to the rendezvous point (RP) routing device by means of the receiver's (host's) designated router (DR). This builds the rendezvous-point tree (RPT) connecting the host with interested listeners to the RP routing device. The RPT is the initial path used by the sender to transmit information to the interested listeners. Nonquerier routing devices do not transmit MLD queries on a subnet but can do so if the querier routing device fails.

All MLD-configured routing devices start as querier routing devices on each attached subnet (see Figure 126 on page 3966). The querier routing device on the right is the receiver's DR.

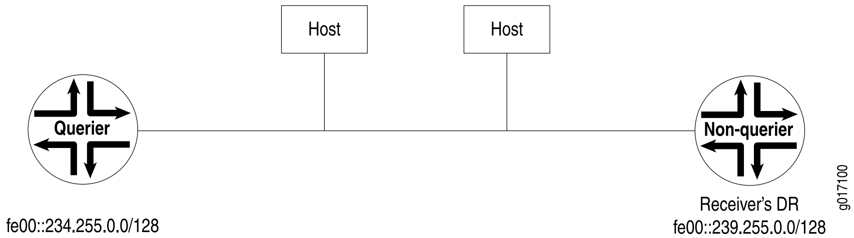
Figure 126: Routing Devices Start Up on a Subnet



To elect the querier routing device, the routing devices exchange query messages containing their IPv6 source addresses. If a routing device hears a query message whose IPv6 source address is numerically lower than its own selected address, it becomes a nonquerier. In Figure 127 on page 3967, the routing device on the left has a source address numerically lower than the one on the right and therefore becomes the querier routing device.

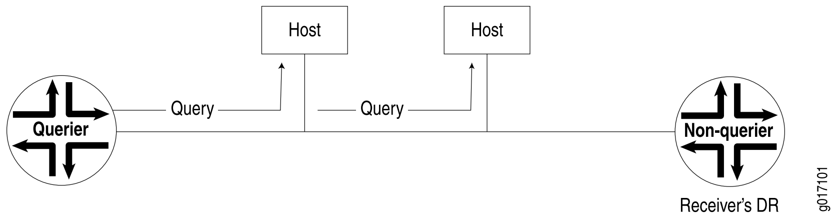
NOTE: In the practical application of MLD, several routing devices on a subnet are nonqueriers. If the elected querier routing device fails, query messages are exchanged among the remaining routing devices. The routing device with the lowest IPv6 source address becomes the new querier routing device. The IPv6 Neighbor Discovery Protocol (NDP) implementation drops incoming Neighbor Announcement (NA) messages that have a broadcast or multicast address in the target link-layer address option. This behavior is recommended by RFC 2461.

Figure 127: Querier Routing Device Is Determined



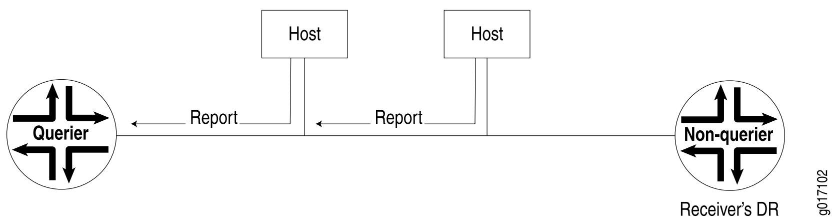
The querier routing device sends general MLD queries on the **link-scope all-nodes** multicast address FF02::1 at short intervals to all attached subnets to solicit group membership information (see Figure 128 on page 3967). Within the query message is the *maximum response delay* value, specifying the maximum allowed delay for the host to respond with a report message.

Figure 128: General Query Message Is Issued



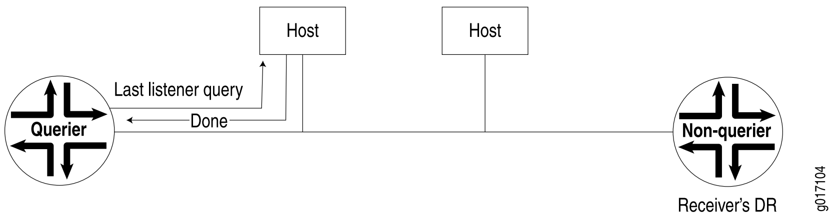
If interested listeners are attached to the host receiving the query, the host sends a report containing the host's IPv6 address to the routing device (see Figure 129 on page 3967). If the reported address is not yet in the routing device's list of multicast addresses with interested listeners, the address is added to the list and a timer is set for the address. If the address is already on the list, the timer is reset. The host's address is transmitted to the RP in the PIM domain.

Figure 129: Reports Are Received by the Querier Routing Device



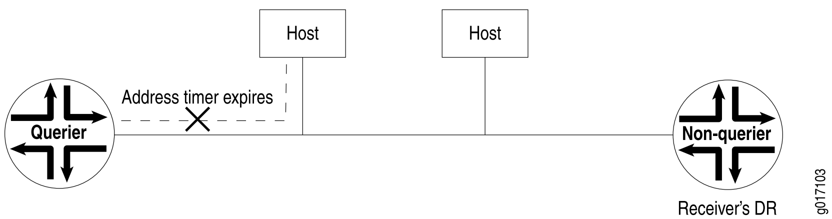
If the host has no interested multicast listeners, it sends a done message to the querier routing device. On receipt, the querier routing device issues a multicast address-specific query containing the last **listener query interval** value to the multicast address of the host. If the routing device does not receive a report from the multicast address, it removes the multicast address from the list and notifies the RP in the PIM domain of its removal (see Figure 130 on page 3968).

Figure 130: Host Has No Interested Receivers and Sends a Done Message to Routing Device



If a done message is not received by the querier routing device, the querier routing device continues to send multicast address-specific queries. If the timer set for the address on receipt of the last report expires, the querier routing device assumes there are no longer interested listeners on that subnet, removes the multicast address from the list, and notifies the RP in the PIM domain of its removal (see Figure 131 on page 3968).

Figure 131: Host Address Timer Expires and Address Is Removed from Multicast Address List



Related Documentation

- Examples: Configuring MLD on page 4059

Introduction to MSDP

- Understanding MSDP on page 3968
- Filtering MSDP SA Messages on page 3969

Understanding MSDP

The Multicast Source Discovery Protocol (MSDP) is used to connect multicast routing domains. It typically runs on the same router as the Protocol Independent Multicast (PIM) sparse-mode rendezvous point (RP). Each MSDP router establishes adjacencies with internal and external MSDP peers similar to the way BGP establishes peers. These peer routers inform each other about active sources within the domain. When they detect active sources, the routers can send PIM sparse-mode explicit join messages to the active source.

The peer with the higher IP address passively listens to a well-known port number and waits for the side with the lower IP address to establish a Transmission Control Protocol (TCP) connection. When a PIM sparse-mode RP that is running MSDP becomes aware of a new local source, it sends source-active type, length, and values (TLVs) to its MSDP peers. When a source-active TLV is received, a peer-reverse-path-forwarding (peer-RPF) check (not the same as a multicast RPF check) is done to make sure that this peer is in the path that leads back to the originating RP. If not, the source-active TLV is dropped. This TLV is counted as a “rejected” source-active message.

The MSDP peer-RPF check is different from the normal RPF checks done by non-MSDP multicast routers. The goal of the peer-RPF check is to stop source-active messages from looping. Router R accepts source-active messages originated by Router S only from neighbor Router N or an MSDP mesh group member. For more information about configuring MSDP mesh groups, see “Example: Configuring MSDP with Active Source Limits and Mesh Groups” on page 4088.

Router R locates its MSDP peer-RPF neighbor (Router N) deterministically. A series of rules is applied in a particular order to received source-active messages, and the first rule that applies determines the peer-RPF neighbor. All source-active messages from other routers are rejected.

The six rules applied to source-active messages originating at Router S received at Router R from Router X are as follows:

1. If Router X originated the source-active message (Router X is Router S), then Router X is also the peer-RPF neighbor, and its source-active messages are accepted.
2. If Router X is a member of the Router R mesh group, or is the configured peer, then Router X is the peer-RPF neighbor, and its source-active messages are accepted.
3. If Router X is the BGP next hop of the active multicast RPF route toward Router S (Router X installed the route on Router R), then Router X is the peer-RPF neighbor, and its source-active messages are accepted.
4. If Router X is an external BGP (EBGP) or internal BGP (IBGP) peer of Router R, and the last autonomous system (AS) number in the BGP AS-path to Router S is the same as Router X's AS number, then Router X is the peer-RPF neighbor, and its source-active messages are accepted.
5. If Router X uses the same next hop as the next hop to Router S, then Router X is the peer-RPF neighbor, and its source-active messages are accepted.
6. If Router X fits none of these criteria, then Router X is not an MSDP peer-RPF neighbor, and its source-active messages are rejected.

The MSDP peers that receive source-active TLVs can be constrained by BGP reachability information. If the AS path of the network layer reachability information (NLRI) contains the receiving peer's AS number prepended second to last, the sending peer is using the receiving peer as a next hop for this source. If the split horizon information is not being received, the peer can be pruned from the source-active TLV distribution list.

Related Documentation

• Configuring MSDP on page 4083

Filtering MSDP SA Messages

Along with applying MSDP source active (SA) filters on all external MSDP sessions (in and out) to prevent SAs for groups and sources from leaking in and out of the network, you need to apply bootstrap router (BSR) filters. Applying a BSR filter to the boundary of a network prevents foreign BSR messages (which announce RP addresses) from leaking into your network. Since the routers in a PIM sparse-mode domain need to know the address of only one RP router, having more than one in the network can create issues.

If you did not use multicast scoping to create boundary filters for all customer-facing interfaces, you might want to use PIM join filters. Multicast scopes prevent the actual multicast data packets from flowing in or out of an interface. PIM join filters prevent PIM sparse-mode state from being created in the first place. Since PIM join filters apply only to the PIM sparse-mode state, it might be more beneficial to use multicast scoping to filter the actual data.

NOTE: When you apply firewall filters, firewall action modifiers, such as **log**, **sample**, and **count**, work only when you apply the filter on an inbound interface. The modifiers do not work on an outbound interface.

Related Documentation

- *Understanding Multicast Administrative Scoping*
- Filtering Incoming PIM Join Messages on page 4012
- Example: Configuring PIM BSR Filters on page 4009

Introduction to Source-Specific Multicast

Source-Specific Multicast Groups Overview

Source-specific multicast (SSM) is a service model that identifies session traffic by both source and group address. SSM implemented in Junos OS has the efficient explicit join procedures of Protocol Independent Multicast (PIM) sparse mode but eliminates the immediate shared tree and rendezvous point (RP) procedures using (*,G) pairs. The (*) is a wildcard referring to any source sending to group G, and “G” refers to the IP multicast group. SSM builds shortest-path trees (SPTs) directly represented by (S,G) pairs. The “S” refers to the source's unicast IP address, and the “G” refers to the specific multicast group address. The SSM (S,G) pairs are called channels to differentiate them from any-source multicast (ASM) groups. Although ASM supports both one-to-many and many-to-many communications, ASM's complexity is in its method of source discovery. For example, if you click a link in a browser, the receiver is notified about the group information, but not the source information. With SSM, the client receives both source and group information.

SSM is ideal for one-to-many multicast services such as network entertainment channels. However, many-to-many multicast services might require ASM.

To deploy SSM successfully, you need an end-to-end multicast-enabled network and applications that use an Internet Group Management Protocol version 3 (IGMPv3) or Multicast Listener Discovery version 2 (MLDv2) stack, or you need to configure SSM mapping from IGMPv1 or IGMPv2 to IGMPv3. An IGMPv3 stack provides the capability of a host operating system to use the IGMPv3 protocol. IGMPv3 is available for Windows XP, Windows Vista, and most UNIX operating systems.

SSM mapping allows operators to support an SSM network without requiring all hosts to support IGMPv3. This support exists in static (S,G) configurations, but SSM mapping also supports dynamic per-source group state information, which changes as hosts join and leave the group using IGMP.

SSM is typically supported with a subset of IGMPv3 and PIM sparse mode known as *PIM SSM*. Using SSM, a client can receive multicast traffic directly from the source. PIM SSM uses the PIM sparse-mode functionality to create an SPT between the client and the source, but builds the SPT without the help of an RP.

An SSM-configured network has distinct advantages over a traditionally configured PIM sparse-mode network. There is no need for shared trees or RP mapping (no RP is required), or for RP-to-RP source discovery through the Multicast Source Discovery Protocol (MSDP).

Understanding PIM Source-Specific Mode

RFC 1112, the original multicast RFC, supported both many-to-many and one-to-many models. These came to be known collectively as any-source multicast (ASM) because ASM allowed one or many sources for a multicast group's traffic. However, an ASM network must be able to determine the locations of all sources for a particular multicast group whenever there are interested listeners, no matter where the sources might be located in the network. In ASM, the key function of *source discovery* is a required function of the network itself.

Multicast source discovery appears to be an easy process, but in sparse mode it is not. In dense mode, it is simple enough to flood traffic to every router in the whole network so that every router learns the source address of the content for that multicast group. However, the flooding presents scalability and network resource use issues and is not a viable option in sparse mode.

PIM sparse mode (like any sparse mode protocol) achieves the required source discovery functionality without flooding at the cost of a considerable amount of complexity. The RP routers must be added and must know all multicast sources, and complicated shared distribution trees must be built to the RPs.

In an environment where many sources come and go, such as for a videoconferencing service, ASM is appropriate. However, by ignoring the many-to-many model and focusing attention on the one-to-many source-specific multicast (SSM) model, several commercially promising multicast applications, such as television channel distribution over the Internet, might be brought to the Internet much more quickly and efficiently than if full ASM functionality were required of the network.

PIM SSM is simpler than PIM sparse mode because only the one-to-many model is supported. Initial commercial multicast Internet applications are likely to be available to *subscribers* (that is, receivers that issue join messages) from only a single source (a special case of SSM covers the need for a backup source). PIM SSM therefore forms a subset of PIM sparse mode. PIM SSM builds shortest-path trees (SPTs) rooted at the source immediately because in SSM, the router closest to the interested receiver host is informed of the unicast IP address of the source for the multicast traffic. That is, PIM SSM bypasses the RP connection stage through shared distribution trees, as in PIM sparse mode, and goes directly to the source-based distribution tree.

PIM SSM introduces new terms for many of the concepts in PIM sparse mode. PIM SSM can technically be used in the entire 224/4 multicast address range, although PIM SSM operation is guaranteed only in the 232/8 range (232.0.0/24 is reserved). The new SSM terms are appropriate for Internet video applications and are summarized in Table 300 on page 3972.

Table 300: ASM and SSM Terminology

Term	Any-Source Multicast	Source-Specific Multicast
Address identifier	G	S,G
Address designation	group	channel
Receiver operations	join, leave	subscribe, unsubscribe
Group address range	224/4 excluding 232/8	224/4 (guaranteed only for 232/8)

Although PIM SSM describes receiver operations as *subscribe* and *unsubscribe*, the same PIM sparse mode join and leave messages are used by both forms of the protocol. The terminology change distinguishes ASM from SSM even though the receiver messages are identical.

PIM SSM

PIM source-specific multicast (SSM) uses a subset of PIM sparse mode and IGMP version 3 (IGMPv3) to allow a client to receive multicast traffic directly from the source. PIM SSM uses the PIM sparse-mode functionality to create an SPT between the receiver and the source, but builds the SPT without the help of an RP.

By default, the SSM group multicast address is limited to the IP address range from 232.0.0.0 through 232.255.255.255. However, you can extend SSM operations into another Class D range by including the **ssm-groups** statement at the **[edit routing-options multicast]** hierarchy level. The default SSM address range from 232.0.0.0 through 232.255.255.255 cannot be used in the **ssm-groups** statement. This statement is for adding other multicast addresses to the default SSM group addresses. This statement does not override the default SSM group address range.

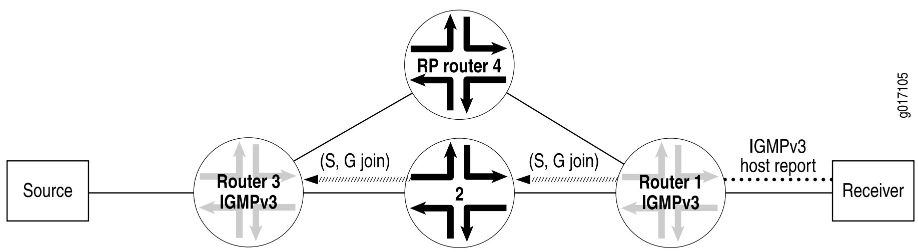
You can also configure the Junos OS to accept any-source multicast (ASM) join messages (*,G) for group addresses that are within the default or configured range of source-specific multicast (SSM) groups. This allows you to support a mix of any-source and source-specific multicast groups simultaneously.

An SSM-configured network has distinct advantages over a traditionally configured PIM sparse-mode network. There is no need for shared trees or RP mapping (no RP is required), or for RP-to-RP source discovery through MSDP.

Deploying SSM is easy. You need to configure PIM sparse mode on all router interfaces and issue the necessary SSM commands, including specifying IGMPv3 on the receiver's LAN. If PIM sparse mode is not explicitly configured on both the source and group member interfaces, multicast packets are not forwarded. Source lists, supported in IGMPv3, are used in PIM SSM. As sources become active and start sending multicast packets, interested receivers in the SSM group receive the multicast packets.

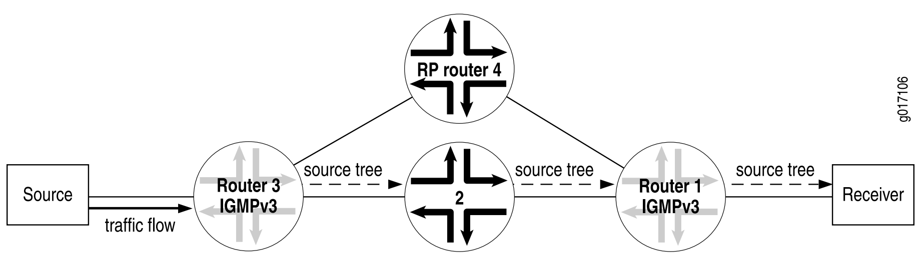
In a PIM SSM-configured network, a host subscribes to an SSM channel (by means of IGMPv3), announcing a desire to join group G and source S (see Figure 132 on page 3973). The directly connected PIM sparse-mode router, the receiver's DR, sends an (S,G) join message to its RPF neighbor for the source. Notice in Figure 132 on page 3973 that the RP is not contacted in this process by the receiver, as would be the case in normal PIM sparse-mode operations.

Figure 132: Receiver Announces Desire to Join Group G and Source S



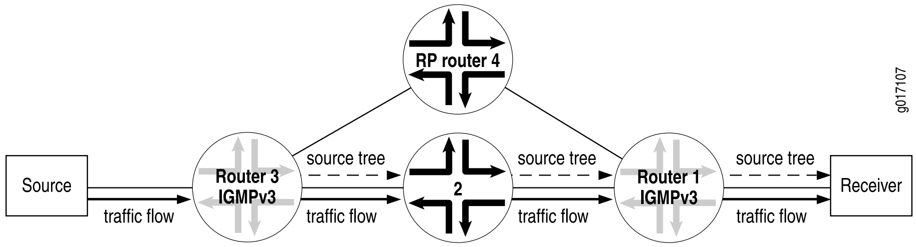
The (S,G) join message initiates the source tree and then builds it out hop by hop until it reaches the source. In Figure 133 on page 3973, the source tree is built across the network to Router 3, the last-hop router connected to the source.

Figure 133: Router 3 (Last-Hop Router) Joins the Source Tree



Using the source tree, multicast traffic is delivered to the subscribing host (see Figure 134 on page 3974).

Figure 134: (S,G) State Is Built Between the Source and the Receiver



To configure additional SSM groups, include the **ssm-groups** statement at the **[edit routing-options multicast]** hierarchy level.

Related Documentation

- Source-Specific Multicast Groups Overview on page 3970
- Example: Configuring Source-Specific Multicast Groups with Any-Source Override on page 4103

Introduction to Multicast VLAN Registration

- Understanding Multicast VLAN Registration on page 3974

Understanding Multicast VLAN Registration

Multicast VLAN registration (MVR) enables you to efficiently distribute IPTV multicast streams across an Ethernet ring-based Layer 2 network and reduce the amount of bandwidth consumed by this multicast traffic.

In a standard Layer 2 network, a multicast stream received on one VLAN is never distributed to interfaces outside that VLAN. If hosts in multiple VLANs request the same multicast stream, a separate copy of that multicast stream is distributed to the requesting VLANs.

MVR introduces the concept of a *multicast source VLAN* (MVLAN), which is created by MVR and becomes the only VLAN over which IPTV multicast traffic flows throughout the Layer 2 network. The Juniper Networks EX Series Ethernet Switch or the QFX Series that is enabled for MVR selectively forwards IPTV multicast traffic from interfaces on the MVLAN (source interfaces) to hosts that are connected to interfaces that are not part of the MVLAN. These interfaces are known as *MVR receiver ports*. The MVR receiver ports can receive traffic from a port on the MVLAN but cannot send traffic onto the MVLAN, and they remain in their own VLANs for bandwidth and security reasons.

This topic includes:

- How MVR Works on page 3974

How MVR Works

In many ways, MVR is similar to IGMP snooping. Both MVR and IGMP snooping monitor IGMP join and leave messages and build forwarding tables based on the media access control (MAC) addresses of the hosts sending those IGMP messages. Whereas IGMP snooping operates within a given VLAN to regulate multicast traffic, MVR can operate with hosts on different VLANs in a Layer 2 network to selectively deliver IPTV multicast traffic to requesting hosts, thereby reducing the amount of bandwidth needed to forward multicast traffic.

When you configure an MVLAN, you assign a range of multicast group addresses to it. You then configure other VLANs to be MVR receiver VLANs, which receive multicast streams from the MVLAN. The MVR receiver ports comprise all the interfaces that exist on any of the MVR receiver VLANs. Interfaces that are on the MVLAN itself cannot be MVR receiver ports for that MVLAN.

NOTE: MVR is supported on VLANs running IGMP version 2 (IGMPv2) only.

MVR Modes

MVR operates in two modes: MVR transparent mode and MVR proxy mode. Both modes enable MVR to forward only one copy of a multicast stream to the Layer 2 network.

- MVR Transparent Mode on page 3975
- MVR Proxy Mode on page 3975

MVR Transparent Mode

In MVR transparent mode, the switch receives one copy of each IPTV multicast stream and then replicates the stream only to those hosts that want to receive it, while forwarding all other types of multicast traffic without modification. Transparent mode is the default mode.

The switch handles IGMP packets destined for both the multicast source VLAN and multicast receiver VLANs in the same way that it handles them when MVR is not being used. That is, when a host on a VLAN sends IGMP join and leave messages, the switch floods the messages to all router interfaces in the VLAN. Similarly, when a VLAN receives IGMP queries from its router interfaces, it floods the queries to all interfaces in the VLAN.

If a host on a multicast receiver port joins an MVR group on the multicast receiver VLAN, the appropriate bridging entry is added and the MVLAN forwards that group's IPTV multicast traffic on that port (even though that port is not in the MVLAN). Likewise, if a host on a multicast receiver port leaves an MVR group on the multicast receiver VLAN, the appropriate bridging entry is deleted, and the MVLAN stops forwarding that group's IPTV multicast traffic on that port. In addition, you can configure the switch to statically install the bridging entries on the multicast receiver VLAN.

MVR Proxy Mode

When you use MVR in proxy mode, the switch acts as a proxy for any MVR group in both the upstream and downstream directions. In the downstream direction, the switch acts as the querier for the groups in the MVR receiver VLANs. In the upstream direction, the switch originates the IGMP reports and leaves and answers IGMP queries from multicast routers. When the MVR receiver VLANs receive IGMP joins and leaves, the switch creates bridging entries on the MVLAN as needed, as it does in MVR transparent mode. In addition, the switch sends out IGMP joins and leaves on the MVLAN based on these bridging entries.

Configuring MVR proxy mode on the MVLAN automatically enables IGMP snooping proxy mode on all MVR receiver VLANs as well as on the MVLAN.

Related Documentation

- Understanding FIP Snooping, FBF, and MVR Filter Scalability on page 4872
- Example: Configuring Multicast VLAN Registration on page 4054
- Configuring Multicast VLAN Registration (CLI Procedure) on page 4053

CHAPTER 48

Configuration

PIM Basics

Changing the PIM Version

All systems on a subnet must run the same version of PIM.

The default PIM version can be version 1 or version 2, depending on the mode you are configuring. PIMv1 is the default for rendezvous point (RP) mode (at the **[edit protocols pim rp static address *address*]** hierarchy level). However, PIMv2 is the default for interface mode (at the **[edit protocols pim interface *interface-name*]** hierarchy level). Explicitly configured versions override the defaults.

To configure the PIM version, include the **version** statement:

```
version (1 | 2);
```

Modifying the PIM Hello Interval

Routing devices send hello messages at a fixed interval on all PIM-enabled interfaces. By using hello messages, routing devices advertise their existence as PIM routing devices on the subnet. With all PIM-enabled routing devices advertised, a single designated router for the subnet is established.

When a routing device is configured for PIM, it sends a hello message at a 30-second default interval. The interval range is from 0 through 255. When the interval counts down to 0, the routing device sends another hello message, and the timer is reset. A routing device that receives no response from a neighbor in 3.5 times the interval value drops the neighbor. In the case of a 30-second interval, the amount of time a routing device waits for a response is 105 seconds.

If a PIM hello message contains the hold-time option, the neighbor timeout is set to the hold-time sent in the message. If a PIM hello message does not contain the hold-time option, the neighbor timeout is set to the default hello hold time.

To modify how often the routing device sends hello messages out of an interface:

1. This example shows the configuration for the routing instance. Configure the interface globally or in the routing instance.

   ```
   [edit routing-instances PIM.master protocols pim interface fe-3/0/2.0]
   user@host# set hello-interval 255
   ```

2. Verify the configuration by checking the **Hello Option Holdtime** field in the output of the **show pim neighbors detail** command.

   ```
   user@host> show pim neighbors detail
   Instance: PIM.master
   Interface: fe-3/0/2.0
   Address: 192.168.195.37, IPv4, PIM v2, Mode: Sparse
   Hello Option Holdtime: 255 seconds
   Hello Option DR Priority: 1
   Hello Option LAN Prune Delay: delay 500 ms override 2000 ms
   Join Suppression supported
   Rx Join: Group Source Timeout
   225.1.1.1 192.168.195.78 0
   ```

```
225.1.1.1 0

Interface: lo0.0
Address: 10.255.245.91, IPv4, PIM v2, Mode: Sparse
Hello Option Holdtime: 255 seconds
Hello Option DR Priority: 1
Hello Option LAN Prune Delay: delay 500 ms override 2000 ms
Join Suppression supported

Interface: pd-6/0/0.32768
Address: 0.0.0.0, IPv4, PIM v2, Mode: Sparse
Hello Option Holdtime: 255 seconds
Hello Option DR Priority: 0
Hello Option LAN Prune Delay: delay 500 ms override 2000 ms
Join Suppression supported
```

Related Documentation

- show pim neighbors on page 4375 in the CLI Explorer

Preserving Multicast Performance by Disabling Response to the ping Utility

The ping utility uses ICMP Echo messages to verify connectivity to any device with an IP address. However, in the case of multicast applications, a single ping sent to a multicast address can degrade the performance of routers because the stream of packets is replicated multiple times.

You can disable the router's response to ping (ICMP Echo) packets sent to multicast addresses. The system responds normally to unicast ping packets.

To disable the router's response to ping packets sent to multicast addresses:

1. Include the **no-multicast-echo** statement:

   [edit system]
   user@host# **set** no-multicast-echo

2. Verify the configuration by checking the **echo drops with broadcast or multicast destination address** field in the output of the **show system statistics icmp** command.

   user@host> **show system statistics icmp**

```
icmp:
0 drops due to rate limit
0 calls to icmp_error
0 errors not generated because old message was icmp
Output histogram:
echo reply: 21
0 messages with bad code fields
0 messages less than the minimum length
0 messages with bad checksum
0 messages with bad source address
0 messages with bad length
100 echo drops with broadcast or multicast destination address
0 timestamp drops with broadcast or multicast destination address
Input histogram:
echo: 21
21 message responses generated
```

Related Documentation

- *Configuring the Junos OS to Disable the Routing Engine Response to Multicast Ping Packets* in the *Junos OS Administration Library for Routing Devices*
- *show system statistics icmp* in the CLI Explorer

Configuring PIM Trace Options

Tracing operations record detailed messages about the operation of routing protocols, such as the various types of routing protocol packets sent and received, and routing policy actions. You can specify which trace operations are logged by including specific tracing flags. The following table describes the flags that you can include.

Flag	Description
all	Trace all operations.
assert	Trace assert messages, which are used to resolve which of the parallel routers connected to a multiaccess LAN is responsible for forwarding packets to the LAN.
autorp	Trace bootstrap, RP, and auto-RP messages.
bidirectional-df-election	Trace bidirectional PIM designated-forwarder (DF) election events.
bootstrap	Trace bootstrap messages, which are sent periodically by the PIM domain's bootstrap router and are forwarded, hop by hop, to all routers in that domain.
general	Trace general events.
graft	Trace graft and graft acknowledgment messages.
hello	Trace hello packets, which are sent so that neighboring routers can discover one another.
join	Trace join messages, which are sent to join a branch onto the multicast distribution tree.
mdt	Trace messages related to multicast data tunnels.
normal	Trace normal events.
nsr-synchronization	Trace nonstop routing synchronization events
packets	Trace all PIM packets.
policy	Trace poison-route-reverse packets.
prune	Trace prune messages, which are sent to prune a branch off the multicast distribution tree.

Flag	Description
register	Trace register and register-stop messages. Register messages are sent to the RP when a multicast source first starts sending to a group.
route	Trace routing information.
rp	Trace candidate RP advertisements.
state	Trace state transitions.
task	Trace task processing.
timer	Trace timer processing.

In the following example, tracing is enabled for all routing protocol packets. Then tracing is narrowed to focus only on PIM packets of a particular type.

To configure tracing operations for PIM:

1. (Optional) Configure tracing at the [**routing-options** hierarchy level to trace all protocol packets.

   [edit routing-options traceoptions]
   user@host# **set file all-packets-trace**
   user@host# **set flag all**

2. Configure the filename for the PIM trace file.

   [edit protocols pim traceoptions]
   user@host# **set file pim-trace**

3. (Optional) Configure the maximum number of trace files.

   [edit protocols pim traceoptions]
   user@host# **set file files 5**

4. (Optional) Configure the maximum size of each trace file.

   [edit protocols pim traceoptions]
   user@host# **set file size 1m**

5. (Optional) Enable unrestricted file access.

   [edit protocols pim traceoptions]
   user@host# **set file world-readable**

6. Configure tracing flags.
   Suppose you are troubleshooting issues with PIM version 1 control packets that are received on an interface configured for PIM version 2. The following example shows how to trace messages associated with this problem.

   [edit protocols pim traceoptions]
   user@host# **set flag packets | match “Rx V1 Require V2”**

7. View the trace file.

```
user@host> file list /var/log
user@host> file show /var/log/pim-trace
```

Related Documentation

- PIM Overview on page 3937
- *Junos OS Tracing and Logging Operations* in the *Junos OS Administration Library for Routing Devices*

Disabling PIM

By default, when configured, the PIM protocol is enabled on all interfaces for all families. If desired, you can disable PIM at the protocol, interface, or family hierarchy levels.

The hierarchy in which you configure PIM is critical. In general, the most specific configuration takes precedence. However, if PIM is disabled at the protocol level, then any disable statements with respect to an interface or family are ignored.

For example, the order of precedence for disabling PIM on a particular interface family is:

1. If PIM is disabled at the **[edit protocols pim interface *interface-name* family]** hierarchy level, then PIM is disabled for that interface family.
2. If PIM is not configured at the **[edit protocols pim interface *interface-name* family]** hierarchy level, but is disabled at the **[edit protocols pim interface *interface-name*]** hierarchy level, then PIM is disabled for all families on the specified interface.
3. If PIM is not configured at either the **[edit protocols pim interface *interface-name* family]** hierarchy level or the **[edit protocols pim interface *interface-name*]** hierarchy level, but is disabled at the **[edit protocols pim]** hierarchy level, then the PIM protocol is disabled globally for all interfaces and all families.

The following sections describe how to disable PIM at the various hierarchy levels.

Disabling the PIM Protocol

You can explicitly disable the PIM protocol. Disabling the PIM protocol disables the protocol for all interfaces and all families. This is accomplished at the **[edit protocols pim]** hierarchy level:

```
[edit protocols]
pim {
  disable;
}
```

To disable the PIM protocol:

1. Include the **disable** statement.


```
user@host# set protocols pim disable
```

2. (Optional) Verify your configuration settings before committing them by using the **show protocols pim** command.

```
user@host# run show protocols pim
```

Disabling PIM On an Interface

You can disable the PIM protocol on a per-interface basis. This is accomplished at the **[edit protocols pim interface *interface-name*]** hierarchy level:

```
[edit protocols]
pim {
  interface interface-name {
    disable;
  }
}
```

To disable PIM on an interface:

1. Include the **disable** statement.

```
user@host# set protocols pim interface fe-0/1/0 disable
```

2. (Optional) Verify your configuration settings before committing them by using the **show protocols pim** command.

```
user@host# run show protocols pim
```

Disabling PIM for a Family

You can disable the PIM protocol on a per-family basis. This is accomplished at the **[edit protocols pim family]** hierarchy level:

```
[edit protocols]
pim {
  family inet {
    disable;
  }
  family inet6 {
    disable;
  }
}
```

To disable PIM for a family:

1. Include the **disable** statement.

```
user@host#  set protocols pim family inet disable
user@host#  set protocols pim family inet6 disable
```

2. (Optional) Verify your configuration settings before committing them by using the **show protocols pim** command.

```
user@host#  run show protocols pim
```


Disabling PIM for a Rendezvous Point

You can disable the PIM protocol for a rendezvous point (RP) on a per-family basis. This is accomplished at the **[edit protocols pim rp local family]** hierarchy level:

```
[edit protocols]
pim {
  rp {
    local {
      family inet {
        disable;
      }
      family inet6 {
        disable;
      }
    }
  }
}
```

To disable PIM for an RP family:

1. Use the **disable** statement.

   ```
   user@host# set protocols pim rp local family inet disable
   user@host# set protocols pim rp local family inet6 disable
   ```
2. (Optional) Verify your configuration settings before committing them by using the **show protocols pim** command.

   ```
   user@host# run show protocols pim
   ```

PIM Designated Router

Configuring Interface Priority for PIM Designated Router Selection

A designated router (DR) sends periodic join messages and prune messages toward a group-specific rendezvous point (RP) for each group for which it has active members. When a Protocol Independent Multicast (PIM) router learns about a source, it originates a Multicast Source Discovery Protocol (MSDP) source-address message if it is the DR on the upstream interface.

By default, every PIM interface has an equal probability (priority 1) of being selected as the DR. Configuring the interface DR priority helps ensure that changing an IP address does not alter your forwarding model.

To configure the interface designated router priority:

1. This example shows the configuration for the routing instance. Configure the interface globally or in the routing instance.

   ```
   [edit routing-instances PIM.master protocols pim interface ge-0/0/0.0 family inet]
   user@host# set priority 5
   ```


2. Verify the configuration by checking the **Hello Option DR Priority** field in the output of the **show pim neighbors detail** command.

   user@host> **show pim neighbors detail**

```
Instance: PIM.master
Interface: ge-0/0/0.0
Address: 192.168.195.37, IPv4, PIM v2, Mode: Sparse
Hello Option Holdtime: 65535 seconds
Hello Option DR Priority: 5
Hello Option LAN Prune Delay: delay 500 ms override 2000 ms
Join Suppression supported
Rx Join: Group Source Timeout
225.1.1.1 192.168.195.78 0
225.1.1.1 0

Interface: lo0.0
Address: 10.255.245.91, IPv4, PIM v2, Mode: Sparse
Hello Option Holdtime: 65535 seconds
Hello Option DR Priority: 1
Hello Option LAN Prune Delay: delay 500 ms override 2000 ms
Join Suppression supported

Interface: pd-6/0/0.32768
Address: 0.0.0.0, IPv4, PIM v2, Mode: Sparse
Hello Option Holdtime: 65535 seconds
Hello Option DR Priority: 0
Hello Option LAN Prune Delay: delay 500 ms override 2000 ms
Join Suppression supported
```

Related Documentation

- Configuring PIM Designated Router Election on Point-to-Point Links on page 3985
- Understanding PIM Sparse Mode on page 3941
- **show pim neighbors on page 4375** in the CLI Explorer

Configuring PIM Designated Router Election on Point-to-Point Links

To comply with the latest PIM drafts, enable designated router (DR) election on all PIM interfaces, including point-to-point (P2P) interfaces. (DR election is enabled by default on all other interfaces.) One of the two routers might join a multicast group on its P2P link interface. The DR on that link is responsible for initiating the relevant join messages.

To enable DR election on point-to-point interfaces:

1. On both point-to-point link routers, configure the router globally or in the routing instance. This example shows the configuration for the routing instance.

   [edit routing-instances PIM.master protocols pim]
   user@host# **set** dr-election-on-p2p

2. Verify the configuration by checking the **State** field in the output of the **show pim interfaces** command. The possible values for the **State** field are DR, NotDR, and P2P. When a point-to-point link interface is elected to be the DR, the interface state becomes DR instead of P2P.

3. If the **show pim interfaces** command continues to report the P2P state, consider running the **restart routing** command on both routers on the point-to-point link. Then recheck the state.

CAUTION: Do not restart a software process unless specifically asked to do so by your Juniper Networks customer support representative. Restarting a software process during normal operation of a routing platform could cause interruption of packet forwarding and loss of data.

```
[edit]
user@host# run restart routing
```

Related Documentation

- Understanding PIM Sparse Mode on page 3941
- Configuring Interface Priority for PIM Designated Router Selection on page 3984
- **show pim interfaces on page 4358** in the CLI Explorer

PIM Sparse Mode

Enabling PIM Sparse Mode

In PIM sparse mode (PIM-SM), the assumption is that very few of the possible receivers want packets from a source, so the network establishes and sends packets only on branches that have at least one leaf indicating (by message) a desire for the traffic. WANs are appropriate networks for sparse-mode operation.

By default, PIM is disabled. When you enable PIM, it operates in sparse mode by default. You do not need to configure Internet Group Management Protocol (IGMP) version 2 for a sparse mode configuration. After you enable PIM, by default, IGMP version 2 is also enabled.

All systems on a subnet must run the same version of PIM.

The default PIM version can be version 1 or version 2, depending on the mode you are configuring. PIMv1 is the default for rendezvous point (RP) mode (at the **[edit protocols pim rp static address *address*]** hierarchy level). However, PIMv2 is the default for interface mode (at the **[edit protocols pim interface *interface-name*]** hierarchy level). Explicitly configured versions override the defaults. The following example explicitly configures PIMv2 on the interfaces.

You can configure PIM sparse mode globally or for a routing instance. This example shows how to configure PIM sparse mode globally on all interfaces. It also shows how to configure a static RP router and how to configure the non-RP routers.

To configure the router properties for PIM sparse mode:

1. Configure the static RP router.

   [edit protocols pim]
   user@host# **set** rp local family **inet address 192.168.3.253**

2. Configure the RP router interfaces. When configuring all interfaces, exclude the **fxp0.0** management interface by including the **disable** statement for that interface.

   [edit protocols pim]
   user@host# **set interface all mode sparse**
   user@host# **set interface all** version **2**
   user@host# **set interface fxp0.0 disable**

3. Configure the non-RP routers. Include the following configuration on all of the non-RP routers.

   [edit protocols pim]
   user@host# **set** rp **static address 192.168.3.253 version 2**
   user@host# **set interface all mode sparse**
   user@host# **set interface all version 2**
   user@host# **set interface fxp0.0 disable**

4. Monitor the operation of PIM sparse mode.

   - show pim interfaces
   - show pim join
   - show pim neighbors
   - show pim rps

Related Documentation

- Understanding PIM Sparse Mode on page 3941

Configuring PIM Join Load Balancing

By default, PIM join messages are sent toward a source based on the RPF routing table check. If there is more than one equal-cost path toward the source, then one upstream interface is chosen to send the join message. This interface is also used for all downstream traffic, so even though there are alternative interfaces available, the multicast load is concentrated on one upstream interface and routing device.

For PIM sparse mode, you can configure PIM join load balancing to spread join messages and traffic across equal-cost upstream paths (interfaces and routing devices) provided by unicast routing toward a source. PIM join load balancing is only supported for PIM sparse mode configurations.

PIM join load balancing is supported on draft-rosen multicast VPNs (also referred to as dual PIM multicast VPNs). PIM join load balancing is not supported on multiprotocol BGP-based multicast VPNs (also referred to as next-generation Layer 3 VPN multicast). When PIM join load balancing is enabled in a draft-rosen Layer 3 VPN scenario, the load balancing is achieved based on the join counts for the far-end PE routing devices, not for any intermediate P routing devices.

If an internal BGP (IBGP) multipath forwarding VPN route is available, the Junos OS uses the multipath forwarding VPN route to send join messages to the remote PE routers to achieve load balancing over the VPN.

By default, when multiple PIM joins are received for different groups, all joins are sent to the same upstream gateway chosen by the unicast routing protocol. Even if there are multiple equal-cost paths available, these alternative paths are not utilized to distribute multicast traffic from the source to the various groups.

When PIM join load balancing is configured, the PIM joins are distributed equally among all equal-cost upstream interfaces and neighbors. Every new join triggers the selection of the least-loaded upstream interface and neighbor. If there are multiple neighbors on the same interface (for example, on a LAN), join load balancing maintains a value for each of the neighbors and distributes multicast joins (and downstream traffic) among these as well.

Join counts for interfaces and neighbors are maintained globally, not on a per-source basis. Therefore, there is no guarantee that joins for a particular source are load-balanced. However, the joins for all sources and all groups known to the routing device are load-balanced. There is also no way to administratively give preference to one neighbor over another: all equal-cost paths are treated the same way.

You can configure message filtering globally or for a routing instance. This example shows the global configuration.

You configure PIM join load balancing on the non-RP routers in the PIM domain.

1. Determine if there are multiple paths available for a source (for example, an RP) with the output of the **show pim join extensive** or **show pim source** commands.

```
user@host> show pim join extensive
Instance: PIM.master Family: INET

Group: 224.1.1.1
    Source: *
    RP: 10.255.245.6
    Flags: sparse,rptree,wildcard
    Upstream interface: t1-0/2/3.0
    Upstream neighbor: 192.168.38.57
    Upstream state: Join to RP
    Downstream neighbors:
        Interface: t1–0/2/1.0
```



```
            192.168.38.16 State: JOIN Flags; SRW Timeout: 164
Group: 224.2.127.254
    Source: *
    RP: 10.255.245.6
    Flags: sparse,rptree,wildcard
    Upstream interface: so-0/3/0.0
    Upstream neighbor: 192.168.38.47
    Upstream state: Join to RP
    Downstream neighbors:
        Interface: t1-0/2/3.0
            192.168.38.16 State: JOIN Flags; SRW Timeout: 164
```

Note that for this router, the RP at IP address 10.255.245.6 is the source for two multicast groups: 224.1.1.1 and 224.2.127.254. This router has two equal-cost paths through two different upstream interfaces (**t1-0/2/3.0** and **so-0/3/0.0**) with two different neighbors (192.168.38.57 and 192.168.38.47). This router is a good candidate for PIM join load balancing.

2. On the non-RP router, configure PIM join load balancing.

   [edit protocols pim rp]
   user@host# **set static address 10.10.10.1**
   user@host# **set interface all mode sparse version 2**
   user@host# **set join-load-balance**

   The static address is the address of the RP.

3. Monitor the operation.

   If load balancing is enabled for this router, the number of PIM joins sent on each interface is shown in the output for the **show pim interfaces** command.

```
user@host> show pim interfaces
Instance: PIM.master

Name             Stat Mode        IP V State NbrCnt JoinCnt   DR address
lo0.0            Up   Sparse       4 2 DR         0       0   10.255.168.58
pe-1/2/0.32769   Up   Sparse       4 2 P2P        0       0
so-0/3/0.0       Up   Sparse       4 2 P2P        1       1
t1-0/2/1.0       Up   Sparse       4 2 P2P        1       0
t1-0/2/3.0       Up   Sparse       4 2 P2P        1       1
lo0.0           Up   Sparse       6 2 DR        0       0   fe80::2a0:a5ff:4b7
```

Note that the two equal-cost paths shown by the **show pim interfaces** command now have nonzero join counts. If the counts differ by more than one and were zero (0) when load balancing commenced, an error occurs (joins before load balancing are not redistributed). The join count also appears in the **show pim neighbors detail** output:

```
user@host> show pim neighbors detail
Interface: so-0/3/0.0

    Address: 192.168.38.46, IPv4, PIM v2, Mode: Sparse, Join Count: 0
        Hello Option Holdtime: 65535 seconds
        Hello Option DR Priority: 1
        Hello Option Generation ID: 1689116164
        Hello Option LAN Prune Delay: delay 500 ms override 2000 ms

    Address: 192.168.38.47, IPv4, PIM v2, Join Count: 1
        BFD: Disabled
        Hello Option Holdtime: 105 seconds 102 remaining
        Hello Option DR Priority: 1
```



```
        Hello Option Generation ID: 792890329
        Hello Option LAN Prune Delay: delay 500 ms override 2000 ms

Interface: t1-0/2/3.0

    Address: 192.168.38.56, IPv4, PIM v2, Mode: Sparse, Join Count: 0
        Hello Option Holdtime: 65535 seconds
        Hello Option DR Priority: 1
        Hello Option Generation ID: 678582286
        Hello Option LAN Prune Delay: delay 500 ms override 2000 ms

    Address: 192.168.38.57, IPv4, PIM v2, Join Count: 1
        BFD: Disabled
        Hello Option Holdtime: 105 seconds 97 remaining
        Hello Option DR Priority: 1
        Hello Option Generation ID: 1854475503
        Hello Option LAN Prune Delay: delay 500 ms override 2000 ms
```

Note that the join count is nonzero on the two load-balanced interfaces toward the upstream neighbors.

PIM join load balancing only takes effect when the feature is configured. Prior joins are not redistributed to achieve perfect load balancing. In addition, if an interface or neighbor fails, the new joins are redistributed among remaining active interfaces and neighbors. However, when the interface or neighbor is restored, prior joins are not redistributed. The **clear pim join-distribution** command redistributes the existing flows to new or restored upstream neighbors. Redistributing the existing flows causes traffic to be disrupted, so we recommend that you perform PIM join redistribution during a maintenance window.

Related Documentation

- *clear pim join-distribution* in the CLI Explorer
- show pim interfaces on page 4358 in the CLI Explorer
- show pim neighbors on page 4375 in the CLI Explorer
- show pim source on page 4386 in the CLI Explorer

Modifying the Join State Timeout

This section describes how to configure the join state timeout.

A downstream router periodically sends join messages to refresh the join state on the upstream router. If the join state is not refreshed before the timeout expires, the join state is removed.

By default, the join state timeout is 210 seconds. You can change this timeout to allow additional time to receive the join messages. Because the messages are called join-prune messages, the name used is the **join-prune-timeout** statement.

To modify the timeout, include the **join-prune-timeout** statement:

user@host# **set protocols pim join-prune-timeout 230**

The join timeout value can be from 210 through 240 seconds.

Related Documentation

- join-prune-timeout on page 4141

Example: Enabling Join Suppression

This example describes how to enable PIM join suppression.

Requirements

Before you begin:

- Configure the router interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure an interior gateway protocol or static routing. See the *Junos OS Routing Protocols Library for Routing Devices*.
- Configure PIM Sparse Mode on the interfaces. See "Enabling PIM Sparse Mode" on page 3986.

Overview

PIM join suppression enables a router on a multiaccess network to defer sending join messages to an upstream router when it sees identical join messages on the same network. Eventually, only one router sends these join messages, and the other routers suppress identical messages. Limiting the number of join messages improves scalability and efficiency by reducing the number of messages sent to the same router.

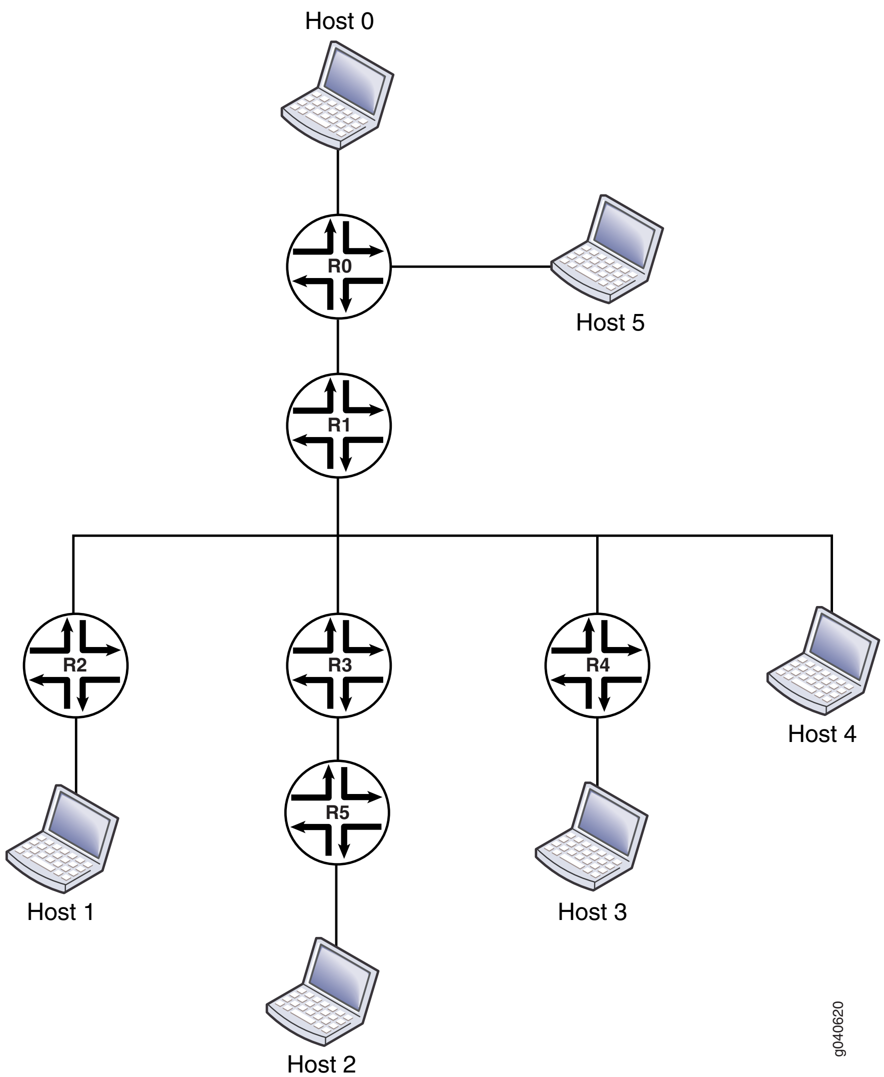
This example includes the following statements:

- **override-interval**—Sets the maximum time in milliseconds to delay sending override join messages. When a router sees a prune message for a join it is currently suppressing, it waits before it sends an override join message. Waiting helps avoid multiple downstream routers sending override join messages at the same time. The override interval is a random timer with a value of 0 through the maximum override value.
- **propagation-delay**—Sets a value in milliseconds for a prune pending timer, which specifies how long to wait before executing a prune on an upstream router. During this period, the router waits for any prune override join messages that might be currently suppressed. The period for the prune pending timer is the sum of the **override-interval** value and the value specified for **propagation-delay**.
- **reset-tracking-bit**—Enables PIM join suppression on each multiaccess downstream interface. This statement resets a tracking bit field (T-bit) on the LAN prune delay hello option from the default of 1 (join suppression disabled) to 0 (join suppression enabled).

When multiple identical join messages are received, a random join suppression timer is activated, with a range of 66 through 84 milliseconds. The timer is reset each time join suppression is triggered.

Figure 135 on page 3992 shows the topology used in this example.

Figure 135: Join Suppression



The items in the figure represent the following functions:

- Host 0 is the multicast source.
- Host 1, Host 2, Host 3, and Host 4 are receivers.
- Router R0 is the first-hop router and the RP.
- Router R1 is an upstream router.
- Routers R2, R3, R4, and R5 are downstream routers in the multicast LAN.

This example shows the configuration of the downstream devices: Routers R2, R3, R4, and R5.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
[edit]
set protocols pim traceoptions file pim.log
set protocols pim traceoptions file size 5m
set protocols pim traceoptions file world-readable
set protocols pim traceoptions flag join detail
set protocols pim traceoptions flag prune detail
set protocols pim traceoptions flag normal detail
set protocols pim traceoptions flag register detail
set protocols pim rp static address 10.255.112.160
set protocols pim interface all mode sparse
set protocols pim interface all version 2
set protocols pim interface fxp0.0 disable
set protocols pim reset-tracking-bit
set protocols pim propagation-delay 500
set protocols pim override-interval 4000
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure PIM join suppression on a non-RP downstream router in the multicast LAN:

1. Configure PIM sparse mode on the interfaces.

```
[edit]
user@host# edit protocols pim
[edit protocols pim]
user@host# set rp static address 10.255.112.160
[edit protocols pim]
user@host# set interface all mode sparse version 2
[edit protocols pim]
user@host# set interface all version 2
[edit protocols pim]
user@host# set interface fxp0.0 disable
```

2. Enable the join suppression timer.

```
[edit protocols pim]
user@host# set reset-tracking-bit
```

3. Configure the prune override interval value.

```
[edit protocols pim]
user@host# set override-interval 4000
```

4. Configure the propagation delay of the link.

   [edit protocols pim]
   user@host# **set propagation-delay 500**

5. (Optional) Configure PIM tracing operations.

   [edit protocols pim]
   user@host# **set traceoptions file pim.log size 5m world-readable**
   [edit protocols pim]
   user@host# **set traceoptions flag join detail**
   [edit protocols pim]
   user@host# **set traceoptions flag normal detail**
   [edit protocols pim]
   user@host# **set traceoptions flag register detail**

6. If you are done configuring the device, commit the configuration.

   [edit protocols pim]
   user@host# **commit**

Results

From configuration mode, confirm your configuration by entering the **show protocols** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show protocols
pim {
  traceoptions {
    file pim.log size 5m world-readable;
    flag join detail;
    flag prune detail;
    flag normal detail;
    flag register detail;
  }
  rp {
    static {
      address 10.255.112.160;
    }
  }
  interface all {
    mode sparse;
    version 2;
  }
  interface fxp0.0 {
    disable;
  }
  reset-tracking-bit;
  propagation-delay 500;
  override-interval 4000;
}
```


Verification

To verify the configuration, run the following commands on the upstream and downstream routers:

- **show pim join extensive**
- **show multicast route extensive**

Related Documentation

- Example: Configuring the PIM Assert Timeout on page 4015
- *Example: Configuring PIM RPF Selection*
- Example: Configuring the PIM SPT Threshold Policy on page 4018
- Enabling PIM Sparse Mode on page 3986
- PIM Overview on page 3937

Static RP

Configuring Local PIM RPs

Local RP configuration makes the routing device a statically defined RP. Consider statically defining an RP if the network does not have many different RPs defined or if the RP assignment does not change very often. The Junos IPv6 PIM implementation supports only static RP configuration. Automatic RP announcement and bootstrap routers are not available with IPv6.

You can configure a local RP globally or for a routing instance. This example shows how to configure a local RP in a routing instance for IPv4 or IPv6.

To configure the routing device's RP properties:

1. Configure the routing instance as the local RP.

   ```
   [routing-instances VPN-A protocols pim]
   user@host# set rp local
   ```

2. Configure the IP protocol family and IP address.

   IPv6 PIM hello messages are sent to every interface on which you configure **family inet6**, whether at the PIM level of the hierarchy or not. As a result, if you configure an interface with both **family inet** at the **[edit interface *interface-name*]** hierarchy level and **family inet6** at the **[edit protocols pim interface *interface-name*]** hierarchy level, PIM sends both IPv4 and IPv6 hellos to that interface.

   By default, PIM operates in sparse mode on an interface. If you explicitly configure sparse mode, PIM uses this setting for all IPv6 multicast groups. However, if you configure sparse-dense mode, PIM does not accept IPv6 multicast groups as dense groups and operates in sparse mode over them.

```
[edit routing-instances VPN-A protocols pim rp local]
user@host# set family inet6 address 2001:db8:85a3::8a2e:370:7334
user@host# set family inet address 10.1.2.254
```

3. (IPv4 only) Configure the routing device's RP priority.

   NOTE: The priority statement is not supported for IPv6, but is included here for informational purposes. The routing device's priority value for becoming the RP is included in the bootstrap messages that the routing device sends. Use a smaller number to increase the likelihood that the routing device becomes the RP for local multicast groups. Each PIM routing device uses the priority value and other factors to determine the candidate RPs for a particular group range. After the set of candidate RPs is distributed, each routing device determines algorithmically the RP from the candidate RP set using a hash function. By default, the priority value is set to 1. If this value is set to 0, the bootstrap router can override the group range being advertised by the candidate RP.

   ```
   [edit routing-instances VPN-A protocols pim rp local]
   user@host# set priority 5
   ```

4. Configure the groups for which the routing device is the RP.

   By default, a routing device running PIM is eligible to be the RP for all IPv4 or IPv6 groups (224.0.0.0/4 or FF70::/12 to FFF0::/12). The following example limits the groups for which this routing device can be the RP.

   ```
   [edit routing-instances VPN-A protocols pim rp local]
   user@host# set group-ranges fec0::/10
   user@host# set group-ranges 10.1.2.0/24
   ```

5. (IPv4 only) Modify the local RP hold time.

   If the local routing device is configured as an RP, it is considered a candidate RP for its local multicast groups. For candidate RPs, the hold time is used by the bootstrap router to time out RPs, and applies to the bootstrap RP-set mechanism. The RP hold time is part of the candidate RP advertisement message sent by the local routing device to the bootstrap router. If the bootstrap router does not receive a candidate RP advertisement from an RP within the hold time, it removes that routing device from its list of candidate RPs. The default hold time is 150 seconds.

   ```
   [edit routing-instances VPN-A protocols pim rp local]
   user@host# set hold-time 200
   ```

6. (Optional) Override dynamic RP for the specified group address range.

   If you configure both static RP mapping and dynamic RP mapping (such as auto-RP) in a single routing instance, allow the static mapping to take precedence for the given static RP group range, and allow dynamic RP mapping for all other groups.

   If you exclude this statement from the configuration and you use both static and dynamic RP mechanisms for different group ranges within the same routing instance, the dynamic RP mapping takes precedence over the static RP mapping, even if static RP is defined for a specific group range.

[edit routing-instances VPN-A protocols pim rp local]
user@host# **set override**

7. Monitor the operation of PIM by running the **show pim** commands. Run **show pim ?** to display the supported commands.

Related Documentation

- PIM Overview on page 3937
- Understanding MLD on page 3965

Configuring the Static PIM RP Address on the Non-RP Routing Device

Consider statically defining an RP if the network does not have many different RPs defined or if the RP assignment does not change very often. The Junos IPv6 PIM implementation supports only static RP configuration. Automatic RP announcement and bootstrap routers are not available with IPv6.

You configure a static RP address on the non-RP routing device. This enables the non-RP routing device to recognize the local statically defined RP. For example, if R0 is a non-RP router and R1 is the local RP router, you configure R0 with the static RP address of R1. The static IP address is the routable address assigned to the loopback interface on R1. In the following example, the loopback address of the RP is 2001:db8:85a3::8a2e:370:7334.

You can configure a static RP address globally or for a routing instance. This example shows how to configure a static RP address in a routing instance for IPv6.

To configure the static RP address:

1. On a non-RP routing device, configure the routing instance to point to the routable address assigned to the loopback interface of the RP.

   [routing-instances VPN-A protocols pim rp]
   user@host# **set** static address **2001:db8:85a3::8a2e:370:7334**

   NOTE: **Logical systems are also supported. You can configure a static RP address in a logical system only if the logical system is not directly connected to a source.**

2. (Optional) Set the PIM sparse mode version.

   For each static RP address, you can optionally specify the PIM version. The default PIM version is version 1.

   [edit routing-instances VPN-A protocols pim rp]
   user@host# **set** static address **2001:db8:85a3::8a2e:370:7334** version **2**

NOTE: The default PIM version can be version 1 or version 2, depending on the mode you are configuring. PIM version 1 is the default for RP mode (**[edit pim rp static address *address*]**). PIM version 2 is the default for interface mode (**[edit pim interface *interface-name*]**). Explicitly configured versions override the defaults.

3. (Optional) Set the group address range.

   By default, a routing device running PIM is eligible to be the RP for all IPv4 or IPv6 groups (224.0.0.0/4 or FF70::/12 to FFF0::/12). The following example limits the groups for which the 2001:db8:85a3::8a2e:370:7334 address can be the RP.

   ```
   [edit routing-instances VPN-A protocols pim rp]
   user@host# set static address 2001:db8:85a3::8a2e:370:7334 group-ranges fec0::/10
   ```

   The RP that you select for a particular group must be consistent across all routers in a multicast domain.

4. (Optional) Override dynamic RP for the specified group address range.

   If you configure both static RP mapping and dynamic RP mapping (such as auto-RP) in a single routing instance, allow the static mapping to take precedence for the given static RP group range, and allow dynamic RP mapping for all other groups.

   If you exclude this statement from the configuration and you use both static and dynamic RP mechanisms for different group ranges within the same routing instance, the dynamic RP mapping takes precedence over the static RP mapping, even if static RP is defined for a specific group range.

   ```
   [edit routing-instances VPN-A protocols pim rp static address
     2001:db8:85a3::8a2e:370:7334]
   user@host# set override
   ```

5. Monitor the operation of PIM by running the **show pim** commands. Run **show pim ?** to display the supported commands.

Related Documentation

- PIM Overview on page 3937
- Understanding MLD on page 3965

Anycast RP

Example: Configuring PIM Anycast With or Without MSDP

When you configure anycast RP, you bypass the restriction of having one active rendezvous point (RP) per multicast group, and instead deploy multiple RPs for the same group range. The RP routers share one unicast IP address. Sources from one RP are known to other RPs that use the Multicast Source Discovery Protocol (MSDP). Sources and receivers use the closest RP, as determined by the interior gateway protocol (IGP).

You can use anycast RP within a domain to provide redundancy and RP load sharing. When an RP stops operating, sources and receivers are taken to a new RP by means of unicast routing.

You can configure anycast RP to use PIM and MSDP for IPv4, or PIM alone for both IPv4 and IPv6 scenarios. Both are discussed in this section.

We recommend a static RP mapping with anycast RP over a bootstrap router and auto-RP configuration because it provides all the benefits of a bootstrap router and auto-RP without the complexity of the BSR and auto-RP mechanisms.

All systems on a subnet must run the same version of PIM.

The default PIM version can be version 1 or version 2, depending on the mode you are configuring. PIMv1 is the default RP mode (at the **[edit protocols pim rp static address *address*]** hierarchy level). However, PIMv2 is the default for interface mode (at the **[edit protocols pim interface *interface-name*]** hierarchy level). Explicitly configured versions override the defaults. This example explicitly configures PIMv2 on the interfaces.

The following example shows an anycast RP configuration for the RP routers, first with MSDP and then using PIM alone, and for non-RP routers.

1. For a network using an RP with MSDP, configure the RP using the **lo0** loopback interface, which is always up. Include the **address** statement and specify the unique and routable router ID and the RP address at the **[edit interfaces lo0 unit 0 family inet]** hierarchy level. In this example, the router ID is **198.58.3.254** and the shared RP address is **198.58.3.253**. Include the **primary** statement for the first address. Including the **primary** statement selects the router's primary address from all the preferred addresses on all interfaces.

```
interfaces {
  lo0 {
    description "PIM RP";
    unit 0 {
      family inet {
        address 198.58.3.254/32;
        primary;
        address 198.58.3.253/32;
      }
    }
  }
}
```

2. Specify the RP address. Include the **address** statement at the **[edit protocols pim rp local]** hierarchy level (the same address as the secondary **lo0** interface).

For all interfaces, include the **mode** statement to set the mode to **sparse** and the **version** statement to specify PIM version 2 at the **[edit protocols pim rp local interface all]** hierarchy level. When configuring all interfaces, exclude the **fxp0.0** management interface by including the **disable** statement for that interface.

```
protocols {
  pim {
    rp {
      local {
        family inet;
        address 198.58.3.253;
      }
      interface all {
        mode sparse;
        version 2;
      }
      interface fxp0.0 {
        disable;
      }
    }
  }
}
```

3. Configure MSDP peering. Include the **peer** statement to configure the address of the MSDP peer at the **[edit protocols msdp]** hierarchy level. For MSDP peering, use the unique, primary addresses instead of the anycast address. To specify the local address for MSDP peering, include the **local-address** statement at the **[edit protocols msdp peer]** hierarchy level.

```
protocols {
  msdp {
    peer 198.58.3.250 {
      local-address address 198.58.3.254;
    }
  }
}
```

NOTE: If you need to configure a PIM RP for both IPv4 and IPv6 scenarios, perform Step 4 and Step 5. Otherwise, go to Step 6.

4. Configure an RP using the **lo0** loopback interface, which is always up. Include the **address** statement to specify the unique and routable router address and the RP address at the **[edit interfaces lo0 unit 0 family inet]** hierarchy level. In this example, the router ID is **198.58.3.254** and the shared RP address is **198.58.3.253**. Include the **primary** statement on the first address. Including the **primary** statement selects the router's primary address from all the preferred addresses on all interfaces.

```
interfaces {
  lo0 {
    description "PIM RP";
    unit 0 {
      family inet {
        address 198.58.3.254/32 {
```



```
                primary;
            }
            address 198.58.3.253/32;
        }
    }
  }
}
```

5. Include the **address** statement at the **[edit protocols pim rp local]** hierarchy level to specify the RP address (the same address as the secondary **lo0** interface).

   For all interfaces, include the **mode** statement to set the mode to **sparse**, and the **version** statement to specify PIM version 2 at the **[edit protocols pim rp local interface all]** hierarchy level. When configuring all interfaces, exclude the **fxp0.0** management interface by Including the **disable** statement for that interface.

   Include the **anycast-pim** statement to configure anycast RP without MSDP (for example, if IPv6 is used for multicasting). The other RP routers that share the same IP address are configured using the **rp-set** statement. There is one entry for each RP, and the maximum that can be configured is 15. For each RP, specify the routable IP address of the router and whether MSDP source active (SA) messages are forwarded to the RP.

   MSDP configuration is not necessary for this type of IPv4 anycast RP configuration.

```
protocols {
  pim {
    rp {
      local {
        family inet {
          address 198.58.3.253;
          anycast-pim {
            rp-set {
              address 198.58.3.240;
              address 198.58.3.241 forward-msdp-sa;
            }
            local-address 198.58.3.254; #If not configured, use lo0 primary
          }
        }
      }
    }
    interface all {
      mode sparse;
      version 2;
    }
    interface fxp0.0 {
      disable;
    }
  }
}
```

6. Configure the non-RP routers. The anycast RP configuration for a non-RP router is the same whether MSDP is used or not. Specify a static RP by adding the address at the **[edit protocols pim rp static]** hierarchy level. Include the **version** statement at the **[edit protocols pim rp static address]** hierarchy level to specify PIM version 2.


```
protocols {
  pim {
    rp {
      static {
        address 198.58.3.253 {
          version 2;
        }
      }
    }
  }
}
```

7. Include the **mode** statement at the **[edit protocols pim interface all]** hierarchy level to specify sparse mode on all interfaces. Then include the **version** statement at the **[edit protocols pim rp interface all mode]** to configure all interfaces for PIM version 2. When configuring all interfaces, exclude the **fxp0.0** management interface by including the **disable** statement for that interface.

```
protocols {
  pim {
    interface all {
      mode sparse;
      version 2;
    }
    interface fxp0.0 {
      disable;
    }
  }
}
```

Configuring a PIM Anycast RP Router with MSDP

Add the **address** statement at the **[edit protocols pim rp local]** hierarchy level to specify the RP address (the same address as the secondary **lo0** interface).

For all interfaces, use the **mode** statement to set the mode to **sparse** and the **version** statement to specify PIM version 2 at the **[edit protocols pim rp local interface all]** hierarchy level. When configuring all interfaces, exclude the **fxp0.0** management interface by adding the **disable** statement for that interface.

```
protocols {
  pim {
    rp {
      local {
        family inet;
        address 198.58.3.253;
      }
      interface all {
        mode sparse;
        version 2;
      }
      interface fxp0.0 {
        disable;
      }
    }
```



```
    }
}
```

To configure MSDP peering, add the **peer** statement to configure the address of the MSDP peer at the **[edit protocols msdp]** hierarchy level. For MSDP peering, use the unique, primary addresses instead of the anycast address. To specify the local address for MSDP peering, add the **local-address** statement at the **[edit protocols msdp peer]** hierarchy level.

```
protocols {
    msdp {
        peer 198.58.3.250 {
            local-address 198.58.3.254;
        }
    }
}
```

Configuring a PIM Anycast RP Router Using Only PIM

In this example, configure an RP using the **lo0** loopback interface, which is always up. Use the **address** statement to specify the unique and routable router address and the RP address at the **[edit interfaces lo0 unit 0 family inet]** hierarchy level. In this case, the router ID is 198.58.3.254/32 and the shared RP address is 198.58.3.253/32. Add the flag statement **primary** to the first address. Using this flag selects the router's primary address from all the preferred addresses on all interfaces.

```
interfaces {
    lo0 {
        description "PIM RP";
        unit 0 {
            family inet {
                address 198.58.3.254/32 {
                    primary;
                }
                address 198.58.3.253/32;
            }
        }
    }
}
```

Add the **address** statement at the **[edit protocols pim rp local]** hierarchy level to specify the RP address (the same address as the secondary **lo0** interface).

For all interfaces, use the **mode** statement to set the mode to **sparse**, and include the **version** statement to specify PIM version 2 at the **[edit protocols pim rp local interface all]** hierarchy level. When configuring all interfaces, exclude the **fxp0.0** management interface by adding the **disable** statement for that interface.

Use the **anycast-pim** statement to configure anycast RP without MSDP (for example, if IPv6 is used for multicasting). The other RP routers that share the same IP address are configured using the **rp-set** statement. There is one entry for each RP, and the maximum that can be configured is 15. For each RP, specify the routable IP address of the router and whether MSDP source active (SA) messages are forwarded to the RP.

```
protocols {
   pim {
      rp {
         local {
            family inet {
               address 198.58.3.253;
               anycast-pim {
                  rp-set {
                     address 198.58.3.240;
                     address 198.58.3.241 forward-msdp-sa;
                  }
                  local-address 198.58.3.254; #If not configured, use lo0 primary
               }
            }
         }
      }
      interface all {
         mode sparse;
         version 2;
      }
      interface fxp0.0 {
         disable;
      }
   }
}
```

MSDP configuration is not necessary for this type of IPv4 anycast RP configuration.

Configuring All PIM Anycast Non-RP Routers

Use the **mode** statement at the **[edit protocols pim rp interface all]** hierarchy level to specify sparse mode on all interfaces. Then add the **version** statement at the **[edit protocols pim rp interface all mode]** to configure all interfaces for PIM version 2. When configuring all interfaces, exclude the **fxp0.0** management interface by adding the **disable** statement for that interface.

```
protocols {
   pim {
      interface all {
         mode sparse;
         version 2;
      }
      interface fxp0.0 {
         disable;
      }
   }
}
```

Example: Configuring Multiple RPs in a Domain with Anycast RP

This example shows how to configure anycast RP on each RP router in the PIM-SM domain. With this configuration you can deploy more than one RP for a single group range. This enables load balancing and redundancy.

Requirements

Before you begin:

- Configure the router interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure an interior gateway protocol or static routing. See the *Junos OS Routing Protocols Library for Routing Devices*.
- Configure PIM Sparse Mode on the interfaces. See "Enabling PIM Sparse Mode" on page 3986.

Overview

When you configure anycast RP, the RP routers in the PIM-SM domain use a shared address. In this example, the shared address is 10.1.1.2/32. Anycast RP uses Multicast Source Discovery Protocol (MSDP) to discover and maintain a consistent view of the active sources. Anycast RP also requires an RP selection method, such as static, auto-RP, or bootstrap RP. This example uses static RP and shows only one RP router configuration.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

RP Routers

```
set interfaces lo0 unit 0 family inet address 192.168.132.1/32 primary
set interfaces lo0 unit 0 family inet address 10.1.1.2/32
set protocols msdp local-address 192.168.132.1
set protocols msdp peer 192.168.12.1
set protocols pim rp local address 10.1.1.2
set routing-options router-id 192.168.132.1
```

Non-RP Routers

```
set protocols pim rp static address 10.1.1.2
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure anycast RP:

1. On each RP router in the domain, configure the shared anycast address on the router's loopback address.

   ```
   [edit interfaces]
   user@host# set lo0 unit 0 family inet address 10.1.1.2/32
   ```

2. On each RP router in the domain, make sure that the router's regular loopback address is the primary address for the interface, and set the router ID.

   ```
   [edit interfaces]
   user@host# set lo0 unit 0 family inet address 192.168.132.1/32 primary

   [edit routing-options]
   user@host# set router-id 192.168.132.1
   ```

3. On each RP router in the domain, configure the local RP address, using the shared address.

   ```
   [edit protocols pim]
   user@host# set rp local address 10.1.1.2
   ```

4. On each RP router in the domain, create MSDP sessions to the other RPs in the domain.

   ```
   [edit protocols msdp]
   user@host# set local-address 192.168.132.1
   user@host# set peer 192.168.12.1
   ```

5. On each non-RP router in the domain, configure a static RP address using the shared address.

   ```
   [edit protocols pim]
   user@host# set rp static address 10.1.1.2
   ```

6. If you are done configuring the devices, commit the configuration.

   ```
   user@host# commit
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show interfaces
lo0 {
  unit 0 {
    family inet {
      address 192.168.132.1/32 {
        primary;
      }
      address 10.1.1.2/32;
```



```
        }
    }
}
```

On the RP routers:

```
user@host# show protocols
msdp {
    local-address 192.168.132.1;
    peer 192.168.12.1;
}
pim {
    rp {
        local {
            address 10.1.1.2;
        }
    }
}
```

On the non-RP routers:

```
user@host# show protocols
pim {
    rp {
        static {
            address 10.1.1.2;
        }
    }
}

user@host# show routing-options
router-id 192.168.132.1;
```

Verification

To verify the configuration, run the **show pim rps extensive inet** command.

Related Documentation

- Example: Configuring PIM Anycast With or Without MSDP on page 3999
- Understanding PIM Sparse Mode on page 3941
- Understanding RP Mapping with Anycast RP on page 3945

PIM Bootstrap Router

Configuring PIM Bootstrap Properties for IPv4 or IPv6

For correct operation, every multicast router within a PIM domain must be able to map a particular multicast group address to the same rendezvous point (RP). The bootstrap router mechanism is one way that a multicast router can learn the set of group-to-RP mappings. Bootstrap routers are supported in IPv4 and IPv6.

To determine which routing device is the RP, all routing devices within a PIM domain collect bootstrap messages. A PIM domain is a contiguous set of routing devices that implement PIM. All devices are configured to operate within a common boundary. The domain's bootstrap router initiates bootstrap messages, which are sent hop by hop within the domain. The routing devices use bootstrap messages to distribute RP information dynamically and to elect a bootstrap router when necessary.

You can configure bootstrap properties globally or for a routing instance. This example shows the global configuration.

To configure the bootstrap router properties:

1. Configure the bootstrap priority.

   By default, each routing device has a bootstrap priority of 0, which means the routing device can never be the bootstrap router. The routing device with the highest priority value is elected to be the bootstrap router. In the case of a tie, the routing device with the highest IP address is elected to be the bootstrap router. A simple bootstrap configuration assigns a bootstrap priority value to a routing device.

   NOTE: In the IPv4-only configuration, specifying a bootstrap priority of 0 disables the bootstrap function and does not cause the routing device to send BSR packets with a 0 in the priority field. In the combined IPv4 and IPv6 configuration, specifying a bootstrap priority of 0 does not disable the function, but causes the routing device to send BSR packets with a 0 in the priority field. To disable the bootstrap function in the IPv4 and IPv6 configuration, delete the **bootstrap** statement.

   ```
   user@host# edit protocols pim rp
   user@host# set bootstrap family inet priority 3
   ```

2. (Optional) Create import and export policies to control the flow of bootstrap messages to and from the RP, and apply the policies to PIM. Import and export policies are useful when some of the routers in your PIM domain have interfaces that connect to other PIM domains. Configuring a policy prevents bootstrap messages from crossing domain boundaries. The **import** statement prevents messages from being imported into the RP. The **export** statement prevents messages from being exported from the RP.

   ```
   [edit protocols pim rp]
   user@host# set bootstrap family inet import pim-bootstrap-import
   user@host# set bootstrap family inet export pim-bootstrap-export
   user@host# exit
   ```

3. Configure the policies.

   ```
   user@host# edit policy-options policy-statement pim-bootstrap-import
   [edit policy-options policy-statement pim-bootstrap-import]
   user@host# set from interface se-0/0/0
   user@host# set then reject
   user@host# exit
   ```

```
user@host# edit policy-options policy-statement pim-bootstrap-export
user@host# set from interface se-0/0/0
user@host# set then reject
user@host# exit
```

4. Monitor the operation of PIM bootstrap routers by running the **show pim bootstrap** command.

Related Documentation

- Understanding PIM Sparse Mode on page 3941
- Example: Rejecting PIM Bootstrap Messages at the Boundary of a PIM Domain on page 4009
- **show pim bootstrap on page 4356** in the CLI Explorer

Example: Rejecting PIM Bootstrap Messages at the Boundary of a PIM Domain

In this example, the **from interface so-0-1/0 then reject** policy statement rejects bootstrap messages from the specified interface (the example is configured for both IPv4 and IPv6 operation):

```
protocols {
  pim {
    rp {
      bootstrap {
        family inet {
          priority 1;
          import pim-import;
          export pim-export;
        }
        family inet6 {
          priority 1;
          import pim-import;
          export pim-export;
        }
      }
    }
  }
}
policy-options {
  policy-statement pim-import {
    from interface so-0/1/0;
    then reject;
  }
  policy-statement pim-export {
    to interface so-0/1/0;
    then reject;
  }
}
```

Example: Configuring PIM BSR Filters

Configure a filter to prevent BSR messages from entering or leaving your network. Add this configuration to all routers:

```
protocols {
  pim {
    rp {
      bootstrap-import no-bsr;
      bootstrap-export no-bsr;
    }
  }
}
policy-options {
  policy-statement no-bsr {
    then reject;
  }
}
```

PIM Filtering

Configuring Interface-Level PIM Neighbor Policies

You can configure a policy to filter unwanted PIM neighbors. In the following example, the PIM interface compares neighbor IP addresses with the IP address in the policy statement before any hello processing takes place. If any of the neighbor IP addresses (primary or secondary) match the IP address specified in the prefix list, PIM drops the hello packet and rejects the neighbor.

If you configure a PIM neighbor policy after PIM has already established a neighbor adjacency to an unwanted PIM neighbor, the adjacency remains intact until the neighbor hold time expires. When the unwanted neighbor sends another hello message to update its adjacency, the router recognizes the unwanted address and rejects the neighbor.

To configure a policy to filter unwanted PIM neighbors:

1. Configure the policy. The neighbor policy must be a properly structured policy statement that uses a prefix list (or a route filter) containing the neighbor primary address (or any secondary IP addresses) in a prefix list, and the **reject** option to reject the unwanted address.

   ```
   [edit policy-options]
   user@host# set prefix-list nbrGroup 1 20.20.20.1/32
   user@host# set policy-statement nbr-policy from prefix-list nbrGroup1
   user@host# set policy-statement nbr-policy then reject
   ```

2. Configure the interface globally or in the routing instance. This example shows the configuration for the routing instance.

   ```
   [edit routing-instances PIM.master protocols pim]
   user@host# set neighbor-policy nbr-policy
   ```

3. Verify the configuration by checking the **Hello dropped on neighbor policy** field in the output of the **show pim statistics** command.

Related Documentation

- Understanding PIM Sparse Mode on page 3941
- *Routing Policy Feature Guide for Routing Devices*
- **show pim statistics on page 4389** in the CLI Explorer

Filtering Outgoing PIM Join Messages

When the core of your network is using MPLS, PIM join and prune messages stop at the customer edge (CE) routers and are not forwarded toward the core, because these routers do not have PIM neighbors on the core-facing interfaces. When the core of your network is using IP, PIM join and prune messages are forwarded to the upstream PIM neighbors in the core of the network.

When the core of your network is using a mix of IP and MPLS, you might want to filter certain PIM join and prune messages at the upstream egress interface of the CE routers.

You can filter PIM sparse mode (PIM-SM) join and prune messages at the egress interfaces for IPv4 and IPv6 in the upstream direction. The messages can be filtered based on the group address, source address, outgoing interface, PIM neighbor, or a combination of these values. If the filter is removed, the join is sent after the PIM periodic join timer expires.

To filter PIM sparse mode join and prune messages at the egress interfaces, create a policy rejecting the group address, source address, outgoing interface, or PIM neighbor, and then apply the policy.

The following example filters PIM join and prune messages for group addresses 224.0.1.2 and 225.1.1.1.

1. In configuration mode, create the policy.

```
user@host# set policy-options policy-statement block-groups term t1 from route-filter
  224.0.1.2/32 exact
user@host# set policy-options policy-statement block-groups term t1 from route-filter
  225.1.1.1/32 exact
user@host# set policy-options policy-statement block-groups term t1 then reject
user@host# set policy-options policy-statement block-groups term last then accept
```

2. Verify the policy configuration by running the **show policy-options** command.

```
user@host# show policy-options
policy-statement block-groups {
  term t1 {
    from {
      route-filter 224.0.1.2/32 exact;
      route-filter 225.1.1.1/32 exact;
      then reject;
    }
    term last {
      then accept;
    }
  }
```

3. Apply the PIM join and prune message filter.

```
user@host> set protocols pim export block-groups
```

4. After the configuration is committed, use the **show pim statistics** command to verify that outgoing PIM join and prune messages are being filtered.

```
user@host> show pim statistics | grep filtered
RP Filtered Source                    0

Rx Joins/Prunes filtered              0

Tx Joins/Prunes filtered              254
```

The egress filter count is shown on the **Tx Joins/Prunes filtered** line.

Related Documentation

• Filtering Incoming PIM Join Messages on page 4012

Filtering Incoming PIM Join Messages

Multicast scoping controls the propagation of multicast messages. Whereas multicast scoping prevents the actual multicast data packets from flowing in or out of an interface, PIM join filters prevent a state from being created in a router. A state—the (*,G) or (S,G) entries—is the information used for forwarding unicast or multicast packets. Using PIM join filters prevents the transport of multicast traffic across a network and the dropping of packets at a scope at the edge of the network. Also, PIM join filters reduce the potential for denial-of-service (DoS) attacks and PIM state explosion—large numbers of PIM join messages forwarded to each router on the rendezvous-point tree (RPT), resulting in memory consumption.

To use PIM join filters to efficiently restrict multicast traffic from certain source addresses, create and apply the routing policy across all routers in the network.

See Table 301 on page 4012 for a list of match conditions.

Table 301: PIM Join Filter Match Conditions

Match Condition	Matches On
interface	Router interface or interfaces specified by name or IP address
neighbor	Neighbor address (the source address in the IP header of the join and prune message)
route-filter	Multicast group address embedded in the join and prune message
source-address-filter	Multicast source address embedded in the join and prune message

The following example shows how to create a PIM join filter. The filter is composed of a route filter and a source address filter—**bad-groups** and **bad-sources**, respectively. the **bad-groups** filter prevents (*,G) or (S,G) join messages from being received for all groups listed. The **bad-sources** filter prevents (S,G) join messages from being received for all sources listed. The **bad-groups** filter and **bad-sources** filter are in two different terms. If route filters and source address filters are in the same term, they are logically ANDed.

To filter incoming PIM join messages:

1. Configure the policy.

```
[edit policy-statement pim-join-filter term bad-groups]
user@host# set from route-filter 224.0.1.2/32 exact
user@host# set from route-filter 239.0.0.0/8 orlonger
user@host# set then reject

[edit policy-statement pim-join-filter term bad-sources]
user@host# set from source-address-filter 10.0.0.0/8 orlonger
user@host# set from source-address-filter 127.0.0.0/8 orlonger
user@host# set then reject

[edit policy-statement pim-join-filter term last]
user@host# set then accept
```

2. Apply one or more policies to routes being imported into the routing table from PIM.

```
[edit protocols pim]
user@host# set import pim-join-filter
```

3. Verify the configuration by checking the output of the **show pim join** and **show policy** commands.

Related Documentation

- *Understanding Multicast Administrative Scoping*
- Filtering Outgoing PIM Join Messages on page 4011
- **show pim join on page 4361** in the CLI Explorer
- *show policy* in the CLI Explorer

Configuring Register Message Filters on a PIM RP and DR

PIM register messages are sent to the rendezvous point (RP) by a designated router (DR). When a source for a group starts transmitting, the DR sends unicast PIM register packets to the RP.

Register messages have the following purposes:

- Notify the RP that a source is sending to a group.
- Deliver the initial multicast packets sent by the source to the RP for delivery down the shortest-path tree (SPT).

The PIM RP keeps track of all active sources in a single PIM sparse mode domain. In some cases, you want more control over which sources an RP discovers, or which sources a DR notifies other RPs about. A high degree of control over PIM register messages is provided by RP or DR register message filtering. Message filtering prevents unauthorized groups and sources from registering with an RP router.

You configure RP or DR register message filtering to control the number and location of multicast sources that an RP discovers. You can apply register message filters on a DR to control outgoing register messages, or apply them on an RP to control incoming register messages.

When anycast RP is configured, all RPs in the anycast RP set need to be configured with the same register message filtering policy.

You can configure message filtering globally or for a routing instance. These examples show the global configuration.

To configure an RP filter to drop the register packets for multicast group range 224.1.1.0/24 from source address 10.10.94.2:

1. On the RP, configure the policy.

   [edit policy-options policy-statement incoming-policy-for-rp from]
   user@host# **set route-filter 224.1.1.0/24 orlonger**
   user@host# **set source-address-filter 10.10.94.2/32 exact**
   user@host# **set then reject**
   user@host# **exit**

2. Apply the policy to the RP.

   [edit protocols pim rp]
   user@host# **set rp-register-policy incoming-policy-for-rp**
   user@host# **set local address 10.10.10.5**
   user@host# **exit**

To configure a DR filter to prevent sending register packets for group range 224.1.1.0/24 and source address 10.10.10.1/32:

1. On the DR, configure the policy.

   [edit policy-options policy-statement outgoing-policy-for-rp]
   user@host# **set from route-filter 224.1.1.0/24 orlonger**
   user@host# **set from source-address-filter 10.10.10.1/32 exact**
   user@host# **set then reject**
   user@host# **exit**

2. Apply the policy to the DR.

   The static address is the address of the RP to which you do not want the DR to send the filtered register messages.

   [edit protocols pim rp]
   user@host# **set dr-register-policy outgoing-policy-for-dr**
   user@host# **set static 10.10.10.3**
   user@host# **exit**

To configure a policy expression to accept register messages for multicast group 224.1.1.5 but reject those for 224.1.1.1:

1. On the RP, configure the policies.

   [edit policy-options policy-statement reject_224_1_1_1]
   user@host# **set from route-filter 224.1.1.0/24 orlonger**
   user@host# **set from source-address-filter 10.10.94.2/32 exact**
   user@host# **set then reject**
   user@host# **exit**

   [edit policy-options policy-statement accept_224_1_1_5]
   user@host# **set term one from route-filter 224.1.1.5/32 exact**


```
user@host# set term one from source-address-filter 10.10.94.2/32 exact
user@host# set term one then accept
user@host# set term two then reject
user@host# exit
```

2. Apply the policies to the RP.

```
[edit protocols pim rp]
user@host# set rp-register-policy [ reject_224_1_1_1 | accept_224_1_1_5 ]
user@host# set local address 10.10.10.5
```

To monitor the operation of the filters, run the **show pim statistics** command. The command output contains the following fields related to filtering:

- **RP Filtered Source**
- **Rx Joins/Prunes filtered**
- **Tx Joins/Prunes filtered**
- **Rx Register msgs filtering drop**
- **Tx Register msgs filtering drop**

Related Documentation

- PIM Sparse Mode Source Registration on page 3950
- Filtering RP and DR Register Messages on page 3947
- **show pim statistics on page 4389** in the CLI Explorer

PIM RPT and SPT Cutover

Example: Configuring the PIM Assert Timeout

This example shows how to configure the timeout period for a PIM assert forwarder.

Requirements

Before you begin:

- Configure the router interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure an interior gateway protocol or static routing. See the *Junos OS Routing Protocols Library for Routing Devices*.
- Configure PIM Sparse Mode on the interfaces. See "Enabling PIM Sparse Mode" on page 3986.

Overview

The role of PIM assert messages is to determine the forwarder on a network with multiple routers. The forwarder is the router that forwards multicast packets to a network with multicast group members. The forwarder is generally the same as the PIM DR.

A router sends an assert message when it receives a multicast packet on an interface that is listed in the outgoing interface list of the matching routing entry. Receiving a message on an outgoing interface is an indication that more than one router forwards the same multicast packets to a network.

In Figure 136 on page 4017, both routing devices R1 and R2 forward multicast packets for the same (S,G) entry on a network. Both devices detect this situation and both devices send assert messages on the Ethernet network. An assert message contains, in addition to a source address and group address, a unicast cost metric for sending packets to the source, and a preference metric for the unicast cost. The preference metric expresses a preference between unicast routing protocols. The routing device with the smallest preference metric becomes the forwarder (also called the assert winner). If the preference metrics are equal, the device that sent the lowest unicast cost metric becomes the forwarder. If the unicast metrics are also equal, the routing device with the highest IP address becomes the forwarder. After the transmission of assert messages, only the forwarder continues to forward messages on the network.

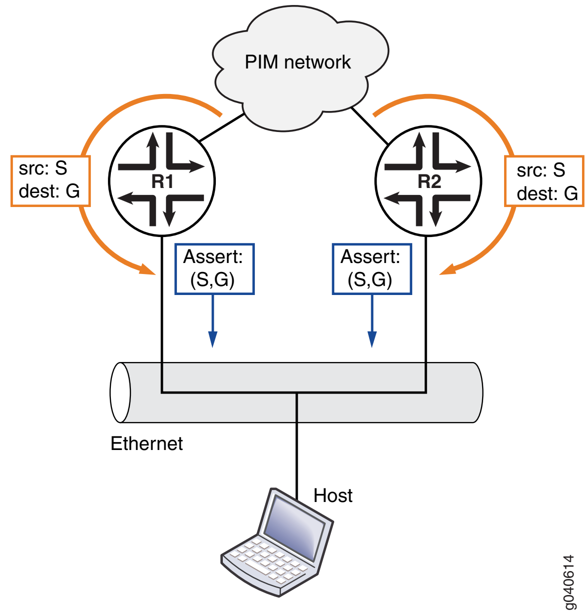
When an assert message is received and the RPF neighbor is changed to the assert winner, the assert timer is set to an assert timeout period. The assert timeout period is restarted every time a subsequent assert message for the route entry is received on the incoming interface. When the assert timer expires, the routing device resets its RPF neighbor according to its unicast routing table. Then, if multiple forwarders still exist, the forwarders reenter the assert message cycle. In effect, the assert timeout period determines how often multicast routing devices enter a PIM assert message cycle.

The range is from 5 through 210 seconds. The default is 180 seconds.

Assert messages are useful for LANs that connect multiple routing devices and no hosts.

Figure 136 on page 4017 shows the topology for this example.

Figure 136: PIM Assert Topology



Configuration

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure an assert timeout:

1. Configure the timeout period, in seconds.

   ```
   [edit protocols pim]
   user@host# set assert-timeout 60
   ```

2. (Optional) Trace assert messages.

   ```
   [edit protocols pim]
   user@host# set traceoptions file PIM.log
   user@host# set traceoptions flag assert detail
   ```

3. If you are done configuring the device, commit the configuration.

   ```
   user@host# commit
   ```

4. To verify the configuration, run the following commands:

   - show pim join
   - show pim statistics

Related Documentation

- Configuring PIM Trace Options on page 3980
- SPT Cutover on page 3954
- SPT Cutover Control on page 3957

Example: Configuring the PIM SPT Threshold Policy

This example shows how to apply a policy that suppresses the transition from the rendezvous-point tree (RPT) rooted at the RP to the shortest-path tree (SPT) rooted at the source.

Requirements

Before you begin:

- Configure the router interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure an interior gateway protocol or static routing. See the *Junos OS Routing Protocols Library for Routing Devices*.
- Configure PIM Sparse Mode on the interfaces. See "Enabling PIM Sparse Mode" on page 3986.

Overview

Multicast routing devices running PIM sparse mode can forward the same stream of multicast packets onto the same LAN through an RPT rooted at the RP or through an SPT rooted at the source. In some cases, the last-hop routing device needs to stay on the shared RPT to the RP and not transition to a direct SPT to the source. Receiving the multicast data traffic on SPT is optimal but introduces more state in the network, which might not be desirable in some multicast deployments. Ideally, low-bandwidth multicast streams can be forwarded on the SPT, and high-bandwidth streams can use the SPT. This example shows how to configure such a policy.

This example includes the following settings:

- **spt-threshold**—Enables you to configure an SPT threshold policy on the last-hop routing device to control the transition to a direct SPT. When you include this statement in the main PIM instance, the PE router stays on the RPT for control traffic.
- **infinity**—Applies an SPT cutover threshold of infinity to a source-group address pair, so that the last-hop routing device never transitions to a direct SPT. For all other source-group address pairs, the last-hop routing device transitions immediately to a direct SPT rooted at the source DR. This statement must reference a properly configured policy to set the SPT cutover threshold for a particular source-group pair to infinity. The use of values other than infinity for the SPT threshold is not supported. You can configure more than one policy.
- **policy-statement**—Configures the policy. The simplest type of SPT threshold policy uses a route filter and source address filter to specify the multicast group and source

addresses and to set the SPT threshold for that pair of addresses to infinity. The policy is applied to the main PIM instance.

This example sets the SPT transition value for the source-group pair 10.10.10.1 and 224.1.1.1 to infinity. When the policy is applied to the last-hop router, multicast traffic from this source-group pair never transitions to a direct SPT to the source. Traffic will continue to arrive through the RP. However, traffic for any other source-group address combination at this router transitions to a direct SPT to the source.

Note these points when configuring the SPT threshold policy:

- Configuration changes to the SPT threshold policy affect how the routing device handles the SPT transition.

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- Configuration changes to the SPT threshold policy affect how the routing device handles the SPT transition.
- When the policy is configured for the first time, the routing device continues to transition to the direct SPT for the source-group address pair until the PIM-join state is cleared with the **clear pim join** command.
- If you do not clear the PIM-join state when you apply the infinity policy configuration for the first time, you must apply it before the PE router is brought up.
- When the policy is deleted for a source-group address pair for the first time, the routing device does not transition to the direct SPT for that source-group address pair until the PIM-join state is cleared with the **clear pim join** command.
- When the policy is changed for a source-group address pair for the first time, the routing device does not use the new policy until the PIM-join state is cleared with the **clear pim join** command.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
[edit]
set policy-options policy-statement spt-infinity-policy term one from route-filter
  224.1.1.1/32 exact
set policy-options policy-statement spt-infinity-policy term one from source-address-filter
  10.10.10.1/32 exact
set policy-options policy-statement spt-infinity-policy term one then accept
set policy-options policy-statement spt-infinity-policy term two then reject
set protocols pim spt-threshold infinity spt-infinity-policy
```


Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see the *CLI User Guide*.

To configure an SPT threshold policy:

1. Apply the policy.

```
[edit]
user@host# edit protocols pim
[edit protocols pim]
user@host# set spt-threshold infinity spt-infinity-policy
[edit protocols pim]
user@host# exit
```

2. Configure the policy.

```
[edit]
user@host# edit policy-options policy-statement spt-infinity-policy
[edit policy-options policy-statement spt-infinity-policy]
user@host# set term one from route-filter 224.1.1.1/32 exact
[edit policy-options policy-statement spt-infinity-policy]
user@host# set term one from source-address-filter 10.10.10.1/32 exact
[edit policy-options policy-statement spt-infinity-policy]
user@host# set term one then accept
[edit policy-options policy-statement spt-infinity-policy]
user@host# set term two then reject
[edit policy-options policy-statement spt-infinity-policy]
user@host# exit
policy-statement {
```

3. If you are done configuring the device, commit the configuration.

```
[edit]
user@host# commit
```

4. Clear the PIM join cache to force the configuration to take effect.

```
[edit]
user@host# run clear pim join
```

Results

Confirm your configuration by entering the **show policy-options** command and the **show protocols** command from configuration mode. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show policy-options
policy-statement spt-infinity-policy {
  term one {
    from {
      route-filter 224.1.1.1/32 exact;
      source-address-filter 10.10.10.1/32 exact;
    }
    then accept;
  }
  term two {
    then reject;
```

```
    }
}
user@host# show protocols
pim {
    spt-threshold {
        infinity spt-infinity-policy;
    }
}
```

Verification

To verify the configuration, run the **show pim join** command.

Related Documentation

- SPT Cutover Control on page 3957

PIM and the BFD Protocol

Configuring BFD for PIM

The Bidirectional Forwarding Detection (BFD) Protocol is a simple hello mechanism that detects failures in a network. BFD works with a wide variety of network environments and topologies. A pair of routing devices exchanges BFD packets. Hello packets are sent at a specified, regular interval. A neighbor failure is detected when the routing device stops receiving a reply after a specified interval. The BFD failure detection timers have shorter time limits than the Protocol Independent Multicast (PIM) hello hold time, so they provide faster detection.

The BFD failure detection timers are adaptive and can be adjusted to be faster or slower. The lower the BFD failure detection timer value, the faster the failure detection and vice versa. For example, the timers can adapt to a higher value if the adjacency fails (that is, the timer detects failures more slowly). Or a neighbor can negotiate a higher value for a timer than the configured value. The timers adapt to a higher value when a BFD session flap occurs more than three times in a span of 15 seconds. A back-off algorithm increases the receive (Rx) interval by two if the local BFD instance is the reason for the session flap. The transmission (Tx) interval is increased by two if the remote BFD instance is the reason for the session flap. You can use the **clear bfd adaptation** command to return BFD interval timers to their configured values. The **clear bfd adaptation** command is hitless, meaning that the command does not affect traffic flow on the routing device.

You must specify the minimum transmit and minimum receive intervals to enable BFD on PIM.

To enable failure detection:

1. Configure the interface globally or in a routing instance.

   This example shows the global configuration.

[edit protocols pim]
user@host# **edit interface fe-1/0/0.0 family inet bfd-liveness-detection**

2. Configure the minimum transmit interval.

   This is the minimum interval after which the routing device transmits hello packets to a neighbor with which it has established a BFD session. Specifying an interval smaller than 300 ms can cause undesired BFD flapping.

   [edit protocols pim interface fe-1/0/0.0 family inet bfd-liveness-detection]
   user@host# **set transmit-interval 350**

3. Configure the minimum interval after which the routing device expects to receive a reply from a neighbor with which it has established a BFD session.

   Specifying an interval smaller than 300 ms can cause undesired BFD flapping.

   [edit protocols pim interface fe-1/0/0.0 family inet bfd-liveness-detection]
   user@host# **set minimum-receive-interval 350**

4. (Optional) Configure other BFD settings.

   As an alternative to setting the receive and transmit intervals separately, configure one interval for both.

   [edit protocols pim interface fe-1/0/0.0 family inet bfd-liveness-detection]
   user@host# **set minimum-interval 350**

5. Configure the threshold for the adaptation of the BFD session detection time.

   When the detection time adapts to a value equal to or greater than the threshold, a single trap and a single system log message are sent.

   [edit protocols pim interface fe-1/0/0.0 family inet bfd-liveness-detection]
   user@host# **set detection-time threshold 800**

6. Configure the number of hello packets not received by a neighbor that causes the originating interface to be declared down.

   [edit protocols pim interface fe-1/0/0.0 family inet bfd-liveness-detection]
   user@host# **set multiplier 50**

7. Configure the BFD version.

   [edit protocols pim interface fe-1/0/0.0 family inet bfd-liveness-detection]
   user@host# **set version 1**

8. Specify that BFD sessions should not adapt to changing network conditions.

   We recommend that you not disable BFD adaptation unless it is preferable not to have BFD adaptation enabled in your network.

   [edit protocols pim interface fe-1/0/0.0 family inet bfd-liveness-detection]
   user@host# **set no-adaptation**

9. Verify the configuration by checking the output of the **show bfd session** command.

Related Documentation

- *show bfd session* in the CLI Explorer

Configuring BFD Authentication for PIM

Beginning with Junos OS Release 9.6, you can configure authentication for Bidirectional Forwarding Detection (BFD) sessions running over Protocol Independent Multicast (PIM). Routing instances are also supported. The following steps are needed to configure authentication on a BFD session:

1. Specify the BFD authentication algorithm for the PIM protocol.
2. Associate the authentication keychain with the PIM protocol.
3. Configure the related security authentication keychain.

The following sections provide instructions for configuring and viewing BFD authentication on PIM:

- Configuring BFD Authentication Parameters on page 4023
- Viewing Authentication Information for BFD Sessions on page 4024

Configuring BFD Authentication Parameters

BFD authentication is only supported in the Canada and United States version of the Junos OS image and is not available in the export version.

To configure BFD authentication:

1. Specify the algorithm (**keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**, or **simple-password**) to use for BFD authentication on a PIM route or routing instance.

   ```
   [edit protocols pim]
   user@host# set interface ge-0/1/5 family inet bfd-liveness-detection authentication
     algorithm keyed-sha-1
   ```

   NOTE: Nonstop active routing (NSR) is not supported with the meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.

2. Specify the keychain to be used to associate BFD sessions on the specified PIM route or routing instance with the unique security authentication keychain attributes.

   The keychain you specify must match the keychain name configured at the **[edit security authentication key-chains]** hierarchy level.

   ```
   [edit protocols pim]
   user@host# set interface ge-0/1/5 family inet bfd-liveness-detection authentication
     keychain bfd-pim
   ```


NOTE: The algorithm and keychain must be configured on both ends of the BFD session, and they must match. Any mismatch in configuration prevents the BFD session from being created.

3. Specify the unique security authentication information for BFD sessions:
   - The matching keychain name as specified in Step 2.
   - At least one key, a unique integer between **0** and **63**. Creating multiple keys allows multiple clients to use the BFD session.
   - The secret data used to allow access to the session.
   - The time at which the authentication key becomes active, in the format *yyyy-mm-dd.hh:mm:ss*.

   ```
   [edit security]
   user@host# set authentication-key-chains key-chain bfd-pim key 53 secret
     $9$ggaJDmPQ6/tJgF/AtREVsyPsnCtUHm start-time 2009-06-14.10:00:00
   ```
4. (Optional) Specify loose authentication checking if you are transitioning from nonauthenticated sessions to authenticated sessions.

   ```
   [edit protocols pim]
   user@host# set interface ge-0/1/5 family inet bfd-liveness-detection authentication
     loose-check
   ```
5. (Optional) View your configuration by using the **show bfd session detail** or **show bfd session extensive** command.
6. Repeat these steps to configure the other end of the BFD session.

Viewing Authentication Information for BFD Sessions

You can view the existing BFD authentication configuration by using the **show bfd session detail** and **show bfd session extensive** commands.

The following example shows BFD authentication configured for the **ge-0/1/5** interface. It specifies the keyed SHA-1 authentication algorithm and a keychain name of **bfd-pim**. The authentication keychain is configured with two keys. Key **1** contains the secret data "**9ggaJDmPQ6/tJgF/AtREVsyPsnCtUHm**" and a start time of June 1, 2009, at 9:46:02 AM PST. Key **2** contains the secret data "**9a5jiKW9l.reP38ny.TszF2/9**" and a start time of June 1, 2009, at 3:29:20 PM PST.

```
[edit protocols pim]
interface ge-0/1/5 {
  family inet {
    bfd-liveness-detection {
      authentication {
        key-chain bfd-pim;
        algorithm keyed-sha-1;
      }
    }
  }
```



```
}
[edit security]
authentication key-chains {
  key-chain bfd-pim {
    key 1 {
      secret "$9$ggaJDmPQ6/tJgF/AtREVsyPsnCtUHm";
      start-time "2009-6-1.09:46:02 -0700";
    }
    key 2 {
      secret "$9$a5jiKW9l.reP38ny.TszF2/9";
      start-time "2009-6-1.15:29:20 -0700";
    }
  }
}
```

If you commit these updates to your configuration, you see output similar to the following example. In the output for the **show bfd session detail** command, **Authenticate** is displayed to indicate that BFD authentication is configured. For more information about the configuration, use the **show bfd session extensive** command. The output for this command provides the keychain name, the authentication algorithm and mode for each client in the session, and the overall BFD authentication configuration status, keychain name, and authentication algorithm and mode.

show bfd session detail

```
user@host# show bfd session detail

                                                  Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
50.0.0.2                 Up        ge-0/1/5.0     0.900     0.300        3
 Client PIM, TX interval 0.300, RX interval 0.300, Authenticate
 Session up time 3d 00:34
 Local diagnostic None, remote diagnostic NbrSignal
 Remote state Up, version 1
 Replicated
```

show bfd session extensive

```
user@host# show bfd session extensive
                                                  Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier
50.0.0.2                 Up        ge-0/1/5.0     0.900     0.300        3
 Client PIM, TX interval 0.300, RX interval 0.300, Authenticate
        keychain bfd-pim, algo keyed-sha-1, mode strict
 Session up time 00:04:42
 Local diagnostic None, remote diagnostic NbrSignal
 Remote state Up, version 1
 Replicated
 Min async interval 0.300, min slow interval 1.000
 Adaptive async TX interval 0.300, RX interval 0.300
 Local min TX interval 0.300, minimum RX interval 0.300, multiplier 3
 Remote min TX interval 0.300, min RX interval 0.300, multiplier 3
 Local discriminator 2, remote discriminator 2
 Echo mode disabled/inactive
 Authentication enabled/active, keychain bfd-pim, algo keyed-sha-1, mode strict
```

Related Documentation

- *Understanding Bidirectional Forwarding Detection Authentication for PIM*

IGMP

Configuring IGMP

Before you begin:

1. Determine whether the router is directly attached to any multicast sources. Receivers must be able to locate these sources.
2. Determine whether the router is directly attached to any multicast group receivers. If receivers are present, IGMP is needed.
3. Determine whether to configure multicast to use sparse, dense, or sparse-dense mode. Each mode has different configuration considerations.
4. Determine the address of the RP if sparse or sparse-dense mode is used.
5. Determine whether to locate the RP with the static configuration, BSR, or auto-RP method.

6. Determine whether to configure multicast to use its own RPF routing table when configuring PIM in sparse, dense, or sparse-dense mode.
7. Configure the SAP and SDP protocols to listen for multicast session announcements. See *Configuring the Session Announcement Protocol*.

To configure the Internet Group Management Protocol (IGMP), include the **igmp** statement:

```
igmp {
  accounting;
  interface interface-name {
    disable;
    (accounting | no-accounting);
    group-policy [ policy-names ];
    immediate-leave;
    oif-map map-name;
    promiscuous-mode;
    ssm-map ssm-map-name;
    static {
      group multicast-group-address {
        exclude;
        group-count number;
        group-increment increment;
        source ip-address {
          source-count number;
          source-increment increment;
        }
      }
    }
    version version;
  }
  query-interval seconds;
  query-last-member-interval seconds;
  query-response-interval seconds;
  robust-count number;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
}
```

You can include this statement at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems *logical-system-name* protocols]**

By default, IGMP is enabled on all interfaces on which you configure Protocol Independent Multicast (PIM), and on all broadcast interfaces on which you configure the Distance Vector Multicast Routing Protocol (DVMRP).

NOTE: You can configure IGMP on an interface without configuring PIM. PIM is generally not needed on IGMP downstream interfaces. Therefore, only one “pseudo PIM interface” is created to represent all IGMP downstream (IGMP-only) interfaces on the router. This reduces the amount of router resources, such as memory, that are consumed. You must configure PIM on upstream IGMP interfaces to enable multicast routing, perform reverse-path forwarding for multicast data packets, populate the multicast forwarding table for upstream interfaces, and in the case of bidirectional PIM and PIM sparse mode, to distribute IGMP group memberships into the multicast routing domain.

Enabling IGMP

The Internet Group Management Protocol (IGMP) manages multicast groups by establishing, maintaining, and removing groups on a subnet. Multicast routing devices use IGMP to learn which groups have members on each of their attached physical networks. IGMP must be enabled for the router to receive IPv4 multicast packets. IGMP is only needed for IPv4 networks, because multicast is handled differently in IPv6 networks. IGMP is automatically enabled on all IPv4 interfaces on which you configure PIM and on all IPv4 broadcast interfaces when you configure DVMRP.

If IGMP is not running on an interface—either because PIM and DVMRP are not configured on the interface or because IGMP is explicitly disabled on the interface—you can explicitly enable IGMP.

To explicitly enable IGMP:

1. If PIM and DVMRP are not running on the interface, explicitly enable IGMP by including the interface name.

   ```
   [edit protocols igmp]
   user@host# set interface fe-0/0/0.0
   ```

2. See if IGMP is disabled on any interfaces. In the following example, IGMP is disabled on a Gigabit Ethernet interface.

   ```
   [edit protocols igmp]
   user@host# show
   interface fe-0/0/0.0;
   interface ge-1/0/0.0 {
     disable;
   }
   ```

3. Enable IGMP on the interface by deleting the **disable** statement.

   ```
   [edit protocols igmp]
   delete interface ge-1/0/0.0 disable
   ```

4. Verify the configuration.

   ```
   [edit protocols igmp]
   user@host# show
   interface fe-0/0/0.0;
   ```


interface ge-1/0/0.0;

5. Verify the operation of IGMP on the interfaces by checking the output of the **show igmp interface** command.

Related Documentation

- Understanding IGMP on page 3959
- Disabling IGMP on page 4047
- **show igmp interface on page 4298**

Changing the IGMP Version

By default, the routing device runs IGMPv2. Routing devices running different versions of IGMP determine the lowest common version of IGMP that is supported by hosts on their subnet and operate in that version.

To enable source-specific multicast (SSM) functionality, you must configure version 3 on the host and the host's directly connected routing device. If a source address is specified in a multicast group that is statically configured, the version must be set to IGMPv3.

If a static multicast group is configured with the source address defined, and the IGMP version is configured to be version 2, the source is ignored and only the group is added. In this case, the join is treated as an IGMPv2 group join.

If you configure the IGMP version setting at the individual interface hierarchy level, it overrides the **interface all** statement.

If you have already configured the routing device to use IGMP version 1 (IGMPv1) and then configure it to use IGMPv2, the routing device continues to use IGMPv1 for up to 6 minutes and then uses IGMPv2.

To change to IGMPv3 for SSM functionality:

1. Configure the IGMP interface.

   ```
   [edit protocols igmp]
   user@host# set interface ge-0/0/0 version 3
   ```

2. Verify the configuration by checking the version field in the output of the **show igmp interfaces** command. The **show igmp statistics** command has version-specific output fields, such as V1 Membership Report, V2 Membership Report, and V3 Membership Report.

Related Documentation

- Understanding IGMP on page 3959
- **show pim interfaces on page 4358**
- **show igmp statistics on page 4302**
- RFC 2236, *Internet Group Management Protocol, Version 2*
- RFC 3376, *Internet Group Management Protocol, Version 3*

Modifying the IGMP Host-Query Message Interval

The objective of IGMP is to keep routers up to date with group membership of the entire subnet. Routers need not know who all the members are, only that members exist. Each host keeps track of which multicast groups are subscribed to. On each link, one router is elected the querier. The IGMP querier router periodically sends general host-query messages on each attached network to solicit membership information. The messages are sent to the all-systems multicast group address, 224.0.0.1.

The query interval, the response interval, and the robustness variable are related in that they are all variables that are used to calculate the group membership timeout. The group membership timeout is the number of seconds that must pass before a multicast router determines that no more members of a host group exist on a subnet. The group membership timeout is calculated as the (robustness variable x query-interval) + (query-response-interval). If no reports are received for a particular group before the group membership timeout has expired, the routing device stops forwarding remotely-originated multicast packets for that group onto the attached network.

By default, host-query messages are sent every 125 seconds. You can change this interval to change the number of IGMP messages sent on the subnet.

To modify the query interval:

1. Configure the interval.

   ```
   [edit protocols igmp]
   user@host# set query-interval 200
   ```

   The value can be from 1 through 1024 seconds.

2. Verify the configuration by checking the IGMP Query Interval field in the output of the **show igmp interface** command.

3. Verify the operation of the query interval by checking the Membership Query field in the output of the **show igmp statistics** command.

Related Documentation

- Understanding IGMP on page 3959
- Modifying the IGMP Query Response Interval on page 4034
- Modifying the IGMP Robustness Variable on page 4035
- **show igmp interface on page 4298**
- **show igmp statistics on page 4302**

Modifying the IGMP Last-Member Query Interval

The last-member query interval is the maximum amount of time between group-specific query messages, including those sent in response to leave-group messages. You can configure this interval to change the amount of time it takes a routing device to detect the loss of the last member of a group.

When the routing device that is serving as the querier receives a leave-group message from a host, the routing device sends multiple group-specific queries to the group being left. The querier sends a specific number of these queries at a specific interval. The number of queries sent is called the last-member query count. The interval at which the queries are sent is called the last-member query interval. Because both settings are configurable, you can adjust the leave latency. The IGMP leave latency is the time between a request to leave a multicast group and the receipt of the last byte of data for the multicast group.

The last-member query count x (times) the last-member query interval = (equals) the amount of time it takes a routing device to determine that the last member of a group has left the group and to stop forwarding group traffic.

The default last-member query interval is 1 second. You can configure a subsecond interval up to one digit to the right of the decimal point. The configurable range is 0.1 through 0.9, then in 1-second intervals 1 through 999,999.

To modify this interval:

1. Configure the time (in seconds) that the routing device waits for a report in response to a group-specific query.

   ```
   [edit protocols igmp]
   user@host# set query-last-member-interval 0.1
   ```

2. Verify the configuration by checking the IGMP Last Member Query Interval field in the output of the **show igmp interfaces** command.

NOTE: You can configure the last-member query count by configuring the robustness variable. The two are always equal.

Related Documentation

- Modifying the IGMP Robustness Variable on page 4035
- **show pim interfaces on page 4358**

Specifying Immediate-Leave Host Removal for IGMP

The immediate leave setting is useful for minimizing the leave latency of IGMP memberships. When this setting is enabled, the routing device leaves the multicast group immediately after the last host leaves the multicast group.

The immediate-leave setting enables host tracking, meaning that the device keeps track of the hosts that send join messages. This allows IGMP to determine when the last host sends a leave message for the multicast group.

When the immediate leave setting is enabled, the device removes an interface from the forwarding-table entry without first sending IGMP group-specific queries to the interface. The interface is pruned from the multicast tree for the multicast group specified in the IGMP leave message. The immediate leave setting ensures optimal bandwidth management for hosts on a switched network, even when multiple multicast groups are being used simultaneously.

When immediate leave is disabled and one host sends a leave group message, the routing device first sends a group query to determine if another receiver responds. If no receiver responds, the routing device removes all hosts on the interface from the multicast group. Immediate leave is disabled by default for both IGMP version 2 and IGMP version 3.

NOTE: Although host tracking is enabled for IGMPv2 and MLDv1 when you enable immediate leave, use immediate leave with these versions only when there is one host on the interface. The reason is that IGMPv2 and MLDv1 use a report suppression mechanism whereby only one host on an interface sends a group join report in response to a membership query. The other interested hosts suppress their reports. The purpose of this mechanism is to avoid a flood of reports for the same group. But it also interferes with host tracking, because the router only knows about the one interested host and does not know about the others.

To enable immediate leave on an interface:

1. Configure immediate leave on the IGMP interface.

   ```
   [edit protocols IGMP]
   user@host# set interface ge-0/0/0.1 immediate-leave
   ```

2. Verify the configuration by checking the Immediate Leave field in the output of the **show igmp interface** command.

Related Documentation

- Understanding IGMP on page 3959
- show igmp interface on page 4298

Filtering Unwanted IGMP Reports at the IGMP Interface Level

Suppose you need to limit the subnets that can join a certain multicast group. The **group-policy** statement enables you to filter unwanted IGMP reports at the interface level. When this statement is enabled on a router running IGMP version 2 (IGMPv2) or version 3 (IGMPv3), after the router receives an IGMP report, the router compares the group against the specified group policy and performs the action configured in that policy (for example, rejects the report if the policy matches the defined address or network).

You define the policy to match only IGMP group addresses (for IGMPv2) by using the policy's **route-filter** statement to match the group address. You define the policy to match IGMP (source, group) addresses (for IGMPv3) by using the policy's **route-filter** statement to match the group address and the policy's **source-address-filter** statement to match the source address.

To filter unwanted IGMP reports:

1. Configure an IGMPv2 policy.

   ```
   [edit policy-statement reject_policy_v2]
   user@host# set from route-filter 224.1.1.1/32 exact
   user@host# set from route-filter 239.0.0.0/8 orlonger
   ```



```
user@host# set then reject
```

2. Configure an IGMPv3 policy.

```
[edit policy-statement reject_policy_v3]
user@host# set from route-filter 224.1.1.1/32 exact
user@host# set from route-filter 239.0.0.0/8 orlonger
user@host# set from source-address-filter 10.0.0.0/8 orlonger
user@host# set from source-address-filter 127.0.0.0/8 orlonger
user@host# set then reject
```

3. Apply the policies to the IGMP interfaces on which you prefer not to receive specific group or (source, group) reports. In this example, **ge-0/0/0.1** is running IGMPv2, and **ge-0/1/1.0** is running IGMPv3.

```
[edit protocols igmp]
user@host# set interface ge-0/0/0.1 group-policy reject_policy_v2
user@host# set interface ge-0/1/1.0 group-policy reject_policy_v3
```

4. Verify the operation of the filter by checking the Rejected Report field in the output of the **show igmp statistics** command.

Related Documentation

- Understanding IGMP on page 3959
- *Example: Configuring Policy Chains and Route Filters*
- show igmp statistics on page 4302

Accepting IGMP Messages from Remote Subnetworks

By default, IGMP interfaces accept IGMP messages only from the same subnet. Including the **promiscuous-mode** statement enables the routing device to accept IGMP messages from indirectly connected subnets.

NOTE: When you enable IGMP on an unnumbered Ethernet interface that uses a /32 loopback address as a donor address, you must configure IGMP promiscuous mode to accept the IGMP packets received on this interface.

NOTE: When enabling promiscuous-mode, all routers on the ethernet segment must be configured with the promiscuous mode statement. Otherwise, only the interface configured with lowest IPv4 address acts as the querier for IGMP for this Ethernet segment.

To enable IGMP promiscuous mode on an interface:

1. Configure the IGMP interface.

```
[edit protocols igmp]
user@host# set interface ge-0/1/1.0 promiscuous-mode
```

2. Verify the configuration by checking the Promiscuous Mode field in the output of the **show igmp interface** command.

3. Verify the operation of the filter by checking the Rx non-local field in the output of the **show igmp statistics** command.

Related Documentation

- Understanding IGMP on page 3959
- *Configuring the Loopback Interface* in the *Junos OS Network Interfaces Library for Routing Devices*
- **show igmp interface on page 4298**
- **show igmp statistics on page 4302**

Modifying the IGMP Query Response Interval

The query response interval is the maximum amount of time that can elapse between when the querier router sends a host-query message and when it receives a response from a host. Configuring this interval allows you to adjust the burst peaks of IGMP messages on the subnet. Set a larger interval to make the traffic less bursty. Bursty traffic refers to an uneven pattern of data transmission: sometimes a very high data transmission rate, whereas at other times a very low data transmission rate.

The query response interval, the host-query interval, and the robustness variable are related in that they are all variables that are used to calculate the group membership timeout. The group membership timeout is the number of seconds that must pass before a multicast router determines that no more members of a host group exist on a subnet. The group membership timeout is calculated as the (robustness variable x query-interval) + (query-response-interval). If no reports are received for a particular group before the group membership timeout has expired, the routing device stops forwarding remotely originated multicast packets for that group onto the attached network.

The default query response interval is 10 seconds. You can configure a subsecond interval up to one digit to the right of the decimal point. The configurable range is 0.1 through 0.9, then in 1-second intervals 1 through 999,999.

To modify the query response interval:

1. Configure the interval.

   ```
   [edit protocols igmp]
   user@host# set query-response-interval 0.4
   ```

2. Verify the configuration by checking the IGMP Query Response Interval field in the output of the **show igmp interface** command.
3. Verify the operation of the query interval by checking the Membership Query field in the output of the **show igmp statistics** command.

Related Documentation

- Understanding IGMP on page 3959
- Modifying the IGMP Host-Query Message Interval on page 4030
- Modifying the IGMP Robustness Variable on page 4035
- **show igmp interface on page 4298**

- show igmp statistics on page 4302

Modifying the IGMP Robustness Variable

Fine-tune the IGMP robustness variable to allow for expected packet loss on a subnet. The robust count automatically changes certain IGMP message intervals for IGMPv2 and IGMPv3. Increasing the robust count allows for more packet loss but increases the leave latency of the subnetwork.

When the query router receives an IGMP leave message on a shared network running IGMPv2, the query router must send an IGMP group query message a specified number of times. The number of IGMP group query messages sent is determined by the robust count.

The value of the robustness variable is also used in calculating the following IGMP message intervals:

- Group member interval—Amount of time that must pass before a multicast router determines that there are no more members of a group on a network. This interval is calculated as follows: (robustness variable x query-interval) + (1 x query-response-interval).
- Other querier present interval—The robust count is used to calculate the amount of time that must pass before a multicast router determines that there is no longer another multicast router that is the querier. This interval is calculated as follows: (robustness variable x query-interval) + (0.5 x query-response-interval).
- Last-member query count—Number of group-specific queries sent before the router assumes there are no local members of a group. The number of queries is equal to the value of the robustness variable.

In IGMPv3, a change of interface state causes the system to immediately transmit a state-change report from that interface. In case the state-change report is missed by one or more multicast routers, it is retransmitted. The number of times it is retransmitted is the robust count minus one. In IGMPv3, the robust count is also a factor in determining the group membership interval, the older version querier interval, and the other querier present interval.

By default, the robustness variable is set to 2. You might want to increase this value if you expect a subnet to lose packets.

The number can be from 2 through 10.

To change the value of the robustness variable:

1. Configure the robust count.

   When you set the robust count, you are in effect configuring the number of times the querier retries queries on the connected subnets.

   ```
   [edit protocols igmp]
   user@host# set robust-count 5
   ```

2. Verify the configuration by checking the IGMP Robustness Count field in the output of the **show igmp interfaces** command.

Related Documentation

- Modifying the IGMP Host-Query Message Interval on page 4030
- Modifying the IGMP Query Response Interval on page 4034
- Modifying the IGMP Last-Member Query Interval on page 4030
- **show pim interfaces on page 4358**
- RFC 2236, *Internet Group Management Protocol, Version 2*
- RFC 3376, *Internet Group Management Protocol, Version 3*

Limiting the Maximum IGMP Message Rate

This section describes how to change the limit for the maximum number of IGMP packets transmitted in 1 second by the router.

Increasing the maximum number of IGMP packets transmitted per second might be useful on a router with a large number of interfaces participating in IGMP.

To change the limit for the maximum number of IGMP packets the router can transmit in 1 second, include the **maximum-transmit-rate** statement and specify the maximum number of packets per second to be transmitted.

Related Documentation

- **maximum-transmit-rate (Protocols IGMP) on page 4192**

Enabling IGMP Static Group Membership

You can create IGMP static group membership to test multicast forwarding without a receiver host. When you enable IGMP static group membership, data is forwarded to an interface without that interface receiving membership reports from downstream hosts. The router on which you enable static IGMP group membership must be the designated router (DR) for the subnet. Otherwise, traffic does not flow downstream.

When enabling IGMP static group membership, you cannot configure multiple groups using the **group-count**, **group-increment**, **source-count**, and **source-increment** statements if the **all** option is specified as the IGMP interface.

Class-of-service (CoS) adjustment is not supported with IGMP static group membership.

In this example, you create static group 225.1.1.1.

1. On the DR, configure the static groups to be created by including the **static** statement and **group** statement and specifying which IP multicast address of the group to be created. When creating groups individually, you must specify a unique address for each group.

```
[edit protocols igmp]
user@host# set interface fe-0/1/2 static group 225.1.1.1
```


2. After you commit the configuration, use the **show configuration protocol igmp** command to verify the IGMP protocol configuration.

   user@host> **show configuration protocol igmp**

   ```
   interface fe-0/1/2.0 {
     static {
       group 225.1.1.1 ;
     }
   }
   ```

3. After you have committed the configuration and the source is sending traffic, use the **show igmp group** command to verify that static group 225.1.1.1 has been created.

   ```
   user@host> show igmp group
   Interface: fe-0/1/2
        Group: 225.1.1.1
             Source: 10.0.0.2
             Last reported by: Local
             Timeout: 0 Type: Static
   ```

NOTE: When you configure static IGMP group entries on point-to-point links that connect routing devices to a rendezvous point (RP), the static IGMP group entries do not generate join messages toward the RP.

When you create IGMP static group membership to test multicast forwarding on an interface on which you want to receive multicast traffic, you can specify that a number of static groups be automatically created. This is useful when you want to test forwarding to multiple receivers without having to configure each receiver separately.

In this example, you create three groups.

1. On the DR, configure the number of static groups to be created by including the **group-count** statement and specifying the number of groups to be created.

   [edit protocols igmp]
   user@host# **set interface fe-0/1/2 static group 225.1.1.1 group-count 3**

2. After you commit the configuration, use the **show configuration protocol igmp** command to verify the IGMP protocol configuration.

   user@host> **show configuration protocol igmp**

   ```
   interface fe-0/1/2.0 {
     static {
       group 225.1.1.1 {
         group-count 3;
       }
     }
   }
   ```

3. After you have committed the configuration and after the source is sending traffic, use the **show igmp group** command to verify that static groups 225.1.1.1, 225.1.1.2, and 225.1.1.3 have been created.

   ```
   user@host> show igmp group
   ```

```
Interface: fe-0/1/2
     Group: 225.1.1.1
         Source: 10.0.0.2
         Last reported by: Local
         Timeout: 0 Type: Static
     Group: 225.1.1.2
         Source: 10.0.0.2
         Last reported by: Local
         Timeout: 0 Type: Static
     Group: 225.1.1.3
         Source: 10.0.0.2
         Last reported by: Local
         Timeout: 0 Type: Static
```

When you create IGMP static group membership to test multicast forwarding on an interface on which you want to receive multicast traffic, you can also configure the group address to be automatically incremented for each group created. This is useful when you want to test forwarding to multiple receivers without having to configure each receiver separately and when you do not want the group addresses to be sequential.

In this example, you create three groups and increase the group address by an increment of two for each group.

1. On the DR, configure the group address increment by including the **group-increment** statement and specifying the number by which the address should be incremented for each group. The increment is specified in dotted decimal notation similar to an IPv4 address.

   [edit protocols igmp]
   user@host# **set interface fe-0/1/2 static group 225.1.1.1 group-count 3 group-increment 0.0.0.2**

2. After you commit the configuration, use the **show configuration protocol igmp** command to verify the IGMP protocol configuration.

   user@host> **show configuration protocol igmp**

   ```
   interface fe-0/1/2.0 {
     version 3;
     static {
       group 225.1.1.1 {
         group-increment 0.0.0.2;
         group-count 3;
       }
     }
   }
   ```

3. After you have committed the configuration and after the source is sending traffic, use the **show igmp group** command to verify that static groups 225.1.1.1, 225.1.1.3, and 225.1.1.5 have been created.

```
user@host> show igmp group
Interface: fe-0/1/2
     Group: 225.1.1.1
         Source: 10.0.0.2
         Last reported by: Local
         Timeout: 0 Type: Static
     Group: 225.1.1.3
```



```
            Source: 10.0.0.2
            Last reported by: Local
            Timeout: 0 Type: Static
        Group: 225.1.1.5
            Source: 10.0.0.2
            Last reported by: Local
            Timeout: 0 Type: Static
```

When you create IGMP static group membership to test multicast forwarding on an interface on which you want to receive multicast traffic, and your network is operating in source-specific multicast (SSM) mode, you can also specify that the multicast source address be accepted. This is useful when you want to test forwarding to multicast receivers from a specific multicast source.

If you specify a group address in the SSM range, you must also specify a source.

If a source address is specified in a multicast group that is statically configured, the IGMP version on the interface must be set to IGMPv3. IGMPv2 is the default value.

In this example, you create group 225.1.1.1 and accept IP address 10.0.0.2 as the only source.

1. On the DR, configure the source address by including the **source** statement and specifying the IPv4 address of the source host.

   [edit protocols igmp]
   user@host# **set interface fe-0/1/2 static group 225.1.1.1 source 10.0.0.2**

2. After you commit the configuration, use the **show configuration protocol igmp** command to verify the IGMP protocol configuration.

   user@host> **show configuration protocol igmp**

   ```
   interface fe-0/1/2.0 {
     version 3;
     static {
       group 225.1.1.1 {
         source 10.0.0.2;
       }
     }
   }
   ```

3. After you have committed the configuration and the source is sending traffic, use the **show igmp group** command to verify that static group 225.1.1.1 has been created and that source 10.0.0.2 has been accepted.

```
user@host> show igmp group
Interface: fe-0/1/2
        Group: 225.1.1.1
            Source: 10.0.0.2
            Last reported by: Local
            Timeout: 0 Type: Static
```


When you create IGMP static group membership to test multicast forwarding on an interface on which you want to receive multicast traffic, you can specify that a number of multicast sources be automatically accepted. This is useful when you want to test forwarding to multicast receivers from more than one specified multicast source.

In this example, you create group 255.1.1.1 and accept addresses 10.0.0.2, 10.0.0.3, and 10.0.0.4 as the sources.

1. On the DR, configure the number of multicast source addresses to be accepted by including the **source-count** statement and specifying the number of sources to be accepted.

   ```
   [edit protocols igmp]
   user@host# set interface fe-0/1/2 static group 225.1.1.1 source 10.0.0.2 source-count 3
   ```

2. After you commit the configuration, use the **show configuration protocol igmp** command to verify the IGMP protocol configuration.

   ```
   user@host> show configuration protocol igmp

   interface fe-0/1/2.0 {
     version 3;
     static {
       group 225.1.1.1 {
         source 10.0.0.2 {
           source-count 3;
         }
       }
     }
   }
   ```

3. After you have committed the configuration and the source is sending traffic, use the **show igmp group** command to verify that static group 225.1.1.1 has been created and that sources 10.0.0.2, 10.0.0.3, and 10.0.0.4 have been accepted.

```
user@host> show igmp group
Interface: fe-0/1/2
     Group: 225.1.1.1
         Source: 10.0.0.2
         Last reported by: Local
         Timeout: 0 Type: Static
     Group: 225.1.1.1
         Source: 10.0.0.3
         Last reported by: Local
         Timeout: 0 Type: Static
     Group: 225.1.1.1
         Source: 10.0.0.4
         Last reported by: Local
         Timeout: 0 Type: Static
```

When you configure static groups on an interface on which you want to receive multicast traffic, and specify that a number of multicast sources be automatically accepted, you can also specify the number by which the address should be incremented for each source accepted. This is useful when you want to test forwarding to multiple receivers without having to configure each receiver separately and you do not want the source addresses to be sequential.

In this example, you create group 225.1.1.1 and accept addresses 10.0.0.2, 10.0.0.4, and 10.0.0.6 as the sources.

1. Configure the multicast source address increment by including the **source-increment** statement and specifying the number by which the address should be incremented for each source. The increment is specified in dotted decimal notation similar to an IPv4 address.

   [edit protocols igmp]
   user@host# **set interface fe-0/1/2 static group 225.1.1.1 source 10.0.0.2 source-count 3 source-increment 0.0.0.2**

2. After you commit the configuration, use the **show configuration protocol igmp** command to verify the IGMP protocol configuration.

   user@host> **show configuration protocol igmp**

   ```
   interface fe-0/1/2.0 {
     version 3;
     static {
       group 225.1.1.1 {
         source 10.0.0.2 {
           source-count 3;
           source-increment 0.0.0.2;
         }
       }
     }
   }
   ```

3. After you have committed the configuration and after the source is sending traffic, use the **show igmp group** command to verify that static group 225.1.1.1 has been created and that sources 10.0.0.2, 10.0.0.4, and 10.0.0.6 have been accepted.

```
user@host> show igmp group
Interface: fe-0/1/2
     Group: 225.1.1.1
         Source: 10.0.0.2
         Last reported by: Local
         Timeout: 0 Type: Static
     Group: 225.1.1.1
         Source: 10.0.0.4
         Last reported by: Local
         Timeout: 0 Type: Static
     Group: 225.1.1.1
         Source: 10.0.0.6
         Last reported by: Local
         Timeout: 0 Type: Static
```

When you configure static groups on an interface on which you want to receive multicast traffic and your network is operating in source-specific multicast (SSM) mode, you can specify that certain multicast source addresses be excluded.

By default the multicast source address configured in a static group operates in include mode. In include mode the multicast traffic for the group is accepted from the source address configured. You can also configure the static group to operate in exclude mode. In exclude mode the multicast traffic for the group is accepted from any address other than the source address configured.

If a source address is specified in a multicast group that is statically configured, the IGMP version on the interface must be set to IGMPv3. IGMPv2 is the default value.

In this example, you exclude address 10.0.0.2 as a source for group 225.1.1.1.

1. On the DR, configure a multicast static group to operate in exclude mode by including the **exclude** statement and specifying which IPv4 source address to exclude.

   ```
   [edit protocols igmp]
   user@host# set interface fe-0/1/2 static group 225.1.1.1 exclude source 10.0.0.2
   ```

2. After you commit the configuration, use the **show configuration protocol igmp** command to verify the IGMP protocol configuration.

   ```
   user@host> show configuration protocol igmp

   interface fe-0/1/2.0 {
     version 3;
     static {
       group 225.1.1.1 {
         exclude;
         source 10.0.0.2;
       }
     }
   }
   ```

3. After you have committed the configuration and the source is sending traffic, use the **show igmp group detail** command to verify that static group 225.1.1.1 has been created and that the static group is operating in exclude mode.

   ```
   user@host> show igmp group detail
   Interface: fe-0/1/2
        Group: 225.1.1.1
            Group mode: Exclude
            Source: 10.0.0.2
            Last reported by: Local
            Timeout: 0 Type: Static
   ```

Related Documentation

- Enabling MLD Static Group Membership on page 4070
- group (Protocols IGMP) on page 4184
- group-count (Protocols IGMP) on page 4185
- group-increment (Protocols IGMP) on page 4185
- source-count (Protocols IGMP) on page 4199

- source-increment (Protocols IGMP) on page 4199
- static (Protocols IGMP) on page 4200

Recording IGMP Join and Leave Events

To determine whether IGMP tuning is needed in a network, you can configure the routing device to record IGMP join and leave events. You can record events globally for the routing device or for individual interfaces.

Table 302 on page 4043 describes the recordable IGMP events.

Table 302: IGMP Event Messages

ERRMSG Tag	Definition
RPD_IGMP_JOIN	Records IGMP join events.
RPD_IGMP_LEAVE	Records IGMP leave events.
RPD_IGMP_ACCOUNTING_ON	Records when IGMP accounting is enabled on an IGMP interface.
RPD_IGMP_ACCOUNTING_OFF	Records when IGMP accounting is disabled on an IGMP interface.
RPD_IGMP_MEMBERSHIP_TIMEOUT	Records IGMP membership timeout events.

To enable IGMP accounting:

1. Enable accounting globally or on an IGMP interface. This example shows both options.

   ```
   [edit protocols igmp]
   user@host# set accounting
   user@host# set interface fe-0/1/0.2 accounting
   ```

2. Configure the events to be recorded and filter the events to a system log file with a descriptive filename, such as **igmp-events**.

   ```
   [edit system syslog file igmp-events]
   user@host# set any info
   user@host# set match “.*RPD_IGMP_JOIN.* | .*RPD_IGMP_LEAVE.* |
     .*RPD_IGMP_ACCOUNTING.* | .*RPD_IGMP_MEMBERSHIP_TIMEOUT.*”
   ```

3. Periodically archive the log file.

   This example rotates the file size when it reaches 100 KB and keeps three files.

   ```
   [edit system syslog file igmp-events]
   user@host# set archive size 100000
   user@host# set archive files 3
   user@host# set archive archive-sites “ftp://user@host1//var/tmp” password
     “anonymous”
   user@host# set archive archive-sites “ftp://user@host2//var/tmp” password “test”
   user@host# set archive transfer-interval 24
   user@host# set archive start-time 2011-01-07:12:30
   ```

4. You can monitor the system log file as entries are added to the file by running the ***monitor start*** and **monitor stop** commands.

   user@host> **monitor start igmp-events**

```
*** igmp-events ***
Apr 16 13:08:23  host mgd[16416]: UI_CMDLINE_READ_LINE: User 'user', command
'run monitor start igmp-events '
monitor
```

Related Documentation

- Understanding IGMP on page 3959
- Specifying Log File Size, Number, and Archiving Properties on page 6139

Limiting the Number of IGMP Multicast Group Joins on Logical Interfaces

The **group-limit** statement enables you to limit the number of IGMP multicast group joins for logical interfaces. When this statement is enabled on a router running IGMP version 2 (IGMPv2) or version 3 (IGMPv3), the limit is applied upon receipt of the group report. Once the group limit is reached, subsequent join requests are rejected.

When configuring limits for IGMP multicast groups, keep the following in mind:

- Each any-source group (*,G) counts as one group toward the limit.
- Each source-specific group (S,G) counts as one group toward the limit.
- Groups in IGMPv3 exclude mode are counted toward the limit.
- Multiple source-specific groups count individually toward the group limit, even if they are for the same group. For example, (S1, G1) and (S2, G1) would count as two groups toward the configured limit.
- Combinations of any-source groups and source-specific groups count individually toward the group limit, even if they are for the same group. For example, (*, G1) and (S, G1) would count as two groups toward the configured limit.
- Configuring and committing a group limit on a network that is lower than what already exists on the network results in the removal of all groups from the configuration. The groups must then request to rejoin the network (up to the newly configured group limit).
- You can dynamically limit multicast groups on IGMP logical interfaces using dynamic profiles.

Beginning with Junos OS 12.2, you can optionally configure a system log warning threshold for IGMP multicast group joins received on the logical interface. It is helpful to review the system log messages for troubleshooting purposes and to detect if an excessive amount of IGMP multicast group joins have been received on the interface. These log messages convey when the configured group limit has been exceeded, when the configured threshold has been exceeded, and when the number of groups drop below the configured threshold.

The **group-threshold** statement enables you to configure the threshold at which a warning message is logged. The range is 1 through 100 percent. The warning threshold is a percentage of the group limit, so you must configure the **group-limit** statement to configure a warning threshold. For instance, when the number of groups exceed the configured warning threshold, but remain below the configured group limit, multicast groups continue to be accepted, and the device logs the warning message. In addition, the device logs a warning message after the number of groups drop below the configured warning threshold. You can further specify the amount of time (in seconds) between the log messages by configuring the **log-interval** statement. The range is 6 through 32,767 seconds.

You might consider throttling log messages because every entry added after the configured threshold and every entry rejected after the configured limit causes a warning message to be logged. By configuring a log interval, you can throttle the amount of system log warning messages generated for IGMP multicast group joins.

To limit multicast group joins on an IGMP logical interface:

1. Access the logical interface at the IGMP protocol hierarchy level.

   [edit]
   user@host# **edit protocols igmp interface *interface-name***

2. Specify the group limit for the interface.

   [edit protocols igmp interface *interface-name*]
   user@host# **set group-limit *limit***

3. (Optional) Configure the threshold at which a warning message is logged.

   [edit protocols igmp interface *interface-name*]
   user@host# **set group-threshold *value***

4. (Optional) Configure the amount of time between log messages.

   [edit protocols igmp interface *interface-name*]
   user@host# **set log-interval *seconds***

To confirm your configuration, use the **show protocols igmp** command. To verify the operation of IGMP on the interface, including the configured group limit and the optional warning threshold and interval between log messages, use the **show igmp interface** command.

Related Documentation

- Enabling IGMP Static Group Membership on page 4036

Tracing IGMP Protocol Traffic

Tracing operations record detailed messages about the operation of routing protocols, such as the various types of routing protocol packets sent and received, and routing policy actions. You can specify which trace operations are logged by including specific tracing flags. The following table describes the flags that you can include.

Flag	Description
all	Trace all operations.
client-notification	Trace notifications.

Flag	Description
general	Trace general flow.
group	Trace group operations.
host-notification	Trace host notifications.
leave	Trace leave group messages (IGMPv2 only).
mtrace	Trace mtrace packets. Use the **mtrace** command to troubleshoot the software.
normal	Trace normal events.
packets	Trace all IGMP packets.
policy	Trace policy processing.
query	Trace IGMP membership query messages, including general and group-specific queries.
report	Trace membership report messages.
route	Trace routing information.
state	Trace state transitions.
task	Trace task processing.
timer	Trace timer processing.

In the following example, tracing is enabled for all routing protocol packets. Then tracing is narrowed to focus only on IGMP packets of a particular type. To configure tracing operations for IGMP:

1. (Optional) Configure tracing at the routing options level to trace all protocol packets.

   [edit routing-options traceoptions]
   user@host# **set file all-packets-trace**
   user@host# **set flag all**

2. Configure the filename for the IGMP trace file.

   [edit protocols igmp traceoptions]
   user@host# **set file igmp-trace**

3. (Optional) Configure the maximum number of trace files.

   [edit protocols igmp traceoptions]
   user@host# **set file files 5**

4. (Optional) Configure the maximum size of each trace file.

[edit protocols igmp traceoptions]
user@host# **set file size 1m**

5. (Optional) Enable unrestricted file access.

   [edit protocols igmp traceoptions]
   user@host# **set file world-readable**

6. Configure tracing flags. Suppose you are troubleshooting issues with a particular multicast group. The following example shows how to flag all events for packets associated with the group IP address.

   [edit protocols igmp traceoptions]
   user@host# **set flag group | match 232.1.1.2**

7. View the trace file.

   user@host> **file list /var/log**
   user@host> **file show /var/log/igmp-trace**

Related Documentation

- Understanding IGMP on page 3959
- *Junos OS Tracing and Logging Operations* in the *Junos OS Administration Library for Routing Devices*
- **mtrace on page 4281** in the CLI Explorer

Disabling IGMP

To disable IGMP on an interface, include the **disable** statement:

disable;

You can include this statement at the following hierarchy levels:

- **[edit protocols igmp interface *interface-name*]**
- **[edit logical-systems *logical-system-name* protocols igmp interface *interface-name*]**

Related Documentation

- Enabling IGMP on page 4028

IGMP Snooping

Configuring IGMP Snooping

With IGMP snooping enabled, a switch monitors the IGMP (Internet Group Management Protocol) traffic between hosts and multicast routers and uses what it learns to forward multicast traffic to only the downstream interfaces that are connected to interested receivers. This conserves bandwidth by allowing the switch to send multicast traffic to only those interfaces that are connected to devices that want to receive the traffic (instead of flooding the traffic to all the downstream VLAN interfaces).

NOTE: You cannot configure IGMP snooping on a secondary VLAN.

To enable IGMP snooping and configure individual options as needed for your network by using the CLI:

1. Enable IGMP snooping on a VLAN:

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan employee-vlan
   ```
2. Configure the switch to immediately remove group membership from interfaces on a VLAN when it receives a leave message through that VLAN, and have it not forward any membership queries for the multicast group to the VLAN (IGMPv2 only):

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan vlan-name immediate-leave
   ```
3. Configure an interface to belong to a multicast group:

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan-name interface interface-name static group
   group-address
   ```
4. Configure an interface to forward IGMP queries received from multicast routers.

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan vlan-name interface interface-name
   multicast-router-interface
   ```
5. Configure the switch to wait for four timeout intervals before timing out a multicast group on a VLAN:

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan vlan-name robust-count 4
   ```
6. If you want the switch to act as an IGMP querier, enter the following:

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan vlan-name igmp-querier source-address source address
   ```
   The switch uses the address that you configure as the source address in the IGMP queries that it sends. If there are any multicast routers on the same local network, make sure the source address for the IGMP querier is greater (a higher number) than the IP addresses for those routers on the network. This ensures that switch is always the IGMP querier on the network.

   NOTE: The igmp-querier statement is not supported on QFabric systems.

Related Documentation

- IGMP Snooping Overview on page 3962
- Example: Configuring IGMP Snooping on page 4049
- Changing the IGMP Snooping Group Timeout Value on page 4051
- Monitoring IGMP Snooping on page 4257

Example: Configuring IGMP Snooping

With IGMP snooping enabled, a switch monitors the IGMP (Internet Group Management Protocol) traffic between hosts and multicast routers and uses what it learns to forward multicast traffic to only the downstream interfaces that are connected to interested receivers. This conserves bandwidth by allowing the switch to send multicast traffic to only those interfaces that are connected to devices that want to receive the traffic (instead of flooding the traffic to all the downstream VLAN interfaces).

This example describes how to configure IGMP snooping:

- Requirements on page 4049
- Overview and Topology on page 4049
- Configuration on page 4050

Requirements

This example requires Junos OS Release 11.1 or later on a QFX Series product.

Before you configure IGMP snooping, be sure you have:

- Configured the **employee-vlan** VLAN
- Assigned interfaces **ge-0/0/1**, **ge-0/0/2**, and **ge-0/0/3** to **employee-vlan**

Overview and Topology

In this example you configure an interface to receive multicast traffic from a source and configure some multicast-related behavior for downstream interfaces. The example assumes that IGMP snooping was previously disabled for the VLAN.

Table 303 on page 4049 shows the components of the topology for this example.

Table 303: Components of the IGMP Snooping Topology

Components	Settings
VLAN name	**employee-vlan**, tag **20**
Interfaces in **employee-vlan**	**ge-0/0/1**, **ge-0/0/2**, **ge-0/0/3**
Multicast IP address for **employee-vlan**	**225.100.100.100**

Configuration

To configure basic IGMP snooping on a switch:

CLI Quick Configuration

To quickly configure IGMP snooping, copy the following commands and paste them into a terminal window:

```
[edit protocols]
set igmp-snooping vlan employee-vlan
set igmp-snooping vlan employee-vlan interface ge-0/0/3 static group 225.100.100.100
set igmp-snooping vlan employee-vlan interface ge-0/0/2 multicast-router-interface
set igmp-snooping vlan employee-vlan robust-count 4
```

Step-by-Step Procedure

Configure IGMP snooping:

1. Enable and configure IGMP snooping on the VLAN **employee-vlan**:

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan employee-vlan
   ```
2. Configure a interface to belong to a multicast group:

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan employee-vlan interface ge-0/0/3 static group
   225.100.100.100
   ```
3. Configure an interface to forward IGMP queries received from multicast routers.

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan employee-vlan interface ge-0/0/2
   multicast-router-interface
   ```
4. Configure the switch to wait for four timeout intervals before timing out a multicast group on a VLAN:

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan employee-vlan robust-count 4
   ```

Results

Check the results of the configuration:

```
user@switch# show protocols igmp-snooping
  vlan employee-vlan {
    robust-count 4;
    }
    interface ge-0/0/2 {
      multicast-router-interface;
    }
    interface ge-0/0/3 {
      static {
        group 255.100.100.100;
      }
    }
  }
```

Related Documentation

- IGMP Snooping Overview on page 3962
- Configuring IGMP Snooping on page 4048
- Changing the IGMP Snooping Group Timeout Value on page 4051
- Monitoring IGMP Snooping on page 4257

- Example: Setting Up Bridging with Multiple VLANs on page 1451.

Using a Switch as an IGMP Querier

If IGMP snooping is enabled on a pure Layer 2 a local network (that is, Layer 3 is not enabled on the network), and there is not multicast router in the network, multicast traffic might not be properly forwarded through the network. This problem occurs if the local network is configured such that multicast traffic must be forwarded between switches in order to reach a multicast receiver. In this case, an upstream switch does not forward multicast traffic to a downstream switch (and therefore to the multicast receivers attached to the downstream switch) because the downstream switch does not forward IGMP reports to the upstream switch. You can solve this problem by configuring one of the switches to be an IGMP querier. This switch sends periodic general query packets to all the switches in the network, which ensures that the snooping membership tables are updated and prevents any multicast traffic loss.

If you configure multiple switches to be IGMP queriers, the switch with the highest (greatest) IGMP querier source address takes precedence and acts as the querier. Switches with lower IGMP querier source addresses stop sending IGMP queries unless they do not receive IGMP queries for 255 seconds. If a switch with a lower IGMP querier source address does not receive any IGMP queries during that period, it starts sending queries again.

To configure a switch to act as an IGMP querier, enter the following:

```
[edit protocols]
user@switch# set igmp-snooping vlan vlan-name igmp-querier source-address source address
```

NOTE: **The igmp-querier statement is not supported on QFabric systems.**

Related Documentation

- IGMP Snooping Overview on page 3962
- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048
- Changing the IGMP Snooping Group Timeout Value on page 4051
- Monitoring IGMP Snooping on page 4257

IGMP Snooping (Original CLI Only)

Changing the IGMP Snooping Group Timeout Value

The IGMP snooping group timeout value determines how long a switch waits to receive an IGMP query from a multicast router before removing a multicast group from its multicast cache table. A switch calculates the timeout value by using the **query-interval** and **query-response-interval** values.

When you enable IGMP snooping, the **query-interval** and **query-response-interval** values are applied to all VLANs on the switch. The values are:

- **query-interval**—125 seconds
- **query-response-interval**—10 seconds

The switch automatically calculates the group timeout value for an IGMP snooping-enabled switch by multiplying the **query-interval** value by 2 (the default **robust-count** value) and then adding the **query-response-interval** value. By default, the switch waits 260 seconds to receive an IGMP query before removing a multicast group from its multicast cache table: (125 x 2) + 10 = 260.

You can modify the group timeout value by changing the **robust-count** value. For example, if you want the system to wait 510 seconds before timing groups out—(125 x 4) + 10 = 510—enter this command:

```
[edit protocols]
user@switch# set igmp-snooping vlan employee-vlan robust-count (IGMP Snooping) 4
```

Related Documentation

- Verifying the IGMP Snooping Group Timeout Value on page 4258
- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048

Configuring Multicast VLAN Registration (CLI Procedure)

Multicast VLAN registration (MVR) enables hosts that are not part of a multicast source VLAN (MVLAN) to still receive multicast streams from the MVLAN, allowing an MVLAN to be shared across a Layer 2 network. Hosts remain in their own VLANs for bandwidth and security reasons but are able to receive multicast streams from the MVLAN.

You can configure one or more VLANs on a switch to be MVLANs or MVR receiver VLANs. By default, MVR is not configured on EX Series switches and the QFX Series.

NOTE: MVR is supported on VLANs running IGMP version 2 (IGMPv2) only.

NOTE: When you configure MVR, the following restrictions apply:

- You cannot enable multicast protocols on VLAN interfaces that are members of MVLANs.
- If you configure an MVLAN in proxy mode, IGMP snooping proxy mode is automatically enabled on all MVR receiver VLANs of this MVLAN. If a VLAN is an MVR receiver VLAN for multiple MVLANs, all of the MVLANs must have proxy mode enabled or all must have proxy mode disabled. You can enable proxy mode only on VLANs that are configured as MVR source VLANs and that are not configured for Q-in-Q tunneling.
- After you configure a VLAN as an MVLAN, that VLAN is no longer available for other uses.

To configure MVR:

1. Configure the VLAN named mv0 to be an MVLAN:

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan mv0 data-forwarding source groups
     225.10.0.0/16
   ```

2. Configure the MVLAN mv0 to be a proxy VLAN:

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan mv0 proxy source-address 10.0.0.1
   ```

3. Configure the VLAN named v2 to be an MVR receiver VLAN with mv0 as its source:

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan v2 data-forwarding receiver source-vlans mv0
   ```

4. Install forwarding entries in the MVR receiver VLAN:

   ```
   [edit protocols]
   user@switch# set igmp-snooping vlan mv0 data-forwarding receiver install
   ```

Related Documentation

- Example: Configuring Multicast VLAN Registration on page 4054

• Understanding Multicast VLAN Registration on page 3974

Example: Configuring Multicast VLAN Registration

Multicast VLAN registration (MVR) enables hosts that are not part of a multicast VLAN (MVLAN) to receive multicast streams from the MVLAN, which enable the MVLAN to be shared across the Layer 2 network and eliminate the need to send duplicate multicast streams to each requesting VLAN in the network. Hosts remain in their own VLANs for bandwidth and security reasons.

This example describes how to configure MVR on EX Series switches and the QFX Series.

Requirements

This example uses the following hardware and software components:

• One EX Series switch or the QFX Series
• Junos OS Release 9.6 or later for EX Series switches or Junos OS Release 12.3 or later for the QFX Series

Before you configure MVR, be sure you have:

• Configured two or more VLANs on the switch. See the task for your platform:
  • *Example: Setting Up Bridging with Multiple VLANs for EX Series Switches*
  • "Example: Setting Up Bridging with Multiple VLANs" on page 1451 for the QFX Series
• Connected the switch to a network that can transmit IPTV multicast streams from a video server.
• Connected a host that is capable of receiving IPTV multicast streams to an interface in one of the VLANs.

Overview and Topology

In a standard Layer 2 network, a multicast stream received on one VLAN is never distributed to interfaces outside that VLAN. If hosts in multiple VLANs request the same multicast stream, a separate copy of that multicast stream is distributed to the requesting VLANs.

MVR introduces the concept of a *multicast source VLAN* (MVLAN), which is created by MVR and becomes the only VLAN over which multicast traffic flows throughout the Layer 2 network. Multicast traffic can then be selectively forwarded from interfaces on the MVLAN (source ports) to hosts that are connected to interfaces (multicast receiver ports) that are not part of the multicast source VLAN. When you configure an MVLAN, you assign a range of multicast group addresses to it. You then configure other VLANs to be MVR receiver VLANs, which receive multicast streams from the MVLAN. The MVR receiver ports comprise all the interfaces that exist on any of the MVR receiver VLANs.

You can configure MVR to operate in one of two modes: transparent mode (the default mode) or proxy mode. Both modes enable MVR to forward only one copy of a multicast stream to the Layer 2 network.

In transparent mode, the switch receives one copy of each IPTV multicast stream and then replicates the stream only to those hosts that want to receive it, while forwarding all other types of multicast traffic without modification. Figure 137 on page 4056 shows how MVR operates in transparent mode.

In proxy mode, the switch acts as a proxy for the IGMP multicast router in the MVLAN for MVR group memberships established in the MVR receiver VLANs and generates and sends IGMP packets into the MVLAN as needed. Figure 138 on page 4057 shows how MVR operates in proxy mode.

This example shows how to configure MVR in both transparent mode and proxy mode on an EX Series switch or the QFX Series. The topology includes a video server that is connected to a multicast router, which in turn forwards the IPTV multicast traffic in the MVLAN to the Layer 2 network.

Figure 137 on page 4056 shows the MVR topology in transparent mode. Interfaces P1 and P2 on Switch C belong to service VLAN s0 and MVLAN mv0. Interface P4 of Switch C also belongs to service VLAN s0. In the upstream direction of the network, only non-IPTV traffic is being carried in individual customer VLANs of service VLAN s0. VLAN c0 is an example of this type of customer VLAN. IPTV traffic is being carried on MVLAN mv0. If any host on any customer VLAN connected to port P4 requests an MVR stream, Switch C takes the stream from VLAN mv0 and replicates that stream onto port P4 with tag mv0. IPTV traffic, along with other network traffic, flows from port P4 out to the Digital Subscriber Line Access Multiplexer (DSLAM) D1.

Figure 137: MVR Topology in Transparent Mode

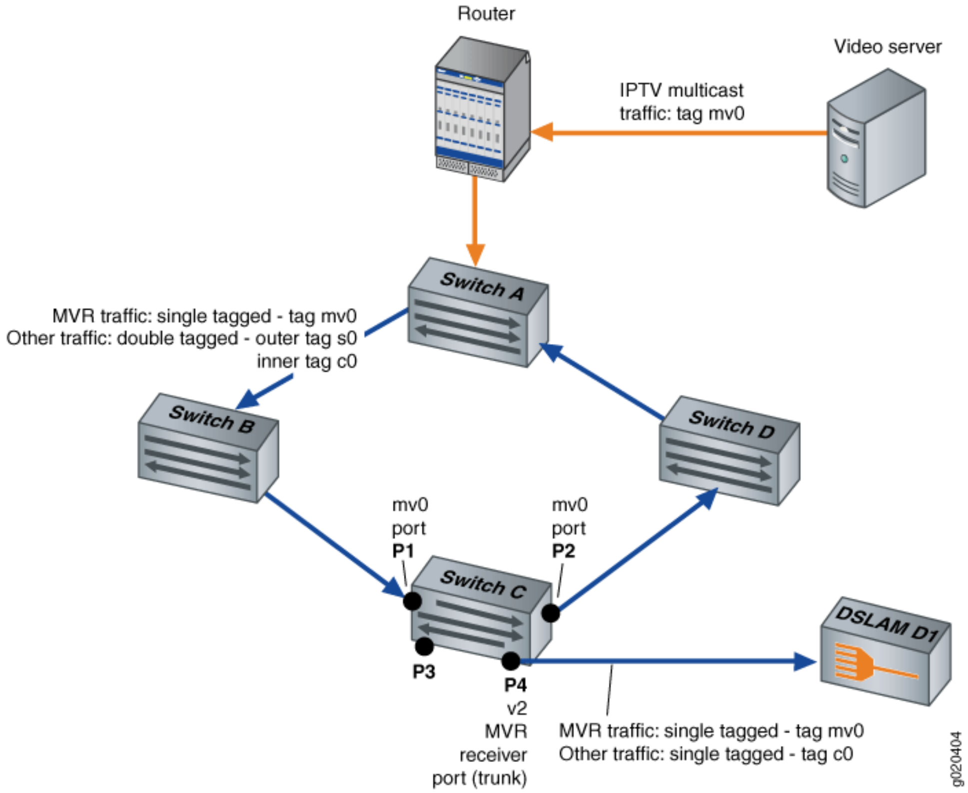
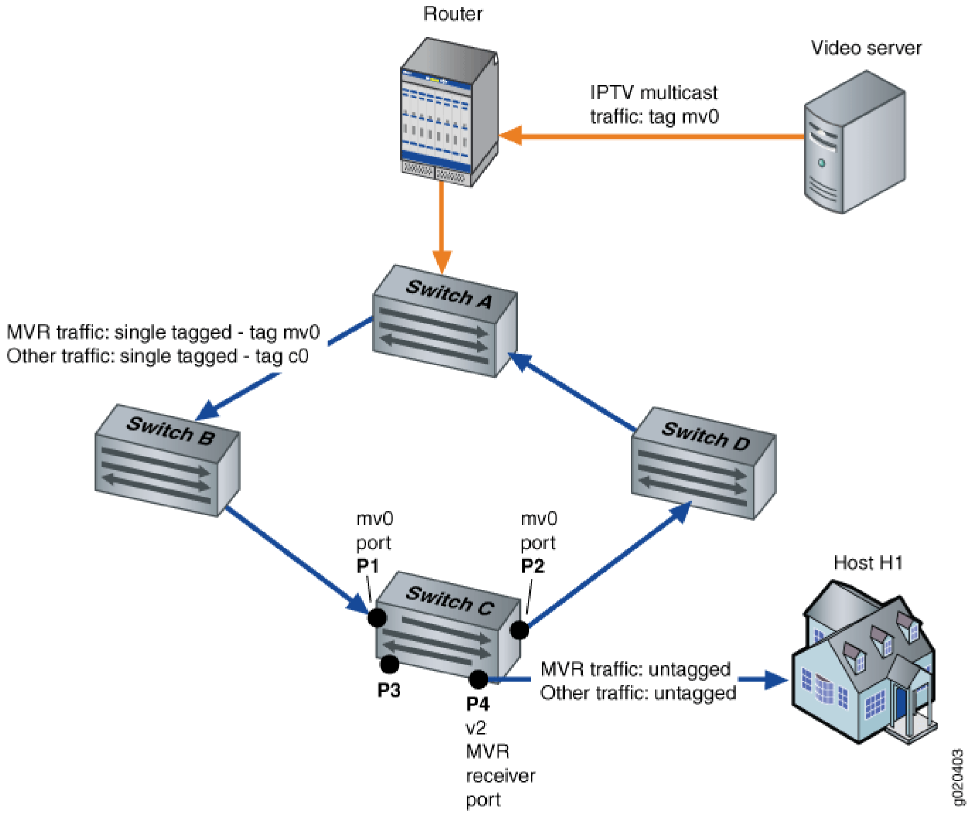


Figure 138 on page 4057 shows the MVR topology in proxy mode. Interfaces P1 and P2 on Switch C belong to MVLAN mv0 and customer VLAN c0. Interface P4 on Switch C is an access port of customer VLAN c0. In the upstream direction of the network, only non-IPTV traffic is being carried on customer VLAN c0. Any IPTV traffic requested by hosts on VLAN c0 is replicated untagged to port P4 based on streams received in MVLAN mv0. IPTV traffic flows from port P4 out to an IPTV-enabled device in Host H1. Other traffic, such as data and voice traffic, also flows from port P4 to other network devices in Host H1.

Figure 138: MVR Topology in Proxy Mode



For information on VLAN tagging, see the topic for your platform:

- *Understanding Bridging and VLANs on EX Series Switches*
- "Understanding Bridging and VLANs" on page 1402 on the QFX Series

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit protocols igmp-snooping]** hierarchy level.

```
set vlan mv0 data-forwarding source groups 225.10.0.0/16
set vlan v2 data-forwarding receiver source-vlans mv0
set vlan v2 data-forwarding receiver install
set vlan mv0 proxy source-address 10.1.1.1
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure MVR:

1. Configure VLAN mv0 to be an MVLAN:

   ```
   [edit protocols igmp-snooping]
   user@switch# set vlan mv0 data-forwarding source groups 225.10.0.0/16
   ```

2. Configure VLAN v2 to be a multicast receiver VLAN with mv0 as its source:

   ```
   [edit protocols igmp-snooping]
   user@switch# set vlan v2 data-forwarding receiver source-vlans mv0
   ```

3. (Optional) Install forwarding entries in the multicast receiver VLAN v2:

   ```
   [edit protocols igmp-snooping]
   user@switch# set vlan v2 data-forwarding receiver install
   ```

4. (Optional) Configure MVR in proxy mode:

   ```
   [edit protocols igmp-snooping]
   user@switch# set vlan mv0 proxy source-address 10.1.1.1
   ```

Results

From configuration mode, confirm your configuration by entering the **show** command at the **[edit protocols igmp-snooping]** hierarchy level. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit protocols igmp-snooping]
user@switch# show
vlan mv0 {
  proxy {
    source-address 10.1.1.1;
  }
  data-forwarding {
    source {
      groups 225.10.0.0/16;
    }
  }
}
vlan v2 {
  data-forwarding {
    receiver {
      source-vlans mv0;
      install;
    }
  }
}
```

Related Documentation

- Configuring Multicast VLAN Registration (CLI Procedure) on page 4053
- Understanding Multicast VLAN Registration on page 3974

IGMP Snooping (ELS CLI Only)

Configuring VLAN-Specific IGMP Snooping Parameters

All of the IGMP snooping statements configured with the **igmp-snooping** statement, with the exception of the **traceoptions** statement, can be qualified with the same statement at the VLAN level. To configure IGMP snooping parameters at the VLAN level, include the **vlan** statement:

```
vlan vlan-id;
  immediate-leave;
  interface interface-name {
    group-limit limit;
    host-only-interface;
    multicast-router-interface;
    static {
      group ip-address {
        source ip-address;
      }
    }
  }
  proxy {
    source-address ip-address;
  }
  query-interval seconds;
  query-last-member-interval seconds;
  query-response-interval seconds;
  robust-count number;
}
```

You can include this statement at the following hierarchy levels:

- **[edit bridge-domains *bridge-domain-name* protocols igmp-snooping]**
- **[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping]**

Related Documentation

- *Multicast Overview*
- *Understanding Multicast Snooping*

MLD

Examples: Configuring MLD

Understanding MLD

The Multicast Listener Discovery (MLD) Protocol manages the membership of hosts and routers in multicast groups. IP version 6 (IPv6) multicast routers use MLD to learn, for each of their attached physical networks, which groups have interested listeners. Each routing device maintains a list of host multicast addresses that have listeners for each subnetwork, as well as a timer for each address. However, the routing device does not need to know the address of each listener—just the address of each host. The routing device provides addresses to the multicast routing protocol it uses, which ensures that multicast packets are delivered to all subnetworks where there are interested listeners. In this way, MLD is used as the transport for the Protocol Independent Multicast (PIM) Protocol.

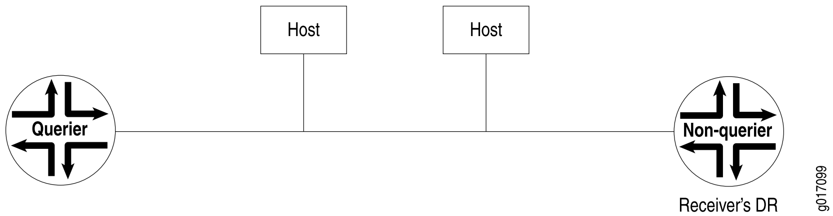
MLD is an integral part of IPv6 and must be enabled on all IPv6 routing devices and hosts that need to receive IP multicast traffic. The Junos OS supports MLD versions 1 and 2. Version 2 is supported for source-specific multicast (SSM) include and exclude modes.

In include mode, the receiver specifies the source or sources it is interested in receiving the multicast group traffic from. Exclude mode works the opposite of include mode. It allows the receiver to specify the source or sources it is not interested in receiving the multicast group traffic from.

For each attached network, a multicast routing device can be either a querier or a nonquerier. A querier routing device, usually one per subnet, solicits group membership information by transmitting MLD queries. When a host reports to the querier routing device that it has interested listeners, the querier routing device forwards the membership information to the rendezvous point (RP) routing device by means of the receiver's (host's) designated router (DR). This builds the rendezvous-point tree (RPT) connecting the host with interested listeners to the RP routing device. The RPT is the initial path used by the sender to transmit information to the interested listeners. Nonquerier routing devices do not transmit MLD queries on a subnet but can do so if the querier routing device fails.

All MLD-configured routing devices start as querier routing devices on each attached subnet (see Figure 126 on page 3966). The querier routing device on the right is the receiver's DR.

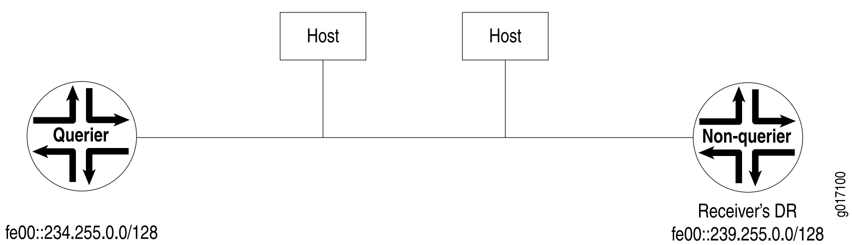
Figure 139: Routing Devices Start Up on a Subnet



To elect the querier routing device, the routing devices exchange query messages containing their IPv6 source addresses. If a routing device hears a query message whose IPv6 source address is numerically lower than its own selected address, it becomes a nonquerier. In Figure 127 on page 3967, the routing device on the left has a source address numerically lower than the one on the right and therefore becomes the querier routing device.

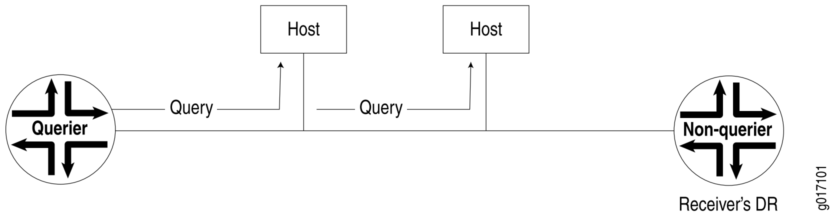
NOTE: In the practical application of MLD, several routing devices on a subnet are nonqueriers. If the elected querier routing device fails, query messages are exchanged among the remaining routing devices. The routing device with the lowest IPv6 source address becomes the new querier routing device. The IPv6 Neighbor Discovery Protocol (NDP) implementation drops incoming Neighbor Announcement (NA) messages that have a broadcast or multicast address in the target link-layer address option. This behavior is recommended by RFC 2461.

Figure 140: Querier Routing Device Is Determined



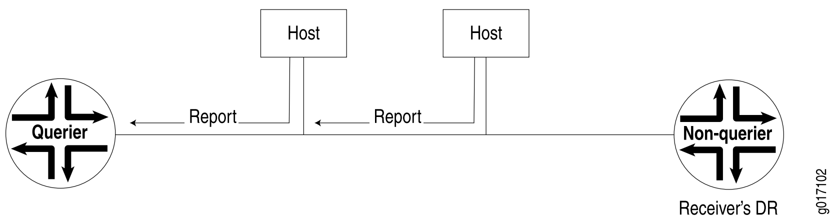
The querier routing device sends general MLD queries on the **link-scope all-nodes** multicast address FF02::1 at short intervals to all attached subnets to solicit group membership information (see Figure 128 on page 3967). Within the query message is the *maximum response delay* value, specifying the maximum allowed delay for the host to respond with a report message.

Figure 141: General Query Message Is Issued



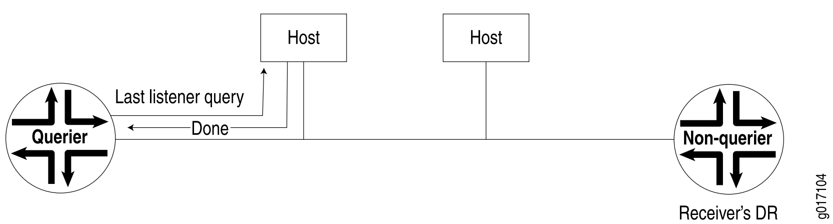
If interested listeners are attached to the host receiving the query, the host sends a report containing the host's IPv6 address to the routing device (see Figure 129 on page 3967). If the reported address is not yet in the routing device's list of multicast addresses with interested listeners, the address is added to the list and a timer is set for the address. If the address is already on the list, the timer is reset. The host's address is transmitted to the RP in the PIM domain.

Figure 142: Reports Are Received by the Querier Routing Device



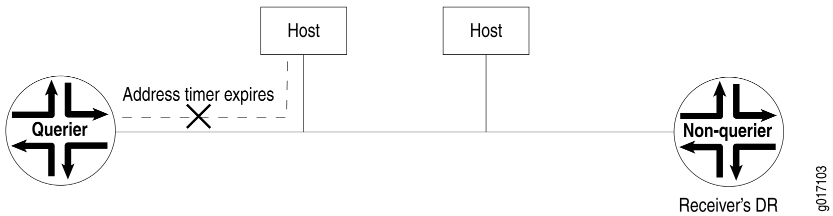
If the host has no interested multicast listeners, it sends a done message to the querier routing device. On receipt, the querier routing device issues a multicast address-specific query containing the last **listener query interval** value to the multicast address of the host. If the routing device does not receive a report from the multicast address, it removes the multicast address from the list and notifies the RP in the PIM domain of its removal (see Figure 130 on page 3968).

Figure 143: Host Has No Interested Receivers and Sends a Done Message to Routing Device



If a done message is not received by the querier routing device, the querier routing device continues to send multicast address-specific queries. If the timer set for the address on receipt of the last report expires, the querier routing device assumes there are no longer interested listeners on that subnet, removes the multicast address from the list, and notifies the RP in the PIM domain of its removal (see Figure 131 on page 3968).

Figure 144: Host Address Timer Expires and Address Is Removed from Multicast Address List



Configuring MLD

To configure the Multicast Listener Discovery (MLD) Protocol, include the **mld** statement:

```
mld {
   accounting;
   interface interface-name {
      disable;
      (accounting | no-accounting);
      group-policy [ policy-names ];
      immediate-leave;
      oif-map [ map-names ];
      passive;
      ssm-map ssm-map-name;
      static {
         group multicast-group-address {
            exclude;
            group-count number;
            group-increment increment;
            source ip-address {
               source-count number;
               source-increment increment;
            }
         }
      }
      version version;
   }
   maximum-transmit-rate packets-per-second;
   query-interval seconds;
   query-last-member-interval seconds;
   query-response-interval seconds;
   robust-count number;
   traceoptions {
      file filename <files number> <size size> <world-readable | no-world-readable>;
      flag flag <flag-modifier> <disable>;
   }
}
```

You can include this statement at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems *logical-system-name* protocols]**

By default, MLD is enabled on all broadcast interfaces when you configure Protocol Independent Multicast (PIM) or the Distance Vector Multicast Routing Protocol (DVMRP).

Enabling MLD

The Multicast Listener Discovery (MLD) Protocol manages multicast groups by establishing, maintaining, and removing groups on a subnet. Multicast routing devices use MLD to learn which groups have members on each of their attached physical networks. MLD must be enabled for the router to receive IPv6 multicast packets. MLD is only needed for IPv6 networks, because multicast is handled differently in IPv4 networks. MLD is enabled on all IPv6 interfaces on which you configure PIM and on all IPv6 broadcast interfaces when you configure DVMRP.

MLD specifies different behaviors for multicast listeners and for routers. When a router is also a listener, the router responds to its own messages. If a router has more than one interface to the same link, it needs to perform the router behavior over only one of those interfaces. Listeners, on the other hand, must perform the listener behavior on all interfaces connected to potential receivers of multicast traffic.

If MLD is not running on an interface—either because PIM and DVMRP are not configured on the interface or because MLD is explicitly disabled on the interface—you can explicitly enable MLD.

To explicitly enable MLD:

1. If PIM and DVMRP are not running on the interface, explicitly enable MLD by including the interface name.

   [edit protocols mld]
   user@host# **set interface fe-0/0/0.0**

2. Check to see if MLD is disabled on any interfaces. In the following example, MLD is disabled on a Gigabit Ethernet interface.

   [edit protocols mld]
   user@host# **show**

   ```
   interface fe-0/0/0.0;
   interface ge-0/0/0.0 {
       disable;
   }
   ```

3. Enable MLD on the interface by deleting the **disable** statement.

   [edit protocols mld]
   delete interface ge-0/0/0.0 disable

4. Verify the configuration.

   [edit protocols mld]
   user@host# **show**

   ```
   interface fe-0/0/0.0;
   interface ge-0/0/0.0;
   ```

5. Verify the operation of MLD by checking the output of the **show mld interface** command.

Modifying the MLD Version

By default, the router supports MLD version 1 (MLDv1). To enable the router to use MLD version 2 (MLDv2) for source-specific multicast (SSM) only, include the **version 2** statement.

If you configure the MLD version setting at the individual interface hierarchy level, it overrides configuring the IGMP version using the **interface all** statement.

If a source address is specified in a multicast group that is statically configured, the version must be set to MLDv2.

To change an MLD interface to version 2:

1. Configure the MLD interface.

   ```
   [edit protocols mld]
   user@host# set interface fe-0/0/0.0 version 2
   ```

2. Verify the configuration by checking the **version** field in the output of the **show mld interface** command. The **show mld statistics** command has version-specific output fields, such as the counters in the **MLD Message type** field.

Modifying the MLD Host-Query Message Interval

The objective of MLD is to keep routers up to date with IPv6 group membership of the entire subnet. Routers need not know who all the members are, only that members exist. Each host keeps track of which multicast groups are subscribed to. On each link, one router is elected the querier. The MLD querier router periodically sends general host-query messages on each attached network to solicit membership information. These messages solicit group membership information and are sent to the **link-scope all-nodes** address **FF02::1**. A general host-query message has a maximum response time that you can set by configuring the query response interval.

The query response timeout, the query interval, and the robustness variable are related in that they are all variables that are used to calculate the multicast listener interval. The multicast listener interval is the number of seconds that must pass before a multicast router determines that no more members of a host group exist on a subnet. The multicast listener interval is calculated as the (robustness variable x query-interval) + (1 x query-response-interval). If no reports are received for a particular group before the multicast listener interval has expired, the routing device stops forwarding remotely-originated multicast packets for that group onto the attached network.

By default, host-query messages are sent every 125 seconds. You can change this interval to change the number of MLD messages sent on the subnet.

To modify the query interval:

1. Configure the interval.

   ```
   [edit protocols mld]
   user@host# set query-interval 200
   ```

   The value can be from 1 through 1024 seconds.

2. Verify the configuration by checking the **MLD Query Interval** field in the output of the **show mld interface** command.

3. Verify the operation of the query interval by checking the **Listener Query** field in the output of the **show mld statistics** command.

Modifying the MLD Query Response Interval

The query response interval is the maximum amount of time that can elapse between when the querier router sends a host-query message and when it receives a response from a host. You can change this interval to adjust the burst peaks of MLD messages on the subnet. Set a larger interval to make the traffic less bursty.

The query response timeout, the query interval, and the robustness variable are related in that they are all variables that are used to calculate the multicast listener interval. The multicast listener interval is the number of seconds that must pass before a multicast router determines that no more members of a host group exist on a subnet. The multicast listener interval is calculated as the (robustness variable x query-interval) + (1 x query-response-interval). If no reports are received for a particular group before the multicast listener interval has expired, the routing device stops forwarding remotely-originated multicast packets for that group onto the attached network.

The default query response interval is 10 seconds. You can configure a subsecond interval up to one digit to the right of the decimal point. The configurable range is 0.1 through 0.9, then in 1-second intervals 1 through 999,999.

To modify the query response interval:

1. Configure the interval.

   ```
   [edit protocols mld]
   user@host# set query-response-interval 0.5
   ```

2. Verify the configuration by checking the **MLD Query Response Interval** field in the output of the **show mld interface** command.

3. Verify the operation of the query interval by checking the **Listener Query** field in the output of the **show mld statistics** command.

Modifying the MLD Last-Member Query Interval

The last-member query interval (also called the last-listener query interval) is the maximum amount of time between group-specific query messages, including those sent in response to done messages sent on the **link-scope-all-routers** address FF02::2. You can lower this interval to reduce the amount of time it takes a router to detect the loss of the last member of a group.

When the routing device that is serving as the querier receives a leave-group (done) message from a host, the routing device sends multiple group-specific queries to the group. The querier sends a specific number of these queries, and it sends them at a specific interval. The number of queries sent is called the last-listener query count. The interval at which the queries are sent is called the last-listener query interval. Both settings are configurable, thus allowing you to adjust the leave latency. The IGMP leave latency is the time between a request to leave a multicast group and the receipt of the last byte of data for the multicast group.

The last-listener query count x (times) the last-listener query interval = (equals) the amount of time it takes a routing device to determine that the last member of a group has left the group and to stop forwarding group traffic.

The default last-listener query interval is 1 second. You can configure a subsecond interval up to one digit to the right of the decimal point. The configurable range is 0.1 through 0.9, then in 1-second intervals 1 through 999,999.

To modify this interval:

1. Configure the time (in seconds) that the routing device waits for a report in response to a group-specific query.

   ```
   [edit protocols mld]
   user@host# set query-last-member-interval 0.1
   ```

2. Verify the configuration by checking the **MLD Last Member Query Interval** field in the output of the **show igmp interfaces** command.

NOTE: **You can configure the last-member query count by configuring the robustness variable. The two are always equal.**

Specifying Immediate-Leave Host Removal for MLD

The immediate leave setting is useful for minimizing the leave latency of MLD memberships. When this setting is enabled, the routing device leaves the multicast group immediately after the last host leaves the multicast group.

The immediate-leave setting enables host tracking, meaning that the device keeps track of the hosts that send join messages. This allows MLD to determine when the last host sends a leave message for the multicast group.

When the immediate leave setting is enabled, the device removes an interface from the forwarding-table entry without first sending MLD group-specific queries to the interface. The interface is pruned from the multicast tree for the multicast group specified in the MLD leave message. The immediate leave setting ensures optimal bandwidth management for hosts on a switched network, even when multiple multicast groups are being used simultaneously.

When immediate leave is disabled and one host sends a leave group message, the routing device first sends a group query to determine if another receiver responds. If no receiver responds, the routing device removes all hosts on the interface from the multicast group. Immediate leave is disabled by default for both MLD version 1 and MLD version 2.

NOTE: Although host tracking is enabled for IGMPv2 and MLDv1 when you enable immediate leave, use immediate leave with these versions only when there is one host on the interface. The reason is that IGMPv2 and MLDv1 use a report suppression mechanism whereby only one host on an interface sends a group join report in response to a membership query. The other interested hosts suppress their reports. The purpose of this mechanism is to avoid a flood of reports for the same group. But it also interferes with host tracking, because the router only knows about the one interested host and does not know about the others.

To enable immediate leave:

1. Configure immediate leave on the MLD interface.

   ```
   [edit protocols mld]
   user@host# set interface ge-0/0/0.1 immediate-leave
   ```

2. Verify the configuration by checking the **Immediate Leave** field in the output of the **show mld interface** command.

Filtering Unwanted MLD Reports at the MLD Interface Level

Suppose you need to limit the subnets that can join a certain multicast group. The **group-policy** statement enables you to filter unwanted MLD reports at the interface level.

When the **group-policy** statement is enabled on a router, after the router receives an MLD report, the router compares the group against the specified group policy and performs the action configured in that policy (for example, rejects the report if the policy matches the defined address or network).

You define the policy to match only MLD group addresses (for MLDv1) by using the policy's **route-filter** statement to match the group address. You define the policy to match MLD (source, group) addresses (for MLDv2) by using the policy's **route-filter** statement to match the group address and the policy's **source-address-filter** statement to match the source address.

To filter unwanted MLD reports:

1. Configure an MLDv1 policy.

   ```
   [edit policy-statement reject_policy_v1]
   user@host# set from route-filter fec0:1:1:4::/64 exact
   user@host# set then reject
   ```

2. Configure an MLDv2 policy.

   ```
   [edit policy-statement reject_policy_v2]
   user@host# set from route-filter fec0:1:1:4::/64 exact
   user@host# set from source-address-filter fe80::2e0:81ff:fe05:1a8d/32 orlonger
   user@host# set then reject
   ```


3. Apply the policies to the MLD interfaces where you prefer not to receive specific group or (source, group) reports. In this example, **ge-0/0/0.1** is running MLDv1 and **ge-0/1/1.0** is running MLDv2.

   [edit protocols mld]
   user@host# **set interface ge-0/0/0.1 group-policy reject_policy_v1**
   user@host# **set interface ge-0/1/1.0 group-policy reject_policy_v2**

4. Verify the operation of the filter by checking the **Rejected Report** field in the output of the **show mld statistics** command.

Example: Modifying the MLD Robustness Variable

This example shows how to configure and verify the MLD robustness variable in a multicast domain.

Requirements

Before you begin:

- Configure the router interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure an interior gateway protocol or static routing. See the *Junos OS Routing Protocols Library for Routing Devices*.
- Enable IPv6 unicast routing. See the *Junos OS Routing Protocols Library for Routing Devices*.
- Enable PIM. See “PIM Overview” on page 3937.

Overview

The MLD robustness variable can be fine-tuned to allow for expected packet loss on a subnet. Increasing the robust count allows for more packet loss but increases the leave latency of the subnetwork.

The value of the robustness variable is used in calculating the following MLD message intervals:

- Group member interval—Amount of time that must pass before a multicast router determines that there are no more members of a group on a network. This interval is calculated as follows: (robustness variable x query-interval) + (1 x query-response-interval).
- Other querier present interval—Amount of time that must pass before a multicast router determines that there is no longer another multicast router that is the querier. This interval is calculated as follows: (robustness variable x query-interval) + (0.5 x query-response-interval).

- Last-member query count—Number of group-specific queries sent before the router assumes there are no local members of a group. The default number is the value of the robustness variable.

By default, the robustness variable is set to 2. The number can be from 2 through 10. You might want to increase this value if you expect a subnet to lose packets.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols mld robust-count 5
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To change the value of the robustness variable:

1. Configure the robust count.

   ```
   [edit protocols mld]
   user@host# set robust-count 5
   ```

2. If you are done configuring the device, commit the configuration.

   ```
   [edit protocols mld]
   user@host# commit
   ```

Verification

To verify the configuration is working properly, check the **MLD Robustness Count** field in the output of the **show mld interfaces** command.

Limiting the Maximum MLD Message Rate

You can change the limit for the maximum number of MLD packets transmitted in 1 second by the router.

Increasing the maximum number of MLD packets transmitted per second might be useful on a router with a large number of interfaces participating in MLD.

To change the limit for the maximum number of MLD packets the router can transmit in 1 second, include the **maximum-transmit-rate** statement and specify the maximum number of packets per second to be transmitted.

Enabling MLD Static Group Membership

You can create MLD static group membership to test multicast forwarding without a receiver host. When you enable MLD static group membership, data is forwarded to an interface without that interface receiving membership reports from downstream hosts.

Class-of-service (CoS) adjustment is not supported with MLD static group membership.

When you configure static groups on an interface on which you want to receive multicast traffic, you can specify the number of static groups to be automatically created.

In this example, you create static group ff0e::1:ff05:1a8d.

1. Configure the static groups to be created by including the **static** statement and **group** statement and specifying which IPv6 multicast address of the group to be created.

   [edit protocols mld]
   user@host# **set interface fe-0/1/2 static group ff0e::1:ff05:1a8d**

2. After you commit the configuration, use the **show configuration protocol mld** command to verify the MLD protocol configuration.

   user@host> **show configuration protocol mld**

   ```
   interface fe-0/1/2.0 {
     static {
       group ff0e::1:ff05:1a8d;
     }
   }
   ```

3. After you have committed the configuration and after the source is sending traffic, use the **show mld group** command to verify that static group ff0e::1:ff05:1a8d has been created.

   ```
   user@host> show mld group
   Interface: fe-0/1/2
   Group: ff0e::1:ff05:1a8d
   Group mode: Include
   Source: fe80::2e0:81ff:fe05:1a8d
   Last reported by: Local
   Timeout: 0 Type: Static
   ```

NOTE: You must specify a unique address for each group.

Automatically create static groups

When you create MLD static group membership to test multicast forwarding on an interface on which you want to receive multicast traffic, you can specify that a number of static groups be automatically created. This is useful when you want to test forwarding to multiple receivers without having to configure each receiver separately.

In this example, you create three groups.

1. Configure the number of static groups to be created by including the **group-count** statement and specifying the number of groups to be created.

   [edit protocols mld]
   user@host# **set interface fe-0/1/2 static group ff0e::1:ff05:1a8d** group-count **3**

2. After you commit the configuration, use the **show configuration protocol mld** command to verify the MLD protocol configuration.

user@host> **show configuration protocol mld**

```
interface fe-0/1/2.0 {
  static {
    group ff0e::1:ff05:1a8d {
      group-count 3;
    }
  }
}
```

3. After you have committed the configuration and the source is sending traffic, use the **show mld group** command to verify that static groups ff0e::1:ff05:1a8d, ff0e::1:ff05:1a8e, and ff0e::1:ff05:1a8f have been created.

   user@host> **show mld group**

```
Interface: fe-0/1/2
     Group: ff0e::1:ff05:1a8d
         Source: fe80::2e0:81ff:fe05:1a8d
         Last reported by: Local
         Timeout: 0 Type: Static
Interface: fe-0/1/2
     Group: ff0e::1:ff05:1a8e
         Source: fe80::2e0:81ff:fe05:1a8d
         Last reported by: Local
         Timeout: 0 Type: Static
Interface: fe-0/1/2
     Group: ff0e::1:ff05:1a8f
         Source: fe80::2e0:81ff:fe05:1a8d
         Last reported by: Local
         Timeout: 0 Type: Static
```

Automatically increment group addresses

When you configure static groups on an interface on which you want to receive multicast traffic and you specify the number of static groups to be automatically created, you can also configure the group address to be automatically incremented by some number of addresses.

In this example, you create three groups and increase the group address by an increment of two for each group.

1. Configure the group address increment by including the **group-increment** statement and specifying the number by which the address should be incremented for each group. The increment is specified in a format similar to an IPv6 address.

   [edit protocols mld]
   user@host# **set interface fe-0/1/2 static group ff0e::1:ff05:1a8d group-count 3 group-increment ::2**

2. After you commit the configuration, use the **show configuration protocol mld** command to verify the MLD protocol configuration.

   user@host> **show configuration protocol mld**

```
interface fe-0/1/2.0 {
  static {
```



```
            group ff0e::1:ff05:1a8d {
              group-increment ::2;
              group-count 3;
            }
          }
        }
```

3. After you have committed the configuration and the source is sending traffic, use the **show mld group** command to verify that static groups ff0e::1:ff05:1a8d, ff0e::1:ff05:1a8f, and ff0e::1:ff05:1a91 have been created.

   user@host> **show mld group**

```
Interface: fe-0/1/2
     Group: ff0e::1:ff05:1a8d
         Source: fe80::2e0:81ff:fe05:1a8d
         Last reported by: Local
         Timeout: 0 Type: Static
Interface: fe-0/1/2
     Group: ff0e::1:ff05:1a8f
         Source: fe80::2e0:81ff:fe05:1a8d
         Last reported by: Local
         Timeout: 0 Type: Static
Interface: fe-0/1/2
     Group: ff0e::1:ff05:1a91
         Source: fe80::2e0:81ff:fe05:1a8d
         Last reported by: Local
         Timeout: 0 Type: Static
```

Specify multicast source address (in SSM mode)

When you configure static groups on an interface on which you want to receive multicast traffic and your network is operating in source-specific multicast (SSM) mode, you can specify the multicast source address to be accepted.

If you specify a group address in the SSM range, you must also specify a source.

If a source address is specified in a multicast group that is statically configured, the MLD version must be set to MLDv2 on the interface. MLDv1 is the default value.

In this example, you create group ff0e::1:ff05:1a8d and accept IPv6 address fe80::2e0:81ff:fe05:1a8d as the only source.

1. Configure the source address by including the **source** statement and specifying the IPv6 address of the source host.

   [edit protocols mld]
   user@host# **set interface fe-0/1/2 static group ff0e::1:ff05:1a8d source fe80::2e0:81ff:fe05:1a8d**

2. After you commit the configuration, use the **show configuration protocol mld** command to verify the MLD protocol configuration.

   user@host> **show configuration protocol mld**

```
interface fe-0/1/2.0 {
  static {
```

```
        group ff0e::1:ff05:1a8d {
          source fe80::2e0:81ff:fe05:1a8d;
        }
      }
    }
```

3. After you have committed the configuration and the source is sending traffic, use the **show mld group** command to verify that static group ff0e::1:ff05:1a8d has been created and that source fe80::2e0:81ff:fe05:1a8d has been accepted.

   ```
   user@host> show mld group

   Interface: fe-0/1/2
        Group: ff0e::1:ff05:1a8d
            Source: fe80::2e0:81ff:fe05:1a8d
            Last reported by: Local
            Timeout: 0 Type: Static
   ```

Automatically specify multicast sources

When you configure static groups on an interface on which you want to receive multicast traffic, you can specify a number of multicast sources to be automatically accepted.

In this example, you create static group ff0e::1:ff05:1a8d and accept fe80::2e0:81ff:fe05:1a8d, fe80::2e0:81ff:fe05:1a8e, and fe80::2e0:81ff:fe05:1a8f as the source addresses.

1. Configure the number of multicast source addresses to be accepted by including the **source-count** statement and specifying the number of sources to be accepted.

   ```
   [edit protocols mld]
   user@host# set interface fe-0/1/2 static group ff0e::1:ff05:1a8d source
     fe80::2e0:81ff:fe05:1a8d source-count 3
   ```

2. After you commit the configuration, use the **show configuration protocol mld** command to verify the MLD protocol configuration.

   ```
   user@host> show configuration protocol mld

   interface fe-0/1/2.0 {
     static {
       group ff0e::1:ff05:1a8d {
         source fe80::2e0:81ff:fe05:1a8d {
           source-count 3;
         }
       }
     }
   }
   ```

3. After you have committed the configuration and the source is sending traffic, use the **show mld group** command to verify that static group ff0e::1:ff05:1a8d has been created and that sources fe80::2e0:81ff:fe05:1a8d, fe80::2e0:81ff:fe05:1a8e, and fe80::2e0:81ff:fe05:1a8f have been accepted.

   ```
   user@host> show mld group

   Interface: fe-0/1/2
        Group: ff0e::1:ff05:1a8d
   ```

```
            Source: fe80::2e0:81ff:fe05:1a8d
            Last reported by: Local
            Timeout: 0 Type: Static
Interface: fe-0/1/2
      Group: ff0e::1:ff05:1a8d
            Source: fe80::2e0:81ff:fe05:1a8e
            Last reported by: Local
            Timeout: 0 Type: Static
Interface: fe-0/1/2
      Group: ff0e::1:ff05:1a8d
            Source: fe80::2e0:81ff:fe05:1a8f
            Last reported by: Local
            Timeout: 0 Type: Static
```

Automatically increment source addresses

When you configure static groups on an interface on which you want to receive multicast traffic, and specify a number of multicast sources to be automatically accepted, you can also specify the number by which the address should be incremented for each source accepted.

In this example, you create static group ff0e::1:ff05:1a8d and accept fe80::2e0:81ff:fe05:1a8d, fe80::2e0:81ff:fe05:1a8f, and fe80::2e0:81ff:fe05:1a91 as the sources.

1. Configure the number of multicast source addresses to be accepted by including the **source-increment** statement and specifying the number of sources to be accepted.

   ```
   [edit protocols mld]
   user@host# set interface fe-0/1/2 static group ff0e::1:ff05:1a8d source
     fe80::2e0:81ff:fe05:1a8d source-count 3 source-increment ::2
   ```

2. After you commit the configuration, use the **show configuration protocol mld** command to verify the MLD protocol configuration.

   ```
   user@host> show configuration protocol mld

   interface fe-0/1/2.0 {
     static {
       group ff0e::1:ff05:1a8d {
         source fe80::2e0:81ff:fe05:1a8d {
           source-count 3;
           source-increment ::2;
         }
       }
     }
   }
   ```

3. After you have committed the configuration and the source is sending traffic, use the **show mld group** command to verify that static group ff0e::1:ff05:1a8d has been created and that sources fe80::2e0:81ff:fe05:1a8d, fe80::2e0:81ff:fe05:1a8f, and fe80::2e0:81ff:fe05:1a91 have been accepted.

   ```
   user@host> show mld group

   Interface: fe-0/1/2
   ```



```
     Group: ff0e::1:ff05:1a8d
         Source: fe80::2e0:81ff:fe05:1a8d
         Last reported by: Local
         Timeout: 0 Type: Static
Interface: fe-0/1/2
     Group: ff0e::1:ff05:1a8d
         Source: fe80::2e0:81ff:fe05:1a8f
         Last reported by: Local
         Timeout: 0 Type: Static
Interface: fe-0/1/2
     Group: ff0e2::1:ff05:1a8d
         Source: fe80::2e0:81ff:fe05:1a91
         Last reported by: Local
         Timeout: 0 Type: Static
```

```
Interface: fe-0/1/2
Group: ff0e::1:ff05:1a8d
Group mode: Include
Source: fe80::2e0:81ff:fe05:1a8d
Last reported by: Local
Timeout: 0 Type: Static
Group: ff0e::1:ff05:1a8d
Group mode: Include
Source: fe80::2e0:81ff:fe05:1a8f
Last reported by: Local
Timeout: 0 Type: Static
Group: ff0e::1:ff05:1a8d
Group mode: Include
Source: fe80::2e0:81ff:fe05:1a91
Last reported by: Local
Timeout: 0 Type: Static
```

Exclude multicast source addresses (in SSM mode)

When you configure static groups on an interface on which you want to receive multicast traffic and your network is operating in source-specific multicast (SSM) mode, you can specify that certain multicast source addresses be excluded.

By default the multicast source address configured in a static group operates in include mode. In include mode the multicast traffic for the group is accepted from the configured source address. You can also configure the static group to operate in exclude mode. In exclude mode the multicast traffic for the group is accepted from any address other than the configured source address.

If a source address is specified in a multicast group that is statically configured, the MLD version must be set to MLDv2 on the interface. MLDv1 is the default value.

In this example, you exclude address fe80::2e0:81ff:fe05:1a8d as a source for group ff0e::1:ff05:1a8d.

1. Configure a multicast static group to operate in exclude mode by including the **exclude** statement and specifying which IPv6 source address to be excluded.

   [edit protocols mld]
   user@host# **set interface fe-0/1/2 static group ff0e::1:ff05:1a8d exclude source fe80::2e0:81ff:fe05:1a8d**

2. After you commit the configuration, use the **show configuration protocol mld** command to verify the MLD protocol configuration.

   user@host> **show configuration protocol mld**

   ```
   interface fe-0/1/2.0 {
     static {
       group ff0e::1:ff05:1a8d {
         exclude;
         source fe80::2e0:81ff:fe05:1a8d;
       }
     }
   }
   ```

3. After you have committed the configuration and the source is sending traffic, use the **show mld group detail** command to verify that static group ff0e::1:ff05:1a8d has been created and that the static group is operating in exclude mode.

   ```
   user@host> show mld group detail
   Interface: fe-0/1/2
        Group: ff0e::1:ff05:1a8d
            Group mode: Exclude
            Source: fe80::2e0:81ff:fe05:1a8d
            Last reported by: Local
            Timeout: 0 Type: Static
   ```

Similar configuration is available for IPv4 multicast traffic using the IGMP protocol.

Example: Recording MLD Join and Leave Events

This example shows how to determine whether MLD tuning is needed in a network by configuring the routing device to record MLD join and leave events.

Requirements

Before you begin:

- Configure the router interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure an interior gateway protocol or static routing. See the *Junos OS Routing Protocols Library for Routing Devices*.
- Enable IPv6 unicast routing. See the *Junos OS Routing Protocols Library for Routing Devices*.
- Enable PIM. See "PIM Overview" on page 3937.

Overview

Table 304 on page 4078 describes the recordable MLD join and leave events.

Table 304: MLD Event Messages

ERRMSG Tag	Definition
RPD_MLD_JOIN	Records MLD join events.
RPD_MLD_LEAVE	Records MLD leave events.
RPD_MLD_ACCOUNTING_ON	Records when MLD accounting is enabled on an MLD interface.
RPD_MLD_ACCOUNTING_OFF	Records when MLD accounting is disabled on an MLD interface.
RPD_MLD_MEMBERSHIP_TIMEOUT	Records MLD membership timeout events.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols mld interface fe-0/1/0.2 accounting
set system syslog file mld-events any info
set system syslog file mld-events match ".*RPD_MLD_JOIN.* | .*RPD_MLD_LEAVE.* |
  .*RPD_MLD_ACCOUNTING.* | .*RPD_MLD_MEMBERSHIP_TIMEOUT.*"
set system syslog file mld-events archive size 100000
set system syslog file mld-events archive files 3
set system syslog file mld-events archive transfer-interval 1440
set system syslog file mld-events archive archive-sites "ftp://user@host1//var/tmp"
  password "anonymous"
set system syslog file mld-events archive archive-sites "ftp://user@host2//var/tmp"
  password "test"
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure recording of MLD join and leave events:

1. Enable accounting globally or on an MLD interface. This example shows the interface configuration.

```
[edit protocols mld]
user@host# set interface fe–0/1/0.2 accounting
```

2. Configure the events to be recorded, and filter the events to a system log file with a descriptive filename, such as **mld-events**.

```
[edit system syslog file mld-events]
user@host# set any info
[edit system syslog file mld-events]
user@host# set match “.*RPD_MLD_JOIN.* | .*RPD_MLD_LEAVE.* |
  .*RPD_MLD_ACCOUNTING.* | .*RPD_MLD_MEMBERSHIP_TIMEOUT.*”
```

3. Periodically archive the log file.

This example rotates the file every 24 hours (1440 minutes) when it reaches 100 KB and keeps three files.

[edit system syslog file mld-events]
user@host# **set archive size 100000**
[edit system syslog file mld-events]
user@host# **set archive files 3**
[edit system syslog file mld-events]
user@host# **set archive archive-sites "ftp://user@host1//var/tmp" password "anonymous"**
[edit system syslog file mld-events]
user@host# **set archive archive-sites "ftp://user@host2//var/tmp" password "test"**
[edit system syslog file mld-events]
user@host# **set archive transfer-interval 1440**
[edit system syslog file mld-events]
user@host# **set archive start-time 2011–01–07:12:30**

4. If you are done configuring the device, commit the configuration.

   [edit system syslog file mld-events]]
   user@host# **commit**

Verification

You can view the system log file by running the file show command.

user@host> **file show mld-events**

You can monitor the system log file as entries are added to the file by running the ***monitor start*** and **monitor stop** commands.

user@host> **monitor start mld-events**

```
*** mld-events ***
Apr 16 13:08:23  host mgd[16416]: UI_CMDLINE_READ_LINE: User 'user', command 'run
 monitor start mld-events '
monitor
```

Configuring the Number of MLD Multicast Group Joins on Logical Interfaces

The **group-limit** statement enables you to limit the number of MLD multicast group joins for logical interfaces. When this statement is enabled on a router running MLD version 2, the limit is applied upon receipt of the group report. Once the group limit is reached, subsequent join requests are rejected.

When configuring limits for MLD multicast groups, keep the following in mind:

- Each any-source group (*,G) counts as one group toward the limit.
- Each source-specific group (S,G) counts as one group toward the limit.
- Groups in MLDv2 exclude mode are counted toward the limit.
- Multiple source-specific groups count individually toward the group limit, even if they are for the same group. For example, (S1, G1) and (S2, G1) would count as two groups toward the configured limit.

- Combinations of any-source groups and source-specific groups count individually toward the group limit, even if they are for the same group. For example, (*, G1) and (S, G1) would count as two groups toward the configured limit.
- Configuring and committing a group limit on a network that is lower than what already exists on the network results in the removal of all groups from the configuration. The groups must then request to rejoin the network (up to the newly configured group limit).
- You can dynamically limit multicast groups on MLD logical interfaces by using dynamic profiles. For detailed information about creating dynamic profiles, see the *Junos OS Subscriber Management and Services Library*.

Beginning with Junos OS 12.2, you can optionally configure a system log warning threshold for MLD muticast group joins received on the logical interface. It is helpful to review the system log messages for troubleshooting purposes and to detect if an excessive amount of MLD multicast group joins have been received on the interface. These log messages convey when the configured group limit has been exceeded, when the configured threshold has been exceeded, and when the number of groups drop below the configured threshold.

The **group-threshold** statement enables you to configure the threshold at which a warning message is logged. The range is 1 through 100 percent. The warning threshold is a percentage of the group limit, so you must configure the **group-limit** statement to configure a warning threshold. For instance, when the number of groups exceed the configured warning threshold, but remain below the configured group limit, multicast groups continue to be accepted, and the device logs a warning message. In addition, the device logs a warning message after the number of groups drop below the configured warning threshold. You can further specify the amount of time (in seconds) between the log messages by configuring the **log-interval** statement. The range is 6 through 32,767 seconds.

You might consider throttling log messages because every entry added after the configured threshold and every entry rejected after the configured limit causes a warning message to be logged. By configuring a log interval, you can throttle the amount of system log warning messages generated for MLD multicast group joins.

To limit multicast group joins on an MLD logical interface:

1. Access the logical interface at the MLD protocol hierarchy level.

   [edit]
   user@host# **edit protocols mld interface *interface-name***

2. Specify the group limit for the interface.

   [edit protocols mld interface *interface-name*]
   user@host# **set group-limit *limit***

3. (Optional) Configure the threshold at which a warning message is logged.

   [edit protocols mld interface *interface-name*]
   user@host# **set group-threshold *value***

4. (Optional) Configure the amount of time between log messages.

   [edit protocols mld interface *interface-name*]
   user@host# **set log-interval *seconds***

To confirm your configuration, use the **show protocols mld** command. To verify the operation of MLD on the interface, including the configured group limit and the optional warning threshold and interval between log messages, use the **show mld interface** command.

Tracing MLD Protocol Traffic

Tracing operations record detailed messages about the operation of routing protocols, such as the various types of routing protocol packets sent and received, and routing policy actions. You can specify which trace operations are logged by including specific tracing flags. The following table describes the flags that you can include.

Flag	Description
all	Trace all operations.
client-notification	Trace notifications.
general	Trace general flow.
group	Trace group operations.
host-notification	Trace host notifications.
leave	Trace leave group messages.
mtrace	Trace mtrace packets. Use the **mtrace** command to troubleshoot the software.
normal	Trace normal events.
packets	Trace all MLD packets.
policy	Trace policy processing.
query	Trace MLD membership query messages, including general and group-specific queries.
report	Trace membership report messages.
route	Trace routing information.
state	Trace state transitions.
task	Trace task processing.
timer	Trace timer processing.

In the following example, tracing is enabled for all routing protocol packets. Then tracing is narrowed to focus only on MLD packets of a particular type. To configure tracing operations for MLD:

1. (Optional) Configure tracing at the routing options level to trace all protocol packets.

   [edit routing-options traceoptions]
   user@host# **set file all-packets-trace**
   user@host# **set flag all**

2. Configure the filename for the MLD trace file.

   [edit protocols mld traceoptions]
   user@host# **set file mld-trace**

3. (Optional) Configure the maximum number of trace files.

   [edit protocols mld traceoptions]
   user@host# **set file files 5**

4. (Optional) Configure the maximum size of each trace file.

   [edit protocols mld traceoptions]
   user@host# **set file size 1m**

5. (Optional) Enable unrestricted file access.

   [edit protocols mld traceoptions]
   user@host# **set file world-readable**

6. Configure tracing flags. Suppose you are troubleshooting issues with a particular interface. The following example shows how to flag all events for packets associated with the interface name.

   [edit protocols mld traceoptions]
   user@host# **set flag all | match fe-1/0/1.0**

7. View the trace file.

   user@host> **file list /var/log**
   user@host> **file show /var/log/mld-trace**

Disabling MLD

To disable MLD on an interface, include the **disable** statement:

```
interface interface-name {
  disable;
}
```

You can include this statement at the following hierarchy levels:

- **[edit protocols mld]**
- **[edit logical-systems *logical-system-name* protocols mld]**

Related Documentation

- *Configuring IGMP*

MSDP

Configuring MSDP

To configure the Multicast Source Discovery Protocol (MSDP), include the **msdp** statement:

```
msdp {
  disable;
  active-source-limit {
    maximum number;
    threshold number;
  }
  data-encapsulation (disable | enable);
  export [ policy-names ];
  group group-name {
    ... group-configuration ...
  }
  hold-time seconds;
  import [ policy-names ];
  local-address address;
  keep-alive seconds;
  peer address {
    ... peer-configuration ...
  }
  rib-group group-name;
  source ip-prefix</prefix-length> {
    active-source-limit {
      maximum number;
      threshold number;
    }
  }
  sa-hold-time seconds;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier > <disable>;
  }
  group group-name {
    disable;
    export [ policy-names ];
    import [ policy-names ];
    local-address address;
    mode (mesh-group | standard);
```

```
        peer address {
            ... same statements as at the [edit protocols msdp peer address] hierarchy level shown
              just following ...
        }
        traceoptions {
            file filename <files number> <size size> <world-readable | no-world-readable>;
            flag flag <flag-modifier> <disable>;
        }
    }
    peer address {
        disable;
        active-source-limit {
            maximum number;
            threshold number;
        }
        authentication-key peer-key;
        default-peer;
        export [ policy-names ];
        import [ policy-names ];
        local-address address;
        traceoptions {
            file filename <files number> <size size> <world-readable | no-world-readable>;
            flag flag <flag-modifier> <disable>;
        }
    }
}
```

You can include this statement at the following hierarchy levels:

- **[edit protocols]**
- **[edit routing-instances *routing-instance-name* protocols]**
- **[edit logical-systems *logical-system-name* protocols]**
- **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols]**

By default, MSDP is disabled.

Related Documentation

- *Example: Configuring MSDP in a Routing Instance*
- Example: Configuring MSDP with Active Source Limits and Mesh Groups on page 4088

Tracing MSDP Protocol Traffic

Tracing operations record detailed messages about the operation of routing protocols, such as the various types of routing protocol packets sent and received, and routing policy actions. You can specify which trace operations are logged by including specific tracing flags. The following table describes the flags that you can include.

Flag	Description
all	Trace all operations.

Flag	Description
general	Trace general events.
keepalive	Trace keepalive messages.
normal	Trace normal events.
packets	Trace all MSDP packets.
policy	Trace policy processing.
route	Trace MSDP changes to the routing table.
source-active	Trace source-active packets.
source-active-request	Trace source-active request packets.
source-active-response	Trace source-active response packets.
state	Trace state transitions.
task	Trace task processing.
timer	Trace timer processing.

You can configure MSDP tracing for all peers, for all peers in a particular group, or for a particular peer.

In the following example, tracing is enabled for all routing protocol packets. Then tracing is narrowed to focus only on MSDP peers in a particular group. To configure tracing operations for MSDP:

1. (Optional) Configure tracing by including the **traceoptions** statement at the **[edit routing-options]** hierarchy level and set the **all-packets-trace** and **all** flags to trace all protocol packets.

   [edit routing-options traceoptions]
   user@host# **set file all-packets-trace**
   user@host# **set flag all**

2. Configure the filename for the MSDP trace file.

   [edit protocols msdp group groupa traceoptions]
   user@host# **set file msdp-trace**

3. (Optional) Configure the maximum number of trace files.

   [edit protocols msdp group groupa traceoptions]
   user@host# **set file files 5**

4. (Optional) Configure the maximum size of each trace file.

   [edit protocols msdp group groupa traceoptions] user@host# **set file size 1m**

5. (Optional) Enable unrestricted file access.

   [edit protocols msdp group groupa traceoptions]
   user@host# **set file world-readable**

6. Configure tracing flags. Suppose you are troubleshooting issues with the source-active cache for **groupa**. The following example shows how to trace messages associated with the group address.

   [edit protocols msdp group groupa traceoptions]
   user@host# **set flag source-active | match 230.0.0.3**

7. View the trace file.

   user@host> **file list /var/log**
   user@host> **file show /var/log/msdp-trace**

Related Documentation

- Understanding MSDP on page 3968
- *Junos OS Tracing and Logging Operations* in the *Junos OS Administration Library for Routing Devices*

Configuring the Interface to Accept Traffic from a Remote Source

You can configure an incoming interface to accept traffic from a remote source. A remote source is a source that is not on the same subnet as the incoming interface. This enables the remote source to be learned and advertised by MSDP so that receivers in other MSDP areas can join the source. You do not need to disable RPF checking, but you do need to ensure that the best path to reach the remote source is through the incoming interface.

In this sample configuration, the incoming interface (**ge-1/3/0**) is on a provider edge (PE) router on the receiver side of a multicast VPN.

To accept traffic from a remote source:

1. Edit the incoming interface.

   [edit protocols pim interface ge-1/3/0.0]
   user@host# **set accept-remote-source**

2. If the incoming interface is not the only way to reach the remote source, ensure that the best path to reach the remote source is through the incoming interface. One way to do this is to use AS path prepending on the other possible routes.

   [edit policy-options policy-statement as-path-prepend term prepend]
   user@host# **set from route-filter 192.168.0.0/16 orlonger**
   user@host# **set from route-filter 172.16.0.0/16 orlonger**
   user@host# **set then as-path-prepend "1 1 1 1"**

   Another way to do this might be to configure a static route on the receiver side PE router to the source.

4. After the configuration is committed, use the **show pim statistics** and **show msdp source** commands to verify that the interface is accepting traffic from the remote source.

Related Documentation

- *Example: Allowing MBGP MVPN Remote Sources*
- *Understanding Prepending AS Numbers to BGP AS Paths* in the *Routing Policy Feature Guide for Routing Devices*
- show msdp source on page 4316 in the CLI Explorer
- show pim statistics on page 4389 in the CLI Explorer

Example: Configuring MSDP

Configure a router to act as a PIM sparse-mode rendezvous point and an MSDP peer:

```
[edit]
routing-options {
   interface-routes {
      rib-group ifrg;
   }
   rib-groups {
      ifrg {
         import-rib [inet.0 inet.2];
      }
      mcrg {
         export-rib inet.2;
         import-rib inet.2;
      }
   }
}
protocols {
   bgp {
      group lab {
         type internal;
         family any;
         neighbor 192.168.6.18 {
            local-address 192.168.6.17;
         }
      }
   }
   pim {
      dense-groups {
         224.0.1.39/32;
         224.0.1.40/32;
      }
      rib-group mcrg;
      rp {
         local {
            address 192.168.1.1;
         }
      }
      interface all {
         mode sparse-dense;
         version 1;
      }
   }
   msdp {
```



```
            rib-group mcrg;
            group lab {
                peer 192.168.6.18 {
                    local-address 192.168.6.17;
                }
            }
        }
    }
```

Example: Configuring MSDP with Active Source Limits and Mesh Groups

This example shows how to configure MSDP to filter source-active messages and limit the flooding of source-active messages.

Requirements

Before you begin:

- Configure the router interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.
- Configure an interior gateway protocol or static routing. See the *Junos OS Routing Protocols Library for Routing Devices*.
- Enable PIM sparse mode. See "PIM Overview" on page 3937.
- Configure the router as a PIM sparse-mode RP. See "Configuring Local PIM RPs" on page 3995.

Overview

A router interested in MSDP messages, such as an RP, might have to process a large number of MSDP messages, especially source-active messages, arriving from other routers. Because of the potential need for a router to examine, process, and create state tables for many MSDP packets, there is a possibility of an MSDP-based denial-of-service (DoS) attack on a router running MSDP. To minimize this possibility, you can configure the router to limit the number of source active messages the router accepts. Also, you can configure a threshold for applying random early discard (RED) to drop some but not all MSDP active source messages. Beginning with Junos OS 12.2, you can optionally configure a warning threshold so the device can log warning messages in the system log when a certain number of source-active messages have been received. It is helpful to review the system log messages for troubleshooting purposes and to detect if an excessive amount of source-active messages have been received. These log messages convey when the configured message limit has been exceeded, when the configured warning threshold has been exceeded, and when the number of messages drop below the configured warning threshold.

By default, the router accepts 25,000 source active messages before ignoring the rest. The limit can be from 1 through 1,000,000. The limit is applied to both the number of messages and the number of MSDP peers.

By default, the router accepts 24,000 source-active messages before applying the RED profile to prevent a possible DoS attack. This number can also range from 1 through 1,000,000. The next 1000 messages are screened by the RED profile and the accepted messages processed. If you configure no drop profiles (as this example does not), RED is still in effect and functions as the primary mechanism for managing congestion. In the default RED drop profile, when the packet queue fill-level is 0 percent, the drop probability is 0 percent. When the fill-level is 100 percent, the drop probability is 100 percent.

NOTE: **The router ignores source-active messages with encapsulated TCP packets. Multicast does not use TCP; segments inside source-active messages are most likely the result of worm activity.**

The number configured for the threshold must be less than the number configured for the maximum number of active MSDP sources.

The warning threshold is a percentage of maximum number of MSDP source-active messages received, so you must configure the source-active message limit to configure a warning threshold. The range for the warning threshold is 1 through 100 percent. You can further specify the amount of time (in seconds) between the log messages. The range is 6 through 32,767 seconds.

You can configure an active source limit globally, for a group, or for a peer. If active source limits are configured at multiple levels of the hierarchy (as shown in this example), all are applied.

You can configure an active source limit for an address range as well as for a specific peer. A per-source active source limit uses an IP prefix and prefix length instead of a specific address. You can configure more than one per-source active source limit. The longest match determines the limit.

Per-source active source limits can be combined with active source limits at the peer, group, and global (instance) hierarchy level. Per-source limits are applied before any other type of active source limit. Limits are tested in the following order:

- Per-source
- Per-peer or group
- Per-instance

An active source message must “pass” all limits established before being accepted. For example, if a source is configured with an active source limit of 10,000 active multicast groups and the instance is configured with a limit of 5000 (and there are no other sources or limits configured), only 5000 active source messages are accepted from this source.

MSDP mesh groups are groups of peers configured in a full-mesh topology that limits the flooding of source-active messages to neighboring peers. Every mesh group member must have a peer connection with every other mesh group member. When a source-active message is received from a mesh group member, the source-active message is always accepted but is not flooded to other members of the same mesh group. However, the source-active message is flooded to non-mesh group peers or members of other mesh groups. By default, standard flooding rules apply if **mesh-group** is not specified.

CAUTION: When configuring MSDP mesh groups, you must configure all members the same way. If you do not configure a full mesh, excessive flooding of source-active messages can occur.

A common application for MSDP mesh groups is peer-reverse-path-forwarding (peer-RPF) check bypass. For example, if there are two MSDP peers inside an autonomous system (AS), and only one of them has an external MSDP session to another AS, the internal MSDP peer often rejects incoming source-active messages relayed by the peer with the external link. Rejection occurs because the external MSDP peer must be reachable by the internal MSDP peer through the next hop toward the source in another AS, and this next-hop condition is not certain. To prevent rejections, configure an MSDP mesh group on the internal MSDP peer so it always accepts source-active messages.

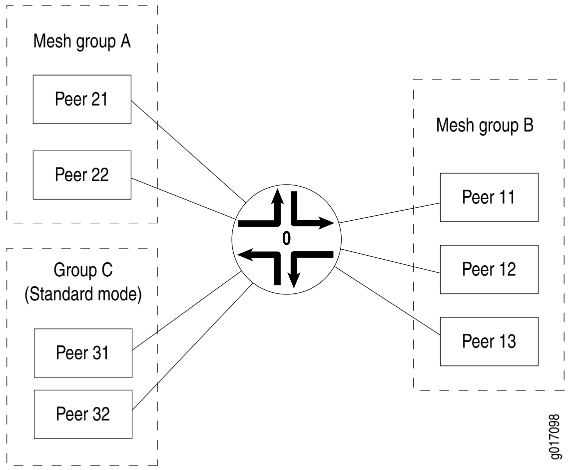
NOTE: An alternative way to bypass the peer-RPF check is to configure a default peer. In networks with only one MSDP peer, especially stub networks, the source-active message always needs to be accepted. An MSDP default peer is an MSDP peer from which all source-active messages are accepted without performing the peer-RPF check. You can establish a default peer at the peer or group level by including the default-peer statement.

Table 305 on page 4090 explains how flooding is handled by peers in this example. Figure 145 on page 4091 illustrates source-active message flooding between different mesh groups and peers within the same mesh group.

Table 305: Source-Active Message Flooding Explanation

Source-Active Message Received From	Source-Active Message Flooded To	Source-Active Message Not Flooded To
Peer 21	Peer 11, Peer 12, Peer 13, Peer 31, Peer 32	Peer 22
Peer 11	Peer 21, Peer 22, Peer 31, Peer 32	Peer 12, Peer 13
Peer 31	Peer 21, Peer 22, Peer 11, Peer 12, Peer 13, Peer 32	–

Figure 145: Source-Active Message Flooding



This example includes the following settings:

- **active-source-limit maximum 10000**—Applies a limit of 10,000 active sources to all other peers.
- **active-source-limit log-warning 80**—(Optional) Applies a warning threshold of 80 percent. In this example, the active source maximum is 10,000, so the device will start logging warning messages once it receives 8,000 active source messages.
- **active-source-limit log-interval 20**—(Optional) Applies a 20 second waiting period between system log messages.
- **data-encapsulation disable**—On an RP router using MSDP, disables the default encapsulation of multicast data received in MSDP register messages inside MSDP source-active messages.

  MSDP data encapsulation mainly concerns bursty sources of multicast traffic. Sources that send only one packet every few minutes have trouble with the timeout of state relationships between sources and their multicast groups (S,G). Routers lose data while they attempt to reestablish (S,G) state tables. As a result, multicast register messages contain data, and this data encapsulation in MSDP source-active messages can be turned on or off through configuration.

  By default, MSDP data encapsulation is enabled. An RP running MSDP takes the data packets arriving in the source's register message and encapsulates the data inside an MSDP source-active message.

  However, data encapsulation creates both a multicast forwarding cache entry in the **inet.1** table (this is also the forwarding table) and a routing table entry in the **inet.4** table. Without data encapsulation, MSDP creates only a routing table entry in the **inet.4** table. In some circumstances, such as the presence of Internet worms or other forms of DoS attack, the router's forwarding table might fill up with these entries. To prevent the forwarding table from filling up with MSDP entries, you can configure the router not to use MSDP data encapsulation. However, if you disable data encapsulation, the router ignores and discards the encapsulated data. Without data encapsulation, multicast applications with bursty sources having transmit intervals greater than about 3 minutes might not work well.

- **group MSDP-group local-address 10.1.2.3**—Specifies the address of the local router (this router).
- **group MSDP-group mode mesh-group**—Specifies that all peers belonging to the **MSDP-group** group are mesh group members.
- **group MSDP-group peer 10.10.10.10**—Prevents the sending of source-active messages to neighboring peer 10.10.10.10.
- **group MSDP-group peer 10.10.10.10 active-source-limit maximum 7500**—Applies a limit of 7500 active sources to MSDP peer 10.10.10.10 in group **MSDP-group**.
- **peer 10.0.0.1 active-source-limit maximum 5000 threshold 4000**—Applies a threshhold of 4000 active sources and a limit of 5000 active sources to MSDP peer 10.0.0.1.
- **source 10.1.0.0/16 active-source-limit maximum 500**—Applies a limit of 500 active sources to any source on the 10.1.0.0/16 network.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols msdp data-encapsulation disable
set protocols msdp active-source-limit maximum 10000
set protocols msdp active-source-limit log-warning 80
set protocols msdp active-source-limit log-interval 20
set protocols msdp peer 10.0.0.1 active-source-limit maximum 5000
set protocols msdp peer 10.0.0.1 active-source-limit threshold 4000
set protocols msdp source 10.1.0.0/16 active-source-limit maximum 500
set protocols msdp group MSDP-group mode mesh-group
set protocols msdp group MSDP-group local-address 10.1.2.3
set protocols msdp group MSDP-group peer 10.10.10.10 active-source-limit maximum
  7500
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure MSDP source active routes and mesh groups:

1. (Optional) Disable data encapsulation.

```
[edit protocols msdp]
user@host# set data-encapsulation disable
```

2. Configure the active source limits.

```
[edit protocols msdp]
user@host# set peer 10.0.0.1 active-source-limit maximum 5000 threshold 4000
```



```
user@host# set group MSDP-group peer 10.10.10.10 active-source-limit maximum
  7500
user@host# set active-source-limit maximum 10000
user@host# set source 10.1.0.0/16 active-source-limit maximum 500
```

3. (Optional) Configure the threshold at which warning messages are logged and the amount of time between log messages.

```
[edit protocols msdp]
user@host# set active-source-limit log-warning 80
user@host# set active-source-limit log-interval 20
```

4. Configure the mesh group.

```
[edit protocols msdp]
user@host# set group MSDP-group mode mesh-group
user@host# set group MSDP-group peer 10.10.10.10
user@host# set group MSDP-group local-address 10.1.2.3
```

5. If you are done configuring the device, commit the configuration.

```
[edit routing-instances]
user@host# commit
```

Results

Confirm your configuration by entering the **show protocols** command.

```
user@host# show protocols
msdp {
  data-encapsulation disable;
  active-source-limit {
    maximum 10000;
    log-warning 80;
    log-interval 20;
  }
  peer 10.0.0.1 {
    active-source-limit {
      maximum 5000;
      threshold 4000;
    }
  }
  source 10.1.0.0/16 {
    active-source-limit {
      maximum 500;
    }
  }
  group MSDP-group {
    mode mesh-group;
    local-address 10.1.2.3;
    peer 10.10.10.10 {
      active-source-limit {
        maximum 7500;
      }
    }
  }
}
```


Verification

To verify the configuration, run the following commands:

- show msdp source-active
- show msdp statistics

Related Documentation

- *Example: Configuring MSDP in a Routing Instance*
- Filtering MSDP SA Messages on page 3969
- *Configuring RED Drop Profiles* in the *Junos OS Class of Service Library for Routing Devices*
- Configuring Local PIM RPs on page 3995

Example: Configuring PIM Anycast With or Without MSDP

When you configure anycast RP, you bypass the restriction of having one active rendezvous point (RP) per multicast group, and instead deploy multiple RPs for the same group range. The RP routers share one unicast IP address. Sources from one RP are known to other RPs that use the Multicast Source Discovery Protocol (MSDP). Sources and receivers use the closest RP, as determined by the interior gateway protocol (IGP).

You can use anycast RP within a domain to provide redundancy and RP load sharing. When an RP stops operating, sources and receivers are taken to a new RP by means of unicast routing.

You can configure anycast RP to use PIM and MSDP for IPv4, or PIM alone for both IPv4 and IPv6 scenarios. Both are discussed in this section.

We recommend a static RP mapping with anycast RP over a bootstrap router and auto-RP configuration because it provides all the benefits of a bootstrap router and auto-RP without the complexity of the BSR and auto-RP mechanisms.

All systems on a subnet must run the same version of PIM.

The default PIM version can be version 1 or version 2, depending on the mode you are configuring. PIMv1 is the default RP mode (at the **[edit protocols pim rp static address *address*]** hierarchy level). However, PIMv2 is the default for interface mode (at the **[edit protocols pim interface *interface-name*]** hierarchy level). Explicitly configured versions override the defaults. This example explicitly configures PIMv2 on the interfaces.

The following example shows an anycast RP configuration for the RP routers, first with MSDP and then using PIM alone, and for non-RP routers.

1. For a network using an RP with MSDP, configure the RP using the **lo0** loopback interface, which is always up. Include the **address** statement and specify the unique and routable router ID and the RP address at the **[edit interfaces lo0 unit 0 family inet]** hierarchy level. In this example, the router ID is **198.58.3.254** and the shared RP address is **198.58.3.253**. Include the **primary** statement for the first address. Including the

primary statement selects the router's primary address from all the preferred addresses on all interfaces.

```
interfaces {
    lo0 {
        description "PIM RP";
        unit 0 {
            family inet {
                address 198.58.3.254/32;
                primary;
                address 198.58.3.253/32;
            }
        }
    }
}
```

2. Specify the RP address. Include the **address** statement at the **[edit protocols pim rp local]** hierarchy level (the same address as the secondary **lo0** interface).

   For all interfaces, include the **mode** statement to set the mode to **sparse** and the **version** statement to specify PIM version 2 at the **[edit protocols pim rp local interface all]** hierarchy level. When configuring all interfaces, exclude the **fxp0.0** management interface by including the **disable** statement for that interface.

```
protocols {
    pim {
        rp {
            local {
                family inet;
                address 198.58.3.253;
            }
            interface all {
                mode sparse;
                version 2;
            }
            interface fxp0.0 {
                disable;
            }
        }
    }
}
```

3. Configure MSDP peering. Include the **peer** statement to configure the address of the MSDP peer at the **[edit protocols msdp]** hierarchy level. For MSDP peering, use the unique, primary addresses instead of the anycast address. To specify the local address for MSDP peering, include the **local-address** statement at the **[edit protocols msdp peer]** hierarchy level.

```
protocols {
    msdp {
        peer 198.58.3.250 {
            local-address address 198.58.3.254;
        }
    }
}
```

NOTE: If you need to configure a PIM RP for both IPv4 and IPv6 scenarios, perform Step 4 and Step 5. Otherwise, go to Step 6.

4. Configure an RP using the **lo0** loopback interface, which is always up. Include the **address** statement to specify the unique and routable router address and the RP address at the **[edit interfaces lo0 unit 0 family inet]** hierarchy level. In this example, the router ID is **198.58.3.254** and the shared RP address is **198.58.3.253**. Include the **primary** statement on the first address. Including the **primary** statement selects the router's primary address from all the preferred addresses on all interfaces.

```
interfaces {
  lo0 {
    description "PIM RP";
    unit 0 {
      family inet {
        address 198.58.3.254/32 {
          primary;
        }
        address 198.58.3.253/32;
      }
    }
  }
}
```

5. Include the **address** statement at the **[edit protocols pim rp local]** hierarchy level to specify the RP address (the same address as the secondary **lo0** interface).

   For all interfaces, include the **mode** statement to set the mode to **sparse**, and the **version** statement to specify PIM version 2 at the **[edit protocols pim rp local interface all]** hierarchy level. When configuring all interfaces, exclude the **fxp0.0** management interface by Including the **disable** statement for that interface.

   Include the **anycast-pim** statement to configure anycast RP without MSDP (for example, if IPv6 is used for multicasting). The other RP routers that share the same IP address are configured using the **rp-set** statement. There is one entry for each RP, and the maximum that can be configured is 15. For each RP, specify the routable IP address of the router and whether MSDP source active (SA) messages are forwarded to the RP.

   MSDP configuration is not necessary for this type of IPv4 anycast RP configuration.

```
protocols {
  pim {
    rp {
      local {
        family inet {
          address 198.58.3.253;
          anycast-pim {
            rp-set {
              address 198.58.3.240;
              address 198.58.3.241 forward-msdp-sa;
            }
            local-address 198.58.3.254; #If not configured, use lo0 primary
```

```
                }
            }
        }
    }
    interface all {
        mode sparse;
        version 2;
    }
    interface fxp0.0 {
        disable;
    }
  }
}
```

6. Configure the non-RP routers. The anycast RP configuration for a non-RP router is the same whether MSDP is used or not. Specify a static RP by adding the address at the **[edit protocols pim rp static]** hierarchy level. Include the **version** statement at the **[edit protocols pim rp static address]** hierarchy level to specify PIM version 2.

```
protocols {
    pim {
        rp {
            static {
                address 198.58.3.253 {
                    version 2;
                }
            }
        }
    }
}
```

7. Include the **mode** statement at the **[edit protocols pim interface all]** hierarchy level to specify sparse mode on all interfaces. Then include the **version** statement at the **[edit protocols pim rp interface all mode]** to configure all interfaces for PIM version 2. When configuring all interfaces, exclude the **fxp0.0** management interface by including the **disable** statement for that interface.

```
protocols {
    pim {
        interface all {
            mode sparse;
            version 2;
        }
        interface fxp0.0 {
            disable;
        }
    }
}
```

Configuring a PIM Anycast RP Router with MSDP

Add the **address** statement at the **[edit protocols pim rp local]** hierarchy level to specify the RP address (the same address as the secondary **lo0** interface).

For all interfaces, use the **mode** statement to set the mode to **sparse** and the **version** statement to specify PIM version 2 at the **[edit protocols pim rp local interface all]** hierarchy level. When configuring all interfaces, exclude the **fxp0.0** management interface by adding the **disable** statement for that interface.

```
protocols {
   pim {
      rp {
         local {
            family inet;
            address 198.58.3.253;
         }
         interface all {
            mode sparse;
            version 2;
         }
         interface fxp0.0 {
            disable;
         }
      }
   }
}
```

To configure MSDP peering, add the **peer** statement to configure the address of the MSDP peer at the **[edit protocols msdp]** hierarchy level. For MSDP peering, use the unique, primary addresses instead of the anycast address. To specify the local address for MSDP peering, add the **local-address** statement at the **[edit protocols msdp peer]** hierarchy level.

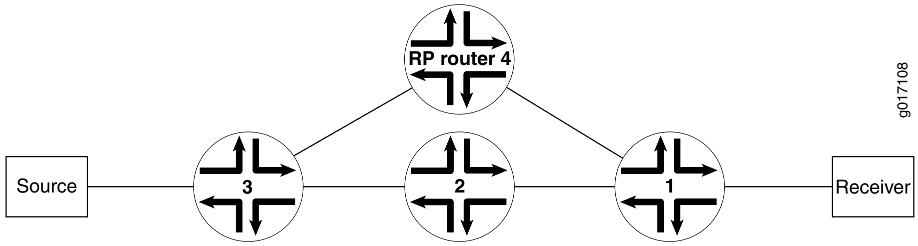
```
protocols {
   msdp {
      peer 198.58.3.250 {
         local-address 198.58.3.254;
      }
   }
}
```

Source-Specific Multicast

Example: Configuring PIM SSM on a Network

The following example shows how PIM SSM is configured between a receiver and a source in the network illustrated in Figure 146 on page 4099.

Figure 146: Network on Which to Configure PIM SSM



This example shows how to configure the IGMP version to IGMPv3 on all receiving host interfaces.

1. Enable IGMPv3 on all host-facing interfaces, and disable IGMP on the **fxp0.0** interface on Router 1.

   ```
   user@router1# set protocols igmp interface all version 3
   user@router1# set protocols igmp interface fxp0.0 disable
   ```

   NOTE: When you configure IGMPv3 on a router, hosts on interfaces configured with IGMPv2 cannot join the source tree.

2. After the configuration is committed, use the **show configuration protocol igmp** command to verify the IGMP protocol configuration.

   ```
   user@router1> show configuration protocol igmp

   [edit protocols igmp]
   interface all {
     version 3;
   }
   interface fxp0.0 {
     disable;
   }
   ```

3. Use the **show igmp interface** command to verify that IGMP interfaces are configured.

   ```
   user@router1> show igmp interface
   Interface      State    Querier       Timeout Version Groups
   fe-0/0/0.0     Up       198.58.3.245     213       3      0
   fe-0/0/1.0     Up       198.58.3.241     220       3      0
   fe-0/0/2.0     Up       198.58.3.237     218       3      0
   Configured Parameters:
   IGMP Query Interval (1/10 secs): 1250
   IGMP Query Response Interval (1/10 secs): 100
   IGMP Last Member Query Interval (1/10 secs): 10
   IGMP Robustness Count: 2
   Derived Parameters:
   IGMP Membership Timeout (1/10 secs): 2600
   IGMP Other Querier Present Timeout (1/10 secs): 2550
   ```

4. Use the **show pim join extensive** command to verify the PIM join state on Router 2 and Router 3 (the upstream routers).

   ```
   user@router2> show pim join extensive
   232.1.1.1      10.4.1.2                        sparse
        Upstream interface: fe-1/1/3.0
   ```

```
    Upstream State: Local Source
    Keepalive timeout: 209
    Downstream Neighbors:
       Interface: so-1/0/2.0
           10.10.71.1       State: Join   Flags: S    Timeout: 209
```

5. Use the **show pim join extensive** command to verify the PIM join state on Router 1 (the router connected to the receiver).

```
user@router1> show pim join extensive
232.1.1.1       10.4.1.2                        sparse
    Upstream interface: so-1/0/2.0
    Upstream State: Join to Source
    Keepalive timeout: 209
    Downstream Neighbors:
       Interface: fe-0/2/3.0
           10.3.1.1         State: Join   Flags: S    Timeout: Infinity
```

Example: Configuring an SSM-Only Domain

Deploying an SSM-only domain is much simpler than deploying an ASM domain because it only requires a few configuration steps. Enable PIM sparse mode on all interfaces by adding the **mode** statement at the **[edit protocols pim interface all]** hierarchy level. When configuring all interfaces, exclude the **fxp0.0** management interface by adding the **disable** statement for that interface. Then configure IGMPv3 on all host-facing interfaces by adding the **version** statement at the **[edit protocols igmp interface *interface-name*]** hierarchy level.

In the following example, the host-facing interface is **fe-0/1/2**:

```
[edit]
protocols {
  pim {
    interface all {
      mode sparse;
      version 2;
    }
    interface fxp0.0 {
      disable;
    }
  }
  igmp {
    interface fe-0/1/2 {
      version 3;
    }
  }
}
```

Example: Configuring SSM Mapping

SSM mapping does not require that all hosts support IGMPv3. SSM mapping translates IGMPv1 or IGMPv2 membership reports to an IGMPv3 report. This enables hosts running IGMPv1 or IGMPv2 to participate in SSM until the hosts transition to IGMPv3.

SSM mapping applies to all group addresses that match the policy, not just those that conform to SSM addressing conventions (232/8 for IPv4, ff30::/32 through ff3F::/32 for IPv6).

We recommend separate SSM maps for IPv4 and IPv6 if both address families require SSM support. If you apply an SSM map containing both IPv4 and IPv6 addresses to an interface in an IPv4 context (using IGMP), only the IPv4 addresses in the list are used. If there are no such addresses, no action is taken. Similarly, if you apply an SSM map containing both IPv4 and IPv6 addresses to an interface in an IPv6 context (using MLD), only the IPv6 addresses in the list are used. If there are no such addresses, no action is taken.

In this example, you create a policy to match the group addresses that you want to translate to IGMPv3. Then you define the SSM map that associates the policy with the source addresses where these group addresses are found. Finally, you apply the SSM map to one or more IGMP (for IPv4) or MLD (for IPv6) interfaces.

1. Create an SSM policy named **ssm-policy-example**. The policy terms match the IPv4 SSM group address 232.1.1.1/32 and the IPv6 SSM group address ff35::1/128. All other addresses are rejected.

   ```
   user@router1# set policy-options policy-statement ssm-policy-example term A from
     route-filter 232.1.1.1/32 exact
   user@router1# set policy-options policy-statement ssm-policy-example term A then
     accept
   user@router1# set policy-options policy-statement ssm-policy-example term B from
     route-filter ff35::1/128 exact
   user@router1# set policy-options policy-statement ssm-policy-example term B then
     accept
   ```

2. After the configuration is committed, use the **show configuration policy-options** command to verify the policy configuration.

   ```
   user@host> show configuration policy-options

   [edit policy-options]
   policy-statement ssm-policy-example {
     term A {
       from {
         route-filter 232.1.1.1/32 exact;
       }
       then accept;
     }
     term B {
       from {
         route-filter ff35::1/128 exact;
       }
       then accept;
     }
     then reject;
   }
   ```

   The group addresses must match the configured policy for SSM mapping to occur.

3. Define two SSM maps, one called **ssm-map-ipv6-example** and one called **ssm-map-ipv4-example**, by applying the policy and configuring the source addresses as a multicast routing option.

   ```
   user@host# set routing-options multicast ssm-map ssm-map-ipv6-example policy
     ssm-policy-example
   user@host# set routing-options multicast ssm-map ssm-map-ipv6-example source
     fec0::1 fec0::12
   user@host# set routing-options multicast ssm-map ssm-map-ipv4-example policy
     ssm-policy-example
   user@host# set routing-options multicast ssm-map ssm-map-ipv4-example source
     10.10.10.4
   user@host# set routing-options multicast ssm-map ssm-map-ipv4-example source
     192.168.43.66
   ```

4. After the configuration is committed, use the **show configuration routing-options** command to verify the policy configuration.

   ```
   user@host> show configuration routing-options

   [edit routing-options]
   multicast {
     ssm-map ssm-map-ipv6-example {
       policy ssm-policy-example;
       source [ fec0::1 fec0::12 ];
     }
     ssm-map ssm-map-ipv4-example {
       policy ssm-policy-example;
       source [ 10.10.10.4 192.168.43.66 ];
     }
   }
   ```

   We recommend separate SSM maps for IPv4 and IPv6.

5. Apply SSM maps for IPv4-to-IGMP interfaces and SSM maps for IPv6-to-MLD interfaces:

   ```
   user@host# set protocols igmp interface fe-0/1/0.0 ssm-map ssm-map-ipv4-example
   user@host# set protocols mld interface fe-0/1/1.0 ssm-map ssm-map-ipv6-example
   ```

6. After the configuration is committed, use the **show configuration protocol** command to verify the IGMP and MLD protocol configuration.

   ```
   user@router1> show configuration protocol

   [edit protocols]
   igmp {
     interface fe-0/1/0.0 {
       ssm-map ssm-map-ipv4-example;
     }
   }
   mld {
     interface fe-/0/1/1.0 {
       ssm-map ssm-map-ipv6-example;
     }
   }
   ```

7. Use the **show igmp interface** and the **show mld interface** commands to verify that the SSM maps are applied to the interfaces.


```
user@host> show igmp interface fe-0/1/0.0
Interface: fe-0/1/0.0
     Querier: 192.168.224.28
     State:         Up Timeout:    None Version:   2 Groups:   2
     SSM Map: ssm-map-ipv4-example
```

```
user@host> show mld interface fe-0/1/1.0
Interface: fe-0/1/1.0
     Querier: fec0:0:0:0:1::12
     State:         Up Timeout:    None Version:   2 Groups:   2
     SSM Map: ssm-map-ipv6-example
```

Example: Configuring Source-Specific Multicast Groups with Any-Source Override

This example shows how to extend source-specific multicast (SSM) group operations beyond the default IP address range of 232.0.0.0 through 232.255.255.255. This example also shows how to accept any-source multicast (ASM) join messages (*,G) for group addresses that are within the default or configured range of SSM groups. This allows you to support a mix of any-source and source-specific multicast groups simultaneously.

- Requirements on page 4103
- Overview on page 4103
- Configuration on page 4105
- Verification on page 4106

Requirements

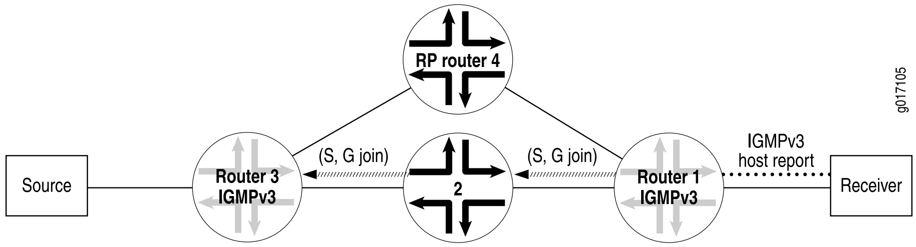
Before you begin, configure the router interfaces. See the *Junos OS Network Interfaces Library for Routing Devices*.

Overview

To deploy SSM, configure PIM sparse mode on all routing device interfaces and issue the necessary SSM commands, including specifying IGMPv3 or MLDv2 on the receiver's LAN. If PIM sparse mode is not explicitly configured on both the source and group members interfaces, multicast packets are not forwarded. Source lists, supported in IGMPv3 and MLDv2, are used in PIM SSM. Only sources that are specified send traffic to the SSM group.

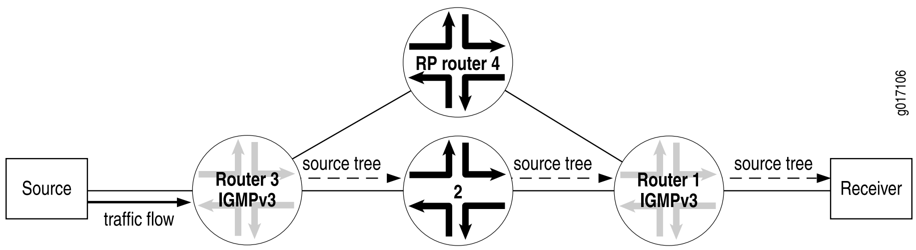
In a PIM SSM-configured network, a host subscribes to an SSM channel (by means of IGMPv3 or MLDv2) to join group G and source S (see Figure 147 on page 4104). The directly connected PIM sparse-mode router, the receiver's designated router (DR), sends an (S,G) join message to its reverse-path forwarding (RPF) neighbor for the source. Notice in Figure 147 on page 4104 that the RP is not contacted in this process by the receiver, as would be the case in normal PIM sparse-mode operations.

Figure 147: Receiver Sends Messages to Join Group G and Source S



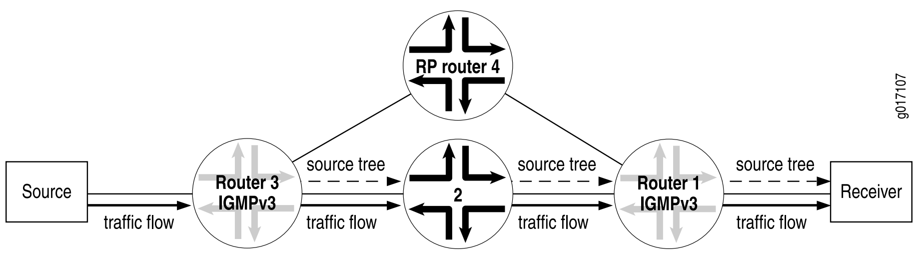
The (S,G) join message initiates the source tree and then builds it out hop by hop until it reaches the source. In Figure 148 on page 4104, the source tree is built across the network to Router 3, the last-hop router connected to the source.

Figure 148: Router 3 (Last-Hop Router) Joins the Source Tree



Using the source tree, multicast traffic is delivered to the subscribing host (see Figure 149 on page 4104).

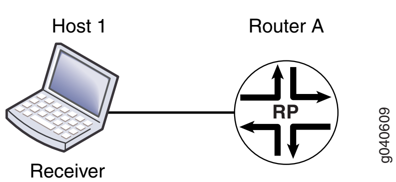
Figure 149: (S,G) State Is Built Between the Source and the Receiver



SSM can operate in include mode or in exclude mode. In exclude mode the receiver specifies a list of sources that it does not want to receive the multicast group traffic from. The routing device forwards traffic to the receiver from any source except the sources specified in the exclusion list. The receiver accepts traffic from any sources except the sources specified in the exclusion list.

This example works with the simple RPF topology shown in Figure 150 on page 4104.

Figure 150: Simple RPF Topology



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface all
set protocols pim rp local address 10.255.72.46
set protocols pim rp local group-ranges 239.0.0.0/24
set protocols pim interface fe-1/0/0.0 mode sparse
set protocols pim interface lo0.0 mode sparse
set routing-options multicast ssm-groups 232.0.0.0/8
set routing-options multicast ssm-groups 239.0.0.0/8
set routing-options multicast asm-override-ssm
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure an RPF policy:

1. Configure OSPF.

   ```
   [edit protocols ospf]
   user@host# set area 0.0.0.0 interface fxp0.0 disable
   user@host# set area 0.0.0.0 interface all
   ```

2. Configure PIM sparse mode.

   ```
   [edit protocols pim]
   user@host# set rp local address 10.255.72.46
   user@host# set rp local group-ranges 239.0.0.0/24
   user@host# set interface fe-1/0/0.0 mode sparse
   user@host# set interface lo0.0 mode sparse
   ```

3. Configure additional SSM groups.

   ```
   [edit routing-options]
   user@host# set ssm-groups [ 232.0.0.0/8 239.0.0.0/8 ]
   ```

4. Configure the RP to accept ASM join messages for groups within the SSM address range.

   ```
   [edit routing-options]
   user@host# set multicast asm-override-ssm
   ```

5. If you are done configuring the device, commit the configuration.

   ```
   user@host# commit
   ```

Results

Confirm your configuration by entering the **show protocols** and **show routing-options** commands.

```
user@host# show protocols
ospf {
    area 0.0.0.0 {
        interface fxp0.0 {
            disable;
        }
        interface all;
    }
}
pim {
    rp {
        local {
            address 10.255.72.46;
            group-ranges {
                239.0.0.0/24;
            }
        }
    }
    interface fe-1/0/0.0 {
        mode sparse;
    }
    interface lo0.0 {
        mode sparse;
    }
}
```

```
user@host# show routing-options
multicast {
    ssm-groups [ 232.0.0.0/8 239.0.0.0/8 ];
    asm-override-ssm;
}
```

Verification

To verify the configuration, run the following commands:

- show igmp group
- show igmp statistics
- show pim join

Related Documentation

- Source-Specific Multicast Groups Overview on page 3970

Example: Configuring SSM Maps for Different Groups to Different Sources

Multiple SSM Maps and Groups for Interfaces

You can configure multiple source-specific multicast (SSM) maps so that different groups map to different sources, which enables a single multicast group to map to different sources for different interfaces.

Example: Configuring Multiple SSM Maps Per Interface

This example shows how to assign more than one SSM map to an IGMP interface.

Requirements

This example requires Junos OS Release 11.4 or later.

Overview

In this example, you configure a routing policy, POLICY-ipv4-example1, that maps multicast group join messages over an IGMP logical interface to IPv4 multicast source addresses based on destination IP address as follows:

Routing Policy Name	Multicast Group Join Messages for a Route Filter at This Destination Address	Multicast Source Addresses
POLICY-ipv4-example1 term 1	232.1.1.1	10.10.10.4, 192.168.43.66
POLICY-ipv4-example1 term 2	232.1.1.2	10.10.10.5, 192.168.43.67

You apply routing policy POLICY-ipv4-example1 to IGMP logical interface fe-0/1/0.0.

Configuration

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see the *CLI User Guide*.

To configure this example, perform the following task:

CLI Quick Configuration

To quickly configure this example, copy the following configuration commands into a text file, remove any line breaks, and then paste the commands into the CLI at the **[edit]** hierarchy level.

```
set policy-options policy-statement POLICY-ipv4-example1 term 1 from route-filter
  232.1.1.1/32 exact
set policy-options policy-statement POLICY-ipv4-example1 term 1 then ssm-source
  10.10.10.4
set policy-options policy-statement POLICY-ipv4-example1 term 1 then ssm-source
  192.168.43.66
set policy-options policy-statement POLICY-ipv4-example1 term 1 then accept
set policy-options policy-statement POLICY-ipv4-example1 term 2 from route-filter
  232.1.1.2/32 exact
set policy-options policy-statement POLICY-ipv4-example1 term 2 then ssm-source
  10.10.10.5
```



```
set policy-options policy-statement POLICY-ipv4-example1 term 2 then ssm-source
  192.168.43.67
set policy-options policy-statement POLICY-ipv4-example1 term 2 then accept
set protocols igmp interface fe-0/1/0.0 ssm-map-policy POLICY-ipv4-example1
```

Step-by-Step Procedure

To configure multiple SSM maps per interface:

1. Configure protocol-independent routing options for route filter 232.1.1.1, and specify the multicast source addresses to which matching multicast groups are to be mapped.

   ```
   [edit policy-options policy-statement POLICY-ipv4-example1 term 1]
   user@host# set from route-filter 232.1.1.1/32 exact
   user@host# set then ssm-source 10.10.10.4
   user@host# set then ssm-source 192.168.43.66
   user@host# set then accept
   ```

2. Configure protocol-independent routing options for route filter 232.1.1.2, and specify the multicast source addresses to which matching multicast groups are to be mapped.

   ```
   [edit policy-options policy-statement POLICY-ipv4-example1 term 2]
   user@host# set from route-filter 232.1.1.2/32 exact
   user@host# set then ssm-source 10.10.10.5
   user@host# set then ssm-source 192.168.43.67
   user@host# set then accept
   ```

3. Apply the policy map POLICY-ipv4-example1 to IGMP logical interface fe-0/1/1/0.

   ```
   [edit protocols igmp interface fe-0/1/0.0]
   user@host# set ssm-map-policy POLICY-ipv4-example1
   ```

Results

After the configuration is committed, confirm the configuration by entering the **show policy-options** and **show protocols** configuration mode commands. If the command output does not display the intended configuration, repeat the instructions in this procedure to correct the configuration.

```
user@host#> show policy-options
policy-statement POLICY-ipv4-example1 {
  term 1 {
    from {
      route-filter 232.1.1.1/32 exact;
    }
    then {
      ssm-source [ 10.10.10.4 192.168.43.66 ];
      accept;
    }
  }
  term 2{
    from {
      route-filter 232.1.1.2/32 exact;
    }
    then {
      ssm-source [ 10.10.10.5 192.168.43.67 ];
      accept;
    }
  }
```



```
}

user@host# show protocols
igmp {
  interface fe-0/1/0.0 {
    ssm-map-policy POLICY-ipv4-example1;
  }
}
```

Verification

Confirm that the configuration is working properly.

- Displaying Information About IGMP-Enabled Interfaces on page 4109
- Displaying the PIM Groups on page 4109
- Displaying the Entries in the IP Multicast Forwarding Table on page 4109

Displaying Information About IGMP-Enabled Interfaces

Purpose Verify that the SSM map policy POLICY-ipv4-example1 is applied to logical interface fe-0/1/0.0.

Action Use the **show igmp interface** operational mode command for the IGMP logical interface to which you applied the SSM map policy.

```
user@host> show igmp interface
Interface: fe-0/1/0.0
    Querier: 10.111.30.1
    State:         Up Timeout:    None Version:  2 Groups:      2
    SSM Map Policy: POLICY-ipv4-example1;

Configured Parameters:
IGMP Query Interval: 125.0
IGMP Query Response Interval: 10.0
IGMP Last Member Query Interval: 1.0
IGMP Robustness Count: 2

Derived Parameters:
IGMP Membership Timeout: 260.0
IGMP Other Querier Present Timeout: 255.0
```

The command output displays the name of IGMP logical interface (fe-0/1/0.0), the address of the routing device that has been elected to send membership queries and group information.

Displaying the PIM Groups

Purpose Verify the Protocol Independent Multicast (PIM) source and group pair (S,G) entries.

Action Use the **show pim join extensive 232.1.1.1** operational mode command to display the PIM source and group pair (S,G) entries for the 232.1.1.1 group.

Displaying the Entries in the IP Multicast Forwarding Table

Purpose Verify that the IP multicast forwarding table displays the mroute state.

Action Use the **show multicast route extensive** operational mode command to display the entries in the IP multicast forwarding table to verify that the **Route state** is active and that the **Forwarding state** is forwarding.

Related Documentation

- *Example: Configuring Source-Specific Multicast*
- *Example: Configuring Source-Specific Draft-Rosen 7 Multicast VPNs*

PIM Configuration Statements

- version (PIM) on page 4179
- wildcard-source (PIM RPF Selection) on page 4180

address (Anycast RPs)

Syntax address *address* <forward-msdp-sa>;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp local (inet | inet6) anycast-pim rp-set],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp local (inet | inet6) anycast-pim rp-set],
[edit protocols pim rp local (inet | inet6) anycast-pim rp-set],
[edit routing-instances *routing-instance-name* protocols pim rp local (inet | inet6) anycast-pim rp-set]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the anycast rendezvous point (RP) addresses in the RP set. Multiple addresses can be configured in an RP set. If the RP has peer Multicast Source Discovery Protocol (MSDP) connections, then the RP must forward MSDP source active (SA) messages.

Options *address*—RP address in an RP set.

forward-msdp-sa—(Optional) Forward MSDP SAs to this address.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

address (Local RPs)

Syntax address *address*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp local family (inet | inet6)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp local family (inet | inet6)],
[edit protocols pim rp local family (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols pim rp local family (inet | inet6)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the local rendezvous point (RP) address.

Options *address*—Local RP address.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring Local PIM RPs on page 3995

address (Static RPs)

Syntax

```
address address {
  group-ranges {
    destination-ip-prefix</prefix-length>;
  }
  override;
  version version;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim rp static],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp static],
[edit protocols pim static],
[edit routing-instances *routing-instance-name* protocols pim rp static]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure static rendezvous point (RP) addresses. You can configure a static RP in a logical system only if the logical system is not directly connected to a source.

For each static RP address, you can optionally specify the PIM version and the groups for which this address can be the RP. The default PIM version is version 1.

Options

address—Static RP address.

Default: 224.0.0.0/4

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Static PIM RP Address on the Non-RP Routing Device on page 3997

algorithm

Syntax

algorithm *algorithm-name*;

Hierarchy Level

[edit protocols pim interface *interface-name* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* bfd-liveness-detection authentication]

Release Information

Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Specify the algorithm to use for BFD authentication.

Options

algorithm-name—Name of algorithm to use for BFD authentication:

- **simple-password**—Plain-text password. One to 16 bytes of plain text. One or more passwords can be configured.
- **keyed-md5**—Keyed Message Digest 5 hash algorithm for sessions with transmit and receive rates greater than 100 ms.
- **meticulous-keyed-md5**—Meticulous keyed Message Digest 5 hash algorithm.
- **keyed-sha-1**—Keyed Secure Hash Algorithm I for sessions with transmit and receive rates greater than 100 ms.
- **meticulous-keyed-sha-1**—Meticulous keyed Secure Hash Algorithm I.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Understanding Bidirectional Forwarding Detection Authentication for PIM*
- Configuring BFD Authentication for PIM on page 4023
- **authentication on page 4118**

anycast-pim

Syntax

```
anycast-pim {
  rp-set {
    address address <forward-msdp-sa>;
  }
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim rp local family (inet | inet6)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp local family (inet | inet6)],
[edit protocols pim rp local family (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols pim rp local family (inet | inet6)]

Release Information

Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure properties for anycast RP using PIM.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring PIM Anycast With or Without MSDP on page 3999

assert-timeout

Syntax assert-timeout *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Multicast routing devices running PIM sparse mode often forward the same stream of multicast packets onto the same LAN through the rendezvous-point tree (RPT) and shortest-path tree (SPT). PIM assert messages help routing devices determine which routing device forwards the traffic and prunes the RPT for this group. By default, routing devices enter an assert cycle every 180 seconds. You can configure this assert timeout to be between 5 and 210 seconds.

Options *seconds*—Time for routing device to wait before another assert message cycle.

Range: 5 through 210 seconds

Default: 180 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring the PIM Assert Timeout on page 4015

authentication (Protocols PIM)

Syntax

```
authentication {
  algorithm algorithm-name;
  key-chain key-chain-name;
  loose-check;
}
```

Hierarchy Level [edit protocols pim interface *interface-name* family (inet | inet6) bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols pim interface family (inet | inet6) *interface-name* bfd-liveness-detection]

Release Information Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the algorithm, security keychain, and level of authentication for BFD sessions running on PIM interfaces.

The remaining statements are explained separately.

Options The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD Authentication for PIM on page 4023
- Configuring BFD for PIM on page 4021
- *Understanding Bidirectional Forwarding Detection Authentication for PIM*
- bfd-liveness-detection on page 4119
- key-chain (Protocols PIM) on page 4142
- loose-check on page 4145

bfd-liveness-detection (Protocols PIM)

Syntax

```
bfd-liveness-detection {
  authentication {
    algorithm algorithm-name;
    key-chain key-chain-name;
    loose-check;
  }
  detection-time {
    threshold milliseconds;
  }
  minimum-interval milliseconds;
  minimum-receive-interval milliseconds;
  multiplier number;
  no-adaptation;
  transmit-interval {
    minimum-interval milliseconds;
    threshold milliseconds;
  }
  version (0 | 1 | automatic);
}
```

Hierarchy Level

[edit protocols pim interface *interface-name* family (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* family (inet | inet6)]

Release Information

Statement introduced in Junos OS Release 8.1.
authentication option introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure bidirectional forwarding detection (BFD) timers and authentication for PIM.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD for PIM on page 4021
- Configuring BFD Authentication for PIM on page 4023

bootstrap

Syntax

```
bootstrap {
  family (inet | inet6) {
    export [ policy-names ];
    import [ policy-names ];
    priority number;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim rp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp],
[edit protocols pim rp],
[edit routing-instances *routing-instance-name* protocols pim rp]

Release Information

Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure parameters to control bootstrap routers and messages.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring PIM Bootstrap Properties for IPv4*
- *Configuring PIM Bootstrap Properties for IPv4 or IPv6*

bootstrap-export

Syntax bootstrap-export [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp],
[edit protocols pim rp],
[edit routing-instances *routing-instance-name* protocols pim rp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Apply one or more export policies to control outgoing PIM bootstrap messages.

Options ***policy-names***—Name of one or more import policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring PIM Bootstrap Properties for IPv4*
- *Configuring PIM Bootstrap Properties for IPv4 or IPv6*
- bootstrap-import on page 4122

bootstrap-import

Syntax bootstrap-import [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp],
[edit protocols pim rp],
[edit routing-instances *routing-instance-name* protocols pim rp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Apply one or more import policies to control incoming PIM bootstrap messages.

Options ***policy-names***—Name of one or more import policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring PIM Bootstrap Properties for IPv4*
- *Configuring PIM Bootstrap Properties for IPv4 or IPv6*
- bootstrap-export on page 4121

bootstrap-priority

Syntax bootstrap-priority *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp],
[edit protocols pim rp],
[edit routing-instances *routing-instance-name* protocols pim rp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure whether this routing device is eligible to be a bootstrap router. In the case of a tie, the routing device with the highest IP address is elected to be the bootstrap router.

Options *number*—Priority for becoming the bootstrap router. A value of 0 means that the routing device is not eligible to be the bootstrap router.

Range: 0 through 255

Default: 0

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring PIM Bootstrap Properties for IPv4*

detection-time (BFD for PIM)

Syntax

```
detection-time {
  threshold milliseconds;
}
```

Hierarchy Level

[edit protocols pim interface *interface-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Enable BFD failure detection. The BFD failure detection timers are adaptive and can be adjusted to be faster or slower. The lower the BFD failure detection timer value, the faster the failure detection and vice versa. For example, the timers can adapt to a higher value if the adjacency fails (that is, the timer detects failures more slowly). Or a neighbor can negotiate a higher value for a timer than the configured value. The timers adapt to a higher value when a BFD session flap occurs more than three times in a span of 15 seconds. A back-off algorithm increases the receive (Rx) interval by two if the local BFD instance is the reason for the session flap. The transmission (Tx) interval is increased by two if the remote BFD instance is the reason for the session flap. You can use the **clear bfd adaptation** command to return BFD interval timers to their configured values. The **clear bfd adaptation** command is hitless, meaning that the command does not affect traffic flow on the routing device.

The remaining statement is explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD for PIM on page 4021
- **bfd-liveness-detection on page 4119**
- **threshold on page 4172**

disable (PIM)

Syntax disable;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* protocols pim family (inet | inet6)],
[edit logical-systems *logical-system-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* protocols pim rp local family (inet | inet6)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp local family (inet | inet6)],
[edit protocols pim],
[edit protocols pim family (inet | inet6)],
[edit protocols pim interface *interface-name*],
[edit protocols pim rp local family (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols pim],
[edit routing-instances *routing-instance-name* protocols pim family (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols pim rp local family (inet | inet6)]

Release Information Statement introduced before Junos OS Release 7.4.
disable statement extended to the **[family]** hierarchy level in Junos OS Release 9.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Explicitly disable PIM at the protocol, interface or family hierarchy levels.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Disabling PIM on page 3982
- *disable (PIM Graceful Restart)*

dr-election-on-p2p

Syntax dr-election-on-p2p;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim]

Release Information Statement introduced in Junos OS Release 9.1.
Statement introduced in Junos OS Release 9.1 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Enable PIM designated router (DR) election on point-to-point (P2P) links.

Default No PIM DR election is performed on point-to-point links.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring PIM Designated Router Election on Point-to-Point Links on page 3985

dr-register-policy

Syntax dr-register-policy [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp],
[edit protocols pim rp],
[edit routing-instances *routing-instance-name* protocols pim rp]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Apply one or more policies to control outgoing PIM register messages.

Options *policy-names*—Name of one or more import policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Register Message Filters on a PIM RP and DR on page 4013
- rp-register-policy on page 4166

embedded-rp

Syntax

```
embedded-rp {
  group-ranges {
    destination-ip-prefix</prefix-length>;
  }
  maximum-rps limit;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim rp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp],
[edit protocols pim rp],
[edit routing-instances *routing-instance-name* protocols pim rp]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure properties for embedded IP version 6 (IPv6) RPs.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring PIM Embedded RP for IPv6*

export (Protocols PIM Bootstrap)

Syntax
export [*policy-names*];

Hierarchy Level
[edit logical-systems *logical-system-name* protocols pim rp bootstrap family (inet | inet6)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp bootstrap family (inet | inet6)],
[edit protocols pim rp bootstrap family (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols pim rp bootstrap family (inet | inet6)]

Release Information
Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description
Apply one or more export policies to control outgoing PIM bootstrap messages.

Options
policy-names—Name of one or more import policies.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring PIM Bootstrap Properties for IPv4*
- *Configuring PIM Bootstrap Properties for IPv4 or IPv6*
- import (Protocols PIM Bootstrap) on page 4136

export (Protocols PIM)

Syntax
export [*policy-names*];

Hierarchy Level
[edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim]

Release Information
Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description
Apply one or more export policies to control outgoing PIM join and prune messages. PIM join and prune filters can be applied to PIM-SM and PIM-SSM messages. PIM join and prune filters cannot be applied to PIM-DM messages.

Required Privilege Level
view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

Related Documentation

- Filtering Outgoing PIM Join Messages on page 4011

family (Bootstrap)

Syntax

```
family (inet | inet6) {
  export [ policy-names ];
  import [ policy-names ];
  priority number;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim rp bootstrap],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp bootstrap],
[edit protocols pim rp bootstrap],
[edit routing-instances *routing-instance-name* protocols pim rp bootstrap]

Release Information

Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure which IP protocol type bootstrap properties to apply.

Options

inet—Apply IP version 4 (IPv4) local RP properties.

inet6—Apply IPv6 local RP properties.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring PIM Bootstrap Properties for IPv4*
- *Configuring PIM Bootstrap Properties for IPv4 or IPv6*

family (Protocols PIM)

Syntax

```
family (inet | inet6) {
   disable;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*]

Release Information

Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS 11.3 for the QFX Series.

Description

Enable the PIM protocol for the specified family.

Options

inet—Enable the PIM protocol for the IP version 4 (IPv4) address family.

inet6—Enable the PIM protocol for the IP version 6 (IPv6) address family.

The remaining statement is explained separately.

Related Documentation

- Disabling PIM on page 3982
- *disable (PIM Graceful Restart)*
- **disable (PIM) on page 4125**

family (Local RP)

Syntax

```
family (inet | inet6) {
  disable;
  address address;
  anycast-pim {
    local-address address;
    rp-set {
      address address <forward-msdp-sa>;
    }
  }
  group-ranges {
    destination-ip-prefix</prefix-length>;
  }
  hold-time seconds;
  override;
  priority number;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim rp local],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp local],
[edit protocols pim rp local],
[edit routing-instances *routing-instance-name* protocols pim rp local]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure which IP protocol type local RP properties to apply.

Options

inet—Apply IP version 4 (IPv4) local RP properties.

inet6—Apply IPv6 local RP properties.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Local PIM RPs on page 3995

group (RPF Selection)

Syntax

```
group group-address{
  sourcesource-address{
    next-hop next-hop-address;
  }
  wildcard-source {
    next-hop next-hop-address;
  }
}
```

Hierarchy Level [edit routing-instances *routing-instance-name* edit protocols pim rpf-selection]

Release Information Statement introduced in JUNOS Release 10.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the PIM group address for which you configure RPF selectiongroup (RPF Selection).

Default By default, PIM RPF selection is not configured.

Options *group-address*—PIM group address for which you configure RPF selection.

Required Privilege Level view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

Related Documentation

- *Example: Configuring PIM RPF Selection*

group-ranges

Syntax

```
group-ranges {
  destination-ip-prefix</prefix-length>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim rp bidirectional address *address*],
[edit logical-systems *logical-system-name* protocols pim rp embedded-rp],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols pim rp bidirectional address *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp embedded-rp],
[edit protocols pim rp bidirectional address *address*],
[edit protocols pim rp embedded-rp],
[edit protocols pim rp local family (inet | inet6)],
[edit protocols pim rp static address *address*],
[edit routing-instances *instance-name* protocols pim rp bidirectional address *address*],
[edit routing-instances *routing-instance-name* protocols pim rp embedded-rp],
[edit routing-instances *routing-instance-name* protocols pim rp local family (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols pim rp static address *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Support for bidirectional RP addresses introduced in Junos OS Release 12.1.

Description

Configure the address ranges of the multicast groups for which this routing device can be a rendezvous point (RP).

Default

The routing device is eligible to be the RP for all IPv4 or IPv6 groups (224.0.0.0/4 or FF70::/12 to FFF0::/12).

Options

destination-ip-prefix</prefix-length>—Addresses or address ranges for which this routing device can be an RP.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Local PIM RPs on page 3995 in the *Multicast Protocols Feature Guide for Routing Devices*
- *Configuring PIM Embedded RP for IPv6* in the *Multicast Protocols Feature Guide for Routing Devices*
- *Example: Configuring Bidirectional PIM*

hello-interval (Protocols PIM)

Syntax

hello-interval *seconds*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim interface *interface-name*],
[edit protocols pim interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Specify how often the routing device sends PIM hello packets out of an interface.

Options

seconds—Length of time between PIM hello packets.

Range: 0 through 255

Default: 30 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- hold-time on page 4135
- Modifying the PIM Hello Interval on page 3978

hold-time (Protocols PIM)

Syntax hold-time *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp bidirectional address *address*],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols pim rp bidirectional address *address*],
[edit protocols pim rp bidirectional address *address*],
[edit protocols pim rp local family (inet | inet6)],
[edit routing-instances *instance-name* protocols pim rp bidirectional address *address*],
[edit routing-instances *routing-instance-name* protocols pim rp local family (inet | inet6)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Support for bidirectional RP addresses introduced in Junos OS Release 12.1.

Description Specify the time period for which a neighbor is to consider the sending routing device (this routing device) to be operative (up).

Options *seconds*—Hold time.

Range: 0 through 255

Default: 150 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Local PIM RPs on page 3995 in the *Multicast Protocols Feature Guide for Routing Devices*
- *Example: Configuring Bidirectional PIM*

import (Protocols PIM Bootstrap)

Syntax import [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp bootstrap (inet | inet6)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp bootstrap (inet | inet6)],
[edit protocols pim rp bootstrap (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols pim rp bootstrap (inet | inet6)]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Apply one or more import policies to control incoming PIM bootstrap messages.

Options ***policy-names***—Name of one or more import policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring PIM Bootstrap Properties for IPv4*
- *Configuring PIM Bootstrap Properties for IPv4 or IPv6*
- export (Protocols PIM Bootstrap) on page 4128

import (Protocols PIM)

Syntax import [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Apply one or more policies to routes being imported into the routing table from PIM. Use the **import** statement to filter PIM join messages and prevent them from entering the network.

Options ***policy-names***—Name of one or more policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Filtering Incoming PIM Join Messages on page 4012

infinity

Syntax infinity [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim spt-threshold],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim spt-threshold],
[edit protocols pim spt-threshold],
[edit routing-instances *routing-instance-name* protocols pim spt-threshold]

Release Information Statement introduced in Junos OS Release 8.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Apply one or more policies to set the SPT threshold to infinity for a source-group address pair. Use the **infinity** statement to prevent the last-hop routing device from transitioning from the RPT rooted at the RP to an SPT rooted at the source for that source-group address pair.

Options ***policy-names***—Name of one or more policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring the PIM SPT Threshold Policy on page 4018

interface

Syntax

```
interface (all | interface-name) {
  disable;
  family (inet | inet6) {
    disable;
  }
  hello-interval seconds;
  mode (dense | sparse | sparse-dense);
  neighbor-policy [ policy-names ];
  override-interval milliseconds;
  priority number;
  propagation-delay milliseconds;
  reset-tracking-bit;
  version version;
}
```

Hierarchy Level

[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Enable PIM on an interface and configure interface-specific properties.

Options *interface-name*—Name of the interface. Specify the full interface name, including the physical and logical address components. To configure all interfaces, you can specify **all**.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- PIM on Aggregated Interfaces on page 3940

join-load-balance

Syntax

```
join-load-balance {
  automatic;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim]

Release Information

Statement introduced in Junos OS Release 9.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Enable load balancing of PIM join messages across interfaces and routing devices.

Options

automatic—Enables automatic load balancing of PIM join messages. When a new interface or neighbor is introduced into the network, ECMP joins are redistributed with minimal disruption to traffic.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring PIM Make-Before-Break Join Load Balancing*
- Configuring PIM Join Load Balancing on page 3987
- *clear pim join-distribution* in the CLI Explorer

join-prune-timeout

Syntax join-prune-timeout *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim]

Release Information Statement introduced in Junos OS Release 8.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the timeout for the join state. If the periodic join refresh message is not received before the timeout expires, the join state is removed.

Options **seconds**—Number of seconds to wait for the periodic join message to arrive.

Range: 210 through 240 seconds

Default: 210 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Modifying the Join State Timeout on page 3990

key-chain (Protocols PIM)

Syntax key-chain *key-chain-name*;

Hierarchy Level [edit protocols pim interface *interface-name* family {inet | inet6} bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* family {inet | inet6} bfd-liveness-detection authentication]

Release Information Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement modified in Junos OS Release 12.2 to include **family** in the hierarchy level.

Description Specify the security keychain to use for BFD authentication.

Options ***key-chain-name***—Name of the security keychain to use for BFD authentication. The name is a unique integer between **0** and **63**. This must match one of the keychains in the **authentication-key-chains** statement at the **[edit security]** hierarchy level.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD Authentication for PIM on page 4023
- *Understanding Bidirectional Forwarding Detection Authentication for PIM*
- authentication on page 4118

local

Syntax

```
local {
  disable;
  address address;
  family (inet | inet6) {
    disable;
    address address;
    anycast-pim {
      local-address address;
        rp-set {
        address address <forward-msdp-sa>;
      }
    }
    group-ranges {
      destination-ip-prefix</prefix-length>;
    }
    hold-time seconds;
    override;
    priority number;
  }
  group-ranges {
    destination-ip-prefix</prefix-length>;
  }
  hold-time seconds;
  override;
  priority number;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim rp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp],
[edit protocols pim rp],
[edit routing-instances *routing-instance-name* protocols pim rp]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
The remaining statements are explained separately.

Description

Configure the routing device's RP properties.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Local PIM RPs on page 3995

local-address (Protocols PIM)

Syntax local-address *address*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp local family (inet | inet6) anycast-pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp local family (inet | inet6) anycast-pim],
[edit protocols pim rp local family (inet | inet6) anycast-pim],
[edit routing-instances *routing-instance-name* protocols pim rp local family (inet | inet6) anycast-pim]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the routing device local address for the anycast rendezvous point (RP). If this statement is omitted, the router ID is used as this address.

Options ***address***—Anycast RP IPv4 or IPv6 address, depending on **family** configuration.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring PIM Anycast With or Without MSDP on page 3999

loose-check

Syntax loose-check;

Hierarchy Level [edit protocols pim interface *interface-name* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*
bfd-liveness-detection authentication]

Release Information Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify loose authentication checking on the BFD session. Use loose authentication for transitional periods only when authentication might not be configured at both ends of the BFD session.

By default, strict authentication is enabled and authentication is checked at both ends of each BFD session. Optionally, to smooth migration from nonauthenticated sessions to authenticated sessions, you can configure *loose checking*. When loose checking is configured, packets are accepted without authentication being checked at each end of the session.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD Authentication for PIM on page 4023
- *Understanding Bidirectional Forwarding Detection Authentication for PIM*
- **authentication on page 4118**

maximum-rps

Syntax maximum-rps *limit*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp embedded-rp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp embedded-rp],
[edit protocols pim rp embedded-rp],
[edit routing-instances *routing-instance-name* protocols pim rp embedded-rp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Limit the number of RPs that the routing device acknowledges.

Options *limit*—Number of RPs.

Range: 1 through 500

Default: 100

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Configuring PIM Embedded RP for IPv6*

minimum-interval (PIM BFD Liveness Detection)

Syntax

minimum-interval *milliseconds*;

Hierarchy Level

[edit protocols pim interface *interface-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure the minimum interval after which the local routing device transmits hello packets and then expects to receive a reply from a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can specify the minimum transmit and receive intervals separately using the **transmit-interval minimum-interval** and **minimum-receive-interval** statements.

Options

milliseconds—Minimum transmit and receive interval.

Range: 1 through 255,000 milliseconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD for PIM on page 4021

minimum-interval (PIM BFD Transmit Interval)

Syntax minimum-interval *milliseconds*;

Hierarchy Level [edit protocols pim interface *interface-name* bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* bfd-liveness-detection transmit-interval]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the minimum interval after which the local routing device transmits hello packets to a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum transmit interval using the **minimum-interval** statement at the **[edit protocols pim interface *interface-name* bfd-liveness-detection]** hierarchy level.

Options *milliseconds*—Minimum transmit interval value.

Range: 1 through 255,000

NOTE: The threshold value specified in the **threshold** statement must be greater than the value specified in the **minimum-interval** statement for the **transmit-interval** statement.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD for PIM on page 4021
- bfd-liveness-detection on page 4119
- minimum-interval on page 4147
- threshold on page 4173

minimum-receive-interval

Syntax minimum-receive-interval *milliseconds*;

Hierarchy Level [edit protocols pim interface *interface-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* bfd-liveness-detection]

Release Information Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the minimum interval after which the local routing device must receive a reply from a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum receive interval using the **minimum-interval** statement at the **[edit protocols pim interface *interface-name* bfd-liveness-detection]** hierarchy level.

Options ***milliseconds***—Minimum receive interval.

Range: 1 through 255,000 milliseconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD for PIM on page 4021

mode (Protocols PIM)

Syntax mode (dense | sparse | sparse-dense);

Hierarchy Level [edit protocols pim interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure PIM to operate in sparse, dense, or sparse-dense mode.

NOTE: The QFX Series does not support dense or sparse-dense mode.

Options **dense**—Operate in dense mode.

sparse—Operate in sparse mode.

sparse-dense—Operate in sparse-dense mode.

Default: sparse

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

multiplier

Syntax multiplier *number*;

Hierarchy Level [edit protocols pim interface *interface-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* bfd-liveness-detection]

Release Information Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the number of hello packets not received by a neighbor that causes the originating interface to be declared down.

Options *number*—Number of hello packets.

Range: 1 through 255

Default: 3

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring BFD for PIM on page 4021

neighbor-policy

Syntax neighbor-policy [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim interface *interface-name*],
[edit protocols pim interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Apply a PIM interface-level policy to filter neighbor IP addresses.

Options ***policy-name***—Name of the policy that filters neighbor IP addresses.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Interface-Level PIM Neighbor Policies on page 4010

next-hop (PIM RPF Selection)

Syntax next-hop *next-hop-address*;

Hierarchy Level [edit routing-instances *routing-instance-name* protocols pim rpf-selection group *group-address* source *source-address*],
[edit routing-instances *routing-instance-name* protocols pim rpf-selection group *group-address* wildcard-source],
[edit routing-instances *routing-instance-name* protocols pim rpf-selection prefix-list *prefix-list-addresses* source *source-address*],
[edit routing-instances *routing-instance-name* protocols pim rpf-selection prefix-list *prefix-list-addresses* wildcard-source]

Release Information Statement introduced in JUNOS Release 10.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the specific next-hop address for the PIM group source.

Options ***next-hop-address***—Specific next-hop address for the PIM group source.

Required Privilege Level view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

Related Documentation

- *Example: Configuring PIM RPF Selection*

no-adaptation (PIM BFD Liveness Detection)

Syntax no-adaptation;

Hierarchy Level [edit protocols pim interface *interface-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* bfd-liveness-detection]

Release Information Statement introduced in Junos OS Release 9.0
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure BFD sessions not to adapt to changing network conditions. We recommend that you *do not* disable BFD adaptation unless it is preferable to have BFD adaptation disabled in your network.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD for PIM on page 4021
- **bfd-liveness-detection on page 4119**

override-interval

Syntax override-interval *milliseconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim interface *interface-name*],
[edit protocols pim],
[edit protocols pim interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols pim]
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*]

Release Information Statement introduced in Junos OS Release 10.1.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Set the maximum time in milliseconds to delay sending override join messages for a multicast network that has join suppression enabled. When a router or switch sees a prune message for a join it is currently suppressing, it waits for the interval specified by the override timer before it sends an override join message.

Options This is a random timer with a value in milliseconds.

Range: 0 through maximum override value

Default: 2000 milliseconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Enabling Join Suppression on page 3991
- propagation-delay on page 4161
- reset-tracking-bit on page 4162

pim

Syntax

```
pim {
  disable;
  assert-timeout seconds;
  dense-groups {
    addresses;
  }
  dr-election-on-p2p;
  export;
  family (inet | inet6) {
    disable;
  }
  graceful-restart {
    disable;
    restart-duration seconds;
  }
  import [ policy-names ];
  interface interface-name {
    accept-remote-source;
    disable;
    family (inet | inet6) {
      disable;
    }
    hello-interval seconds;
    mode (dense | sparse | sparse-dense);
    neighbor-policy [ policy-names ];
    override-interval milliseconds;
    priority number;
    propagation-delay milliseconds;
    reset-tracking-bit;
    version version;
  }
  join-load-balance;
  join-prune-timeout;
  nonstop-routing;
  override-interval milliseconds;
  propagation-delay milliseconds;
  reset-tracking-bit;
  rib-group group-name;
  rp {
    auto-rp {
      (announce | discovery | mapping);
      (mapping-agent-election | no-mapping-agent-election);
    }
    bootstrap {
      family (inet | inet6) {
        export [ policy-names ];
        import [ policy-names ];
        priority number;
      }
    }
    bootstrap-import [ policy-names ];
    bootstrap-export [ policy-names ];
```

```
    bootstrap-priority number;
    dr-register-policy [ policy-names ];
    embedded-rp {
      group-ranges {
        destination-ip-prefix</prefix-length>;
      }
      maximum-rps limit;
    }
    local {
      family (inet | inet6) {
        address address;
        anycast-pim {
          disable;
            rp-set {
            address address <forward-msdp-sa>;
          }
          local-address address;
        }
        group-ranges {
          destination-ip-prefix</prefix-length>;
        }
        hold-time seconds;
        priority number;
      }
    }
    rp-register-policy [ policy-names ];
    spt-threshold {
      infinity [ policy-names ];
    }
    static {
      address address {
        group-ranges {
        version version;
        destination-ip-prefix</prefix-length>;
        }
      }
    }
  }
  rpf-selection {
    group group-address{
      source source-address{
        next-hop next-hop-address;
      }
      wildcard-source {
        next-hop next-hop-address;
      }
    }
    prefix-list prefix-list-addresses {
      source source-address {
        next-hop next-hop-address;
      }
      wildcard-source {
        next-hop next-hop-address;
      }
    }
  traceoptions {
```

```
        file filename <files number> <size size> <world-readable | no-world-readable>;
        flag flag <flag-modifier> <disable>;
    }
    tunnel-devices [ mt-fpc/pic/port ];
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols],
[edit protocols],
[edit routing-instances *routing-instance-name* protocols]

Release Information

Statement introduced before Junos OS Release 7.4.
family statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Enable PIM on the routing device.

The statements are explained separately.

Default

PIM is disabled on the routing device.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

prefix-list (PIM RPF Selection)

Syntax

```
prefix-list prefix-list-addresses {
  source source-address {
    next-hop next-hop-address;
  }
  wildcard-source {
    next-hop next-hop-address;
  }
}
```

Hierarchy Level

[edit routing-instances *routing-instance-name* protocols pim rpf-selection group *group-address* source *source-address*],
[edit routing-instances *routing-instance-name* protocols pim rpf-selection group *group-address* wildcard-source],
[edit routing-instances *routing-instance-name* protocols pim rpf-selection prefix-list *prefix-list-addresses* source *source-address*],
[edit routing-instances *routing-instance-name* protocols pim rpf-selection prefix-list *prefix-list-addresses* wildcard-source]

Release Information

Statement introduced in Junos OS Release 10.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

(Optional) Configure a list of prefixes (addresses) for multiple PIM groups.

Options

prefix-list-addresses—List of prefixes (addresses) for multiple PIM groups.

The remaining statements are explained separately.

Required Privilege Level

view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

Related Documentation

- *Example: Configuring PIM RPF Selection*

priority (Bootstrap)

Syntax priority *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp bootstrap (inet | inet6)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp bootstrap (inet | inet6)],
[edit protocols pim rp bootstrap (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols pim rp bootstrap (inet | inet6)]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the routing device's likelihood to be elected as the bootstrap router.

Options *number*—Routing device's priority for becoming the bootstrap router. A higher value corresponds to a higher priority.

Range: 0 through a 32-bit number

Default: 0 (The routing device has the least likelihood of becoming the bootstrap router and sends packets with a priority of 0.)

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring PIM Bootstrap Properties for IPv4*
- *Configuring PIM Bootstrap Properties for IPv4 or IPv6*
- bootstrap-priority on page 4123

priority (PIM Interfaces)

Syntax

priority *number*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim interface *interface-name*],
[edit protocols pim interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure the routing device's likelihood to be elected as the designated router.

Options

number—Routing device's priority for becoming the designated router. A higher value corresponds to a higher priority.

Range: 0 through a 32-bit number

Default: 1

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Interface Priority for PIM Designated Router Selection on page 3984

priority (PIM RPs)

Syntax priority *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim rp bidirectional address *address*],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols pim rp bidirectional address *address*],
[edit protocols pim rp bidirectional address *address*],
[edit protocols pim rp local family (inet | inet6)],
[edit routing-instances *instance-name* protocols pim rp bidirectional address *address*],
[edit routing-instances *routing-instance-name* protocols pim rp local family (inet | inet6)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Support for bidirectional RP addresses introduced in Junos OS Release 12.1.

Description For PIM-SM, configure this routing device's priority for becoming an RP.

For bidirectional PIM, configure this RP address' priority for becoming an RP.

The bootstrap router uses this field when selecting the list of candidate rendezvous points to send in the bootstrap message. A smaller number increases the likelihood that the routing device or RP address becomes the RP. A priority value of 0 means that bootstrap router can override the group range being advertised by the candidate RP.

Options *number*—Priority for becoming an RP. A lower value corresponds to a higher priority.

Range: 0 through 255

Default: 1

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Local PIM RPs on page 3995 in the *Multicast Protocols Feature Guide for Routing Devices*
- *Example: Configuring Bidirectional PIM*

propagation-delay

Syntax propagation-delay *milliseconds*;

Hierarchy Level [edit protocols pim],
[edit protocols pim interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols pim],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim interface *interface-name*]

Release Information Statement introduced in Junos OS Release 10.1.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Set a delay for implementing a PIM prune message on the upstream routing device on a multicast network for which join suppression has been enabled. The routing device waits for the prune pending period to detect whether a join message is currently being suppressed by another routing device.

Options *milliseconds*—Interval for the prune pending timer, which is the sum of the **propagation-delay** value and the **override-interval** value.

Range: 250 through 2000 milliseconds

Default: 500 milliseconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Enabling Join Suppression on page 3991
- **override-interval on page 4153**
- **reset-tracking-bit on page 4162**

reset-tracking-bit

Syntax reset-tracking-bit;

Hierarchy Level [edit protocols pim],
[edit protocols pim interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols pim],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim interface *interface-name*]

Release Information Statement introduced in Junos OS Release 10.1.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Change the value of a tracking bit (T-bit) field in the LAN prune delay hello option from the default of 1 to 0, which enables join suppression for a multicast interface. When the network starts receiving multiple identical join messages, join suppression triggers a random timer with a value of 66 through 84 milliseconds (1.1 × periodic through 1.4 × periodic, where periodic is 60 seconds). This creates an interval during which no identical join messages are sent. Eventually, only one of the identical messages is sent. Join suppression is triggered each time identical messages are sent for the same join.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Enabling Join Suppression on page 3991
- **override-interval on page 4153**
- **propagation-delay on page 4161**

rib-group (Protocols PIM)

Syntax

```
rib-group {
   inet group-name;
   inet6 group-name;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Associate a routing table group with PIM.

Options

table-name—Name of the routing table. The name must be one that you defined with the **rib-groups** statement at the **[edit routing-options]** hierarchy level.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring a Dedicated PIM RPF Routing Table*

rp

Syntax

```
rp {
  auto-rp {
    (announce | discovery | mapping);
    (mapping-agent-election | no-mapping-agent-election);
  }
  bidirectional {
    address address {
      group-ranges {
        destination-ip-prefix</prefix-length>;
      }
      hold-time seconds;
      priority number;
      }
    }
  bootstrap {
    family (inet | inet6) {
      export [ policy-names ];
      import [ policy-names ];
      priority number;
    }
  }
  bootstrap-export [ policy-names ];
  bootstrap-import [ policy-names ];
  bootstrap-priority number;
  dr-register-policy [ policy-names ];
  embedded-rp {
    group-ranges {
      destination-ip-prefix</prefix-length>;
    }
    maximum-rps limit;
  }
  group-rp-mapping {
    family (inet | inet6) {
      log-interval seconds;
      maximum limit;
      threshold value;
      }
    }
    log-interval seconds;
    maximum limit;
    threshold value;
    }
  }
  local {
    family (inet | inet6) {
      disable;
      address address;
      anycast-pim {
        local-address address;
          address address <forward-msdp-sa>;
          rp-set {
        }
```



```
        }
        group-ranges {
          destination-ip-prefix</prefix-length>;
        }
        hold-time seconds;
        override;
        priority number;
      }
    }
    register-limit {
      family (inet | inet6) {
        log-interval seconds;
        maximum limit;
        threshold value;
        }
      }
      log-interval seconds;
      maximum limit;
      threshold value;
      }
    }
    register-probe-time register-probe-time;
    }
    rp-register-policy [ policy-names ];
    static {
      address address {
        override;
        version version;
        group-ranges {
          destination-ip-prefix</prefix-length>;
        }
      }
    }
  }
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the routing device as an actual or potential RP. A routing device can be an RP for more than one group.

The remaining statements are explained separately.

Default If you do not include the **rp** statement, the routing device can never become the RP.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding PIM Sparse Mode on page 3941

rp-register-policy

Syntax

rp-register-policy [*policy-names*];

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim rp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp],
[edit protocols pim rp],
[edit routing-instances *routing-instance-name* protocols pim rp]

Release Information

Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Apply one or more policies to control incoming PIM register messages.

Options

policy-names—Name of one or more import policies.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Register Message Filters on a PIM RP and DR on page 4013
- **dr-register-policy on page 4126**

rp-set

Syntax

```
rp-set {
  address address <forward-msdp-sa>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim local family (inet | inet6) anycast-pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim local family (inet | inet6) anycast-pim],
[edit protocols pim local family (inet | inet6) anycast-pim],
[edit routing-instances *routing-instance-name* protocols pim local family (inet | inet6) anycast-pim]

Release Information

Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure a set of rendezvous point (RP) addresses for anycast RP. You can configure up to 15 RPs.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring PIM Anycast With or Without MSDP on page 3999

rpf-selection

Syntax

```
rpf-selection {
  group group-address {
    sourcesource-address {
      next-hop next-hop-address;
    }
    wildcard-source {
      next-hop next-hop-address;
    }
  }
  prefix-list prefix-list-addresses {
    source source-address {
      next-hop next-hop-address;
    }
    wildcard-source {
      next-hop next-hop-address;
    }
  }
```

Hierarchy Level [edit routing-instances *routing-instance-name* protocols pim]

Release Information Statement introduced in JUNOS Release 10.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the PIM RPF next-hop neighbor for a specific group and source for a VRF routing instance.

The remaining statements are explained separately.

Default If you omit the **rpf-selection** statement, PIM RPF checks typically choose the best path determined by the unicast protocol for all multicast flows.

Options *source-address*—Specific source address for the PIM group.

Required Privilege Level view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

Related Documentation

- *Example: Configuring PIM RPF Selection*

source (PIM RPF Selection)

Syntax

source *source-address* {
  next-hop *next-hop-address*;
}

Hierarchy Level

[edit routing-instances *routing-instance-name* protocols pim rpf-selection group *group-address*],
[edit routing-instances *routing-instance-name* protocols pim rpf-selection prefix-list *prefix-list-addresses*]

Release Information

Statement introduced in JUNOS Release 10.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure the source address for the PIM group.

Options

source-address—Specific source address for the PIM group.

The remaining statements are explained separately.

Required Privilege Level

view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

Related Documentation

- *Example: Configuring PIM RPF Selection*

spt-threshold

Syntax

```
spt-threshold {
  infinity [ policy-names ];
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim]

Release Information

Statement introduced in Junos OS Release 8.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Set the SPT threshold to infinity for a source-group address pair. Last-hop multicast routing devices running PIM sparse mode can forward the same stream of multicast packets onto the same LAN through an RPT rooted at the RP or an SPT rooted at the source. By default, last-hop routing devices transition to a direct SPT to the source. You can configure this routing device to set the SPT transition value to infinity to prevent this transition for any source-group address pair.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring the PIM SPT Threshold Policy on page 4018

static (Protocols PIM)

Syntax

```
static {
  address address {
    group-ranges {
      destination-ip-prefix</prefix-length>;
    }
    override;
    version version;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim rp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp],
[edit protocols pim rp],
[edit routing-instances *routing-instance-name* protocols pim rp]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure static RP addresses. The default static RP address is 224.0.0.0/4. To configure other addresses, include one or more **address** statements. You can configure a static RP in a logical system only if the logical system is not directly connected to a source.

For each static RP address, you can optionally specify the PIM version and the groups for which this address can be the RP. The default PIM version is version 1.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Static PIM RP Address on the Non-RP Routing Device on page 3997

threshold (PIM BFD Detection Time)

Syntax threshold *milliseconds*;

Hierarchy Level [edit protocols pim interface *interface-name* bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*
bfd-liveness-detection detection-time]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the threshold for the adaptation of the BFD session detection time. When the detection time adapts to a value equal to or greater than the threshold, a single trap and a single system log message are sent.

NOTE: The threshold value must be equal to or greater than the transmit interval.

The threshold time must be equal to or greater than the value specified in the minimum-interval or the minimum-receive-interval statement.

Options *milliseconds*—Value for the detection time adaptation threshold.

Range: 1 through 255,000

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD for PIM on page 4021
- bfd-liveness-detection on page 4119
- detection-time on page 4124
- minimum-interval on page 4147
- minimum-receive-interval on page 4149

threshold (PIM BFD Transmit Interval)

Syntax threshold *milliseconds*;

Hierarchy Level [edit protocols pim interface *interface-name* bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* bfd-liveness-detection transmit-interval]

Release Information Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the threshold for the adaptation of the BFD session transmit interval. When the transmit interval adapts to a value greater than the threshold, a single trap and a single system message are sent.

Options *milliseconds*—Value for the transmit interval adaptation threshold.

Range: 0 through 4,294,967,295 (2^{32} – 1)

NOTE: The threshold value specified in the **threshold** statement must be greater than the value specified in the **minimum-interval** statement for the **transmit-interval** statement.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD for PIM on page 4021
- bfd-liveness-detection on page 4119

transmit-interval (PIM BFD Liveness Detection)

Syntax

```
transmit-interval {
  minimum-interval milliseconds;
  threshold milliseconds;
}
```

Hierarchy Level

[edit protocols pim interface *interface-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Specify the transmit interval for the **bfd-liveness-detection** statement. The negotiated transmit interval for a peer is the interval between the sending of BFD packets to peers. The receive interval for a peer is the minimum interval between receiving packets sent from its peer; the receive interval is not negotiated between peers. To determine the transmit interval, each peer compares its configured minimum transmit interval with its peer's minimum receive interval. The larger of the two numbers is accepted as the transmit interval for that peer.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD for PIM on page 4021
- bfd-liveness-detection on page 4119
- threshold on page 4173
- minimum-interval on page 4148
- minimum-receive-interval on page 4149

traceoptions (Protocols PIM)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim],
[edit protocols pim],
[edit routing-instances *routing-instance-name* protocols pim]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure PIM tracing options.

To specify more than one tracing operation, include multiple **flag** statements.

Default

The default PIM trace options are those inherited from the routing protocol's **traceoptions** statement included at the **[edit routing-options]** hierarchy level.

Options

disable—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file ***filename***—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. We recommend that you place tracing output in the **pim-log** file.

files ***number***—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum number of files, you must also include the **size** statement to specify the maximum file size.

Range: 2 through 1000 files

Default: 2 files

flag ***flag***—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

PIM Tracing Flags

- **assert**—Assert messages
- **bidirectional-df-election**—Bidirectional PIM designated-forwarder (DF) election events

- **bootstrap**—Bootstrap messages
- **cache**—Packets in the PIM sparse mode routing cache
- **graft**—Graft and graft acknowledgment messages
- **hello**—Hello packets
- **join**—Join messages
- **mt**—Multicast tunnel messages
- **nsr-synchronization**—Nonstop active routing (NSR) synchronization messages
- **packets**—All PIM packets
- **prune**—Prune messages
- **register**—Register and register stop messages
- **rp**—Candidate RP advertisements
- **all**—All tracing operations
- **general**—A combination of the **normal** and **route** trace operations
- **normal**—All normal operations

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **policy**—Policy operations and actions
- **route**—Routing table changes
- **state**—State transitions
- **task**—Interface transactions and processing
- **timer**—Timer usage

flag-modifier—(Optional) Modifier for the tracing flag. You can specify one or more of these modifiers:

- **detail**—Detailed trace information
- **receive**—Packets being received
- **send**—Packets being transmitted

no-stamp—(Optional) Do not place timestamp information at the beginning of each line in the trace file.

Default: If you omit this option, timestamp information is placed at the beginning of each line of the tracing output.

no-world-readable—(Optional) Do not allow users to read the log file.

replace—(Optional) Replace an existing trace file if there is one.

Default: If you do not include this option, tracing output is appended to an existing trace file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When ***trace-file*** again reaches this size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also include the **files** statement to specify the maximum number of trace files.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 0 KB through the maximum file size supported on your system

Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation

- Configuring PIM Trace Options on page 3980
- *Tracing DVMRP Protocol Traffic*
- Tracing MSDP Protocol Traffic on page 4084
- Configuring PIM Trace Options on page 3980

version (BFD)

Syntax version (0 | 1 | automatic);

Hierarchy Level [edit protocols piminterface *interface-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name* bfd-liveness-detection]

Release Information Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the bidirectional forwarding detection (BFD) protocol version that you want to detect.

Options Configure the BFD version to detect: **1** (BFD version 1) or **automatic** (autodetect the BFD version)

Default: automatic

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BFD for PIM on page 4021

version (PIM)

Syntax

version *version*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* protocols pim rp static address *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols pim rp static address *address*],
[edit protocols pim interface *interface-name*],
[edit protocols pim rp static address *address*],
[edit routing-instances *routing-instance-name* protocols pim interface *interface-name*],
[edit routing-instances *routing-instance-name* protocols pim rp static address *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Specify the version of PIM.

Options

version—PIM version number.

Range: 1 or 2

Default: PIMv1 for rendezvous point (RP) mode (at the **[edit protocols pim rp static address *address*]** hierarchy level). PIMv2 for interface mode (at the **[edit protocols pim interface *interface-name*]** hierarchy level).

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Enabling PIM Sparse Mode on page 3986
- *Configuring PIM Dense Mode Properties*
- *Configuring PIM Sparse-Dense Mode Properties*

wildcard-source (PIM RPF Selection)

Syntax

```
wildcard-source {
  next-hop next-hop-address;
}
```

Hierarchy Level

[edit routing-instances *routing-instance-name* protocols pim rpf-selection group *group-address*],
[edit routing-instances *routing-instance-name* protocols pim rpf-selection prefix-list *prefix-list-addresses*]

Release Information

Statement introduced in Junos OS Release 10.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Use a wildcard for the multicast source instead of (or in addition to) a specific multicast source.

The remaining statements are explained separately.

Required Privilege Level

view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

Related Documentation

- *Example: Configuring PIM RPF Selection*

IGMP Configuration Statements

- query-interval (Protocols IGMP) on page 4194
- query-last-member-interval (Protocols IGMP) on page 4195
- query-response-interval (Protocols IGMP) on page 4196
- robust-count (Protocols IGMP) on page 4197
- source (Protocols IGMP) on page 4198
- source-count (Protocols IGMP) on page 4199
- source-increment (Protocols IGMP) on page 4199
- static (Protocols IGMP) on page 4200
- traceoptions (Protocols IGMP) on page 4201
- version (Protocols IGMP) on page 4203

accounting (Protocols IGMP)

Syntax accounting;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp],
[edit protocols igmp]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable the collection of IGMP join and leave event statistics on the system.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Recording IGMP Join and Leave Events on page 4043

accounting (Protocols IGMP Interface)

Syntax (accounting | no-accounting);

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable or disable the collection of IGMP join and leave event statistics for an interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Recording IGMP Join and Leave Events on page 4043

asm-override-ssm

Syntax asm-override-ssm;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options multicast]

Release Information Statement introduced in Junos OS Release 9.4.
Statement introduced in Junos OS Release 9.5 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Enable the routing device to accept any-source multicast join messages (*,G) for group addresses that are within the default or configured range of source-specific multicast groups.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Source-Specific Multicast Groups with Any-Source Override on page 4103

disable (Protocols IGMP)

Syntax disable;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Disable IGMP on the system.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Disabling IGMP on page 4047

exclude (Protocols IGMP)

Syntax exclude;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name* static group *multicast-group-address*],
[edit protocols igmp interface *interface-name* static group *multicast-group-address*]

Release Information Statement introduced in Junos OS Release 9.3.

Description Configure the static group to operate in exclude mode. In exclude mode all sources except the address configured are accepted for the group. If this statement is not included, the group operates in include mode.

Required Privilege Level view-level—To view this statement in the configuration.
control-level—To add this statement to the configuration.

Related Documentation

- Enabling IGMP Static Group Membership on page 4036

group (Protocols IGMP)

Syntax

```
group multicast-group-address {
  exclude;
  group-count number;
  group-increment increment;
  source ip-address {
    source-count number;
    source-increment increment;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols igmp interface *interface-name* static],
[edit protocols igmp interface *interface-name* static]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Specify the IGMP multicast group address and (optionally) the source address for the multicast group being statically configured on an interface.

NOTE: You must specify a unique address for each group.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Enabling IGMP Static Group Membership on page 4036

group-count (Protocols IGMP)

Syntax group-count *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name* static group *multicast-group-address*],
[edit protocols igmp interface *interface-name* static group *multicast-group-address*]

Release Information Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the number of static groups to be created.

Options *number*—Number of static groups.

Default:

Range: 1 through 512

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Enabling IGMP Static Group Membership on page 4036

group-increment (Protocols IGMP)

Syntax group-increment *increment*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name* static group *multicast-group-address*],
[edit protocols igmp interface *interface-name* static group *multicast-group-address*]

Release Information Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the number of times the address should be incremented for each static group created. The increment is specified in dotted decimal notation similar to an IPv4 address.

Options *increment*—Number of times the address should be incremented.

Default: 0.0.0.1

Range: 0.0.0.1 through 255.255.255.255

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Enabling IGMP Static Group Membership on page 4036

group-limit

Syntax group-limit *limit*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information Statement introduced in Junos OS Release 10.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure a limit for the number of multicast groups (or [S,G] channels in IGMPv3) allowed on an interface. After this limit is reached, new reports are ignored and all related flows are not flooded on the interface.

To confirm the configured group limit on the interface, use the show igmp interface command.

Default By default, there is no limit to the number of multicast groups that can join the interface.

Options *limit*—group limit value for the interface.

Range: 1 through 32767

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Limiting the Number of IGMP Multicast Group Joins on Logical Interfaces on page 4044
- *group-threshold*
- *log-interval*

group-policy (Protocols IGMP)

Syntax group-policy [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information Statement introduced in Junos OS Release 9.1.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description When this statement is enabled on a router running IGMP version 2 (IGMPv2) or version 3 (IGMPv3), after the router receives an IGMP report, the router compares the group against the specified group policy and performs the action configured in that policy (for example, rejects the report).

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Filtering Unwanted IGMP Reports at the IGMP Interface Level on page 4032

igmp

Syntax

```
igmp {
  accounting;
  interface interface-name {
    disable;
    (accounting | no-accounting);
    group-limit limit;
    group-policy [ policy-names ];
    group-threshold
    immediate-leave;
    log-interval
    oif-map map-name;
    passive;
    promiscuous-mode;
    ssm-map ssm-map-name;
    ssm-map-policy ssm-map-policy-name;
    static {
      group multicast-group-address {
        exclude;
        group-count number;
        group-increment increment;
        source ip-address {
          source-count number;
          source-increment increment;
        }
      }
    }
    version version;
  }
  query-interval seconds;
  query-last-member-interval seconds;
  query-response-interval seconds;
  robust-count number;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols],
[edit protocols]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description

Enable IGMP on the router or switch. IGMP must be enabled for the router or switch to receive multicast packets.

The remaining statements are explained separately.

Default IGMP is disabled on the router or switch. IGMP is automatically enabled on all broadcast interfaces when you configure Protocol Independent Multicast (PIM) or Distance Vector Multicast Routing Protocol (DVMRP).

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Enabling IGMP on page 4028

immediate-leave (Protocols IGMP)

Syntax immediate-leave;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description The immediate leave setting is useful for minimizing the leave latency of IGMP memberships. When this setting is enabled, the routing device leaves the multicast group immediately after the last host leaves the multicast group.

Starting in Junos OS Release 9.3, both IGMP version 2 and IGMP version 3 do host tracking when the **immediate-leave** statement is configured. This means that the multicast group leaves only when the last host leaves. The routing device keeps track of the hosts that send join messages. This allows IGMP to determine when the last host sends a leave message for the multicast group.

When the immediate leave setting is enabled, the device removes an interface from the forwarding-table entry without first sending IGMP group-specific queries to the interface. The interface is pruned from the multicast tree for the multicast group specified in the IGMP leave message. The immediate leave setting ensures optimal bandwidth management for hosts on a switched network, even when multiple multicast groups are being used simultaneously.

When immediate leave is disabled and one host sends a leave group message, the routing device first sends a group query to determine if another receiver responds. If no receiver responds, the routing device removes all hosts on the interface from the multicast group. Immediate leave is disabled by default for both IGMP version 2 and IGMP version 3.

NOTE: Although host tracking is enabled for IGMPv2 and MLDv1 when you enable immediate leave, use immediate leave with these versions only when there is one host on the interface. The reason is that IGMPv2 and MLDv1 use a report suppression mechanism whereby only one host on an interface sends a group join report in response to a membership query. The other interested hosts suppress their reports. The purpose of this mechanism is to avoid a flood of reports for the same group. But it also interferes with host tracking, because the routing device only knows about the one interested host and does not know about the others.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Specifying Immediate-Leave Host Removal for IGMP on page 4031

interface (Protocols IGMP)

Syntax

```
interface interface-name {
  disable;
  (accounting | no-accounting);
  group-limit limit;
  group-policy [ policy-names ];
  immediate-leave;
  oif-map map-name;
  passive;
  promiscuous-mode;
  ssm-map ssm-map-name;
  ssm-map-policy ssm-map-policy-name;
  static {
    group multicast-group-address {
      exclude;
      group-count number;
      group-increment increment;
      source ip-address {
        source-count number;
        source-increment increment;
      }
    }
  }
  version version;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols igmp],
[edit protocols igmp]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Enable IGMP on an interface and configure interface-specific properties.

Options

interface-name—Name of the interface. Specify the full interface name, including the physical and logical address components. To configure all interfaces, you can specify **all**.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Enabling IGMP on page 4028

maximum-transmit-rate (Protocols IGMP)

Syntax maximum-transmit-rate *packets-per-second*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp],
[edit protocols igmp]

Release Information Statement introduced in Junos OS Release 9.3.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Limit the transmission rate of IGMP packets

Options packets-per-second—Maximum number of IGMP packets transmitted in one second by the routing device.

Range: 1 through 10000

Default: 500 packets

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Limiting the Maximum IGMP Message Rate on page 4036

oif-map

Syntax oif-map *map-name*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Associates an outgoing interface (OIF) map to the IGMP interface. The OIF map is a routing policy statement that can contain multiple terms.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Multicast with Subscriber VLANs*

passive (IGMP)

Syntax passive <allow-receive> <send-general-query> <send-group-query>;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information Statement introduced in Junos OS Release 9.6.
allow-receive, **send-general-query**, and **send-group-query** options were added in Junos OS Release 10.0.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify that IGMP run on the interface and either not send and receive control traffic or selectively send and receive control traffic such as IGMP reports, queries, and leaves.

NOTE: You can selectively activate up to two out of the three available options for the **passive** statement while keeping the other functions passive (inactive). Activating all three options would be equivalent to not using the **passive** statement.

Options **allow-receive**—Enables IGMP to receive control traffic on the interface.

send-general-query—Enables IGMP to send general queries on the interface.

send-group-query—Enables IGMP to send group-specific and group-source-specific queries on the interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Multicast with Subscriber VLANs*
- Enabling IGMP on page 4028

promiscuous-mode (Protocols IGMP)

Syntax promiscuous-mode;

Hierarchy Level [edit dynamic-profiles *profile-name* protocols igmp interface *interface-name*],
[edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 9.2 for dynamic profiles.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify that the interface accepts IGMP reports from hosts on any subnetwork. Note that when enabling promiscuous-mode, all routing devices on the ethernet segment must be configured with the promiscuous mode statement. Otherwise, only the interface configured with lowest IPv4 address acts as the querier for IGMP for this Ethernet segment.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring a Dynamic Profile for Client Access*
- Accepting IGMP Messages from Remote Subnetworks on page 4033

query-interval (Protocols IGMP)

Syntax query-interval *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp],
[edit protocols igmp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify how often the querier routing device sends general host-query messages.

Options *seconds*—Time interval.

Range: 1 through 1024

Default: 125 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Modifying the IGMP Host-Query Message Interval on page 4030
- query-last-member-interval (Protocols IGMP) on page 4195
- query-response-interval (Protocols IGMP) on page 4196

query-last-member-interval (Protocols IGMP)

Syntax query-last-member-interval *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp],
[edit protocols igmp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify how often the querier routing device sends group-specific query messages.

Options *seconds*—Time interval, in fractions of a second or seconds.

Range: 0.1 through 0.9, then in 1-second intervals 1 through 999999

Default: 1 second

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Modifying the IGMP Last-Member Query Interval on page 4030
- **query-interval (Protocols IGMP) on page 4194**
- **query-response-interval (Protocols IGMP) on page 4196**

query-response-interval (Protocols IGMP)

Syntax query-response-interval *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp],
[edit protocols igmp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify how long the querier routing device waits to receive a response to a host-query message from a host.

Options *seconds*—The query response interval must be less than the query interval.

Range: 1 through 1024

Default: 10 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Modifying the IGMP Query Response Interval on page 4034
- **query-interval (Protocols IGMP) on page 4194**
- **query-last-member-interval (Protocols IGMP) on page 4195**

robust-count (Protocols IGMP)

Syntax robust-count *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp],
[edit protocols igmp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Tune the expected packet loss on a subnet. This factor is used to calculate the group member interval, other querier present interval, and last-member query count.

Options *number*—Robustness variable.

Range: 2 through 10

Default: 2

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Modifying the IGMP Robustness Variable on page 4035

source (Protocols IGMP)

Syntax

```
source ip-address {
  source-count number;
  source-increment increment;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols igmp interface *interface-name* static group *multicast-group-address*],
[edit protocols igmp interface *interface-name* static group *multicast-group-address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Specify the IP version 4 (IPv4) unicast source address for the multicast group being statically configured on an interface.

Options

ip-address—IPv4 unicast address.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Enabling IGMP Static Group Membership on page 4036

source-count (Protocols IGMP)

Syntax
source-count *number*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols igmp interface *interface-name* static group *multicast-group-address* source],
[edit protocols igmp interface *interface-name* static group *multicast-group-address* source]

Release Information
Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description
Configure the number of multicast source addresses that should be accepted for each static group created.

Options
number—Number of source addresses.

Default: 1

Range: 1 through 1024

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Enabling IGMP Static Group Membership on page 4036

source-increment (Protocols IGMP)

Syntax
source-increment *number*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols igmp interface *interface-name* static group *multicast-group-address* source],
[edit protocols igmp interface *interface-name* static group *multicast-group-address* source]

Release Information
Statement introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description
Configure the number of times the multicast source address should be incremented for each static group created. The increment is specified in dotted decimal notation similar to an IPv4 address.

Options
increment—Number of times the source address should be incremented.

Default: 0.0.0.1

Range: 0.0.0.1 through 255.255.255.255

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Enabling IGMP Static Group Membership on page 4036

static (Protocols IGMP)

Syntax

```
static {
  group multicast-group-address {
    exclude;
    group-count number;
    group-increment increment;
    source ip-address {
      source-count number;
      source-increment increment;
    }
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Test multicast forwarding on an interface without a receiver host.

The **static** statement simulates IGMP joins on a routing device statically on an interface without any IGMP hosts. It is supported for both IGMPv2 and IGMPv3 joins. This statement is especially useful for testing multicast forwarding on an interface without a receiver host.

NOTE: To prevent joining too many groups accidentally, the **static** statement is not supported with the **interface all** statement.

The remaining statements are explained separately.

Required Privilege Level

routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation

- Enabling IGMP Static Group Membership on page 4036

traceoptions (Protocols IGMP)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols igmp],
[edit protocols igmp]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure IGMP tracing options.

To specify more than one tracing operation, include multiple **flag** statements.

To trace the paths of multicast packets, use the **mtrace** command.

Default

The default IGMP trace options are those inherited from the routing protocols **traceoptions** statement included at the **[edit routing-options]** hierarchy level.

Options

disable—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *filename*—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. We recommend that you place tracing output in the file **igmp-log**.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum number of files, you must also include the **size** statement to specify the maximum file size.

Range: 2 through 1000 files

Default: 2 files

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

IGMP Tracing Flags

- **leave**—Leave group messages (for IGMP version 2 only).
- **mtrace**—Mtrace packets. Use the **mtrace** command to troubleshoot the software.
- **packets**—All IGMP packets.

- **query**—IGMP membership query messages, including general and group-specific queries.
- **report**—Membership report messages.

Global Tracing Flags

- **all**—All tracing operations
- **general**—A combination of the **normal** and **route** trace operations
- **normal**—All normal operations

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **policy**—Policy operations and actions
- **route**—Routing table changes
- **state**—State transitions
- **task**—Interface transactions and processing
- **timer**—Timer usage

flag-modifier—(Optional) Modifier for the tracing flag. You can specify one or more of these modifiers:

- **detail**—Detailed trace information
- **receive**—Packets being received
- **send**—Packets being transmitted

no-stamp—(Optional) Do not place timestamp information at the beginning of each line in the trace file.

Default: If you omit this option, timestamp information is placed at the beginning of each line of the tracing output.

no-world-readable—(Optional) Do not allow users to read the log file.

replace—(Optional) Replace an existing trace file if there is one.

Default: If you do not include this option, tracing output is appended to an existing trace file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When ***trace-file*** again reaches this size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also include the **files** statement to specify the maximum number of trace files.

Syntax: ***xk*** to specify KB, ***xm*** to specify MB, or ***xg*** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level
routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation
- Tracing IGMP Protocol Traffic on page 4045

version (Protocols IGMP)

Syntax
version *version*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description
Specify the version of IGMP.

Options
version—IGMP version number.

Range: 1, 2, or 3

Default: IGMP version 2

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Changing the IGMP Version on page 4029

IGMP Snooping Configuration Statements

- multicast-router-interface (IGMP Snooping) on page 4209
- proxy (Multicast VLAN Registration) on page 4209
- receiver on page 4210
- robust-count (IGMP Snooping) on page 4210
- source (Multicast VLAN Registration) on page 4211
- source-address (IGMP Querier) on page 4211
- source-vlans on page 4212
- static (IGMP Snooping) on page 4212
- traceoptions (IGMP Snooping) on page 4213
- version (IGMP Snooping) on page 4215

data-forwarding

Syntax

```
data-forwarding {
  receiver {
    source-vlans vlan-list;
    install;
  }
  source {
    groups group-prefix;
  }
}
```

Hierarchy Level [edit protocols igmp-snooping vlan (all | *vlan-name*)]

Release Information Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure the VLAN to be a multicast source VLAN (MVLAN) or a multicast VLAN registration (MVR) receiver VLAN. Each data-forwarding VLAN, which can be a multicast source VLAN (MVLAN) or a multicast receiver VLAN, must have exactly one source statement or exactly one receiver statement. A data-forwarding VLAN can operate only in IGMP version 2 (IGMPv2) mode.

The remaining statements are explained separately.

Default Disabled

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Multicast VLAN Registration on page 4054
- Configuring Multicast VLAN Registration (CLI Procedure) on page 4053

disable (IGMP Snooping)

Syntax disable;

Hierarchy Level [edit protocols igmp-snooping vlan *vlan-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Disable IGMP snooping on all interfaces in a VLAN.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048

group (IGMP Snooping)

Syntax group *ip-address*;

Hierarchy Level [edit protocols igmp-snooping vlan *vlan-name* interface *interface-name* static]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a static multicast group using a valid IP multicast address.

Default None.

Options *ip-address* —IP address of the multicast group receiving data on an interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show igmp-snooping vlans on page 4312
- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048

groups (Multicast VLAN Registration)

Syntax groups *group-prefix*;

Hierarchy Level [edit protocols igmp-snooping vlan (all | *vlan-name*) data-forwarding source]

Release Information Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Specify the IP address range of the multicast VLAN (MVLAN) source interfaces.

Default Disabled

Options *group-prefix*—IP address range of the source group. Each MVLAN must have exactly one **groups** statement. If there are multiple MVLANs on the switch, their group ranges must be unique.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Multicast VLAN Registration on page 4054
- Configuring Multicast VLAN Registration (CLI Procedure) on page 4053

igmp-querier

Syntax igmp-querier source-address*source address*;

Hierarchy Level [edit protocols igmp-snooping vlan *vlan-name*]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure the switch to be an IGMP querier. If there are any multicast routers on the same local network, make sure the source address for the IGMP querier is greater (a higher number) than the IP addresses for those routers on the network. This ensures that switch is always the IGMP querier on the network.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048
- show igmp-snooping vlans on page 4312
- show configuration protocols igmp on page 4292

igmp-snooping

Syntax

```
igmp-snooping {
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable> <match
      regex>;
    flag flag (detail | disable | receive | send);
  }
  vlan vlan-name {
    data-forwarding {
      source {
        groups group-prefix;
      }
      receiver {
        source-vlans vlan-list;
        install ;
      }
    }
    disable;
    immediate-leave;
    interface interface-name {
      multicast-router-interface;
      static {
        group ip-address;
      }
    }
    robust-count number;
    version number;
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
version statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable and configure IGMP snooping.

The remaining statements are explained separately.

Default IGMP snooping is disabled by default.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048

install (Multicast VLAN Registration)

Syntax install;

Hierarchy Level [edit protocols igmp-snooping vlan (all | *vlan-name*) data-forwarding receiver]

Release Information Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Install forwarding entries in the multicast receiver VLAN. By default, the multicast VLAN (MVLAN) installs forwarding entries for MVLAN groups only.

Default Disabled

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Multicast VLAN Registration on page 4054
- Configuring Multicast VLAN Registration (CLI Procedure) on page 4053

interface (IGMP Snooping)

Syntax

```
interface interface-name {
  multicast-router-interface;
  static {
    group ip-address;
  }
}
```

Hierarchy Level [edit protocols igmp-snooping vlan *vlan-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Enable IGMP snooping on an interface and configure interface-specific properties.

The remaining statements are explained separately.

Options *interface-name*—Name of the interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048
- show igmp-snooping vlans on page 4312

multicast-router-interface (IGMP Snooping)

Syntax multicast-router-interface;

Hierarchy Level [edit protocols igmp-snooping vlan *vlan-name* interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure an interface to forward IGMP messages to multicast routers.

Default Disabled. If this statement is disabled, the interface drops IGMP messages it receives.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show igmp-snooping vlans on page 4312**
- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048

proxy (Multicast VLAN Registration)

Syntax proxy source-address *ip-address*;

Hierarchy Level [edit protocols igmp-snooping vlan (all | *vlan-name*)]

Release Information Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Specify that the VLAN operate in proxy mode. The proxy option is supported only for a VLAN acting as a data-forwarding source.

Default Disabled

Options **source-address** ***ip-address***—IP address of the source VLAN to act as proxy.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Multicast VLAN Registration on page 4054
- Configuring Multicast VLAN Registration (CLI Procedure) on page 4053

receiver

Syntax

```
receiver {
  source-vlans vlan-list;
  install;
}
```

Hierarchy Level [edit protocols igmp-snooping vlan (all | *vlan-name*) data-forwarding]

Release Information Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure a VLAN as a multicast receiver VLAN of the multicast VLAN (MVLAN).

The remaining statements are explained separately.

Default Disabled

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Multicast VLAN Registration on page 4054
- Configuring Multicast VLAN Registration (CLI Procedure) on page 4053

robust-count (IGMP Snooping)

Syntax robust-count *number*;

Hierarchy Level [edit protocols igmp-snooping vlan *vlan-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the number of intervals the switch waits before removing a multicast group from the multicast forwarding table. Configure the length of each interval using the **query-interval** statement.

Default 2 intervals

Options *number*—Number of intervals the switch waits before timing out a multicast group.

Range: 2 through 10

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048
- **show igmp-snooping vlans on page 4312**

source (Multicast VLAN Registration)

Syntax

```
source {
  groups group-prefix;
}
```

Hierarchy Level [edit protocols igmp-snooping vlan (all | *vlan-name*) data-forwarding]

Release Information Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure a VLAN to be a multicast source VLAN (MVLAN).

The remaining statement is explained separately.

Default Disabled

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Multicast VLAN Registration on page 4054
- Configuring Multicast VLAN Registration (CLI Procedure) on page 4053

source-address (IGMP Querier)

Syntax src-address *source address*;

Hierarchy Level [edit protocols igmp-snooping vlan *vlan-name* igmp-querier]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure the address that the switch uses as the source address in the IGMP queries that it sends. If there are any multicast routers on the same local network, make sure the source address for the IGMP querier is greater (a higher number) than the IP addresses for those routers on the network. This ensures that switch is always the IGMP querier on the network.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048
- show igmp-snooping vlans on page 4312
- show configuration protocols igmp on page 4292

source-vlans

Syntax source-vlans *vlan-list*;

Hierarchy Level [edit protocols igmp-snooping vlan (all | *vlan-name*) data-forwarding receiver]

Release Information Statement introduced in Junos OS Release 9.6 for EX Series switches.
Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Specify a list of multicast VLANs (MVLANs) from which this multicast receiver VLAN receives multicast traffic. Either all of these MVLANs must be in proxy mode or none of them can be in proxy mode.

Default Disabled

Options *vlan-list*—Names of the MVLANs.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Multicast VLAN Registration on page 4054
- Configuring Multicast VLAN Registration (CLI Procedure) on page 4053

static (IGMP Snooping)

Syntax

```
static {
  group ip-address;
}
```

Hierarchy Level [edit protocols igmp-snooping vlan *vlan-name* interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Statically define multicast groups on an interface.

The remaining statement is explained separately.

Default No multicast groups are statically defined.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048
- **show igmp-snooping vlans on page 4312**

traceoptions (IGMP Snooping)

Syntax

```
traceoptions {
  file filename <files number> <no-stamp> <size size> <replace> <world-readable |
    no-world-readable>;
  flag flag (detail | disable | receive | send);
}
```

Hierarchy Level

For platforms without ELS:

[edit protocols igmp-snooping]

For platforms with ELS:

[edit protocols igmp-snooping vlan]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Define tracing operations for IGMP snooping.

Default

The **traceoptions** feature is disabled by default.

Options

file ***filename***—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**.

files ***number***—(Optional) Maximum number of trace files. When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**, then **trace-file.1**, and so on, until the maximum number of trace files is reached (***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify gigabytes), at which point the oldest trace file is overwritten. If you specify a maximum number of files, you also must specify a maximum file size with the **size** option.

Range: 2 through 1000

Default: 3 files

flag ***flag*** —Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. You can include the following flags:

- **all**—All tracing operations.
- **general**—Trace general IGMP snooping protocol events.
- **krt**—Trace communication over routing sockets.
- **nexthop**— Trace next-hop related events.
- **normal**—Trace normal IGMP snooping protocol events.
- **packets**—Trace all IGMP packets.
- **policy**—Trace policy processing.
- **query**—Trace IGMP membership query messages.
- **report**—Trace membership report messages.

- **route**—Trace routing information.
- **state**—Trace IGMP state transitions.
- **task**—Trace routing protocol task processing.
- **timer**—Trace routing protocol timer processing.
- **vlan**—Trace VLAN related events.

no-stamp—(Optional) Do not time stamp trace file.

no-world-readable—(Optional) Restrict file access to the user who created the file.

size ***size*** —(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**, then **trace-file.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten. If you specify a maximum number of files, you also must specify a maximum file size with the **files** option. Use ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify gigabytes.

Range: 10 KB through 1 gigabytes

Default: 128 KB

world-readable—(Optional) Enable unrestricted file access.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048

version (IGMP Snooping)

Syntax version *number*;

Hierarchy Level [edit protocols igmp-snooping vlan (all | *vlan-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the IGMP version for the IGMP general query that the switch sends to hosts when an interface comes up. The configured IGMP version affects only the version of the general queries sent by a switch. It does not affect the version of IGMP messages that the switch can snoop. For example, If the switch is configured for IGMP version 1 (IGMPv1), it can snoop IGMPv2 and IGMPv3 messages.

Default If you do not configure the **version** statement, the default is IGMPv2.

Options *version*—IGMP version number.

Range: 1 and 2.

NOTE: IGMP v3 snooping is not supported.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring IGMP Snooping (CLI Procedure)*
- Configuring IGMP Snooping on page 4048

IGMP Snooping Configuration Statements (Original CLI Only)

disable (IGMP Snooping)

Syntax disable;

Hierarchy Level [edit protocols igmp-snooping vlan *vlan-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Disable IGMP snooping on all interfaces in a VLAN.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048

igmp-snooping

Syntax

```
igmp-snooping {
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable> <match
      regex>;
    flag flag (detail | disable | receive | send);
  }
  vlan vlan-name {
    data-forwarding {
      source {
        groups group-prefix;
      }
      receiver {
        source-vlans vlan-list;
        install ;
      }
    }
    disable;
    immediate-leave;
    interface interface-name {
      multicast-router-interface;
      static {
        group ip-address;
      }
    }
    robust-count number;
    version number;
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
version statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable and configure IGMP snooping.

The remaining statements are explained separately.

Default IGMP snooping is disabled by default.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048

immediate-leave (IGMP Snooping)

Syntax immediate-leave;

Hierarchy Level [edit protocols igmp-snooping vlan *vlan-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description After the switch receives a leave group membership message from a host, immediately remove the group membership from the interface and suppress the sending of any group-specific queries for the multicast group.

NOTE: When configuring this statement, ensure that the IGMP interface has only one IGMPv2 host connected. If more than one IGMPv2 host is connected to the switch through the same interface and one of the hosts sends a leave message, the switch removes all hosts on the interface from the multicast group. The switch loses contact with the hosts in the multicast group that did not send a leave message until they send join requests in response to the next general multicast listener query from the router.

Default The immediate-leave feature is disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048
- show igmp-snooping vlans on page 4312

vlan (IGMP Snooping)

Syntax

```
vlan vlan-name {
  immediate-leave;
  interface interface-name {
    multicast-router-interface;
    static {
      group ip-address;
    }
  }
  version number;
}
```

Hierarchy Level [edit protocols igmp-snooping]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
version statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure IGMP snooping parameters for a VLAN.

The remaining statements are explained separately.

TIP: To display a list of all configured VLANs on the system, including VLANs that are configured but not committed, type ? after vlan or vlans in your configuration mode command line. Note that only one VLAN is displayed for a VLAN range. For IGMP snooping, secondary private VLANs are not listed.

Default IGMP snooping options apply to the specified VLAN.

Options *vlan-name*—Name of a VLAN.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048
- show igmp-snooping vlans on page 4312

IGMP Snooping Configuration Statements (ELS CLI Only)

- interface (Bridge Domains) on page 4224
- l2-querier on page 4225
- query-interval (Bridge Domains) on page 4226
- query-last-member-interval (Bridge Domains) on page 4227
- query-response-interval (Bridge Domains) on page 4228
- source-address on page 4229
- vlan (IGMP Snooping) on page 4230

group-limit

Syntax group-limit *limit*;

Hierarchy Level [edit bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols vlan *vlan-id* igmp-snooping interface *interface-name*]
[edit protocols igmp-snooping vlan interface]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Configure a limit for the number of multicast groups (or [S,G] channels in IGMPv3) allowed on an interface. After this limit is reached, new reports are ignored and all related flows are not flooded on the interface.

Default By default, there is no limit to the number of multicast groups joining an interface.

Options *limit*—a 32-bit number for the limit on the interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring IGMP Snooping*

host-only-interface

Syntax host-only-interface;

Hierarchy Level [edit bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols vlan *vlan-id* igmp-snooping interface *interface-name*]
[edit protocols igmp-snooping vlan interface]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Configure an interface as a host-facing interface. IGMP queries received on these interfaces are dropped.

Default The interface can either be a host-side or multicast-routing device interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring IGMP Snooping*
- *multicast-router-interface*

igmp-snooping

Syntax

```
igmp-snooping {
  vlan vlan-id {
    immediate-leave;
    interface interface-name {
      group-limit limit;
      host-only-interface;
      immediate-leave;
      multicast-router-interface;
      static {
        group ip-address {
          source ip-address;
        }
      }
    }
    l2-querier {
      source-address ip-address;
    }
    proxy {
      source-address ip-address;
    }
    query-interval seconds;
    query-last-member-interval seconds;
    query-response-interval seconds;
    robust-count number;
    traceoptions {
      file filename <files number> <no-stamp> <replace> <size size> <world-readable |
        no-world-readable>;
      flag flag <flag-modifier>;
    }
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Enable IGMP snooping on the router or switch.

Default IGMP snooping is disabled on the router or switch.

Options The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Understanding IGMP Snooping*
- *IGMP Snooping in MC-LAG Active-Active on MX Series Routers Overview*

immediate-leave (Bridge Domains)

Syntax immediate-leave;

Hierarchy Level [edit bridge-domains *bridge-domain-name* protocols igmp-snooping],
[edit bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols vlan *vlan-id* igmp-snooping interface *interface-name*]
[edit protocols igmp-snooping vlan interface]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description The immediate leave setting is useful for minimizing the leave latency of IGMP memberships. When this setting is enabled, the routing device leaves the multicast group immediately after the last host leaves the multicast group.

The immediate-leave setting enables host tracking, meaning that the device keeps track of the hosts that send join messages. This allows IGMP to determine when the last host sends a leave message for the multicast group.

When the immediate leave setting is enabled, the device removes an interface from the forwarding-table entry without first sending IGMP group-specific queries to the interface. The interface is pruned from the multicast tree for the multicast group specified in the IGMP leave message. The immediate leave setting ensures optimal bandwidth management for hosts on a switched network, even when multiple multicast groups are being used simultaneously.

When immediate leave is disabled and one host sends a leave group message, the routing device first sends a group query to determine if another receiver responds. If no receiver responds, the routing device removes all hosts on the interface from the multicast group. Immediate leave is disabled by default for both IGMP version 2 and IGMP version 3.

NOTE: Although host tracking is enabled for IGMPv2 and MLDv1 when you enable immediate leave, use immediate leave with these versions only when there is one host on the interface. The reason is that IGMPv2 and MLDv1 use a report suppression mechanism whereby only one host on an interface sends a group join report in response to a membership query. The other interested hosts suppress their reports. The purpose of this mechanism is to avoid a flood of reports for the same group. But it also interferes with host tracking, because the routing device only knows about the one interested host and does not know about the others.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring IGMP Snooping*

interface (Bridge Domains)

Syntax

```
interface interface-name {
  group-limit limit;
  host-only-interface;
  multicast-router-interface;
  static {
    group ip-address {
      source ip-address;
    }
  }
}
```

Hierarchy Level
[edit bridge-domains *bridge-domain-name* protocols igmp-snooping],
[edit bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols vlan *vlan-id* igmp-snooping]
[edit protocols igmp-snooping vlan],

Release Information
Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description
Enable IGMP snooping on an interface and configure interface-specific properties.

Options
interface-name—Name of the interface. Specify the full interface name, including the physical and logical address components. To configure all interfaces, you can specify **all**.

The remaining statements are explained separately.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring IGMP Snooping*

l2-querier

Syntax

```
l2-querier {
  source-address ip-address;
}
```

Hierarchy Level [edit protocols igmp-snooping vlan],

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure the switch to be an IGMP querier. Also configure the source address to use for IGMP snooping queries

Options *seconds*—Time interval.

Range: 1 through 1024

Default: 125 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

query-interval (Bridge Domains)

Syntax query-interval *seconds*;

Hierarchy Level [edit bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id* interface *interface-name*]
[edit protocols igmp-snooping vlan]

Release Information Statement introduced before Junos OS Release 8.5.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Configure the interval for host-query message timeouts.

Options *seconds*—Time interval.

Range: 1 through 1024

Default: 125 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring IGMP Snooping*
- query-last-member-interval (Bridge Domains) on page 4227
- query-response-interval (Bridge Domains) on page 4228

query-last-member-interval (Bridge Domains)

Syntax query-last-member-interval *seconds*;

Hierarchy Level [edit bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id* interface *interface-name*]
[edit protocols igmp-snooping vlan],

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Configure the interval for group-specific query timeouts.

Options *seconds*—Time interval, in fractions of a second or seconds.

Range: 0.1 through 0.9, then in 1-second intervals 1 through 1024

Default: 1 second

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring IGMP Snooping*
- query-interval on page 4226
- query-response-interval on page 4228

query-response-interval (Bridge Domains)

Syntax

query-response-interval *seconds*;

Hierarchy Level

[edit bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id* interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id* interface *interface-name*]
[edit protocols igmp-snooping vlan],

Release Information

Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description

Specify how long to wait to receive a response to a specific query message from a host.

Options

seconds—Time interval. This interval must be less than the host-query interval.

Range: 1 through 1024

Default: 10 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring IGMP Snooping*
- query-interval (Bridge Domains) on page 4226
- query-last-member-interval (Bridge Domains) on page 4227

source-address

Syntax source-address *ip-address*;

Hierarchy Level [edit bridge-domains *bridge-domain-name* protocols igmp-snooping proxy],
[edit bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id* proxy],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping proxy],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* protocols igmp-snooping vlan *vlan-id* proxy]
[edit protocols igmp-snooping vlan [edit protocols igmp-snooping l2-querier]

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Specify the IP address to use as the source for IGMP snooping reports in proxy mode. Reports are sent with address 0.0.0.0 as the source address unless there is a source address configured.

Options ***ip-address***—IP address to use as the source for proxy-mode IGMP snooping reports.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring IGMP Snooping*

vlan (IGMP Snooping)

Syntax

```
vlan vlan-id {
  immediate-leave;
  interface interface-name {
    group-limit limit;
    host-only-interface;
    multicast-router-interface;
    static {
      group multicast-group-address {
        source ip-address;
      }
    }
  }
  proxy {
    source-address ip-address;
  }
  query-interval seconds;
  query-last-member-interval seconds;
  query-response-interval seconds;
  robust-count number;
}
```

Hierarchy Level [edit protocols igmp-snooping],

Release Information Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Configure IGMP snooping parameters for a particular VLAN.

Default By default, IGMP snooping options apply to all VLANs.

Options *vlan-id*—Apply the parameters to this VLAN.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring VLAN-Specific IGMP Snooping Parameters on page 4059
- igmp-snooping on page 4222

MSDP Configuration Statements

active-source-limit

Syntax

```
active-source-limit {
  log-interval seconds;
  log-warning value;
  maximum number;
  threshold number;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* protocols msdp peer *address*],
[edit logical-systems *logical-system-name* protocols msdp source *ip-address/prefix-length*],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp source *ip-address/prefix-length*],
[edit protocols msdp],
[edit protocols msdp group *group-name* peer *address*],
[edit protocols msdp peer *address*],
[edit protocols msdp source *ip-address/prefix-length*],
[edit routing-instances *routing-instance-name* protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp source *ip-address/prefix-length*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Limit the number of active source messages the routing device accepts.

Default

If you do not include this statement, the router accepts any number of MSDP active source messages.

Options

The options are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring MSDP with Active Source Limits and Mesh Groups on page 4088

authentication-key

Syntax

authentication-key *peer-key*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* protocols msdp peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp peer *address*],
[edit protocols msdp group *group-name* peer *address*],
[edit protocols msdp peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp peer *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Associate a Message Digest 5 (MD5) signature option authentication key with an MSDP peering session.

Default

If you do not include this statement, the routing device accepts any valid MSDP messages from the peer address.

Options

peer-key—MD5 authentication key. The peer key can be a text string up to 16 letters and digits long. Strings can include any ASCII characters with the exception of (,), &, and [. If you include spaces in an MSDP authentication key, enclose all characters in quotation marks (“ ”).

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring MSDP in a Routing Instance*

data-encapsulation

Syntax data-encapsulation (disable | enable);

Hierarchy Level [edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp],
[edit protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure a rendezvous point (RP) using MSDP to encapsulate multicast data received in MSDP register messages inside forwarded MSDP source-active messages.

Default If you do not include this statement, the RP encapsulates multicast data.

Options **disable**—(Optional) Do not use MSDP data encapsulation.

enable—Use MSDP data encapsulation.

Default: **enable**

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring MSDP with Active Source Limits and Mesh Groups on page 4088

default-peer

Syntax default-peer;

Hierarchy Level [edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* protocols msdp peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp peer *address*],
[edit protocols msdp],
[edit protocols msdp group *group-name*],
[edit protocols msdp group *group-name* peer *address*],
[edit protocols msdp peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp peer *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Establish this peer as the default MSDP peer and accept source-active messages from the peer without the usual peer-reverse-path-forwarding (peer-RPF) check.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Configuring MSDP with Active Source Limits and Mesh Groups on page 4088

disable (Protocols MSDP)

Syntax

disable;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* protocols msdp peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp peer *address*],
[edit protocols msdp],
[edit protocols msdp group *group-name*],
[edit protocols msdp group *group-name* peer *address*],
[edit protocols msdp peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp peer *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Explicitly disable MSDP.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Disabling MSDP*

export (Protocols MSDP)

Syntax

export [*policy-names*];

Hierarchy Level

[edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* protocols msdp peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp peer *address*],
[edit protocols msdp],
[edit protocols msdp group *group-name*],
[edit protocols msdp group *group-name* peer *address*],
[edit protocols msdp peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp peer *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Apply one or more policies to routes being exported from the routing table into MSDP.

Options

policy-names—Name of one or more policies.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring MSDP in a Routing Instance*
- import on page 4239

group

Syntax

```
group group-name {
  disable;
  export [ policy-names ];
  import [ policy-names ];
  local-address address;
  mode (mesh-group | standard);
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
  peer address; {
    disable;
    active-source-limit {
      maximum number;
      threshold number;
    }
    authentication-key peer-key;
    default-peer;
    export [ policy-names ];
    import [ policy-names ];
    local-address address;
    traceoptions {
      file filename <files number> <size size> <world-readable | no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp],
[edit protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Define an MSDP peer group. MSDP peers within groups share common tracing options, if present and not overridden for an individual peer with the peer statement. To configure multiple MSDP groups, include multiple **group** statements.

By default, the group's options are identical to the global MSDP options. To override the global options, include group-specific options within the **group** statement.

The group must contain at least one peer.

Options

group-name—Name of the MSDP group.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring MSDP in a Routing Instance*

import (Protocols MSDP)

Syntax import [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* protocols msdp peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp peer *address*],
[edit protocols msdp],
[edit protocols msdp group *group-name*],
[edit protocols msdp group *group-name* peer *address*],
[edit protocols msdp peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp peer *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Apply one or more policies to routes being imported into the routing table from MSDP.

Options ***policy-names***—Name of one or more policies.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring MSDP in a Routing Instance*
- export on page 4237

local-address

Syntax local-address *address*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* protocols msdp peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp peer *address*],
[edit protocols msdp],
[edit protocols msdp group *group-name*],
[edit protocols msdp group *group-name* peer *address*],
[edit protocols msdp peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp peer *address*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the local end of an MSDP session. You must configure at least one peer for MSDP to function. When configuring a peer, you must include this statement. This address is used to accept incoming connections to the peer and to establish connections to the remote peer.

Options ***address***—IP address of the local end of the connection.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring MSDP in a Routing Instance*

maximum

Syntax maximum *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols msdp active-source-limit],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp active-source-limit],
[edit protocols msdp active-source-limit],
[edit routing-instances *routing-instance-name* protocols msdp active-source-limit]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure the maximum number of MSDP active source messages the router accepts.

Options *number*—Maximum number of active source messages.

Range: 1 through 1,000,000

Default: 25,000

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring MSDP with Active Source Limits and Mesh Groups on page 4088
- threshold on page 4248

mode (Protocols MSDP)

Syntax mode (mesh-group | standard);

Hierarchy Level [edit logical-systems *logical-system-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit protocols msdp group *group-name*],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure groups of peers in a full mesh topology to limit excessive flooding of source-active messages to neighboring peers. The default flooding mode is **standard**.

Default If you do not include this statement, default flooding is applied.

Options **mesh-group**—Group of peers that are mesh group members.

standard—Use standard MSDP source-active flooding rules.

Default: standard

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Configuring MSDP with Active Source Limits and Mesh Groups on page 4088

msdp

Syntax

```
msdp {
  disable;
  active-source-limit {
    log-interval seconds;
    log-warning value;
    maximum number;
    threshold number;
  }
  data-encapsulation (disable | enable);
  export [ policy-names ];
  group group-name {
    ... group-configuration ...
  }
  hold-time seconds;
  import [ policy-names ];
  local-address address;
  keep-alive seconds;
  peer address {
    ... peer-configuration ...
  }
  rib-group group-name;
  source ip-prefix</prefix-length> {
    active-source-limit {
      maximum number;
      threshold number;
    }
  }
  sa-hold-time seconds;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
  group group-name {
    disable;
    export [ policy-names ];
    import [ policy-names ];
    local-address address;
    mode (mesh-group | standard);
    peer address {
      ... same statements as at the  [edit protocols msdp peer address] hierarchy level shown
        just following ...
    }
    traceoptions {
      file filename <files number> <size size> <world-readable | no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
  }
  peer address {
    disable;
    active-source-limit {
      maximum number;
      threshold number;
```



```
        }
        authentication-key peer-key;
        default-peer;
        export [ policy-names ];
        import [ policy-names ];
        local-address address;
        traceoptions {
            file filename <files number> <size size> <world-readable | no-world-readable>;
            flag flag <flag-modifier> <disable>;
        }
    }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols],
[edit protocols],
[edit routing-instances *routing-instance-name* protocols]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.4 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Enable MSDP on the router or switch. You must also configure at least one peer for MSDP to function.

Default

MSDP is disabled on the router or switch.

Options

The statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring MSDP in a Routing Instance*

peer (Protocols MSDP)

Syntax

```
peer address {
  disable;
  active-source-limit {
    maximum number;
    threshold number;
  }
  authentication-key peer-key;
  default-peer;
  export [ policy-names ];
  import [ policy-names ];
  local-address address;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit protocols msdp],
[edit protocols msdp group *group-name*],
[edit routing-instances *routing-instance-name* protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Define an MSDP peering relationship. An MSDP routing device must know which routing devices are its peers. You define the peer relationships explicitly by configuring the neighboring routing devices that are the MSDP peers of the local routing device. After peer relationships are established, the MSDP peers exchange messages to advertise active multicast sources. To configure multiple MSDP peers, include multiple **peer** statements.

By default, the peer's options are identical to the global or group-level MSDP options. To override the global or group-level options, include peer-specific options within the peer (Protocols MSDP) statement.

At least one peer must be configured for MSDP to function. You must configure ***address*** and **local-address**.

Options

address—Name of the MSDP peer.

The remaining statements are explained separately.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring MSDP in a Routing Instance*

rib-group (Protocols MSDP)

Syntax rib-group *group-name*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp],
[edit protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Associate a routing table group with MSDP.

Options ***group-name***—Name of the routing table group. The name must be one that you defined with the **rib-groups** statement at the **[edit routing-options]** hierarchy level.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring MSDP in a Routing Instance*

source

Syntax

```
source ip-address</prefix-length> {
  active-source-limit {
    maximum number;
    threshold number;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp],
[edit protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Limit the number of active source messages the routing device accepts from sources in this address range.

Default

If you do not include this statement, the routing device accepts any number of MSDP active source messages.

Options

The other statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring MSDP with Active Source Limits and Mesh Groups on page 4088

threshold

Syntax

threshold *number*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols msdp active-source-limit],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp active-source-limit],
[edit protocols msdp active-source-limit],
[edit routing-instances *routing-instance-name* protocols msdp active-source-limit]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure the random early detection (RED) threshold for MSDP active source messages. This number must be less than the configured or default maximum.

Options

number—RED threshold for active source messages.

Range: 1 through 1,000,000

Default: 24,000

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring MSDP with Active Source Limits and Mesh Groups on page 4088
- maximum on page 4241

traceoptions (Protocols MSDP)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols msdp],
[edit logical-systems *logical-system-name* protocols msdp group *group-name*],
[edit logical-systems *logical-system-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* protocols msdp peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols msdp peer *address*],
[edit protocols msdp],
[edit protocols msdp group *group-name*],
[edit protocols msdp group *group-name* peer *address*],
[edit protocols msdp peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name*],
[edit routing-instances *routing-instance-name* protocols msdp group *group-name* peer *address*],
[edit routing-instances *routing-instance-name* protocols msdp peer *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Configure MSDP tracing options.

To specify more than one tracing operation, include multiple **flag** statements.

Default

The default MSDP trace options are those inherited from the routing protocol's **traceoptions** statement included at the **[edit routing-options]** hierarchy level.

Options

disable—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *filename*—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. We recommend that you place tracing output in the **msdp-log** file.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum number of files, you must also include the **size** statement to specify the maximum file size.

Range: 2 through 1000 files

Default: 2 files

flag ***flag***—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

MSDP Tracing Flags

- **keepalive—**Keepalive messages
- **packets**—All MSDP packets
- **route**—MSDP changes to the routing table
- **source-active**—Source-active packets
- **source-active-request**—Source-active request packets
- **source-active-response**—Source-active response packets

Global Tracing Flags

- **all**—All tracing operations
- **general**—A combination of the **normal** and **route** trace operations
- **normal**—All normal operations

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **policy**—Policy operations and actions
- **route**—Routing table changes
- **state**—State transitions
- **task**—Interface transactions and processing
- **timer**—Timer usage

flag-modifier—(Optional) Modifier for the tracing flag. You can specify one or more of these modifiers:

- **detail**—Detailed trace information
- **receive**—Packets being received
- **send**—Packets being transmitted

no-stamp—(Optional) Do not place timestamp information at the beginning of each line in the trace file.

Default: If you omit this option, timestamp information is placed at the beginning of each line of the tracing output.

no-world-readable—(Optional) Do not allow any user to read the log file.

replace—(Optional) Replace an existing trace file if there is one.

Default: If you do not include this option, tracing output is appended to an existing trace file.

size ***size***—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When ***trace-file*** again reaches this size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also include the **files** statement to specify the maximum number of trace files.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation

- Tracing MSDP Protocol Traffic on page 4084

Source-Specific Multicast Configuration Statements

asm-override-ssm

Syntax asm-override-ssm;

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options multicast]

Release Information Statement introduced in Junos OS Release 9.4.
Statement introduced in Junos OS Release 9.5 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Enable the routing device to accept any-source multicast join messages (*,G) for group addresses that are within the default or configured range of source-specific multicast groups.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Source-Specific Multicast Groups with Any-Source Override on page 4103

policy (SSM Maps)

Syntax policy [*policy-names*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast ssm-map *ssm-map-name*],
[edit logical-systems *logical-system-name* routing-options multicast ssm-map *ssm-map-name*],
[edit routing-instances *routing-instance-name* routing-options multicast ssm-map *ssm-map-name*],
[edit routing-options multicast ssm-map *ssm-map-name*]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Apply one or more policies to an SSM map.

Options ***policy-names***—Name of one or more policies for SSM mapping.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To view this statement in the configuration.

Related Documentation

- Example: Configuring SSM Mapping on page 4100

ssm-groups

Syntax ssm-groups [*ip-addresses*];

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options multicast]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure source-specific multicast (SSM) groups.

By default, the SSM group multicast address is limited to the IP address range from 232.0.0.0 through 232.255.255.255. However, you can extend SSM operations into another Class D range by including the **ssm-groups** statement in the configuration. The default SSM address range from 232.0.0.0 through 232.255.255.255 cannot be used in the **ssm-groups** statement. This statement is for adding other multicast addresses to the default SSM group addresses. This statement does not override the default SSM group address range.

IGMPv3 supports SSM groups. By utilizing inclusion lists, only sources that are specified send to the SSM group.

Options *ip-addresses*—List of one or more additional SSM group addresses separated by a space.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Configuring Source-Specific Multicast Groups with Any-Source Override on page 4103

ssm-map (Protocols IGMP)

Syntax ssm-map *ssm-map-name*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Apply an SSM map to an IGMP interface.

Options ***ssm-map-name***—Name of SSM map.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring SSM Mapping on page 4100

ssm-map (Routing Options Multicast)

Syntax

```
ssm-map ssm-map-name {
  policy [ policy-names ];
  source [ addresses ];
}
```

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options multicast],
[edit logical-systems *logical-system-name* routing-options multicast],
[edit routing-instances *routing-instance-name* routing-options multicast],
[edit routing-options multicast]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure SSM mapping.

Options ***ssm-map-name***—Name of the SSM map.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring SSM Mapping on page 4100

ssm-map-policy (IGMP)

Syntax ssm-map-policy *ssm-map-policy-name*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols igmp interface *interface-name*],
[edit protocols igmp interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.4.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Apply an SSM map policy to an IGMP interface.

Options ***ssm-map-policy-name***—Name of SSM map policy.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring SSM Maps for Different Groups to Different Sources on page 4106

CHAPTER 49

Administration

Routine Monitoring

Monitoring IGMP Snooping

Purpose Use the monitoring feature to view status and information about the IGMP snooping configuration.

Action To display IGMP snooping details in the CLI, enter the following commands:

- **show igmp-snooping vlans**
- **show igmp-snooping statistics**
- **show igmp-snooping route**
- **show igmp-snooping membership**

Meaning Table 306 on page 4257 summarizes the IGMP snooping details displayed.

Table 306: Summary of IGMP Snooping Output Fields

Field	Values
IGMP Snooping Monitor	
VLAN	VLAN for which IGMP snooping is enabled.
Interfaces	Interface connected to a multicast router.
Groups	Number of the multicast groups learned by the VLAN.
MRouters	Multicast router.
Receivers	Multicast receiver.

Table 306: Summary of IGMP Snooping Output Fields *(continued)*

Field	Values
IGMP Route Information	
VLAN	VLAN for which IGMP snooping is enabled.
Next-Hop	Next hop assigned by the switch after performing the route lookup.
Group	Multicast groups learned by the VLAN.

Related Documentation

- IGMP Snooping Overview on page 3962
- Example: Configuring IGMP Snooping on page 4049
- Configuring IGMP Snooping on page 4048
- Changing the IGMP Snooping Group Timeout Value on page 4051

Verifying the IGMP Snooping Group Timeout Value

Purpose Verify that the IGMP snooping group timeout value has been changed correctly from its default value.

Action Display the IGMP snooping membership information, which contains the group timeout value that was derived from the IGMP configuration:

```
user@switch> show igmp-snooping membership detail
VLAN: v43 Tag: 43 (Index: 4)
      Group: 225.0.0.1
      Receiver count: 1, Flags: <v2-hosts>
          ge-0/0/15.0 Uptime: 00:00:05 timeout: 510
```

Meaning The IGMP snooping group timeout value determines how long a switch waits to receive an IGMP query from a multicast router before removing a multicast group from its multicast cache table. When you enable IGMP snooping, the default IGMP snooping group timeout value of 260 seconds is applied to all VLANs, which means that the switch waits 260 seconds to receive an IGMP query before removing a multicast group from its multicast cache table. You can change the timeout value by using the **robust-count** option.

Related Documentation

- Changing the IGMP Snooping Group Timeout Value on page 4051

Monitoring Commands for Multicast Protocols

- clear igmp membership
- clear igmp-snooping membership
- clear igmp statistics
- clear igmp-snooping statistics

- clear msdp cache
- clear msdp statistics
- clear multicast bandwidth-admission
- clear multicast scope
- clear multicast sessions
- clear multicast statistics
- clear pim join
- clear pim register
- clear pim statistics
- mtrace
- mtrace from-source
- mtrace monitor
- mtrace to-gateway
- show configuration protocols igmp
- show igmp group
- show igmp interface
- show igmp statistics
- show igmp-snooping membership
- show igmp-snooping route
- show igmp-snooping statistics
- show igmp-snooping vlans
- show msdp
- show msdp source
- show msdp source-active
- show msdp statistics
- show multicast flow-map
- show multicast interface
- show multicast mrinfo
- show multicast next-hops
- show multicast pim-to-igmp-proxy
- show multicast pim-to-mld-proxy
- show multicast route
- show multicast rpf
- show multicast scope
- show multicast sessions
- show multicast usage
- show pim bootstrap

- show pim interfaces
- show pim join
- show pim neighbors
- show pim rps
- show pim source
- show pim statistics
- show system statistics igmp
- test msdp

clear igmp membership

Syntax

clear igmp membership
<group *address-range*>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

clear igmp membership
<group *address-range*>
<interface *interface-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Clear Internet Group Management Protocol (IGMP) group members.

Options

none—Clear all IGMP members on all interfaces and for all address ranges.

group *address-range*—(Optional) Clear all IGMP members that are in a particular address range. An example of a range is **224.2/16**. If you omit the destination prefix length, the default is **/32**.

interface *interface-name*—(Optional) Clear all IGMP group members on an interface.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

clear

Related Documentation

- show igmp group on page 4294
- show igmp interface on page 4298

List of Sample Output

clear igmp membership on page 4261
clear igmp membership interface on page 4262
clear igmp membership group on page 4262

Output Fields

See show igmp group for an explanation of output fields.

Sample Output

clear igmp membership

The following sample output displays IGMP group information before and after the **clear igmp membership** command is entered:

```
user@host> show igmp group
Interface        Group           Last Reported   Timeout
so-0/0/0         224.2.127.253   10.1.128.1          186
so-0/0/0         224.2.127.254   10.1.128.1          186
so-0/0/0         239.255.255.255 10.1.128.1          187
```

```
so-0/0/0         224.1.127.255   10.1.128.1         188
local            224.0.0.6       (null)               0
local            224.0.0.5       (null)               0
local            224.2.127.254   (null)               0
local            239.255.255.255 (null)               0
local            224.0.0.2       (null)               0
local            224.0.0.13      (null)               0

user@host> clear igmp membership
Clearing Group Membership Info for so-0/0/0
Clearing Group Membership Info for so-1/0/0
Clearing Group Membership Info for so-2/0/0

user@host> show igmp group
Interface        Group           Last Reported   Timeout
local            224.0.0.6       (null)               0
local            224.0.0.5       (null)               0
local            224.2.127.254   (null)               0
local            239.255.255.255 (null)               0
local            224.0.0.2       (null)               0
local            224.0.0.13      (null)               0
```

clear igmp membership interface

The following sample output displays IGMP group information before and after the **clear igmp membership interface** command is issued:

```
user@host> show igmp group
Interface        Group           Last Reported   Timeout
so-0/0/0         224.2.127.253   10.1.128.1         210
so-0/0/0         239.255.255.255 10.1.128.1         210
so-0/0/0         224.1.127.255   10.1.128.1         215
so-0/0/0         224.2.127.254   10.1.128.1         216
local            224.0.0.6       (null)               0
local            224.0.0.5       (null)               0
local            224.2.127.254   (null)               0
local            239.255.255.255 (null)               0
local            224.0.0.2       (null)               0
local            224.0.0.13      (null)               0

user@host> clear igmp membership interface so-0/0/0
Clearing Group Membership Info for so-0/0/0

user@host> show igmp group
Interface        Group           Last Reported   Timeout
local            224.0.0.6       (null)               0
local            224.0.0.5       (null)               0
local            224.2.127.254   (null)               0
local            239.255.255.255 (null)               0
local            224.0.0.2       (null)               0
local            224.0.0.13      (null)               0
```

clear igmp membership group

The following sample output displays IGMP group information before and after the **clear igmp membership group** command is entered:

```
user@host> show igmp group
```



```
Interface        Group           Last Reported   Timeout
so-0/0/0         224.2.127.253   10.1.128.1          210
so-0/0/0         239.255.255.255 10.1.128.1          210
so-0/0/0         224.1.127.255   10.1.128.1          215
so-0/0/0         224.2.127.254   10.1.128.1          216
local            224.0.0.6       (null)                0
local            224.0.0.5       (null)                0
local            224.2.127.254   (null)                0
local            239.255.255.255 (null)                0
local            224.0.0.2       (null)                0
local            224.0.0.13      (null)                0
```

```
user@host> clear igmp membership group 239.225/16
Clearing Group Membership Range 239.225.0.0/16 on so-0/0/0
Clearing Group Membership Range 239.225.0.0/16 on so-1/0/0
Clearing Group Membership Range 239.225.0.0/16 on so-2/0/0
```

```
user@host> show igmp group
Interface        Group           Last Reported   Timeout
so-0/0/0         224.1.127.255   10.1.128.1          231
so-0/0/0         224.2.127.254   10.1.128.1          233
so-0/0/0         224.2.127.253   10.1.128.1          236
local            224.0.0.6       (null)                0
local            224.0.0.5       (null)                0
local            224.2.127.254   (null)                0
local            239.255.255.255 (null)                0
local            224.0.0.2       (null)                0
local            224.0.0.13      (null)                0
```


clear igmp-snooping membership

Syntax

clear igmp-snooping membership
<vlan ***vlan-name*****>**

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear IGMP snooping membership information.

Options **vlan** ***vlan-name***—(Optional) Name of the VLAN.

Required Privilege Level view

Related Documentation

- show igmp-snooping membership on page 4305

List of Sample Output clear igmp-snooping membership on page 4264

Sample Output

clear igmp-snooping membership

```
user@switch> clear igmp-snooping membership vlan employee-vlan
```


clear igmp statistics

Syntax

clear igmp statistics
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches)

clear igmp statistics
<interface *interface-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Clear Internet Group Management Protocol (IGMP) statistics.

Options

none—Clear IGMP statistics on all interfaces.

interface *interface-name*—(Optional) Clear IGMP statistics for the specified interface only.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

clear

Related Documentation

- show igmp statistics on page 4302

List of Sample Output

clear igmp statistics on page 4265

Output Fields

See show igmp statistics for an explanation of output fields.

Sample Output

clear igmp statistics

The following sample output displays IGMP statistics information before and after the **clear igmp statistics** command is entered:

```
user@host> show igmp statistics
IGMP packet statistics for all interfaces
IGMP Message type       Received       Sent  Rx errors
Membership Query            8883        459          0
V1 Membership Report           0          0          0
DVMRP                      19784      35476          0
PIM V1                     18310          0          0
Cisco Trace                    0          0          0
V2 Membership Report           0          0          0
Group Leave                    0          0          0
Mtrace Response                0          0          0
Mtrace Request                 0          0          0
Domain Wide Report             0          0          0
V3 Membership Report           0          0          0
```



```
Other Unknown types                              0
IGMP v3 unsupported type                         0
IGMP v3 source required for SSM                  0
IGMP v3 mode not applicable for SSM              0

IGMP Global Statistics
Bad Length                  0
Bad Checksum                0
Bad Receive If              0
Rx non-local             1227


user@host>  clear igmp statistics
user@host> show igmp statistics
IGMP packet statistics for all interfaces
IGMP Message type      Received       Sent  Rx errors
Membership Query              0          0          0
V1 Membership Report          0          0          0
DVMRP                         0          0          0
PIM V1                        0          0          0
Cisco Trace                   0          0          0
V2 Membership Report          0          0          0
Group Leave                   0          0          0
Mtrace Response               0          0          0
Mtrace Request                0          0          0
Domain Wide Report            0          0          0
V3 Membership Report          0          0          0
Other Unknown types                                 0
IGMP v3 unsupported type                            0
IGMP v3 source required for SSM                     0
IGMP v3 mode not applicable for SSM                 0
IGMP Global Statistics
Bad Length                    0
Bad Checksum                  0
Bad Receive If                0
Rx non-local                  0
```


clear igmp-snooping statistics

Syntax **clear igmp-snooping statistics**

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear IGMP snooping statistics.

Required Privilege Level view

Related Documentation

- show igmp-snooping statistics on page 4310

List of Sample Output clear igmp-snooping statistics on page 4267

Sample Output

clear igmp-snooping statistics

```
user@switch> clear igmp-snooping statistics
```


clear msdp cache

Syntax

clear msdp cache
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<peer *peer-address*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Clear the entries in the Multicast Source Discovery Protocol (MSDP) source-active cache.

Options

none—Clear entries in the MSDP source-active cache for all instances, logical systems, and peers.

instance *instance-name*—(Optional) Clear entries for a specific MSDP instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

peer *peer-address*—(Optional) Clear the MSDP source-active cache entries learned from a specific peer.

Required Privilege Level

clear

Related Documentation

- show msdp source-active on page 4318

List of Sample Output

clear msdp cache on page 4268

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear msdp cache

```
user@host> clear msdp cache
```

clear msdp statistics

Syntax

clear msdp statistics
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<peer *peer-address*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Clear Multicast Source Discovery Protocol (MSDP) peer statistics.

Options

none—Clear MSDP statistics for all peers.

instance ***instance-name***—(Optional) Clear statistics for the specified instance.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

peer ***peer-address***—(Optional) Clear the statistics for the specified peer.

Required Privilege Level

clear

Related Documentation

- show msdp statistics on page 4321

List of Sample Output

clear msdp statistics on page 4269

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear msdp statistics

```
user@host> clear msdp statistics
```

clear multicast bandwidth-admission

Syntax

clear multicast bandwidth-admission
<group *group-address*>
<inet | inet6>
<instance *instance-name*>
<interface *interface-name*>
<source *source-address*>

Release Information

Command introduced in Junos OS Release 8.3.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Reapply IP multicast bandwidth admissions.

Options

none—Reapply multicast bandwidth admissions for all IPv4 forwarding entries in the master routing instance.

group *group-address*—(Optional) Reapply multicast bandwidth admissions for the specified group.

inet—(Optional) Reapply multicast bandwidth admission settings for IPv4 flows.

inet6—(Optional) Reapply multicast bandwidth admission settings for IPv6 flows.

instance *instance-name*—(Optional) Reapply multicast bandwidth admission settings for the specified instance. If you do not specify an instance, the command applies to the master routing instance.

interface *interface-name*—(Optional) Examines the corresponding outbound interface in the relevant entries and acts as follows:

- If the interface is congested, and it was admitted previously, it is removed.
- If the interface was rejected previously, the **clear multicast bandwidth-admission** command enables the interface to be admitted as long as enough bandwidth exists on the interface.
- If you do not specify an interface, issuing the **clear multicast bandwidth-admission** command readmits any previously rejected interface for the relevant entries as long as enough bandwidth exists on the interface.

To manually reject previously admitted outbound interfaces, you must specify the interface.

source *source-address*—(Optional) Use with the **group** option to reapply multicast bandwidth admission settings for the specified (source, group) entry.

Required Privilege Level

clear

Related Documentation
- show multicast interface on page 4327

List of Sample Output clear multicast bandwidth-admission on page 4271

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear multicast bandwidth-admission

```
user@host> clear multicast bandwidth-admission
```

clear multicast scope

Syntax

clear multicast scope
<inet | inet6>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

clear multicast scope
<inet | inet6>
<interface *interface-name*>

Release Information

Command introduced in Junos OS Release 7.6.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 option introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Clear IP multicast scope statistics.

Options

none—(Same as **logical-system all**) Clear multicast scope statistics.

inet—(Optional) Clear multicast scope statistics for IPv4 family addresses.

inet6—(Optional) Clear multicast scope statistics for IPv6 family addresses.

interface *interface-name*—(Optional) Clear multicast scope statistics on a specific interface.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

clear

Related Documentation

- show multicast scope on page 4348

List of Sample Output

clear multicast scope on page 4272

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear multicast scope

```
user@host> clear multicast scope
```

clear multicast sessions

Syntax

clear multicast sessions
<logical-system (all | *logical-system-name*)>
<*regular-expression*>

Syntax (EX Series Switch and the QFX Series)

clear multicast sessions
<*regular-expression*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Clear IP multicast sessions.

Options

none—(Same as **logical-system all**) Clear multicast sessions.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

regular-expression—(Optional) Clear only multicast sessions that contain the specified regular expression.

Required Privilege Level

clear

Related Documentation

- show multicast sessions on page 4350

List of Sample Output

clear multicast sessions on page 4273

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear multicast sessions

user@host> **clear multicast sessions**

clear multicast statistics

Syntax

clear multicast statistics
<inet | inet6>
<instance *instance-name*>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

clear multicast statistics
<inet | inet6>
<instance *instance-name*>
<interface *interface-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Clear IP multicast statistics.

Options

none—Clear multicast statistics for all supported address families on all interfaces.

inet—(Optional) Clear multicast statistics for IPv4 family addresses.

inet6—(Optional) Clear multicast statistics for IPv6 family addresses.

instance *instance-name*—(Optional) Clear multicast statistics for the specified instance.

interface *interface-name*—(Optional) Clear multicast statistics on a specific interface.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

clear

Related Documentation

- *show multicast statistics*

List of Sample Output

clear multicast statistics on page 4274

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear multicast statistics

```
user@host> clear multicast statistics
```

clear pim join

Syntax

clear pim join
<*group-address*>
<bidirectional | dense | sparse>
<exact>
<inet | inet6>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<rp *ip-address/prefix* | source *ip-address/prefix*>
<sg | star-g>

Syntax (EX Series Switch and the QFX Series)

clear pim join
<*group-address*>
<dense | sparse>
<exact>
<inet | inet6>
<instance *instance-name*>
<rp *ip-address/prefix* | source *ip-address/prefix*>
<sg | star-g>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Multiple new filter options introduced in Junos OS Release 13.2.

Description

Clear the Protocol Independent Multicast (PIM) join and prune states.

Options

none—Clear the PIM join and prune states for all groups, family addresses, and instances.

group-address—(Optional) Clear the PIM join and prune states for a group address.

bidirectional | dense | sparse—(Optional) Clear PIM bidirectional mode, dense mode, or sparse and source-specific multicast (SSM) mode entries.

exact—(Optional) Clear only the group that exactly matches the specified group address.

inet | inet6—(Optional) Clear the PIM entries for IPv4 or IPv6 family addresses, respectively.

instance *instance-name*—(Optional) Clear the entries for a specific PIM-enabled routing instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

rp *ip-address/prefix* | source *ip-address/prefix*—(Optional) Clear the PIM entries with a specified rendezvous point (RP) address and prefix or with a specified source address and prefix. You can omit the prefix.

sg | star-g—(Optional) Clear PIM (S,G) or (*,G) entries.

Additional Information The **clear pim join** command cannot be used to clear the PIM join and prune state on a backup Routing Engine when nonstop active routing is enabled.

Required Privilege Level clear

Related Documentation

- show pim join on page 4361

List of Sample Output

clear pim join on page 4276
clear pim join inet6 on page 4276
clear pim join inet6 star-g on page 4276

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear pim join

```
user@host> clear pim join
Cleared 8 Join/Prune states
```

clear pim join inet6

```
user@host> clear pim join inet6
Cleared 4 Join/Prune states
```

clear pim join inet6 star-g

```
user@host> clear pim join inet6 star-g
Cleared 1 Join/Prune states
```


clear pim register

Syntax

clear pim register
<inet | inet6>
<instance *instance-name*>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

clear pim register
<inet | inet6>
<instance *instance-name*>
<interface *interface-name*>

Syntax (PTX Series)

clear pim register
<inet | inet6>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Release Information

Command introduced in Junos OS Release 7.6.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Clear Protocol Independent Multicast (PIM) register message counters.

Options

none—Clear PIM register message counters for all family addresses, instances, and interfaces.

inet | inet6—(Optional) Clear PIM register message counters for IPv4 or IPv6 family addresses, respectively.

instance *instance-name*—(Optional) Clear register message counters for a specific PIM-enabled routing instance.

interface *interface-name*—(Optional) Clear PIM register message counters for a specific interface.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Additional Information

The **clear pim register** command cannot be used to clear the PIM register state on a backup Routing Engine when nonstop active routing is enabled.

Required Privilege Level

clear

Related Documentation

- show pim statistics on page 4389

List of Sample Output

clear pim register on page 4278

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear pim register

`user@host>` **clear pim register**

clear pim statistics

Syntax

clear pim statistics
<inet | inet6>
<instance *instance-name*>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

clear pim statistics
<inet | inet6>
<instance *instance-name*>
<interface *interface-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Clear Protocol Independent Multicast (PIM) statistics.

Options

none—Clear PIM statistics for all family addresses, instances, and interfaces.

inet | inet6—(Optional) Clear PIM statistics for IPv4 or IPv6 family addresses, respectively.

instance *instance-name*—(Optional) Clear statistics for a specific PIM-enabled routing instance.

interface *interface-name*—(Optional) Clear PIM statistics for a specific interface.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Additional Information

The **clear pim statistics** command cannot be used to clear the PIM statistics on a backup Routing Engine when nonstop active routing is enabled.

Required Privilege Level

clear

Related Documentation

- show pim statistics on page 4389

List of Sample Output

clear pim statistics on page 4279

Output Fields

See show pim statistics for an explanation of output fields.

Sample Output

clear pim statistics

The following sample output displays PIM statistics before and after the **clear pim statistics** command is entered:

```
user@host> show pim statistics
PIM statistics on all interfaces:
PIM Message type       Received       Sent  Rx errors
Hello                         0          0          0
Register                      0          0          0
Register Stop                 0          0          0
Join Prune                    0          0          0
Bootstrap                     0          0          0
Assert                        0          0          0
Graft                         0          0          0
Graft Ack                     0          0          0
Candidate RP                  0          0          0
V1 Query                   2111       4222          0
V1 Register                   0          0          0
V1 Register Stop              0          0          0
V1 Join Prune             14200      13115          0
V1 RP Reachability            0          0          0
V1 Assert                     0          0          0
V1 Graft                      0          0          0
V1 Graft Ack                  0          0          0
PIM statistics summary for all interfaces:
Unknown type                            0
V1 Unknown type                         0
Unknown Version                         0
Neighbor unknown                        0
Bad Length                              0
Bad Checksum                            0
Bad Receive If                          0
Rx Intf disabled                     2007
Rx V1 Require V2                        0
Rx Register not RP                      0
RP Filtered Source                      0
Unknown Reg Stop                        0
Rx Join/Prune no state               1040
Rx Graft/Graft Ack no state             0
...
```

```
user@host> clear pim statistics
user@host> show pim statistics
PIM statistics on all interfaces:
PIM Message type       Received       Sent  Rx errors
Hello                         0          0          0
Register                      0          0          0
Register Stop                 0          0          0
Join Prune                    0          0          0
Bootstrap                     0          0          0
Assert                        0          0          0
Graft                         0          0          0
Graft Ack                     0          0          0
Candidate RP                  0          0          0
V1 Query                      1          0          0
V1 Register                   0          0          0
...
```


mtrace

Syntax

mtrace *source*
<logical-system *logical-system-name*>
<routing-instance *routing-instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 9.5 for SRX1400, SRX3400, SRX3600, SRX5600, and SRX5800 devices.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 12.3 for the PTX Series.

Description

Display trace information about an IP multicast path.

Options

source—Source hostname or address.

logical-system (*logical-system-name*)—(Optional) Perform this operation on a logical system.

routing-instance *routing-instance-name*—(Optional) Trace a particular routing instance.

Additional Information

The **mtrace** command for multicast traffic is similar to the **traceroute** command used for unicast traffic. Unlike **traceroute**, **mtrace** traces traffic backwards, from the receiver to the source.

Required Privilege Level

view

List of Sample Output

mtrace source on page 4283

Output Fields

Table 307 on page 4281 describes the output fields for the **mtrace** command. Output fields are listed in the approximate order in which they appear.

Table 307: mtrace Output Fields

Field Name	Field Description
Mtrace from	IP address of the receiver.
to	IP address of the source.
via group	IP address of the multicast group (if any).
Querying full reverse path	Indicates the full reverse path query has begun.
number-of-hops	Number of hops from the source to the named router or switch.
router-name	Name of the router or switch for this hop.
address	Address of the router or switch for this hop.

Table 307: mtrace Output Fields *(continued)*

Field Name	Field Description
protocol	Protocol used (for example, PIM).
Round trip time	Average round-trip time, in milliseconds (ms).
total ttl of	Time-to-live (TTL) threshold.

Sample Output

mtrace source

```
user@host> mtrace 192.1.4.2
Mtrace from 192.1.4.2 to 192.1.1.2 via group 0.0.0.0
Querying full reverse path... * *
  0  routerA.lab.mycompany.net (192.1.1.2)
 -1  routerB.lab.mycompany.net (192.1.2.2)  PIM  thresh^ 1
 -2  routerC.lab.mycompany.net (192.1.3.2)  PIM  thresh^ 1
 -3  hostA.lab.mycompany.net (192.1.4.2)
Round trip time 2 ms; total ttl of 2 required.
```

mtrace from-source

Syntax

mtrace from-source source *source*
<brief | detail>
<extra-hops *extra-hops*>
<group *group*>
<interval *interval*>
<loop>
<max-hops *max-hops*>
<max-queries *max-queries*>
<multicast-response | unicast-response>
<no-resolve>
<no-router-alert>
<response *response*>
<routing-instance *routing-instance-name*>
<ttl *ttl*>
<wait-time *wait-time*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display trace information about an IP multicast path from a source to this router or switch. If you specify a group address with this command, Junos OS returns additional information, such as packet rates and losses.

Options

brief | detail—(Optional) Display the specified level of output.

extra-hops ***extra-hops***—(Optional) Number of hops to take after reaching a nonresponsive router. You can specify a number between **0** and **255**.

group ***group***—(Optional) Group address for which to trace the path. The default group address is **0.0.0.0**.

interval ***interval***—(Optional) Number of seconds to wait before gathering statistics again. The default value is **10** seconds.

loop—(Optional) Loop indefinitely, displaying rate and loss statistics.

max-hops ***max-hops***—(Optional) Maximum hops to trace toward the source. The range of values is **0** through **255**. The default value is **32** hops.

max-queries ***max-queries***—(Optional) Maximum number of query attempts for any hop. The range of values is **1** through **32**. The default is **3**.

multicast-response—(Optional) Always request the response using multicast.

no-resolve—(Optional) Do not attempt to display addresses symbolically.

no-router-alert—(Optional) Do not use the router-alert IP option.

response ***response***—(Optional) Send trace response to a host or multicast address.

routing-instance ***routing-instance-name***—(Optional) Trace a particular routing instance.

source ***source***—Source hostname or address.

ttl ***ttl***—(Optional) IP time-to-live (TTL) value. You can specify a number between **0** and **255**. Local queries to the multicast group use a value of **1**. Otherwise, the default value is **127**.

unicast-response—(Optional) Always request the response using unicast.

wait-time ***wait-time***—(Optional) Number of seconds to wait for a response. The default value is **3**.

Required Privilege Level

view

List of Sample Output

mtrace from-source on page 4286

Output Fields

Table 308 on page 4285 describes the output fields for the **mtrace from-source** command. Output fields are listed in the approximate order in which they appear.

Table 308: mtrace from-source Output Fields

Field Name	Field Description
Mtrace from	IP address of the receiver.
to	IP address of the source.
via group	IP address of the multicast group (if any).
Querying full reverse path	Indicates the full reverse path query has begun.
number-of-hops	Number of hops from the source to the named router or switch.
router-name	Name of the router or switch for this hop.
address	Address of the router or switch for this hop.
protocol	Protocol used (for example, PIM).
Round trip time	Average round-trip time, in milliseconds (ms).
total ttl of	Time-to-live (TTL) threshold.
source	Source address.
Response Dest	Response destination address.
Overall	Average packet rate for all traffic at each hop.

Table 308: mtrace from-source Output Fields *(continued)*

Field Name	Field Description
Packet Statistics for Traffic From	Number of packets lost, number of packets sent, percentage of packets lost, and average packet rate at each hop.
Receiver	IP address receiving the multicast.
Query source	IP address sending the mtrace query.

Sample Output

mtrace from-source

```
user@host> mtrace from-source source 192.1.4.2 group 225.1.1.1
Mtrace from 192.1.4.2 to 192.1.1.2 via group 225.1.1.1
Querying full reverse path... * *
  0  routerA.lab.mycompany.net (192.1.1.2)
 -1  routerB.lab.mycompany.net (192.1.2.2)  PIM  thresh^ 1
 -2  routerC.lab.mycompany.net (192.1.3.2)  PIM  thresh^ 1
 -3  hostA.lab.mycompany.net (192.1.4.2)
Round trip time 2 ms; total ttl of 2 required.

Waiting to accumulate statistics...Results after 10 seconds:

Source        Response Dest    Overall     Packet Statistics For Traffic From
192.1.4.2 192.1.1.2    Packet      192.1.4.2 To 225.1.1.1
     v       __/  rtt    2 ms     Rate       Lost/Sent = Pct  Rate
192.1.2.1
192.1.3.2  routerC.lab.mycompany.net
     v     ^      ttl    2                      0/0    = --    0 pps
192.1.4.1
192.1.2.2   routerB.lab.mycompany.net
     v      \__   ttl    3                      ?/0            0 pps
192.1.1.2   192.1.1.2
  Receiver      Query Source
```


mtrace monitor

Syntax

mtrace monitor

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Listen passively for IP multicast responses. To exit the **mtrace monitor** command, type Ctrl+c.

Options

none—Trace the master instance.

Required Privilege Level

view

List of Sample Output

mtrace monitor on page 4288

Output Fields

Table 309 on page 4287 describes the output fields for the **mtrace monitor** command. Output fields are listed in the approximate order in which they appear.

Table 309: mtrace monitor Output Fields

Field Name	Field Description
Mtrace query at	Date and time of the query.
by	Address of the host issuing the query.
resp to	Response destination.
qid	Query ID number.
packet from...to	IP address of the query source and default group destination.
from...to	IP address of the multicast source and the response address.
via group	IP address of the group to trace.
mxhop	Maximum hop setting.

Sample Output

mtrace monitor

```
user@host> mtrace monitor
Mtrace query at Oct 22 13:36:14 by 192.1.3.2, resp to 224.0.1.32, qid 74a5b8
packet from 192.1.3.2 to 224.0.0.2
from 192.1.3.2 to 192.1.3.38 via group 224.1.1.1 (mxhop=60)

Mtrace query at Oct 22 13:36:17 by 192.1.3.2, resp to 224.0.1.32, qid 1d07ba
packet from 192.1.3.2 to 224.0.0.2
from 192.1.3.2 to 192.1.3.38 via group 224.1.1.1 (mxhop=60)

Mtrace query at Oct 22 13:36:20 by 192.1.3.2, resp to same, qid 2fea1d
packet from 192.1.3.2 to 224.0.0.2
from 192.1.3.2 to 192.1.3.38 via group 224.1.1.1 (mxhop=60)

Mtrace query at Oct 22 13:36:30 by 192.1.3.2, resp to same, qid 7c88ad
packet from 192.1.3.2 to 224.0.0.2
from 192.1.3.2 to 192.1.3.38 via group 224.1.1.1 (mxhop=60)
```

mtrace to-gateway

Syntax

mtrace to-gateway gateway *gateway*
<brief | detail>
<extra-hops *extra-hops*>
<group *group*>
<interface *interface-name*>
<interval *interval*>
<loop>
<max-hops *max-hops*>
<max-queries *max-queries*>
<multicast-response | unicast-response>
<no-resolve>
<no-router-alert>
<response *response*>
<routing-instance *routing-instance-name*>
<ttl *ttl*>
<unicast-response>
<wait-time *wait-time*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display trace information about a multicast path from this router or switch to a gateway router or switch.

Options

gateway *gateway*—Send the trace query to a gateway multicast address.

brief | detail—(Optional) Display the specified level of output.

extra-hops *extra-hops*—(Optional) Number of hops to take after reaching a nonresponsive router or switch. You can specify a number between **0** and **255**.

group *group*—(Optional) Group address for which to trace the path. The default group address is **0.0.0.0**.

interface *interface-name*—(Optional) Source address for sending the trace query.

interval *interval*—(Optional) Number of seconds to wait before gathering statistics again. The default value is **10**.

loop—(Optional) Loop indefinitely, displaying rate and loss statistics.

max-hops *max-hops*—(Optional) Maximum hops to trace toward the source. You can specify a number between **0** and **255**.. The default value is **32**.

max-queries *max-queries*—(Optional) Maximum number of query attempts for any hop. You can specify a number between **0** and **255**. The default value is **3**.

multicast-response—(Optional) Always request the response using multicast.

no-resolve—(Optional) Do not attempt to display addresses symbolically.

no-router-alert—(Optional) Do not use the router-alert IP option.

response ***response***—(Optional) Send trace response to a host or multicast address.

routing-instance ***routing-instance-name***—(Optional) Trace a particular routing instance.

ttl ***ttl***—(Optional) IP time-to-live value. You can specify a number between **0** and **225**. Local queries to the multicast group use TTL **1**. Otherwise, the default value is **127**.

unicast-response—(Optional) Always request the response using unicast.

wait-time ***wait-time***—(Optional) Number of seconds to wait for a response. The default value is **3**.

Required Privilege Level view

List of Sample Output mtrace to-gateway on page 4290

Output Fields Table 310 on page 4290 describes the output fields for the **mtrace to-gateway** command. Output fields are listed in the approximate order in which they appear.

Table 310: mtrace to-gateway Output Fields

Field Name	Field Description
Mtrace from	IP address of the receiver.
to	IP address of the source.
via group	IP address of the multicast group (if any).
Querying full reverse path	Indicates the full reverse path query has begun.
number-of-hops	Number of hops from the source to the named router or switch.
router-name	Name of the router or switch for this hop.
address	Address of the router or switch for this hop.
protocol	Protocol used (for example, PIM).
Round trip time	Average round-trip time, in milliseconds (ms).
total ttl of	Time-to-live (TTL) threshold.

Sample Output

mtrace to-gateway

```
user@host> mtrace to-gateway gateway 192.1.3.2 group 225.1.1.1 interface 192.1.1.73 brief

Mtrace from 192.1.1.73 to 192.1.1.2 via group 225.1.1.1
```

```
Querying full reverse path... * *
  0  routerA.lab.mycompany.net (192.1.1.2)
 -1  routerA.lab.mycompany.net (192.1.1.2)  PIM  thresh^ 1
 -2  routerB.lab.mycompany.net (192.1.2.2)  PIM  thresh^ 1
 -3  routerC.lab.mycompany.net (192.1.3.2)  PIM  thresh^ 1
Round trip time 2 ms; total ttl of 3 required.
```

show configuration protocols igmp

Syntax show configuration protocols igmp

Release Information Command introduced in Junos OS Release 11.3 for the QFX Series.

Description Display Internet Group Management Protocol (IGMP) information.

Required Privilege Level view

Related Documentation

- IGMP Snooping Overview on page 3962
- Configuring IGMP Snooping on page 4048

List of Sample Output show configuration protocols igmp on page 4292

Output Fields Table 311 on page 4292 describes the output fields for the **show configuration protocols igmp** command that relate to IGMP querying.

Table 311: show igmp group Output Fields

Field Name	Field Description	Level of Output
accounting	Enables notification for join and leave events.	All levels
igmp-querier	Configured source address for the IGMP querier.	All levels
interface	Name of the interface that receives IGMP membership reports.	All levels
query-interval	Interval at which the IGMP querier sends general host-query messages to solicit membership information.	All levels
query-response-interval	How long the IGMP querier waits to receive a response from a query message before sending another query.	All levels
src-address	Source address of IGMP queries.	
version	IGMP version.	All levels

Sample Output

show configuration protocols igmp

```
user@switch> show configuration protocols igmp
query-interval 150;
query-response-interval 50;
accounting;
interface vlan.43 {
 version 2;
 }
igmp-querier {
```



```
  src-address 10.0.0.2;
}
```

show igmp group

Syntax

show igmp group
<brief | detail>
<*group-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show igmp group
<brief | detail>
<*group-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display Internet Group Management Protocol (IGMP) group membership information.

Options

none—Display standard information about membership for all IGMP groups.

brief | detail—(Optional) Display the specified level of output.

group-name—(Optional) Display group membership for the specified IP address only.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- clear igmp membership on page 4261

List of Sample Output

show igmp group (Include Mode) on page 4295
show igmp group (Exclude Mode) on page 4296
show igmp group brief on page 4296
show igmp group detail on page 4296

Output Fields

Table 311 on page 4292 describes the output fields for the **show igmp group** command. Output fields are listed in the approximate order in which they appear.

Table 312: show igmp group Output Fields

Field Name	Field Description	Level of Output
Interface	Name of the interface that received the IGMP membership report. A name of **local** indicates that the local routing device joined the group itself.	All levels
Group	Group address.	All levels
Group Mode	Mode the SSM group is operating in: **Include** or **Exclude**.	All levels
Source	Source address.	All levels

Table 312: show igmp group Output Fields *(continued)*

Field Name	Field Description	Level of Output
Source timeout	Time remaining until the group traffic is no longer forwarded. The timer is refreshed when a listener in include mode sends a report. A group in exclude mode or configured as a static group displays a zero timer.	**detail**
Last reported by	Address of the host that last reported membership in this group.	All levels
Timeout	Time remaining until the group membership is removed.	**brief none**
Group timeout	Time remaining until a group in exclude mode moves to include mode. The timer is refreshed when a listener in exclude mode sends a report. A group in include mode or configured as a static group displays a zero timer.	**detail**
Type	Type of group membership: • **Dynamic**—Host reported the membership. • **Static**—Membership is configured.	All levels

Sample Output

show igmp group (Include Mode)

```
user@host> show igmp group
Interface: t1-0/1/0.0
    Group: 232.1.1.1
        Group mode: Include
        Source: 10.0.0.2
        Last reported by: 10.9.5.2
        Timeout:      24 Type: Dynamic
    Group: 232.1.1.1
        Group mode: Include
        Source: 10.0.0.3
        Last reported by: 10.9.5.2
        Timeout:      24 Type: Dynamic
    Group: 232.1.1.1
        Group mode: Include
        Source: 10.0.0.4
        Last reported by: 10.9.5.2
        Timeout:      24 Type: Dynamic
    Group: 232.1.1.2
        Group mode: Include
        Source: 10.0.0.4
        Last reported by: 10.9.5.2
        Timeout:      24 Type: Dynamic
Interface: t1-0/1/1.0
Interface: ge-0/2/2.0
Interface: ge-0/2/0.0
Interface: local
    Group: 224.0.0.2
        Source: 0.0.0.0
        Last reported by: Local
        Timeout:       0 Type: Dynamic
    Group: 224.0.0.22
        Source: 0.0.0.0
```



```
        Last reported by: Local
        Timeout:       0 Type: Dynamic
```

show igmp group (Exclude Mode)

```
user@host> show igmp group
Interface: t1-0/1/0.0
Interface: t1-0/1/1.0
Interface: ge-0/2/2.0
Interface: ge-0/2/0.0
Interface: local
    Group: 224.0.0.2
        Source: 0.0.0.0
        Last reported by: Local
        Timeout:       0 Type: Dynamic
    Group: 224.0.0.22
        Source: 0.0.0.0
        Last reported by: Local
        Timeout:       0 Type: Dynamic
```

show igmp group brief

The output for the **show igmp group brief** command is identical to that for the **show igmp group** command.

show igmp group detail

```
user@host> show igmp group detail
Interface: t1-0/1/0.0
    Group: 232.1.1.1
        Group mode: Include
        Source: 10.0.0.2
        Source timeout: 12
        Last reported by: 10.9.5.2
        Group timeout:       0 Type: Dynamic
    Group: 232.1.1.1
        Group mode: Include
        Source: 10.0.0.3
        Source timeout: 12
        Last reported by: 10.9.5.2
        Group timeout:       0 Type: Dynamic
    Group: 232.1.1.1
        Group mode: Include
        Source: 10.0.0.4
        Source timeout: 12
        Last reported by: 10.9.5.2
        Group timeout:       0 Type: Dynamic
    Group: 232.1.1.2
        Group mode: Include
        Source: 10.0.0.4
        Source timeout: 12
        Last reported by: 10.9.5.2
        Group timeout:       0 Type: Dynamic
Interface: t1-0/1/1.0
Interface: ge-0/2/2.0
Interface: ge-0/2/0.0
Interface: local
    Group: 224.0.0.2
        Group mode: Exclude
        Source: 0.0.0.0
        Source timeout: 0
```



```
    Last reported by: Local
    Group timeout:       0 Type: Dynamic
Group: 224.0.0.22
    Group mode: Exclude
    Source: 0.0.0.0
    Source timeout: 0
    Last reported by: Local
    Group timeout:       0 Type: Dynamic
```

show igmp interface

Syntax

show igmp interface
<brief | detail>
<*interface-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switches and the QFX Series)

show igmp interface
<brief | detail>
<*interface-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display information about Internet Group Management Protocol (IGMP)-enabled interfaces.

Options

none—Display standard information about all IGMP-enabled interfaces.

brief | detail—(Optional) Display the specified level of output.

interface-name—(Optional) Display information about the specified IGMP-enabled interface only.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- clear igmp membership on page 4261

List of Sample Output

show igmp interface on page 4300
show igmp interface brief on page 4300
show igmp interface detail on page 4301
show igmp interface <interface-name> on page 4301

Output Fields

Table 313 on page 4298 describes the output fields for the **show igmp interface** command. Output fields are listed in the approximate order in which they appear.

Table 313: show igmp interface Output Fields

Field Name	Field Description	Level of Output
Interface	Name of the interface.	All levels
Querier	Address of the routing device that has been elected to send membership queries.	All levels
State	State of the interface: **Up** or **Down**.	All levels

Table 313: show igmp interface Output Fields *(continued)*

Field Name	Field Description	Level of Output
SSM Map Policy	Name of the source-specific multicast (SSM) map policy that has been applied to the IGMP interface.	All levels
Timeout	How long until the IGMP querier is declared to be unreachable, in seconds.	All levels
Version	IGMP version being used on the interface: **1** , **2** , or **3**.	All levels
Groups	Number of groups on the interface.	All levels
Group limit	Maximum number of groups allowed on the interface. Any joins requested after the limit is reached are rejected.	All levels
Group threshold	Configured threshold at which a warning message is generated. This threshold is based on a percentage of groups received on the interface. If the number of groups received reaches the configured threshold, the device generates a warning message.	All levels
Group log-interval	Time (in seconds) between consecutive log messages.	All levels
Immediate Leave	State of the immediate leave option: • **On**—Indicates that the router removes a host from the multicast group as soon as the router receives a leave group message from a host associated with the interface. • **Off**—Indicates that after receiving a leave group message, instead of removing a host from the multicast group immediately, the router sends a group query to determine if another receiver responds.	All levels
Promiscuous Mode	State of the promiscuous mode option: • **On**—Indicates that the router can accept IGMP reports from subnetworks that are not associated with its interfaces. • **Off**—Indicates that the router can accept IGMP reports only from subnetworks that are associated with its interfaces.	All levels
Passive	State of the passive mode option: • **On**—Indicates that the router can run IGMP on the interface but not send or receive control traffic such as IGMP reports, queries, and leaves. • **Off**—Indicates that the router can run IGMP on the interface and send or receive control traffic such as IGMP reports, queries, and leaves. The **passive** statement enables you to selectively activate up to two out of a possible three available query or control traffic options. When enabled, the following options appear after the **on** state declaration: • **send-general-query**—The interface sends general queries. • **send-group-query**—The interface sends group-specific and group-source-specific queries. • **allow-receive**—The interface receives control traffic.	All levels
OIF map	Name of the OIF map (if configured) associated with the interface.	All levels

Table 313: show igmp interface Output Fields *(continued)*

Field Name	Field Description	Level of Output
SSM map	Name of the source-specific multicast (SSM) map (if configured) used on the interface.	All levels
Configured Parameters	Information configured by the user: • **IGMP Query Interval**—Interval (in seconds) at which this router sends membership queries when it is the querier. • **IGMP Query Response Interval**—Time (in seconds) that the router waits for a report in response to a general query. • **IGMP Last Member Query Interval**—Time (in seconds) that the router waits for a report in response to a group-specific query. • **IGMP Robustness Count**—Number of times the router retries a query.	All levels
Derived Parameters	Derived information: • **IGMP Membership Timeout**—Timeout period (in seconds) for group membership. If no report is received for these groups before the timeout expires, the group membership is removed. • **IGMP Other Querier Present Timeout**—Time (in seconds) that the router waits for the IGMP querier to send a query.	All levels

Sample Output

show igmp interface

```
user@host> show igmp interface
Interface: at-0/3/1.0
    Querier: 10.111.30.1
    State:         Up Timeout:    None Version:  2 Groups:      4
    SSM Map Policy: ssm-policy-A
Interface: so-1/0/0.0
    Querier: 10.111.10.1
    State:         Up Timeout:    None Version:  2 Groups:      2
    SSM Map Policy: ssm-policy-B
Interface: so-1/0/1.0
    Querier: 10.111.20.1
    State:         Up Timeout:    None Version:  2 Groups:      4
    SSM Map Policy: ssm-policy-C
Immediate Leave: On
Promiscuous Mode: Off

Configured Parameters:
IGMP Query Interval: 125.0
IGMP Query Response Interval: 10.0
IGMP Last Member Query Interval: 1.0
IGMP Robustness Count: 2

Derived Parameters:
IGMP Membership Timeout: 260.0
IGMP Other Querier Present Timeout: 255.0
```

show igmp interface brief

The output for the **show igmp interface brief** command is identical to that for the **show igmp interface** command. For sample output, see show igmp interface on page 4300.

show igmp interface detail

The output for the **show igmp interface detail** command is identical to that for the **show igmp interface** command. For sample output, see show igmp interface on page 4300.

show igmp interface <interface-name>

```
user@host# show igmp interface ge-3/2/0.0
Interface: ge-3/2/0.0
  Querier: 20.1.1.1
  State: Up Timeout:    None Version:  3 Groups:      1
  Group limit: 8
  Group threshold: 60
  Group log-interval: 10
  Immediate leave:  Off
  Promiscuous mode:  Off
```

show igmp statistics

Syntax

show igmp statistics
<brief | detail>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show igmp statistics
<brief | detail>
<interface *interface-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display Internet Group Management Protocol (IGMP) statistics.

Options

none—Display IGMP statistics for all interfaces.

brief | detail—(Optional) Display the specified level of output.

interface ***interface-name***—(Optional) Display IGMP statistics about the specified interface only.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- clear igmp statistics on page 4265

List of Sample Output

show igmp statistics on page 4303
show igmp statistics interface on page 4304

Output Fields

Table 314 on page 4302 describes the output fields for the **show igmp statistics** command. Output fields are listed in the approximate order in which they appear.

Table 314: show igmp statistics Output Fields

Field Name	Field Description
IGMP packet statistics	Heading for IGMP packet statistics for all interfaces or for the specified interface name.

Table 314: show igmp statistics Output Fields *(continued)*

Field Name	Field Description
IGMP Message type	Summary of IGMP statistics: • **Membership Query**—Number of membership queries sent and received. • **V1 Membership Report**—Number of version 1 membership reports sent and received. • **DVMRP**—Number of DVMRP messages sent or received. • **PIM V1**—Number of PIM version 1 messages sent or received. • **Cisco Trace**—Number of Cisco trace messages sent or received. • **V2 Membership Report**—Number of version 2 membership reports sent or received. • **Group Leave**—Number of group leave messages sent or received. • **Mtrace Response**—Number of Mtrace response messages sent or received. • **Mtrace Request**—Number of Mtrace request messages sent or received. • **Domain Wide Report**—Number of domain-wide reports sent or received. • **V3 Membership Report**—Number of version 3 membership reports sent or received. • **Other Unknown types**—Number of unknown message types received. • **IGMP v3 unsupported type**—Number of messages received with unknown and unsupported IGMP version 3 message types. • **IGMP v3 source required for SSM**—Number of IGMP version 3 messages received that contained no source. • **IGMP v3 mode not applicable for SSM**—Number of IGMP version 3 messages received that did not contain a mode applicable for source-specific multicast (SSM).
Received	Number of messages received.
Sent	Number of messages sent.
Rx errors	Number of received packets that contained errors.
IGMP Global Statistics	Summary of IGMP statistics for all interfaces. • **Bad Length**—Number of messages received with length errors so severe that further classification could not occur. • **Bad Checksum**—Number of messages received with a bad IP checksum. No further classification was performed. • **Bad Receive If**—Number of messages received on an interface not enabled for IGMP. • **Rx non-local**—Number of messages received from senders that are not local. • **Timed out**—Number of groups that timed out as a result of not receiving an explicit leave message. • **Rejected Report**—Number of reports dropped because of the IGMP group policy. • **Total Interfaces**—Number of interfaces configured to support IGMP.

Sample Output

show igmp statistics

```
user@host> show igmp statistics
IGMP packet statistics for all interfaces
IGMP Message type      Received       Sent  Rx errors
Membership Query           8883        459          0
V1 Membership Report          0          0          0
```

```
DVMRP                          0          0          0
PIM V1                         0          0          0
Cisco Trace                    0          0          0
V2 Membership Report           0          0          0
Group Leave                    0          0          0
Mtrace Response                0          0          0
Mtrace Request                 0          0          0
Domain Wide Report             0          0          0
V3 Membership Report           0          0          0
Other Unknown types                                  0
IGMP v3 unsupported type                             0
IGMP v3 source required for SSM                      0
IGMP v3 mode not applicable for SSM                  0

IGMP Global Statistics
Bad Length                     0
Bad Checksum                   0
Bad Receive If                 0
Rx non-local                1227
Timed out                      0
Rejected Report                0
Total Interfaces               2
```

show igmp statistics interface

```
user@host> show igmp statistics interface fe-1/0/1.0
IGMP interface packet statistics for fe-1/0/1.0
IGMP Message type      Received       Sent  Rx errors
Membership Query              0        230          0
V1 Membership Report          0          0          0
```

show igmp-snooping membership

Syntax

show igmp-snooping membership
<brief | detail>
<interface *interface-name*>
<vlan *vlan-id* | *vlan-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.
IGMPv3 output introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display IGMP snooping membership information.

Options

none—Display general parameters.

brief | detail—(Optional) Display the specified level of output.

interface *interface-name*—(Optional) Display IGMP snooping information for the specified interface.

vlan *vlan-id* | *vlan-name*—(Optional) Display IGMP snooping information for the specified VLAN.

Required Privilege Level

view

Related Documentation

- Monitoring IGMP Snooping on page 4257
- Configuring IGMP Snooping on page 4048
- show igmp-snooping route on page 4308
- show igmp-snooping statistics on page 4310
- show igmp-snooping vlans on page 4312

List of Sample Output

show igmp-snooping membership on page 4306
show igmp-snooping membership detail on page 4307

Output Fields

Table 315 on page 4305 lists the output fields for the **show igmp-snooping membership** command. Output fields are listed in the approximate order in which they appear.

Table 315: show igmp-snooping membership Output Fields

Field Name	Field Description	Level of Output
VLAN	Name of the VLAN.	All
Interfaces	Interfaces assigned to the VLAN.	All
Tag	Numerical identifier of the VLAN.	**detail**

Table 315: show igmp-snooping membership Output Fields *(continued)*

Field Name		Field Description	Level of Output
Router interfaces		Names of multicast router interfaces.	**detail**
	• **static** or **dynamic**	Whether the multicast router interface is **static** or **dynamic**.	**detail**
	• **Uptime**	For static interfaces, length of time since the interface was configured as a multicast router interface; for dynamic interfaces, length of time since the first query was received on the interface.	**detail**
	• **timeout**	Query timeout in seconds.	**detail**
Group		IP multicast address of the multicast group.	**detail**
Receiver count		Number of interfaces that have membership in a multicast group.	**detail**
Flags		IGMP version of the host sending a join message.	**detail**
Uptime		Length of time a multicast group has been active on the interface.	**detail**
timeout		Time (in seconds) left until the entry for the multicast group is removed.	All
Last reporter		Last host to report membership for the multicast group.	**detail**
Include source		Source addresses from which multicast streams are allowed based on IGMPv3 reports.	**detail**

Sample Output

show igmp-snooping membership

```
user@switch> show igmp-snooping membership
VLAN: v1
    224.1.1.1      *             258 secs
        Interfaces: ge-0/0/0.0
    224.1.1.3      *             258 secs
        Interfaces: ge-0/0/0.0
    224.1.1.5      *             258 secs
        Interfaces: ge-0/0/0.0
    224.1.1.7      *             258 secs
```



```
    Interfaces: ge-0/0/0.0
224.1.1.9      *              258 secs
    Interfaces: ge-0/0/0.0
224.1.1.11     *              258 secs
    Interfaces: ge-0/0/0.0
```

show igmp-snooping membership detail

```
user@switch> show igmp-snooping membership detail
VLAN: v43 Tag: 43 (Index: 4)
   Group: 225.0.0.2
   Receiver count: 1, Flags: <V3-hosts>
     ge-0/0/15.0 Uptime: 00:00:11 timeout: 248 Last reporter: 10.2.10.16
       Include source: 1.2.1.1, 1.3.1.1
VLAN: v44 Tag: 44 (Index: 5)
   Group: 225.0.0.1
   Receiver count: 1, Flags: <V2-hosts>
     ge-0/0/21.0 Uptime: 00:00:02 timeout: 257
VLAN: v110 Tag: 110 (Index: 4)
 Router interfaces:
         ge-0/0/3.0 static Uptime: 00:08:45
         ge-0/0/2.0 static Uptime: 00:08:45
         ge-0/0/4.0 dynamic Uptime: 00:16:41 timeout: 254
     Group: 225.0.0.3
     Receiver count: 1, Flags: <V3-hosts>
         ge-0/0/5.0 Uptime: 00:00:19 timeout: 259
     Group: 225.1.1.1
     Receiver count: 1, Flags: <V2-hosts>
         ge-0/0/5.0 Uptime: 00:22:43 timeout: 96
     Group: 225.2.2.2
     Receiver count: 1, Flags: <V2-hosts Static>
         ge-0/0/5.0 Uptime: 00:23:13
```


show igmp-snooping route

Syntax

show igmp-snooping route
<brief | detail>
<ethernet-switching <brief | detail | vlan (*vlan-id* | *vlan-name*)>>
<inet <brief | detail | vlan *vlan-name*>>
<vlan *vlan-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display IGMP snooping route information.

Options

none—Display general parameters.

brief | detail—(Optional) Display the specified level of output.

ethernet-switching—(Optional) Display Ethernet switching information.

inet—(Optional) Display **inet** information.

vlan *vlan-name*—(Optional) Display route information for the specified VLAN.

Required Privilege Level

view

Related Documentation

- Monitoring IGMP Snooping on page 4257
- Configuring IGMP Snooping on page 4048
- **show igmp-snooping statistics on page 4310**
- **show igmp-snooping vlans on page 4312**

List of Sample Output

show igmp-snooping route on page 4309
show igmp-snooping route vlan v1 on page 4309

Output Fields

Table 316 on page 4308 lists the output fields for the **show igmp-snooping route** command. Output fields are listed in the approximate order in which they appear.

Table 316: show igmp-snooping route Output Fields

Field Name	Field Description
Table	(For internal use only. Value is always 0.)
VLAN	Name of the VLAN.
Group	Multicast group address.
Interfaces	Interfaces on which IGMP packets were snooped.
Next-hop	ID associated with the next-hop device.

Sample Output

show igmp-snooping route

```
user@switch> show igmp-snooping route
VLAN             Group           Next-hop
V11              224.1.1.1, *         533
        Interfaces: ge-0/0/13.0, ge-0/0/1.0
VLAN             Group           Next-hop
v12              224.1.1.3, *         534
        Interfaces: ge-0/0/13.0, ge-0/0/0.0
```

show igmp-snooping route vlan v1

```
user@switch> show igmp-snooping route vlan v1
Table: 0
VLAN             Group           Next-hop
v1               224.1.1.1, *        1266
        Interfaces: ge-0/0/0.0
v1               224.1.1.3, *        1266
        Interfaces: ge-0/0/0.0
v1               224.1.1.5, *        1266
        Interfaces: ge-0/0/0.0
v1               224.1.1.7, *        1266
        Interfaces: ge-0/0/0.0
v1               224.1.1.9, *        1266
        Interfaces: ge-0/0/0.0
v1               224.1.1.11, *       1266
        Interfaces: ge-0/0/0.0
```

show igmp-snooping statistics

Syntax **show igmp-snooping statistics**

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display IGMP snooping statistics.

Required Privilege Level view

Related Documentation

- Monitoring IGMP Snooping on page 4257
- Configuring IGMP Snooping on page 4048
- **show igmp-snooping route on page 4308**
- **show igmp-snooping vlans on page 4312**

List of Sample Output **show igmp-snooping statistics on page 4311**

Output Fields Table 317 on page 4310 lists the output fields for the **show igmp-snooping statistics** command. Output fields are listed in the approximate order in which they appear.

Table 317: show igmp-snooping statistics Output Fields

Field Name	Field Description
Bad length	IGMP packet has illegal or bad length.
Bad checksum	IGMP or IP checksum is incorrect.
Invalid interface	Packet was received through an invalid interface.
Not local	Number of packets received from senders that are not local.
Receive unknown	Unknown IGMP type.
Timed out	Number of timeouts for all multicast groups.
IGMP Type	Type of IGMP message (**Queries**, **Reports**, **Leaves**, or **Other**).
Received	Number of IGMP packets received.
Transmitted	Number of IGMP packets transmitted.
Recv Errors	Number of general receive errors.

Sample Output

show igmp-snooping statistics

```
user@switch> show igmp-snooping statistics
Bad length: 0 Bad checksum: 0 Invalid interface: 0
Not local: 0 Receive unknown: 0 Timed out: 58

    IGMP Type           Received       Transmitted    Recv Errors
    Queries:               74295                 0              0
    Reports:            18148423                 0       16333523
    Leaves:                    0                 0              0
    Other:                     0                 0              0
```

show igmp-snooping vlans

Syntax

show igmp-snooping vlans
<brief | detail>
<vlan *vlan-id* | *vlan-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display IGMP snooping VLAN information.

Options

none—Display general parameters.

brief | detail—(Optional) Display the specified level of output.

vlan *vlan-id* | vlan *vlan-number*—(Optional) Display VLAN information for the specified VLAN.

Required Privilege Level view

Related Documentation

- Monitoring IGMP Snooping on page 4257
- Configuring IGMP Snooping on page 4048
- **show igmp-snooping route on page 4308**
- **show igmp-snooping statistics on page 4310**

List of Sample Output

show igmp-snooping vlans on page 4313
show igmp-snooping vlans vlan on page 4313
show igmp-snooping vlans vlan detail on page 4313

Output Fields Table 318 on page 4312 lists the output fields for the **show igmp-snooping vlans** command. Output fields are listed in the approximate order in which they appear.

Table 318: show igmp-snooping vlans Output Fields

Field Name	Field Description	Level of Output
VLAN	Name of the VLAN.	All levels
IGMP-L2-Querier	Source address for IGMP snooping queries (if switch is an IGMP querier)	All levels
Interfaces	Number of interfaces in the VLAN.	All levels
Groups	Number of groups in the VLAN.	All levels
MRouters	Number of multicast routers associated with the VLAN.	All levels
Receivers	Number of host receivers in the VLAN.	All levels

Table 318: show igmp-snooping vlans Output Fields *(continued)*

Field Name	Field Description	Level of Output
Tag	Numerical identifier of the VLAN.	**detail**
tagged | untagged	Interface participates in a tagged (802.1Q) or untagged (native) VLAN.	**detail**
vlan-interface	Internal VLAN interface identifier.	**detail**
Membership timeout	Membership timeout value.	**detail**
Querier timeout	Timeout value for interfaces dynamically marked as router or switch interfaces (interfaces that receive queries). When the querier timeout is reached, the switch marks the interface as a host interface.	**detail**
Interface	Name of the interface.	**detail**
Reporters	Number of dynamic groups on an interface.	**detail**

Sample Output

show igmp-snooping vlans

```
user@switch> show igmp-snooping vlans
VLAN      Interfaces Groups MRouters Receivers
default     0           0      0         0
v1          11          50     0         0
v10         1           0      0         0
v11         1           0      0         0
v180        3           0      1         0
v181        3           0      0         0
v182        3           0      0         0
```

show igmp-snooping vlans vlan

```
user@switch> show igmp-snooping vlans vlan v10
user@switch> show igmp-snooping vlans vlan v10
VLAN       Interfaces Groups MRouters Receivers
v10        1           0      0         0
```

show igmp-snooping vlans vlan detail

```
user@switch> show igmp-snooping vlans vlan v10 detail
VLAN: v10, Tag: 10, vlan-interface: vlan.10
        Interface: ge-0/0/10.0, tagged, Groups: 0
IGMP-L2-Querier: Stopped, SourceAddress: 10.10.1.2
```


show msdp

Syntax

show msdp
<brief | detail>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<peer *peer-address*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display Multicast Source Discovery Protocol (MSDP) information.

Options

none—Display standard MSDP information for all routing instances.

brief | detail—(Optional) Display the specified level of output.

instance ***instance-name***—(Optional) Display information for the specified instance only.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

peer ***peer-address***—(Optional) Display information about the specified peer only,

Required Privilege Level

view

Related Documentation

- show msdp source on page 4316
- show msdp source-active on page 4318
- show msdp statistics on page 4321

List of Sample Output

show msdp on page 4315
show msdp brief on page 4315
show msdp detail on page 4315

Output Fields

Table 319 on page 4314 describes the output fields for the **show msdp** command. Output fields are listed in the approximate order in which they appear.

Table 319: show msdp Output Fields

Field Name	Field Description	Level of Output
Peer address	IP address of the peer.	All levels
Local address	Local address of the peer.	All levels
State	Status of the MSDP connection: **Listen**, **Established**, or **Inactive**.	All levels
Last up/down	Time at which the most recent peer-state change occurred.	All levels

Table 319: show msdp Output Fields *(continued)*

Field Name	Field Description	Level of Output
Peer-Group	Peer group name.	All levels
SA Count	Number of source-active cache entries advertised by each peer that were accepted, compared to the number that were received, in the format ***number-accepted/number-received***.	All levels
Peer Connect Retries	Number of peer connection retries.	**detail**
State timer expires	Number of seconds before another message is sent to a peer.	**detail**
Peer Times out	Number of seconds to wait for a response from the peer before the peer is declared unavailable.	**detail**
SA accepted	Number of entries in the source-active cache accepted from the peer.	**detail**
SA received	Number of entries in the source-active cache received by the peer.	**detail**

Sample Output

show msdp

```
user@host> show msdp
Peer address    Local address   State       Last up/down Peer-Group SA Count
198.32.8.193    198.32.8.195    Established  5d 19:25:44 North23    120/150
198.32.8.194    198.32.8.195    Established  3d 19:27:27 North23    300/345
198.32.8.196    198.32.8.195    Established  5d 19:39:36 North23    10/13
198.32.8.197    198.32.8.195    Established  5d 19:32:27 North23    5/6
198.32.8.198    198.32.8.195    Established  3d 19:33:04 North23    2305/3000
```

show msdp brief

The output for the **show msdp brief** command is identical to that for the **show msdp** command. For sample output, see show msdp on page 4315.

show msdp detail

```
user@host> show msdp detail
Peer: 10.255.70.15
Local address: 10.255.70.19
State: Established
Peer Connect Retries: 0
State timer expires: 22
Peer Times out: 49
SA accepted: 0
SA received: 0
```


show msdp source

Syntax

show msdp source
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<*source-address*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display multicast sources learned from Multicast Source Discovery Protocol (MSDP).

Options

none—Display standard MSDP source information for all routing instances.

instance *instance-name*—(Optional) Display information for the specified instance only.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

source-address—(Optional) IP address and optional prefix length. Display information for the specified source address only.

Required Privilege Level

view

Related Documentation

- show msdp on page 4314
- show msdp source-active on page 4318
- show msdp statistics on page 4321

List of Sample Output

show msdp source on page 4317

Output Fields Table 320 on page 4317 describes the output fields for the **show msdp source** command. Output fields are listed in the approximate order in which they appear.

Table 320: show msdp source Output Fields

Field Name	Field Description
Source address	IP address of the source.
/Len	Length of the prefix for this IP address.
Type	Discovery method for this multicast source: • **Configured**—Source-active limit explicitly configured for this source. • **Dynamic**—Source-active limit established when this source was discovered.
Maximum	Source-active limit applied to this source.
Threshold	Source-active threshold applied to this source.
Exceeded	Number of source-active messages received from this source exceeding the established maximum.

Sample Output

show msdp source

```
user@host> show msdp source
Source address /Len   Type       Maximum   Threshold    Exceeded
0.0.0.0        /0     Configured       5       none        0
10.1.0.0       /16    Configured     500       none        0
10.1.1.1       /32    Configured   10000       none        0
10.1.1.2       /32    Dynamic       6936       none        0
10.1.5.5       /32    Dynamic        500       none          123
10.2.1.1       /32    Dynamic          2       none        0
```

show msdp source-active

Syntax

show msdp source-active
<brief | detail>
<group *group*>
<instance *instance-name*>
<local>
<logical-system (all | *logical-system-name*)>
<originator *originator*>
<peer *peer-address*>
<source *source-address*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display the Multicast Source Discovery Protocol (MSDP) source-active cache.

Options

none—Display standard MSDP source-active cache information for all routing instances.

brief | detail—(Optional) Display the specified level of output.

group *group*—(Optional) Display source-active cache information for the specified group.

instance *instance-name*—(Optional) Display information for the specified instance.

local—(Optional) Display all source-active caches originated by this router.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

originator *originator*—(Optional) Display information about the peer that originated the source-active cache entries.

peer *peer-address*—(Optional) Display the source-active cache of the specified peer.

source *source-address*—(Optional) Display the source-active cache of the specified source.

Required Privilege Level

view

Related Documentation

- show msdp on page 4314
- show msdp source on page 4316
- show msdp statistics on page 4321

List of Sample Output

show msdp source-active on page 4319
show msdp source-active brief on page 4319
show msdp source-active detail on page 4320
show msdp source-active source on page 4320

Output Fields

Table 321 on page 4319 describes the output fields for the **show msdp source-active** command. Output fields are listed in the approximate order in which they appear.

Table 321: show msdp source-active Output Fields

Field Name	Field Description
Global active source limit exceeded	Number of times all peers have exceeded configured active source limits.
Global active source limit maximum	Configured number of active source messages accepted by the device.
Global active source limit threshold	Configured threshold for applying random early discard (RED) to drop some but not all MSDP active source messages.
Global active source limit log-warning	Threshold at which a warning message is logged (percentage of the number of active source messages accepted by the device).
Global active source limit log interval	Time (in seconds) between consecutive log messages.
Group address	Multicast address of the group.
Source address	IP address of the source.
Peer address	IP address of the peer.
Originator	Router ID configured on the source of the rendezvous point (RP) that originated the message, or the loopback address when the router ID is not configured.
Flags	Flags: **Accept**, **Reject**, or **Filtered**.

Sample Output

show msdp source-active

```
user@host> show msdp source-active
Group address     Source address  Peer address      Originator      Flags
230.0.0.0         192.168.195.46  local             10.255.14.30    Accept
230.0.0.1         192.168.195.46  local             10.255.14.30    Accept
230.0.0.2         192.168.195.46  local             10.255.14.30    Accept
230.0.0.3         192.168.195.46  local             10.255.14.30    Accept
230.0.0.4         192.168.195.46  local             10.255.14.30    Accept
```

show msdp source-active brief

The output for the **show msdp source-active brief** command is identical to that for the **show msdp source-active** command. For sample output, see show msdp source-active on page 4319.

show msdp source-active detail

The output for the **show msdp source-active detail** command is identical to that for the **show msdp source-active** command. For sample output, see show msdp source-active on page 4319.

show msdp source-active source

```
user@host> show msdp source-active source 192.168.215.246
Global active source limit exceeded: 0
Global active source limit maximum: 25000
Global active source limit threshold: 24000
Global active source limit log-warning: 100
Global active source limit log interval: 0

Group address    Source address  Peer address    Originator      Flags
226.2.2.1        192.168.215.246 10.255.182.140  10.255.182.140  Accept
226.2.2.3        192.168.215.246 10.255.182.140  10.255.182.140  Accept
226.2.2.4        192.168.215.246 10.255.182.140  10.255.182.140  Accept
226.2.2.5        192.168.215.246 10.255.182.140  10.255.182.140  Accept
226.2.2.7        192.168.215.246 10.255.182.140  10.255.182.140  Accept
226.2.2.10       192.168.215.246 10.255.182.140  10.255.182.140  Accept
226.2.2.11       192.168.215.246 10.255.182.140  10.255.182.140  Accept
226.2.2.13       192.168.215.246 10.255.182.140  10.255.182.140  Accept
226.2.2.14       192.168.215.246 10.255.182.140  10.255.182.140  Accept
226.2.2.15       192.168.215.246 10.255.182.140  10.255.182.140  Accept
```


show msdp statistics

Syntax

show msdp statistics
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<peer *peer-address*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display statistics about Multicast Source Discovery Protocol (MSDP) peers.

Options

none—Display statistics about all MSDP peers for all routing instances.

instance *instance-name*—(Optional) Display statistics about a specific MSDP instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

peer *peer-address*—(Optional) Display statistics about a particular MSDP peer.

Required Privilege Level

view

Related Documentation

- clear msdp statistics on page 4269

List of Sample Output

show msdp statistics on page 4323
show msdp statistics peer on page 4323

Output Fields

Table 322 on page 4321 describes the output fields for the **show msdp statistics** command. Output fields are listed in the approximate order in which they appear.

Table 322: show msdp statistics Output Fields

Field Name	Field Description
Global active source limit exceeded	Number of times all peers have exceeded configured active source limits.
Global active source limit maximum	Configured number of active source messages accepted by the device.
Global active source limit threshold	Configured threshold for applying random early discard (RED) to drop some but not all MSDP active source messages.
Global active source limit log-warning	Threshold at which a warning message is logged (percentage of the number of active source messages accepted by the device).
Global active source limit log interval	Time (in seconds) between consecutive log messages.
Peer	Address of peer.

Table 322: show msdp statistics Output Fields *(continued)*

Field Name	Field Description
Last State Change	How long ago the peer state changed.
Last message received from the peer	How long ago the last message was received from the peer.
RPF Failures	Number of reverse path forwarding (RPF) failures.
Remote Closes	Number of times the remote peer closed.
Peer Timeouts	Number of peer timeouts.
SA messages sent	Number of source-active messages sent.
SA messages received	Number of source-active messages received.
SA request messages sent	Number of source-active request messages sent.
SA request messages received	Number of source-active request messages received.
SA response messages sent	Number of source-active response messages sent.
SA response messages received	Number of source-active response messages received.
Active source exceeded	Number of times this peer has exceeded configured source-active limits.
Active source Maximum	Configured number of active source messages accepted by this peer.
Active source threshold	Configured threshold on this peer for applying random early discard (RED) to drop some but not all MSDP active source messages.
Active source log-warning	Configured threshold on this peer at which a warning message is logged (percentage of the number of active source messages accepted by the device).
Active source log-interval	Time (in seconds) between consecutive log messages on this peer.
Keepalive messages sent	Number of keepalive messages sent.
Keepalive messages received	Number of keepalive messages received.
Unknown messages received	Number of unknown messages received.

Table 322: show msdp statistics Output Fields *(continued)*

Field Name	Field Description
Error messages received	Number of error messages received.

Sample Output

show msdp statistics

```
user@host> show msdp statistics
Global active source limit exceeded: 0
Global active source limit maximum: 10
Global active source limit threshold: 8
Global active source limit log-warning: 60
Global active source limit log interval: 60

Peer: 10.255.245.39
Last State Change: 11:54:49 (00:24:59)
Last message received from peer: 11:53:32 (00:26:16)
RPF Failures: 0
Remote Closes: 0
Peer Timeouts: 0
SA messages sent: 376
SA messages received: 459
SA request messages sent: 0
SA request messages received: 0
SA response messages sent: 0
SA response messages received: 0
Active source exceeded: 0
Active source Maximum: 10
Active source threshold: 8
Active source log-warning: 60
Active source log-interval 120
Keepalive messages sent: 17
Keepalive messages received: 19
Unknown messages received: 0
Error messages received: 0
```

show msdp statistics peer

```
user@host> show msdp statistics peer 10.255.182.140
Peer: 10.255.182.140
    Last State Change: 8:19:23 (00:01:08)
    Last message received from peer: 8:20:05 (00:00:26)
    RPF Failures: 0
    Remote Closes: 0
    Peer Timeouts: 0
    SA messages sent: 17
    SA messages received: 16
    SA request messages sent: 0
    SA request messages received: 0
    SA response messages sent: 0
    SA response messages received: 0
    Active source exceeded: 20
    Active source Maximum: 10
    Active source threshold: 8
    Active source log-warning: 60
    Active source log-interval: 120
    Keepalive messages sent: 0
```

```
Keepalive messages received: 0
Unknown messages received: 0
Error messages received: 0
```


show multicast flow-map

Syntax

show multicast flow-map
<brief | detail>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show multicast flow-map
<brief | detail>

Release Information

Command introduced in Junos OS Release 8.2.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display configuration information about IP multicast flow maps.

Options

none—Display configuration information about IP multicast flow maps on all systems.

brief | detail—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show multicast flow-map on page 4326
show multicast flow-map detail on page 4326

Output Fields

Table 323 on page 4325 describes the output fields for the **show multicast flow-map** command. Output fields are listed in the approximate order in which they appear.

Table 323: show multicast flow-map Output Fields

Field Name	Field Description	Levels of Output
Name	Name of the flow map.	All levels
Policy	Name of the policy associated with the flow map.	All levels
Cache-timeout	Cache timeout value assigned to the flow map.	All levels
Bandwidth	Bandwidth setting associated with the flow map.	All levels
Adaptive	Whether or not adaptive mode is enabled for the flow map.	none
Flow-map	Name of the flow map.	**detail**
Adaptive Bandwidth	Whether or not adaptive mode is enabled for the flow map.	**detail**
Redundant Sources	Redundant sources defined for the same destination group.	**detail**

Sample Output

show multicast flow-map

```
user@host> show multicast flow-map
Instance: master
Name            Policy                  Cache timeout        Bandwidth Adaptive
map2            policy2                         never          2000000 no
map1            policy1                    60 seconds          2000000 no
```

Sample Output

show multicast flow-map detail

```
user@host> show multicast flow-map detail
Instance: master
Flow-map: map1
    Policy:             policy1
    Cache Timeout:      600 seconds
    Bandwidth:          2000000
    Adaptive Bandwidth: yes
    Redundant Sources:  11.11.11.11
    Redundant Sources:  11.11.11.12
    Redundant Sources:  11.11.11.13
```


show multicast interface

Syntax

show multicast interface
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show multicast interface

Release Information

Command introduced in Junos OS Release 8.3.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display bandwidth information about IP multicast interfaces.

Options

none—Display all interfaces that have multicast configured.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show multicast interface on page 4328

Output Fields

Table 324 on page 4327 describes the output fields for the **show multicast interface** command. Output fields are listed in the approximate order in which they appear.

Table 324: show multicast interface Output Fields

Field Name	Field Description
Interface	Name of the multicast interface.
Maximum bandwidth (bps)	Maximum bandwidth setting, in bits per second, for this interface.
Remaining bandwidth (bps)	Amount of bandwidth, in bits per second, remaining on the interface.
Mapped bandwidth deduction (bps)	Amount of bandwidth, in bits per second, used by any flows that are mapped to the interface. NOTE: Adding the mapped bandwidth deduction value to the local bandwidth deduction value results in the total deduction value for the interface. This field does not appear in the output when the no QoS adjustment feature is disabled.

Table 324: show multicast interface Output Fields *(continued)*

Field Name	Field Description
Local bandwidth deduction (bps)	Amount of bandwidth, in bits per second, used by any mapped flows that are traversing the interface. NOTE: Adding the mapped bandwidth deduction value to the local bandwidth deduction value results in the total deduction value for the interface. This field does not appear in the output when the no QoS adjustment feature is disabled.
Reverse OIF mapping	State of the reverse OIF mapping feature (**on** or **off**). NOTE: This field does not appear in the output when the no QoS adjustment feature is disabled.
Reverse OIF mapping no QoS adjustment	State of the no QoS adjustment feature (**on** or **off**) for interfaces that are using reverse OIF mapping. NOTE: This field does not appear in the output when the no QoS adjustment feature is disabled.
Leave timer	Amount of time a mapped interface remains active after the last mapping ends. NOTE: This field does not appear in the output when the no QoS adjustment feature is disabled.
No QoS adjustment	State (**on**) of the no QoS adjustment feature when this feature is enabled. NOTE: This field does not appear in the output when the no QoS adjustment feature is disabled.

Sample Output

show multicast interface

```
user@host> show multicast interface
Interface                Maximum bandwidth (bps) Remaining bandwidth (bps)
fe-0/0/3                                10000000                         0
fe-0/0/3.210                            10000000                  -2000000
fe-0/0/3.220                           100000000                 100000000
fe-0/0/3.230                            20000000                  18000000
fe-0/0/2.200                           100000000                 100000000
```

show multicast mrinfo

Syntax

show multicast mrinfo
<*host*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display configuration information about IP multicast networks, including neighboring multicast router addresses.

Options

none—Display configuration information about all multicast networks.

host—(Optional) Display configuration information about a particular host. Replace *host* with a hostname or IP address.

Required Privilege Level

view

List of Sample Output

show multicast mrinfo on page 4330

Output Fields

Table 325 on page 4329 describes the output fields for the **show multicast mrinfo** command. Output fields are listed in the approximate order in which they appear.

Table 325: show multicast mrinfo Output Fields

Field Name	Field Description
source-address	Query address, hostname (DNS name or IP address of the source address), and multicast protocol version or the software version of another vendor.
ip-address-1—>*ip-address-2*	Queried router interface address and directly attached neighbor interface address, respectively.
(*name* or *ip-address*)	Name or IP address of neighbor.

[*metric/threshold/type/flags*]	Neighbor's multicast profile:
	• *metric*—Always has a value of **1**, because **mrinfo** queries the directly connected interfaces of a device.
	• *threshold*—Multicast threshold time-to-live (TTL). The range of values is **0** through **255**.
	• *type*—Multicast connection type: **pim** or **tunnel**.
	• *flags*—Flags for this route:
	  ◦ **querier**—Queried router is the designated router for the neighboring session.
	  ◦ **leaf**—Link is a leaf in the multicast network.
	  ◦ **down**—Link status indicator.

Sample Output

show multicast mrinfo

```
user@host> show multicast mrinfo 10.35.4.1
10.35.4.1 (10.35.4.1) [version 12.0]:
  192.168.195.166 -> 0.0.0.0 (local) [1/0/pim/querier/leaf]
  10.38.20.1 -> 0.0.0.0 (local) [1/0/pim/querier/leaf]
  10.47.1.1 -> 10.47.1.2 (10.47.1.2) [1/5/pim]
  0.0.0.0 -> 0.0.0.0 (local) [1/0/pim/down]
```

show multicast next-hops

Syntax

show multicast next-hops
<brief | detail>
<*identifier-number*>
<inet | inet6>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show multicast next-hops
<brief | detail>
<*identifier-number*>
<inet | inet6>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 option introduced in Junos OS Release 10.0 for EX Series switches.
detail option display of next-hop ID number introduced in Junos OS Release 11.1 for M Series and T Series routers and EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Support for bidirectional PIM added in Junos OS Release 12.1.

Description

Display the entries in the IP multicast next-hop table.

Options

none—Display standard information about all entries in the multicast next-hop table for all supported address families.

brief | detail—(Optional) Display the specified level of output.

When you include the **detail** option on M Series and T Series routers and EX Series switches, the downstream interface name includes the next-hop ID number in parentheses, in the form **fe-0/1/2.0-(1048574)** where **1048574** is the next-hop ID number.

identifier-number—(Optional) Show a particular next hop by ID number. The range of values is **1** through **65,535**.

inet | inet6—(Optional) Display entries for IPv4 or IPv6 family addresses, respectively.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show multicast next-hops on page 4332
show multicast next-hops (Bidirectional PIM on page 4332
show multicast next-hops brief on page 4333
show multicast next-hops detail on page 4333

Output Fields

Table 326 on page 4332 describes the output fields for the **show multicast next-hops** command. Output fields are listed in the approximate order in which they appear.

Table 326: show multicast next-hops Output Fields

Field Name	Field Description
Family	Protocol family (such as **INET**).
ID	Next-hop identifier of the prefix. The identifier is returned by the routing device's Packet Forwarding Engine.
Refcount	Number of cache entries that are using this next hop.
KRefcount	Kernel reference count for the next hop.
Downstream interface	Interface names associated with each multicast next-hop ID.
Incoming interface list	List of interfaces that accept incoming traffic. Only shown for routes that do not use strict RPF-based forwarding, for example for bidirectional PIM.

Sample Output

show multicast next-hops

```
user@host> show multicast next-hops
Family: INET
ID       Refcount  KRefcount Downstream interface
262142          4          2 so-1/0/0.0
262143          2          1 mt-1/1/0.49152
262148          2          1 mt-1/1/0.32769
```

show multicast next-hops (Bidirectional PIM

```
user@host> show multicast next-hops
Family: INET
ID           Refcount KRefcount Downstream interface
2097151             8         4 ge-0/0/1.0

Family: INET6
ID           Refcount KRefcount Downstream interface
2097157             2         1 ge-0/0/1.0

Family: Incoming interface list
ID           Refcount KRefcount Downstream interface
513                 5         2 lo0.0
                                ge-0/0/1.0
514                 5         2 lo0.0
                                ge-0/0/1.0
                                xe-4/1/0.0
515                 3         1 lo0.0
                                ge-0/0/1.0
                                xe-4/1/0.0
544                 1         0 lo0.0
                                xe-4/1/0.0
```


show multicast next-hops brief

The output for the **show multicast next-hops brief** command is identical to that for the **show multicast next-hops** command. For sample output, see show multicast next-hops on page 4332.

show multicast next-hops detail

```
user@host> show multicast next-hops detail
Family: INET
ID          Refcount KRefcount Downstream interface
1048577            2         1 fe-0/1/2.0-(1048574)
                               ge-0/2/3.0-(1048576)
```

show multicast pim-to-igmp-proxy

Syntax

show multicast pim-to-igmp-proxy
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show multicast pim-to-igmp-proxy
<instance *instance-name*>

Release Information

Command introduced in Junos OS Release 9.6.
Command introduced in Junos OS Release 9.6 for EX Series switches.
instance option introduced in Junos OS Release 10.3.
instance option introduced in Junos OS Release 10.3 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display configuration information about PIM-to-IGMP message translation, also known as PIM-to-IGMP proxy.

Options

none—Display configuration information about PIM-to-IGMP message translation for all routing instances.

instance ***instance-name***—(Optional) Display configuration information about PIM-to-IGMP message translation for a specific multicast instance.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- *Configuring PIM-to-IGMP and PIM-to-MLD Message Translation*

List of Sample Output

show multicast pim-to-igmp-proxy on page 4335
show multicast pim-to-igmp-proxy instance on page 4335

Output Fields

Table 327 on page 4334 describes the output fields for the **show multicast pim-to-igmp-proxy** command. Output fields are listed in the order in which they appear.

Table 327: show multicast pim-to-igmp-proxy Output Fields

Field Name	Field Description
Instance	Routing instance. Default instance is **master** (inet.0 routing table).
Proxy state	State of PIM-to-IGMP message translation, also known as PIM-to-IGMP proxy, on the configured upstream interfaces: **enabled** or **disabled**.
interface-name	Name of upstream interface (no more than two allowed) on which PIM-to-IGMP message translation is configured.

Sample Output

show multicast pim-to-igmp-proxy

```
user@host> show multicast pim-to-igmp-proxy
Instance: master Proxy state: enabled
ge-0/1/0.1
ge-0/1/0.2
```

show multicast pim-to-igmp-proxy instance

```
user@host> show multicast pim-to-igmp-proxy instance VPN-A
Instance: VPN-A Proxy state: enabled
ge-0/1/0.1
```

show multicast pim-to-mld-proxy

Syntax

show multicast pim-to-mld-proxy
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show multicast pim-to-mld-proxy
<instance *instance-name*>

Release Information

Command introduced in Junos OS Release 9.6.
Command introduced in Junos OS Release 9.6 for EX Series switches.
instance option introduced in Junos OS Release 10.3.
instance option introduced in Junos OS Release 10.3 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display configuration information about PIM-to-MLD message translation, also known as PIM-to-MLD proxy.

Options

none—Display configuration information about PIM-to-MLD message translation for all routing instances.

instance *instance-name*—(Optional) Display configuration information about PIM-to-MLD message translation for a specific multicast instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show multicast pim-to-mld-proxy on page 4337
show multicast pim-to-mld-proxy instance on page 4337

Output Fields

Table 328 on page 4336 describes the output fields for the **show multicast pim-to-mld-proxy** command. Output fields are listed in the order in which they appear.

Table 328: show multicast pim-to-mld-proxy Output Fields

Field Name	Field Description
Proxy state	State of PIM-to-MLD message translation, also known as PIM-to-MLD proxy, on the configured upstream interfaces: **enabled** or **disabled**.
interface-name	Name of upstream interface (no more than two allowed) on which PIM-to-MLD message translation is configured.

Sample Output

show multicast pim-to-mld-proxy

```
user@host> show multicast pim-to-mld-proxy
Instance: master Proxy state: enabled
ge-0/5/0.1
ge-0/5/0.2
```

show multicast pim-to-mld-proxy instance

```
user@host> show multicast pim-to-mld-proxy instance VPN-A
Instance: VPN-A Proxy state: enabled
ge-0/5/0.1
```


show multicast route

Syntax

show multicast route
<brief | detail | extensive | summary>
<active | all | inactive>
<group *group*>
<inet | inet6>
<instance *instance name*>
<logical-system (all | *logical-system-name*)>
<*regular-expression*>
<source-prefix *source-prefix*>

Syntax (EX Series Switch and the QFX Series)

show multicast route
<brief | detail | extensive | summary>
<active | all | inactive>
<group *group*>
<inet | inet6>
<instance *instance name*>
<*regular-expression*>
<source-prefix *source-prefix*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Support for bidirectional PIM added in Junos OS Release 12.1.

Description

Display the entries in the IP multicast forwarding table. You can display similar information with the **show route table inet.1** command.

Options

none—Display standard information about all entries in the multicast forwarding table for all routing instances.

brief | detail | extensive | summary—(Optional) Display the specified level of output.

active | all | inactive—(Optional) Display all active entries, all entries, or all inactive entries, respectively, in the multicast forwarding table.

group *group*—(Optional) Display the cache entries for a particular group.

inet | inet6—(Optional) Display multicast forwarding table entries for IPv4 or IPv6 family addresses, respectively.

instance *instance-name*—(Optional) Display entries in the multicast forwarding table for a specific multicast instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

regular-expression—(Optional) Display information about the multicast forwarding table entries that match a UNIX OS-style regular expression.

source-prefix ***source-prefix***—(Optional) Display the cache entries for a particular source prefix.

Required Privilege Level view

List of Sample Output

show multicast route on page 4340
show multicast route (Bidirectional PIM) on page 4341
show multicast route brief on page 4341
show multicast route detail on page 4341
show multicast route extensive (Bidirectional PIM) on page 4342
show multicast route instance <instance-name> on page 4343
show multicast route summary on page 4343

Output Fields Table 329 on page 4339 describes the output fields for the **show multicast route** command. Output fields are listed in the approximate order in which they appear.

Table 329: show multicast route Output Fields

Field Name	Field Description	Level of Output
family	IPv4 address family (**INET**) or IPv6 address family (**INET6**).	All levels
Group	Group address. For any-source multicast routes, for example for bidirectional PIM, the group address includes the prefix length.	All levels
Source	Prefix and length of the source as it is in the multicast forwarding table.	All levels
Incoming interface list	List of interfaces that accept incoming traffic. Only shown for routes that do not use strict RPF-based forwarding, for example for bidirectional PIM.	All levels
Upstream interface	Name of the interface on which the packet with this source prefix is expected to arrive.	All levels
Downstream interface list	List of interface names to which the packet with this source prefix is forwarded.	All levels
Number of outgoing interfaces	Total number of outgoing interfaces for each (S,G) entry.	**extensive**
Session description	Name of the multicast session.	**detail extensive**
Statistics	Rate at which packets are being forwarded for this source and group entry (in Kbps and pps), and number of packets that have been forwarded to this prefix. If one or more of the kilobits per second packet forwarding statistic queries fails or times out, the statistics field displays **Forwarding statistics are not available**. NOTE: On QFX Series switches, this field does not report valid statistics.	**detail extensive**
Next-hop ID	Next-hop identifier of the prefix. The identifier is returned by the routing device's Packet Forwarding Engine and is also displayed in the output of the **show multicast nexthops** command.	**detail extensive**

Table 329: show multicast route Output Fields *(continued)*

Field Name	Field Description	Level of Output
Incoming interface list ID	For bidirectional PIM, incoming interface list identifier. Identifiers for interfaces that accept incoming traffic. Only shown for routes that do not use strict RPF-based forwarding, for example for bidirectional PIM.	**detail extensive**
Upstream protocol	The protocol that maintains the active multicast forwarding route for this group or source. When the **show multicast route extensive** command is used with the **display-origin-protocol** option, the field name is only **Protocol** and not **Upstream Protocol**. However, this field also displays the protocol that installed the active route.	**detail extensive**
Route type	Type of multicast route. Values can be (S,G) or (*,G).	**summary**
Route state	Whether the group is **Active** or **Inactive**.	**summary extensive**
Route count	Number of multicast routes.	**summary**
Forwarding state	Whether the prefix is pruned or forwarding.	**extensive**
Cache lifetime/timeout	Number of seconds until the prefix is removed from the multicast forwarding table. A value of **never** indicates a permanent forwarding entry. A value of **forever** indicates routes that do not have keepalive times.	**extensive**
Wrong incoming interface notifications	Number of times that the upstream interface was not available.	**extensive**
Uptime	Time since the creation of a multicast route.	**extensive**

Sample Output

show multicast route

```
user@host> show multicast route
Family: INET

Group: 228.0.0.0
    Source: 10.255.14.144/32
    Upstream interface: local
    Downstream interface list:
        so-1/0/0.0

Group: 239.1.1.1
    Source: 10.255.14.144/32
    Upstream interface: local
    Downstream interface list:
        so-1/0/0.0

Group: 239.1.1.1
    Source: 10.255.70.15/32
```



```
    Upstream interface: so-1/0/0.0
    Downstream interface list:
        mt-1/1/0.1081344

Family: INET6
```

show multicast route (Bidirectional PIM)

```
user@host> show multicast route
Family: INET

Group: 224.1.1.0/24
    Source: *
    Incoming interface list:
        lo0.0 ge-0/0/1.0
    Downstream interface list:
        ge-0/0/1.0

Group: 224.1.3.0/24
    Source: *
    Incoming interface list:
        lo0.0 ge-0/0/1.0 xe-4/1/0.0
    Downstream interface list:
        ge-0/0/1.0

Group: 225.1.1.0/24
    Source: *
    Incoming interface list:
        lo0.0 ge-0/0/1.0
    Downstream interface list:
        ge-0/0/1.0

Group: 225.1.3.0/24
    Source: *
    Incoming interface list:
        lo0.0 ge-0/0/1.0 xe-4/1/0.0
    Downstream interface list:
        ge-0/0/1.0
Family: INET6
```

show multicast route brief

The output for the **show multicast route brief** command is identical to that for the **show multicast route** command. For sample output, see show multicast route on page 4340 or show multicast route (Bidirectional PIM) on page 4341.

show multicast route detail

```
user@host> show multicast route detail
Family: INET

Group: 228.0.0.0
    Source: 10.255.14.144/32
    Upstream interface: local
    Downstream interface list:
        so-1/0/0.0
    Session description: Unknown
    Statistics: 8 kBps, 100 pps, 45272 packets
    Next-hop ID: 262142
    Upstream protocol: PIM
```

```
Group: 239.1.1.1
    Source: 10.255.14.144/32
    Upstream interface: local
    Downstream interface list:
        so-1/0/0.0
    Session description: Administratively Scoped
    Statistics: 0 kBps, 0 pps, 13404 packets
    Next-hop ID: 262142
    Upstream protocol: PIM

Group: 239.1.1.1
    Source: 10.255.70.15/32
    Upstream interface: so-1/0/0.0
    Downstream interface list:
        mt-1/1/0.1081344
    Session description: Administratively Scoped
    Statistics: 46 kBps, 1000 pps, 921077 packets

    Next-hop ID: 262143
    Upstream protocol: PIM

Family: INET6
```

show multicast route extensive (Bidirectional PIM)

```
user@host> show multicast route extensive
Family: INET

Group: 224.1.1.0/24
    Source: *
    Incoming interface list:
        lo0.0 ge-0/0/1.0
    Downstream interface list:
        ge-0/0/1.0
    Number of outgoing interfaces: 1
    Session description: NOB Cross media facilities
    Statistics: 0 kBps, 0 pps, 0 packets
    Next-hop ID: 2097153
    Incoming interface list ID: 585
    Upstream protocol: PIM
    Route state: Active
    Forwarding state: Forwarding
    Cache lifetime/timeout: forever
    Wrong incoming interface notifications: 0

Group: 224.1.3.0/24
    Source: *
    Incoming interface list:
        lo0.0 ge-0/0/1.0 xe-4/1/0.0
    Downstream interface list:
        ge-0/0/1.0
    Number of outgoing interfaces: 1
    Session description: NOB Cross media facilities
    Statistics: 0 kBps, 0 pps, 0 packets
    Next-hop ID: 2097153
    Incoming interface list ID: 589
    Upstream protocol: PIM
    Route state: Active
    Forwarding state: Forwarding
    Cache lifetime/timeout: forever
    Wrong incoming interface notifications: 0
```



```
Family: INET6
```

show multicast route instance <instance-name>

```
user@host> show multicast route instance v1 extensive
Instance: v1 Family: INET

Group: 224.1.1.1
    Source: (null)/0
    Upstream interface: fe-1/3/0.111
    Downstream interface list:
        lt-0/3/0.42 lt-0/3/0.46 lt-0/3/0.43
    Number of outgoing interfaces: 3

Group: 224.1.1.2
    Source: (null)/0
    Upstream interface: fe-1/3/0.111
    Downstream interface list:
        lt-0/3/0.42 lt-0/3/0.46 lt-0/3/0.43
    Number of outgoing interfaces: 3

Group: 224.1.1.3
    Source: (null)/0
    Upstream interface: fe-1/3/0.111
    Downstream interface list:
        lt-0/3/0.42 lt-0/3/0.46 lt-0/3/0.43
    Number of outgoing interfaces: 3

Instance: v1 Family: INET6
```

show multicast route summary

```
user@host>show multicast route summary
Instance: master Family: INET

Route type   Route state    Route count
(S,G)             Active            2
(S,G)             Inactive          3

Instance: master Family: INET6
```


show multicast rpf

Syntax

show multicast rpf
<inet | inet6>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<*prefix*>
<summary>

Syntax (EX Series Switch and the QFX Series)

show multicast rpf
<inet | inet6>
<instance *instance-name*>
<*prefix*>
<summary>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display information about multicast reverse-path-forwarding (RPF) calculations.

Options

none—Display RPF calculation information for all supported address families.

inet | inet6—(Optional) Display the RPF calculation information for IPv4 or IPv6 family addresses, respectively.

instance *instance-name*—(Optional) Display information about multicast RPF calculations for a specific multicast instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

prefix—(Optional) Display the RPF calculation information for the specified prefix.

summary—(Optional) Display a summary of all multicast RPF information.

Required Privilege Level

view

List of Sample Output

show multicast rpf on page 4345
show multicast rpf inet6 on page 4346
show multicast rpf prefix on page 4347
show multicast rpf summary on page 4347

Output Fields Table 330 on page 4345 describes the output fields for the **show multicast rpf** command. Output fields are listed in the approximate order in which they appear.

Table 330: show multicast rpf Output Fields

Field Name	Field Description
Instance	Name of the routing instance. (Displayed when multicast is configured within a routing instance.)
Source prefix	Prefix and length of the source as it exists in the multicast forwarding table.
Protocol	How the route was learned.
Interface	Upstream RPF interface. NOTE: The displayed interface information does not apply to bidirectional PIM RP addresses. This is because the **show multicast rpf** command does not take into account equal-cost paths or the designated forwarder. For accurate upstream RPF interface information, always use the **show pim join extensive** command when bidirectional PIM is configured.
Neighbor	Upstream RPF neighbor. NOTE: The displayed neighbor information does not apply to bidirectional PIM. This is because the **show multicast rpf** command does not take into account equal-cost paths or the designated forwarder. For accurate upstream RPF neighbor information, always use the **show pim join extensive** command when bidirectional PIM is configured.

Sample Output

show multicast rpf

```
user@host> show multicast rpf

Multicast RPF table: inet.0, 12 entries

0.0.0.0/0
    Protocol: Static

10.255.14.132/32
    Protocol: Direct
    Interface: lo0.0

10.255.245.91/32
    Protocol: IS-IS
    Interface: so-1/1/1.0
    Neighbor: 192.168.195.21

127.0.0.1/32
Inactive172.16.0.0/12
Protocol: Static
Interface: fxp0.0
```

```
Neighbor: 192.168.14.254

192.168.0.0/16
Protocol: Static
Interface: fxp0.0
Neighbor: 192.168.14.254

192.168.14.0/24
Protocol: Direct
Interface: fxp0.0

192.168.14.132/32
Protocol: Local

192.168.195.20/30
Protocol: Direct
Interface: so-1/1/1.0

192.168.195.22/32
Protocol: Local

192.168.195.36/30
Protocol: IS-IS
Interface: so-1/1/1.0
Neighbor: 192.168.195.21
```

show multicast rpf inet6

```
user@host> show multicast rpf inet6

Multicast RPF table: inet6.0, 12 entries

::10.255.14.132/128
    Protocol: Direct
    Interface: lo0.0

::10.255.245.91/128
Protocol: IS-IS
Interface: so-1/1/1.0
Neighbor: fe80::2a0:a5ff:fe28:2e8c

::192.168.195.20/126
Protocol: Direct
Interface: so-1/1/1.0

::192.168.195.22/128
Protocol: Local

::192.168.195.36/126
Protocol: IS-IS
Interface: so-1/1/1.0
Neighbor: fe80::2a0:a5ff:fe28:2e8c

::192.168.195.76/126
Protocol: Direct
Interface: fe-2/2/0.0

::192.168.195.77/128
Protocol: Local
```

```
fe80::/64
Protocol: Direct
Interface: so-1/1/1.0

fe80::290:69ff:fe0c:993a/128
Protocol: Local

fe80::2a0:a5ff:fe12:84f/128
Protocol: Direct
Interface: lo0.0

ff02::2/128
Protocol: PIM

ff02::d/128
Protocol: PIM
```

show multicast rpf prefix

`user@host>` **show multicast rpf ff02::/16**

```
Multicast RPF table: inet6.0, 13 entries

ff02::2/128
    Protocol: PIM

ff02::d/128
    Protocol: PIM

...
```

show multicast rpf summary

`user@host>` **show multicast rpf summary**

```
Multicast RPF table: inet.0, 16 entries
Multicast RPF table: inet6.0, 12 entries
```


show multicast scope

Syntax

show multicast scope
<inet | inet6>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show multicast scope
<inet | inet6>
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display administratively scoped IP multicast information.

Options

none—Display standard information about administratively scoped multicast information for all supported address families in all routing instances.

inet | inet6—(Optional) Display scoped multicast information for IPv4 or IPv6 family addresses, respectively.

instance *instance-name*—(Optional) Display administratively scoped information for a specific multicast instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show multicast scope on page 4349
show multicast scope inet on page 4349
show multicast scope inet6 on page 4349

Output Fields

Table 331 on page 4348 describes the output fields for the **show multicast scope** command. Output fields are listed in the approximate order in which they appear.

Table 331: show multicast scope Output Fields

Field Name	Field Description
Scope name	Name of the multicast scope.
Group Prefix	Range of multicast groups that are scoped.
Interface	Interface that is the boundary of the administrative scope.
Resolve Rejects	Number of kernel resolve rejects.

Sample Output

show multicast scope

```
user@host> show multicast scope
                                                                Resolve
Scope name           Group Prefix       Interface               Rejects
232-net              232.232.0.0/16     fe-0/0/0.1                    0
local                239.255.0.0/16     fe-0/0/0.1                    0
local                ff05::/16          fe-0/0/0.1                    0
larry                ff05::1234/128     fe-0/0/0.1                    0
```

show multicast scope inet

```
user@host> show multicast scope inet
                                                                Resolve
Scope name           Group Prefix       Interface               Rejects
232-net              232.232.0.0/16     fe-0/0/0.1                    0
local                239.255.0.0/16     fe-0/0/0.1                    0
```

show multicast scope inet6

```
user@host> show multicast scope inet6
                                                                Resolve
Scope name           Group Prefix       Interface               Rejects
local                ff05::/16          fe-0/0/0.1                    0
larry                ff05::1234/128     fe-0/0/0.1                    0
```


show multicast sessions

Syntax

show multicast sessions
<brief | detail | extensive>
<logical-system (all | *logical-system-name*)>
<*regular-expression*>

Syntax (EX Series Switch and the QFX Series)

show multicast sessions
<brief | detail | extensive>
<*regular-expression*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display information about announced IP multicast sessions.

Options

none—Display standard information about all multicast sessions for all routing instances.

brief | detail | extensive—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

regular-expression—(Optional) Display information about announced sessions that match a UNIX-style regular expression.

Required Privilege Level

view

List of Sample Output

show multicast sessions on page 4351
show multicast sessions regular-expression detail on page 4351

Output Fields

Table 332 on page 4350 describes the output fields for the **show multicast sessions** command. Output fields are listed in the approximate order in which they appear.

Table 332: show multicast sessions Output Fields

Field Name	Field Description
session-name	Name of the known announced multicast sessions.

Sample Output

show multicast sessions

```
user@host> show multicast sessions
1-Department of Biological Sciences, LSU
  ...
  Monterey Bay - DockCam
  Monterey Bay - JettyCam
  Monterey Bay - StandCam
  Monterey DockCam
  Monterey DockCam / ROV cam
  ...
  NASA TV (MPEG-1)
  ...
  UO Broadcast - NASA Videos - 25 Years of Progress
  UO Broadcast - NASA Videos - Journey through the Solar System
  UO Broadcast - NASA Videos - Life in the Universe
  UO Broadcast - NASA Videos - Nasa and the Airplane
  UO Broadcasts OPB's Oregon Story
  UO DOD News Clips
  UO Medical Management of Biological Casualties (1)
  UO Medical Management of Biological Casualties (2)
  UO Medical Management of Biological Casualties (3)
...
  376 active sessions.
```

show multicast sessions regular-expression detail

```
user@host> show multicast sessions "NASA TV" detail
SDP Version: 0  Originated by: -@128.223.83.33
 Session: NASA TV (MPEG-1)
 Description: NASA television in MPEG-1 format, provided by Private University.
Please contact the UO if you have problems with this feed.
 Email: Your Name Here <multicast@lists.private.edu>
 Phone: Your Name Here <888/555-1212>
Bandwidth: AS:1000
Start time: permanent
Stop time: none
Attribute: type:broadcast
Attribute: tool:IP/TV Content Manager 3.4.14
Attribute: live:capture:1
Attribute: x-iptv-capture:mp1s
Media: video 54302 RTP/AVP 32 31 96 97
Connection Data: 224.2.231.45 ttl 127
Attribute: quality:8
Attribute: framerate:30
Attribute: rtpmap:96 WBIH/90000
Attribute: rtpmap:97 MP4V-ES/90000
Attribute: x-iptv-svr:video 128.223.91.191 live
Attribute: fmtp:32 type=mpeg1
Media: audio 28848 RTP/AVP 14 0 96 3 5 97 98 99 100 101 102 10 11 103 104 105 106
 Connection Data: 224.2.145.37 ttl 127
Attribute: rtpmap:96 X-WAVE/8000
Attribute: rtpmap:97 L8/8000/2
Attribute: rtpmap:98 L8/8000
Attribute: rtpmap:99 L8/22050/2
Attribute: rtpmap:100 L8/22050
Attribute: rtpmap:101 L8/11025/2
Attribute: rtpmap:102 L8/11025
Attribute: rtpmap:103 L16/22050/2
```



```
Attribute: rtpmap:104 L16/22050

  1 matching sessions.
```

show multicast usage

Syntax

show multicast usage
<brief | detail>
<inet | inet6>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show multicast usage
<brief | detail>
<inet | inet6>
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display usage information about the 10 most active Distance Vector Multicast Routing Protocol (DVMRP) or Protocol Independent Multicast (PIM) groups.

Options

none—Display multicast usage information for all supported address families for all routing instances.

brief | detail—(Optional) Display the specified level of output.

inet | inet6—(Optional) Display usage information for IPv4 or IPv6 family addresses, respectively.

instance *instance-name*—(Optional) Display information about the most active DVMRP or PIM groups for a specific multicast instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show multicast usage on page 4354
show multicast usage brief on page 4354
show multicast usage instance on page 4354
show multicast usage detail on page 4355

Output Fields

Table 333 on page 4353 describes the output fields for the **show multicast usage** command. Output fields are listed in the approximate order in which they appear.

Table 333: show multicast usage Output Fields

Field Name	Field Description
Instance	Name of the routing instance. (Displayed when multicast is configured within a routing instance.)

Table 333: show multicast usage Output Fields *(continued)*

Field Name	Field Description
Group	Group address.
Sources	Number of sources.
Packets	Number of packets that have been forwarded to this prefix. If one or more of the packets forwarded statistic queries fails or times out, the packets field displays **unavailable**.
Bytes	Number of bytes that have been forwarded to this prefix. If one or more of the packets forwarded statistic queries fails or times out, the bytes field displays **unavailable**.
Prefix	IP address.
/len	Prefix length.
Groups	Number of multicast groups.

Sample Output

show multicast usage

```
user@host> show multicast usage
Group           Sources Packets                    Bytes
228.0.0.0       1       52847                      4439148
239.1.1.1       2       13450                      1125530


Prefix          /len Groups Packets                    Bytes
10.255.14.144   /32  2      66254                      5561304
10.255.70.15    /32  1      43                         3374...
```

show multicast usage brief

The output for the **show multicast usage brief** command is identical to that for the **show multicast usage** command. For sample output, see show multicast usage on page 4354.

show multicast usage instance

```
user@host> show multicast usage instance VPN-A
Group           Sources Packets                    Bytes
224.2.127.254   1       5538                       509496
224.0.1.39      1       13                         624
224.0.1.40      1       13                         624

Prefix          /len Groups Packets                    Bytes
192.168.195.34  /32  1      5538                       509496
10.255.14.30    /32  1      13                         624
10.255.245.91   /32  1      13                         624
...
```


show multicast usage detail

```
user@host> show multicast usage detail
Group           Sources Packets              Bytes
228.0.0.0       1       53159                4465356
    Source: 10.255.14.144   /32 Packets: 53159 Bytes: 4465356
239.1.1.1       2       13450                1125530
    Source: 10.255.14.144   /32 Packets: 13407 Bytes: 1122156
    Source: 10.255.70.15    /32 Packets: 43 Bytes: 3374


Prefix          /len Groups Packets              Bytes
10.255.14.144   /32  2      66566                5587512
    Group: 228.0.0.0       Packets: 53159 Bytes: 4465356
    Group: 239.1.1.1       Packets: 13407 Bytes: 1122156
10.255.70.15    /32  1      43                   3374
    Group: 239.1.1.1       Packets: 43 Bytes: 3374
```


show pim bootstrap

Syntax

show pim bootstrap
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show pim bootstrap
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
instance option introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

For sparse mode only, display information about Protocol Independent Multicast (PIM) bootstrap routers.

Options

none—Display PIM bootstrap router information for all routing instances.

instance ***instance-name***—(Optional) Display information about bootstrap routers for a specific PIM-enabled routing instance.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show pim bootstrap on page 4357
show pim bootstrap instance on page 4357

Output Fields

Table 334 on page 4356 describes the output fields for the **show pim bootstrap** command. Output fields are listed in the approximate order in which they appear.

Table 334: show pim bootstrap Output Fields

Field Name	Field Description
Instance	Name of the routing instance.
BSR	Bootstrap router.
Pri	Priority of the routing device as elected to be the bootstrap router.
Local address	Local routing device address.
Pri	Local routing device address priority to be elected as the bootstrap router.
State	Local routing device election state: **Candidate**, **Elected**, or **Ineligible**.

Table 334: show pim bootstrap Output Fields *(continued)*

Field Name	Field Description
Timeout	How long until the local routing device declares the bootstrap router to be unreachable, in seconds.

Sample Output

show pim bootstrap

```
user@host> show pim bootstrap
Instance: PIM.master

BSR                     Pri Local address           Pri State      Timeout
None                      0 10.255.71.46              0 InEligible       0
feco:1:1:1:1:0:aff:785c 34 feco:1:1:1:1:0:aff:7c12   0 InEligible       0
```

show pim bootstrap instance

```
user@host> show pim bootstrap instance VPN-A
Instance: PIM.VPN-A

BSR              Pri Local address   Pri State      Timeout
None               0 192.168.196.105   0 InEligible       0
```

show pim interfaces

Syntax

show pim interfaces
<inet | inet6>
<instance (*instance-name* | all)>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show pim interfaces
<inet | inet6>
<instance (*instance-name* | all)>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Commmand introduced in Junos OS Release 11.3 for the QFX Series.
Support for bidirectional PIM added in Junos OS Release 12.1.
Support for the **instance all** option added in Junos OS Release 12.1.

Description

Display information about the interfaces on which Protocol Independent Multicast (PIM) is configured.

Options

none—Display interface information for all family addresses for the main instance.

inet | inet6—(Optional) Display interface information for IPv4 or IPv6 family addresses, respectively.

instance (*instance-name* | all)—(Optional) Display information about interfaces for a specific PIM-enabled routing instance or for all routing instances.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show pim interfaces on page 4359

Output Fields

Table 335 on page 4358 describes the output fields for the **show pim interfaces** command. Output fields are listed in the approximate order in which they appear.

Table 335: show pim interfaces Output Fields

Field Name	Field Description
Instance	Name of the routing instance.
Name	Interface name.
State	State of the interface. The state also is displayed in the **show interfaces** command.

Table 335: show pim interfaces Output Fields *(continued)*

Field Name	Field Description
Mode	PIM mode running on the interface: • **B**—In bidirectional mode, multicast groups are carried across the network over bidirectional shared trees. This type of tree minimizes PIM routing state, which is especially important in networks with numerous and dispersed senders and receivers. • **S**—In sparse mode, routing devices must join and leave multicast groups explicitly. Upstream routing devices do not forward multicast traffic to this routing device unless this device has sent an explicit request (using a join message) to receive multicast traffic. • **Dense**—Unlike sparse mode, where data is forwarded only to routing devices sending an explicit request, dense mode implements a flood-and-prune mechanism, similar to DVMRP (the first multicast protocol used to support the multicast backbone). (Not supported on QFX Series.) • **Sparse-Dense**—Sparse-dense mode allows the interface to operate on a per-group basis in either sparse or dense mode. A group specified as **dense** is not mapped to a rendezvous point (RP). Instead, data packets destined for that group are forwarded using PIM-Dense Mode (PIM-DM) rules. A group specified as **sparse** is mapped to an RP, and data packets are forwarded using PIM-Sparse Mode (PIM-SM) rules. (Not supported on QFX Series.) When sparse-dense mode is configured, the output includes both **S** and **D**. When bidirectional-sparse mode is configured, the output includes **S** and **B**. When bidirectional-sparse-dense mode is configured, the output includes **B**, **S**, and **D**.
IP	Version number of the address family on the interface: **4** (IPv4) or **6** (IPv6).
V	PIM version running on the interface: **1** or **2**.
State	State of PIM on the interface: • **Active**—Bidirectional mode is enabled on the interface and on all PIM neighbors. • **DR**—Designated router. • **NotCap**—Bidirectional mode is not enabled on the interface. This can happen when bidirectional PIM is not configured locally, when one of the neighbors is not configured for bidirectional PIM, or when one of the neighbors has not implemented the bidirectional PIM protocol. • **NotDR**—Not the designated router. • **P2P**—Point to point.
NbrCnt	Number of neighbors that have been seen on the interface.
JoinCnt(sg)	Number of (s,g) join messages that have been seen on the interface.
JointCnt(*g)	Number of (*,g) join messages that have been seen on the interface.
DR address	Address of the designated router.

Sample Output

show pim interfaces

```
user@host> show pim interfaces
Stat = Status, V = Version, NbrCnt = Neighbor Count,
S = Sparse, D = Dense, B = Bidirectional,
DR = Designated Router, P2P = Point-to-point link,
```



```
Active = Bidirectional is active, NotCap = Not Bidirectional Capable

Name               Stat Mode IP V State        NbrCnt JoinCnt(sg/*g) DR address
ge-0/3/0.0         Up   S     4 2 NotDR,NotCap      1 0/0            40.0.0.3
ge-0/3/3.50        Up   S     4 2 DR,NotCap         1 9901/100       50.0.0.2
ge-0/3/3.51        Up   S     4 2 DR,NotCap         1 0/0            51.0.0.2
pe-1/2/0.32769     Up   S     4 2 P2P,NotCap        0 0/0
```


show pim join

Syntax

show pim join
<brief | detail | extensive | summary>
<bidirectional | dense | sparse>
<exact>
<inet | inet6>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<*range*>
<rp *ip-address/prefix* | source *ip-address/prefix*>
<sg | star-g>

Syntax (EX Series Switch and the QFX Series)

show pim join
<brief | detail | extensive | summary>
<dense | sparse>
<exact>
<inet | inet6>
<instance *instance-name*>
<*range*>
<rp *ip-address/prefix* | source *ip-address/prefix*>
<sg | star-g>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
summary option introduced in Junos OS Release 9.6.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Support for bidirectional PIM added in Junos OS Release 12.1.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Multiple new filter options introduced in Junos OS Release 13.2.

Description

Display information about Protocol Independent Multicast (PIM) groups for all PIM modes.

For bidirectional PIM, display information about PIM group ranges (*,G-range) for each active bidirectional RP group range, in addition to each of the joined (*,G) routes.

Options

none—Display the standard information about PIM groups for all supported family addresses for all routing instances.

brief | detail | extensive | summary—(Optional) Display the specified level of output.

bidirectional | dense | sparse—(Optional) Display information about PIM bidirectional mode, dense mode, or sparse and source-specific multicast (SSM) mode entries.

exact—(Optional) Display information about only the group that exactly matches the specified group address.

inet | inet6—(Optional) Display PIM group information for IPv4 or IPv6 family addresses, respectively.

instance ***instance-name***—(Optional) Display information about groups for the specified PIM-enabled routing instance only.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

range—(Optional) Address range of the group, specified as ***prefix/prefix-length***.

rp ***ip-address/prefix*** **| source** ***ip-address/prefix***—(Optional) Display information about the PIM entries with a specified rendezvous point (RP) address and prefix or with a specified source address and prefix. You can omit the prefix.

sg | star-g—(Optional) Display information about PIM (S,G) or (*,G) entries.

Required Privilege Level

view

Related Documentation

- clear pim join on page 4275

List of Sample Output

show pim join summary on page 4366
show pim join (PIM Sparse Mode) on page 4366
show pim join (Bidirectional PIM) on page 4366
show pim join inet6 on page 4367
show pim join inet6 star-g on page 4367
show pim join instance <instance-name> on page 4367
show pim join detail on page 4368
show pim join extensive (PIM Sparse Mode) on page 4368
show pim join extensive (Bidirectional PIM) on page 4369
show pim join extensive (Bidirectional PIM with a Directly Connected Phantom RP) on page 4370
show pim join instance <instance-name> extensive on page 4371
show pim join extensive (Ingress Node with Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs) on page 4371
show pim join extensive (Egress Node with Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs) on page 4372

Output Fields

Table 336 on page 4362 describes the output fields for the **show pim join** command. Output fields are listed in the approximate order in which they appear.

Table 336: show pim join Output Fields

Field Name	Field Description	Level of Output
Instance	Name of the routing instance.	**brief detail extensive summary** none
Family	Name of the address family: **inet** (IPv4) or **inet6** (IPv6).	**brief detail extensive summary** none
Route type	Type of multicast route: (S,G) or (*,G).	**summary**
Route count	Number of (S,G) routes and number of (*,G) routes.	**summary**

Table 336: show pim join Output Fields *(continued)*

Field Name	Field Description	Level of Output
R	Rendezvous Point Tree.	**brief detail extensive** none
S	Sparse.	**brief detail extensive** none
W	Wildcard.	**brief detail extensive** none
Group	Group address.	**brief detail extensive** none
Bidirectional group prefix length	For bidirectional PIM, length of the IP prefix for RP group ranges.	All levels
Source	Multicast source: • ***** (wildcard value) • ***ipv4-address*** • ***ipv6-address***	**brief detail extensive** none
RP	Rendezvous point for the PIM group.	**brief detail extensive** none
Flags	PIM flags: • **bidirectional**—Bidirectional mode entry. • **dense**—Dense mode entry. • **rptree**—Entry is on the rendezvous point tree. • **sparse**—Sparse mode entry. • **spt**—Entry is on the shortest-path tree for the source. • **wildcard**—Entry is on the shared tree.	**brief detail extensive** none
Upstream interface	RPF interface toward the source address for the source-specific state (S,G) or toward the rendezvous point (RP) address for the non-source-specific state (*,G). For bidirectional PIM, **RP Link** means that the interface is directly connected to a subnet that contains a phantom RP address. A pseudo multipoint LDP (M-LDP) interface appears on egress nodes in M-LDP point-to-multipoint LSPs with inband signaling.	**brief detail extensive** none

Table 336: show pim join Output Fields *(continued)*

Field Name	Field Description	Level of Output
Upstream neighbor	Information about the upstream neighbor: **Direct**, **Local**, **Unknown**, or a specific IP address. For bidirectional PIM, **Direct** means that the interface is directly connected to a subnet that contains a phantom RP address. The multipoint LDP (M-LDP) root appears on egress nodes in M-LDP point-to-multipoint LSPs with inband signaling.	**extensive**
Upstream state	Information about the upstream interface: • **Join to RP**—Sending a join to the rendezvous point. • **Join to Source**—Sending a join to the source. • **Local RP**—Sending neither join messages nor prune messages toward the RP, because this routing device is the rendezvous point. • **Local Source**—Sending neither join messages nor prune messages toward the source, because the source is locally attached to this routing device. • **Prune to RP**—Sending a prune to the rendezvous point. • **Prune to Source**—Sending a prune to the source. NOTE: RP group range entries have **None** in the **Upstream state** field because RP group ranges do not trigger actual PIM join messages between routing devices.	**extensive**

Table 336: show pim join Output Fields *(continued)*

Field Name	Field Description	Level of Output
Downstream neighbors	Information about downstream interfaces: • **Interface**—Interface name for the downstream neighbor. A pseudo PIM-SM interface appears for all IGMP-only interfaces. A pseudo multipoint LDP (M-LDP) interface appears on ingress root nodes in M-LDP point-to-multipoint LSPs with inband signaling. • **Interface address**—Address of the downstream neighbor. • **State**—Information about the downstream neighbor: **join** or **prune**. • **Flags**—PIM join flags: **R (RPtree)**, **S (Sparse)**, **W (Wildcard)**, or **zero**. • **Uptime**—Time since the downstream interface joined the group. • **Time since last Join**—Time since the last join message was received from the downstream interface. • **Time since last Prune**—Time since the last prune message was received from the downstream interface.	**extensive**
Number of downstream interfaces	Total number of outgoing interfaces for each (S,G) entry.	**extensive**
Assert Timeout	Length of time between assert cycles on the downstream interface. Not displayed if the assert timer is null.	**extensive**
Keepalive timeout	Time remaining until the downstream join state is updated (in seconds). If the downstream join state is not updated before this keepalive timer reaches zero, the entry is deleted. If there is a directly connected host, **Keepalive timeout** is **Infinity**.	**extensive**
Uptime	Time since the creation of (S,G) or (*,G) state. The uptime is not refreshed every time a PIM join message is received for an existing (S,G) or (*,G) state.	**extensive**
Bidirectional accepting interfaces	Interfaces on the routing device that forward bidirectional PIM traffic. The reasons for forwarding bidirectional PIM traffic are that the interface is the winner of the designated forwarder election (**DF Winner**), or the interface is the reverse path forwarding (RPF) interface toward the RP (**RPF**).	**extensive**

Sample Output

show pim join summary

```
user@host> show pim join summary
Instance: PIM.master Family: INET

Route type            Route count
(s,g)                 2
(*,g)                 1

Instance: PIM.master Family: INET6
```

show pim join (PIM Sparse Mode)

```
user@host> show pim join
Instance: PIM.master Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 239.1.1.1
    Source: *
    RP: 10.255.14.144
    Flags: sparse,rptree,wildcard
    Upstream interface: Local

Group: 239.1.1.1
    Source: 10.255.14.144
    Flags: sparse,spt
    Upstream interface: Local

Group: 239.1.1.1
    Source: 10.255.70.15
    Flags: sparse,spt
    Upstream interface: so-1/0/0.0

Instance: PIM.master Family: INET6
R = Rendezvous Point Tree, S = Sparse, W = Wildcard
```

show pim join (Bidirectional PIM)

```
user@host> show pim join
Instance: PIM.master Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 224.1.1.0
    Bidirectional group prefix length: 24
    Source: *
    RP: 10.10.13.2
    Flags: bidirectional,rptree,wildcard
    Upstream interface: ge-0/0/1.0

Group: 224.1.3.0
    Bidirectional group prefix length: 24
    Source: *
    RP: 10.10.1.3
    Flags: bidirectional,rptree,wildcard
    Upstream interface: ge-0/0/1.0 (RP Link)

Group: 225.1.1.0
    Bidirectional group prefix length: 24
    Source: *
```



```
    RP: 10.10.13.2
    Flags: bidirectional,rptree,wildcard
    Upstream interface: ge-0/0/1.0

Group: 225.1.3.0
    Bidirectional group prefix length: 24
    Source: *
    RP: 10.10.1.3
    Flags: bidirectional,rptree,wildcard
    Upstream interface: ge-0/0/1.0 (RP Link)

Instance: PIM.master Family: INET6
R = Rendezvous Point Tree, S = Sparse, W = Wildcard
```

show pim join inet6

```
user@host> show pim join inet6
Instance: PIM.master Family: INET6
 R = Rendezvous Point Tree, S = Sparse, W = Wildcard

 Group: ff04::e000:101
     Source: *
     RP: ::46.0.0.13
     Flags: sparse,rptree,wildcard
     Upstream interface: Local

 Group: ff04::e000:101
     Source: ::1.1.1.1
     Flags: sparse
     Upstream interface: unknown (no neighbor)

 Group: ff04::e800:101
     Source: ::1.1.1.1
     Flags: sparse
     Upstream interface: unknown (no neighbor)

 Group: ff04::e800:101
     Source: ::1.1.1.2
     Flags: sparse
     Upstream interface: unknown (no neighbor)
```

show pim join inet6 star-g

```
user@host> show pim join inet6 star-g
Instance: PIM.master Family: INET6
 R = Rendezvous Point Tree, S = Sparse, W = Wildcard

 Group: ff04::e000:101
     Source: *
     RP: ::46.0.0.13
     Flags: sparse,rptree,wildcard
     Upstream interface: Local
```

show pim join instance <instance-name>

```
user@host> show pim join instance VPN-A
Instance: PIM.VPN-A Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 235.1.1.2
    Source: *
    RP: 10.10.47.100
```



```
    Flags: sparse,rptree,wildcard
    Upstream interface: Local

Group: 235.1.1.2
    Source: 192.168.195.74
    Flags: sparse,spt
    Upstream interface: at-0/3/1.0

Group: 235.1.1.2
    Source: 192.168.195.169
    Flags: sparse
    Upstream interface: so-1/0/1.0

Instance: PIM.VPN-A Family: INET6
R = Rendezvous Point Tree, S = Sparse, W = Wildcard
```

show pim join detail

```
user@host> show pim join detail
Instance: PIM.master Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 239.1.1.1
    Source: *
    RP: 10.255.14.144
    Flags: sparse,rptree,wildcard
    Upstream interface: Local

Group: 239.1.1.1
    Source: 10.255.14.144
    Flags: sparse,spt
    Upstream interface: Local

Group: 239.1.1.1
    Source: 10.255.70.15
    Flags: sparse,spt
    Upstream interface: so-1/0/0.0

Instance: PIM.master Family: INET6
R = Rendezvous Point Tree, S = Sparse, W = Wildcard
```

show pim join extensive (PIM Sparse Mode)

```
user@host> show pim join extensive
Instance: PIM.master Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 239.1.1.1
    Source: *
    RP: 10.255.14.144
    Flags: sparse,rptree,wildcard
    Upstream interface: Local
    Upstream neighbor: Local
    Upstream state: Local RP
    Uptime: 00:03:49
    Downstream neighbors:
        Interface: so-1/0/0.0
            10.111.10.2 State: Join Flags: SRW Timeout: 174
            Uptime: 00:03:49 Time since last Join: 00:01:49
        Interface: mt-1/1/0.32768
            10.10.47.100 State: Join Flags: SRW  Timeout: Infinity
```

```
            Uptime: 00:03:49 Time since last Join: 00:01:49
    Number of downstream interfaces: 2

Group: 239.1.1.1
    Source: 10.255.14.144
    Flags: sparse,spt
    Upstream interface: Local
    Upstream neighbor: Local
    Upstream state: Local Source, Local RP
    Keepalive timeout: 344
    Uptime: 00:03:49
    Downstream neighbors:
        Interface: so-1/0/0.0
            10.111.10.2 State: Join Flags: S Timeout: 174
            Uptime: 00:03:49 Time since last Prune: 00:01:49
        Interface: mt-1/1/0.32768
            10.10.47.100 State: Join Flags: S   Timeout: Infinity
            Uptime: 00:03:49 Time since last Prune: 00:01:49
    Number of downstream interfaces: 2

Group: 239.1.1.1
    Source: 10.255.70.15
    Flags: sparse,spt
    Upstream interface: so-1/0/0.0
    Upstream neighbor: 10.111.10.2
    Upstream state: Local RP, Join to Source
    Keepalive timeout: 344
    Uptime: 00:03:49
    Downstream neighbors:
        Interface: Pseudo-GMP
            fe-0/0/0.0 fe-0/0/1.0 fe-0/0/3.0
        Interface: so-1/0/0.0 (pruned)
            10.111.10.2 State: Prune Flags: SR Timeout: 174
            Uptime: 00:03:49 Time since last Prune: 00:01:49
        Interface: mt-1/1/0.32768
            10.10.47.100 State: Join Flags: S   Timeout: Infinity
            Uptime: 00:03:49 Time since last Prune: 00:01:49
    Number of downstream interfaces: 3

Instance: PIM.master Family: INET6
R = Rendezvous Point Tree, S = Sparse, W = Wildcard
```

show pim join extensive (Bidirectional PIM)

```
user@host> show pim join extensive
Instance: PIM.master Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 224.1.1.0
    Bidirectional group prefix length: 24
    Source: *
    RP: 10.10.13.2
    Flags: bidirectional,rptree,wildcard
    Upstream interface: ge-0/0/1.0
    Upstream neighbor: 10.10.1.2
    Upstream state: None
    Uptime: 00:03:49
    Bidirectional accepting interfaces:
        Interface: ge-0/0/1.0    (RPF)
        Interface: lo0.0         (DF Winner)
    Number of downstream interfaces: 0
```

```
Group: 225.1.1.0
    Bidirectional group prefix length: 24
    Source: *
    RP: 10.10.13.2
    Flags: bidirectional,rptree,wildcard
    Upstream interface: ge-0/0/1.0
    Upstream neighbor: 10.10.1.2
    Upstream state: None
    Uptime: 00:03:49
    Bidirectional accepting interfaces:
        Interface: ge-0/0/1.0    (RPF)
        Interface: lo0.0         (DF Winner)
     Downstream neighbors:
         Interface: lt-1/0/10.24
             10.0.24.4 State: Join   RW  Timeout: 185
         Interface: lt-1/0/10.23
             10.0.23.3 State: Join   RW  Timeout: 184
     Number of downstream interfaces: 2

Group: 225.1.3.0
    Bidirectional group prefix length: 24
    Source: *
    RP: 10.10.1.3
    Flags: bidirectional,rptree,wildcard
    Upstream interface: ge-0/0/1.0 (RP Link)
    Upstream neighbor: Direct
    Upstream state: Local RP
    Uptime: 00:03:49
    Bidirectional accepting interfaces:
        Interface: ge-0/0/1.0    (RPF)
        Interface: lo0.0         (DF Winner)
        Interface: xe-4/1/0.0    (DF Winner)
    Number of downstream interfaces: 0

Instance: PIM.master Family: INET6
R = Rendezvous Point Tree, S = Sparse, W = Wildcard
```

show pim join extensive (Bidirectional PIM with a Directly Connected Phantom RP)

```
user@host> show pim join extensive
Instance: PIM.master Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 224.1.3.0
    Bidirectional group prefix length: 24
    Source: *
    RP: 10.10.1.3
    Flags: bidirectional,rptree,wildcard
    Upstream interface: ge-0/0/1.0 (RP Link)
    Upstream neighbor: Direct
    Upstream state: Local RP
    Uptime: 00:03:49
    Bidirectional accepting interfaces:
        Interface: ge-0/0/1.0    (RPF)
        Interface: lo0.0         (DF Winner)
        Interface: xe-4/1/0.0    (DF Winner)
    Number of downstream interfaces: 0
```


show pim join instance <instance-name> extensive

```
user@host> show pim join instance VPN-A extensive
Instance: PIM.VPN-A Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 235.1.1.2
    Source: *
    RP: 10.10.47.100
    Flags: sparse,rptree,wildcard
    Upstream interface: Local
    Upstream neighbor: Local
    Upstream state: Local RP
    Uptime: 00:03:49
    Downstream neighbors:
        Interface: mt-1/1/0.32768
            10.10.47.101 State: Join Flags: SRW Timeout: 156
            Uptime: 00:03:49 Time since last Join: 00:01:49
    Number of downstream interfaces: 1

Group: 235.1.1.2
    Source: 192.168.195.74
    Flags: sparse,spt
    Upstream interface: at-0/3/1.0
    Upstream neighbor: 10.111.30.2
    Upstream state: Local RP, Join to Source
    Keepalive timeout: 156
    Uptime: 00:14:52

Group: 235.1.1.2
    Source: 192.168.195.169
    Flags: sparse
    Upstream interface: so-1/0/1.0
    Upstream neighbor: 10.111.20.2
    Upstream state: Local RP, Join to Source
    Keepalive timeout: 156
    Uptime: 00:14:52
```

show pim join extensive (Ingress Node with Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs)

```
user@host> show pim join extensive
Instance: PIM.master Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 232.1.1.1
    Source: 192.168.219.11
    Flags: sparse,spt
    Upstream interface: fe-1/3/1.0
    Upstream neighbor: Direct
    Upstream state: Local Source
    Keepalive timeout:
    Uptime: 11:27:55
    Downstream neighbors:
        Interface: Pseudo-MLDP
        Interface: lt-1/2/0.25
            1.2.5.2 State: Join Flags: S   Timeout: Infinity
            Uptime: 11:27:55 Time since last Join: 11:27:55

Group: 232.1.1.2
    Source: 192.168.219.11
    Flags: sparse,spt
```

```
    Upstream interface: fe-1/3/1.0
    Upstream neighbor: Direct
    Upstream state: Local Source
    Keepalive timeout:
    Uptime: 11:27:41
    Downstream neighbors:
        Interface: Pseudo-MLDP

Group: 232.1.1.3
    Source: 192.168.219.11
    Flags: sparse,spt
    Upstream interface: fe-1/3/1.0
    Upstream neighbor: Direct
    Upstream state: Local Source
    Keepalive timeout:
    Uptime: 11:27:41
    Downstream neighbors:
        Interface: Pseudo-MLDP

Group: 232.2.2.2
    Source: 1.2.7.7
    Flags: sparse,spt
    Upstream interface: lt-1/2/0.27
    Upstream neighbor: Direct
    Upstream state: Local Source
    Keepalive timeout:
    Uptime: 11:27:25
    Downstream neighbors:
        Interface: Pseudo-MLDP

Instance: PIM.master Family: INET6
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: ff3e::1:2
    Source: abcd::1:2:7:7
    Flags: sparse,spt
    Upstream interface: lt-1/2/0.27
    Upstream neighbor: Direct
    Upstream state: Local Source
    Keepalive timeout:
    Uptime: 11:27:26
    Downstream neighbors:
        Interface: Pseudo-MLDP
```

show pim join extensive (Egress Node with Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs)

```
user@host> show pim join extensive
Instance: PIM.master Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 227.1.1.1
    Source: *
    RP: 1.1.1.1
    Flags: sparse,rptree,wildcard
    Upstream interface: Local
    Upstream neighbor: Local
    Upstream state: Local RP
    Uptime: 11:31:33
    Downstream neighbors:
        Interface: fe-1/3/0.0
            192.168.209.9 State: Join Flags: SRW  Timeout: Infinity
```

```
            Uptime: 11:31:33 Time since last Join: 11:31:32

Group: 232.1.1.1
    Source: 192.168.219.11
    Flags: sparse,spt
    Upstream protocol: MLDP
    Upstream interface: Pseudo MLDP
    Upstream neighbor: MLDP LSP root <1.1.1.2>
    Upstream state: Join to Source
    Keepalive timeout:
    Uptime: 11:31:32
    Downstream neighbors:
        Interface: so-0/1/3.0
            192.168.92.9 State: Join Flags: S   Timeout: Infinity
            Uptime: 11:31:30 Time since last Join: 11:31:30
    Downstream neighbors:
        Interface: fe-1/3/0.0
            192.168.209.9 State: Join Flags: S   Timeout: Infinity
            Uptime: 11:31:32 Time since last Join: 11:31:32

Group: 232.1.1.2
    Source: 192.168.219.11
    Flags: sparse,spt
    Upstream protocol: MLDP
    Upstream interface: Pseudo MLDP
    Upstream neighbor: MLDP LSP root <1.1.1.2>
    Upstream state: Join to Source
    Keepalive timeout:
    Uptime: 11:31:32
    Downstream neighbors:
        Interface: so-0/1/3.0
            192.168.92.9 State: Join Flags: S   Timeout: Infinity
            Uptime: 11:31:30 Time since last Join: 11:31:30
    Downstream neighbors:
        Interface: lt-1/2/0.14
            1.1.4.4 State: Join Flags: S Timeout: 177
            Uptime: 11:30:33 Time since last Join: 00:00:33
    Downstream neighbors:
        Interface: fe-1/3/0.0
            192.168.209.9 State: Join Flags: S   Timeout: Infinity
            Uptime: 11:31:32 Time since last Join: 11:31:32

Group: 232.1.1.3
    Source: 192.168.219.11
    Flags: sparse,spt
    Upstream protocol: MLDP
    Upstream interface: Pseudo MLDP
    Upstream neighbor: MLDP LSP root <1.1.1.2>
    Upstream state: Join to Source
    Keepalive timeout:
    Uptime: 11:31:32
    Downstream neighbors:
        Interface: fe-1/3/0.0
            192.168.209.9 State: Join Flags: S   Timeout: Infinity
            Uptime: 11:31:32 Time since last Join: 11:31:32

Group: 232.2.2.2
    Source: 1.2.7.7
    Flags: sparse,spt
    Upstream protocol: MLDP
    Upstream interface: Pseudo MLDP
```



```
    Upstream neighbor: MLDP LSP root <1.1.1.2>
    Upstream state: Join to Source
    Keepalive timeout:
    Uptime: 11:31:30
    Downstream neighbors:
        Interface: so-0/1/3.0
            192.168.92.9 State: Join Flags: S   Timeout: Infinity
            Uptime: 11:31:30 Time since last Join: 11:31:30

Instance: PIM.master Family: INET6
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: ff3e::1:2
    Source: abcd::1:2:7:7
    Flags: sparse,spt
    Upstream protocol: MLDP
    Upstream interface: Pseudo MLDP
    Upstream neighbor: MLDP LSP root <1.1.1.2>
    Upstream state: Join to Source
    Keepalive timeout:
    Uptime: 11:31:32
    Downstream neighbors:
        Interface: fe-1/3/0.0
            fe80::21f:12ff:fea5:c4db State: Join Flags: S   Timeout: Infinity
            Uptime: 11:31:32 Time since last Join: 11:31:32
```


show pim neighbors

Syntax

show pim neighbors
<brief | detail>
<inet | inet6>
<instance (*instance-name* | all)>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show pim neighbors
<brief | detail>
<inet | inet6>
<instance (*instance-name* | all)>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Support for bidirectional PIM added in Junos OS Release 12.1.
Support for the **instance all** option added in Junos OS Release 12.1.

Description

Display information about Protocol Independent Multicast (PIM) neighbors.

Options

none—(Same as **brief**) Display standard information about PIM neighbors for all supported family addresses for the main instance.

brief | detail—(Optional) Display the specified level of output.

inet | inet6—(Optional) Display information about PIM neighbors for IPv4 or IPv6 family addresses, respectively.

instance (*instance-name* | all)—(Optional) Display information about neighbors for the specified PIM-enabled routing instance or for all routing instances.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show pim neighbors on page 4377
show pim neighbors brief on page 4377
show pim neighbors instance on page 4377
show pim neighbors detail on page 4377
show pim neighbors detail (With BFD) on page 4378

Output Fields

Table 337 on page 4376 describes the output fields for the **show pim neighbors** command. Output fields are listed in the approximate order in which they appear.

Table 337: show pim neighbors Output Fields

Field Name	Field Description	Level of Output
Instance	Name of the routing instance.	All levels
Interface	Interface through which the neighbor is reachable.	All levels
Neighbor addr	Address of the neighboring PIM routing device.	All levels
IP	IP version: **4** or **6**.	All levels
V	PIM version running on the neighbor: **1** or **2**.	All levels
Mode	PIM mode of the neighbor: **Sparse**, **Dense**, **SparseDense**, or **Unknown**. When the neighbor is running PIM version 2, this mode is always **Unknown**.	All levels
Option	Can be one or more of the following: • **B**—Bidirectional Capable. • **H**—Hello Option Holdtime. • **G**—Generation Identifier. • **P**—Hello Option DR Priority. • **L**—Hello Option LAN Prune Delay.	**brief** none
Uptime	Time the neighbor has been operational since the PIM process was last initialized, in the format ***dd:hh:mm:ss* ago** for less than a week and ***nwnd:hh:mm:ss* ago** for more than a week.	All levels
Address	Address of the neighboring PIM routing device.	**detail**
BFD	Status and operational state of the Bidirectional Forwarding Detection (BFD) protocol on the interface: **Enabled**, **Operational state is up**, or **Disabled**.	**detail**
Hello Option Holdtime	Time for which the neighbor is available, in seconds. The range of values is **0** through **65,535.**	**detail**
Hello Default Holdtime	Default holdtime and the time remaining if the **holdtime** option is not in the received hello message.	**detail**
Hello Option DR Priority	Designated router election priority. The range of values is **0** through **255**.	**detail**
Hello Option Generation ID	9-digit or 10-digit number used to tag hello messages.	**detail**
Hello Option Bi-Directional PIM supported	Neighbor can process bidirectional PIM messages.	**detail**
Hello Option LAN Prune Delay	Time to wait before the neighbor receives prune messages, in the format **delay *nnn* ms override *nnnn* ms**.	**detail**

Table 337: show pim neighbors Output Fields *(continued)*

Field Name	Field Description	Level of Output
Join Suppression supported	Neighbor is capable of join suppression.	**detail**
Rx Join	Information about joins received from the neighbor. • **Group**—Group addresses in the join message. • **Source**—Address of the source in the join message. • **Timeout**—Time for which the join is valid.	**detail**

Sample Output

show pim neighbors

```
user@host> show pim neighbors
Instance: PIM.master
B = Bidirectional Capable, G = Generation Identifier,
H = Hello Option Holdtime, L = Hello Option LAN Prune Delay,
P = Hello Option DR Priority

Interface           IP V Mode        Option      Uptime Neighbor addr
so-1/0/0.0           4 2             HPLG      00:07:10 10.111.10.2
```

show pim neighbors brief

The output for the **show pim neighbors brief** command is identical to that for the **show pim neighbors** command. For sample output, see show pim neighbors on page 4377.

show pim neighbors instance

```
user@host> show pim neighbors instance VPN-A
Instance: PIM.VPN-A
B = Bidirectional Capable, G = Generation Identifier,
H = Hello Option Holdtime, L = Hello Option LAN Prune Delay,
P = Hello Option DR Priority

Interface           IP V Mode        Option      Uptime Neighbor addr
at-0/3/1.0           4 2             HPLG      00:07:54 10.111.30.2
mt-1/1/0.32768       4 2             HPLG      00:07:22 10.10.47.101
so-1/0/1.0           4 2             HPLG      00:07:50 10.111.20.2
```

show pim neighbors detail

```
user@host> show pim neighbors detail
Instance: PIM.master
Interface: ge-0/0/1.0

    Address: 10.10.1.1, IPv4, PIM v2, Mode: SparseDense, sg Join Count: 0, tsg
Join Count: 2
        Hello Option Holdtime: 65535 seconds
        Hello Option DR Priority: 1
        Hello Option Generation ID: 2053759302
        Hello Option Bi-Directional PIM supported
        Hello Option LAN Prune Delay: delay 500 ms override 2000 ms
                              Join Suppression supported
```



```
    Address: 10.10.1.2, IPv4, PIM v2, sg Join Count: 0, tsg Join Count: 2
        BFD: Disabled
        Hello Option Holdtime: 105 seconds 93 remaining
        Hello Option DR Priority: 1
        Hello Option Generation ID: 1734018161
        Hello Option Bi-Directional PIM supported
        Hello Option LAN Prune Delay: delay 500 ms override 2000 ms
                                      Join Suppression supported

Interface: lo0.0

    Address: 10.255.179.246,    IPv4, PIM v2, Mode: SparseDense, sg Join Count:
0, tsg Join Count: 0
        Hello Option Holdtime: 65535 seconds
        Hello Option DR Priority: 1
        Hello Option Generation ID: 1997462267
        Hello Option Bi-Directional PIM supported
        Hello Option LAN Prune Delay: delay 500 ms override 2000 ms
                                      Join Suppression supported
```

show pim neighbors detail (With BFD)

```
user@host> show pim neighbors detail
Instance: PIM.master
Interface: fe-1/0/0.0
    Address: 192.168.11.1,        IPv4, PIM v2, Mode: Sparse
        Hello Option Holdtime: 65535 seconds
        Hello Option DR Priority: 1
        Hello Option Generation ID: 836607909
        Hello Option LAN Prune Delay: delay 500 ms override 2000 ms

    Address: 192.168.11.2,        IPv4, PIM v2
        BFD: Enabled, Operational state is up
        Hello Default Holdtime: 105 seconds 104 remaining
        Hello Option DR Priority: 1
        Hello Option Generation ID: 1907549685
        Hello Option LAN Prune Delay: delay 500 ms override 2000 ms

Interface: fe-1/0/1.0
    Address: 192.168.12.1,        IPv4, PIM v2
        BFD: Disabled
        Hello Default Holdtime: 105 seconds 80 remaining
        Hello Option DR Priority: 1
        Hello Option Generation ID: 1971554705
        Hello Option LAN Prune Delay: delay 500 ms override 2000 ms
```


show pim rps

Syntax

show pim rps
<brief | detail | extensive>
<*group-address*>
<inet | inet6>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show pim rps
<brief | detail | extensive>
<*group-address*>
<inet | inet6>
<instance *instance-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Support for bidirectional PIM added in Junos OS Release 12.1.

Description

Display information about Protocol Independent Multicast (PIM) rendezvous points (RPs).

Options

none—Display standard information about PIM RPs for all groups and family addresses for all routing instances.

brief | detail | extensive—(Optional) Display the specified level of output.

group-address—(Optional) Display the RPs for a particular group. If you specify a group address, the output lists the routing device that is the RP for that group.

inet | inet6—(Optional) Display information for IPv4 or IPv6 family addresses, respectively.

instance *instance-name*—(Optional) Display information about RPs for a specific PIM-enabled routing instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- *Example: Configuring Bidirectional PIM*

List of Sample Output

show pim rps on page 4382
show pim rps brief on page 4382
show pim rps <group-address> (Bidirectional PIM) on page 4382
show pim rps <group-address> (PIM Dense Mode) on page 4382

show pim rps <group-address> (SSM Range Without asm-override-ssm Configured) on page 4382
show pim rps <group-address> (SSM Range With asm-override-ssm Configured and a Sparse-Mode RP) on page 4383
show pim rps <group-address> (SSM Range With asm-override-ssm Configured and a Bidirectional RP) on page 4383
show pim rps instance on page 4383
show pim rps extensive (PIM Sparse Mode) on page 4383
show pim rps extensive (Bidirectional PIM) on page 4384
show pim rps extensive (PIM Anycast RP in Use) on page 4384

Output Fields Table 338 on page 4380 describes the output fields for the **show pim rps** command. Output fields are listed in the approximate order in which they appear.

Table 338: show pim rps Output Fields

Field Name	Field Description	Level of Output
Instance	Name of the routing instance.	All levels
Family or Address family	Name of the address family: **inet** (IPv4) or **inet6** (IPv6).	All levels
RP address	Address of the rendezvous point.	All levels
Type	Type of RP: • **auto-rp**—Address of the RP known through the Auto-RP protocol. • **bootstrap**—Address of the RP known through the bootstrap router protocol (BSR). • **embedded**—Address of the RP known through an embedded RP (IPv6). • **static**—Address of RP known through static configuration.	**brief** none
Holdtime	How long to keep the RP active, with time remaining, in seconds.	All levels
Timeout	How long until the local routing device determines the RP to be unreachable, in seconds.	All levels
Groups	Number of groups currently using this RP.	All levels
Group prefixes	Addresses of groups that this RP can span.	**brief** none
Learned via	Address and method by which the RP was learned.	**detail extensive**
Mode	The PIM mode of the RP: bidirectional or sparse. If a sparse and bidirectional RPs are configured with the same RP address, they appear as separate entries in both formats.	All levels
Time Active	How long the RP has been active, in the format ***hh:mm:ss***.	**detail extensive**

Table 338: show pim rps Output Fields *(continued)*

Field Name	Field Description	Level of Output
Device Index	Index value of the order in which Junos OS finds and initializes the interface. For bidirectional RPs, the **Device Index** output field is omitted because bidirectional RPs do not require encapsulation and de-encapsulation interfaces.	**detail extensive**
Subunit	Logical unit number of the interface. For bidirectional RPs, the **Subunit** output field is omitted because bidirectional RPs do not require encapsulation and de-encapsulation interfaces.	**detail extensive**
Interface	Either the encapsulation or the de-encapsulation logical interface, depending on whether this routing device is a designated router (DR) facing an RP router, or is the local RP, respectively. For bidirectional RPs, the **Interface** output field is omitted because bidirectional RPs do not require encapsulation and de-encapsulation interfaces.	**detail extensive**
Group Ranges	Addresses of groups that this RP spans.	**detail extensive** *group-address*
Active groups using RP	Number of groups currently using this RP.	**detail extensive**
total	Total number of active groups for this RP.	**detail extensive**
Register State for RP	Current register state for each group: • **Group**—Multicast group address. • **Source**—Multicast source address for which the PIM register is sent or received, depending on whether this router is a designated router facing an RP router, or is the local RP, respectively: • **First Hop**—PIM-designated routing device that sent the Register message (the source address in the IP header). • **RP Address**—RP to which the Register message was sent (the destination address in the IP header). • **State**: On the designated router: ◦ **Send**—Sending Register messages. ◦ **Probe**—Sent a null register. If a Register-Stop message does not arrive in 5 seconds, the designated router resumes sending Register messages. ◦ **Suppress**—Received a Register-Stop message. The designated router is waiting for the timer to resume before changing to **Probe** state. • On the RP: ◦ **Receive**—Receiving Register messages.	**extensive**
Anycast-PIM rpset	If anycast RP is configured, the addresses of the RPs in the set.	**extensive**
Anycast-PIM local address used	If anycast RP is configured, the local address used by the RP.	**extensive**

Table 338: show pim rps Output Fields *(continued)*

Field Name	Field Description	Level of Output

Anycast-PIM Register State	If anycast RP is configured, the current register state for each group:
	• **Group**—Multicast group address.
	• **Source**—Multicast source address for which the PIM register is sent or received, depending on whether this routing device is a designated router facing an RP router, or is the local RP, respectively.
	• **Origin**—How the information was obtained:
	  • **DIRECT**—From a local attachment
	  • **MSDP**—From the Multicast Source Discovery Protocol (MSDP)
	  • **DR**—From the designated router
		extensive

RP selected	For sparse mode and bidirectional mode, the identity of the RP for the specified group address.	*group-address*

Sample Output

show pim rps

```
user@host> show pim rps
Instance: PIM.master
Address family INET
RP address       Type        Mode   Holdtime Timeout Groups Group prefixes
10.10.1.3        static      bidir       150     None      2 224.1.3.0/24
                                                             225.1.3.0/24
10.10.13.2       static      bidir       150     None      2 224.1.1.0/24
                                                             225.1.1.0/24
```

show pim rps brief

The output for the **show pim rps brief** command is identical to that for the **show pim rps** command. For sample output, see show pim rps on page 4382.

show pim rps <group-address> (Bidirectional PIM)

```
user@host> show pim rps 224.1.1.1
Instance: PIM.master

224.1.0.0/16
        11.4.12.75 (Bidirectional)

RP selected: 11.4.12.75
```

show pim rps <group-address> (PIM Dense Mode)

```
user@host> show pim rps 224.1.1.1
Instance: PIM.master

Dense Mode active for group 224.1.1.1
```

show pim rps <group-address> (SSM Range Without asm-override-ssm Configured)

```
user@host> show pim rps 224.1.1.1
```



```
Instance: PIM.master

Source-specific Mode (SSM) active for group 224.1.1.1
```

show pim rps <group-address> (SSM Range With asm-override-ssm Configured and a Sparse-Mode RP)

```
user@host> show pim rps 224.1.1.1
Instance: PIM.master

Source-specific Mode (SSM) active with Sparse Mode ASM override for group 224.1.1.1

224.1.0.0/16
        11.4.12.75

RP selected: 11.4.12.75
```

show pim rps <group-address> (SSM Range With asm-override-ssm Configured and a Bidirectional RP)

```
user@host> show pim rps 224.1.1.1
Instance: PIM.master

Source-specific Mode (SSM) active with Sparse Mode ASM override for group 224.1.1.1

224.1.0.0/16
        11.4.12.75 (Bidirectional)

RP selected: (null)
```

show pim rps instance

```
user@host> show pim rps instance VPN-A
Instance: PIM.VPN-A
Address family INET
RP address                Type        Holdtime Timeout Groups Group prefixes
10.10.47.100              static             0    None      1 224.0.0.0/4

Address family INET6
```

show pim rps extensive (PIM Sparse Mode)

```
user@host> show pim rps extensive
Instance: PIM.master

Family: INET
RP: 10.255.245.91
Learned via: static configuration
Time Active: 00:05:48
Holdtime: 45 with 36 remaining
Device Index: 122
Subunit: 32768
Interface: pd-6/0/0.32768
Group Ranges:
    224.0.0.0/4, 36s remaining
Active groups using RP:
    225.1.1.1

    total 1 groups active

Register State for RP:
Group          Source          FirstHop        RP Address      State    Timeout
225.1.1.1      192.168.195.78  10.255.14.132   10.255.245.91   Receive        0
```

show pim rps extensive (Bidirectional PIM)

```
user@host> show pim rps extensive
Instance: PIM.master
Address family INET

RP: 10.10.1.3
Learned via: static configuration
Mode: Bidirectional
Time Active: 01:58:07
Holdtime: 150
Group Ranges:
        224.1.3.0/24
        225.1.3.0/24

RP: 10.10.13.2
Learned via: static configuration
Mode: Bidirectional
Time Active: 01:58:07
Holdtime: 150
Group Ranges:
        224.1.1.0/24
        225.1.1.0/24
```

show pim rps extensive (PIM Anycast RP in Use)

```
user@host> show pim rps extensive
Instance: PIM.master

Family: INET
RP: 10.10.10.2
Learned via: static configuration
Time Active: 00:54:52
Holdtime: 0
Device Index: 130
Subunit: 32769
Interface: pimd.32769
Group Ranges:
    224.0.0.0/4
Active groups using RP:
    224.10.10.10

    total 1 groups active

Anycast-PIM rpset:
           10.100.111.34
           10.100.111.17
           10.100.111.55

Anycast-PIM local address used: 10.100.111.1
Anycast-PIM Register State:
Group                      Source                                Origin
224.1.1.1                  10.10.95.2                            DIRECT
224.1.1.2                  10.10.95.2                            DIRECT
224.10.10.10               10.10.70.1                            MSDP
224.10.10.11               10.10.70.1                            MSDP
224.20.20.1                10.10.71.1                            DR

Address family INET6

Anycast-PIM rpset:
```



```
          ab::1
          ab::2
Anycast-PIM local address used: cd::1

Anycast-PIM Register State:
Group                    Source                               Origin
::224.1.1.1              ::10.10.95.2                         DIRECT
::224.1.1.2              ::10.10.95.2                         DIRECT
::224.20.20.1            ::10.10.71.1                         DR
```

show pim source

Syntax

show pim source
<brief | detail>
<inet | inet6>
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>
<*source-prefix*>

Syntax (EX Series Switch and the QFX Series)

show pim source
<brief | detail>
<inet | inet6>
<instance *instance-name*>
<*source-prefix*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.

Description

Display information about the Protocol Independent Multicast (PIM) source reverse path forwarding (RPF) state.

Options

none—Display standard information about the PIM RPF state for all supported family addresses for all routing instances.

brief | detail—(Optional) Display the specified level of output.

inet | inet6—(Optional) Display information for IPv4 or IPv6 family addresses, respectively.

instance *instance-name*—(Optional) Display information about the RPF state for a specific PIM-enabled routing instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

source-prefix—(Optional) Display the state for source RPF states in the given range.

Required Privilege Level

view

List of Sample Output

show pim source on page 4387
show pim source brief on page 4387
show pim source detail on page 4387
show pim source (Egress Node with Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs) on page 4388

Output Fields

Table 339 on page 4387 describes the output fields for the **show pim source** command. Output fields are listed in the approximate order in which they appear.

Table 339: show pim source Output Fields

Field Name	Field Description
Instance	Name of the routing instance.
Source	Address of the source or reverse path.
Prefix/length	Prefix and prefix length for the route used to reach the RPF address.
Upstream Protocol	
Upstream interface	RPF interface toward the source address. A pseudo multipoint LDP (M-LDP) interface appears on egress nodes in M-LDP point-to-multipoint LSPs with inband signaling.
Upstream Neighbor	Address of the RPF neighbor used to reach the source address. The multipoint LDP (M-LDP) root appears on egress nodes in M-LDP point-to-multipoint LSPs with inband signaling.

Sample Output

show pim source

```
user@host> show pim source
Instance: PIM.master Family: INET

Source 10.255.14.144
    Prefix 10.255.14.144/32
    Upstream interface Local
    Upstream neighbor Local

Source 10.255.70.15
    Prefix 10.255.70.15/32
    Upstream interface so-1/0/0.0
    Upstream neighbor 10.111.10.2

Instance: PIM.master Family: INET6
```

show pim source brief

The output for the **show pim source brief** command is identical to that for the **show pim source** command. For sample output, see show pim source on page 4387.

show pim source detail

```
user@host> show pim source detail
Instance: PIM.master Family: INET

Source 10.255.14.144
    Prefix 10.255.14.144/32
    Upstream interface Local
    Upstream neighbor Local
    Active groups:228.0.0.0
        239.1.1.1
```



```
        239.1.1.1

Source 10.255.70.15
    Prefix 10.255.70.15/32
    Upstream interface so-1/0/0.0
    Upstream neighbor 10.111.10.2
    Active groups:239.1.1.1

Instance: PIM.master Family: INET6
```

show pim source (Egress Node with Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs)

```
user@host> show pim source
Instance: PIM.master Family: INET

Source 1.1.1.1
    Prefix 1.1.1.1/32
    Upstream interface Local
    Upstream neighbor Local

Source 1.2.7.7
    Prefix 1.2.7.0/24
    Upstream protocol MLDP
    Upstream interface Pseudo MLDP
    Upstream neighbor MLDP LSP root <1.1.1.2>

Source 192.168.219.11
    Prefix 192.168.219.0/28
    Upstream protocol MLDP
    Upstream interface Pseudo MLDP
    Upstream neighbor MLDP LSP root <1.1.1.2>

Instance: PIM.master Family: INET6

Source abcd::1:2:7:7
    Prefix abcd::1:2:7:0/120
    Upstream protocol MLDP
    Upstream interface Pseudo MLDP
    Upstream neighbor MLDP LSP root <1.1.1.2>
```

show pim statistics

Syntax

show pim statistics
<inet |inet6)>
<instance *instance-name*>
<interface *interface-name*>
<logical-system (all | *logical-system-name*)>

Syntax (EX Series Switch and the QFX Series)

show pim statistics
<inet |inet6)>
<instance *instance-name*>
<interface *interface-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
inet6 and **instance** options introduced in Junos OS Release 10.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Support for bidirectional PIM added in Junos OS Release 12.1.

Description

Display Protocol Independent Multicast (PIM) statistics.

Options

none—Display PIM statistics.

inet | inet6—(Optional) Display IPv4 or IPv6 PIM statistics, respectively.

instance *instance-name*—(Optional) Display statistics for a specific routing instance enabled by Protocol Independent Multicast (PIM).

interface *interface-name*—(Optional) Display statistics about the specified interface.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- clear pim statistics on page 4279

List of Sample Output

show pim statistics on page 4396
show pim statistics inet interface <interface-name> on page 4398
show pim statistics inet6 interface <interface-name> on page 4398
show pim statistics instance <instance-name> on page 4399
show pim statistics interface <interface-name> on page 4400

Output Fields

Table 340 on page 4390 describes the output fields for the **show pim statistics** command. Output fields are listed in the approximate order in which they appear.

Table 340: show pim statistics Output Fields

Field Name	Field Description
Instance	Name of the routing instance. This field only appears if you specify an interface, for example: • **inet interface** ***interface-name*** • **inet6 interface** ***interface-name*** • **interface** ***interface-name***
Family	Output is for IPv4 or IPv6 PIM statistics. **INET** indicates IPv4 statistics, and **INET6** indicates IPv6 statistics. This field only appears if you specify an interface, for example: • **inet interface** ***interface-name*** • **inet6 interface** ***interface-name*** • **interface** ***interface-name***
PIM statistics	PIM statistics for all interfaces or for the specified interface.
PIM message type	Message type for which statistics are displayed.
Received	Number of received statistics.
Sent	Number of messages sent of a certain type.
Rx errors	Number of received packets that contained errors.
V2 Hello	PIM version 2 hello packets.
V2 Register	PIM version 2 register packets.
V2 Register Stop	PIM version 2 register stop packets.
V2 Join Prune	PIM version 2 join and prune packets.
V2 Bootstrap	PIM version 2 bootstrap packets.
V2 Assert	PIM version 2 assert packets.
V2 Graft	PIM version 2 graft packets.
V2 Graft Ack	PIM version 2 graft acknowledgment packets.
V2 Candidate RP	PIM version 2 candidate RP packets.

Table 340: show pim statistics Output Fields *(continued)*

Field Name	Field Description
V2 State Refresh	PIM version 2 control messages related to PIM dense mode (PIM-DM) state refresh. State refresh is an extension to PIM-DM. It not supported in Junos OS.
V2 DF Election	PIM version 2 send and receive messages associated with bidirectional PIM designated forwarder election.
V1 Query	PIM version 1 query packets.
V1 Register	PIM version 1 register packets.
V1 Register Stop	PIM version 1 register stop packets.
V1 Join Prune	PIM version 1 join and prune packets.
V1 RP Reachability	PIM version 1 RP reachability packets.
V1 Assert	PIM version 1 assert packets.
V1 Graft	PIM version 1 graft packets.
V1 Graft Ack	PIM version 1 graft acknowledgment packets.
AutoRP Announce	Auto-RP announce packets.
AutoRP Mapping	Auto-RP mapping packets.
AutoRP Unknown type	Auto-RP packets with an unknown type.
Anycast Register	Auto-RP announce packets.
Anycast Register Stop	Auto-RP announce packets.
Global Statistics	Summary of PIM statistics for all interfaces.
Hello dropped on neighbor policy	Number of hello packets dropped because of a configured neighbor policy.
Unknown type	Number of PIM control packets received with an unknown type.
V1 Unknown type	Number of PIM version 1 control packets received with an unknown type.
Unknown Version	Number of PIM control packets received with an unknown version. The version is not version 1 or version 2.

Table 340: show pim statistics Output Fields *(continued)*

Field Name	Field Description
Neighbor unknown	Number of PIM control packets received (excluding PIM hello) without first receiving the hello packet.
Bad Length	Number of PIM control packets received for which the packet size does not match the PIM length field in the packet.
Bad Checksum	Number of PIM control packets received for which the calculated checksum does not match the checksum field in the packet.
Bad Receive If	Number of PIM control packets received on an interface that does not have PIM configured.
Rx Bad Data	Number of PIM control packets received that contain data for TCP Bad register packets.
Rx Intf disabled	Number of PIM control packets received on an interface that has PIM disabled.
Rx V1 Require V2	Number of PIM version 1 control packets received on an interface configured for PIM version 2.
Rx V2 Require V1	Number of PIM version 2 control packets received on an interface configured for PIM version 1.
Rx Register not RP	Number of PIM register packets received when the routing device is not the RP for the group.
Rx Register no route	Number of PIM register packets received when the RP does not have a unicast route back to the source.
Rx Register no decap if	Number of PIM register packets received when the RP does not have a de-encapsulation interface.
Null Register Timeout	Number of NULL register timeout packets.
RP Filtered Source	Number of PIM packets received when the routing device has a source address filter configured for the RP.
Rx Unknown Reg Stop	Number of register stop messages received with an unknown type.
Rx Join/Prune no state	Number of join and prune messages received for which the routing device has no state.
Rx Join/Prune on upstream if	Number of join and prune messages received on the interface used to reach the upstream routing device, toward the RP.
Rx Join/Prune for invalid group	Number of join or prune messages received for invalid multicast group addresses.

Table 340: show pim statistics Output Fields *(continued)*

Field Name	Field Description
Rx Join/Prune messages dropped	Number of join and prune messages received and dropped.
Rx sparse join for dense group	Number of PIM sparse mode join messages received for a group that is configured for dense mode.
Rx Graft/Graft Ack no state	Number of graft and graft acknowledgment messages received for which the router or switch has no state.
Rx Graft on upstream if	Number of graft messages received on the interface used to reach the upstream routing device, toward the RP.
Rx CRP not BSR	Number of BSR messages received in which the PIM message type is Candidate-RP-Advertisement, not Bootstrap.
Rx BSR when BSR	Number of BSR messages received in which the PIM message type is Bootstrap.
Rx BSR not RPF if	Number of BSR messages received on an interface that is not the RPF interface.
Rx unknown hello opt	Number of PIM hello packets received with options that Junos OS does not support.
Rx data no state	Number of PIM control packets received for which the routing device has no state for the data type.
Rx RP no state	Number of PIM control packets received for which the routing device has no state for the RP.
Rx aggregate	Number of PIM aggregate MDT packets received.
Rx malformed packet	Number of PIM control packets received with a malformed IP unicast or multicast address family.
No RP	Number of PIM control packets received with no RP address.
No register encap if	Number of PIM register packets received when the first-hop routing device does not have an encapsulation interface.
No route upstream	Number of PIM control packets received when the routing device does not have a unicast route to the the interface used to reach the upstream routing device, toward the RP.
Nexthop Unusable	Number of PIM control packets with an unusable nexthop. A path can be unusable if the route is hidden or the link is down.
RP mismatch	Number of PIM control packets received for which the routing device has an RP mismatch.

Table 340: show pim statistics Output Fields *(continued)*

Field Name	Field Description
RP mode mismatch	RP mode (sparse or bidirectional) mismatches encountered when processing join and prune messages.
RPF neighbor unknown	Number of PIM control packets received for which the routing device has an unknown RPF neighbor for the source.
Rx Joins/Prunes filtered	The number of join and prune messages filtered because of configured route filters and source address filters.
Tx Joins/Prunes filtered	The number of join and prune messages filtered because of configured route filters and source address filters.
Embedded-RP invalid addr	Number of packets received with an invalid embedded RP address in PIM join messages and other types of messages sent between routing domains.
Embedded-RP limit exceed	Number of times the limit configured with the **maximum-rps** statement is exceeded. The **maximum-rps** statement limits the number of embedded RPs created in a specific routing instance. The range is from 1 through 500. The default is 100.
Embedded-RP added	Number of packets in which the embedded RP for IPv6 is added. The following receive events trigger extraction of an IPv6 embedded RP address on the routing device: • Multicast Listener Discovery (MLD) report for an embedded RP multicast group address • PIM join message with an embedded RP multicast group address • Static embedded RP multicast group address associated with an interface • Packets sent to an embedded RP multicast group address received on the DR An embedded RP node discovered through these receive events is added if it does not already exist on the routing platform.
Embedded-RP removed	Number of packets in which the embedded RP for IPv6 is removed. The embedded RP is removed whenever all PIM join states using this RP are removed or the configuration changes to remove the embedded RP feature.
Rx Register msgs filtering drop	Number of received register messages dropped because of a filter configured for PIM register messages.
Tx Register msgs filtering drop	Number of register messages dropped because of a filter configured for PIM register messages.
Rx Bidir Join/Prune on non-Bidir if	Error counter for join and prune messages received on non-bidirectional PIM interfaces.

Table 340: show pim statistics Output Fields *(continued)*

Field Name	Field Description
Rx Bidir Join/Prune on non-DF if	Error counter for join and prune messages received on non-designated forwarder interfaces.
V4 (S,G) Maximum	Maximum number of (S,G) IPv4 multicast routes accepted for the VPN routing and forwarding (VRF) routing instance. If this number is met, additional (S,G) entries are not accepted.
V4 (S,G) Accepted	Number of accepted (S,G) IPv4 multicast routes.
V4 (S,G) Threshold	Threshold at which a warning message is logged (percentage of the maximum number of (S,G) IPv4 multicast routes accepted by the device).
V4 (S,G) Log Interval	Time (in seconds) between consecutive log messages.
V6 (S,G) Maximum	Maximum number of (S,G) IPv6 multicast routes accepted for the VPN routing and forwarding (VRF) routing instance. If this number is met, additional (S,G) entries are not accepted.
V6 (S,G) Accepted	Number of accepted (S,G) IPv6 multicast routes.
V6 (S,G) Threshold	Threshold at which a warning message is logged (percentage of the maximum number of (S,G) IPv6 multicast routes accepted by the device).
V6 (S,G) Log Interval	Time (in seconds) between consecutive log messages.
V4 (grp-prefix, RP) Maximum	Maximum number of group-to-rendezvous point (RP) IPv4 multicast mappings accepted for the VRF routing instance. If this number is met, additional mappings are not accepted.
V4 (grp-prefix, RP) Accepted	Number of accepted group-to-RP IPv4 multicast mappings.
V4 (grp-prefix, RP) Threshold	Threshold at which a warning message is logged (percentage of the maximum number of group-to-RP IPv4 multicast mappings accepted by the device).
V4 (grp-prefix, RP) Log Interval	Time (in seconds) between consecutive log messages.
V6 (grp-prefix, RP) Maximum	Maximum number of group-to RP IPv6 multicast mappings accepted for the VRF routing instance. If this number is met, additional mappings are not accepted.
V6 (grp-prefix, RP) Accepted	Number of accepted group-to-RP IPv6 multicast mappings.

Table 340: show pim statistics Output Fields *(continued)*

Field Name	Field Description
V6 (grp-prefix, RP) Threshold	Threshold at which a warning message is logged (percentage of the maximum number of group-to-RP IPv6 multicast mappings accepted by the device).
V6 (grp-prefix, RP) Log Interval	Time (in seconds) between consecutive log messages.
V4 Register Maximum	Maximum number of IPv4 PIM registers accepted for the VRF routing instance. If this number is met, additional PIM registers are not accepted. You configure the register limits on the RP.
V4 Register Accepted	Number of accepted IPv4 PIM registers.
V4 Register Threshold	Threshold at which a warning message is logged (percentage of the maximum number of IPv4 PIM registers accepted by the device).
V4 Register Log Interval	Time (in seconds) between consecutive log messages.
V6 Register Maximum	Maximum number of IPv6 PIM registers accepted for the VRF routing instance. If this number is met, additional PIM registers are not accepted. You configure the register limits on the RP.
V6 Register Accepted	Number of accepted IPv6 PIM registers.
V6 Register Threshold	Threshold at which a warning message is logged (percentage of the maximum number of IPv6 PIM registers accepted by the device).
V6 Register Log Interval	Time (in seconds) between consecutive log messages.

Sample Output

show pim statistics

```
user@host> show pim statistics
PIM Message type        Received       Sent  Rx errors
V2 Hello                      15         32          0
V2 Register                    0        362          0
V2 Register Stop             483          0          0
V2 Join Prune                 18        518          0
V2 Bootstrap                   0          0          0
V2 Assert                      0          0          0
V2 Graft                       0          0          0
V2 Graft Ack                   0          0          0
V2 Candidate RP                0          0          0
V2 State Refresh               0          0          0
V2 DF Election                 0          0          0
V1 Query                       0          0          0
V1 Register                    0          0          0
```

```
V1 Register Stop            0          0          0
V1 Join Prune               0          0          0
V1 RP Reachability          0          0          0
V1 Assert                   0          0          0
V1 Graft                    0          0          0
V1 Graft Ack                0          0          0
AutoRP Announce             0          0          0
AutoRP Mapping              0          0          0
AutoRP Unknown type         0
Anycast Register            0          0          0
Anycast Register Stop       0          0          0

Global Statistics

Hello dropped on neighbor policy              0
Unknown type                                  0
V1 Unknown type                               0
Unknown Version                               0
ipv4 BSR pkt drop due to excessive rate       0
ipv6 BSR pkt drop due to excessive rate       0
Neighbor unknown                              0
Bad Length                                    0
Bad Checksum                                  0
Bad Receive If                                0
Rx Bad Data                                   0
Rx Intf disabled                              0
Rx V1 Require V2                              0
Rx V2 Require V1                              0
Rx Register not RP                            0
Rx Register no route                          0
Rx Register no decap if                       0
Null Register Timeout                         0
RP Filtered Source                            0
Rx Unknown Reg Stop                           0
Rx Join/Prune no state                        0
Rx Join/Prune on upstream if                  0
Rx Join/Prune for invalid group               5
Rx Join/Prune messages dropped                0
Rx sparse join for dense group                0
Rx Graft/Graft Ack no state                   0
Rx Graft on upstream if                       0
Rx CRP not BSR                                0
Rx BSR when BSR                               0
Rx BSR not RPF if                             0
Rx unknown hello opt                          0
Rx data no state                              0
Rx RP no state                                0
Rx aggregate                                  0
Rx malformed packet                           0
Rx illegal TTL                                0
Rx illegal destination address                0
No RP                                         0
No register encap if                          0
No route upstream                             0
Nexthop Unusable                              0
RP mismatch                                   0
RP mode mismatch                              0
RPF neighbor unknown                          0
Rx Joins/Prunes filtered                      0
Tx Joins/Prunes filtered                      0
Embedded-RP invalid addr                      0
```

```
Embedded-RP limit exceed                      0
Embedded-RP added                             0
Embedded-RP removed                           0
Rx Register msgs filtering drop               0
Tx Register msgs filtering drop               0
Rx Bidir Join/Prune on non-Bidir if           0
Rx Bidir Join/Prune on non-DF if              0
```

Sample Output

show pim statistics inet interface <interface-name>

```
user@host> show pim statistics inet interface ge-0/3/0.0
Instance: PIM.master Family: INET

PIM Interface statistics for ge-0/3/0.0

PIM Message type        Received       Sent  Rx errors
V2 Hello                       0          4          0
V2 Register                    0          0          0
V2 Register Stop               0          0          0
V2 Join Prune                  0          0          0
V2 Bootstrap                   0          0          0
V2 Assert                      0          0          0
V2 Graft                       0          0          0
V2 Graft Ack                   0          0          0
V2 Candidate RP                0          0          0
V1 Query                       0          0          0
V1 Register                    0          0          0
V1 Register Stop               0          0          0
V1 Join Prune                  0          0          0
V1 RP Reachability             0          0          0
V1 Assert                      0          0          0
V1 Graft                       0          0          0
V1 Graft Ack                   0          0          0
AutoRP Announce                0          0          0
AutoRP Mapping                 0          0          0
AutoRP Unknown type            0
Anycast Register               0          0          0
Anycast Register Stop          0          0          0
```

Sample Output

show pim statistics inet6 interface <interface-name>

```
user@host> show pim statistics inet6 interface ge-0/3/0.0
Instance: PIM.master Family: INET6

PIM Interface statistics for ge-0/3/0.0

PIM Message type        Received       Sent  Rx errors
V2 Hello                       0          4          0
V2 Register                    0          0          0
V2 Register Stop               0          0          0
V2 Join Prune                  0          0          0
V2 Bootstrap                   0          0          0
V2 Assert                      0          0          0
V2 Graft                       0          0          0
V2 Graft Ack                   0          0          0
V2 Candidate RP                0          0          0
```



```
Anycast Register            0          0          0
Anycast Register Stop       0          0          0
```

show pim statistics instance <instance-name>

```
user@host> show pim statistics instance VPN-A
PIM Message type        Received       Sent  Rx errors
V2 Hello                      31         37          0
V2 Register                    0          0          0
V2 Register Stop               0          0          0
V2 Join Prune                  0         16          0
V2 Bootstrap                   0          0          0
V2 Assert                      0          0          0
V2 Graft                       0          0          0
V2 Graft Ack                   0          0          0
V2 Candidate RP                0          0          0
V2 State Refresh               0          0          0
V2 DF Election                 0          0          0
V1 Query                       0          0          0
V1 Register                    0          0          0
V1 Register Stop               0          0          0
V1 Join Prune                  0          0          0
V1 RP Reachability             0          0          0
V1 Assert                      0          0          0
V1 Graft                       0          0          0
V1 Graft Ack                   0          0          0
AutoRP Announce                0          0          0
AutoRP Mapping                 0          0          0
AutoRP Unknown type            0
Anycast Register               0          0          0
Anycast Register Stop          0          0          0

Global Statistics

Hello dropped on neighbor policy              0
Unknown type                                  0
V1 Unknown type                               0
Unknown Version                               0
Neighbor unknown                              0
Bad Length                                    0
Bad Checksum                                  0
Bad Receive If                                0
Rx Bad Data                                   0
Rx Intf disabled                              0
Rx V1 Require V2                              0
Rx V2 Require V1                              0
Rx Register not RP                            0
Rx Register no route                          0
Rx Register no decap if                       0
Null Register Timeout                         0
RP Filtered Source                            0
Rx Unknown Reg Stop                           0
Rx Join/Prune no state                        0
Rx Join/Prune on upstream if                  0
Rx Join/Prune for invalid group               0
Rx Join/Prune messages dropped                0
Rx sparse join for dense group                0
Rx Graft/Graft Ack no state                   0
Rx Graft on upstream if                       0
Rx CRP not BSR                                0
Rx BSR when BSR                               0
```



```
Rx BSR not RPF if                             0
Rx unknown hello opt                          0
Rx data no state                              0
Rx RP no state                                0
Rx aggregate                                  0
Rx malformed packet                           0
Rx illegal TTL                                0
Rx illegal destination address                0
No RP                                         0
No register encap if                          0
No route upstream                            28
Nexthop Unusable                              0
RP mismatch                                   0
RP mode mismatch                              0
RPF neighbor unknown                          0
Rx Joins/Prunes filtered                      0
Tx Joins/Prunes filtered                      0
Embedded-RP invalid addr                      0
Embedded-RP limit exceed                      0
Embedded-RP added                             0
Embedded-RP removed                           0
Rx Register msgs filtering drop               0
Tx Register msgs filtering drop               0
Rx Bidir Join/Prune on non-Bidir if           0
Rx Bidir Join/Prune on non-DF if              0
V4 (S,G) Maximum                             10
V4 (S,G) Accepted                             9
V4 (S,G) Threshold                           80
V4 (S,G) Log Interval                        80
V6 (S,G) Maximum                              8
V6 (S,G) Accepted                             8
V6 (S,G) Threshold                           50
V6 (S,G) Log Interval                       100
V4 (grp-prefix, RP) Maximum                 100
V4 (grp-prefix, RP) Accepted                  5
V4 (grp-prefix, RP) Threshold                80
V4 (grp-prefix, RP) Log Interval             10
V6 (grp-prefix, RP) Maximum                  20
V6 (grp-prefix, RP) Accepted                  0
V6 (grp-prefix, RP) Threshold                90
V6 (grp-prefix, RP) Log Interval             20
V4 Register Maximum                         100
V4 Register Accepted                         10
V4 Register Threshold                        80
V4 Register Log Interval                     10
V6 Register Maximum                          20
V6 Register Accepted                          0
V6 Register Threshold                        90
V6 Register Log Interval                     20
```

Sample Output

show pim statistics interface <interface-name>

```
user@host> show pim statistics interface ge-0/3/0.0
Instance: PIM.master Family: INET

PIM Interface statistics for ge-0/3/0.0

PIM Message type        Received       Sent  Rx errors
V2 Hello                       0          3          0
```



```
V2 Register                0          0          0
V2 Register Stop           0          0          0
V2 Join Prune              0          0          0
V2 Bootstrap               0          0          0
V2 Assert                  0          0          0
V2 Graft                   0          0          0
V2 Graft Ack               0          0          0
V2 Candidate RP            0          0          0
V1 Query                   0          0          0
V1 Register                0          0          0
V1 Register Stop           0          0          0
V1 Join Prune              0          0          0
V1 RP Reachability         0          0          0
V1 Assert                  0          0          0
V1 Graft                   0          0          0
V1 Graft Ack               0          0          0
AutoRP Announce            0          0          0
AutoRP Mapping             0          0          0
AutoRP Unknown type        0
Anycast Register           0          0          0
Anycast Register Stop      0          0          0

Instance: PIM.master Family: INET6

PIM Interface statistics for ge-0/3/0.0

PIM Message type       Received       Sent  Rx errors
V2 Hello                      0          3          0
V2 Register                   0          0          0
V2 Register Stop              0          0          0
V2 Join Prune                 0          0          0
V2 Bootstrap                  0          0          0
V2 Assert                     0          0          0
V2 Graft                      0          0          0
V2 Graft Ack                  0          0          0
V2 Candidate RP               0          0          0
Anycast Register              0          0          0
Anycast Register Stop         0          0          0
```

show system statistics igmp

Syntax

show system statistics igmp

Syntax (EX Series Switches)

show system statistics igmp
<all-members>
<local>
<member *member-id*>

Syntax (TX Matrix Router)

show system statistics igmp
<all-chassis | all-lcc | lcc *number* | scc>

Syntax (TX Matrix Plus Router)

show system statistics igmp
<all-chassis | all-lcc | lcc *number* | sfc *number*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
sfc option introduced for the TX Matrix Plus router in Junos OS Release 9.6.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display system-wide Internet Group Management Protocol (IGMP) statistics.

Options

none—Display system statistics for IGMP.

all-chassis—(TX Matrix routers and TX Matrix Plus routers only) (Optional) Display system statistics for IGMP for all the routers in the chassis.

all-lcc—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display system statistics for IGMP for all T640 routers (or line-card chassis) connected to the TX Matrix router. On a TX Matrix Plus router, display system statistics for IGMP for all connected T1600 or T4000 LCCs.

all-members—(EX4200 switches only) (Optional) Display IGMP statistics for all members of the Virtual Chassis configuration.

lcc *number*—(TX Matrix routers and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display system statistics for IGMP for a specific T640 router that is connected to the TX Matrix router. On a TX Matrix Plus router, display system statistics for IGMP for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(EX4200 switches only) (Optional) Display IGMP statistics for the local Virtual Chassis member.

member ***member-id***—(EX4200 switches only) (Optional) Display IGMP statistics for the specified member of the Virtual Chassis configuration. Replace *member-id* with a value from 0 through 9.

scc—(TX Matrix routers only) (Optional) Display system statistics for IGMP for the TX Matrix router (or switch-card chassis).

sfc ***number***—(TX Matrix Plus routers only) (Optional) Display system statistics for IGMP for the TX Matrix Plus router. Replace *number* with 0.

Additional Information

By default, when you issue the **show system statistics igmp** command on the master Routing Engine of a TX Matrix router or a TX Matrix Plus router, the command is broadcast to all the master Routing Engines of the LCCs connected to it in the routing matrix. Likewise, if you issue the same command on the backup Routing Engine of a TX Matrix or a TX Matrix Plus router, the command is broadcast to all backup Routing Engines of the LCCs that are connected to it in the routing matrix.

Required Privilege Level

view

Related Documentation

- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

List of Sample Output

Sample Output

show system statistics igmp

```
user@host> show system statistics igmp
igmp:
        17178 messages received
        0 messages received with too few bytes
        0 messages received with bad checksum
        0 membership queries received
        0 membership queries received with invalid field(s)
        0 membership reports received
        0 membership reports received with invalid field(s)
        0 membership reports received for groups to which we belong
        0 membership reports sent
```

show system statistics igmp (EX Series Switches)

```
user@host> show system statistics igmp
igmp:
         0 messages received
         0 messages received with too few bytes
         0 messages received with bad checksum
         0 membership queries received
         0 membership queries received with invalid fields
         0 membership reports received
```

```
         0 membership reports received with invalid fields
         0 membership reports received for groups to which we belong
         0 Membership reports sent
```

show system statistics igmp (TX Matrix Plus Router)

```
user@host> show system statistics igmp
sfc0-re0:
--------------------------------------------------------------------------
igmp:
        0 messages received
        0 messages received with too few bytes
        0 messages received with bad checksum
        0 membership queries received
        0 membership queries received with invalid field(s)
        0 membership reports received
        0 membership reports received with invalid field(s)
        0 membership reports received for groups to which we belong
        0 membership reports sent

lcc0-re0:
--------------------------------------------------------------------------
igmp:
        0 messages received
        0 messages received with too few bytes
        0 messages received with bad checksum
        0 membership queries received
        0 membership queries received with invalid field(s)
        0 membership reports received
        0 membership reports received with invalid field(s)
        0 membership reports received for groups to which we belong
        0 membership reports sent

lcc1-re0:
--------------------------------------------------------------------------
igmp:
        0 messages received
        0 messages received with too few bytes
        0 messages received with bad checksum
        0 membership queries received
        0 membership queries received with invalid field(s)
        0 membership reports received
        0 membership reports received with invalid field(s)
        0 membership reports received for groups to which we belong
        0 membership reports sent

lcc2-re0:
--------------------------------------------------------------------------
igmp:
        0 messages received
        0 messages received with too few bytes
        0 messages received with bad checksum
        0 membership queries received
        0 membership queries received with invalid field(s)
        0 membership reports received
        0 membership reports received with invalid field(s)
        0 membership reports received for groups to which we belong
        0 membership reports sent

lcc3-re0:
--------------------------------------------------------------------------
```



```
igmp:
        0 messages received
        0 messages received with too few bytes
        0 messages received with bad checksum
        0 membership queries received
        0 membership queries received with invalid field(s)
        0 membership reports received
        0 membership reports received with invalid field(s)
        0 membership reports received for groups to which we belong
        0 membership reports sent
```

test msdp

Syntax

test msdp (dependent-peers *prefix* | rpf-peer *originator*)
<instance *instance-name*>
<logical-system (all | *logical-system-name*)>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Find Multicast Source Discovery Protocol (MSDP) peers.

Options

dependent-peers ***prefix***—Find downstream dependent MSDP peers.

rpf-peer ***originator***—Find the MSDP reverse-path-forwarding (RPF) peer for the originator.

instance ***instance-name***—(Optional) Find MDSP peers for the specified routing instance.

logical-system (all | ***logical-system-name*****)**—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

test msdp dependent-peers on page 4406

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

test msdp dependent-peers

```
user@host> test msdp dependent-peers 10.0.0.1/24
```

PART 16

Security

CHAPTER 50

Overview

Firewall Filters

Overview of Firewall Filters

Firewall filters provide rules that define whether to accept or discard packets that are transiting an interface on a QFX Series product. If a packet is accepted, you can configure additional actions to perform on the packet, such as class-of-service (CoS) marking (grouping similar types of traffic together and treating each type of traffic as a class with its own level of service priority) and traffic policing (controlling the maximum rate of traffic sent or received). You configure firewall filters to determine whether to accept or discard a packet before it enters or exits any of these:

- Port
- VLAN

- Layer 3 (routed) interface
- Routed VLAN interface (RVI)

An *ingress* firewall filter is applied to packets that are entering an interface or VLAN, and an *egress* firewall filter is applied to packets that are exiting an interface or VLAN.

NOTE: Firewall filters are sometimes called *access control lists* (ACLs).

Firewall Filter Types

The following firewall filter types are supported on the QFX Series:

- Port (Layer 2) firewall filter—Port firewall filters apply to Layer 2 traffic transiting system ports.
- VLAN firewall filter—VLAN firewall filters provide access control for packets that enter a VLAN, are bridged within a VLAN, or leave a VLAN.
- Router (Layer 3) firewall filter—You can apply a router firewall filter in both ingress and egress directions on IPv4 or IPv6 Layer 3 (routed) interfaces, routed VLAN interfaces (RVI) and a loopback interface, which filters traffic sent to the switch itself or generated by the switch. (You apply a filter to a loopback interface in the input direction to protect the switch from unwanted traffic. You might want to apply a filter to a loopback interface in the output direction so that you can set the forwarding class and DSCP bit value for packets that originate on the switch itself. This feature gives you very fine control over the classification of CPU generated packets. For example, you might want to assign different DSCP values and forwarding classes to traffic generated by different routing protocols so the traffic for those protocols can be treated in a differentiated manner by other devices.)

  NOTE: You can apply a firewall filter to a management interface (for example, me0) on a QFX3500 device. You cannot apply a firewall filter to a management interface on a QFX3000-G or QFX3000-M system.

- MPLS filter—You can apply a firewall filter to an MPLS interface

To apply a firewall filter:

1. Configure the firewall filter.
2. Apply the firewall filter to a port, VLAN, or router interface.

NOTE: You can apply only one firewall filter to a port, VLAN, or interface for a given direction. For example, for interface ge-0/0/6.0, you can apply one filter for the ingress direction and one for the egress direction.

Firewall Filter Components

In a firewall filter, you first define the family address type (ethernet-switching, inet (for IPv4), inet6 (for IPv6), or mpls) and then define one or more terms that specify the filtering criteria and the action to take if a match occurs.

Each term consists of the following components:

- Match conditions—Specify values that a packet must contain to be considered a match. You can specify values for most fields in the IP, TCP, UDP, or ICMP headers. You can also match on interface names.
- Action—Specifies what to do if a packet matches the match conditions. A filter can accept, discard, or reject a matching packet and then perform additional actions, such as counting, classifying, and policing. If no action is specified for a term, the default is to accept the matching packet.

Firewall Filter Processing

If there are multiple terms in a filter, the order of the terms is important. If a packet matches the first term, the switch executes the action defined by that term, and no other terms are evaluated. If the switch does not find a match between the packet and the first term, it compares the packet to the next term. If no match occurs between the packet and the second term, the system continues to compare the packet to each successive term in the filter until a match is found. If the packet does not match any terms in the filter, the switch discards the packet by default.

Related Documentation

- Understanding Firewall Filter Planning on page 4434
- Understanding Firewall Filter Processing Points for Bridged and Routed Packets on page 4439
- Understanding How Firewall Filters Are Evaluated on page 4412
- Understanding Firewall Filter Match Conditions on page 4415
- Overview of Policers on page 4441
- Configuring Firewall Filters on page 4531

Understanding Filter-Based Forwarding

You can use firewall filters in conjunction with virtual routing instances to specify different routes for packets to travel in their networks. To set up this feature—called filter-based forwarding—you specify a filter and match criteria and then specify the virtual routing instance to send packets to.

You might want to use filter-based forwarding to route specific types of traffic through a firewall or other security device before the traffic continues on its path. You can also use filter-based forwarding to give certain types of traffic preferential treatment. For example, you might want to ensure that the highest-priority traffic is forwarded over a 40-Gigabit Ethernet link. You might also use filter-based forwarding to obtain more control over load balancing than dynamic routing protocols provide.

NOTE: **You can create as many as 128 filters or terms that direct packets to a given virtual routing instance.**

Filters used for filter-based forwarding consume memory in two ternary content addressable memories (TCAMs), and this affects the number of supported filters. See "Planning the Number of Firewall Filters to Create" on page 4435 and "Understanding FIP Snooping, FBF, and MVR Filter Scalability" on page 4872 for more information. The section *FBF Filter VFP TCAM Consumption* in the latter topic specifically addresses the number of supported filters when using filter-based forwarding.

Related Documentation

- Understanding Virtual Router Routing Instances on page 2304
- Overview of Firewall Filters on page 4409
- Example: Using Filter-Based Forwarding to Route Application Traffic to a Security Device on page 4479

Understanding How Firewall Filters Are Evaluated

A firewall filter consists of one or more terms, and the order of the terms within a filter is important. Before you configure firewall filters, you should understand how the QFX Series products evaluate the terms within a filter and how packets are evaluated against the terms.

When a firewall filter consists of a single term, the filter is evaluated as follows:

- If the packet matches all the conditions, the action in the **then** statement is taken.
- If the packet matches all the conditions, and no action is specified in the **then** statement, the default action **accept** is taken.
- If the packet does not match all the conditions, the switch discards it.

When a firewall filter consists of more than one term, the filter is evaluated sequentially:

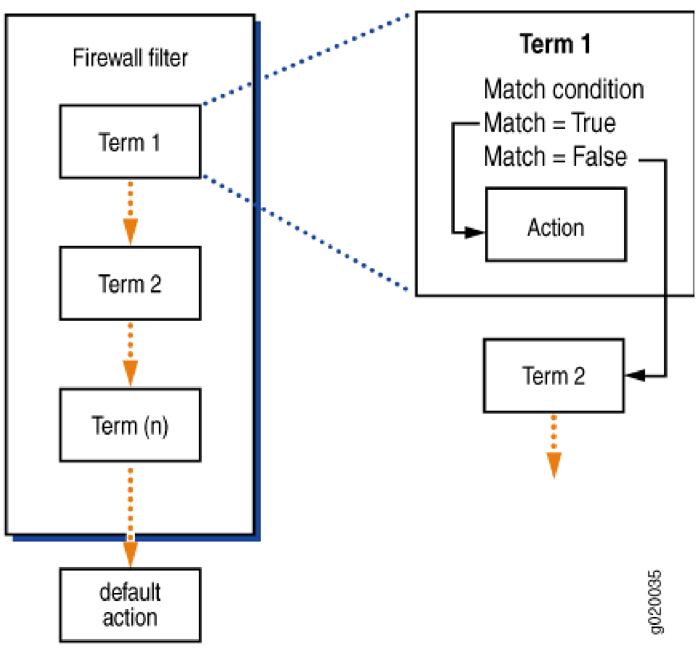
1. The packet is evaluated against the conditions in the **from** statement in the first term.
2. If the packet matches all the conditions in the term, the action in the **then** statement is taken and the evaluation ends. Subsequent terms in the filter are not evaluated.
3. If the packet does not match all the conditions in the term, the packet is evaluated against the conditions in the **from** statement in the second term.

   This process continues until the packet matches all the conditions in the **from** statement in one of the subsequent terms or there are no more terms in the filter.
4. If a packet passes through all the terms in the filter without a match, the switch discards it.

NOTE: The order of conditions in a from statement is not important because a packet must match all the conditions to be considered a match.

Figure 151 on page 4413 shows how QFX Series products evaluate the terms within a firewall filter.

Figure 151: Evaluation of Terms Within a Firewall Filter



If you do not include a **from** statement in a term, all packets will match the term and be processed by the **then** statement. If a term does not contain a **then** statement or if an action has not been configured in the **then** statement, the term accepts any matching packets.

Every firewall filter contains an implicit **deny** statement at the end of the filter, which is equivalent to the following explicit filter term:

```
term implicit-rule {
  then discard;
}
```

Consequently, a packet that does not match any of the terms in a firewall filter is discarded. If you configure a filter that has no terms, all packets that pass through the filter are discarded.

NOTE: Firewall filtering is supported on packets that are at least 64 bytes long.

Related Documentation

- Overview of Firewall Filters on page 4409
- Understanding Firewall Filter Match Conditions on page 4415
- Overview of Policers on page 4441
- Configuring Firewall Filters on page 4531

Understanding How Firewall Filters Control Packet Flows

A switch supports firewall filters that allow you to control flows of data packets and local packets. *Data packets* transit a switch as they are forwarded from a source to a destination. *Local packets* are destined for or sent by a Routing Engine (they do not transit a switch). Local packets usually contain routing protocol data, data for IP services such as Telnet or SSH, or data for administrative protocols such as the Internet Control Message Protocol (ICMP).

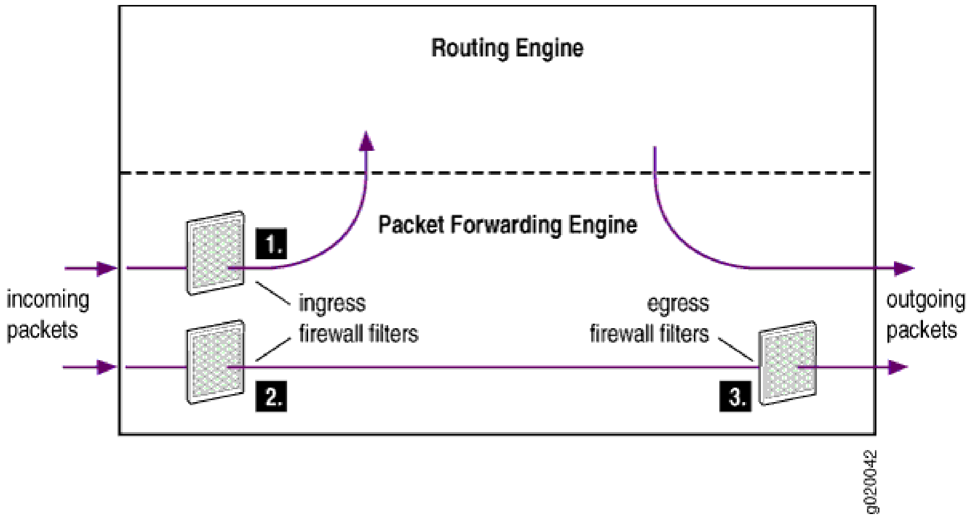
Firewall filters affect packet flows entering into or exiting from a switch as follows:

- Ingress firewall filters affect the flow of data packets that are received on switch interfaces. When a switch receives a data packet, the Packet Forwarding Engine in the system that contains the ingress interface determines where to forward the packet by looking in its Layer 2 or Layer 3 forwarding table for the best route to the destination. Data packets are forwarded to an egress interface. Locally destined packets are forwarded to the Routing Engine.
- Egress firewall filters affect data packets that are transiting a switch but do not affect packets sent by the Routing Engine. These filters are applied by the Packet Forwarding Engine in the system that contains the egress interface.

Figure 152 on page 4415 illustrates the application of ingress and egress firewall filters to control the flow of packets through a switch:

1. Ingress firewall filter applied to locally destined packets that are received on switch interfaces and are destined for the Routing Engine.
2. Ingress firewall filter applied to data packets that are received on switch interfaces and will transit the switch.
3. Egress firewall filter applied to data packets that are transiting the switch.

Figure 152: Application of Firewall Filters to Control Packet Flow



Related Documentation

- Understanding Firewall Filter Processing Points for Bridged and Routed Packets on page 4439
- Understanding How Firewall Filters Are Evaluated on page 4412
- Configuring Firewall Filters on page 4531

Understanding Firewall Filter Match Conditions

Before you define terms for firewall filters, you must understand how the conditions in a term are handled and how to specify interface, numeric, address, and bit-field filter match conditions to achieve the desired filter results.

- Filter Match Conditions on page 4415
- Numeric Filter Match Conditions on page 4416
- Interface Filter Match Conditions on page 4416
- IP Address Filter Match Conditions on page 4417
- MAC Address Filter Match Conditions on page 4417
- Bit-Field Filter Match Conditions on page 4418

Filter Match Conditions

In the **from** statement of a firewall filter term, you specify the conditions that the packet must match for the action in the **then** statement to be taken. All conditions must match for the action to be implemented. The order in which you specify match conditions is not important, because a packet must match all the conditions in a term for a match to occur.

If you specify multiple values for the same condition, a match on any one of those values matches that condition. For example, if you specify multiple IP source addresses using the **source-address** statement, a packet that contains any one of those IP source addresses matches the condition. In some cases you can specify multiple values for the same condition by enclosing the possible values in square brackets, as in:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set protocol (icmp | udp)
```

In other cases you must enter multiple statements, as in:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set source-address 10.1.1.1
user@switch# set source-address 10.1.1.2
```

If you specify no match conditions in a term, that term matches all packets.

NOTE: **Unlike traditional Junos OS firewall filters, you cannot use except in a condition statement to negate the condition.**

Numeric Filter Match Conditions

You can specify numeric filter match conditions that are identified by a numeric value, such as port and protocol numbers. For numeric filter match conditions, you specify the condition and a single value that a field in a packet must contain to be considered a match.

You can specify the numeric value in one of the following ways:

- Single number—A match occurs if the value of the field matches the number. For example, to match Telnet traffic:

  ```
  [edit firewall family family-name filter filter-name term term-name from]
  user@switch# set source-port 23
  ```
- Text synonym for a single number—A match occurs if the value of the field matches the number that corresponds to the synonym. For example, to match Telnet traffic:

  ```
  [edit firewall family family-name filter filter-name term term-name from]
  user@switch# set source-port telnet
  ```
- To specify multiple values for the same match condition in a filter term, enter each value in its own match statement. For example, a match occurs in the following term if the value of the source port in the packet is 22 or 23.

  ```
  [edit firewall family family-name filter filter-name term term-name from]
  user@switch# set source-port 22
  user@switch# set source-port 23
  ```

Interface Filter Match Conditions

You can specify an interface filter match condition to match an interface on which a packet is received or transmitted. For example, if you apply a filter to a VLAN you might want the filter to match on some interfaces that participate in the VLAN and not match on other interfaces in the VLAN. When you specify the name of the interface, you must include a logical unit.

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set interface ge-0/0/6.0
```


In this example, the final character (0) specifies the logical unit. You can include the wildcard (*) as part of the interface name. For example:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set interface ge-0/*/6.0
user@switch# set interface ge-0/1/*.0
user@switch# set interface ge-0/0/6.*
```

Note that you must specify a value or a wildcard for the logical unit.

IP Address Filter Match Conditions

You can specify an address filter match condition to match an IP source or destination address or prefix in a packet. Specify the address or prefix type and the address or prefix itself. For example:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set destination-address 10.2.1.0/24;
```

If you omit the prefix length, it defaults to /32. For example:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set destination-address 10
[edit firewall family family-name filter filter-name term term-name from]
user@switch# show
destination-address {
10.0.0.0/32;
}
```

To specify more than one IP address or prefix in a filter term, enter each address or prefix in its own match statement. For example, a match occurs in the following term if the source address of a packet matches either of the following prefixes:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set source-address 10.1.0.0/16
user@switch# set source-address 10.2.0.0/16
```

MAC Address Filter Match Conditions

You can specify a MAC address filter match condition to match a source or destination MAC address. You specify the address type and value that a packet must contain to be considered a match.

You can specify the MAC address as six hexadecimal bytes in any of the following formats:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set destination-mac-address 00:11:22:33:44:55
```

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set destination-mac-address 0011.2233.4455
```

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set destination-mac-address 001122334455
```

Regardless of the formats you use, the system resolves the address to the standard format, in this case 00:11:22:33:44:55.

To specify more than one MAC address in a filter term, enter each MAC address in its own match statement. For example, a match occurs in the following term if the value of the MAC source address matches either of the following addresses:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set source-mac-address 00:11:22:33:44:55
```



```
user@switch# set source-mac-address 00:11:22:33:20:15
```

Bit-Field Filter Match Conditions

You can specify bit-field filter match conditions to match particular bits within certain fields in Ethernet frames and IP, TCP, UDP, and ICMP headers. You usually specify the field and the bit within the field that must be set in a packet to be considered a match.

In most cases you can use a keyword to specify the bit you want to match on. For example, to match on a TCP SYN packet you can enter **syn**, as in:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set tcp-flags syn
```

You can also enter **0x02** because the SYN bit is the third least-significant bit of the 8-bit tcp-flags field:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set tcp-flags 0x02
```

To match multiple bit-field values, use the logical operators, which are described in Table 341 on page 4418. The operators are listed in order from highest precedence to lowest precedence. Operations are evaluated from left to right.

Table 341: Actions for Firewall Filters

Logical Operators	Description
!	Negation
&	Logical AND
|	Logical OR

If you use a logical operator, enclose the values in quotation marks and do not include any spaces. For example, the following statement matches the second packet of a TCP handshake:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set tcp-flags "syn&ack"
```

To negate a match, precede the value with an exclamation point. For example, the following statement matches only the initial packet of a TCP handshake:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set tcp-flags "syn&!ack"
```

You can use text synonyms to specify some common bit-field matches. For example, the following statement also matches the initial packet of a TCP handshake:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set tcp-initial
```

Related Documentation

- Overview of Firewall Filters on page 4409
- Understanding How a Firewall Filter Tests a Protocol on page 4433
- Firewall Filter Match Conditions and Actions on page 4419
- Configuring Firewall Filters on page 4531

Firewall Filter Match Conditions and Actions

Each term in a firewall filter consists of *match conditions* and an *action*. Match conditions are the fields and values that a packet must contain to be considered a match. You can define single or multiple match conditions in *match statements*. You can also include no match statement, in which case the term matches all packets.

When a packet matches a filter, a switch takes the action specified in the term. In addition, you can specify action modifiers to count, mirror, rate-limit, and classify packets. If no match conditions are specified for the term, the switch accepts the packet by default.

This topic describes the various match conditions, actions, and action modifiers that you can define in a firewall filter.

- Table 342 on page 4419 describes the match conditions you can specify when configuring a firewall filter. Some of the numeric range and bit-field match conditions allow you to specify a text synonym. To see a list of all the synonyms for a match condition, type **?** at the appropriate place in a statement.
- Table 343 on page 4430 shows the actions that you can specify in a term.
- Table 344 on page 4431 shows the action modifiers you can use to count, mirror, rate-limit, and classify packets.

Table 342: Supported Match Conditions for Firewall Filters

Match Condition	Description	Direction and Interface
arp-type	ARP request packet or ARP reply packet.	Egress and ingress ports.
destination-address ***ip-address***	IP destination address field, which is the address of the final destination node.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces, and IPv6 (inet6) interfaces.
destination-mac-address ***mac-address***	Destination media access control (MAC) address of the packet.	Ingress ports, VLANs and IPv4 (inet) interfaces. Egress ports and VLANs.

Table 342: Supported Match Conditions for Firewall Filters *(continued)*

Match Condition	Description	Direction and Interface
destination-port *value*	TCP or UDP destination port field. Typically, you specify this match in conjunction with the **protocol** match statement. For the following well-known ports you can specify text synonyms (the port numbers are also listed): **afs** (1483), **bgp** (179), **biff** (512), **bootpc** (68), **bootps** (67), **cmd** (514), **cvspserver** (2401), **dhcp** (67), **domain** (53), **eklogin** (2105), **ekshell** (2106), **exec** (512), **finger** (79), **ftp** (21), **ftp-data** (20), **http** (80), **https** (443), **ident** (113), **imap** (143), **kerberos-sec** (88), **klogin** (543), **kpasswd** (761), **krb-prop** (754), **krbupdate** (760), **kshell** (544), **ldap** (389), **login** (513), **mobileip-agent** (434), **mobilip-mn** (435), **msdp** (639), **netbios-dgm** (138), **netbios-ns** (137), **netbios-ssn** (139), **nfsd** (2049), **nntp** (119), **ntalk** (518), **ntp** (123), **pop3** (110), **pptp** (1723), **printer** (515), **radacct** (1813),**radius** (1812), **rip** (520), **rkinit** (2108), **smtp** (25), **snmp** (161), **snmptrap** (162), **snpp** (444), **socks** (1080), **ssh** (22), **sunrpc** (111), **syslog** (514), **tacacs-ds** (65), **talk** (517), **telnet** (23), **tftp** (69), **timed** (525), **who** (513), **xdmcp** (177), **zephyr-clt** (2103), **zephyr-hm** (2104)	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.

Table 342: Supported Match Conditions for Firewall Filters *(continued)*

Match Condition	Description	Direction and Interface
destination-port range-optimize *range*	Match a range of TCP or UDP port ranges while using the available memory more efficiently. Using this condition allows you to configure more firewall filters than if you configure individual destination ports.	Egress and ingress IPv4 (inet) interfaces.
destination-prefix-list *prefix-list*	IP destination prefix list field. You can define a list of IP address prefixes under a prefix-list alias for frequent use. Define this list at the **[edit policy-options]** hierarchy level.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces and IPv6 (inet6) interfaces.
dot1q-tag *number*	802.1Q VLAN ID field in the Ethernet frame. The tag values can be 1–4094.	Ingress ports and VLANs. Egress ports and VLANs (*Number* must be the VLAN ID of the VLAN you want to match).
dot1q-user-priority *number*	802.1Q priority field in the Ethernet frame (used for class-of-service priorities). Values can be 0–7. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed): • **best-effort (0)**—Best effort • **background (1)**—Background • **standard (2)**—Standard or spare • **excellent-load (3)**—Excellent load • **controlled-load (4)**—Controlled load • **video (5)**—Video • **voice (6)**—Voice • **network-control (7)**—Network control reserved traffic	Ingress ports and VLANs. Egress ports and VLANs.

Table 342: Supported Match Conditions for Firewall Filters *(continued)*

Match Condition	Description	Direction and Interface
dscp ***value***	Differentiated Services code point (DSCP). The DiffServ protocol uses the type-of-service (ToS) byte in the IP header. The most-significant 6 bits of this byte form the DSCP. You can specify DSCP in hexadecimal, binary, or decimal form. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed): • **be**—best effort (default) • **ef (46)**—as defined in RFC 3246, *An Expedited Forwarding PHB*. • **af11 (10)**, **af12 (12)**, **af13 (14)**; **af21 (18)**, **af22 (20)**, **af23 (22)**; **af31 (26)**, **af32 (28)**, **af33 (30)**; **af41 (34)**, **af42 (36)**, **af43 (38)** These four classes, with three drop precedences in each class, for a total of 12 code points, are defined in RFC 2597, *Assured Forwarding PHB*. • **cs0**, **cs1**, **cs2**, **cs3**, **cs4**, **cs5**, **cs6**, **cs7**, **cs5**	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.

Table 342: Supported Match Conditions for Firewall Filters *(continued)*

Match Condition	Description	Direction and Interface
ether-type ***value***	Ethernet type field of a packet. The EtherType value specifies what protocol is being transported in the Ethernet frame. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed): • **aarp (0x80F3)**—EtherType value AARP • **appletalk (0x809B)**—EtherType value AppleTalk • **arp (0x0806)**—EtherType value ARP • **fcoe (0x8906)**—EtherType value FCoE • **fip (0x8914)**—EtherType value FIP • **ipv4 (0x0800)**—EtherType value IPv4 • **ipv6 (0x08DD)**—EtherType value IPv6 • **mpls-multicast (0x8848)**—EtherType value MPLS multicast • **mpls-unicast (0x8847)**—EtherType value MPLS unicast • **oam (0x88A8)**—EtherType value OAM • **ppp (0x880B)**—EtherType value PPP • **pppoe-discovery (0x8863)**—EtherType value PPPoE Discovery Stage • **pppoe-session (0x8864)**—EtherType value PPPoE Session Stage • **sna (0x80D5)**—EtherType value SNA	Ingress ports and VLANs. Egress ports and VLANs.
exp	Match on MPLS EXP bits.	Ingress MPLS interfaces. Egress MPLS interfaces.
fragment-flags ***value***	IP fragmentation flags. In place of the numeric value, you can specify one of the following text synonyms (the hexadecimal values are also listed): • **is-fragment** • **dont-fragment (0x4000)** • **more-fragments (0x2000)** • **reserved (0x8000)**	Ingress ports and VLANs.

Table 342: Supported Match Conditions for Firewall Filters *(continued)*

<table>
<tr><th>Match Condition</th><th>Description</th><th>Direction and Interface</th></tr>
<tr><td>icmp-code value</td><td>ICMP code field. Because the meaning of the value depends upon the associated icmp-type, you must specify a value for icmp-type along with a value for icmp-code. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed). The keywords are grouped by the ICMP type with which they are associated:

IPv4: parameter-problem—ip-header-bad (0), required-option-missing (1)
IPv6: parameter-problem—ip6-header-bad (0), unrecognized-next-header (1), unrecognized-option (2)
redirect—redirect-for-network (0), redirect-for-host (1), redirect-for-tos-and-net (2), redirect-for-tos-and-host (3)
time-exceeded—ttl-eq-zero-during-reassembly (1), ttl-eq-zero-during-transit (0)
IPv4: unreachable—network-unreachable (0), host-unreachable (1), protocol-unreachable (2), port-unreachable (3), fragmentation-needed (4), source-route-failed (5), destination-network-unknown (6), destination-host-unknown (7), source-host-isolated (8), destination-network-prohibited (9), destination-host-prohibited (10), network-unreachable-for-TOS (11), host-unreachable-for-TOS (12), communication-prohibited-by-filtering (13), host-precedence-violation (14), precedence-cutoff-in-effect (15)
IPv6: unreachable—address-unreachable (3), administratively-prohibited (1), no-route-to-destination (0), port-unreachable (4)
</td><td>Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces.

Egress IPv4 (inet) interfaces.</td></tr>
</table>

Table 342: Supported Match Conditions for Firewall Filters *(continued)*

Match Condition	Description	Direction and Interface
icmp-type *value*	ICMP message type field. Typically, you specify this match in conjunction with the **protocol** match statement to determine which protocol is being used on the port. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed): *IPv4:* **echo-reply (0)**, **destination unreachable (3)**, **source-quench (4)**, **redirect (5)**, **echo-request (8)**, **IPv4 (inet)-advertisement (9)**, **IPv4 (inet)-solicit (10)**, **time-exceeded (11)**, **parameter-problem (12)**, **timestamp (13)**, **timestamp-reply (14)**, **info-request (15)**, **info-reply (16)**, **mask-request (17)**, **mask-reply (18)** *IPv6:* **destination-unreachable (1)**, **packet-too-big (2)**, **time-exceeded (3)**, **parameter-problem (4)**, **echo-request (128)**, **echo-reply (129)**, **membership-query (130)**, **membership-report (131)**, **membership-termination (132)**, **router-solicit (133)**, **router-advertisement (134)**, **neighbor-solicit (135)**, **neighbor-advertisement (136)**, **redirect (137)**, **router-renumbering (138)**, **node-information-request (139)**, **node-information-reply (140)** See also **icmp-code** ***variable***.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
interface *interface-name*	Interface on which the packet is received, including the logical unit. You can include the wildcard character (*****) as part of an interface name or logical unit. NOTE: An interface from which a packet is sent cannot be used as a match condition.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces and IPv6 (inet6) interfaces.
ip-destination-address *address*	32-bit address that is the final destination node address for the packet.	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
ip-options	Specify **any** to create a match if anything is specified in the options field in the IP header.	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.

Table 342: Supported Match Conditions for Firewall Filters *(continued)*

Match Condition	Description	Direction and Interface
ip-precedence *ip-precedence-field*	IP precedence field. In place of the numeric field value, you can specify one of the following text synonyms (the field values are also listed): **critical-ecp** (0xa0), **flash** (0x60), **flash-override** (0x80), **immediate** (0x40), **internet-control** (0xc0), **net-control** (0xe0), **priority** (0x20), or **routine** (0x00).	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
ip-protocol *number*	IP protocol field.	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
ip-source-address *address*	IP address of the source node sending the packet.	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
ip-version *address*	IP version of the packet.	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
is-fragment	Using this condition causes a match if the More Fragments flag is enabled in the IP header or if the fragment offset is not zero.	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
l2-encap-type llc-non-snap	Match on logical link control (LLC) layer packets for non-Subnet Access Protocol (SNAP) Ethernet Encapsulation type.	Ingress ports and VLANs. Egress ports and VLANs.
label	Match on MPLS label bits.	Ingress MPLS interfaces. Egress MPLS interfaces.
learn-vlan-id *number*	VLAN identifier used for MAC learning.	Ingress ports and VLANs. Egress ports and VLANs.
next-header	IPv4 or IPv6 protocol value. In place of the numeric value, you can specify one of the following text synonyms (the numeric values are also listed): **hop-by-hop (0)**,**icmp (1)**, **icmp6 (58)**, **igmp (2)**, **ipip (4)**, **tcp (6)**, **egp (8)**, **udp (17)**, **ipv6 (41)**, **routing (43)**, **fragment (44)**,**rsvp (46)**, **gre (47)**, **esp (50)**, **ah (51)**, **icmp6 (58)**, **no-next-header (59)**, **dstopts (60)**, **ospf (89)**, **pim (103)**, **vrrp (112)**, **sctp (132)**	Ingress ports, VLANs, and IPv6 (inet6) interfaces. Egress IPv6 (inet6) interfaces.

Table 342: Supported Match Conditions for Firewall Filters *(continued)*

Match Condition	Description	Direction and Interface
packet-length	Packet length in bytes. You must enter a value between 0 and 65535.	Ingress ports, VLANs, IPv4 (inet), and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
payload-protocol	IPv4 or IPv6 protocol value. In place of the numeric value, you can specify one of the following text synonyms (the numeric values are also listed): **hop-by-hop** (0),**icmp** (1), **icmp6** (58), **igmp** (2), **ipip** (4), **tcp** (6), **egp** (8), **udp** (17), **ipv6** (41), **routing** (43), **fragment** (44),**rsvp** (46), **gre** (47), **esp** (50), **ah** (51), **icmp6** (58), **no-next-header** (59), **dstopts** (60), **ospf** (89), **pim** (103), **vrrp** (112), **sctp** (132)	Ingress ports, VLANs, and IPv6 (inet6) interfaces. Egress IPv6 (inet6) interfaces.
precedence *value*	IP precedence bits in the type-of-service (ToS) byte in the IP header. (This byte can also used for the DiffServ DSCP.) In place of the numeric value, you can specify one of the following text synonyms (the numeric values are also listed): • **routine** (0) • **priority** (1) • **immediate** (2) • **flash** (3) • **flash-override** (4) • **critical-ecp** (5) • **internet-control** (6) • **net-control** (7)	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
protocol *type*	IPv4 or IPv6 protocol value. In place of the numeric value, you can specify one of the following text synonyms (the numeric values are also listed): **hop-by-hop** (0),**icmp** (1), **icmp6**, **igmp** (2), **ipip** (4), **tcp** (6), **egp** (8), **udp** (17), **ipv6** (41), **routing** (43), **fragment** (44),**rsvp** (46), **gre** (47), **esp** (50), **ah** (51), **icmp6** (58), **no-next-header** (59), **dstopts** (60), **ospf** (89), **pim** (103), **vrrp** (112), **sctp** (132)	Ingress ports, VLANs and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.

Table 342: Supported Match Conditions for Firewall Filters *(continued)*

Match Condition	Description	Direction and Interface
rat-type *tech-type-value*	Match the radio-access technology (RAT) type specified in the 8-bit Tech-Type field of Proxy Mobile IPv4 (PMIPv4) access technology type extension. The technology type specifies the access technology through which the mobile device is connected to the access network. Specify a single value, a range of values, or a set of values. You can specify a technology type as a numeric value from 0 through 255 or as a system keyword. • Numeric value 1 matches IEEE 802.3. • Numeric value 2 matches IEEE 802.11a/b/g. • Numeric value 3 matches IEEE 802.16e • Numeric value 4 matches IEEE 802.16m. • Text string **eutran** matches 4G. • Text string **geran** matches 2G. • Text string **utran** matches 3G. •	Egress and ingress IPv4 (inet) interfaces.
sample	Sample the packet traffic. Apply this option only if you have enabled traffic sampling.	Egress and ingress IPv4 (inet) interfaces.
source-address *ip-address*	IP source address field, which is the address of the node that sent the packet.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
source-mac-address *mac-address*	Source media access control (MAC) address of the packet.	Ingress ports and VLANs. Egress ports and VLANs.
source-port *value*	TCP or UDP source port. Typically, you specify this match in conjunction with the **protocol** match statement. In place of the numeric field, you can specify one of the text synonyms listed under **destination-port**.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
source-port range-optimize *range*	Match a range of TCP or UDP port ranges while using the available memory more efficiently. Using this condition allows you to configure more firewall filters than if you configure individual source ports.	Egress and ingress IPv4 (inet) interfaces.

Table 342: Supported Match Conditions for Firewall Filters *(continued)*

Match Condition	Description	Direction and Interface
source-prefix-list ***prefix-list***	IP source prefix list. You can define a list of IP address prefixes under a prefix-list alias for frequent use. Define this list at the **[edit policy-options]** hierarchy level.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
tcp-established	Match packets of an established TCP connection. This condition matches packets other than those used to set up a TCP connection—that is, three-way handshake packets are not matched. When you specify **tcp-established**, a switch does not implicitly verify that the protocol is TCP. You must also specify the **protocol tcp** match condition.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
tcp-flags ***value***	One or more TCP flags: • **ack (0x10)** • **fin (0x01)** • **push (0x08)** • **rst (0x04)** • **syn (0x02)** • **urgent (0x20)**	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
tcp-initial	Match the first TCP packet of a connection. A match occurs when the TCP flag **SYN** is set and the TCP flag **ACK** is not set. When you specify **tcp-initial**, a switch does not implicitly verify that the protocol is TCP. You must also specify the **protocol tcp** match condition.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
traffic-class	8-bit field that specifies the class-of-service (CoS) priority of the packet. The traffic-class field is used to specify a DiffServ code point (DSCP) value. This field was previously used as the type-of-service (ToS) field in IPv4, and, the semantics of this field (for example, DSCP) are identical to those of IPv4. You can specify one of the following text synonyms (the field values are also listed): **af11 (10)**, **af12 (12)**, **af13 (14)**, **af21 (18)**, **af22 (20)**, **af23 (22)**, **af31 (26)**, **af32 (28)**, **af33 (30)**, **af41 (34)**, **af42 (36)**, **af43 (38)**, **cs0 (0)**, **cs1 (8)**, **cs2 (16)**, **cs3 (24)**, **cs4 (32)**, **cs5 (40)**, **cs6 (48)**, **cs7 (56)**, **ef (46)**	Ingress ports, VLANs, and IPv6 (inet6) interfaces. Egress IPv6 (inet6) interfaces.

Table 342: Supported Match Conditions for Firewall Filters *(continued)*

Match Condition	Description	Direction and Interface
ttl ***value***	IP Time-to-live (TTL) field in decimal. The value can be 1-255.	Ingress IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
user-vlan-1p-priority ***value***	Match on the IEEE 802.1p user priority bits in the customer VLAN tag (the inner tag in a dual-tag frame with 802.1Q VLAN tags). Specify a single value or multiple values from 0 through 7.	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
user-vlan-id ***number***	Match the first VLAN identifier that is part of the payload.	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
vlan (*vlan-name* | *vlan-id*)	VLAN names or ID.	Ingress ports and VLANs. Egress ports and VLANs.

Use **then** statements to define actions that should occur if a packet matches all conditions in a **from** statement. Table 343 on page 4430 shows the actions that you can specify in a term. (If you do not include a **then** statement, the system accepts packets that match the filter.)

Table 343: Actions for Firewall Filters

Action	Description
accept	Accept a packet. This is the default action for packets that match a term.
discard	Discard a packet silently without sending an Internet Control Message Protocol (ICMP) message.
reject ***message-type***	Discard a packet and send a “destination unreachable” ICMPv4 message (type 3). To log rejected packets, configure the **syslog** action modifier. You can specify one of the following message types: **administratively-prohibited (default), bad-host-tos, bad-network-tos, host-prohibited, host-unknown, host-unreachable, network-prohibited, network-unknown, network-unreachable, port-unreachable, precedence-cutoff, precedence-violation, protocol-unreachable, source-host-isolated, source-route-failed,** or **tcp-reset**. If you specify **tcp-reset**, the system sends a TCP reset if the packet is a TCP packet; otherwise nothing is sent. If you do not specify a message type, the ICMP notification “destination unreachable” is sent with the default message “communication administratively filtered.” NOTE: The **reject** action is supported on ingress interfaces only.

Table 343: Actions for Firewall Filters *(continued)*

Action	Description
routing-instance *instance-name*	Forward matched packets to a virtual routing instance.
vlan *VLAN-name*	Forward matched packets to a specific VLAN. NOTE: The **vlan** action is supported on ingress interfaces only.

You can also specify the action modifiers listed in Table 344 on page 4431 to count, mirror, rate-limit, and classify packets.

Table 344: Action Modifiers for Firewall Filters

Action Modifier	Description
analyzer ***analyzer-name***	Mirror traffic (copy packets) to an analyzer configured at the **[edit ethernet-switching-options analyzer]** hierarchy level. You can specify port mirroring for ingress port, VLAN, and IPv4 (inet) firewall filters only.
count ***counter-name***	Count the number of packets that match the term.
dscp ***value***	Differentiated Services code point (DSCP). The DiffServ protocol uses the type-of-service (ToS) byte in the IP header. The most-significant 6 bits of this byte form the DSCP. You can specify DSCP in hexadecimal, binary, or decimal form. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed): • **be**—best effort (default) • **ef (46)**—as defined in RFC 3246, *An Expedited Forwarding PHB*. • **af11 (10)**, **af12 (12)**, **af13 (14)**; **af21 (18)**, **af22 (20)**, **af23 (22)**; **af31 (26)**, **af32 (28)**, **af33 (30)**; **af41 (34)**, **af42 (36)**, **af43 (38)** These four classes, with three drop precedences in each class, for a total of 12 code points, are defined in RFC 2597, *Assured Forwarding PHB*. • **cs0**, **cs1**, **cs2**, **cs3**, **cs4**, **cs5**, **cs6**, **cs7**, **cs5**

Table 344: Action Modifiers for Firewall Filters *(continued)*

Action Modifier	Description
forwarding-class ***class***	Classify the packet in one of the following forwarding classes: • **best-effort** • **fcoe** • **mcast** • **network-control** • **no-loss** NOTE: To configure a forwarding class, you must also configure loss priority.
log	Log the packet's header information in the Routing Engine. To view this information, enter the **show firewall log** operational mode command. NOTE: The **log** action modifier is supported on ingress interfaces only.
loss-priority (low | medium-low | medium-high | high)	Set the packet loss priority (PLP). NOTE: The **loss-priority** action modifier is supported on ingress interfaces only. NOTE: The **loss-priority** action modifier is not supported in combination with the **policer** action.
policer ***policer-name***	Send packets to a policer (for the purpose of applying rate limiting). You can specify a policer for ingress port, VLAN, IPv4 (inet), IPv6 (inet6), and MPLS filters. NOTE: The **policer** action modifier is not supported in combination with the **loss-priority** action.
syslog	Log an alert for this packet. NOTE: The **syslog** action modifier is supported on ingress interfaces only.
three-color-policer ***three-color-policer-name***	Send packets to a three-color policer (for the purpose of applying rate limiting). You can specify a three-color policer for ingress and egress port, VLAN, IPv4 (inet), IPv6 (inet6), and MPLS filters. NOTE: The **policer** action modifier is not supported in combination with the **loss-priority** action.

Related Documentation

- Understanding Firewall Filter Match Conditions on page 4415
- Understanding How Firewall Filters Are Evaluated on page 4412
- Understanding How a Firewall Filter Tests a Protocol on page 4433
- Overview of Policers on page 4441
- Understanding Port Mirroring on page 4713

- Configuring Firewall Filters on page 4531

Understanding How a Firewall Filter Tests a Protocol

When examining match conditions in a firewall filter, a switch tests only the fields that you specify. It does not implicitly test any fields that you do not explicitly configure. For example, if you specify a match condition of **source-port ssh**, there is no implied test to determine if the protocol is TCP. In this case, the switch considers any packet that has a value of **22** (decimal) in the 2-byte field that follows a *presumed* IP header to be a match. To ensure that the term matches on TCP packets, you also specify a **protocol tcp** match condition.

For the following match conditions, you should explicitly specify the protocol match condition in the same term:

- **destination-port**—Specify **protocol tcp** or **protocol udp**.
- **icmp-code**—Specify **protocol icmp** and **icmp-type**.
- **icmp-type**—Specify **protocol tcp** or **protocol udp**.
- **source-port**—Specify **protocol tcp** or **protocol udp**.
- **tcp-flags**—Specify **protocol tcp**.

Related Documentation

- Overview of Firewall Filters on page 4409
- Understanding Firewall Filter Match Conditions on page 4415
- Configuring Firewall Filters on page 4531

Understanding Firewall Filter Planning

Before you create a firewall filter and apply it, determine what you want the filter to accomplish and how to use its match conditions and actions to achieve your goals. It is important that you understand how packets are matched, the default and configured actions of the firewall filter, and where to apply the firewall filter.

You can apply no more than one firewall filter per port, VLAN, or router interface per direction (input and output). For example, for a given port you can apply at most one filter in the input direction and one filter in the output direction. You should try to be conservative in the number of terms (rules) that you include in each firewall filter, because a large number of terms requires longer processing time during a commit operation and can make testing and troubleshooting more difficult.

Before you configure and apply firewall filters, answer the following questions for each of them:

1. What is the purpose of the filter?

   For example, the system can drop packets based on header information, rate-limit traffic, classify packets into forwarding classes, log and count packets, or prevent denial-of-service attacks.

2. What are the appropriate match conditions? Determine the packet header fields that the packet must contain for a match. Possible fields include:

   - Layer 2 header fields—Source and destination MAC addresses, 802.1Q tag, Ethernet type, or VLAN.
   - Layer 3 header fields—Source and destination IP addresses, protocols, and IP options (IP precedence, IP fragmentation flags, or TTL type).
   - TCP header fields—Source and destination ports and flags.
   - ICMP header fields—Packet type and code.

3. What are the appropriate actions to take if a match occurs?

   The system can accept, discard, or reject packets.

4. What additional action modifiers might be required?

   For example, you can configure the system to mirror (copy) packets to a specified port, count matching packets, apply traffic management, or police packets.

5. On what port, router interface, or VLAN should the firewall filter be applied?

   Start with the following basic guidelines:

   - If packets entering or leaving a Layer 2 interface (port) need to be filtered, apply the filter at the **[edit family ethernet switching filter]** hierarchy level. This is a port filter.
   - If packets entering or leaving any port in a specific VLAN need to be filtered, use a VLAN filter.

- If packets entering or leaving a Layer 3 (routed) interface or routed VLAN interface (RVI) need to be filtered, use a router firewall filter. Apply the filter to the interface at the **[edit family inet]** hierarchy level. You can also apply a router firewall filter on a loopback interface.

Before you choose the interface or VLAN on which to apply a firewall filter, understand how that placement can affect traffic flow to other interfaces. In general, apply a filter close to the source device if the filter matches on source or destination IP addresses, IP protocols, or protocol information—such as ICMP message types, and TCP or UDP port numbers. However, you should apply a filter close to the destination device if the filter matches *only* on a source IP address. When you apply a filter too close to the source device, the filter could prevent that source device from accessing other services that are available on the network.

NOTE: Egress firewall filters do not affect the flow of locally generated control packets from the Routing Engine.

6. In which direction should the firewall filter be applied?

   You typically configure different actions for traffic entering an interface than you configure for traffic exiting an interface.

7. How many filters should I create?

   See "Planning the Number of Firewall Filters to Create" on page 4435 for information about how many firewall filters you can apply.

Related Documentation

- Overview of Firewall Filters on page 4409
- Overview of Policers on page 4441
- Understanding How Firewall Filters Are Evaluated on page 4412
- Planning the Number of Firewall Filters to Create on page 4435
- Configuring Firewall Filters on page 4531

Planning the Number of Firewall Filters to Create

Understanding How Many Firewall Filters Are Supported

QFX3500, QFX3600, and QFX5100 switches and QFabric Node devices support the maximum numbers of firewall filter terms per type of attachment point shown in Table 345 on page 4436.

Table 345: Supported Firewall Filter Numbers

Filter Type	QFX3500, QFX3600	QFX5100
Ingress	768	1536
Egress	1024	1024

These totals are applied in aggregate. For example, on the QFX3500 and QFX3600 you can apply a total of 768 terms in all your port filters, Layer 3 filters, and VLAN filters that are applied in the input direction and 1024 terms in port filters, Layer 3 filters, and VLAN filters that are applied in the output direction.

NOTE: If you want to create more than 512 egress VLAN filters, your first VLAN ID should be 6 and the subsequent VLAN IDs should increase by 1. For example, to create 1024 egress VLAN filters, the first VLAN ID would be 6, the second ID would be 7, and the sequence would continue through VLAN ID 1029. Similarly, if you want to create fewer than 512 egress VLAN filters but want the total number of terms in those filters to exceed 512, you should number your VLAN IDs in the same manner. If you do not use this approach to create your VLAN IDs, the total number of allowed terms or filters will be less than 1024 and might be 512.

The ternary content addressable memory (TCAM) for firewall filters is divided into slices that accommodate 256 terms, and all the terms in a memory slice must be in filters of the same type and applied in the same direction. A memory slice is reserved as soon as you commit a filter. For example, if you create a port filter and apply it in the input direction, a memory slice is reserved that will only store ingress port filters. If you create and apply only one ingress port filter and that filter has only one term, the rest of this slice is unused and is unavailable for other filter types.

Continuing with the above example, assume that you create and apply 256 ingress port filters with one term each so that one memory slice is filled. This leaves two more memory slices available for ingress filters. (Remember that the maximum number of ingress terms is 768.) If you then create and apply an ingress Layer 3 filter with one term, another memory slice is reserved for ingress Layer 3 filters. As before, the rest of the slice is unused and is unavailable for different filter types. At this point there is one memory slice available for any ingress filter type.

Now assume that you create and apply a VLAN ingress filter. The final memory slice is reserved for VLAN ingress filters. Memory allocation for ingress filters (once again assuming one term per filter) is as follows:

- Slice 1: Filled with 256 ingress port filters. You cannot commit any more ingress port filters.
- Slice 2: Contains one ingress Layer 3 filter with one term. You can commit 255 more terms in ingress Layer 3 filters.
- Slice 3: Contains one ingress VLAN filter with one term. You can commit 255 more terms in ingress VLAN filters.

Here is another example. Assume that you create 257 ingress port filters with one term per filter—that is, you create one more term than a single memory slice can accommodate. When you apply the filters and commit the configuration, the filter memory allocation is:

- Slice 1: Filled with 256 ingress port filters. You cannot apply any more ingress port filters.
- Slice 2: Contains one ingress port filter. You can apply 255 more terms in ingress port filters.
- Slice 3: This slice is unassigned. You can create and apply 256 terms in ingress filters of any type (port, Layer 3, or VLAN), but all the filters must be of the same type.

Egress Filters

All of the preceding principles also apply to egress filters, but four memory slices are used because IPv4 Layer 3 filters and IPv6 Layer 3 filters are stored in separate slices. The memory slices for egress filters are the same size as those for ingress filters, so the maximum number of egress filter terms is therefore 1024.

Avoid Configuring too Many Filters

If you violate any of these restrictions and commit a configuration that is not in compliance, Junos OS rejects the excessive filters. For example, if you configure 300 ingress port filters and 300 ingress Layer 3 filters and try to commit the configuration, Junos OS does the following (again assuming one term per filter):

- Accepts the 300 ingress port filters (storing them in two memory slices).
- Accepts the first 256 ingress Layer 3 filters it processes (storing them in the third memory slice).
- Rejects the remaining 44 ingress Layer 3 filters.

NOTE: In this situation, be sure to delete excessive filters (for example, the remaining 44 ingress Layer 3 filters) from the configuration before you reboot the device. If you reboot a device that has a noncompliant configuration, you cannot predict which filters are installed after the reboot. Using the example above, the 44 ingress Layer 3 filters that were originally rejected might be installed, and 44 of the port filters that were originally accepted might be rejected.

Policers can Limit Egress Filters

The number of egress policers that you configure can affect the total number of allowed egress firewall filters. Every policer has two implicit counters that consume two entries in a 1024-entry TCAM that is used for counters, including counters that are configured as action modifiers in firewall filter terms. (Policers consume two entries because one is used for green packets and one is used for nongreen packets regardless of policer type.) If the TCAM becomes full, you cannot commit any more egress firewall filters that have terms with counters. For example, if you configure and commit 512 egress policers (two-color, three-color, or a combination of both policer types), all of the memory entries for counters are used up. If later in your configuration file you insert additional egress firewall filters with terms that also include counters, *none* of the terms in those filters are committed because there is no available memory space for the counters.

Here are some additional examples:

- Assume that you configure egress filters that include a total of 512 policers and no counters. Later in your configuration file you include another egress filter with 10 terms, 1 of which has a counter action modifier. None of the terms in this filter are committed because there is not enough TCAM space for the counter.
- Assume that you configure egress filters that include a total of 500 policers, so 1000 TCAM entries are occupied. Later in your configuration file you include the following two egress filters:
  - Filter A with 20 terms and 20 counters. All the terms in this filter are committed because there is enough TCAM space for all the counters.
  - Filter B comes after Filter A and has five terms and five counters. *None* of the terms in this filter are committed because there is not enough memory space for *all* the counters. (Five TCAM entries are required but only four are available.)

You can prevent this problem from occurring by ensuring that egress firewall filter terms with counter actions are placed earlier in your configuration file than terms that include policers. In this circumstance, Junos OS commits policers even if there is not enough TCAM space for the implicit counters. For example, assume the following:

- You have 1024 egress firewall filter terms with counter actions.
- Later in your configuration file you have an egress filter with 10 terms. None of the terms have counters but one has a policer action modifier.

You can successfully commit the filter with 10 terms even though there is not enough TCAM space for the implicit counters of the policer. The policer is committed without the counters.

Planning for Filter-Specific Policers

You can configure policers to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. When you do this, rate limiting is applied in aggregate, so if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, the total bandwidth allowed by the filter is 1 Gbps. However, the behavior of a filter-specific policer is affected by how the firewall filter terms that reference the policer are stored in ternary content addressable memory (TCAM). If you create a filter-specific policer and reference it in multiple firewall filter terms, the policer allows more traffic than expected if the terms are stored in different TCAM slices. For example, if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms that are stored in three separate memory slices, the total bandwidth allowed by the filter is 3 Gbps, not 1 Gbps.

To prevent this unexpected behavior from occurring, use the information about TCAM slices presented above to organize your configuration file so that all the firewall filter terms that reference a given filter-specific policer are stored in the same TCAM slice.

Planning for Filter-Based Forwarding

You can use firewall filters in conjunction with virtual routing instances to specify different routes for packets to travel in their networks. To set up this feature–called filter-based forwarding–you specify a filter and match criteria and then specify the virtual routing instance to send packets to. Filters used in this way also consume memory in an additional TCAM. See "Understanding FIP Snooping, FBF, and MVR Filter Scalability" on page 4872 for more information. The section *FBF Filter VFP TCAM Consumption* in this topic specifically addresses the number of supported filters when using filter-based forwarding.

Related Documentation

- Overview of Firewall Filters on page 4409
- Understanding How Firewall Filters Are Evaluated on page 4412
- Understanding Firewall Filter Planning on page 4434
- Configuring Firewall Filters on page 4531
- Understanding Filter-Based Forwarding on page 4412

Understanding Firewall Filter Processing Points for Bridged and Routed Packets

You apply firewall filters at multiple processing points in the forwarding path. At each processing point, the action to be taken on a packet is determined by the configuration of the filter and the results of the lookup in the forwarding or routing table.

For both bridged (Layer 2) unicast packets and routed (Layer 3) unicast packets, firewall filters are applied in the prescribed order shown below (assuming that each filter is present and a packet is accepted by each one).

Bridged packets:

1. Ingress port filter
2. Ingress VLAN filter
3. Egress VLAN filter
4. Egress port filter

Routed packets:

1. Ingress port firewall filter
2. Ingress VLAN firewall filter (Layer 2 CoS)
3. Ingress router firewall filter (Layer 3 CoS)
4. Egress router firewall filter
5. Egress VLAN firewall filter
6. Egress port filter

NOTE: MAC learning occurs before filters are applied, so QFX Series products learn the MAC addresses of packets that are dropped by ingress filters.

Related Documentation

- Overview of Firewall Filters on page 4409
- Understanding How Firewall Filters Control Packet Flows on page 4414
- Configuring Firewall Filters on page 4531

Applying Firewall Filters to Interfaces

For a firewall filter to work, you must apply it to at least one interface. To do this, include the **filter** statement when configuring a logical interface at the **[edit interfaces]** hierarchy level:

```
[edit interfaces]
user@switch# set interface-name unit logical-unit-number family family-name filter (input | output) filter-name
```

In the **input** statement, specify a firewall filter to be evaluated when packets are received on the interface. Input filters applied to a loopback interface affect only traffic destined for the Routing Engine.

In the **output** statement, specify a filter to be evaluated when packets exit the interface.

NOTE: When you create a loopback interface, it is important to apply an ingress filter to it so the Routing Engine is protected. We recommend that when you apply a filter to the loopback interface **lo0**, you include the **apply-groups** statement. Doing so ensures that the filter is automatically inherited on every loopback interface, including **lo0** and other loopback interfaces.

Related Documentation

- Configuring Firewall Filters on page 4531

Policers

Overview of Policers

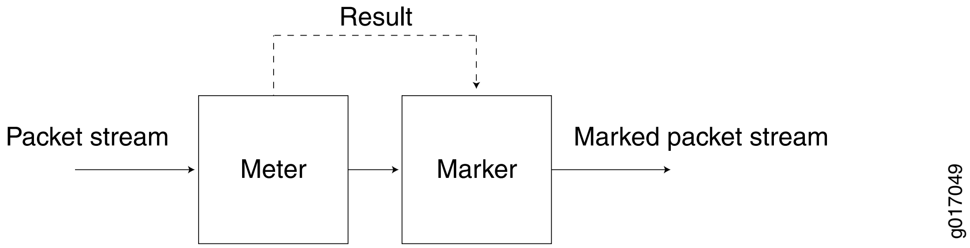
A switch polices traffic by limiting the input or output transmission rate of a class of traffic according to user-defined criteria. Policing (or rate-limiting) traffic allows you to control the maximum rate of traffic sent or received on an interface and to provide multiple priority levels or classes of service.

Policer Overview

You use policers to apply limits to traffic flow and set consequences for packets that exceed these limits—usually applying a higher loss priority—so that if packets encounter downstream congestion, they can be discarded first. Policers apply only to unicast packets.

Policers provide two functions: metering and marking. A policer meters (measures) each packet against traffic rates and burst sizes that you configure. It then passes the packet and the metering result to the marker, which assigns a packet loss priority that corresponds to the metering result. Figure 153 on page 4442 illustrates this process.

Figure 153: Flow of Tricolor Marking Policer Operation



After you name and configure a policer, you use it by specifying it as an action in one or more firewall filters.

Policer Types

A switch supports three types of policers:

- Single-rate two-color marker—A two-color policer (or "policer" when used without qualification) meters the traffic stream and classifies packets into two categories of packet loss priority (PLP) according to a configured bandwidth and burst-size limit. You can mark packets that exceed the bandwidth and burst-size limit with a specified PLP or simply discard them.

  You can specify this type of policer in an ingress or egress firewall.

  NOTE: **A two-color policer is most useful for metering traffic at the port (physical interface) level.**

- Single-rate three-color marker—This type of policer is defined in RFC 2697, *A Single Rate Three Color Marker*, as part of an assured forwarding (AF) per-hop-behavior (PHB) classification system for a Differentiated Services (DiffServ) environment. This type of policer meters traffic based on one rate—the configured committed information rate (CIR) as well as the committed burst size (CBS) and the excess burst size (EBS). The CIR specifies the average rate at which bits are admitted to the switch. The CBS specifies the usual burst size in bytes and the EBS specifies the maximum burst size in bytes. The EBS must be greater than or equal to the CBS, and neither can be 0.

  You can specify this type of policer in an ingress or egress firewall.

  NOTE: **A single-rate three-color marker (TCM) is most useful when a service is structured according to packet length and not peak arrival rate.**

- Two-rate three-color marker—This type of policer is defined in RFC 2698, *A Two Rate Three Color Marker*, as part of an assured forwarding per-hop-behavior classification system for a Differentiated Services environment. This type of policer meters traffic based on two rates—the CIR and peak information rate (PIR) along with their associated burst sizes, the CBS and peak burst size (PBS). The PIR specifies the maximum rate at which bits are admitted to the network and must be greater than or equal to the CIR.

You can specify this type of policer in an ingress or egress firewall.

NOTE: A two-rate three-color policer is most useful when a service is structured according to arrival rates and not necessarily packet length.

See Table 346 on page 4443 for information about how metering results are applied for each of these policer types.

Policer Actions

Policer actions are implicit or explicit and vary by policer type. *Implicit* means that Junos OS assigns the loss priority automatically. Table 346 on page 4443 describes the policer actions.

Table 346: Policer Actions

Policer	Marking	Implicit Action	Configurable Action
Single-rate two-color	Green (conforming)	Assign low loss priority	None
	Red (nonconforming)	None	Discard
Single-rate three-color	Green (conforming)	Assign low loss priority	None
	Yellow (above the CIR and CBS)	Assign medium-high loss priority	None
	Red (above the EBS)	Assign high loss priority	Discard
Two-rate three-color	Green (conforming)	Assign low loss priority	None
	Yellow (above the CIR and CBS)	Assign medium-high loss priority	None
	Red (above the PIR and PBS)	Assign high loss priority	Discard

NOTE: If you specify a policer in an egress firewall filter, the only supported action is discard.

Policer Colors

Single-rate and two-rate three-color policers can operate in two modes:

- Color-blind—In color-blind mode, the three-color policer assumes that all packets examined have not been previously marked or metered. In other words, the three-color policer is “blind” to any previous coloring a packet might have had.
- Color-aware—In color-aware mode, the three-color policer assumes that all packets examined have been previously marked or metered. In other words, the three-color policer is “aware” of the previous coloring a packet might have had. In color-aware mode, the three-color policer can increase the PLP of a packet but cannot decrease it. For example, if a color-aware three-color policer meters a packet with a medium PLP marking, it can raise the PLP level to high but cannot reduce the PLP level to low.

Filter-Specific Policers

You can configure policers to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. When you do this, rate limiting is applied in aggregate, so if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, the total bandwidth allowed by the filter is 1 Gbps. However, the behavior of a filter-specific policer is affected by how the firewall filter terms that reference the policer are stored in TCAM. If you create a filter-specific policer and reference it in multiple firewall filter terms, the policer allows more traffic than expected if the terms are stored in different TCAM slices. For example, if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms that are stored in three separate memory slices, the total bandwidth allowed by the filter is 3 Gbps, not 1 Gbps.

To prevent this unexpected behavior from occurring, use the information about TCAM slices presented in “Planning the Number of Firewall Filters to Create” on page 4435 to organize your configuration file so that all the firewall filter terms that reference a given filter-specific policer are stored in the same TCAM slice.

Suggested Naming Convention for Policers

We recommend that you use the naming convention ***policertypeTCM#-color type*** when configuring three-color policers and ***policer#*** when configuring two-color policers. TCM stands for three-color marker. Because policers can be numerous and must be applied correctly to work, a simple naming convention makes it easier to apply the policers properly. For example, the first single-rate, color-aware three-color policer configured would be named **srTCM1-ca**. The second two-rate, color-blind three-color configured would be named **trTCM2-cb**. The elements of this naming convention are explained below:

- sr (single-rate)
- tr (two-rate)
- TCM (tricolor marking)
- 1 or 2 (number of marker)
- ca (color-aware)
- cb (color-blind)

Policer Counters

Each policer that you configure includes an implicit counter that counts the number of packets that exceed the rate limits that are specified for the policer. If you use the same policer in multiple terms—either within the same filter or in different filters—the implicit counter counts all the packets that are policed in all of these terms. If you want to obtain separate packet counts for each term, use these options:

- Configure a unique policer for each term.
- Configure only one policer, but use a unique, explicit counter in each term.

Policer Algorithms

Policing uses the *token-bucket algorithm*, which enforces a limit on average bandwidth while allowing bursts up to a specified maximum value. It offers more flexibility than the *leaky bucket algorithm* in allowing a certain amount of bursty traffic before it starts discarding packets.

How Many Policers are Supported?

You can configure and commit the following numbers of policers on QFX3500 and QFX3600 devices when they are operating as standalone switches:

- Two-color policers used in ingress firewall filters: 767
- Three-color policers used in ingress firewall filters: 767
- Two-color policers used in egress firewall filters: 1022
- Three-color policers used in egress firewall filters: 512

Policers can Limit Egress Firewall Filters

The number of egress policers that you configure can affect the total number of allowed egress firewall filters. Every policer has two implicit counters that consume two entries in a 1024-entry TCAM that is used for counters, including counters that are configured as action modifiers in firewall filter terms. (Policers consume two entries because one is used for green packets and one is used for nongreen packets regardless of policer type.) If the TCAM becomes full, you cannot commit any more egress firewall filters that have terms with counters. For example, if you configure and commit 512 egress policers (two-color, three-color, or a combination of both policer types), all of the memory entries for counters are used up. If later in your configuration file you insert additional egress firewall filters with terms that also include counters, *none* of the terms in those filters are committed because there is no available memory space for the counters.

Here are some additional examples:

- Assume that you configure egress filters that include a total of 512 policers and no counters. Later in your configuration file you include another egress filter with 10 terms, 1 of which has a counter action modifier. None of the terms in this filter are committed because there is not enough TCAM space for the counter.

- Assume that you configure egress filters that include a total of 500 policers, so 1000 TCAM entries are occupied. Later in your configuration file you include the following two egress filters:
  - Filter A with 20 terms and 20 counters. All the terms in this filter are committed because there is enough TCAM space for all the counters.
  - Filter B comes after Filter A and has five terms and five counters. *None* of the terms in this filter are committed because there is not enough memory space for *all* the counters. (Five TCAM entries are required but only four are available.)

You can prevent this problem by ensuring that egress firewall filter terms with counter actions are placed earlier in your configuration file than terms that include policers. In this circumstance, Junos OS commits policers even if there is not enough TCAM space for the implicit counters. For example, assume the following:

- You have 1024 egress firewall filter terms with counter actions.
- Later in your configuration file you have an egress filter with 10 terms. None of the terms have counters but one has a policer action modifier.

You can successfully commit the filter with 10 terms even though there is not enough TCAM space for the implicit counters of the policer. The policer is committed without the counters.

Related Documentation

- Understanding Color-Blind Mode for Single-Rate Tricolor Marking on page 4447
- Understanding Color-Blind Mode for Two-Rate Tricolor Marking on page 4449
- Understanding Color-Aware Mode for Single-Rate Tricolor Marking on page 4447
- Understanding Color-Aware Mode for Two-Rate Tricolor Marking on page 4449
- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538

Understanding Policers with Link Aggregation Groups

If you apply a policer to a link aggregation group (LAG) on a QFX3500 switch or node, the policer applies to all the interfaces in the LAG in aggregate. For example, if you configure a policer to rate-limit at 1 Gbps and apply the policer (by using a firewall filter) to a LAG that has two member interfaces on a single switch or node, the total allowed throughput for both members is 1 Gbps.

If you apply a policer to a LAG that has members on different nodes in a QFabric network Node group or redundant server Node group, the configured rate applies to the interface on each node. For example, if you configure a policer to rate-limit at 1 Gbps and apply the policer to a LAG that has one member on server node A and one member on server node B, the allowed throughput for each member is 1 Gbps, for a total allowed throughput of 2 Gbps.

Related Documentation

- Overview of Policers on page 4441
- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538

Understanding Color-Blind Mode for Single-Rate Tricolor Marking

With the color-blind mode of single-rate tricolor marking, all packets are evaluated against the CBS. If a packet exceeds the CBS, it is evaluated against the EBS. In color-blind mode, the policer supports three loss priorities only: low, medium-high, and high.

Packets that exceed the CBS but are below the EBS are marked yellow (medium-high). Packets that exceed the EBS are marked red (high), as shown in Table 347 on page 4447.

Table 347: Color-Blind Mode TCM Color-to-PLP Mapping

Color	PLP	Meaning
Green	low	Conforming.
Yellow	medium-high	Packet exceeds the CIR and CBS but does not exceed the EBS.
Red	high	Packet exceeds the EBS.

Related Documentation

- Overview of Policers on page 4441
- Configuring Color-Blind Egress Policers for Medium-Low PLP on page 4537

Understanding Color-Aware Mode for Single-Rate Tricolor Marking

In color-aware mode, the treatment the packet receives depends on its classification. Marking can increase a preassigned PLP but cannot decrease it.

Summary of PLP Changes

Table 348 on page 4447 shows how a packet's incoming priority can be modified with single-rate marking.

Table 348: Color-Aware Mode Single-Rate PLP Mapping

Incoming PLP	Packet Metered Against	Possible Cases	Outgoing PLP
low	CIR, CBS, and EBS	Conforming	low
		Packet exceeds the CIR and CBS but does not exceed the EBS.	medium-high
		Packet exceeds the EBS.	high
medium-low	EBS only	Packet does not exceed the EBS.	medium-low
		Packet exceeds the EBS.	high
medium-high	EBS only	Packet does not exceed the EBS.	medium-high
		Packet exceeds the EBS.	high

Table 348: Color-Aware Mode Single-Rate PLP Mapping *(continued)*

Incoming PLP	Packet Metered Against	Possible Cases	Outgoing PLP
high	Not metered by the policer.	All cases.	**high**

The following sections describe single-rate color-aware PLP mapping in more detail.

Effect on Green Packets (Low PLP)

Packets belonging to the green class have already been marked by a classifier with low PLP. The marking policer can leave the PLP unchanged or increase it to medium-high or high, so these packets are therefore metered against both the CBS and the EBS. For example, if a behavior aggregate or multifield classifier marks a packet with low PLP and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CIR, packets remain marked as low PLP.
- If bursts exceed the CBS but not the EBS, some of the packets are marked as medium-high PLP, and some of the packets remain marked as low PLP.
- If bursts exceed the EBS, some of the packets are marked as high PLP, and some of the packets remain marked as low PLP.

Effect on Yellow Packets (Medium PLP)

Packets belonging to the yellow class have already been marked by a classifier with medium-low or medium-high PLP. The marking policer can leave the PLP unchanged or increase it to high, so these packets are therefore metered against the EBS only. For example, if a behavior aggregate or multifield classifier marks a packet with medium-low PLP and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CBS, the packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the CBS but less than the EBS, the packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the EBS, some of the packets are marked as high PLP and some remain marked as medium-low PLP.

If a BA or multifield classifier marks a packet with medium-high PLP and the two-rate TCM policer is in color-aware mode, the policer assigns output loss priority as follows:

- If the rate of traffic flow is less than the CBS, the packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the CBS but less than the EBS, the packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the EBS, some of the packets are marked as high PLP and some remain marked as medium-high PLP.

Effect on Red Packets (High PLP)

Packets belonging to the red class have already been marked by a classifier with high PLP. Because the policer cannot decrease the PLP, it does not change it, and these packets are not metered against the CBS or the EBS.

Related Documentation

- Overview of Policers on page 4441
- Configuring Color-Blind Egress Policers for Medium-Low PLP on page 4537

Understanding Color-Blind Mode for Two-Rate Tricolor Marking

With the color-blind mode of two-rate tricolor marking, all packets are evaluated against the committed information rate (CIR). If a packet exceeds the CIR, it is evaluated against the peak information rate (PIR). Packets that exceed the CIR but are below the PIR are marked yellow (medium-high). Packets that exceed the PIR are marked red (high).

Table 349: Color-Blind Mode TCM Color-to-PLP Mapping

Color	PLP	Meaning
Green	low	Packet does not exceed the CIR.
Yellow	medium-high	Packet exceeds the CIR but does not exceed the PIR.
Red	high	Packet exceeds the PIR.

Related Documentation

- Overview of Policers on page 4441
- Configuring Color-Blind Egress Policers for Medium-Low PLP on page 4537

Understanding Color-Aware Mode for Two-Rate Tricolor Marking

In color-aware mode, the treatment the packet receives depends on its classification. Marking can increase the preassigned PLP but cannot decrease it

Summary of PLP Changes

Table 350 on page 4449 shows how a packet's incoming priority can be modified with two-rate marking.

Table 350: Color-Aware Mode Two-Rate PLP Mapping

Incoming PLP	Packet Metered Against	Possible Cases	Outgoing PLP
low	CIR and PIR	Packet does not exceed the CIR.	low
		Packet exceeds the CIR but not the PIR.	medium-high
		Packet exceeds the PIR.	high

Table 350: Color-Aware Mode Two-Rate PLP Mapping *(continued)*

Incoming PLP	Packet Metered Against	Possible Cases	Outgoing PLP
medium-low	PIR only	Packet does not exceed the PIR.	**medium-low**
		Packet exceeds the PIR.	**high**
medium-high	PIR only	Packet does not exceed the PIR.	**medium-high**
		Packet exceeds the PIR.	**high**
high	Not metered by the policer.	All cases.	**high**

The following sections describe color-aware two-rate PLP mapping in more detail.

Effect on Green Packets (Low PLP)

Packets belonging to the green class have already been marked by a classifier with low PLP. The marking policer can leave the packet's PLP unchanged or increase the PLP to medium-high or high. These packets are therefore metered against both the CIR and the PIR. For example, if a behavior aggregate or multifield classifier marks a packet with low PLP and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CIR, the packets remain marked as low PLP.
- If the rate of traffic flow is greater than the CIR but less than the PIR, some of the packets are marked as medium-high PLP and some of the packets remain marked as low PLP.
- If the rate of traffic flow is greater than the PIR, some of the packets are marked as high PLP and some of the packets remain marked as low PLP.

Effect on Yellow Packets (Medium PLP)

Packets belonging to the yellow class have already been marked by a classifier with medium-low or medium-high PLP. The marking policer can leave the PLP unchanged or increase it to high. These packets are therefore metered against the PIR only. For example, if a behavior aggregate (BA) or multifield classifier marks a packet with medium-low PLP and the two-rate TCM policer is in color-aware mode, the policer assigns output loss priority as follows:

- If the rate of traffic flow is less than the CIR, the packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the CIR but less than the PIR, the packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the PIR, some of the packets are marked as high PLP and some of the packets remain marked as medium-low PLP.

If a BA or multifield classifier marks a packet with medium-high PLP and the two-rate TCM policer is in color-aware mode, the policer assigns output loss priority as follows:

- If the rate of traffic flow is less than the CIR, the packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the CIR but less than the PIR, the packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the PIR, some of the packets are marked as high PLP and some of the packets remain marked as medium-high PLP.

Effect on Red Packets (High PLP)

Packets belonging to the red class have already been marked by a classifier with high PLP. Because the policer cannot decrease the PLP, it does not change it, and these packets are not metered against the CIR or the PIR.

Related Documentation

- Overview of Policers on page 4441
- Configuring Color-Blind Egress Policers for Medium-Low PLP on page 4537

Port Security

Overview of Access Port Protection

Port security features can protect a switch against various types of attacks. Protection methods against some common attacks are:

Mitigation of Ethernet Switching Table Overflow Attacks

In an overflow attack on an Ethernet switching table, an intruder sends so many requests from new MAC addresses that the table cannot learn all the addresses. The attack forces the switch to send broadcast messages when it needs to send traffic to addresses for which it lacks MAC addresses. In addition to generating unnecessary traffic, the attacker might be able to sniff the broadcast packets.

To mitigate such attacks, you can configure a limit for learned MAC addresses or allow only specific MAC addresses. Use the MAC limit feature to control the total number of MAC addresses that can be added to the Ethernet switching table for the specified interface or interfaces. By setting the MAC addresses that are explicitly allowed, you ensure that the addresses of network devices whose network access is critical are guaranteed to be included in the Ethernet switching table.

Mitigation of Rogue DHCP Server Attacks

By default, all access ports are untrusted, and all trunk ports are trusted with regard to DHCP. Trusted ports allow DHCP servers to provide IP addresses and other information to requesting devices. If someone connects an unauthorized DHCP server to a trusted port, the unauthorized server can start issuing IP addresses and configuration information to the network's DHCP clients. The information provided to the clients by this server can disrupt their network access. The unauthorized server might also assign itself as the default gateway device for the network. An attacker can then sniff the network traffic and perpetrate a man-in-the-middle attack—that is, it misdirects traffic intended for a legitimate network device to a device of its choice.

To mitigate this problem, set the interface to which the unauthorized server is connected as untrusted. That action blocks all ingress DHCP server messages from that interface.

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NOTE: The switch logs all DHCP server packets that are received on untrusted ports. For example:

5 untrusted DHCPOFFER received, interface xe-:0/0/2.0[65], vlan v1[10] server ip/mac 12.12.12.1/00:00:00:00:01:12 offer ip/client mac 12.12.12.253/00:AA:BB:CC:DD:01

You can use these messages to detect unauthorized DHCP servers on the network.

NOTE: If you attach a DHCP server to an access port, you must configure the port as trusted.

Protection Against ARP Spoofing Attacks

In ARP spoofing, an attacker sends faked ARP messages on the network. The attacker associates its own MAC address with the IP address of a network device connected to the switch. Any traffic sent to that IP address is instead sent to the attacker. Now the attacker can create various types of problems, including sniffing the packets that were meant for another host and perpetrating man-in-the middle attacks. (In a man-in-the-middle attack, the attacker intercepts messages between two hosts, reads them, and perhaps alters them, all without the original hosts knowing that their communications have been compromised.)

To protect against ARP spoofing on your switch, enable both DHCP snooping and dynamic ARP inspection (DAI). DHCP snooping builds and maintains the DHCP snooping table. That table contains the MAC addresses, IP addresses, lease times, binding types, VLAN information, and interface information for the untrusted interfaces on the switch. DAI uses the information in the DHCP snooping table to validate ARP packets. Invalid ARP packets are blocked, and when they are blocked, a system log message is recorded that includes the type of ARP packet and the sender's IP address and MAC address.

See "Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks" on page 4513.

Protection Against DHCP Snooping Database Alteration Attacks

In an attack designed to alter the DHCP snooping database, an intruder introduces a DHCP client on one of the switch's untrusted access interfaces that has a MAC address identical to that of a client on another untrusted port. The intruder acquires the DHCP lease, which results in changes to the entries in the DHCP snooping table. Subsequently, what would have been valid ARP requests from the legitimate client are blocked.

To protect against this type of alteration of the DHCP snooping database, configure MAC addresses that are explicitly allowed on the interface. See "Example: Configuring Allowed MAC Addresses to Protect the Switch from DHCP Snooping Database Alteration Attacks" on page 4518.

Protection Against DHCP Starvation Attacks

In a DHCP starvation attack, an attacker floods an Ethernet LAN with DHCP requests from spoofed (counterfeit) MAC addresses so that trusted DHCP servers cannot keep up with requests from legitimate DHCP clients. The address space of those servers is completely used up, so they can no longer assign IP addresses and lease times to clients. DHCP requests from those clients are either dropped—that is, the result is a denial of service (DoS)—or directed to a rogue DHCP server set up by the attacker to imitate a legitimate DHCP server.

To protect the switch from DHCP starvation attacks, use the MAC limiting feature. Specify the maximum number of MAC addresses that the switch can learn on the access interfaces to which DHCP clients connect. The DHCP server or servers can then supply only the specified number of IP addresses over each of those interfaces. If a DHCP starvation attack occurs after the maximum number of IP addresses has been assigned, the attack fails.

Related Documentation

- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Configuring MAC Limiting on page 4545
- Verifying That MAC Limiting Is Working Correctly on page 4674

- Understanding DHCP Option 82 for Port Security on page 4468
- Example: Configuring MAC Limiting to Protect the Switch from DHCP Starvation Attacks on page 4495
- Understanding DAI for Port Security on page 4463

Port Security Overview

Ethernet LANs are vulnerable to attacks such as address spoofing (forging) and Layer 2 denial of service (DoS) on network devices. Port security features help protect the access ports on your switch against the loss of information and productivity that can result from such attacks.

Juniper Networks Junos operating system (Junos OS) provides features to help secure ports on the switch. Ports can be categorized as either trusted or untrusted. You apply policies appropriate to each category to protect ports against various types of attacks.

Basic port security features are enabled in the switch's default configuration. You can configure additional features with minimal configuration steps.

Depending on the particular feature, you can configure the feature either on VLANs or interfaces.

Port security features supported on switches are:

- DHCP snooping—Filters and blocks ingress Dynamic Host Configuration Protocol (DHCP) server messages on untrusted ports; builds and maintains an IP address to MAC address binding (IP-MAC binding) database, which is called the DHCP snooping database.

  NOTE: **DHCP snooping is not enabled in the default switch configurations. DHCP snooping is enabled on a per-VLAN basis. The details of enabling DHCP snooping depend on the particular switch.**

- DHCPv6 snooping—DHCP snooping for IPv6.
- DHCP option 82—Also known as the DHCP Relay Agent information option. This DHCPv4 feature helps protect the switch against attacks such as spoofing of IP addresses and media access control (MAC) addresses and DHCP IP address starvation. Option 82 provides information about the network location of a DHCP client, and the DHCP server uses this information to implement IP addresses or other parameters for the client.
- DHCPv6 option 37—Option 37 is the DHCP for IPv6 (DHCPv6) equivalent of option 82 and is enabled by default when DHCPv6 snooping is enabled on a VLAN.
- Dynamic ARP inspection (DAI)—Prevents Address Resolution Protocol (ARP) spoofing attacks. ARP requests and replies are compared against entries in the DHCP snooping database, and filtering decisions are made on the basis of the results of those comparisons. You enable DAI on a VLAN.

- IPv6 Neighbor Discovery (ND) inspection—Prevents IPv6 address spoofing attacks. Neighbor discovery requests and replies are compared against entries in the DHCPv6 snooping database, and filtering decisions are made on the basis of the results of those comparisons. You enable ND inspection on a VLAN.
- IP source guard—Mitigates the effects of IP address spoofing attacks on the Ethernet LAN. With IP source guard enabled, the source IP address in the packet sent from an untrusted access interface is validated against the source MAC address in the DHCP snooping database. The packet is forwarded if the source IP-MAC binding is valid; if the binding is not valid, the packet is discarded. You enable IP source guard on a VLAN. EX Series switches support IPv6 source guard also.

  NOTE: IP source guard is not supported on the QFX Series.

- MAC limiting—Protects against flooding of the Ethernet switching table (also known as the MAC forwarding table or Layer 2 forwarding table). You can enable MAC limiting on an interface.
- MAC move limiting—(Not supported on EX9200) Tracks MAC movement and detects MAC spoofing on access ports. You enable this feature on a VLAN.
- Persistent MAC learning—Also known as sticky MAC. Persistent MAC learning enables interfaces to retain dynamically learned MAC addresses across switch reboots You enable this feature on an interface.
- Trusted DHCP server—Configuring the DHCP server on a trusted port protects against rogue DHCP servers sending leases. You enable this feature on an interface (port). By default, access ports are untrusted, and trunk ports are trusted. (Access ports are the switch ports that connect to Ethernet endpoints such as user PCs and laptops, servers, and printers. Trunk ports are the switch ports that connect an Ethernet switch to other switches or to routers.)

Related Documentation

- *Security Features for EX Series Switches Overview*
- Understanding DHCP Snooping for Port Security on page 4456
- *Understanding DHCP Snooping for Port Security*
- *Understanding IPv6 Neighbor Discovery Inspection*
- Understanding DAI for Port Security on page 4463
- *Understanding IP Source Guard for Port Security on EX Series Switches*
- *Understanding MAC Limiting and MAC Move Limiting for Port Security on EX Series Switches*
- *Understanding DHCP Option 82 for Port Security on EX Series Switches*

Understanding DHCP Snooping for Port Security

DHCP snooping enables the switch to monitor and control DHCP messages received from untrusted devices connected to the switch. When DHCP snooping is enabled, the system snoops the DHCP messages to view DHCP lease information and build and maintain a database of valid IP address to MAC address (IP-MAC) bindings called the DHCP snooping database. Only clients with valid bindings are allowed access to the network.

DHCP Snooping Basics

Dynamic Host Configuration Protocol (DHCP) allocates IP addresses dynamically, *leasing* addresses to devices so that the addresses can be reused when no longer needed. Hosts and end devices that require IP addresses obtained through DHCP must communicate with a DHCP server across the LAN.

DHCP snooping acts as a guardian of network security by keeping track of valid IP addresses assigned to downstream network devices by a trusted DHCP server (the server is connected to a trusted network port).

By default, all trunk ports on the switch are trusted and all access ports are untrusted for DHCP snooping.

When DHCP snooping is enabled, the lease information from the switch is used to create the DHCP snooping database, a mapping of IP address to MAC-address pairs.

NOTE: **DHCP snooping is disabled in the default switch configuration. You must explicitly enable DHCP snooping by setting examine-dhcp at the [edit ethernet-switching-options secure-access-port] hierarchy level.**

Entries in the DHCP database are updated in these events:

- When a DHCP client releases an IP address (sends a DHCPRELEASE message), the associated mapping entry is deleted from the database.
- If you move a network device from one VLAN to another, typically the device needs to acquire a new IP address. Therefore, its entry in the database, including the VLAN ID, is updated.

- When the lease time (timeout value) assigned by the DHCP server expires, the associated entry is deleted from the database.

TIP: By default, the IP-MAC bindings are lost when the switch is rebooted and DHCP clients (the network devices, or hosts) must reacquire bindings. However, you can configure the bindings to persist by setting the **dhcp-snooping-file** statement to store the database file either locally or remotely.

You can configure the switch to snoop DHCP server responses only from particular VLANs. Doing this prevents spoofing of DHCP server messages.

You configure DHCP snooping per VLAN, not per interface (port). DHCP snooping is disabled by default.

DHCP Snooping Process

The basic process of DHCP snooping consists of the following steps:

NOTE: When DHCP snooping is enabled for a VLAN, all DHCP packets sent from that network devices in that VLAN are subjected to DHCP snooping. The final IP-MAC binding occurs when the DHCP server sends DHCPACK to the DHCP client.

1. The network device sends DHCPDISCOVER packet to request IP address.
2. The switch forwards the packet to the DHCP server.
3. The server sends a DHCPOFFER packet to offer an address. If the DHCPOFFER packet is from a trusted interface, the switch forwards the packet to the DHCP client.
4. The network device sends a DHCPREQUEST packet to accept the IP address. The switch adds an IP-MAC placeholder binding to the database. The entry is considered a placeholder until a DHCPACK packet is received from the server. Until then, the IP address could still be assigned to some other host.
5. The server sends a DHCPACK packet to assign the IP address or a DHCPNAK packet to deny the address request.
6. The switch updates the DHCP database in accordance with the type of packet received:
   - Upon receipt of a DHCPACK packet, the switch updates lease information for the IP-MAC binding in its database.
   - Upon receipt of a DHCPNACK packet, the switch deletes the placeholder.

NOTE: The DHCP database is updated only after the DHCPREQUEST packet has been sent.

For general information about the messages that the DHCP client and DHCP server exchange during the assignment of an IP address for the client, see the *Junos OS System Basics Configuration Guide*.

DHCP Server Access

A switch's access to the DHCP server can be configured in three ways:

Switch, DHCP Clients, and DHCP Server Are All on the Same VLAN

When the switch, DHCP clients, and DHCP server are *all members of the same VLAN*, the DHCP server can be connected to the switch in one of two ways:

- The server is directly connected to the same switch as the one connected to the DHCP clients (the hosts, or network devices, that are requesting IP addresses from the server). The VLAN is enabled for DHCP snooping to protect the untrusted access ports. The trunk port is configured by default as a trusted port. See Figure 154 on page 4458.
- The server is connected to an intermediary switch (Switch 2) that is connected through a trunk port to the switch (Switch 1) that the DHCP clients are connected to. Switch 2 is being used as a transit switch. The VLAN is enabled for DHCP snooping to protect the untrusted access ports. The trunk port is configured by default as a trusted port. See Figure 155 on page 4459—in the figure, **ge-0/0/11** is a trusted trunk port.

Figure 154: DHCP Server Connected Directly to Switch

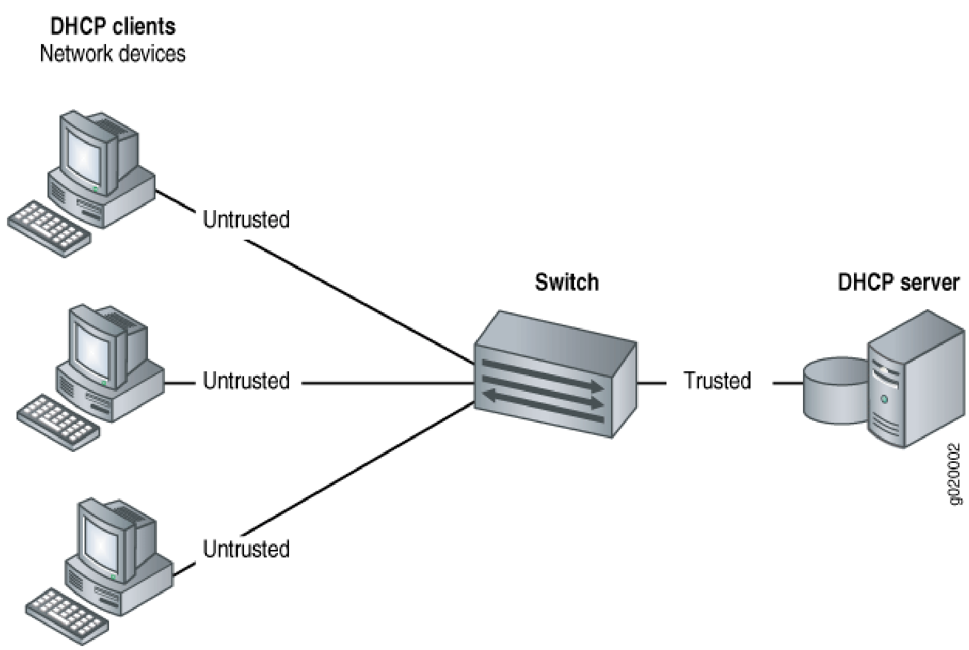
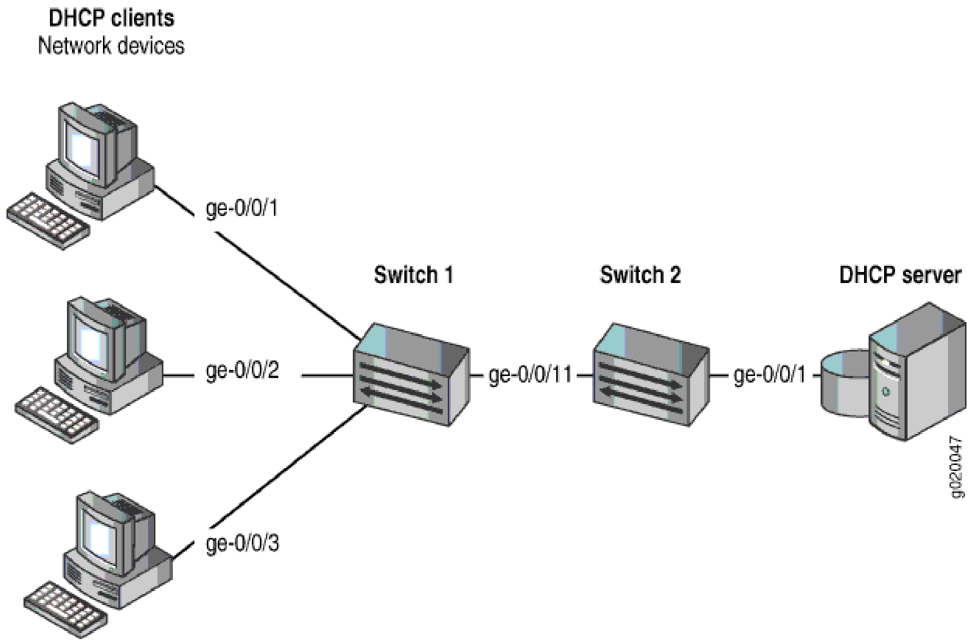


Figure 155: DHCP Server Connected Directly to Switch 2, with Switch 2 Connected to Switch 1 Through a Trusted Trunk Port

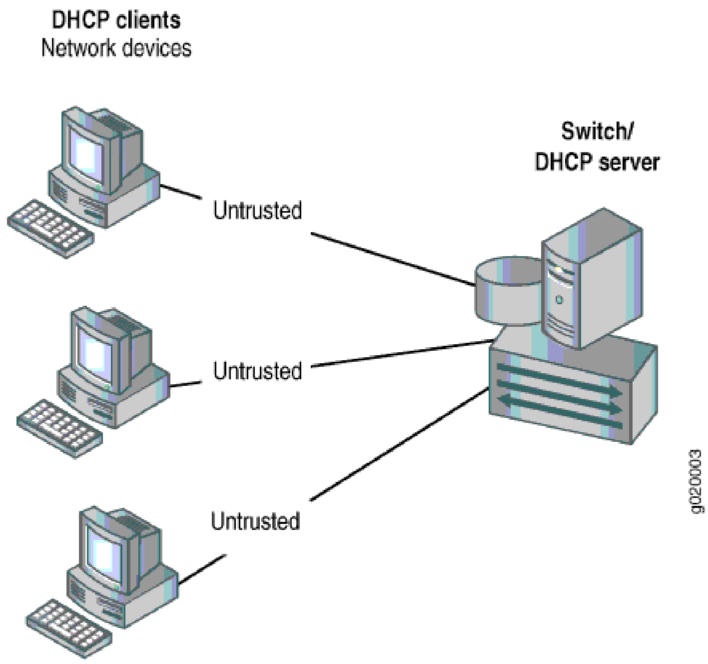


Switch Acts as DHCP Server

NOTE: The switch acting as a DHCP server is not supported on the QFX Series switch.

The switch itself is configured as a DHCP server; this is known as a “local” configuration. See Figure 156 on page 4460.

Figure 156: Switch Is the DHCP Server



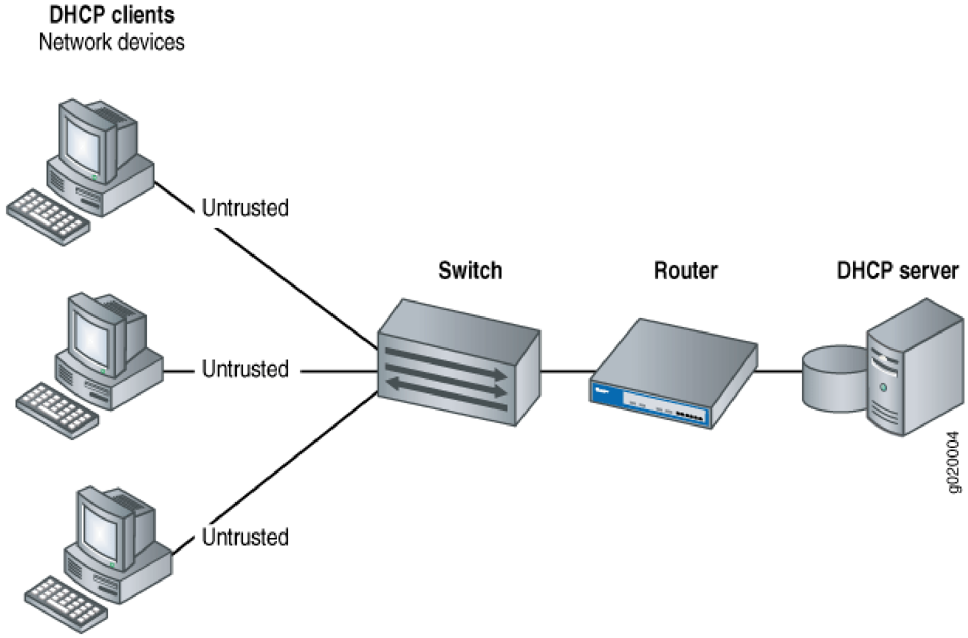
Switch Acts as Relay Agent

The switch functions as a relay agent when the DHCP clients or the DHCP server is connected to the switch through a Layer 3 interface. The Layer 3 interfaces on the switch are configured as routed VLAN interfaces (RVIs,) or integrated routing and bridging interfaces (IRBs). The trunk interfaces are trusted by default.

These two scenarios illustrate the switch acting as a relay agent:

- The DHCP server and clients are in different VLANs.
- The switch is connected to a router that is in turn connected to the DHCP server. See Figure 157 on page 4461.

Figure 157: Switch Acting as Relay Agent Through Router to DHCP Server



DHCP Snooping Table

The software creates a DHCP snooping information table that displays the content of the DHCP snooping database. The table shows current IP-MAC bindings, as well as lease time, type of binding, names of associated VLANs, and associated interface.

To display the DHCP snooping database, issue the operational mode command show dhcp snooping binding.

Static IP Address Additions to the DHCP Snooping Database

You can add specific static IP addresses to the database as well as have the addresses dynamically assigned through DHCP snooping. To add static IP addresses, you supply the IP address, the MAC address of the device, the interface on which the device is connected, and the VLAN with which the interface is associated. No lease time is assigned to the entry. The statically configured entry never expires.

Snooping DHCP Packets That Have Invalid IP Addresses

If you enable DHCP snooping on a VLAN and then devices on that VLAN send DHCP packets that request invalid IP addresses, these invalid IP addresses will be stored in the DHCP snooping database until they are deleted when their default timeout is reached. To eliminate this unnecessary consumption of space in the DHCP snooping database, the switch drops the DCHP packets that request invalid IP addresses, preventing the snooping of these packets. The invalid IP addresses are:

- 0.0.0.0
- 128.0.*x.x*
- 191.255.*x.x*

- 192.0.0.*x*
- 223.255.255.*x*
- 224.*x.x.x*
- 240.*x.x.x* to 255.255.255.255

Prioritizing Snooped Packets

NOTE: Prioritizing snooped packets is not supported on the QFX Series.

You can use class-of-service (CoS) forwarding classes and queues to prioritize DHCP snooped packets for a specified VLAN. This type of configuration places the DHCP snooped packets for that VLAN in the desired egress queue, so that the security procedure does not interfere with the transmittal of high-priority traffic. For additional information, see *Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic*.

Related Documentation

- Port Security Overview on page 4454
- Understanding Trusted DHCP Servers for Port Security on page 4467
- *Understanding DHCP Option 82 for Port Security on EX Series Switches*
- Understanding DHCP Services for Switches on page 36
- *DHCP/BOOTP Relay for Switches Overview*
- Example: Configuring Basic Port Security Features on page 4488
- Enabling DHCP Snooping (CLI Procedure) on page 4551
- *Enabling DHCP Snooping (J-Web Procedure)*
- *Making IP-MAC Bindings in the DHCP Snooping Database Persistent (CLI Procedure)*

Understanding DAI for Port Security

Dynamic ARP inspection (DAI) protects switches against ARP spoofing.

DAI inspects Address Resolution Protocol (ARP) packets on the LAN and uses the information in the DHCP snooping database on the switch to validate ARP packets and to protect against ARP spoofing (also known as ARP poisoning or ARP cache poisoning). ARP requests and replies are compared against entries in the DHCP snooping database, and filtering decisions are made based on the results of those comparisons. When an attacker tries to use a forged ARP packet to spoof an address, the switch compares the address with entries in the database. If the media access control (MAC) address or IP address in the ARP packet does not match a valid entry in the DHCP snooping database, the packet is dropped.

ARP packets are sent to the Routing Engine and are rate-limited to protect the switch from CPU overload.

Address Resolution Protocol

Sending IP packets on a multi-access network requires mapping an IP address to an Ethernet MAC address.

Ethernet LANs use ARP to map MAC addresses to IP addresses.

The switch maintains this mapping in a cache that it consults when forwarding packets to network devices. If the ARP cache does not contain an entry for the destination device, the host (the DHCP client) broadcasts an ARP request for that device's address and stores the response in the cache.

ARP Spoofing

ARP spoofing is one way to initiate man-in-the-middle attacks. The attacker sends an ARP packet that spoofs the MAC address of another device on the LAN. Instead of the switch sending traffic to the proper network device, the switch sends the traffic to the device with the spoofed address that is impersonating the proper device. If the impersonating device is the attacker's machine, the attacker receives all the traffic from the switch that must have gone to another device. The result is that traffic from the switch is misdirected and cannot reach its proper destination.

One type of ARP spoofing is gratuitous ARP, which is when a network device sends an ARP request to resolve its own IP address. In normal LAN operation, gratuitous ARP messages indicate that two devices have the same MAC address. They are also broadcast when a network interface card (NIC) in a device is changed and the device is rebooted, so that other devices on the LAN update their ARP caches. In malicious situations, an attacker can poison the ARP cache of a network device by sending an ARP response to the device that directs all packets destined for a certain IP address to go to a different MAC address instead.

To prevent MAC spoofing through gratuitous ARP and through other types of spoofing, the switches examine ARP responses through DAI.

Dynamic ARP Inspection

DAI examines ARP requests and responses on the LAN and validates ARP packets. The switch intercepts ARP packets from an access port and validates them against the DHCP snooping database. If no IP-MAC entry in the database corresponds to the information in the ARP packet, DAI drops the ARP packet and the local ARP cache is not updated with the information in that packet. DAI also drops ARP packets when the IP address in the packet is invalid. ARP probe packets are not subjected to dynamic ARP inspection. The switch always forwards such packets.

Junos OS for EX Series switches and the QFX Series uses DAI for ARP packets received on access ports because these ports are untrusted by default. Trunk ports are trusted by default, and therefore ARP packets bypass DAI on them.

You configure DAI for each VLAN, not for each interface (port). By default, DAI is disabled for all VLANs.

If you set an interface to be a DHCP trusted port, it is also trusted for ARP packets.

NOTE:

- If your switch uses Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style, see *Enabling a Trusted DHCP Server (CLI Procedure)* for information about configuring an access interface to be a DHCP trusted port. .
- If your switch is not using Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style, see "Enabling a Trusted DHCP Server (CLI Procedure)" on page 4555 for information about configuring an access interface to be a DHCP trusted port.

For packets directed to the switch to which a network device is connected, ARP queries are broadcast on the VLAN. The ARP responses to those queries are subjected to the DAI check.

For DAI, all ARP packets are trapped to the PFE. To prevent CPU overloading, ARP packets destined for the Routing Engine are rate-limited.

If the DHCP server goes down and the lease time for an IP-MAC entry for a previously valid ARP packet runs out, that packet is blocked.

Prioritizing Inspected Packets

NOTE: Prioritizing inspected packets is not supported on the QFX Series.

You can use class-of-service (CoS) forwarding classes and queues to prioritize DAI packets for a specified VLAN. This type of configuration places inspected packets for that VLAN in the egress queue, that you specify, ensuring that the security procedure does not interfere with the transmission of high-priority traffic.

Related Documentation

- Port Security Overview on page 4454
- Understanding DHCP Snooping for Port Security on page 4456
- Example: Configuring Basic Port Security Features on page 4488
- Example: Configuring DHCP Snooping, DAI , and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch on page 4506
- Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks on page 4513
- *Example: Configuring IP Source Guard and Dynamic ARP Inspection to Protect the Switch from IP Spoofing and ARP Spoofing*
- *Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic*
- Enabling Dynamic ARP Inspection (CLI Procedure) on page 4553
- *Enabling Dynamic ARP Inspection (CLI Procedure)*
- *Enabling Dynamic ARP Inspection (J-Web Procedure)*

Understanding MAC Limiting and MAC Move Limiting for Port Security

MAC limiting protects against flooding of the Ethernet switching table (also known as the MAC forwarding table or Layer 2 forwarding table). You enable this feature on Layer 2 interfaces (ports). MAC move limiting detects MAC movement and MAC spoofing on access interfaces. You enable this feature on VLANs.

MAC Limiting

MAC limiting sets a limit on the number of MAC addresses that can be learned on a single Layer 2 access interface or on all the Layer 2 access interfaces on the switch. Junos OS provides two MAC limiting methods:

- Maximum number of MAC addresses—You configure the maximum number of dynamic MAC addresses allowed per interface. When the limit is exceeded, incoming packets with new MAC addresses can be ignored, dropped, or logged. You can also specify that the interface be shut down or temporarily disabled.
- Allowed MAC addresses—You configure specific “allowed” MAC addresses for the access interface. Any MAC address that is not in the list of configured addresses is not

learned, and the switch logs an appropriate message. Allowed MAC binds MAC addresses to a VLAN so that the address does not get registered outside the VLAN. If an allowed MAC setting conflicts with a dynamic MAC setting, the allowed MAC setting takes precedence.

NOTE: If you do not want the system to log messages about invalid MAC addresses received by an interface that has been configured for allowed MAC addresses, disable the logging by configuring the no-allowed-mac-log statement.

You configure MAC limiting per interface, not per VLAN. You can specify the maximum number of dynamic MAC addresses that can be learned on a single Layer 2 access interface (including tagged-access interfaces) or on all Layer 2 access interfaces.

MAC Move Limiting

MAC move limiting causes the switch to track the number of times a MAC address can move to a new interface (port). It can help to prevent MAC spoofing, and it can also detect and prevent loops.

If a MAC address moves more than the configured number of times within 1 second, the switch performs the configured action. You can configure MAC move limiting to apply to all VLANs or to a specific VLAN.

Actions for MAC Limiting

You can choose to have one of the following actions performed when the limit of MAC addresses or the limit of MAC moves is exceeded:

- **drop**—Drop the packet and generate a system log entry. This is the default.
- **log**—Do not drop the packet but generate a system log entry.
- **none**—Take no action.
- **shutdown**—Disable the interface and generate an alarm. If you configure the switch with the **port-error-disable** statement, the disabled interface recovers automatically upon expiration of the specified timeout. If this is not configured, you can bring up the disabled interfaces by running the **clear ethernet-switching port-error** command.

See descriptions of results of these various action settings in "Verifying That MAC Limiting Is Working Correctly" on page 4674.

If you set a MAC limit to apply to all interfaces on the switch, you can override that setting for a particular interface by specifying action **none**. See "Configuring the none Action to Override a MAC Limit Applied to All Interfaces (CLI Procedure)" on page 4549

MAC Addresses That Exceed the MAC Limit or MAC Move Limit

If you have configured the **port-error-disable** statement, you can view which interfaces are temporarily disabled because the MAC limit or MAC move limit was exceeded. Use the **show ethernet-switching interfaces** command.

The log messages that indicate the MAC limit or MAC move limit has been exceeded include the offending MAC addresses.

Related Documentation

- Port Security Overview on page 4454
- Configuring MAC Limiting on page 4545
- Configuring MAC Move Limiting (CLI Procedure) on page 4547
- Verifying That MAC Limiting Is Working Correctly on page 4674
- Verifying That MAC Move Limiting Is Working Correctly on page 4677
- Example: Configuring MAC Limiting to Protect the Switch from DHCP Starvation Attacks on page 4495
- Example: Configuring Basic Port Security Features on page 4488
- **no-allowed-mac-log on page 4598**

Understanding Trusted and Untrusted Ports

By default, all access ports are untrusted and all trunk ports are trusted in regard to DHCP. Trusted ports allow DHCP servers to provide IP addresses and other information to requesting devices. Untrusted ports drop traffic from DHCP servers to prevent unauthorized servers from providing any configuration information to clients.

If you attach a DHCP server to an access port, you must configure the port as trusted. Before you do so, ensure that the server is physically secure—that is, that access to the server is monitored and controlled.

Related Documentation

- Understanding DHCP Snooping for Port Security on page 4456
- Example: Configuring Basic Port Security Features on page 4488
- Enabling a Trusted Port for DHCP on page 4556

Understanding Trusted DHCP Servers for Port Security

Any interface on the switch that connects to a DHCP server can be configured as a trusted port. Configuring a DHCP server on a trusted port protects against rogue DHCP servers sending leases.

Ensure that the DHCP server interface is physically secure—that is, that access to the server is monitored and controlled at the site—before you configure the port as trusted.

Related Documentation

- Understanding DHCP Snooping for Port Security on page 4456
- Example: Configuring Basic Port Security Features on page 4488
- Example: Configuring a DHCP Server Interface as Untrusted to Protect the Switch from Rogue DHCP Server Attacks on page 4503
- *Example: Configuring IP Source Guard and Dynamic ARP Inspection to Protect the Switch from IP Spoofing and ARP Spoofing*

- Enabling a Trusted DHCP Server (CLI Procedure) on page 4555
- *Enabling a Trusted DHCP Server (CLI Procedure)*
- *Enabling a Trusted DHCP Server (J-Web Procedure)*

Understanding DHCP Option 82 for Port Security

You can use DHCP option 82, also known as the DHCP relay agent information option, to help protect the switch against attacks such as spoofing (forging) of IP addresses and MAC addresses, and DHCP IP address starvation. Hosts on untrusted access interfaces on Ethernet LAN switches send requests for IP addresses in order to access the Internet. The switch forwards or relays these requests to DHCP servers, and the servers send offers for IP address leases in response. Attackers can use these messages to perpetrate address spoofing and starvation.

Option 82 provides information about the network location of a DHCP client, and the DHCP server uses this information to implement IP addresses or other parameters for the client. The Juniper Networks Junos operating system (Junos OS) implementation of DHCP option 82 supports RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.

This topic covers:

DHCP Option 82 Processing

If DHCP option 82 is enabled on the switch, then when a DHCP client that is connected to the switch on an untrusted interface sends a DHCP request, the switch inserts information about the client's network location into the packet header of that request. The switch then sends the request to the DHCP server. The DHCP server reads the option 82 information in the packet header and uses it to implement the IP address or another parameter for the client. See “Suboption Components of Option 82” on page 4469 for details about option 82 information.

You can enable DHCP option 82 on a single VLAN or on all VLANs on the switch. You can also configure it on Layer 3 interfaces (in routed VLAN interfaces, or RVIs) when the switch is functioning as a relay agent.

When option 82 is enabled on the switch, then this sequence of events occurs when a DHCP client sends a DHCP request:

1. The switch receives the request and inserts the option 82 information in the packet header.
2. The switch forwards or relays the request to the DHCP server.
3. The server uses the DHCP option 82 information to formulate its reply and sends a response back to the switch. It does not alter the option 82 information.

4. The switch strips the option 82 information from the response packet.
5. The switch forwards the response packet to the client.

NOTE: To use the DHCP option 82 feature, you must ensure that the DHCP server is configured to accept option 82. If it is not configured to accept option 82, then when it receives requests containing option 82 information, it does not use the information in setting parameters and it does not echo the information in its response message.

Suboption Components of Option 82

When configuring DHCP option 82, you can use the following suboptions:

- circuit ID—Identifies the circuit (interface and/or VLAN) on the switch on which the request was received. The circuit ID contains the interface name and/or VLAN name, with the two elements separated by a colon—for example, **xe-0/0/10:vlan1**. If the request packet is received on a Layer 3 interface, the circuit ID is just the interface name—for example, **xe-0/0/10**.

  Use the **prefix** option to add an optional prefix to the circuit ID. If you enable the **prefix** option, the hostname for the switch is used as the prefix; for example, **switch1:xe-0/0/10:vlan1**..

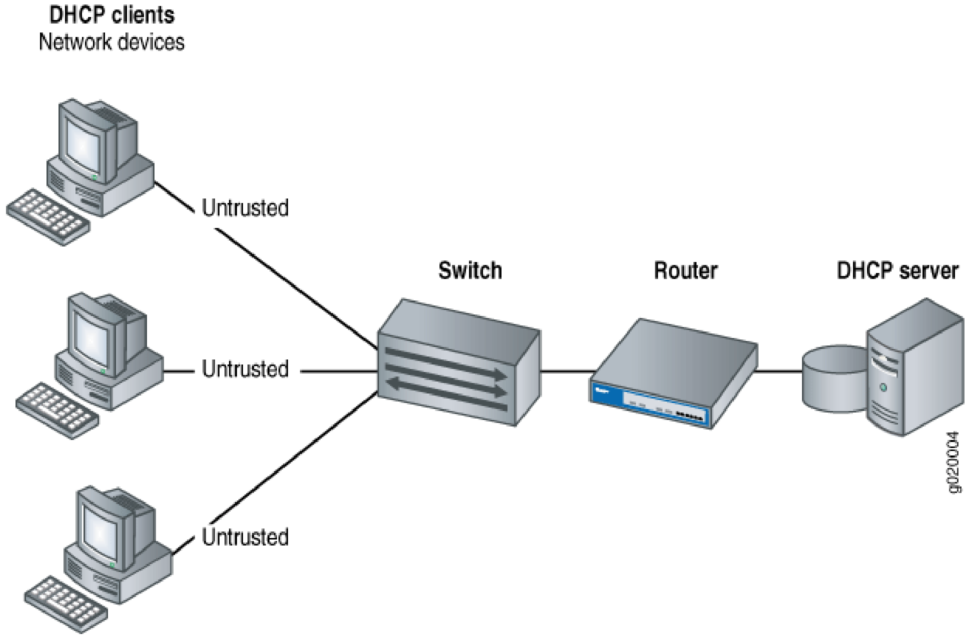
  You can also specify that the interface description be used rather than the interface name and that the VLAN ID be used rather than the VLAN name.
- remote ID—Identifies the host. By default, the remote ID is the MAC address of the switch. You can specify that the remote ID be the hostname of the switch, the interface description, or a character string of your choice. You can also add an optional prefix to the remote ID.
- vendor ID—Identifies the vendor of the host. If you specify the **vendor-id** option but do not enter a value, the default value **Juniper** is used. To specify a value, you type a character string.

Configurations That Support Option 82

You can use option 82 with the following configurations:

- The DHCP client and the DHCP server are on the same VLAN. In this case the switch forwards the requests from the clients on untrusted access interfaces to the server on a trusted interface. For this configuration, you set DHCP option 82 at the **[edit ethernet-switching-options secure-access-port vlan]** hierarchy level.
- The DHCP client or the DHCP server is connected to the switch through a Layer 3 interface and the switch is configured to relay DHCP requests. Figure 158 on page 4470 illustrates a scenario for the switch-as-relay-agent; in this instance, the switch relays requests through a router to the server.

Figure 158: Switch Relays DHCP Requests to Server



For the configuration shown in Figure 158 on page 4470, you set DHCP option 82 at the **[edit forwarding-options helpers bootp]** hierarchy level.

Related Documentation

- Overview of Access Port Protection on page 4451
- DHCP and BOOTP Relay Overview on page 4718
- **dhcp-option82 on page 4608**
- Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server on page 4521
- Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server on page 4525
- Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4557
- Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4560

Understanding Static ARP Entries

You can create explicit mappings between IP addresses and MAC addresses, which are called static ARP table entries. Unlike dynamically learned ARP entries, static entries do not age out. You might want to create static ARP entries in a troubleshooting situation or if your device is unable to learn a MAC address dynamically for any reason.

Related Documentation

- Configuring Static ARP Entries on page 1526
- *arp*

Device Security

Understanding Storm Control

A traffic storm occurs when broadcast packets prompt receiving devices to broadcast packets in response. This prompts further responses, creating a snowball effect. The switch is flooded with packets, which creates unnecessary traffic that leads to poor performance or even a complete loss of service by some clients. Storm control causes a device to monitor traffic levels and take a specified action when a specified traffic level—called the *storm control level*—is exceeded, thus preventing packets from proliferating and degrading service. You can configure devices to drop broadcast and unknown unicast packets, shut down interfaces, or temporarily disable interfaces when the storm control level is exceeded.

Storm control is disabled by default. If you configure storm control and do not specify a storm control level, the default level is 80 percent of the available bandwidth for ingress traffic. You can change the storm control level by configuring it as a specific bandwidth value. (The **level** configuration statement, which allows you to configure the storm control level as a percentage of the combined broadcast and unknown unicast streams, is deprecated and might be removed from future releases. We recommend that you phase out its use and replace it with the **bandwidth** statement.)

NOTE: There is no default rate limiting of BUM traffic to 80% on MX platforms. If the storm control profile is not attached to the IFL, BUM traffic can go up to the line rate.

NOTE: When you configure storm control bandwidth, the value you configure is rounded off internally to the closest multiple of 64 Kbps, and the rounded-off value represents the bandwidth that is actually enforced. For example, if you configure a bandwidth limit of 150 Kbps, storm control enforces a bandwidth limit of 128 Kbps.

NOTE: Storm control must be disabled on all Ethernet interfaces that belong to the FCoE VLAN to prevent FCoE traffic from being dropped. Configuring storm control on an Ethernet interface and including that interface in an FCoE-FC gateway may have undesirable effects, including FCoE packet loss. After disabling storm control on all interfaces, enable storm control on any interfaces that are not part of an FCoE-FC gateway on which you want to use storm control.

CAUTION: The Junos OS allows you to configure a storm control value that exceeds the bandwidth of the interface. If you configure an interface this way, storm control does not drop broadcast or unknown unicast packets even if they consume all the available bandwidth.

Broadcast, multicast, and unicast packets are sent as part of normal operations, so to recognize a storm, you must be able to identify when traffic has reached an abnormal level. Suspect a storm when operations begin timing out and network response times slow down. Users might be unable to access expected services. Monitor the percentage of broadcast and unknown unicast traffic in the network when it is operating normally. This data can then be used as a benchmark to determine when traffic levels are too high. You can then configure storm control to set the level at which you want to drop broadcast and unknown unicast traffic.

Related Documentation

- Example: Configuring Storm Control to Prevent Network Outages on page 4527
- Configuring Autorecovery for MAC Limited or Storm Control Interfaces (CLI Procedure) on page 4549
- Disabling Storm Control on FCoE Interfaces on an FCoE-FC Gateway on page 5056
- **action-shutdown on page 4650**
- **interface (Storm Control) on page 4666**
- **port-error-disable on page 4600**
- **storm-control on page 4667**

Understanding Unicast RPF

Unicast reverse-path forwarding (RPF) helps protect the switch against denial-of-service (DoS) and distributed denial-of-service (DDoS) attacks by verifying the unicast source address of each packet that arrives on an ingress interface where unicast RPF is enabled. It also helps ensure that traffic arriving on ingress interfaces comes from a network source that the receiving interface can reach.

When you enable unicast RPF, the switch forwards a packet only if the receiving interface is the best return path to the packet's unicast source address. This is known as strict mode unicast RPF.

NOTE: On Juniper Networks EX3200, EX4200, and EX4300 Ethernet Switches, the switch applies unicast RPF *globally* to all interfaces when unicast RPF is configured on any interface. For additional information, see "Limitations of the Unicast RPF Implementation on EX3200, EX4200, and EX4300 Switches" on page 4476.

This topic covers:

Unicast RPF for Switches Overview

Unicast RPF functions as an ingress filter that reduces the forwarding of IP packets that might be spoofing an address. By default, unicast RPF is disabled on the switch interfaces.

The type of unicast RPF provided on the switches—that is, strict mode unicast RPF is especially useful on untrusted interfaces. An untrusted interface is an interface where untrusted users or processes can place packets on the network segment.

The switch supports only the active paths method of determining the best return path back to a unicast source address. The active paths method looks up the best reverse path entry in the forwarding table. It does not consider alternate routes specified using routing-protocol-specific methods when determining the best return path.

If the forwarding table lists the receiving interface as the interface to use to forward the packet back to its unicast source, it is the best return path interface.

Use strict mode unicast RPF only on symmetrically routed interfaces. (For information about symmetrically routed interfaces, see "When to Enable Unicast RPF" on page 4474.)

For more information about strict unicast RPF, see RFC 3704, *Ingress Filtering for Multihomed Networks* at http://www.ietf.org/rfc/rfc3704.txt.

Unicast RPF Implementation

This section includes:

Unicast RPF Packet Filtering

When you enable unicast RPF on the switch, the switch handles traffic in the following manner:

- If the switch receives a packet on the interface that is the best return path to the unicast source address of that packet, the switch forwards the packet.
- If the best return path from the switch to the packet's unicast source address is not the receiving interface, the switch discards the packet.
- If the switch receives a packet that has a source IP address that does not have a routing entry in the forwarding table, the switch discards the packet.

Bootstrap Protocol (BOOTP) and DHCP Requests

Bootstrap protocol (BOOTP) and DHCP request packets are sent with a broadcast MAC address and therefore the switch does not perform unicast RPF checks on them. The switch forwards all BOOTP packets and DHCP request packets without performing unicast RPF checks.

Default Route Handling

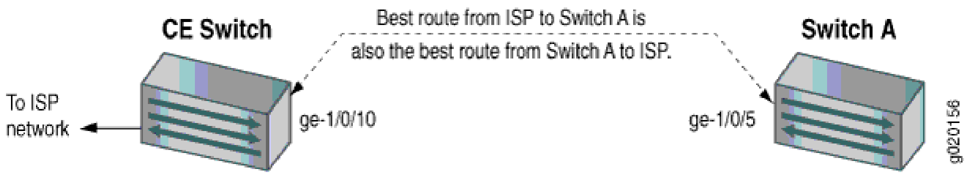
If the best return path to the source is the default route (**0.0.0.0**) and the default route points to **reject**, the switch discards the packets. If the default route points to a valid network interface, the switch performs a normal unicast RPF check on the packets.

When to Enable Unicast RPF

Enable unicast RPF when you want to ensure that traffic arriving on a network interface comes from a source that resides on a network that that interface can reach. You can enable unicast RPF on untrusted interfaces to filter spoofed packets. For example, a common application for unicast RPF is to help defend an enterprise network from DoS/DDoS attacks coming from the Internet.

Enable unicast RPF only on symmetrically routed interfaces. A symmetrically routed interface uses the same route in both directions between the source and the destination, as shown in Figure 159 on page 4475. Symmetrical routing means that if an interface receives a packet, the switch uses the same interface to send a reply to the packet source (the receiving interface matches the forwarding-table entry for the best return path to the source).

Figure 159: Symmetrically Routed Interfaces



Enabling unicast RPF on asymmetrically routed interfaces (where different interfaces receive a packet and reply to its source) results in packets from legitimate sources being filtered (discarded) because the best return path is not the same interface that received the packet.

The following switch interfaces are most likely to be symmetrically routed and thus are candidates for unicast RPF enabling:

- The service provider edge to a customer
- The customer edge to a service provider
- A single access point out of the network (usually on the network perimeter)
- A terminal network that has only one link

NOTE: Because unicast RPF is enabled globally on EX3200, EX4200, and EX4300 switches, ensure that *all* interfaces are symmetrically routed before you enable unicast RPF on these switches. Enabling unicast RPF on asymmetrically routed interfaces results in packets from legitimate sources being filtered.

TIP: Enabling unicast RPF as close as possible to the traffic source stops spoofed traffic before it can proliferate or reach interfaces that do not have unicast RPF enabled.

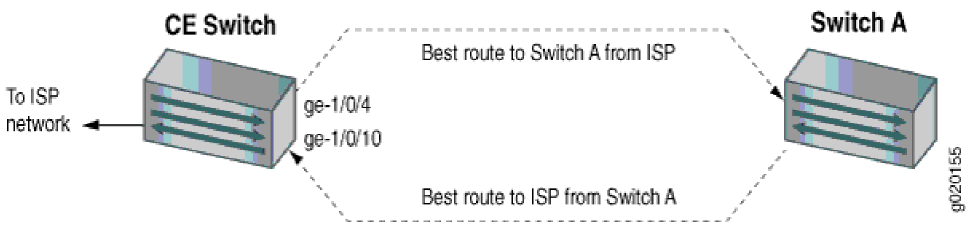
When Not to Enable Unicast RPF

Typically, you will not enable unicast RPF if:

- Switch interfaces are multihomed.
- Switch interfaces are trusted interfaces.
- BGP is carrying prefixes and some of those prefixes are not advertised or are not accepted by the ISP under its policy. (The effect in this case is the same as filtering an interface by using an incomplete access list.)
- Switch interfaces face the network core. Core-facing interfaces are usually asymmetrically routed.

An asymmetrically routed interface uses different paths to send and receive packets between the source and the destination, as shown in Figure 160 on page 4476. This means that if an interface receives a packet, that interface does not match the forwarding table entry as the best return path back to the source. If the receiving interface is not the best return path to the source of a packet, unicast RPF causes the switch to discard the packet even though it comes from a valid source.

Figure 160: Asymmetrically Routed Interfaces



NOTE: Do not enable unicast RPF on EX3200, EX4200, and EX4300 switches if any switch interfaces are asymmetrically routed, because unicast RPF is enabled globally on all interfaces of these switches. All switch interfaces must be symmetrically routed for you to enable unicast RPF without the risk of the switch discarding traffic that you want to forward.

Limitations of the Unicast RPF Implementation on EX3200, EX4200, and EX4300 Switches

On EX3200, EX4200, and EX4300 switches, the switch implements unicast RPF on a global basis. You cannot enable unicast RPF on a per-interface basis. Unicast RPF is globally disabled by default.

- When you enable unicast RPF on any interface, it is automatically enabled on all switch interfaces, including link aggregation groups (LAGs), integrated routing and bridging (IRB) interfaces, and routed VLAN interfaces (RVIs).
- When you disable unicast RPF on the interface (or interfaces) on which you enabled unicast RPF, it is automatically disabled on all switch interfaces.

NOTE: You must explicitly disable unicast RPF on every interface on which it was explicitly enabled or unicast RPF remains enabled on all switch interfaces.

QFX switches and EX3200 and EX4200 switches do not perform unicast RPF filtering on equal-cost multipath (ECMP) traffic. The unicast RPF check examines only one best return path to the packet source, but ECMP traffic employs an address block consisting of multiple paths. Using unicast RPF to filter ECMP traffic on these switches can result in the switch discarding packets that you want to forward because the unicast RPF filter does not examine the entire ECMP address block.

Related Documentation

- *Example: Configuring Unicast RPF on an EX Series Switch*
- Configuring Unicast RPF (CLI Procedure) on page 4562

- Disabling Unicast RPF (CLI Procedure) on page 4564

Understanding Unknown Unicast Forwarding

Unknown unicast traffic consists of unicast packets with unknown destination MAC addresses. By default, the switch floods these unicast packets that are traveling in a VLAN to all interfaces that are members of the VLAN. Forwarding this type of traffic can create unnecessary traffic that leads to poor network performance or even a complete loss of network service. This is known as a traffic storm.

To prevent a storm, you can disable the flooding of unknown unicast packets to all VLAN interfaces by configuring one VLAN or all VLANs to forward all unknown unicast traffic to a specific interface. This channels the unknown unicast traffic to a single interface.

Related Documentation

- *Configuring Unknown Unicast Forwarding (CLI Procedure)*
- Configuring Unknown Unicast Forwarding (CLI Procedure) on page 4565
- *Understanding Storm Control on EX Series Switches*
- *Understanding Storm Control on EX Series Switches*
- *Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches*
- *Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches*

CHAPTER 51

Configuration

Firewall and Policer Configuration Examples

Example: Using Filter-Based Forwarding to Route Application Traffic to a Security Device

You can configure filter-based forwarding by using a firewall filter to forward matched traffic to a specific virtual routing instance.

This example describes how to set up filter-based forwarding:

- Configuration on page 4480
- Verification on page 4482

Requirements

This example requires Junos OS Release 12.2X50-D20 or later.

Overview and Topology

In this example, traffic from one application server that is destined for a different application server is matched by a firewall filter based on the IP address of the source application server. Any matching packets are routed to a virtual routing instance that sends the traffic to a security device. In this case, the security device must be able to forward the traffic to the destination application server. For this example, assume that the address of the destination application server is 192.168.0.1.

Configuration

To configure filter-based forwarding:

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste them into the CLI at the **[edit]** hierarchy level.

```
[edit]
set interfaces xe-0/0/0 unit 0 family inet address 10.1.0.1/24
set interfaces xe-0/0/3 unit 0 family inet address 10.1.3.1/24
set firewall family inet filter f1 term t1 from source-address 10.1.0.50/32
set firewall family inet filter f1 term t1 from protocol tcp
set interfaces xe-0/0/0 unit 0 family inet filter input f1
set routing-instances vrf01 instance-type virtual-router
set routing-instances vrf01 interface xe-0/0/3.0
set routing-instances vrf01 routing-options static route 192.168.0.1/24 next-hop 10.1.3.254
set firewall family inet filter f1 term t1 then routing-instance vrf01
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.To configure filter-based forwarding:

1. Configure an interface to connect to the application server:

   ```
   [edit interfaces]
   user@switch# set xe-0/0/0 unit 0 family inet address 10.1.0.1/24
   ```

2. Configure an interface to connect to the security device:

   ```
   [edit interfaces]
   user@switch# set xe-0/0/3 unit 0 family inet address 10.1.3.1/24
   ```

3. Create a firewall filter that matches packets based on the address of the application server that the traffic will be sent from. Also configure the filter so that it matches only TCP packets:

   ```
   [edit firewall]
   user@switch# set family inet filter f1 term t1 from source-address 10.1.0.50/32
   user@switch# set firewall family inet filter f1 term t1 from protocol tcp
   ```

4. Apply the filter to the interface that connects to the source application server and configure it to match incoming packets:

   ```
   [edit interfaces]
   ```



```
user@switch# set xe-0/0/0 unit 0 family inet filter input f1
```

5. Create a virtual router:

```
[edit]
user@switch# set routing-instances vrf01 instance-type virtual-router
```

6. Associate the virtual router with the interface that connects to the security device:

```
[edit routing-instances]
user@switch# set vrf01 interface xe-0/0/3.0
```

7. Configure the routing information for the virtual routing instance:

```
[edit routing-instances]
user@switch# set vrf01 routing-options static route 192.168.0.1/24 next-hop 10.1.3.254
```

8. Set the filter to forward packets to the virtual router:

```
[edit firewall]
user@switch# set family inet filter f1 term t1 then routing-instance vrf01
```

Results

Check the results of the configuration:

```
user@switch> show configuration
interfaces {
  xe-0/0/0 {
    unit 0 {
      family inet {
        filter {
          input f1;
        }
        address 10.1.0.1/24;
      }
    }
  }
  xe-0/0/3 {
    unit 0 {
      family inet {
        address 10.1.3.1/24;
      }
    }
  }
}
firewall {
  family inet {
    filter f1 {
      term t1 {
        from {
          source-address {
            10.1.0.50/32;
          }
          protocol tcp;
        }
        then {
          routing-instance vrf01;
        }
      }
    }
  }
```



```
    }
    routing-instances {
        vrf01 {
            instance-type virtual-router;
            interface xe-0/0/1.0;
            routing-options {
                static {
                    route 12.34.56.0/24 next-hop 10.1.3.254;
                }
            }
        }
    }
```

Verification

To confirm that the configuration is working properly, perform these tasks:

- Verifying That Filter-Based Forwarding Was Configured on page 4482

Verifying That Filter-Based Forwarding Was Configured

Purpose Verify that filter-based forwarding was properly enabled on the switch.

Action

1. Use the **show interfaces filters** command:

```
user@switch> show interfaces filters xe-0/0/0.0
Interface       Admin Link Proto Input Filter         Output Filter
xe-0/0/0.0      up    down inet  f1
```

2. Use the **show route forwarding-table** command:

```
user@switch> show route forwarding-table

Routing table: default.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            user     1 0:12:f2:21:cf:0    ucst   331     4 me0.0
default            perm     0                    rjct    36     3
0.0.0.0/32         perm     0                    dscd    34     1
10.1.0.0/24        ifdn     0                    rslv   613     1 xe-0/0/0.0
10.1.0.0/32        iddn     0 10.1.0.0           recv   611     1 xe-0/0/0.0
10.1.0.1/32        user     0                    rjct    36     3
10.1.0.1/32        intf     0 10.1.0.1           locl   612     2
10.1.0.1/32        iddn     0 10.1.0.1           locl   612     2
10.1.0.255/32      iddn     0 10.1.0.255         bcst   610     1 xe-0/0/0.0
10.1.1.0/26        ifdn     0                    rslv   583     1 vlan.0
10.1.1.0/32        iddn     0 10.1.1.0           recv   581     1 vlan.0
10.1.1.1/32        user     0                    rjct    36     3
10.1.1.1/32        intf     0 10.1.1.1           locl   582     2
10.1.1.1/32        iddn     0 10.1.1.1           locl   582     2
10.1.1.63/32       iddn     0 10.1.1.63          bcst   580     1 vlan.0
255.255.255.255/32 perm     0                    bcst    32     1

Routing table: vrf01.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct   559     2
0.0.0.0/32         perm     0                    dscd   545     1
10.1.3.0/24        ifdn     0                    rslv   617     1 xe-0/0/3.0
10.1.3.0/32        iddn     0 10.1.3.0           recv   615     1 xe-0/0/3.0
```



```
10.1.3.1/32        user     0                    rjct   559     2
192.168.0.1/24     user     0 10.1.3.254         ucst   616     2 xe-0/0/3.0
192.168.0.1/24     user     0 10.1.3.254         ucst   616     2 xe-0/0/3.0
10.1.3.255/32      iddn     0 10.1.3.255         bcst   614     1 xe-0/0/3.0
224.0.0.0/4        perm     0                    mdsc   546     1
224.0.0.1/32       perm     0 224.0.0.1          mcst   529     1
255.255.255.255/32 perm     0                    bcst   543     1

Routing table: default.iso
ISO:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    60     1

Routing table: vrf01.iso
ISO:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct   600     1
```

Meaning The output indicates that the filter was created on the interface and that the virtual routing instance is forwarding matching traffic to the correct IP address.

Related Documentation

- Configuring Firewall Filters on page 4531
- Understanding Filter-Based Forwarding on page 4412
- Understanding Virtual Router Routing Instances on page 2304

Example: Using Two-Color Policers and Prefix Lists

If you provide specific amounts of bandwidth to internal or external customers, you can use policing to make sure that customers do not consume more bandwidth than they should receive. For example, you might connect many customers to one 10-Gbps interface and want to ensure that none of them congest the interface by using more bandwidth than they have been allotted.

You could accomplish this by creating a two-color policer similar to the following for each customer:

```
firewall {
  policer Limit-Customer-1 {
    if-exceeding {
      bandwidth-limit 100m;
      burst-size-limit 150m;
    }
    then discard;
  }
```

Creating a policer for each customer is clearly not a scalable solution, however. As an alternative, you can create prefix lists that group classes of customers and then create policers for each prefix list. For example, you could create prefix lists such as **Class-A-Customer-Prefixes**, **Class-B-Customer-Prefixes**, and **Class-C-Customer-Prefixes** (at the **[edit policy-options]** hierarchy level) and create the following corresponding policers:

```
firewall {
  policer Class-A {
    if-exceeding {
      bandwidth-limit 100m;
      burst-size-limit 150m;
    }
    then discard;
  }
  policer Class-B {
    if-exceeding {
      bandwidth-limit 75m;
      burst-size-limit 100m;
    }
    then discard;
  }
  policer Class-C {
    if-exceeding {
      bandwidth-limit 50m;
      burst-size-limit 75m;
    }
    then discard;
  }
}
```

You must create filter terms that specify the prefix lists in their **from** statements and the corresponding policers in their **then** statements similar to the following:

```
firewall
  family inet {
    filter Class-A-Customers {
      term term-1 {
        from {
          destination-prefix-list {
            Class-A-Customer-Prefixes;
          }
        }
        then policer Class-A;
      }
    }
    filter Class-B-Customers {
      term term-1 {
        from {
          destination-prefix-list {
            Class-B-Customer-Prefixes;
          }
        }
        then policer Class-B;
      }
    }
    filter Class-C-Customers {
      term term-1 {
        from {
          destination-prefix-list {
            Class-C-Customer-Prefixes;
          }
        }
```



```
            then policer Class-C;
          }
        }
      }
```

Here are the steps to create this firewall configuration:

1. Create the first policer:

   ```
   [edit firewall]
   user@switch# set policer Class-A if-exceeding bandwidth-limit 100m burst-size-limit 150m
   user@switch# set policer Class-A then discard
   ```
2. Create the second policer:

   ```
   [edit firewall]
   user@switch# set policer Class-B if-exceeding bandwidth-limit 75m burst-size-limit 100m
   user@switch# set policer Class-B then discard
   ```
3. Create the third policer:

   ```
   [edit firewall]
   user@switch# set policer Class-C if-exceeding bandwidth-limit 50m burst-size-limit 75m
   user@switch# set policer Class-C then discard
   ```
4. Create a filter for class A customers:

   ```
   [edit firewall]
   user@switch# edit family inet filter Class-A-Customers
   ```
5. Configure the filter to send packets matching the **Class-A-Customer-Prefixes** prefix list to the **Class-A** policer:

   ```
   [edit firewall family inet filter Class-A-Customers]
   user@switch# set term term-1 from source-prefix-list Class-A-Customers
   user@switch# set term term-1 then policer Class-A
   ```
6. Create a filter for class B customers:

   ```
   [edit firewall]
   user@switch# edit family inet filter Class-B-Customers
   ```
7. Configure the filter to send packets matching the **Class-B-Customer-Prefixes** prefix list to the **Class-B** policer:

   ```
   [edit firewall family inet filter Class-B-Customers]
   user@switch# set term term-1 from source-prefix-list Class-B-Customers
   user@switch# set term term-1 then policer Class-B
   ```
8. Create a filter for class C customers:

   ```
   [edit firewall]
   user@switch# edit family inet filter Class-C-Customers
   ```
9. Configure the filter to send packets matching the **Class-C-Customer-Prefixes** prefix list to the **Class-C** policer:

   ```
   [edit firewall family inet filter Class-C-Customers]
   user@switch# set term term-1 from source-prefix-list Class-C-Customers
   user@switch# set term term-1 then policer Class-C
   ```
10. Apply the filters you created to the appropriate interfaces in the output direction.

NOTE: Note that the implicit deny statement in this filter will block traffic from any source that does not match one of the prefix lists. If you want the filter to allow this traffic, you must include an explicit term for this purpose.

Related Documentation

- Overview of Policers on page 4441
- Applying Firewall Filters to Interfaces on page 4440
- *prefix-list*

Example: Using Policers to Manage Oversubscription

You might want to use a policer when an interface is oversubscribed and you want to control what will happen if congestion occurs. For example, you might have servers connected to a switch as listed in Table 351 on page 4486.

Table 351: Servers Connected to Switch

Server Type	Connection	IP Address
Network application server	1-gigabit interface	10.0.0.1
Authentication server	1-gigabit interface	10.0.0.2
Database server	10-gigabit interface	10.0.0.3

In this example, users access services provided by the network application server, which requests information from the database server as appropriate. When it receives a request from a user, the network application server first contacts the authentication server to verify the user's credentials. When a user is authenticated and the network application server provides the requested service, all the packets sent from the database server to the application server must transit the 1-Gigabit Ethernet interface connected to the application server twice—once on ingress to the application server and again on egress to the user.

The sequence of events for a user session is as follows:

1. A user connects to the application server and requests a service.
2. The application server requests the user's credentials and relays them to the authentication server.
3. If the authentication server verifies the credentials, the application server initiates the requested service.
4. The application server requests the files necessary to meet the user's request from the database server.
5. The database server sends the requested files to the application server.
6. The application server includes the requested files in its response to the user.

Traffic from the database server to the application server might congest the 1-gigabit interface to which that the application server is connected. This congestion might prevent the server from responding to requests from users and creating new sessions for them. You can use policing to make sure that this does not occur.

To create this firewall configuration, perform the following steps on the database server:

1. Create a policer to drop traffic from the database server to the application server if it exceeds certain limits:

```
[edit firewall]
user@switch# set policer Database-Egress-Policer if-exceeding bandwidth-limit 400
burst-size-limit 500m
user@switch# set policer Database-Egress-Policer then discard
```

2. Create a filter to examine traffic from the database server to the application server:

```
[edit firewall]
user@switch# edit family inet filter Database-Egress-Filter
```

3. Configure the filter to apply the policer to traffic egressing the database server and destined for the application server:

```
[edit firewall family inet filter Database-Egress-Filter]
user@switch# set term term-1 from destination-address 10.0.0.1
user@switch# set term term-1 then policer Database-Egress-Policer
```

4. If required, configure a term to allow traffic from the database server to other destinations (otherwise the traffic will be dropped by the implicit deny statement):

```
[edit firewall family inet filter Database-Egress-Filter]
user@switch# set term term-2 then accept
```

   Note that omitting a **from** statement causes the term to match all packets, which is the desired behavior.

5. Install the egress filter as an output filter on the database server interface that is connected the application server:

```
[edit interfaces]
user@switch# set xe-0/0/3 unit 0 family inet filter output Database-Egress-Filter
```

Here is how the final configuration would appear:

```
firewall {
  policer Database-Egress-Policer {
    if-exceeding {
      bandwidth-limit 400;
      burst-size-limit 500m;
    }
    then discard;
  }
  family inet {
    filter Database-Egress-Filter {
      term term-1 {
        from {
          destination-address {
            10.0.0.1/24;
          }
        }
        then policer Database-Egress-Policer;
      }
      term term-2 {  # If required, include this term so that traffic from the database server
        to other destinations is allowed.
        then accept;
      }
    }
```

```
    }
  ]
```

Related Documentation

- Overview of Policers on page 4441

Port Security Configuration Examples (Original CLI Only)

Example: Configuring Basic Port Security Features

You can configure DHCP snooping, dynamic ARP inspection (DAI), MAC limiting, persistent MAC learning, and MAC move limiting on the access ports of switches to protect the switches and the Ethernet LAN against address spoofing and Layer 2 denial-of-service (DoS) attacks. You can also configure a trusted DHCP server and specific (allowed) MAC addresses for the switch interfaces.

This example describes how to configure basic port security features on a switch:

Requirements

This example uses the following hardware and software components:

- One EX Series switch or one QFX3500 switch
- Junos OS Release 11.4 or later for EX Series switches or Junos OS Release 12.1 or later for the QFX Series

- A DHCP server to provide IP addresses to network devices on the switch

Before you configure basic port security features, be sure you have:

- Connected the DHCP server to the switch.
- Configured a VLAN on the switch. See the task for your platform:
  - *Configuring VLANs for EX Series Switches (CLI Procedure)*
  - “Configuring VLANs” on page 1534 for the QFX Series

NOTE: **In this example, the DHCP server and its clients are all members of a single VLAN on the switch.**

Overview and Topology

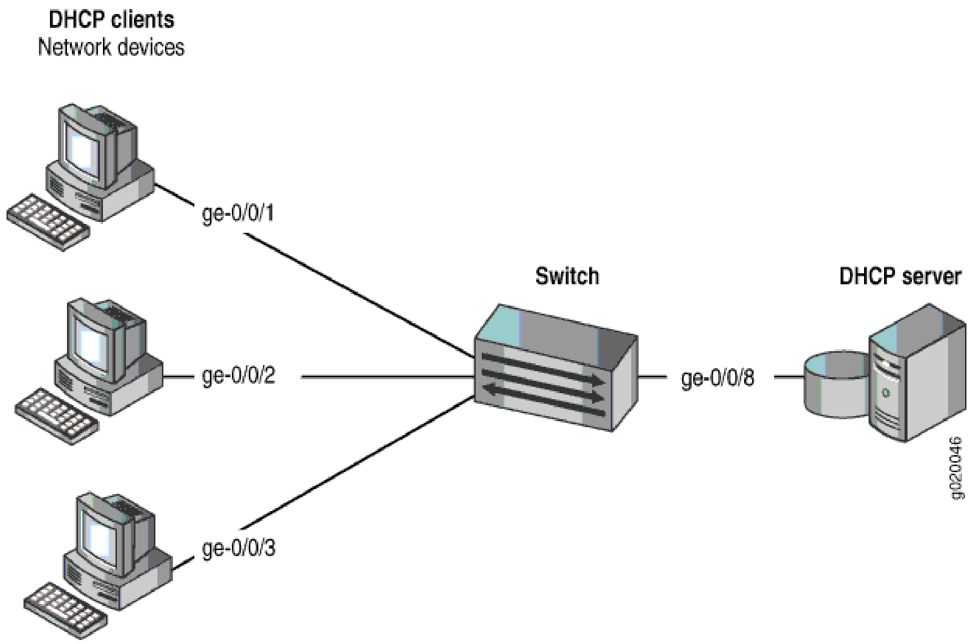
Ethernet LANs are vulnerable to address spoofing and DoS attacks on network devices. To protect the devices from such attacks, you can configure:

- DHCP snooping to validate DHCP server messages
- DAI to protect against MAC spoofing
- MAC limiting to constrain the number of MAC addresses the switch adds to its MAC address cache
- MAC move limiting to help prevent MAC spoofing
- Persistent MAC learning (sticky MAC) to constrain the MAC addresses that can be learned on an interface to the first ones learned, even after a reboot of the switch
- Trusted DHCP server configured on a trusted port to protect against rogue DHCP servers sending leases

This example shows how to configure these security features on a switch connected to a DHCP server.

The setup for this example includes the VLAN **employee-vlan** on the switch. Figure 161 on page 4490 illustrates the topology for this example.

Figure 161: Network Topology for Basic Port Security



The components of the topology for this example are shown in Table 352 on page 4490.

Table 352: Components of the Port Security Topology

Properties	Settings
Switch hardware	One EX Series switch or one QFX3500 switch
VLAN name and ID	**employee-vlan**, tag **20**
VLAN subnets	**192.0.2.16/28** **192.0.2.17** through **192.0.2.30** **192.0.2.31** is subnet's broadcast address
Interfaces in **employee-vlan**	**ge-0/0/1**, **ge-0/0/2**, **ge-0/0/3**, **ge-0/0/8**
Interface for DHCP server	**ge-0/0/8**

In this example, the switch is initially configured with the default port security setup. In the default switch configuration:

- Secure port access is activated on the switch.
- DHCP snooping and DAI are disabled on all VLANs.
- All access ports are untrusted, and all trunk ports are trusted for DHCP snooping.

In the configuration tasks for this example, you set the DHCP server as trusted; you enable DHCP snooping, DAI, and MAC move limiting on a VLAN; you set a value for a MAC limit on some interfaces; you configure some specific (allowed) MAC addresses on an interface; and you configure persistent MAC learning on an interface.

Configuration

To configure basic port security on a switch whose DHCP server and client ports are in a single VLAN:

CLI Quick Configuration

To quickly configure basic port security on the switch, copy the following commands and paste them into the switch terminal window:

```
[edit ethernet-switching-options secure-access-port]
set interface ge-0/0/1 mac-limit 4
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:80
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:81
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:83
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:85
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:88
set interface ge-0/0/2 mac-limit 4
set interface ge-0/0/1 persistent-learning
set interface ge-0/0/8 dhcp-trusted
set vlan employee-vlan arp-inspection
set vlan employee-vlan examine-dhcp
set vlan employee-vlan mac-move-limit 5
```

Step-by-Step Procedure

Configure basic port security on the switch:

1. Enable DHCP snooping on the VLAN:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee-vlan examine-dhcp
   ```
2. Specify the interface (port) from which DHCP responses are allowed:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set interface ge-0/0/8 dhcp-trusted
   ```
3. Enable dynamic ARP inspection (DAI) on the VLAN:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee-vlan arp-inspection
   ```
4. Configure a MAC limit of **4** and use the default action, **drop**. (Packets are dropped, and the MAC address is not added to the Ethernet switching table if the MAC limit is exceeded on the interfaces):

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set interface ge-0/0/1 mac-limit 4
   user@switch# set interface ge-0/0/2 mac-limit 4
   ```
5. Allow learned MAC addresses for a particular interface to persist across restarts of the switch and interface-down events by enabling persistent MAC learning:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set interface ge-0/0/1 persistent-learning
   ```
6. Configure a MAC move limit of **5** and use the default action, **drop**. (Packets are dropped, and the MAC address is not added to the Ethernet switching table if a MAC address has exceeded the MAC move limit):

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee-vlan mac-move-limit 5
   ```
7. Configure allowed MAC addresses:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:80
   user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:81
   user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:83
   ```



```
user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:85
user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:88
```

Results

Check the results of the configuration:

```
[edit ethernet-switching-options secure-access-port]
user@switch# show
interface ge-0/0/1.0 {
  mac-limit 4;
  persistent-learning;
}
interface ge-0/0/2.0 {
  allowed-mac [ 00:05:85:3a:82:80 00:05:85:3a:82:81 00:05:85:3a:82:83
    00:05:85:3a:82:85 00:05:85:3a:82:88 ];
  mac-limit 4;
}
interface ge-0/0/8.0 {
  dhcp-trusted;
}
vlan employee-vlan {
  arp-inspection
  examine-dhcp;
  mac-move-limit 5;
}
```

Verification

To confirm that the configuration is working properly:

- Verifying That DHCP Snooping Is Working Correctly on the Switch on page 4492
- Verifying That DAI Is Working Correctly on the Switch on page 4493
- Verifying That MAC Limiting, MAC Move Limiting, and Persistent MAC Learning Are Working Correctly on the Switch on page 4494
- Verifying That Allowed MAC Addresses Are Working Correctly on the Switch on page 4494

Verifying That DHCP Snooping Is Working Correctly on the Switch

Purpose Verify that DHCP snooping is working on the switch.

Action Send some DHCP requests from network devices (here they are DHCP clients) connected to the switch.

Display the DHCP snooping information when the interface on which the DHCP server connects to the switch is trusted. The following output results when requests are sent from the MAC addresses and the server has provided the IP addresses and leases:

```
user@switch> show dhcp snooping binding
DHCP Snooping Information:
MAC Address         IP Address    Lease    Type     VLAN          Interface
-----------------   ----------    -----    ----     ----          ---------
00:05:85:3A:82:77    192.0.2.17    600    dynamic  employee-vlan   ge-0/0/1.0
00:05:85:3A:82:79    192.0.2.18    653    dynamic  employee-vlan   ge-0/0/1.0
00:05:85:3A:82:80    192.0.2.19    720    dynamic  employee-vlan   ge-0/0/2.0
00:05:85:3A:82:81    192.0.2.20    932    dynamic  employee-vlan   ge-0/0/2.0
00:05:85:3A:82:83    192.0.2.21   1230    dynamic  employee-vlan   ge-0/0/2.0
00:05:85:27:32:88    192.0.2.22   3200    dynamic  employee-vlan   ge-0/0/2.0
```

Meaning When the interface on which the DHCP server connects to the switch has been set to trusted, the output (see preceding sample) shows, for each MAC address, the assigned IP address and lease time—that is, the time, in seconds, remaining before the lease expires.

If the DHCP server had been configured as untrusted, no entries would be added to the DHCP snooping database, and nothing would be shown in the output of the **show dhcp snooping binding** command.

Verifying That DAI Is Working Correctly on the Switch

Purpose Verify that DAI is working on the switch.

Action Send some ARP requests from network devices connected to the switch.

Display the DAI information:

```
user@switch> show arp inspection statistics
ARP inspection statistics:
Interface        Packets received  ARP inspection pass   ARP inspection failed
---------------  ---------------   -------------------- ---------------------
ge-0/0/1.0                      7                     5                     2
ge-0/0/2.0                     10                    10                     0
ge-0/0/3.0                     12                    12                     0
```

Meaning The sample output shows the number of ARP packets received and inspected per interface, with a listing of how many packets passed and how many failed the inspection on each interface. The switch compares the ARP requests and replies against the entries in the DHCP snooping database. If a MAC address or IP address in the ARP packet does not match a valid entry in the database, the packet is dropped.

Verifying That MAC Limiting, MAC Move Limiting, and Persistent MAC Learning Are Working Correctly on the Switch

Purpose Verify that MAC limiting, MAC move limiting, and persistent MAC learning are working on the switch.

Action Suppose that two packets have been sent from hosts on **ge-0/0/1** and five packets from hosts on **ge-0/0/2**, with both interfaces set to a MAC limit of **4** with the default action **drop** and **ge-0/0/1** enabled for persistent MAC learning.

Display the MAC addresses learned:

```
user@switch> show ethernet-switching table
Ethernet-switching table:  7 entries, 4 learned, 2 persistent entries
  VLAN                 MAC address         Type         Age    Interfaces

  employee-vlan        *                   Flood          -    All-members
  employee-vlan        00:05:85:3A:82:77   Persistent     0    ge-0/0/1.0
  employee-vlan        00:05:85:3A:82:79   Persistent     0    ge-0/0/1.0
  employee-vlan        00:05:85:3A:82:80   Learn          0    ge-0/0/2.0
  employee-vlan        00:05:85:3A:82:81   Learn          0    ge-0/0/2.0
  employee-vlan        00:05:85:3A:82:83   Learn          0    ge-0/0/2.0
  employee-vlan        00:05:85:3A:82:85   Learn          0    ge-0/0/2.0
```

Now suppose packets have been sent from two of the hosts on **ge-0/0/2** after they have been moved to other interfaces more than five times in 1 second, with **employee-vlan** set to a MAC move limit of **5** with the default action **drop**.

Display the MAC addresses in the table:

```
user@switch> show ethernet-switching table

Ethernet-switching table:  7 entries, 2 learned, 2 persistent entries
  VLAN                 MAC address         Type         Age    Interfaces

  employee-vlan        *                   Flood          -    All-members
  employee-vlan        00:05:85:3A:82:77   Persistent     0    ge-0/0/1.0
  employee-vlan        00:05:85:3A:82:79   Persistent     0    ge-0/0/1.0
  employee-vlan        00:05:85:3A:82:80   Learn          0    ge-0/0/2.0
  employee-vlan        00:05:85:3A:82:81   Learn          0    ge-0/0/2.0
  employee-vlan        *                   Flood          -    ge-0/0/2.0
  employee-vlan        *                   Flood          -    ge-0/0/2.0
```

Meaning The first sample output shows that with a MAC limit of **4** for each interface, the fifth MAC address on **ge-0/0/2** was not learned because it exceeded the MAC limit. The second sample output shows that MAC addresses for three of the hosts on **ge-/0/0/2** were not learned, because the hosts had been moved back more than five times in 1 second.

Interface ge-0/0/1.0 was enabled for persistent MAC learning, so the MAC addresses associated with this interface are of the type **persistent**.

Verifying That Allowed MAC Addresses Are Working Correctly on the Switch

Purpose Verify that allowed MAC addresses are working on the switch.

Action Display the MAC cache information after five allowed MAC addresses have been configured on interface **ge-0/0/2**:

```
user@switch> show ethernet-switching table
Ethernet-switching table:  5 entries, 4 learned
  VLAN                 MAC address        Type         Age    Interfaces

  employee-vlan        00:05:85:3A:82:80   Learn         0     ge-0/0/2.0
  employee-vlan        00:05:85:3A:82:81   Learn         0     ge-0/0/2.0
  employee-vlan        00:05:85:3A:82:83   Learn         0     ge-0/0/2.0
  employee-vlan        00:05:85:3A:82:85   Learn         0     ge-0/0/2.0
  employee-vlan        *                   Flood         -     ge-0/0/2.0
```

Meaning Because the MAC limit value for this interface has been set to **4**, only four of the five configured allowed addresses are learned.

Related Documentation

- Example: Configuring DHCP Snooping, DAI , and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch on page 4506
- Example: Configuring a DHCP Server Interface as Untrusted to Protect the Switch from Rogue DHCP Server Attacks on page 4503
- Example: Configuring Allowed MAC Addresses to Protect the Switch from DHCP Snooping Database Alteration Attacks on page 4518
- Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks on page 4513
- Example: Configuring MAC Limiting, Including Dynamic and Allowed MAC Addresses, to Protect the Switch from Ethernet Switching Table Overflow Attacks on page 4499
- *Example: Configuring MAC Limiting to Protect the Switch from DHCP Starvation Attacks*
- Configuring Port Security (CLI Procedure) on page 4543
- *Configuring Port Security (J-Web Procedure)*
- *secure-access-port*
- **secure-access-port on page 4622**
- **show arp inspection statistics on page 4688**
- **show dhcp snooping binding on page 4689**
- *show ethernet-switching table*
- **show ethernet-switching table on page 1700**

Example: Configuring MAC Limiting to Protect the Switch from DHCP Starvation Attacks

In a DHCP starvation attack, an attacker floods an Ethernet LAN with DHCP requests from spoofed (counterfeit) MAC addresses. The switch's trusted DHCP server or servers cannot keep up with the requests and can no longer assign IP addresses and lease times to legitimate DHCP clients on the switch. Requests from those clients are either dropped or directed to a rogue DHCP server set up by the attacker.

This example describes how to configure MAC limiting, a port security feature, to protect the switch against DHCP starvation attacks:

Requirements

This example uses the following hardware and software components:

- One QFX3500 switch
- Junos OS Release 12.1 or later for the QFX Series
- A DHCP server to provide IP addresses to network devices on the switch

Before you configure MAC limiting, a port security feature, to mitigate DHCP starvation attacks, be sure you have:

- Connected the DHCP server to the switch.
- Configured the VLAN **employee-vlan** on the switch. See “Example: Setting Up Bridging with Multiple VLANs” on page 1451.

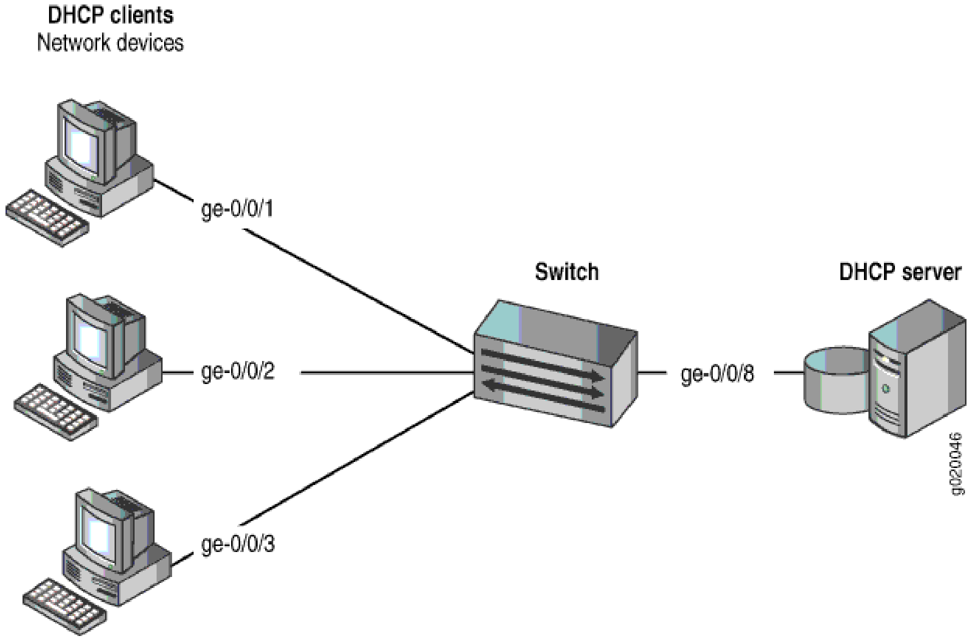
Overview and Topology

Ethernet LANs are vulnerable to address spoofing and DoS attacks on network devices. This example describes how to protect the switch against one common type of attack, a DHCP starvation attack.

This example shows how to configure port security features on a switch that is connected to a DHCP server.

The setup for this example includes the VLAN **employee-vlan** on the switch. Figure 162 on page 4497 illustrates the topology for this example.

Figure 162: Network Topology for Basic Port Security



The components of the topology for this example are shown in Table 353 on page 4497.

Table 353: Components of the Port Security Topology

Properties	Settings
Switch hardware	One QFX3500 switch
VLAN name and ID	**employee-vlan**
Interfaces in **employee-vlan**	**ge-0/0/1**, **ge-0/0/2**, **ge-0/0/3**, **ge-0/0/8**
Interface for DHCP server	**ge-0/0/8**

In this example, the switch has already been configured as follows:

- Secure port access is activated on the switch.
- No MAC limit is set on any of the interfaces.
- DHCP snooping is disabled on the VLAN **employee-vlan**.
- All access interfaces are untrusted, which is the default setting.

Configuration

To configure the MAC limiting port security feature to protect the switch against DHCP starvation attacks:

CLI Quick Configuration

To quickly configure MAC limiting, copy the following commands and paste them into the switch terminal window:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface ge-0/0/1 mac-limit 3 action drop
user@switch# set interface ge-0/0/2 mac-limit 3 action drop
```

Step-by-Step Procedure

Configure MAC limiting:

1. Configure a MAC limit of **3** on **ge-0/0/1** and specify that packets with new addresses be dropped if the limit has been exceeded on the interface:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set interface ge–0/0/1 mac-limit (Access Port Security) 3 action drop
   ```
2. Configure a MAC limit of **3** on **ge-0/0/2** and specify that packets with new addresses be dropped if the limit has been exceeded on the interface:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set interface ge-0/0/2 mac-limit 3 action drop
   ```

Results

Check the results of the configuration:

```
[edit ethernet-switching-options secure-access-port]
user@switch# show
interface ge-0/0/1.0 {
  mac-limit 3 action drop;
}
interface ge-0/0/2.0 {
  mac-limit 3 action drop;
}
```

Verification

Confirm that the configuration is working properly.

Verifying That MAC Limiting Is Working Correctly on the Switch

Purpose

Verify that MAC limiting is working on the switch.

Action Send some DHCP requests from network devices (here they are DHCP clients) connected to the switch.

Display the MAC addresses learned when DHCP requests are sent from hosts on **ge-0/0/1** and from hosts on **ge-0/0/2**, with both interfaces set to a MAC limit of **3** with the action **drop**:

```
user@switch>  show ethernet-switching table
Ethernet-switching table:  7 entries, 6 learned
  VLAN           MAC address         Type         Age    Interfaces

  default        *                   Flood          -    ge-0/0/2.0
  default        00:05:85:3A:82:77   Learn          0    ge-0/0/1.0
  default        00:05:85:3A:82:79   Learn          0    ge-0/0/1.0
  default        00:05:85:3A:82:80   Learn          0    ge-0/0/1.0
  default        00:05:85:3A:82:81   Learn          0    ge-0/0/2.0
  default        00:05:85:3A:82:83   Learn          0    ge-0/0/2.0
  default        00:05:85:3A:82:85   Learn          0    ge-0/0/2.0
```

Meaning The sample output shows that with a MAC limit of **3** for each interface, the DHCP request for a fourth MAC address on **ge-0/0/2** was dropped because it exceeded the MAC limit.

Because only 3 MAC addresses can be learned on each of the two interfaces, attempted DHCP starvation attacks fail.

Related Documentation

- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Configuring MAC Limiting on page 4545

Example: Configuring MAC Limiting, Including Dynamic and Allowed MAC Addresses, to Protect the Switch from Ethernet Switching Table Overflow Attacks

In an Ethernet switching table overflow attack, an intruder sends so many requests from new MAC addresses that the Ethernet switching table fills up and then overflows, forcing the switch to broadcast all messages.

This example describes how to configure MAC limiting and allowed MAC addresses, two port security features, to protect the switch from Ethernet switching table attacks:

Requirements

This example uses the following hardware and software components:

- One EX Series switch or QFX3500 switch

- Junos OS Release 9.0 or later for EX Series switches or Junos OS 12.1 or later for the QFX Series.
- A DHCP server to provide IP addresses to network devices on the switch

Before you configure specific port security features to mitigate common access-interface attacks, be sure you have:

- Connected the DHCP server to the switch.
- Configured a VLAN on the switch. See the task for your platform:

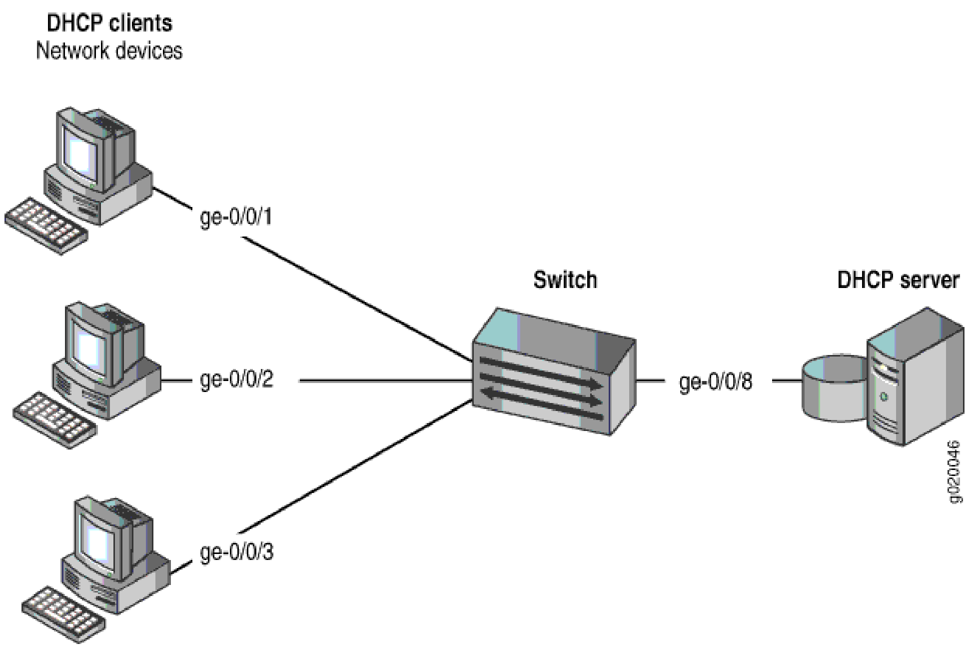
Overview and Topology

Ethernet LANs are vulnerable to address spoofing and DoS attacks on network devices. This example describes how to protect the switch from an attack on the Ethernet switching table that causes the table to overflow and thus forces the switch to broadcast all messages.

This example shows how to configure port security features on a switch connected to a DHCP server.

The setup for this example includes the VLAN **employee-vlan** on the switch. The procedure for creating that VLAN is described in the topic *Example: Setting Up Bridging with Multiple VLANs for EX Series Switches* and “Example: Setting Up Bridging with Multiple VLANs” on page 1451 for the QFX Series. That procedure is not repeated here. Figure 163 on page 4500 illustrates the topology for this example.

Figure 163: Network Topology for Basic Port Security



The components of the topology for this example are shown in Table 354 on page 4501.

Table 354: Components of the Port Security Topology

Properties	Settings
Switch hardware	One EX Series switch or one QFX3500 switch
VLAN name and ID	**employee-vlan**, tag **20**
VLAN subnets	**192.0.2.16/28** **192.0.2.17** through **192.0.2.30** **192.0.2.31** is subnet's broadcast address
Interfaces in **employee-vlan**	**ge-0/0/1**, **ge-0/0/2**, **ge-0/0/3**, **ge-0/0/8**
Interface for DHCP server	**ge-0/0/8**

In this example, use the MAC limit feature to control the total number of MAC addresses that can be added to the Ethernet switching table for the specified interface. Use the allowed MAC addresses feature to ensure that the addresses of network devices whose network access is critical are guaranteed to be included in the Ethernet switching table.

In this example, the switch has already been configured as follows:

- Secure port access is activated on the switch.
- No MAC limit is set on any of the interfaces.
- All access interfaces are untrusted, which is the default setting.

Configuration

To configure MAC limiting and some allowed MAC addresses to protect the switch against Ethernet switching table overflow attacks:

CLI Quick Configuration

To quickly configure MAC limiting, clear the MAC forwarding table, and configure some allowed MAC addresses, copy the following commands and paste them into the switch terminal window:

```
[edit ethernet-switching-options secure-access-port]
set interface ge-0/0/1 mac-limit 4 action drop
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:80
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:81
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:83
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:85
exit
exit
clear ethernet-switching-table interface ge-0/0/1
```

Step-by-Step Procedure

Configure MAC limiting and some allowed MAC addresses:

1. Configure a MAC limit of **4** on **ge-0/0/1** and specify that incoming packets with different addresses be dropped once the limit is exceeded on the interface:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set interface ge-0/0/1 mac-limit (Access Port Security) 4 action drop
   ```

2. Clear the current entries for interface ge-0/0/1 from the MAC address forwarding table :

   `user@switch#` **clear ethernet-switching-table interface ge-0/0/1**

3. Configure the allowed MAC addresses on **ge-0/0/2**:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:80
user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:81
user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:83
user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:85
```

Results Check the results of the configuration:

```
[edit ethernet-switching-options secure-access-port]
user@switch# show
interface ge-0/0/1.0 {
  mac-limit 4 action drop;
}
interface ge-0/0/2.0 {
  allowed-mac [ 00:05:85:3a:82:80 00:05:85:3a:82:81 00:05:85:3a:82:83 00:05:85
  :3a:82:85 ];
}
```

Verification

To confirm that the configuration is working properly:

- Verifying That MAC Limiting Is Working Correctly on the Switch on page 4502

Verifying That MAC Limiting Is Working Correctly on the Switch

Purpose Verify that MAC limiting is working on the switch.

Action Display the MAC cache information after DHCP requests have been sent from hosts on **ge-0/0/1**, with the interface set to a MAC limit of **4** with the action **drop**, and after four allowed MAC addresses have been configured on interface **ge/0/0/2**:

```
user@switch> show ethernet-switching table
Ethernet-switching table:  5 entries, 4 learned
  VLAN              MAC address       Type         Age    Interfaces

  employee-vlan     00:05:85:3A:82:71   Learn        0    ge-0/0/1.0
  employee-vlan     00:05:85:3A:82:74   Learn        0    ge-0/0/1.0
  employee-vlan     00:05:85:3A:82:77   Learn        0    ge-0/0/1.0
  employee-vlan     00:05:85:3A:82:79   Learn        0    ge-0/0/1.0
  employee-vlan     *                   Flood        0    ge-0/0/1.0
  employee-vlan     00:05:85:3A:82:80   Learn        0    ge-0/0/2.0
  employee-vlan     00:05:85:3A:82:81   Learn        0    ge-0/0/2.0
  employee-vlan     00:05:85:3A:82:83   Learn        0    ge-0/0/2.0
  employee-vlan     00:05:85:3A:82:85   Learn        0    ge-0/0/2.0
  employee-vlan     *                   Flood        -    ge-0/0/2.0
```

Meaning The sample output shows that with a MAC limit of **4** for the interface, the DHCP request for a fifth MAC address on **ge-0/0/1** was dropped because it exceeded the MAC limit and that only the specified allowed MAC addresses have been learned on the **ge-0/0/2** interface.

Related Documentation

- Example: Configuring Basic Port Security Features on page 4488
- Configuring MAC Limiting (CLI Procedure) on page 1527
- Configuring MAC Limiting on page 4545
- Configuring MAC Move Limiting (CLI Procedure) on page 4547
- *Configuring MAC Limiting (J-Web Procedure)*

Example: Configuring a DHCP Server Interface as Untrusted to Protect the Switch from Rogue DHCP Server Attacks

In a rogue DHCP server attack, an attacker has introduced a rogue server into the network, allowing it to give IP address leases to the network's DHCP clients and to assign itself as the gateway device.

This example describes how to configure a DHCP server interface as untrusted to protect the switch from a rogue DHCP server:

- Requirements on page 4503
- Overview and Topology on page 4504
- Configuration on page 4505
- Verification on page 4505

Requirements

This example uses the following hardware and software components:

- One EX Series switch or one QFX3500 switch
- Junos OS Release 9.0 or later for EX Series switches or Junos OS Release 12.1 or later for the QFX Series
- A DHCP server to provide IP addresses to network devices on the switch

Before you configure an untrusted DHCP server interface to mitigate rogue DHCP server attacks, be sure you have:

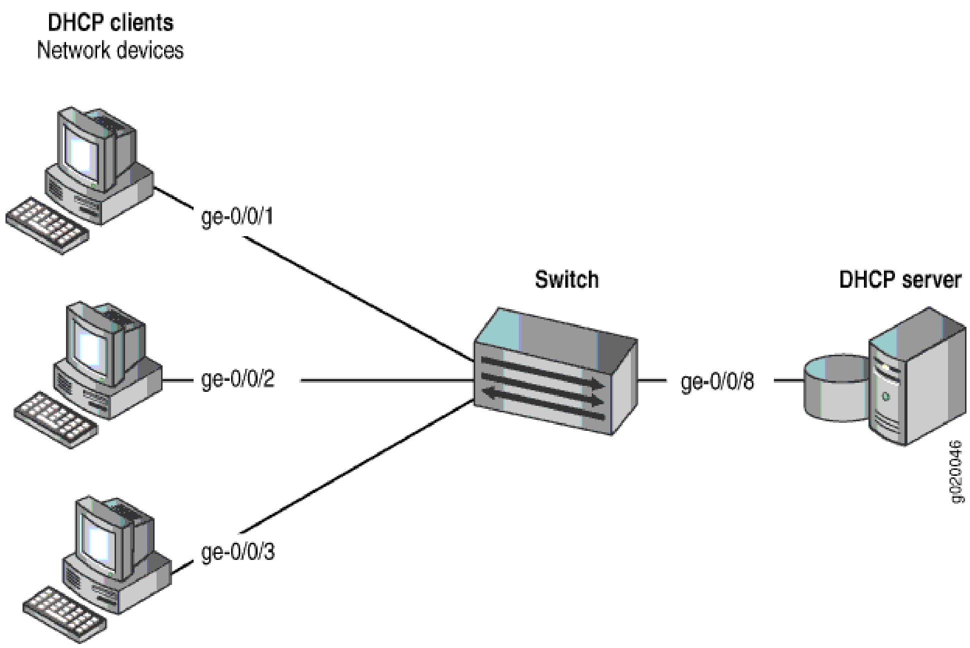
- Connected the DHCP server to the switch.
- Enabled DHCP snooping on the VLAN.
- Configured a VLAN on the switch. See the task for your platform:
  - *Example: Setting Up Bridging with Multiple VLANs for EX Series Switches*
  - “Example: Setting Up Bridging with Multiple VLANs” on page 1451 for the QFX Series

Overview and Topology

Ethernet LANs are vulnerable to address spoofing and DoS attacks on network devices. This example describes how to protect the switch from rogue DHCP server attacks.

This example shows how to explicitly configure an untrusted interface on an EX3200-24P switch and a QFX3500 switch. Figure 164 on page 4504 illustrates the topology for this example.

Figure 164: Network Topology for Basic Port Security



The components of the topology for this example are shown in Table 355 on page 4504.

Table 355: Components of the Port Security Topology

Properties	Settings
Switch hardware	One EX3200-24P, 24 ports (8 PoE ports) or one QFX3500 switch
VLAN name and ID	**employee-vlan**, tag **20**
VLAN subnets	**192.0.2.16/28** **192.0.2.17** through **192.0.2.30** **192.0.2.31** is the subnet's broadcast address
Interfaces in **employee-vlan**	**ge-0/0/1**, **ge-0/0/2**, **ge-0/0/3**, **ge-0/0/8**
Interface for DHCP server	**ge-0/0/8**

In this example, the switch has already been configured as follows:

- Secure port access is activated on the switch.

- DHCP snooping is enabled on the VLAN **employee-vlan**.
- The interface (port) where the rogue DHCP server has connected to the switch is currently trusted.

Configuration

To configure the DHCP server interface as untrusted because the interface is being used by a rogue DHCP server:

CLI Quick Configuration

To quickly set the rogue DHCP server interface as untrusted, copy the following command and paste it into the switch terminal window:

```
[edit ethernet-switching-options secure-access-port]
set interface ge-0/0/8 no-dhcp-trusted
```

Step-by-Step Procedure

To set the DHCP server interface as untrusted:

- Specify the interface (port) from which DHCP responses are not allowed:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface ge-0/0/8 no-dhcp-trusted
```

Results

Check the results of the configuration:

```
[edit ethernet-switching-options secure-access-port]
user@switch# show
interface ge-0/0/8.0 {
  no-dhcp-trusted;
}
```

Verification

Confirm that the configuration is working properly.

Verifying That the DHCP Server Interface Is Untrusted

Purpose

Verify that the DHCP server is untrusted.

Action

1. Send some DHCP requests from network devices (here they are DHCP clients) connected to the switch.
2. Display the DHCP snooping information when the port on which the DHCP server connects to the switch is not trusted.

Meaning

There is no output from the command because no entries are added to the DHCP snooping database.

Related Documentation

- Example: Configuring Basic Port Security Features on page 4488
- Enabling a Trusted DHCP Server (CLI Procedure) on page 4555
- *Enabling a Trusted DHCP Server (J-Web Procedure)*
- *secure-access-port*

- secure-access-port on page 4622
- show dhcp snooping binding on page 4689

Example: Configuring DHCP Snooping, DAI , and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch

You can configure DHCP snooping, dynamic ARP inspection (DAI), and MAC limiting on the access interfaces of switches to protect the switch and the Ethernet LAN against address spoofing and Layer 2 denial-of-service (DoS) attacks. To obtain those basic settings, you can use the switch's default configuration for port security, configure the MAC limit, and enable DHCP snooping and DAI on a VLAN. You can configure those features when the DHCP server is connected to a different switch from the one to which the DHCP clients (network devices) are connected.

This example describes how to configure port security features on a switch whose hosts obtain IP addresses and lease times from a DHCP server connected to a second switch:

Requirements

This example uses the following hardware and software components:

- One EX Series switch or QFX3500 switch—“Switch 1” in this example.
- An additional EX Series switch or QFX3500 switch—”Switch 2” in this example. You do not configure port security on this second switch.
- Junos OS Release 9.0 or later for EX Series switches or Junos OS Release 12.1 or later for the QFX Series.
- A DHCP server connected to Switch 2. You use the server to provide IP addresses to network devices connected to Switch 1.
- At least two network devices (hosts) that you connect to access interfaces on Switch 1. These devices are DHCP clients.

Before you configure DHCP snooping, DAI, and MAC limiting port security features, be sure you have:

- Connected the DHCP server to Switch 2.
- Configured a VLAN on the switch. See the task for your platform:
  - *Example: Setting Up Bridging with Multiple VLANs for EX Series Switches*
  - “Example: Setting Up Bridging with Multiple VLANs” on page 1451 for the QFX Series

Overview and Topology

Ethernet LANs are vulnerable to address spoofing and DoS attacks on network devices. To protect the devices from such attacks, you can configure:

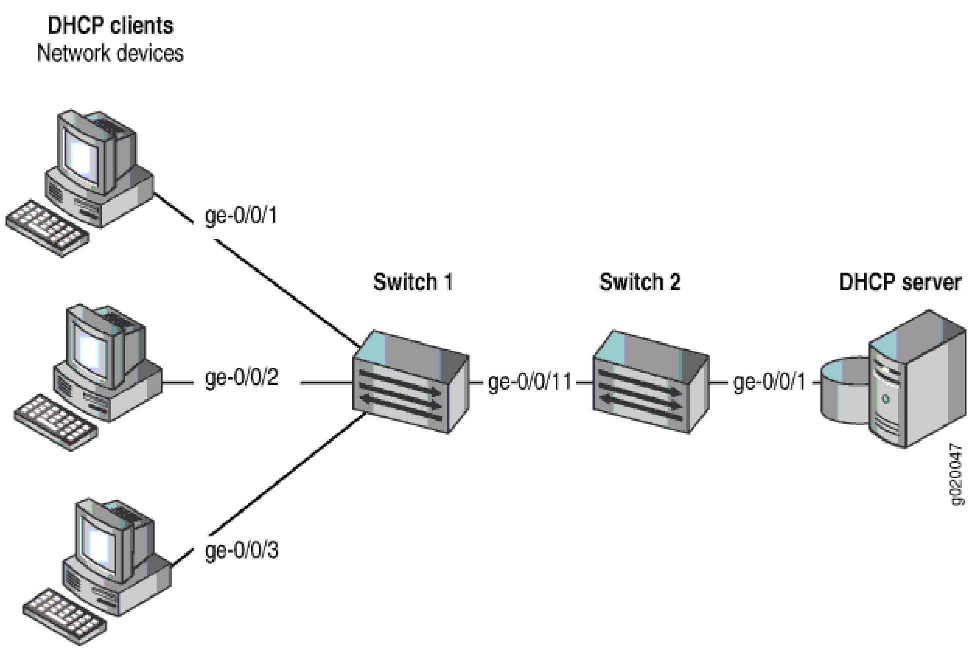
- DHCP snooping to validate DHCP server messages
- DAI to protect against ARP spoofing
- MAC limiting to constrain the number of MAC addresses the switch adds to its MAC address cache

This example shows how to configure these port security features on Switch 1. Switch 1 is connected to another switch (Switch 2) that is not configured with port security features. That second switch is connected to a DHCP server. (See Figure 165 on page 4507.) Network devices (hosts) that are connected to Switch 1 send requests for IP addresses (that is, the devices are DHCP clients). Those requests are transmitted from Switch 1 to Switch 2 and then to the DHCP server connected to Switch 2. Responses to the requests are transmitted along the reverse path of the one followed by the requests.

The setup for this example includes the VLAN **employee-vlan** on both switches.

Figure 165 on page 4507 shows the network topology for the example.

Figure 165: Network Topology for Port Security Setup with Two Switches on the Same VLAN



The components of the topology for this example are shown in Table 356 on page 4508.

Table 356: Components of Port Security Setup on Switch 1 with a DHCP Server Connected to Switch 2

Properties	Settings
Switch hardware	One EX Series switch or one QFX3500 switch (Switch 1), and an additional EX Series switch or QFX3500 switch (Switch 2)
VLAN name and ID	**employee-vlan**, tag **20**
VLAN subnets	**192.0.2.16/28** **192.0.2.17** through **192.0.2.30** **192.0.2.31** is subnet's broadcast address
Trunk interface on both switches	**ge-0/0/11**
Access interfaces on Switch 1	**ge-0/0/1**, **ge-0/0/2**, and **ge-0/0/3**
Access interface on Switch 2	**ge-0/0/1**
Interface for DHCP server	**ge-0/0/1** on Switch 2

Switch 1 is initially configured with the default port security setup. In the default configuration on the switch:

- Secure port access is activated on the switch.
- The switch does not drop any packets, which is the default setting.
- DHCP snooping and dynamic ARP inspection (DAI) are disabled on all VLANs.
- All access interfaces are untrusted and trunk interfaces are trusted; these are the default settings.

In the configuration tasks for this example, you configure a VLAN on both switches.

In addition to configuring the VLAN, you enable DHCP snooping on Switch 1. In this example, you also enable DAI and a MAC limit of **5** on Switch 1.

Because the interface that connects Switch 2 to Switch 1 is a trunk interface, you do not have to configure this interface to be trusted. As noted above, trunk interfaces are automatically trusted, so DHCP messages coming from the DHCP server to Switch 2 and then on to Switch 1 are trusted.

Configuring a VLAN, Interfaces, and Port Security Features on Switch 1

CLI Quick Configuration

To quickly configure a VLAN, interfaces, and port security features, copy the following commands and paste them into the switch terminal window:

```
[edit]
set ethernet-switching-options secure-access-port interface ge-0/0/1 mac-limit 5 action drop
clear ethernet-switching table interface ge-0/0/1
set ethernet-switching-options secure-access-port vlan employee-vlan arp-inspection
set ethernet-switching-options secure-access-port vlan employee-vlan examine-dhcp
set interfaces ge-0/0/1 unit 0 family ethernet-switching vlan members 20
set interfaces ge-0/0/2 unit 0 family ethernet-switching vlan members 20
```

set interfaces ge-0/0/3 unit 0 family ethernet-switching vlan members 20
set interfaces ge-0/0/11 unit 0 family ethernet-switching port-mode trunk
set interfaces ge-0/0/11 unit 0 family ethernet-switching vlan members 20
set vlans employee-vlan vlan-id 20

Step-by-Step Procedure

To configure MAC limiting, a VLAN, and interfaces on Switch 1 and enable DAI and DHCP on the VLAN:

1. Configure the VLAN **employee-vlan** with VLAN ID **20**:

   ```
   [edit vlans]
   user@switch1# set employee-vlan vlan-id 20
   ```
2. Configure an interface on Switch 1 as a trunk interface:

   ```
   [edit interfaces]
   user@switch1# set ge-0/0/11 unit 0 family ethernet-switching port-mode trunk
   ```
3. Associate the VLAN with interfaces **ge-0/0/1**, **ge-0/0/2**, **ge-0/0/3**, and **ge-0/0/11**:

   ```
   [edit interfaces]
   user@switch1# set ge-0/0/1 unit 0 family ethernet-switching vlan members 20
   user@switch1# set ge-0/0/2 unit 0 family ethernet-switching vlan members 20
   user@switch1# set ge-0/0/3 unit 0 family ethernet-switching vlan members 20
   user@switch1# set ge-0/0/11 unit 0 family ethernet-switching vlan members 20
   ```
4. Enable DHCP snooping on the VLAN:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch1# set vlan employee-vlan examine-dhcp
   ```
5. Enable DAI on the VLAN:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch1# set vlan employee-vlan arp-inspection
   ```
6. Configure a MAC limit of **5** on **ge-0/0/1** and use the default action, drop (packets with new addresses are dropped if the limit has been exceeded):

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch1# set interface ge-0/0/1 mac-limit 5 drop
   ```
7. Clear the existing MAC address table entries from interface ge-0/0/1:

   ```
   user@switch1# clear ethernet-switching table interface ge-0/0/1
   ```

Results

Display the results of the configuration:

```
[edit]
user@switch1# show
ethernet-switching-options {
   secure-access-port {
      interface ge-0/0/1.0{
         mac-limit 5 action drop;
      }
      vlan employee-vlan {
         arp-inspection;
         examine-dhcp;
      }
   }
}
interfaces {
   ge-0/0/1 {
      unit 0 {
         family ethernet-switching {
            vlan {
```

```
                members 20;
              }
            }
          }
        }
        ge-0/0/2 {
          unit 0 {
            family ethernet-switching {
              vlan {
                members 20;
              }
            }
          }
        }
        ge-0/0/3 {
          unit 0 {
            family ethernet-switching {
              vlan {
                members 20;
              }
            }
          }
        }
        ge-0/0/11 {
          unit 0 {
            family ethernet-switching {
              port-mode trunk;
              vlan {
                members 20;
              }
            }
          }
        }
      }
      vlans {
        employee-vlan {
          vlan-id 20;
        }
      }
```

Configuring a VLAN and Interfaces on Switch 2

To configure the VLAN and interfaces on Switch 2:

CLI Quick Configuration

To quickly configure the VLAN and interfaces on Switch 2, copy the following commands and paste them into the switch terminal window:

```
[edit]
set interfaces ge-0/0/1 unit 0 family ethernet-switching port-mode trunk
set interfaces ge-0/0/11 unit 0 family ethernet-switching port-mode trunk
set vlans employee-vlan vlan-id 20
```

Step-by-Step Procedure

To configure the VLAN and interfaces on Switch 2:

1. Configure an interface on Switch 2 as a trunk interface:

   ```
   [edit interfaces]
   ```

```
user@switch2# set ge-0/0/11 unit 0 ethernet-switching port-mode trunk
```

2. Associate the VLAN with interfaces **ge-0/0/1** and **ge-0/0/11**:

```
[edit interfaces]
user@switch2# set ge-0/0/1 unit 0 family ethernet-switching vlan members 20
user@switch2# set ge-0/0/11 unit 0 family ethernet-switching vlan members 20
```

Results Display the results of the configuration:

```
[edit]
user@switch2# show
interfaces {
  ge-0/0/1 {
    unit 0 {
      family ethernet-switching {
        vlan {
          members 20;
        }
      }
    }
  }
  ge-0/0/11 {
    unit 0 {
      family ethernet-switching {
        port-mode trunk;
        vlan {
          members 20;
        }
      }
    }
  }
}
vlans {
  employee-vlan {
    vlan-id 20;
  }
}
```

Verification

To confirm that the configuration is working properly.

- Verifying That DHCP Snooping Is Working Correctly on Switch 1 on page 4511
- Verifying That DAI Is Working Correctly on Switch 1 on page 4512
- Verifying That MAC Limiting Is Working Correctly on Switch 1 on page 4512

Verifying That DHCP Snooping Is Working Correctly on Switch 1

Purpose Verify that DHCP snooping is working on Switch 1.

Action Send some DHCP requests from network devices (here they are DHCP clients) connected to the switch.

Display the DHCP snooping information when the interface through which Switch 2 sends the DHCP server replies to clients connected to Switch 1 is trusted. The server has provided the IP addresses and leases:

```
user@switch1> show dhcp snooping binding
DHCP Snooping Information:
MAC Address        IP Address    Lease    Type     VLAN          Interface
-----------------  ----------    -----    ----     ----          ---------
00:05:85:3A:82:77   192.0.2.17    600    dynamic  employee—vlan   ge-0/0/1.0
00:05:85:3A:82:79   192.0.2.18    653    dynamic  employee—vlan   ge-0/0/1.0
00:05:85:3A:82:80   192.0.2.19    720    dynamic  employee—vlan   ge-0/0/1.0
00:05:85:3A:82:81   192.0.2.20    932    dynamic  employee—vlan   ge-0/0/1.0
00:05:85:3A:82:83   192.0.2.21   1230    dynamic  employee—vlan   ge-0/0/1.0
00:05:85:3A:82:90   192.0.2.20    932    dynamic  employee—vlan   ge-0/0/2.0
00:05:85:3A:82:91   192.0.2.21   1230    dynamic  employee—vlan   ge-0/0/3.0
```

Meaning The output shows, for each MAC address, the assigned IP address and lease time—that is, the time, in seconds, remaining before the lease expires.

Verifying That DAI Is Working Correctly on Switch 1

Purpose Verify that DAI is working on Switch 1.

Action Send some ARP requests from network devices connected to the switch.

Display the DAI information:

```
user@switch1> show arp inspection statistics
ARP inspection statistics:
Interface    Packets received  ARP inspection pass  ARP inspection failed
----------   ---------------–  -------------------  ---------------------
ge-0/0/1.0                  7                    5                      2
ge-0/0/2.0                 10                   10                      0
ge-0/0/3.0                 18                   15                      3
```

Meaning The sample output shows the number of ARP packets received and inspected per interface, with a listing of how many packets passed and how many failed the inspection on each interface. The switch compares the ARP requests and replies against the entries in the DHCP snooping database. If a MAC address or IP address in the ARP packet does not match a valid entry in the database, the packet is dropped.

Verifying That MAC Limiting Is Working Correctly on Switch 1

Purpose Verify that MAC limiting is working on Switch 1.

Action Display the MAC addresses that are learned when DHCP requests are sent from hosts on **ge-0/0/1**:

```
user@switch1> show ethernet-switching table

Ethernet-switching table:  6 entries, 5 learned
  VLAN              MAC address       Type         Age    Interfaces

  employee-vlan     00:05:85:3A:82:77   Learn          0    ge-0/0/1.0
  employee-vlan     00:05:85:3A:82:79   Learn          0    ge-0/0/1.0
  employee-vlan     00:05:85:3A:82:80   Learn          0    ge-0/0/1.0
  employee-vlan     00:05:85:3A:82:81   Learn          0    ge-0/0/1.0
  employee-vlan     00:05:85:3A:82:83   Learn          0    ge-0/0/1.0
  employee-vlan     *                   Flood          -    ge-0/0/1.0
```

Meaning The sample output shows that five MAC addresses have been learned for interface **ge-0/0/1**, which corresponds to the MAC limit of **5** set in the configuration. The last line of the output shows that a sixth MAC address request was dropped, as indicated by the asterisk (*) in the **MAC address** column.

Related Documentation

- Example: Configuring Basic Port Security Features on page 4488
- Configuring Port Security (CLI Procedure) on page 4543
- *Configuring Port Security (J-Web Procedure)*
- *secure-access-port*
- **secure-access-port on page 4622**
- **show arp inspection statistics on page 4688**
- **show dhcp snooping binding on page 4689**
- *show ethernet-switching table*
- **show ethernet-switching table on page 1700**

Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks

In an ARP spoofing attack, the attacker associates its own MAC address with the IP address of a network device connected to the switch. Traffic intended for that IP address is now sent to the attacker instead of being sent to the intended destination. The attacker can send faked, or "spoofed," ARP messages on the LAN.

NOTE: When dynamic ARP inspection (DAI) is enabled, the switch logs the number of invalid ARP packets that it receives on each interface, along with the sender's IP and MAC addresses. You can use these log messages to discover ARP spoofing on the network. ARP probe packets are not subjected to dynamic ARP inspection. The switch always forwards such packets.

This example describes how to configure DHCP snooping and dynamic ARP inspection (DAI), two port security features, to protect the switch against ARP spoofing attacks:

- Requirements on page 4514
- Overview and Topology on page 4514
- Configuration on page 4515
- Verification on page 4516

Requirements

This example uses the following hardware and software components:

- One EX Series switch or one QFX3500 switch
- Junos OS Release 11.4 or later for EX Series switches or Junos OS Release 12.1 or later for the QFX Series
- A DHCP server to provide IP addresses to network devices on the switch

Before you configure DHCP snooping and DAI (two port security features) to mitigate ARP spoofing attacks, be sure you have:

- Connected the DHCP server to the switch.
- Configured a VLAN on the switch. See the task for your platform:
  - *Example: Setting Up Bridging with Multiple VLANs for EX Series Switches*
  - "Example: Setting Up Bridging with Multiple VLANs" on page 1451 for the QFX Series

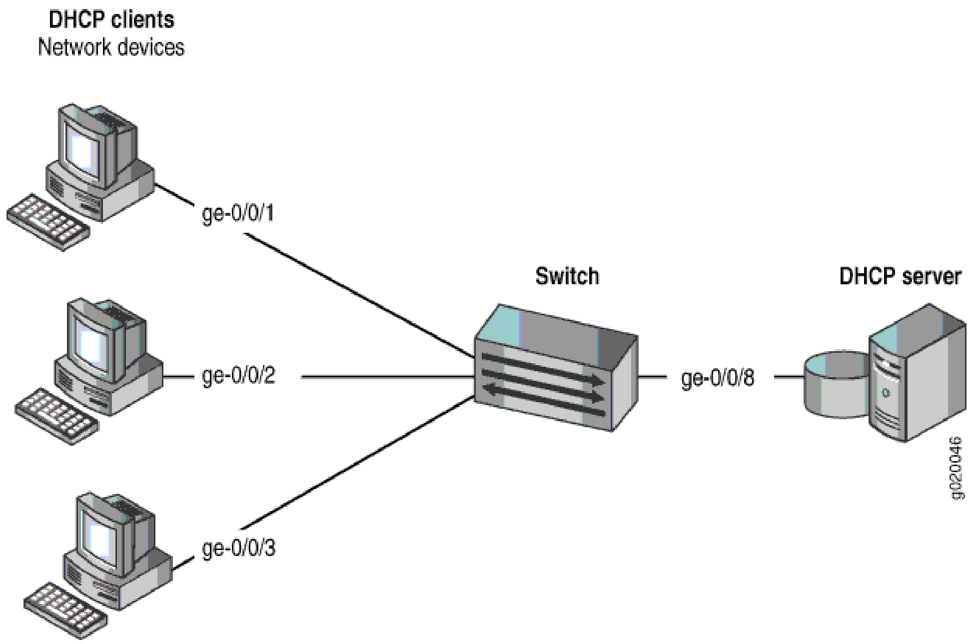
Overview and Topology

Ethernet LANs are vulnerable to address spoofing and DoS attacks on network devices. This example describes how to protect the switch against one common type of attack, an ARP spoofing attack.

In an ARP spoofing attack, the attacker sends faked ARP messages, thus creating various types of problems on the LAN—for example, the attacker might launch a man-in-the middle attack.

This example shows how to configure port security features on a switch that is connected to a DHCP server. The setup for this example includes the VLAN **employee-vlan** on the switch. The procedure for creating that VLAN is described in the topic *Example: Setting Up Bridging with Multiple VLANs for EX Series Switches* and "Example: Setting Up Bridging with Multiple VLANs" on page 1451 for the QFX Series. That procedure is not repeated here. Figure 166 on page 4515 illustrates the topology for this example.

Figure 166: Network Topology for Basic Port Security



The components of the topology for this example are shown in Table 357 on page 4515.

Table 357: Components of the Port Security Topology

Properties	Settings
Switch hardware	One EX3200-24P, 24 ports (8 PoE ports) or one QFX3500 switch
VLAN name and ID	**employee-vlan**, tag **20**
VLAN subnets	**192.0.2.16/28** **192.0.2.17** through **192.0.2.30** **192.0.2.31** is the subnet's broadcast address
Interfaces in **employee-vlan**	**ge-0/0/1**,**ge-0/0/2**, **ge-0/0/3**, **ge-0/0/8**
Interface for DHCP server	**ge-0/0/8**

In this example, the switch has already been configured as follows:

- Secure port access is activated on the switch.
- DHCP snooping is disabled on the VLAN **employee-vlan**.
- All access ports are untrusted, which is the default setting.

Configuration

To configure DHCP snooping and dynamic ARP inspection (DAI) to protect the switch against ARP attacks:

CLI Quick Configuration

To quickly configure DHCP snooping and dynamic ARP inspection (DAI), copy the following commands and paste them into the switch terminal window:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface ge-0/0/8 dhcp-trusted
user@switch# set vlan employee-vlan examine-dhcp
user@switch# set vlan employee-vlan arp-inspection
```

Step-by-Step Procedure

Configure DHCP snooping and dynamic ARP inspection (DAI) on the VLAN:

1. Set the **ge-0/0/8** interface as trusted:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set interface ge-0/0/8 dhcp-trusted
   ```
2. Enable DHCP snooping on the VLAN:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee-vlan examine-dhcp
   ```
3. Enable DAI on the VLAN:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee-vlan arp-inspection
   ```

Results

Check the results of the configuration:

```
[edit ethernet-switching-options secure-access-port]
user@switch# show
interface ge-0/0/8.0 {
  dhcp-trusted;
}
vlan employee-vlan {
  arp-inspection;
  examine-dhcp;
}
```

Verification

Confirm that the configuration is working properly.

- Verifying That DHCP Snooping Is Working Correctly on the Switch on page 4516
- Verifying That DAI Is Working Correctly on the Switch on page 4517

Verifying That DHCP Snooping Is Working Correctly on the Switch

Purpose

Verify that DHCP snooping is working on the switch.

Action Send some DHCP requests from network devices (here they are DHCP clients) connected to the switch.

Display the DHCP snooping information when the port on which the DHCP server connects to the switch is trusted. The following output results when requests are sent from the MAC addresses and the server has provided the IP addresses and leases:

```
user@switch> show dhcp-snooping binding
DHCP Snooping Information:
MAC Address        IP Address    Lease    Type     VLAN            Interface
-----------------  ----------    -----    ----     ----            ---------
00:05:85:3A:82:77   192.0.2.17    600    dynamic  employee-vlan   ge-0/0/1.0
00:05:85:3A:82:79   192.0.2.18    653    dynamic  employee-vlan   ge-0/0/1.0
00:05:85:3A:82:80   192.0.2.19    720    dynamic  employee-vlan   ge-0/0/2.0
00:05:85:3A:82:81   192.0.2.20    932    dynamic  employee-vlan   ge-0/0/2.0
00:05:85:3A:82:83   192.0.2.21   1230    dynamic  employee-vlan   ge-0/0/2.0
00:05:85:27:32:88   192.0.2.22   3200    dynamic  employee-vlan   ge-0/0/3.0
```

Meaning When the interface on which the DHCP server connects to the switch has been set to trusted, the output (see preceding sample) shows, for each MAC address, the assigned IP address and lease time—that is, the time, in seconds, remaining before the lease expires.

Verifying That DAI Is Working Correctly on the Switch

Purpose Verify that DAI is working on the switch.

Action Send some ARP requests from network devices connected to the switch.

Display the DAI information:

```
user@switch> show arp inspection statistics
ARP inspection statistics:
Interface        Packets received  ARP inspection pass   ARP inspection failed
---------------  ---------------   --------------------  ---------------------
ge-0/0/1.0                      7                     5                      2
ge-0/0/2.0                     10                    10                      0
ge-0/0/3.0                     12                    12                      0
```

Meaning The sample output shows the number of ARP packets received and inspected per interface, with a listing of how many packets passed and how many failed the inspection on each interface. The switch compares the ARP requests and replies against the entries in the DHCP snooping database. If a MAC address or IP address in the ARP packet does not match a valid entry in the database, the packet is dropped.

Related Documentation

- Example: Configuring Basic Port Security Features on page 4488
- Enabling DHCP Snooping (CLI Procedure) on page 4551
- *Enabling DHCP Snooping (J-Web Procedure)*
- Enabling Dynamic ARP Inspection (CLI Procedure) on page 4553

- *Enabling Dynamic ARP Inspection (J-Web Procedure)*
- *secure-access-port*
- secure-access-port on page 4622
- show arp inspection statistics on page 4688
- show dhcp snooping binding on page 4689

Example: Configuring Allowed MAC Addresses to Protect the Switch from DHCP Snooping Database Alteration Attacks

In one type of attack on the DHCP snooping database, an intruder introduces a DHCP client on an untrusted access interface with a MAC address identical to that of a client on another untrusted interface. The intruder then acquires the DHCP lease of that other client, thus changing the entries in the DHCP snooping table. Subsequently, what would have been valid ARP requests from the legitimate client are blocked.

This example describes how to configure allowed MAC addresses, a port security feature, to protect the switch from DHCP snooping database alteration attacks:

Requirements

This example uses the following hardware and software components:

- One EX Series switch or one QFX3500 switch
- Junos OS Release 11.4 or later for EX Series switches or Junos OS Release 12.1 or later for the QFX Series
- A DHCP server to provide IP addresses to network devices on the switch

Before you configure specific port security features to mitigate common access-inteface attacks, be sure you have:

- Connected the DHCP server to the switch.
- Configured a VLAN on the switch. See the task for your platform:
  - *Example: Setting Up Bridging with Multiple VLANs for EX Series Switches*
  - "Example: Setting Up Bridging with Multiple VLANs" on page 1451 for the QFX Series

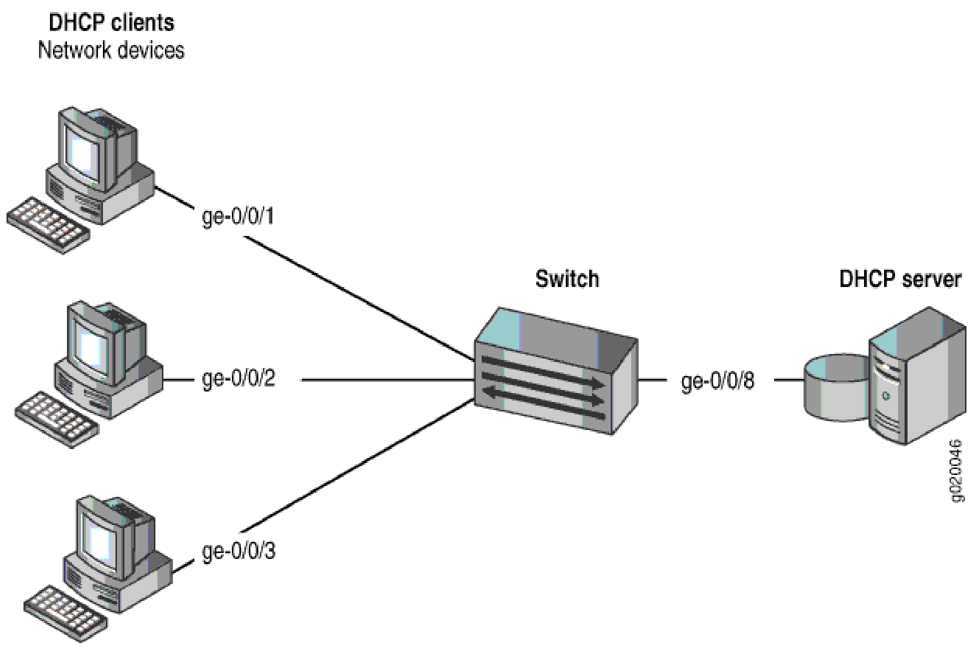
Overview and Topology

Ethernet LANs are vulnerable to address spoofing and DoS attacks on network devices. This example describes how to protect the switch from an attack on the DHCP snooping database that alters the MAC addresses assigned to some clients.

This example shows how to configure port security features on a switch that is connected to a DHCP server.

The setup for this example includes the VLAN **employee-vlan** on the switch. Figure 167 on page 4519 illustrates the topology for this example.

Figure 167: Network Topology for Basic Port Security



The components of the topology for this example are shown in Table 358 on page 4519.

Table 358: Components of the Port Security Topology

Properties	Settings
Switch hardware	One EX3200-24P, 24 ports (8 PoE ports) or one QFX3500 switch
VLAN name and ID	**employee-vlan**, tag **20**
VLAN subnets	**192.0.2.16/28** **192.0.2.17** through **192.0.2.30** **192.0.2.31** is the subnet's broadcast address
Interfaces in **employee-vlan**	**ge-0/0/1**, **ge-0/0/2**, **ge-0/0/3**, **ge-0/0/8**
Interface for DHCP server	**ge-0/0/8**

In this example, the switch has already been configured as follows:

- Secure port access is activated on the switch.
- DHCP snooping is enabled on the VLAN **employee-vlan**.
- All access ports are untrusted, which is the default setting.

Configuration

To configure allowed MAC addresses to protect the switch against DHCP snooping database alteration attacks:

CLI Quick Configuration

To quickly configure some allowed MAC addresses on an interface, copy the following commands and paste them into the switch terminal window:

```
[edit ethernet-switching-options secure-access-port]
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:80
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:81
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:83
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:85
set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:88
```

Step-by-Step Procedure

To configure some allowed MAC addresses on an interface:

Configure the five allowed MAC addresses on an interface:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:80
user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:81
user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:83
user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:85
user@switch# set interface ge-0/0/2 allowed-mac 00:05:85:3A:82:88
```

Results

Check the results of the configuration:

```
[edit ethernet-switching-options secure-access-port]
user@switch# show
interface ge-0/0/2.0 {
  allowed-mac [ 00:05:85:3a:82:80 00:05:85:3a:82:81 00:05:85:3a:82:83 00:05:85
  :3a:82:85 00:05:85:3a:82:88 ];
}
```

Verification

Confirm that the configuration is working properly.

- Verifying That Allowed MAC Addresses Are Working Correctly on the Switch on page 4520

Verifying That Allowed MAC Addresses Are Working Correctly on the Switch

Purpose

Verify that allowed MAC addresses are working on the switch.

Action Display the MAC cache information:

```
user@switch> show ethernet-switching table
Ethernet-switching table:  6 entries, 5 learned
  VLAN                 MAC address        Type         Age    Interfaces

  employee-vlan        00:05:85:3A:82:80  Learn          0    ge-0/0/2.0
  employee-vlan        00:05:85:3A:82:81  Learn          0    ge-0/0/2.0
  employee-vlan        00:05:85:3A:82:83  Learn          0    ge-0/0/2.0
  employee-vlan        00:05:85:3A:82:85  Learn          0    ge-0/0/2.0
  employee-vlan        00:05:85:3A:82:88  Learn          0    ge-0/0/2.0
  employee-vlan        *                  Flood          -    ge-0/0/2.0
```

Meaning The output shows that the five MAC addresses configured as allowed MAC addresses have been learned and are displayed in the MAC cache. The last MAC address in the list, one that had not been configured as allowed, has not been added to the list of learned addresses.

Related Documentation

- Example: Configuring Basic Port Security Features on page 4488
- Configuring MAC Limiting (CLI Procedure) on page 1527
- *Configuring MAC Limiting (J-Web Procedure)*
- *secure-access-port*
- **secure-access-port on page 4622**
- *show ethernet-switching table*
- **show ethernet-switching table on page 1700**

Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server

You can use DHCP option 82, also known as the DHCP relay agent information option, to help protect the switch against attacks such as spoofing (forging) of IP addresses and MAC addresses, and DHCP IP address starvation. Option 82 provides information about the network location of a DHCP client, and the DHCP server uses this information to implement IP addresses or other parameters for the client.

This example describes how to configure DHCP option 82 on a switch with DHCP clients, DHCP server, and switch all on the same VLAN:

- Requirements on page 4521
- Overview and Topology on page 4522
- Configuration on page 4523

Requirements

This example uses the following hardware and software components:

- One EX Series switch or one QFX3500 switch

- Junos OS Release 9.3 or later for EX Series switches or Junos OS Release 12.1 or later for the QFX Series
- A DHCP server to provide IP addresses to network devices on the switch

Before you configure DHCP option 82 on the switch, be sure you have:

- Connected and configured the DHCP server.

NOTE: **Your DHCP server must be configured to accept DHCP option 82. If it is not configured for DHCP option 82, it does not use the DHCP option 82 information in the requests sent to it when it formulates its reply messages.**

- Configured the **employee** VLAN on the switch and associated the interfaces on which the clients and the server connect to the switch with that VLAN. See the task for your platform:
  - *Configuring VLANs for EX Series Switches (CLI Procedure)*
  - “Configuring VLANs” on page 1534 for the QFX Series

Overview and Topology

If DHCP option 82 is enabled on the switch, then when a network device—a DHCP client—that is connected to the switch on an untrusted interface sends a DHCP request, the switch inserts information about the client's network location into the packet header of that request. The switch then sends the request to the DHCP server. The DHCP server reads the option 82 information in the packet header and uses it to implement the IP address or other parameter for the client.

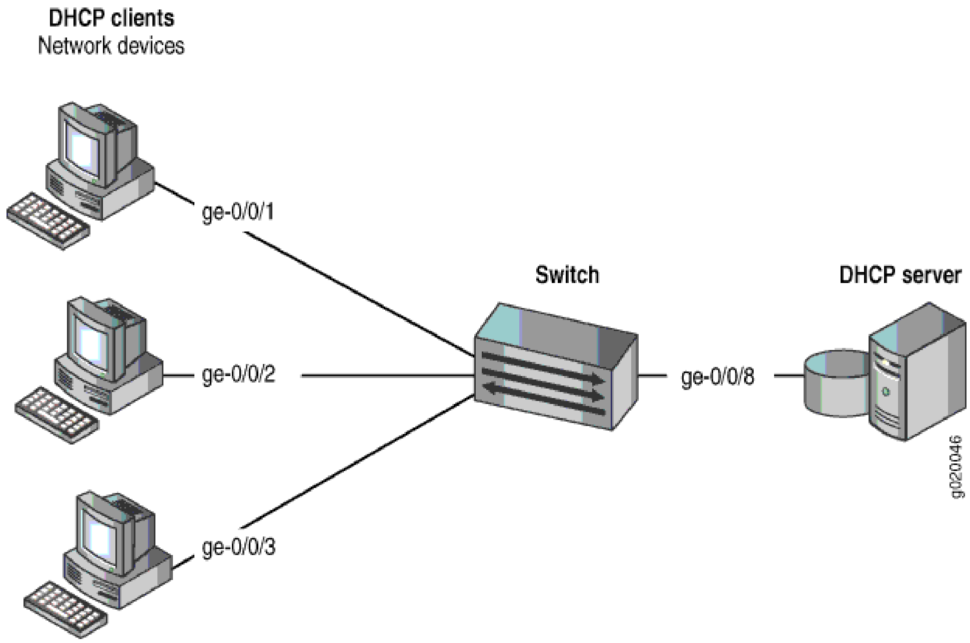
DHCP option 82 is enabled on an individual VLAN or on all VLANs on the switch.

When option 82 is enabled on the switch, then this sequence of events occurs when a DHCP client sends a DHCP request:

1. The switch receives the request and inserts the option 82 information in the packet header.
2. The switch forwards the request to the DHCP server.
3. The server uses the DHCP option 82 information to formulate its reply and sends a response back to the switch. It does not alter the option 82 information.
4. The switch strips the option 82 information from the response packet.
5. The switch forwards the response packet to the client.

Figure 168 on page 4523 illustrates the topology for this example.

Figure 168: Network Topology for Configuring DHCP Option 82 on a Switch That Is on the Same VLAN as the DHCP Clients and the DHCP Server



In this example, you configure DHCP option 82 on the switch. The switch connects to the DHCP server on interface **ge-0/0/8**. The DHCP clients connect to the switch on interfaces **ge-0/0/1**, **ge-0/0/2**, and **ge-0/0/3**. The switch, server, and clients are all members of the **employee** VLAN.

Configuration

CLI Quick Configuration

To quickly configure DHCP option 82, copy the following commands and paste them into the switch terminal window:

set ethernet-switching-options secure-access-port vlan employee dhcp-option82
set ethernet-switching-options secure-access-port vlan employee dhcp-option82 circuit-id prefix hostname
set ethernet-switching-options secure-access-port vlan employee dhcp-option82 circuit-id use-vlan-id
set ethernet-switching-options secure-access-port vlan employee dhcp-option82 remote-id
set ethernet-switching-options secure-access-port vlan employee dhcp-option82 remote-id prefix mac
set ethernet-switching-options secure-access-port vlan employee dhcp-option82 remote-id use-string employee-switch1
set ethernet-switching-options secure-access-port vlan employee dhcp-option82 vendor-id

Step-by-Step Procedure

To configure DHCP option 82:

1. Specify DHCP option 82 for the **employee** VLAN:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set vlan employee dhcp-option82
```

2. Configure a prefix for the circuit ID suboption (the prefix is always the hostname of the switch):

```
[edit ethernet-switching-options secure-access-port]
```

```
user@switch# set vlan employee dhcp-option82 circuit-id prefix hostname
```

3. Specify that the circuit ID suboption value contains the VLAN ID rather than the VLAN name (the default):

```
[edit ethernet-switching-options secure-access-port]
user@switch# set vlan employee dhcp-option82 circuit-id use-vlan-id
```

4. Specify that the remote ID suboption be included in the DHCP option 82 information:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set vlan employee dhcp-option82 remote-id
```

5. Configure a prefix for the remote ID suboption (here, the prefix is the MAC address of the switch):

```
[edit ethernet-switching-options secure-access-port]
user@switch# set vlan employee dhcp-option82 remote-id prefix mac
```

6. Specify that the remote ID suboption value contain a character string (here, the string is **employee-switch1**):

```
[edit ethernet-switching-options secure-access-port]
user@switch# set vlan employee dhcp-option82 remote-id use-string employee-switch1
```

7. Configure a vendor ID suboption value, and use the default value. To use the default value, do not type a character string after the **vendor-id** option keyword:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set vlan employee dhcp-option82 vendor-id
```

Results Check the results of the configuration:

```
[edit ethernet-switching-options secure-access-port]
user@switch# show
vlan employee {
  dhcp-option82 {
    circuit-id {
      prefix hostname;
      use-vlan-id;
    }
    remote-id {
      prefix mac;
      use-string employee-switch1;
    }
    vendor-id;
  }
}
```

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server on page 4525
- Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4557

- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.
- *secure-access-port*
- **secure-access-port on page 4622**

Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server

You can use DHCP option 82, also known as the DHCP relay agent information option, to help protect the switch against attacks such as spoofing (forging) of IP addresses and MAC addresses, and DHCP IP address starvation. Option 82 provides information about the network location of a DHCP client, and the DHCP server uses this information to implement IP addresses or other parameters for the client.

This example describes how to configure DHCP option 82 on a switch that is on the same VLAN with the DHCP clients but on a different VLAN from the DHCP server. in this example, the switch acts as a relay agent:

Requirements

This example uses the following hardware and software components:

- One EX4200-24P switch or one QFX3500 switch
- Junos OS Release 9.3 or later for EX Series switches or Junos OS Release 12.1 or later for the QFX Series
- A DHCP server to provide IP addresses to network devices on the switch

Before you configure DHCP option 82 on the switch, be sure you have:

- Connected and configured the DHCP server.

NOTE: Your DHCP server must be configured to accept DHCP option 82. If it is not configured for DHCP option 82, it does not use the DHCP option 82 information in the requests sent to it when it formulates its reply messages.

- Configured the **employee** VLAN on the switch and associated the interfaces on which the clients connect to the switch with that VLAN. See the task for your platform:
  - *Configuring VLANs for EX Series Switches (CLI Procedure)*
  - “Configuring VLANs” on page 1534 for the QFX Series
- Configured the **corporate** VLAN for the DHCP server.
- Configured the switch as a BOOTP relay agent. See *DHCP/BOOTP Relay for Switches Overview*.
- Configured the routed VLAN interface (RVI) to allow the switch to relay packets to the server and receive packets from the server. See *Configuring Routed VLAN Interfaces (CLI Procedure)* or “Configuring Routed VLAN Interfaces” on page 1532 for the QFX Series.

Overview and Topology

If DHCP option 82 is enabled on the switch, then when a network device—a DHCP client—that is connected to the switch on an untrusted interface sends a DHCP request, the switch inserts information about the client's network location into the packet header of that request. The switch then sends the request (in this setting, it relays the request) to the DHCP server. The DHCP server reads the option 82 information in the packet header and uses it to implement the IP address or other parameter for the client.

When option 82 is enabled on the switch, then this sequence of events occurs when a DHCP client sends a DHCP request:

1. The switch receives the request and inserts the option 82 information in the packet header.
2. The switch relays the request to the DHCP server.
3. The server uses the DHCP option 82 information to formulate its reply and sends a response back to the switch. It does not alter the option 82 information.
4. The switch strips the option 82 information from the response packet.
5. The switch forwards the response packet to the client.

In this example, you configure option 82 on the switch. The switch is configured as a BOOTP relay agent. The switch connects to the DHCP server through the routed VLAN interface (RVI) that you configured. The switch and clients are members of the **employee** VLAN. The DHCP server is a member of the **corporate** VLAN.

Configuration

To configure DHCP option 82:

CLI Quick Configuration

To quickly configure DHCP option 82, copy the following commands and paste them into the switch terminal window:

```
set forwarding-options helpers bootp dhcp-option82
set forwarding-options helpers bootp dhcp-option82 circuit-id prefix hostname
set forwarding-options helpers bootp dhcp-option82 circuit-id use-vlan-id
set forwarding-options helpers bootp dhcp-option82 remote-id
set forwarding-options helpers bootp dhcp-option82 remote-id prefix mac
set forwarding-options helpers bootp dhcp-option82 remote-id use-string employee-switch1
set forwarding-options helpers bootp dhcp-option82 vendor-id
```

Step-by-Step Procedure

To configure DHCP option 82:

1. Specify DHCP option 82 for the **employee** VLAN:

   ```
   [edit forwarding-options helpers bootp]
   user@switch# set dhcp-option82
   ```
2. Configure a prefix for the circuit ID suboption (the prefix is always the hostname of the switch):

   ```
   [edit forwarding-options helpers bootp]
   user@switch# set dhcp-option82 circuit-id prefix hostname
   ```
3. Specify that the circuit ID suboption value contains the VLAN ID rather than the VLAN name (the default):

```
[edit forwarding-options helpers bootp]
user@switch# set dhcp-option82 circuit-id use-vlan-id
```

4. Specify that the remote ID suboption be included in the DHCP option 82 information:

```
[edit forwarding-options helpers bootp]
user@switch# set dhcp-option82 remote-id
```

5. Configure a prefix for the remote ID suboption (here, the prefix is the MAC address of the switch):

```
[edit forwarding-options helpers bootp]
user@switch# set dhcp-option82 remote-id prefix mac
```

6. Specify that the remote ID suboption value contains a character string (here, the string is **employee-switch1**):

```
[edit forwarding-options helpers bootp]
user@switch# set dhcp-option82 remote-id use-string employee-switch1
```

7. Configure a vendor ID suboption value, and use the default value. To use the default value, do not type a character string after the **vendor-id** option keyword:

```
[edit forwarding-options helpers bootp]
user@switch# set dhcp-option82 vendor-id
```

Results Check the results of the configuration:

```
[edit forwarding-options helpers bootp]
user@switch# show
dhcp-option82 {
  circuit-id {
    prefix hostname;
    use-vlan-id;
  }
  remote-id {
    prefix mac;
    use-string employee-switch1;
  }
  vendor-id;
}
```

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server on page 4521
- Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4560
- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.
- *forwarding-options*

Device Security Configuration Example (Original CLI Only)

Example: Configuring Storm Control to Prevent Network Outages

Using storm control can prevent problems caused by broadcast storms. You can configure storm control to rate-limit broadcast traffic and unknown unicast traffic at a specified level and to drop packets when the specified traffic level is exceeded, which prevents packets from proliferating and degrading service or causing a security issue. You can also configure the switch to shut down or temporarily disable an interface when the storm control limit is exceeded.

This example shows how to configure storm control:

NOTE: **This example uses a Junos OS release that does not supports the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see** “Example: Configuring Storm Control to Prevent Network Outages” on page 4529.

Requirements

This example uses the following hardware and software components:

- A switch
- Junos OS Release 11.1 or later

Overview and Topology

A traffic storm occurs when broadcast packets prompt receiving devices to broadcast packets in response. This prompts further responses, creating a snowball effect. The switch is flooded with packets, and the resulting unnecessary traffic leads to poor performance or even a complete loss of service by some clients. Storm control causes a device to monitor traffic levels and take a specified action when a specified traffic level—called the *storm control level*—is exceeded, thus preventing packets from proliferating and degrading service.

Storm control monitors the incoming broadcast traffic and unknown unicast traffic and compares it with the level that you specify. If broadcast traffic and unknown unicast traffic exceed the specified level, the switch drops packets for the controlled traffic types. Storm control is enabled by default on all interfaces, and the default level is 80 percent of the available bandwidth.

This example shows how to configure the storm control level on interface **xe-0/0/0** by setting the level to a traffic rate of 5000000 Kbps, based on the total of the combined broadcast and unknown unicast streams. If broadcast traffic and unknown unicast traffic exceed these levels, the switch drops packets for the controlled traffic types.

Configuration

Step-by-Step Procedure

To configure storm control for a 10-Gigabit Ethernet interface to the equivalent of 50 percent of the available bandwidth:

- Specify the level of allowed broadcast traffic and unknown unicast traffic on a specific interface:

```
[edit ethernet-switching-options]
user@switch# set storm-control interface xe-0/0/0 bandwidth 5000000
```

Results

Display the results of the configuration:

```
[edit ethernet-switching-options]
user@switch# show storm-control
interface xe-0/0/0 {
  bandwidth 5000000;
}
```

Related Documentation

- Understanding Storm Control on page 4471
- Configuring Autorecovery for MAC Limited or Storm Control Interfaces (CLI Procedure) on page 4549
- action-shutdown on page 4650
- interface (Storm Control) on page 4666
- port-error-disable on page 4600

Device Security Configuration Example (ELS CLI Only)

Example: Configuring Storm Control to Prevent Network Outages

Storm control enables you to prevent network outages caused by broadcast storms on the LAN. You can configure storm control on to rate-limit broadcast traffic, multicast traffic, and unknown unicast traffic at a specified level and to have packets dropped when the specified traffic level is exceeded, thereby preventing packets from proliferating and degrading the LAN.

NOTE: This example uses a Junos OS release that supports the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that does not support ELS, see "Example: Configuring Storm Control to Prevent Network Outages" on page 4527. .

Requirements

This example uses the following hardware and software components:

- One QFX Series switch running Junos OS with ELS
- Junos OS Release 13.2 or later

Overview and Topology

A storm is generated when messages are broadcast on a network and each message prompts a receiving node to respond by broadcasting its own messages on the network. This, in turn, prompts further responses, creating a snowball effect and resulting in a broadcast storm that can cause network outages.

You can use storm control to prevent broadcast storms by specifying the amount, also known as the *storm control level*, of broadcast traffic, multicast traffic, and unknown unicast traffic to be allowed on an interface. You specify the storm control level as the traffic rate in kilobits per second (Kbps) of the combined applicable traffic streams or as the percentage of available bandwidth used by the combined applicable traffic streams. By default, storm control is enabled on all interfaces at a level of 80 percent of the available bandwidth.

Storm control monitors the level of applicable incoming traffic and compares it with the level that you specify. If the combined level of the applicable traffic exceeds the specified level, the switch drops packets for the controlled traffic types. As an alternative to having the switch drop packets, you can configure storm control to shut down interfaces or temporarily disable interfaces (see the **action-shutdown** statement or the recovery-timeout statement) when the storm control level is exceeded.

The topology used in this example consists of one switch connected to various network devices. This example shows how to configure the storm control level on interface xe-0/0/0 by setting the level to a traffic rate of 15,000 Kbps, based on the traffic rate of the combined applicable traffic streams. If the combined traffic exceeds this level, the switch drops packets for the controlled traffic types to prevent a network outage.

Configuration

CLI Quick Configuration

To quickly configure storm control based on the traffic rate in kilobits per second of the combined traffic streams, copy the following command and paste it into the switch terminal window:

```
[edit]
set forwarding-options storm-control-profiles sc-profile all bandwidth-level 15000
set interfaces xe-0/0/0 unit 0 family ethernet-switching storm-control sc-profile
```

Step-by-Step Procedure

To configure storm control:

1. Configure a storm control profile, **sc-profile**, and specify the traffic rate in kilobits per second of the combined traffic streams:

   ```
   [edit]
   user@switch> set forwarding-options storm-control-profiles sc-profile all bandwidth-level 15000
   ```

2. Bind the storm control profile, **sc**, to a logical interface:

```
[edit]
user@switch> set interfaces xe-0/0/0 unit 0 family ethernet-switching storm-control
sc-profile
```

Results Display the results of the configuration:

```
[edit forwarding-options]
user@switch> show storm-control-profiles sc-profile
all {
  bandwidth 15000;
}
```

```
[edit]
user@switch> show interfaces xe-0/0/0
unit 0 {
  family ethernet-switching {
    vlan {
      members default;
    }
    storm-control sc-profile;
  }
}
```

Related Documentation

- Understanding Storm Control on page 4471
- Configuring Autorecovery for MAC Limited or Storm Control Interfaces (CLI Procedure) on page 4549

Firewall and Policer Configuration Tasks

Configuring Firewall Filters

You can configure firewall filters in a switch to control traffic that enters switch ports or enters and exits VLANs and Layer 3 (routed) interfaces. To use a firewall filter, you must configure the filter and then apply it to a port, VLAN, or Layer 3 interface.

Configuring a Firewall Filter

To configure a firewall filter:

1. Configure the family address type, filter name, term name, and at least one match condition—for example, match on packets that contain a specific source address:

   ```
   [edit]
   user@switch# set firewall family ethernet-switching filter ingress-port-filter term term-one from source-address 192.0.2.14
   ```

   For a firewall filter that is applied to a port or VLAN, specify the family address type **ethernet-switching**. For a firewall filter that is applied to a Layer 3 (routed) interface, specify the family address type **inet**.

   The filter and term names can contain letters, numbers, and hyphens (-) and can be up to 64 characters long. Each filter name must be unique. A filter can contain one or more terms, and each term name must be unique within a filter.

2. Configure additional match conditions. For example, match on packets that contain a specific source port:

   ```
   [edit firewall family ethernet-switching filter ingress-port-filter term term-one from]
   user@switch# set source-port 80
   ```

   You can specify one or more match conditions in a single **from** statement. For a match to occur, the packet must match all the conditions in the term. The **from** statement is optional, but if included in a term, it cannot be empty. If you omit the **from** statement, all packets are considered to match.

3. If you want to apply a firewall filter to multiple interfaces and be able to see counters specific to each interface, configure the **interface-specific** option:

   ```
   [edit firewall family ethernet-switching filter ingress-port-filter]
   user@switch# set interface-specific
   ```

4. In each firewall filter term, specify the actions to take if the packet matches all the conditions in that term. You can specify an action and action modifiers:

   - To specify a filter action, for example, to discard packets that match the conditions of the filter term:

     ```
     [edit firewall family ethernet-switching filter ingress-port-filter term term-one then]
     user@switch# set discard
     ```

     You can specify no more than one action (**accept**, **discard**, **reject**, **routing-instance**, or **vlan**) per term.

   - To specify action modifiers, for example, to count and classify packets to a forwarding class:

     ```
     [edit firewall family ethernet-switching filter ingress-port-filter term term-one then]
     user@switch# set count counter-one
     user@switch# set forwarding-class expedited-forwarding
     user@switch# set loss-priority high
     ```


You can specify any of the following action modifiers in a **then** statement:

- **analyzer** ***analyzer-name***—Mirror port traffic to a specified analyzer, which you must configure at the **[ethernet-switching-options]** level.
- **count** ***counter-name***—Count the number of packets that pass this filter term.

NOTE: We recommend that you configure a counter for each term in a firewall filter, so that you can monitor the number of packets that match the conditions specified in each filter term.

NOTE: On the QFX Series, filters automatically count packets that have been dropped on ingress because of cyclic redundancy check (CRC) errors.

- **forwarding-class** ***class***—Assign packets to a forwarding class.
- **log**—Log the packet header information in the Routing Engine.
- **loss-priority** ***priority***—Set the priority of dropping a packet.
- **policer** ***policer-name***—Apply rate-limiting to the traffic.
- **syslog**—Log an alert for this packet.

If you omit the **then** statement or do not specify an action, packets that match all the conditions in the **from** statement are accepted. However, you should always explicitly configure an action in the **then** statement. You can include no more than one action statement, but you can use any combination of action modifiers. For an action or action modifier to take effect, all conditions in the **from** statement must match.

NOTE: Implicit discard is also applicable to a firewall filter applied to the loopback interface, lo0.

Applying a Firewall Filter to a Port

To apply a firewall filter to an ingress port:

1. Provide a meaningful description of the firewall filter in the configuration of the port to which the filter will be applied:

```
[edit]
user@switch# set interfaces ge-0/0/6 description "filter to limit tcp traffic at trunk port for employee-vlan"
```

2. Apply the filter to the interface, specifying the unit number, family address type, the direction of the filter (for packets entering the port), and the filter name:

```
[edit]
user@switch# set ge-0/0/6 unit 0 family ethernet-switching filter input ingress-port-filter
```

For firewall filters that are applied to ports, the family address type must be **ethernet-switching**.

NOTE: You can apply only one filter to a port for a given direction (ingress or egress).

Applying a Firewall Filter to a VLAN

To apply a firewall filter to a VLAN:

1. Provide a meaningful description of the firewall filter in the configuration of the VLAN to which the filter will be applied:

   ```
   [edit]
   user@switch# set vlans employee-vlan vlan-id 20 description "filter to block rogue devices on employee-vlan"
   ```
2. Apply firewall filters to filter packets that are entering or exiting the VLAN:

   - To apply a filter to match packets that are entering the VLAN:

     ```
     [edit]
     user@switch# set vlans employee-vlan vlan-id 20 filter input ingress-vlan-rogue-block
     ```
   - To apply a firewall filter to match packets that are exiting the VLAN:

     ```
     [edit]
     user@switch# set vlans employee-vlan vlan-id 20 filter output egress-vlan-filter
     ```

NOTE: You can apply only one filter to a VLAN for a given direction (ingress or egress).

Applying a Firewall Filter to a Layer 3 (Routed) Interface

To apply a firewall filter to a Layer 3 routed interface:

1. Provide a meaningful description of the firewall filter in the configuration of the interface to which the filter will be applied:

   ```
   [edit]
   user@switch# set interfaces ge-0/1/6 description "filter to count and monitor traffic on layer 3 interface"
   ```
2. You can apply firewall filters to filter packets that enter or exit a Layer 3 routed interface:

   - To apply a firewall filter to filter packets that enter a Layer 3 interface:

     ```
     [edit]
     user@switch# set interfaces ge-0/1/6 unit 0 family inet filter input ingress-router-filter
     ```
   - To apply a firewall filter to filter packets that exit a Layer 3 interface:

     ```
     [edit]
     user@switch# set interfaces ge-0/1/6 unit 0 family inet filter output egress-router-filter
     ```

For firewall filters applied to Layer 3 routed interfaces, the family address type must be **inet**.

NOTE: You can apply only one filter to an interface for a given direction (ingress or egress).

Related Documentation

- Overview of Firewall Filters on page 4409
- Firewall Filter Match Conditions and Actions on page 4419
- Verifying That Firewall Filters Are Operational on page 4672
- Monitoring Firewall Filter Traffic on page 4669
- Configuring Port Mirroring on page 4730

Applying Firewall Filters to Interfaces

For a firewall filter to work, you must apply it to at least one interface. To do this, include the **filter** statement when configuring a logical interface at the **[edit interfaces]** hierarchy level:

```
[edit interfaces]
user@switch# set interface-name unit logical-unit-number family family-name filter (input | output) filter-name
```

In the **input** statement, specify a firewall filter to be evaluated when packets are received on the interface. Input filters applied to a loopback interface affect only traffic destined for the Routing Engine.

In the **output** statement, specify a filter to be evaluated when packets exit the interface.

NOTE: When you create a loopback interface, it is important to apply an ingress filter to it so the Routing Engine is protected. We recommend that when you apply a filter to the loopback interface lo0, you include the **apply-groups** statement. Doing so ensures that the filter is automatically inherited on every loopback interface, including lo0 and other loopback interfaces.

Related Documentation

- Configuring Firewall Filters on page 4531

Assigning Forwarding Classes and Loss Priority

You can configure firewall filters to assign packet loss priority (PLP) and forwarding classes so that if congestion occurs, the marked packets can be dropped according to the priority you set. The valid match conditions are one or more of the six packet header fields: destination address, source address, IP protocol, source port, destination port, and DSCP. In other words, you can set the forwarding class and the PLP for each packet entering or an interface with a specific destination address, source address, IP protocol, source port, destination port, or DSCP.

NOTE: Junos OS assigns forwarding classes and PLP on ingress only. Do not use a filter that assigns forwarding classes or PLP as an egress filter.

When tricolor marking is enabled, a switch supports four PLP designations: **low**, **medium-low**, **medium-high**, and **high**. You can also specify any of the forwarding classes listed in Table 359 on page 4536

Table 359: Unicast Forwarding Classes

Unicast Forwarding Class	For CoS Traffic Type
be	Best-effort traffic
no-loss	Guaranteed delivery for TCP traffic
fcoe	Guaranteed delivery for Fibre Channel over Ethernet (FCoE) traffic
nc	Network-control traffic

To assign forwarding classes in firewall filters:

1. Configure the family address type and filter name:

```
[edit]
user@switch# edit firewall family ethernet-switching filter ingress-filter
```

2. Configure the terms of the filter as appropriate, including the **forwarding-class** and **loss-priority** action modifiers. For example, each of the following terms in the filter examines various packet header fields and assigns the appropriate forwarding class and packet loss priority:

   - The term **corp-traffic** matches all IPv4 packets with a **10.1.1.0/24** source address and assigns the packets to forwarding class **no-loss** with a loss priority of **low**:

```
[edit firewall family ethernet-switching filter ingress-filter]
user@switch# set term corp-traffic from source-address 10.1.1.0/24;
user@switch# set term corp-traffic then forwarding-class no-loss
user@switch# set term corp-traffic then loss-priority low
```

   - The term **data-traffic** matches all IPv4 packets with a **10.1.2.0/24** source address and assigns the packets to forwarding class **be** (best effort) with a loss priority of **medium-high**:


```
[edit firewall family ethernet-switching filter ingress-filter]
user@switch# set term data-traffic from source-address 10.1.2.0/24;
user@switch# set term data-traffic then forwarding-class be
user@switch# set term data-traffic then loss-priority medium-high
```

- Because the loss of network-generated packets can jeopardize proper network operation, the delay of these packets is preferable to discarding these packets. The term **network-traffic** assigns the packets with an IP precedence of **net-control** to forwarding class **nc** (network control) with a loss priority of **low**:

```
[edit firewall family ethernet-switching filter ingress-filter]
user@switch# set term network-traffic from precedence net-control
user@switch# set term network-traffic then forwarding-class nc
user@switch# set term network-traffic then loss-priority low
```

- The last term **accept-traffic** matches any packets that did not match on any of the preceding terms and assigns the packets to forwarding class **be** with a loss priority of **high**:

```
[edit firewall family ethernet-switching filter ingress-filter]
user@switch# set term accept-traffic then forwarding-class be
user@switch# set term accept-traffic then loss-priority high
```

3. Apply the filter **ingress-filter** to a port, VLAN, or Layer 3 interface. For information about applying the filter, see "Configuring Firewall Filters" on page 4531. (Assigning forwarding classes and PLP is supported only on ingress filters.)

Related Documentation

- Configuring Firewall Filters on page 4531
- Verifying That Firewall Filters Are Operational on page 4672
- Monitoring Firewall Filter Traffic on page 4669
- Overview of Policers on page 4441
- Understanding CoS Classifiers on page 5334
- Understanding CoS Forwarding Classes on page 5354

Configuring Color-Blind Egress Policers for Medium-Low PLP

If you use color-blind mode and want to configure an egress policer that marks packets to have medium-low PLP, you must configure a single-rate two-color policer at the **[edit firewall policer *policer-name*]** hierarchy level, because color-blind mode does not support medium-low priority. For example:

1. Specify the name of the policer, the bandwidth limit in bits per second (bps) to control the traffic rate on an interface, and the maximum allowed burst size to control the amount of traffic bursting:

```
[edit]
user@switch# set firewall policer policer-name if-exceeding bandwidth-limit bytes
burst-size-limit bytes
```

2. Specify medium-low loss priority for matching packets:

```
[edit]
user@switch# set firewall policer policer-name then loss-priority medium-low;
```

3. Apply the filter to a port, VLAN, or Layer 3 interface.

Related Documentation

- Overview of Policers on page 4441
- Understanding Color-Blind Mode for Single-Rate Tricolor Marking on page 4447
- Understanding Color-Blind Mode for Two-Rate Tricolor Marking on page 4449
- Configuring Firewall Filters on page 4531
- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538

Configuring Two-Color and Three-Color Policers to Control Traffic Rates

You can rate-limit traffic by configuring a policer and specifying it as an action modifier for a term in a firewall filter. By default, if you specify the same policer in multiple terms, Junos OS creates a separate policer instance for each term and applies rate limiting separately for each instance. For example, if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, each policer instance enforces a 1-Gbps limit. In this case, the total bandwidth allowed by the filter is 3 Gbps.

You can also configure a policer to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. When you do this, rate limiting is applied in aggregate, so if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, the total bandwidth allowed by the filter is 1 Gbps.

NOTE: You can include two-color policer actions on ingress firewall filters only. You can include three-color policer actions on ingress and egress filters.

1. Configuring Two-Color Policers on page 4538
2. Configuring Three-Color Policers on page 4539
3. Specifying Policers in a Firewall Filter Configuration on page 4539
4. Applying a Firewall Filter That Includes a Policer on page 4540

Configuring Two-Color Policers

To configure a two-color policer:

1. Specify the name of the policer, the bandwidth limit to control the traffic rate on an interface, and the maximum allowed burst size to control the amount of traffic bursting:

   ```
   [edit firewall]
   user@switch# set policer policer-name <filter-specific> if-exceeding bandwidth-limit bps burst-size-limit bytes
   ```

   The policer name can contain letters, numbers, and hyphens (-) and can have as many as 64 characters.

   The range for the bandwidth limit is 32000 (32k) through 102,300,000,000 (102300m) bps.

To determine the value for the burst-size limit, multiply the bandwidth of the interface on which the filter is applied by the amount of time to allow a burst of traffic at that bandwidth to occur and divide the result by 8:

maximum burst size = (interface bandwidth) X (allowable time for burst) / (8 bits/byte)

The range for the burst-size limit is 1 through 2,147,450,880 bytes.

2. Specify the policer action to discard or assign a loss priority to packets that exceed the rate limits:

```
[edit firewall policer policer-name]
user@switch# set then (discard | loss-priority low | loss-priority high)
```

Configuring Three-Color Policers

To configure a three-color policer:

1. Specify the name of the policer and (optionally) whether to automatically discard packets with high loss priority (PLP):

```
[edit firewall]
user@switch# set three-color-policer policer-name
user@switch# set three-color-policer policer-name action loss-priority high then discard
```

2. Specify whether the three-color policer should be single-rate or two-rate and whether it should be color-aware or color-blind:

```
[edit firewall three-color-policer policer-name]
user@switch# set (single-rate | two-rate) (color-aware | color-blind)
```

3. For single-rate three-color policers, configure the CIR, CBS, and EBS:

```
[edit firewall three-color-policer policer-name single-rate]
user@switch# set committed-information-rate bps
user@switch# set committed-burst-size bytes
user@switch# set excess-burst-size bytes
```

4. For two-rate three-color policers, configure the CIR, CBS, PIR, and PBS:

```
[edit firewall three-color-policer policer-name single-rate]
user@switch# set committed-information-rate bps
user@switch# set committed-burst-size bytes
user@switch# set peak-information-rate bps
user@switch# set peak-burst-size bytes
```

Specifying Policers in a Firewall Filter Configuration

To use a two-color policer, configure a filter term that includes the action **policer**:

```
[edit firewall family family-name]
user@switch# set filter filter-name term name then name
```

For example, the following commands apply a two-color policer to all packets sent from 192.0.2.0/24.

```
[edit firewall family family-name]
user@switch# set filter limit—hosts term term1 from source-address 192.0.2.0/24
user@switch# set filter limit—hosts term term1 then policer policer1
```

To use a three-color policer, configure a filter term that includes the action **three-color-policer**:

```
[edit firewall family name]
user@switch# set filter name term name from match-condition
```


user@switch# **set filter *name* term *name* then three-color-policer (single-rate | two-rate) *name***

For example, the following commands apply a single-rate three-color policer to all packets received or sent by interface **ge-0/0/6** (depending on whether the filter is an ingress or egress filter).

```
[edit firewall family name]
user@switch# set filter srTCM term term-one from interface ge-0/0/6
user@switch# set filter srTCM term term-one then three-color-policer single-rate srTCM1-ca
```

You must specify whether the three-color policer is single-rate or two-rate, and this must match the policer itself. Otherwise, the configuration listing includes an error message indicating that the three-color policer you referenced in the filter does not exist.

Applying a Firewall Filter That Includes a Policer

A firewall filter that includes one or more policer action modifiers must be applied to a port, VLAN, or Layer 3 interface like any other filter. For information about applying firewall filters, see "Configuring Firewall Filters" on page 4531.

NOTE: You can include two-color policer actions on ingress firewall filters only. You can include three-color policer actions on ingress and egress filters.

Related Documentation

- Configuring Firewall Filters on page 4531
- Overview of Policers on page 4441
- Verifying That Two-Color Policers Are Operational on page 4683
- Verifying That Three-Color Policers Are Operational on page 4682
- Configuring Color-Blind Egress Policers for Medium-Low PLP on page 4537

Configuring MPLS Firewall Filters and Policers

You can configure an MPLS firewall filter to count packets based on the EXP bits for the top-level MPLS label in a packet. You can also configure policers for MPLS LSPs.

The following sections discuss MPLS firewall filters and policers:

- Configuring MPLS Firewall Filters on page 4540
- Examples: Configuring MPLS Firewall Filters on page 4541
- Configuring Policers for LSPs on page 4542

Configuring MPLS Firewall Filters

You can configure an MPLS firewall filter to count packets based on the EXP bits for the top-level MPLS label in a packet. You can then apply this filter to a specific interface on input or output. You can also configure a policer for the MPLS filter to police (that is, rate-limit) the traffic on the interface to which the filter is attached. You cannot apply MPLS firewall filters to loopback interfaces.

You can configure the following match conditions for MPLS filters at the **[edit firewall family mpls filter *filter-name* term *term-name* from]** hierarchy level:

- **exp**
- **label**

These **exp** match condition can accept EXP bits in the range 0 through 7. You can configure the following choices:

- A single EXP bit—for example, **exp 3;**
- Several EXP bits—for example, **exp 0, 4;**
- A range of EXP bits—for example, **exp [0-5];**

The **label** match condition can accept a range of values from 0 to 1048575.

If you do not specify a match criterion (that is, you do not configure the **from** statement and use only the **then** statement with the **count** action keyword), all the MPLS packets passing through the interface on which the filter is applied will be counted.

You also can configure any of the following action keywords at the **[edit firewall family mpls filter *filter-name* term *term-name* then]** hierarchy level:

- **accept**
- **count**
- **discard**
- **policer**
- **three-color-policer**

Examples: Configuring MPLS Firewall Filters

The following examples illustrate how you might configure an MPLS firewall filter and then apply the filter to an interface. This filter is configured to count MPLS packets with EXP bits set to either 0 or 4.

The following shows a configuration for an MPLS firewall filter:

```
[edit firewall]
family mpls {
  filter expf {
    term expt0 {
      from {
        exp 0,4;
      }
      then {
        count counter0;
        accept;
      }
    }
  }
}
```


Configuring Policers for LSPs

MPLS LSP policing allows you to control the amount of traffic forwarded through a particular LSP. Policing helps to ensure that the amount of traffic forwarded through an LSP never exceeds the requested bandwidth allocation. LSP policing is supported on regular LSPs, LSPs configured with DiffServ-aware traffic engineering, and multiclass LSPs. You can configure multiple policers for each multiclass LSP. For regular LSPs, each LSP policer is applied to all of the traffic traversing the LSP. The policer's bandwidth limitations become effective as soon as the total sum of traffic traversing the LSP exceeds the configured limit.

You configure the multiclass LSP and DiffServ-aware traffic engineering LSP policers in a filter. The filter can be configured to distinguish between the different class types and apply the relevant policer to each class type. The policers distinguish between class types based on the EXP bits.

You configure LSP policers under the **family any** filter. The **family any** filter is used because the policer is applied to traffic entering the LSP. This traffic might be from different families: IPv6, MPLS, and so on. You do not need to know what sort of traffic is entering the LSP, as long as the match conditions apply to all types of traffic.

LSP Policer Limitations

When configuring MPLS LSP policers, be aware of the following limitations:

- LSP policers are supported for packet LSPs only.
- LSP policers are supported for unicast next hops only. Multicast next hops are not supported.
- LSP policers are not supported on aggregated interfaces.
- The LSP policer runs before any output filters.
- Traffic sourced from the Routing Engine (for example, ping traffic) does not take the same forwarding path as transit traffic. This type of traffic cannot be policed.

Related Documentation

- Overview of Policers on page 4441

Port Security Configuration Tasks (Original CLI Only)

Configuring Port Security (CLI Procedure)

Ethernet LANs are vulnerable to attacks such as address spoofing and Layer 2 denial of service (DoS) on network devices. Port security features such as DHCP snooping, DAI (dynamic ARP inspection), MAC limiting, MAC move limiting, and persistent MAC learning, as well as trusted DHCP server, help protect the access ports on the switch against the losses of information and productivity that can result from such attacks.

Depending on the particular feature, you can configure the port security feature either on:

- VLANs—A specific VLAN or all VLANs
- Interfaces—A specific interface or all interfaces

NOTE: If you configure one of the port security features on all VLANs or all interfaces, the switch software enables that port security feature on all VLANs and all interfaces that are not explicitly configured with other port security features.

However, if you do explicitly configure one of the port security features on a specific VLAN or on a specific interface, you must explicitly configure any additional port security features that you want to apply to that VLAN or interface. Otherwise, the switch software automatically applies the default values for the feature.

For example, if you disable DHCP snooping on all VLANs and decide to explicitly enable IP source guard only on a specific VLAN, you must also explicitly enable DHCP snooping on that specific VLAN. Otherwise, the default value of no DHCP snooping applies to that VLAN.

To configure port security features using the CLI:

- Enabling Persistent MAC Learning on an Interface on page 4545
- Limiting MAC Address Movement on page 4545
- Configuring Trusted DHCP Servers on an Interface on page 4545

Enabling DHCP Snooping

You can configure DHCP snooping to allow the device to monitor DHCP messages received, ensure that hosts only use the IP addresses assigned to them, and allow access only to authorized DHCP servers.

To enable DHCP snooping:

- On a specific VLAN:

```
[edit vlans forwarding-options dhcp-security]
user@switch# set vlan default examine-dhcp
```

- On all VLANs:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set vlan all examine-dhcp
```

Enabling Dynamic ARP Inspection (DAI)

You can enable DAI to protect against ARP snooping. To enable DAI:

- On a single VLAN (here, the VLAN is **employee-vlan**):

```
[edit ethernet-switching-options secure-access-port]
user@switch# set vlan employee-vlan arp-inspection
```

- On all VLANs:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set vlan all arp-inspection
```

Limiting Dynamic MAC Addresses on an Interface

Limit the number of dynamic MAC addresses allowed on an interface and specify the action to take if the limit is exceeded—for example, set a MAC limit of **5** with an action of **drop**:

- On a single interface:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface ge-0/0/1 mac-limit 5 action drop
```

- On all interfaces:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface all mac-limit 5 action drop
```

You can also specify the actions **log** (do not drop the packet but generate an alarm, an SNMP trap, or a system log entry), **none** (no action), or **shutdown** (disable the interface and generate an alarm) to occur if the number of dynamic MAC addresses is exceeded.

Enabling Persistent MAC Learning on an Interface

You can configure learned MAC addresses to persist on an interface across restarts of the switch:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface ge-0/0/1 persistent-learning
```

Limiting MAC Address Movement

You can limit the number of times a MAC address can move from its original interface in 1 second—for example, set a MAC move limit of **5** with an action of **drop** if the limit is exceeded:

- On a single VLAN (here, the VLAN is **employee-vlan**):

  ```
  [edit ethernet-switching-options secure-access-port]
  user@switch# set vlan employee-vlan mac-move-limit 5 action drop
  ```

- On all VLANs:

  ```
  [edit ethernet-switching-options secure-access-port]
  user@switch# set vlan all mac-move-limit 5 action drop
  ```

You can also specify the actions **log** (do not drop the packet but generate an alarm, an SNMP trap, or a system log entry), **none** (no action), or **shutdown** (disable the interface or VLAN and generate an alarm) to occur if the MAC address moves more than the specified number of times in 1 second.

Configuring Trusted DHCP Servers on an Interface

Configure a trusted DHCP server on an interface:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface ge-0/0/1 dhcp-trusted
```

Related Documentation

- *Configuring Port Security (J-Web Procedure)*
- *Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)*
- Example: Configuring Basic Port Security Features on page 4488
- Example: Configuring DHCP Snooping, DAI , and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch on page 4506
- Monitoring Port Security on page 4671
- Port Security Overview on page 4454
- *secure-access-port*
- **secure-access-port on page 4622**

Configuring MAC Limiting

To configure MAC limiting on a specific interface or on all interfaces:

1. To limit the number of dynamic MAC addresses, set a MAC limit of **5**.

The action is not specified, so the switch performs the default action **drop** if the limit is exceeded:

- On a single interface (here, the interface is **xe-0/0/1**):

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface xe-0/0/1 mac-limit (Access Port Security) 5
```

- On all interfaces:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface all mac-limit 5
```

CAUTION: Do not set the MAC limit to 1. The first learned MAC address is often inserted into the forwarding database automatically. (For instance, the first MAC address inserted into the forwarding database for routed VLAN interfaces is the MAC address of the RVI. For Aggregated Ethernet bundles using LACP, the first MAC address inserted into the forwarding database in the forwarding table is the source address of the protocol packet.) The switch therefore fails to learn MAC addresses other than the automatic addresses when the MAC limit is set to 1, and this causes problems with MAC learning and forwarding.

2. To specify allowed MAC addresses:

- On a single interface (here, the interface is **xe-0/0/2**):

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface xe-0/0/2 allowed-mac 00:05:85:3A:82:80
user@switch# set interface xe-0/0/2 allowed-mac 00:05:85:3A:82:81
user@switch# set interface xe-0/0/2 allowed-mac 00:05:85:3A:82:83
```

- On all interfaces:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface all allowed-mac 00:05:85:3A:82:80
user@switch# set interface all allowed-mac 00:05:85:3A:82:81
user@switch# set interface all allowed-mac 00:05:85:3A:82:83
```

Related Documentation

- Port Security Overview on page 4454
- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Overview of Access Port Protection on page 4451
- Verifying That MAC Limiting Is Working Correctly on page 4674
- Example: Configuring MAC Limiting, Including Dynamic and Allowed MAC Addresses, to Protect the Switch from Ethernet Switching Table Overflow Attacks on page 4499
- Example: Configuring MAC Limiting to Protect the Switch from DHCP Starvation Attacks on page 4495
- **no-allowed-mac-log on page 4598**

Configuring MAC Move Limiting (CLI Procedure)

When MAC move limiting is configured, MAC address movements are tracked by the switch and, if a MAC address changes more than the configured number of times within 1 second, the changes to MAC addresses are dropped, logged, ignored, or the interface is shut down.

NOTE: Although you enable this feature on VLANs, the MAC move limitation pertains to the number of movements for each individual MAC address rather than the total number of MAC address moves in the VLAN. For example, If the MAC move limit is set to 1, the switch allows an unlimited number of MAC address movements within the VLAN as long as the same MAC address does not change more than once.

You configure MAC move limiting per VLAN, not per interface (port). In the default configuration, the number of MAC moves permitted is unlimited.

You can choose to have one of the following actions performed when the MAC move limit is exceeded:

- **drop**—Drop the packet and generate a system log entry. This is the default.
- **log**—Do not drop the packet but generate a system log entry.
- **none**—Take no action.
- **shutdown**—Disable the interfaces in the VLAN and generate a system log entry. If you have configured the switch with the **port-error-disable** statement, the disabled interfaces recover automatically upon expiration of the specified disable timeout. If you have not configured the switch for autorecovery from port error disabled conditions, you can bring up the disabled interfaces by running the **clear ethernet-switching port-error** command.

To configure a MAC move limit for MAC addresses within a specific VLAN or for MAC addresses within all VLANs, using the CLI:

- On a single VLAN: To limit the number of MAC address movements that can be made by an individual MAC address within the VLAN **employee-vlan**, set a MAC move limit of **5**:

  ```
  [edit ethernet-switching-options secure-access-port]
  user@switch# set vlan employee-vlan mac-move-limit 5
  ```

  The action is not specified, so the switch performs the default action **drop** if it tracks that an individual MAC address within the **employee-vlan** has moved more than 5 times within one second.

- On all VLANs: To limit the number of MAC movements that can be made by individual MAC addresses within all VLANs, set a MAC move limit of **5**:

  ```
  [edit ethernet-switching-options secure-access-port]
  user@switch# set vlan all mac-move-limit 5
  ```

  The action is not specified, so the switch performs the default action **drop** if it tracks that an individual MAC address within any of the VLANs has moved more than 5 times within 1 second.

Related Documentation

- *Configuring MAC Move Limiting (J-Web Procedure)*
- Example: Configuring Basic Port Security Features on page 4488
- Verifying That MAC Move Limiting Is Working Correctly on page 4677
- Monitoring Port Security on page 4671
- *Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)*
- *Understanding MAC Limiting and MAC Move Limiting for Port Security on EX Series Switches*
- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- *clear ethernet-switching port-error*
- **clear ethernet-switching port-error on page 4686**
- **port-error-disable on page 4600**
- **port-error-disable on page 4600**
- *secure-access-port*
- **secure-access-port on page 4622**

Configuring Autorecovery for MAC Limited or Storm Control Interfaces (CLI Procedure)

An Ethernet access interface might shut down or be disabled as a result of one of the following configurations:

- MAC limiting—**mac-limit** statement is configured with action **shutdown**.
- MAC move limiting—**mac-move-limit** statement is configured with action **shutdown**.
- Storm control—**storm-control** statement is configured with the action **shutdown**.

You can configure a device to automatically restore the disabled interfaces to service after a specified period of time. Autorecovery applies to all the interfaces that have been disabled due to MAC limiting, MAC move limiting, or storm control errors.

To configure autorecovery from the disabled state due to MAC limiting, MAC move limiting, or storm control shutdown actions:

```
[edit ethernet-switching-options]
user@switch# set port-error-disable disable-timeout seconds
```

NOTE: You must specify the disable timeout value—there is no default disable timeout period. If you do not specify a timeout value, you must use the clear ethernet-switching port-error command to clear the errors and restore the interfaces to service.

Related Documentation

- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Configuring MAC Limiting on page 4545
- Configuring MAC Move Limiting (CLI Procedure) on page 4547
- Understanding Storm Control on page 4471

Configuring the none Action to Override a MAC Limit Applied to All Interfaces (CLI Procedure)

If you set a MAC limit in your port security settings to apply to all interfaces, you can override that setting for a particular interface by specifying the action **none**.

To use the **none** action to override a MAC limit setting:

1. Set the MAC limit for all interfaces—for example, a limit of **5** with action **drop**:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set interface all mac-limit (Access Port Security) 5 action drop
   ```
2. Change the action for one interface with this command.

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set interface xe-0/0/2 mac-limit action none
   ```

Related Documentation

- Configuring MAC Limiting on page 4545
- Example: Configuring Basic Port Security Features on page 4488

- Verifying That MAC Limiting Is Working Correctly on page 4674
- Example: Configuring MAC Limiting, Including Dynamic and Allowed MAC Addresses, to Protect the Switch from Ethernet Switching Table Overflow Attacks on page 4499
- *Example: Configuring MAC Limiting to Protect the Switch from DHCP Starvation Attacks*

Configuring Static ARP Entries

You can create static ARP table entries, which are explicit mappings between IP addresses and MAC addresses.

- To configure a static ARP entry:

```
[edit interfaces interface-name unit logical-unit-number family inet address address]
user@switch# set arp ip-address (mac | multicast-mac) mac-address
```

The IP address that you specify must be part of the subnet defined in the enclosing **address** statement.

To associate a multicast MAC address with a unicast IP address, use the **multicast-mac** statement.

Specify the MAC address as 6 hexadecimal bytes in one of the following formats: ***nnnn.nnnn.nnnn*** or ***nn:nn:nn:nn:nn:nn***; for example, **0011.2233.4455** or **00:11:22:33:44:55**.

Related Documentation

- Understanding Static ARP Entries on page 4470
- *arp*

Configuring Static IP Addresses for DHCP Bindings on Access Ports (CLI Procedure)

You can add static (fixed) IP addresses and bind them to fixed MAC addresses in the DHCP snooping database. These bindings are labeled as “static” in the database, while those bindings that have been added through the process of DHCP snooping are labeled “dynamic.”

To configure a static IP address/MAC address binding in the DHCP snooping database (replace **ge-0/0/2**, **10.0.10.12**, **data-vlan**, and **00:05:85:3A:82:80** with values for your configuration):

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface ge-0/0/2 static-ip 10.0.10.12 vlan data-vlan mac 00:05:85:3A:82:80
```

To view results of the configuration steps before committing the configuration, type the **show** command at the user prompt.

To commit these changes to the active configuration, type the **commit** command at the user prompt.

Related Documentation

- Verifying That DHCP Snooping Is Working Correctly on page 4673
- Understanding DHCP Snooping for Port Security on page 4456
- *secure-access-port*

- secure-access-port on page 4622

Enabling DHCP Snooping (CLI Procedure)

DHCP snooping allows the switch to monitor and control DHCP messages received from untrusted devices connected to the switch. It builds and maintains a database of valid IP-address/MAC-address (IP-MAC) bindings called the DHCP snooping database.

NOTE: If you configure DHCP snooping for all VLANs and you enable a different port security feature on a specific VLAN, you must also explicitly enable DHCP snooping on that VLAN. Otherwise, the default value of no DHCP snooping applies to that VLAN.

This topic describes:

Enabling DHCP Snooping

You configure DHCP snooping per VLAN, not per interface (port). By default, DHCP snooping is disabled for all VLANs. You can enable DHCP snooping on all VLANs or on specific VLANs.

To enable DHCP snooping on a VLAN or all VLANs:

- On a specific VLAN:

  ```
  [edit ethernet-switching-options secure-access port]
  user@switch# set vlan vlan-name examine-dhcp
  ```

- On all VLANs:

  ```
  [edit ethernet-switching-options secure-access port]
  user@switch# set vlan all examine-dhcp
  ```

TIP: By default, the IP-MAC bindings are lost when the switch is rebooted and DHCP clients (the network devices, or hosts) must reacquire bindings. However, you can configure the bindings to persist by setting the **dhcp-snooping-file** statement to store the database file either locally or remotely.

TIP: For private VLANs (PVLANs), enable DHCP snooping on the primary VLAN. If you enable DHCP snooping only on a community VLAN, DHCP messages coming from PVLAN trunk ports are not snooped.

Applying CoS Forwarding Classes to Prioritize Snooped Packets

On EX Series switches you might need to use class of service (CoS) to protect packets from critical applications from being dropped during periods of network congestion and delay and you might also need the port security features of DHCP snooping on the same ports through which those critical packets are entering and leaving.

NOTE: This is not supported on the QFX Series switch.

To apply CoS forwarding classes and queues to snooped packets:

1. Create a user-defined forwarding class to be used for prioritizing snooped packets:

   ```
   [edit class-of-service]
   user@switch# set forwarding-classes class class-name queue queue-number
   ```

2. Enable DHCP snooping on a specific VLAN or on all VLANs and apply the desired forwarding class on the snooped packets:

   - On a specific VLAN:

     ```
     [edit ethernet-switching-options secure-access port]
     user@switch# set vlan vlan-name examine-dhcp forwarding-class class-name
     ```


- On all VLANs:

```
[edit ethernet-switching-options secure-access port]
user@switch# set vlan all examine-dhcp forwarding-class class-name
```

Related Documentation

- *Enabling DHCP Snooping (J-Web Procedure)*
- Example: Configuring Basic Port Security Features on page 4488
- Example: Configuring DHCP Snooping, DAI , and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch on page 4506
- Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks on page 4513
- *Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic*
- Verifying That DHCP Snooping Is Working Correctly on page 4673
- Monitoring Port Security on page 4671
- Understanding DHCP Snooping for Port Security on page 4456
- **class-of-service on page 5717**
- *secure-access-port*
- **secure-access-port on page 4622**

Enabling Dynamic ARP Inspection (CLI Procedure)

Dynamic ARP inspection (DAI) protects switches against ARP spoofing. DAI inspects ARP packets on the LAN and uses the information in the DHCP snooping database on the switch to validate ARP packets and to protect against ARP cache poisoning.

This topic describes:

- Enabling DAI on page 4554
- Applying CoS Forwarding Classes to Prioritize Inspected Packets on page 4554

Enabling DAI

You configure DAI for each VLAN, not for each interface (port). By default, DAI is disabled for all VLANs.

To enable DAI on a VLAN or all VLANs:

- On a single VLAN:

  ```
  [edit ethernet-switching-options secure-access-port]
  user@switch# set vlan vlan-name arp-inspection
  ```

- On all VLANs:

  ```
  [edit ethernet-switching-options secure-access-port]
  user@switch# set vlan all arp-inspection
  ```

Applying CoS Forwarding Classes to Prioritize Inspected Packets

You might need to use class of service (CoS) to protect packets from critical applications from being dropped during periods of network congestion and delay and you might also need the port security features of DHCP snooping on the same ports through which those critical packets are entering and leaving.

To apply CoS forwarding classes and queues to DAI packets:

1. Create a user-defined forwarding class to be used for prioritizing DAI packets:

   ```
   [edit class-of-service]
   user@switch# set forwarding-classes class class-name queue queue-number
   ```

2. Enable DAI on a specific VLAN or on all VLANs and apply the desired forwarding class on the DAI packets:

   - On a specific VLAN:

     ```
     [edit ethernet-switching-options secure-access port]
     user@switch# set vlan vlan-name arp-inspection forwarding-class class-name
     ```

   - On all VLANs:

     ```
     [edit ethernet-switching-options secure-access port]
     user@switch# set vlan all arp-inspection forwarding-class class-name
     ```

Related Documentation

- *Enabling Dynamic ARP Inspection (J-Web Procedure)*
- Example: Configuring Basic Port Security Features on page 4488
- Example: Configuring DHCP Snooping, DAI , and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch on page 4506
- Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks on page 4513
- *Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic*
- Verifying That DAI Is Working Correctly on page 4673
- Monitoring Port Security on page 4671

- Understanding DAI for Port Security on page 4463
- Understanding DAI for Port Security on page 4463
- **class-of-service on page 5717**
- *secure-access-port*
- **secure-access-port on page 4622**

Enabling a Trusted DHCP Server (CLI Procedure)

You can configure any interface on a switch that connects to a DHCP server as a trusted interface (port). Configuring a DHCP server on a trusted interface protects against rogue DHCP servers sending leases.

You configure a trusted DHCP server on an interface, not on a VLAN. By default, all access interfaces are untrusted, and all trunk interfaces are trusted.

To configure a trusted interface for a DHCP server by using the CLI (here, the interface is **ge-0/0/8**):

```
[edit ethernet-switching-options secure-access port]
user@switch# set interface ge-0/0/8 dhcp-trusted
```

Related Documentation

- *Enabling a Trusted DHCP Server (J-Web Procedure)*
- Example: Configuring Basic Port Security Features on page 4488
- Example: Configuring a DHCP Server Interface as Untrusted to Protect the Switch from Rogue DHCP Server Attacks on page 4503
- Verifying That a Trusted DHCP Server Is Working Correctly on page 4681
- Monitoring Port Security on page 4671
- Understanding Trusted DHCP Servers for Port Security on page 4467
- *secure-access-port*
- **secure-access-port on page 4622**

Enabling a Trusted Port for DHCP

By default, all access ports are untrusted and all trunk ports are trusted with regard to DHCP. Trusted ports allow DHCP servers to provide IP addresses and other information to requesting devices. Untrusted ports drop traffic from DHCP servers to prevent unauthorized servers from providing any configuration information to clients.

If you attach a DHCP server to an access port, you must configure it as trusted. You configure a trusted DHCP server on an interface, not on a VLAN.

NOTE: **Before you attach a DHCP server to a trusted access port, ensure that the server is physically secure—that is, that access to the server is monitored and controlled.**

- To configure a trusted interface for a DHCP server by using the CLI (here, the interface is **xe-0/0/8**):

```
[edit ethernet-switching-options secure-access port]
user@switch# set interface xe-0/0/8 dhcp-trusted
```

Related Documentation

- *Enabling a Trusted DHCP Server (J-Web Procedure)*
- Example: Configuring Basic Port Security Features on page 4488
- Example: Configuring a DHCP Server Interface as Untrusted to Protect the Switch from Rogue DHCP Server Attacks on page 4503
- Verifying That a Trusted DHCP Server Is Working Correctly on page 4681
- Monitoring Port Security on page 4671
- Understanding Trusted and Untrusted Ports on page 4467

Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)

You can use DHCP option 82, also known as the DHCP relay agent information option, to help protect the switch against attacks such as spoofing (forging) of IP addresses and MAC addresses, and DHCP IP address starvation. Option 82 provides information about the network location of a DHCP client, and the DHCP server uses this information to implement IP addresses or other parameters for the client.

You can configure the DHCP option 82 feature in two topologies:

- The switch, DHCP clients, and DHCP server are all on the same VLAN. The switch forwards the clients' requests to the server and forwards the server's replies to the clients. This topic describes this configuration.
- The switch functions as a relay agent when the DHCP clients or the DHCP server is connected to the switch through a Layer 3 interface. On the switch, these interfaces are configured as routed VLAN interfaces, or RVIs. The switch relays the clients' requests to the server and then forwards the server's replies to the clients. This configuration is described in "Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure)" on page 4560.

Before you configure DHCP option 82 on the switch, perform these tasks:

- Connect and configure the DHCP server.

  NOTE: Your DHCP server must be configured to accept DHCP option 82. If the server is not configured for DHCP option 82, the server does not use the DHCP option 82 information in the requests sent to it when it formulates its reply messages.

- Configure a VLAN on the switch and associate the interfaces on which the clients and the server connect to the switch with that VLAN.

To configure DHCP option 82:

NOTE: Replace values displayed in italics with values for your configuration.

1. Specify DHCP option 82 for all VLANs associated with the switch or for a specified VLAN. (You can also configure the feature for a VLAN range.)
   - On a specific VLAN:

     ```
     [edit ethernet-switching-options secure-access-port]
     user@switch# set vlan employee dhcp-option82
     ```
   - On all VLANs:

     ```
     [edit ethernet-switching-options secure-access-port]
     user@switch# set vlan all dhcp-option82
     ```

   The remaining steps are optional.
2. To configure a prefix for the circuit ID suboption (the prefix is always the hostname of the switch):

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee dhcp-option82 circuit-id prefix hostname
   ```
3. To specify that the circuit ID suboption value should contain the interface description rather than the interface name (the default):

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee dhcp-option82 circuit-id use-interface-description
   ```
4. To specify that the circuit ID suboption value should contain the VLAN ID rather than the VLAN name (the default):

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee dhcp-option82 circuit-id use-vlan-id
   ```
5. To specify that the remote ID suboption be included in the DHCP option 82 information:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee dhcp-option82 remote-id
   ```
6. To configure a prefix for the remote ID suboption (here, the prefix is the MAC address of the switch):

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee dhcp-option82 remote-id prefix mac
   ```
7. To specify that the prefix for the remote ID suboption be the hostname of the switch rather than the MAC address of the switch (the default):

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee dhcp-option82 remote-id prefix hostname
   ```
8. To specify that the remote ID suboption value should contain the interface description:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee dhcp-option82 remote-id use-interface-description
   ```
9. To specify that the remote ID suboption value should contain a character string:

   ```
   [edit ethernet-switching-options secure-access-port]
   user@switch# set vlan employee dhcp-option82 remote-id use-string mystring
   ```
10. To configure a vendor ID suboption and use the default value (the default value is **Juniper**), do not type a character string after the **vendor-id** option keyword:

    ```
    [edit ethernet-switching-options secure-access-port]
    ```

```
user@switch# set vlan employee dhcp-option82 vendor-id
```

11. To specify that the vendor ID suboption value should contain a character string value that you specify rather than **Juniper** (the default):

```
[edit ethernet-switching-options secure-access-port]
user@switch# set vlan employee dhcp-option82 vendor-id mystring
```

To view results of the configuration steps before committing the configuration, type the **show** command at the user prompt.

To commit these changes to the active configuration, type the **commit** command at the user prompt.

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server on page 4521
- *secure-access-port*
- **secure-access-port on page 4622**
- *Understanding DHCP Option 82 for Port Security on EX Series Switches*
- Understanding DHCP Option 82 for Port Security on page 4468
- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.

Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure)

You can use DHCP option 82, also known as the DHCP relay agent information option, to help switches against attacks such as spoofing (forging) of IP addresses and MAC addresses, and DHCP IP address starvation. Option 82 provides information about the network location of a DHCP client, and the DHCP server uses this information to implement IP addresses or other parameters for the client.

You can configure the DHCP option 82 feature in two topologies:

- The switch functions as a relay agent when the DHCP clients or the DHCP server is connected to the switch through a Layer 3 interface. On the switch, these interfaces are configured as routed VLAN interfaces, or RVIs. The switch relays the clients' requests to the server and then forwards the server's replies to the clients. This topic describes this configuration. The configuration for this topology is the same regardless of whether your switch is running Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style or not.
- The switch, DHCP clients, and DHCP server are all on the same VLAN. The switch forwards the clients' requests to the server and forwards the server's replies to the clients. This configuration for this topology differs if your switch is running Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style.
  - If your switch is running Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style. see *Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)*.
  - If your switch is running Junos OS for EX Series switches without support for ELS, see "Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)" on page 4557.

Before you configure DHCP option 82 on the switch, perform these tasks:

- Connect and configure the DHCP server.

  NOTE: **Your DHCP server must be configured to accept DHCP option 82. If the server is not configured for DHCP option 82, the server does not use the DHCP option 82 information in the requests sent to it when it formulates its reply messages.**

- Configure the VLAN on the switch and associate the interfaces on which the clients connect to the switch with that VLAN.
- Configure the routed VLAN interface (RVI) to allow the switch to relay packets to the server and receive packets from the server. See *Configuring Routed VLAN Interfaces (CLI Procedure)* or "Configuring Routed VLAN Interfaces" on page 1532 for the QFX Series.
- Configure the switch as a BOOTP relay agent. See *DHCP/BOOTP Relay for Switches Overview*.

To configure DHCP option 82:

NOTE: Replace values displayed in italics with values for your configuration.

1. Specify DHCP option 82 for the BOOTP server:
   - On all interfaces that connect to the server:

     ```
     [edit forwarding-options helpers bootp]
     user@switch# set dhcp-option82
     ```
   - On a specific interface that connects to the server:

     ```
     [edit forwarding-options helpers bootp]
     user@switch# set interface ge-0/0/10 dhcp-option82
     ```

     The remaining steps are optional. They show configurations for all interfaces; include the specific interface designation to configure any of the following options on a specific interface:
2. To configure a prefix for the circuit ID suboption (the prefix is always the hostname of the switch):

   ```
   [edit forwarding-options helpers bootp]
   user@switch# set dhcp-option82 circuit-id prefix hostname
   ```
3. To specify that the circuit ID suboption value should contain the interface description rather than the interface name (the default):

   ```
   [edit forwarding-options helpers bootp]
   user@switch# set dhcp-option82 circuit-id use-interface-description
   ```
4. To specify that the circuit ID suboption value should contain the VLAN ID rather than the VLAN name (the default):

   ```
   [edit forwarding-options helpers bootp]
   user@switch# set dhcp-option82 circuit-id use-vlan-id
   ```
5. To specify that the remote ID suboption be included in the DHCP option 82 information:

   ```
   [edit forwarding-options helpers bootp]
   user@switch# set dhcp-option82 remote-id
   ```
6. To configure a prefix for the remote ID suboption (here, the prefix is the MAC address of the switch):

   ```
   [edit forwarding-options helpers bootp]
   user@switch# set dhcp-option82 remote-id prefix mac
   ```
7. To specify that the prefix for the remote ID suboption be the hostname of the switch rather than the MAC address of the switch (the default):

   ```
   [edit forwarding-options helpers bootp]
   user@switch# set dhcp-option82 remote-id prefix hostname
   ```
8. To specify that the remote ID suboption value should contain the interface description:

   ```
   [edit forwarding-options helpers bootp]
   user@switch# set dhcp-option82 remote-id use-interface-description
   ```
9. To specify that the remote ID suboption value should contain a character string:

   ```
   [edit forwarding-options helpers bootp]
   user@switch# set dhcp-option82 remote-id use-string mystring
   ```
10. To configure a vendor ID suboption and use the default value (the default value is **Juniper**), do not type a character string after the **vendor-id** option keyword:

```
[edit forwarding-options helpers bootp]
user@switch# set dhcp-option82 vendor-id
```

11. To specify that the vendor ID suboption value contains a character string value that you specify rather than **Juniper** (the default):

```
[edit forwarding-options helpers bootp]
user@switch# set dhcp-option82 vendor-id mystring
```

To view results of the configuration steps before committing the configuration, type the **show** command at the user prompt.

To commit these changes to the active configuration, type the **commit** command at the user prompt.

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server on page 4525

- *[edit forwarding-options] Configuration Statement Hierarchy on EX Series Switches*
- *Understanding DHCP Option 82 for Port Security on EX Series Switches*

- Understanding DHCP Option 82 for Port Security on page 4468

- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.

Device Security Configuration Tasks

Configuring Unicast RPF (CLI Procedure)

Unicast reverse-path forwarding (RPF) can help protect your LAN from denial-of-service (DoS) and distributed denial-of-service (DDoS) attacks on untrusted interfaces. Enabling unicast RPF on the switch interfaces filters traffic with source addresses that do not use the incoming interface as the best return path back to the source. When a packet comes into an interface, if that interface is not the best return path to the source, the switch discards the packet. If the incoming interface is the best return path to the source, the switch forwards the packet.

NOTE: On EX3200, EX4200, and EX4300 switches, you can enable unicast RPF only globally—that is, on all switch interfaces. You cannot enable unicast RPF on a per-interface basis.

Before you begin:

- On an EX8200, EX6200, or QFX Series switch, ensure that the selected switch interface is symmetrically routed before you enable unicast RPF. A symmetrically routed interface is an interface that uses the same route in both directions between the source and the destination. Do not enable unicast RPF on asymmetrically routed interfaces. An asymmetrically routed interface uses different paths to send and receive packets between the source and the destination.

- On an EX3200, EX4200, or EX4300 switch, ensure that *all* switch interfaces are symmetrically routed before you enable unicast RPF on an interface. When you enable unicast RPF on any interface, it is enabled globally on all switch interfaces. Do not enable unicast RPF on asymmetrically routed interfaces. An asymmetrically routed interface uses different paths to send and receive packets between the source and the destination.

To enable unicast RPF, configure it explicitly on a selected customer-edge interface:

[edit interfaces]
user@switch# **set ge-1/0/10 unit 0 family inet rpf-check**

BEST PRACTICE: On EX3200, EX4200, and EX4300 switches, unicast RPF is enabled globally on *all* switch interfaces, regardless of whether you configure it explicitly on only one interface or only on some interfaces.

On EX3200, EX4200, and EX4300 switches, we recommend that you enable unicast RPF explicitly on either all interfaces or only one interface. To avoid possible confusion, do not enable it on only some interfaces:

- Enabling unicast RPF explicitly on only one interface makes it easier if you choose to disable it in the future because you must explicitly disable unicast RPF on every interface on which you explicitly enabled it. If you explicitly enable unicast RPF on two interfaces and you disable it on only one interface, unicast RPF is still implicitly enabled globally on the switch. The drawback of this approach is that the switch displays the flag that indicates that unicast RPF is enabled only on interfaces on which unicast RPF is explicitly enabled, so even though unicast RPF is enabled on all interfaces, this status is not displayed.
- Enabling unicast RPF explicitly on all interfaces makes it easier to know whether unicast RPF is enabled on the switch because every interface shows the correct status. (Only interfaces on which you explicitly enable unicast RPF display the flag that indicates that unicast RPF is enabled.) The drawback of this approach is that if you want to disable unicast RPF, you must explicitly disable it on every interface. If unicast RPF is enabled on any interface, it is implicitly enabled on all interfaces.

Related Documentation

- *Example: Configuring Unicast RPF on an EX Series Switch*
- Verifying Unicast RPF Status on page 4679
- Disabling Unicast RPF (CLI Procedure) on page 4564
- *Troubleshooting Unicast RPF*
- Understanding Unicast RPF on page 4473

Disabling Unicast RPF (CLI Procedure)

Unicast reverse-path forwarding (RPF) can help protect your LAN from denial-of-service (DoS) and distributed denial-of-service (DDoS) attacks on untrusted interfaces. Unicast RPF filters traffic with source addresses that do not use the incoming interface as the best return path back to the source. If the network configuration changes so that an interface that has unicast RPF enabled becomes a trusted interface or becomes asymmetrically routed (the interface that receives a packet is not the best return path to the packet's source), disable unicast RPF.

To disable unicast RPF on an EX3200, EX4200, or EX4300 switch, you must delete it from every interface on which you explicitly configured it. If you do not disable unicast RPF on every interface on which you explicitly enabled it, it remains implicitly enabled on all interfaces. If you attempt to delete unicast RPF from an interface on which it was not explicitly enabled, the **warning: statement not found** message appears. If you do not disable unicast RPF on every interface on which you explicitly enabled it, unicast RPF remains implicitly enabled on all interfaces of the EX3200, EX4200, or EX4300 switch.

On EX8200, EX6200, and QFX Series switches, the switch does not apply unicast RPF to an interface unless you explicitly enable that interface for unicast RPF.

To disable unicast RPF, delete its configuration from the interface:

[edit interfaces]
user@switch# **delete ge-1/0/10 unit 0 family inet** rpf-check

NOTE: On EX3200, EX4200, and EX4300 switches, if you do not disable unicast RPF on every interface on which you explicitly enabled it, unicast RPF remains implicitly enabled on all interfaces.

Related Documentation

- *Example: Configuring Unicast RPF on an EX Series Switch*
- Verifying Unicast RPF Status on page 4679
- Configuring Unicast RPF (CLI Procedure) on page 4562
- Understanding Unicast RPF on page 4473

Configuring Unknown Unicast Forwarding (CLI Procedure)

NOTE: This task uses Junos OS for EX Series switches or QFX Series with support for the Enhanced Layer 2 Software (ELS) configuration style. If your EX Series switch runs software that does not support ELS, see *Configuring Unknown Unicast Forwarding (CLI Procedure)*. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58

Unknown unicast traffic consists of packets with unknown destination MAC addresses. By default, the switch floods these packets to all interfaces associated with a VLAN. Forwarding such traffic to interfaces on the switch can create a security issue.

To prevent flooding unknown unicast traffic across the switch, configure unknown unicast forwarding to direct all unknown unicast packets within a VLAN out to a specific interface. You can configure each VLAN to divert unknown unicast traffic to different interfaces or use one interface for multiple VLANs.

To configure unknown unicast forwarding options:

- Configure unknown unicast forwarding for a specific VLAN (here, the VLAN name is employee), and specify the interface to which all unknown unicast traffic will be forwarded:

  ```
  [edit switch-options]
  user@switch# set unknown-unicast-forwarding vlan vlan-name interface ge-x/y/z.0
  ```

Related Documentation

- *Verifying That Unknown Unicast Packets Are Forwarded to a Single Interface*
- Understanding Unknown Unicast Forwarding on page 4477

Configuration Statements for Firewall Filters

family

Syntax

```
family family-name {
  filter filter-name {
    interface-specific;
    term term-name {
      from {
        match-conditions;
      }
      then {
        action;
        action-modifiers;
      }
    }
  }
}
```

Hierarchy Level [edit firewall]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a firewall filter for IP version 4 or IP version 6.

Options *family-name*—Type of addressing protocol:

- **ethernet-switching**—Filter Layer 2 Ethernet packets and Layer 3 (IP) packets (allows some Layer 3 filtering).
- **inet**—Filter Layer 3 IPv4 packets (provides additional Layer 3 filter options).
- **inet6**—Filter Layer 3 IPv6 packets (provides additional Layer 3 filter options).

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Firewall Filter Match Conditions and Actions on page 4419
- Configuring Firewall Filters on page 4531
- Overview of Firewall Filters on page 4409

filter

Syntax

```
filter filter-name {
  interface-specific;
  term term-name {
    from {
      match-conditions;
    }
    then {
      action;
      action-modifiers;
    }
  }
}
```

Hierarchy Level [edit firewall family *family-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure firewall filters.

Options ***filter-name***—Name that identifies the filter. The name can contain letters, numbers, and hyphens (-), and can be up to 64 characters long. To include spaces in the name, enclose it in quotation marks.

The remaining statements are explained separately.

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Firewall Filter Match Conditions and Actions on page 4419
- Configuring Firewall Filters on page 4531
- Overview of Firewall Filters on page 4409

filter (Layer 2 and Layer 3 Interfaces)

Syntax filter (input | output) *filter-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family *family-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Apply a firewall filter to traffic transiting a port or Layer 3 interface.

Default All incoming traffic is accepted unmodified on the port or Layer 3 interface, and all outgoing traffic is sent unmodified from the port or Layer 3 interface.

Options *filter-name*—Name of a firewall filter defined at the **[edit firewall family *family-name* filter]** hierarchy level.

input—Apply a firewall filter to traffic entering the port or Layer 3 interface.

output—Apply a firewall filter to traffic exiting the port or Layer 3 interface.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Gigabit Ethernet Interfaces (CLI Procedure)
- Configuring Firewall Filters on page 4531
- Overview of Firewall Filters on page 4409

filter (VLANs)

Syntax filter (input | output) *filter-name*;

Hierarchy Level [edit vlans *vlan-name*]
[edit vlans *vlan-name* forwarding-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Apply a firewall filter to traffic ingressing or egressing a VLAN.

Default All incoming traffic is accepted unmodified to a VLAN, and all outgoing traffic is sent unmodified from a VLAN.

Options *filter-name*—Name of a firewall filter defined at the **[edit firewall family *family-name* filter]** hierarchy level.

input—Apply a firewall filter to VLAN ingress traffic.

output—Apply a firewall filter to VLAN egress traffic.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Firewall Filters on page 4531
- Overview of Firewall Filters on page 4409

firewall

Syntax

```
firewall {
  family family-name {
    filter filter-name {
      interface-specific;
      term term-name {
        from {
          match-conditions;
        }
        then {
          action;
          action-modifiers;
        }
      }
    }
  }
  policer policer-name {
    filter-specific;
    if-exceeding {
      bandwidth-limit bps;
      burst-size-limit bytes;
    }
    then {
      policer-action;
    }
  }
  three-color-policer policer-name {
    action {
      loss-priority high then discard;
    }
    single-rate {
      (color-aware | color-blind);
      committed-information-rate bps;
      committed-burst-size bytes;
      excess-burst-size bytes;
    }
    two-rate {
      (color-aware | color-blind);
      committed-information-rate bps;
      committed-burst-size bytes;
      peak-information-rate bps;
      peak-burst-size bytes;
    }
  }
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure firewall filters and policers.

The remaining statements are explained separately.

Required Privilege Level
firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation
- Firewall Filter Match Conditions and Actions on page 4419
- Configuring Firewall Filters on page 4531
- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Firewall Filters on page 4409

from

Syntax

```
from {
  match-conditions;
}
```

Hierarchy Level [edit **firewall family** *family-name* **filter** *filter-name* **term** *term-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Match packet fields to values specified in a match condition. If the **from** statement is not included in a firewall filter configuration, all packets are considered to match and the actions and action modifiers in the **then** statement are implemented.

Options *match-conditions*—Conditions that define the values or fields that the incoming or outgoing packets must contain for a match. You can specify one or more match conditions. If you specify more than one, they all must match for a match to occur and for the action in the **then** statement to be implemented.

Required Privilege Level
firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation
- Firewall Filter Match Conditions and Actions on page 4419
- Configuring Firewall Filters on page 4531
- Understanding Firewall Filter Match Conditions on page 4415

interface-specific

Syntax interface-specific;

Hierarchy Level [edit firewall family *family-name* filter *filter-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure separate counters for each interface to which a filter is applied.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Firewall Filter Match Conditions and Actions on page 4419
- Configuring Firewall Filters on page 4531
- Overview of Firewall Filters on page 4409

term

Syntax

```
term term-name {
  from {
    match-conditions;
  }
  then {
    action;
    action-modifiers;
  }
}
```

Hierarchy Level [edit firewall family *family-name* filter *filter-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define a firewall filter term.

Options *term-name*—Name that identifies the term. The name can contain letters, numbers, and hyphens (-), and can be up to 64 characters long. To include spaces in the name, enclose it in quotation marks.

The remaining statements are explained separately.

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Firewall Filter Match Conditions and Actions on page 4419
- Configuring Firewall Filters on page 4531
- Overview of Firewall Filters on page 4409

then (Filters)

Syntax

```
then {
  action;
  action-modifiers;
}
```

Hierarchy Level [edit firewall family *family-name* filter *filter-name* term *term-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a firewall filter action.

Options *action*—Actions to accept, discard, or forward packets that match all conditions specified in a filter term.

action-modifiers—Additional actions to analyze, classify, count, or police packets that match all conditions specified in a filter term.

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Firewall Filter Match Conditions and Actions on page 4419
- Configuring Firewall Filters on page 4531
- Understanding Firewall Filter Match Conditions on page 4415

Configuration Statements for Policers

- single-rate on page 4588
- then (Policers) on page 4589
- three-color-policer on page 4590
- two-rate on page 4591

action

Syntax

```
action {
  loss-priority high then discard;
}
```

Hierarchy Level [edit firewall three-color-policer *name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Discard traffic on a logical interface using tricolor marking policing.

Options The statements are explained separately.

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

bandwidth-limit

Syntax bandwidth-limit *bps*;

Hierarchy Level [edit firewall policer *policer-name* if-exceeding]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the traffic rate in bits per second.

Options *bps*—Traffic rate in bits per second. Specify *bps* as a decimal value or as a decimal number followed by one of the abbreviation **k** (1000), **m** (1,000,000), or **g** (1,000,000,000).

Range: 32000 bps (32 Kbps) through 10,000,000,000 bps (10 Gbps)

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

burst-size-limit

Syntax burst-size-limit *bytes*;

Hierarchy Level [edit firewall policer *policer-name* if-exceeding]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the maximum allowed burst size to control the amount of traffic bursting.

Options *bytes*—Decimal value or a decimal number followed by k (thousand), m (million), or g (giga).

Range: 1 through 2,147,450,880 bytes (2147 MB)

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

color-aware

Syntax color-aware;

Hierarchy Level [edit firewall three-color-policer *policer-name* single-rate],
[edit firewall three-color-policer *policer-name* two-rate]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the way preclassified packets are metered. In color-aware mode, the switch can assign a higher packet-loss priority, but cannot assign a lower packet loss priority (PLP). For example, suppose an upstream device assigns medium-high PLP to a packet because the packet exceeded its committed information rate (CIR). The switch cannot change the PLP to low even if the packet conforms to the configured CIR of the appropriate interface. On the other hand, if an upstream device assigns low PLP to a packet but the packet exceeds the CIR and committed burst size (CBS) of the switch interface, the switch can increase the PLP to medium-high.

Default If you omit the **color-aware** statement, the default behavior is color-aware mode.

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Overview of Policers on page 4441
- Understanding Color-Aware Mode for Single-Rate Tricolor Marking on page 4447
- Understanding Color-Aware Mode for Two-Rate Tricolor Marking on page 4449
- **color-blind on page 4577**

color-blind

Syntax color-blind;

Hierarchy Level [edit firewall three-color-policer *policer-name* single-rate],
[edit firewall three-color-policer *policer-name* two-rate]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the way preclassified packets are metered. In color-blind mode, the switch ignores any preclassification of packets and can assign a higher or lower packet loss priority (PLP). For example, suppose an upstream device assigns medium-high PLP to a packet because the packet exceeded the CIR on the upstream device. The switch can change the PLP to low if the packet conforms to the CIR of the appropriate interface.

Default If you omit the **color-blind** statement, the default behavior is color-aware mode.

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Overview of Policers on page 4441
- Understanding Color-Blind Mode for Single-Rate Tricolor Marking on page 4447
- Understanding Color-Blind Mode for Two-Rate Tricolor Marking on page 4449
- Configuring Color-Blind Egress Policers for Medium-Low PLP on page 4537
- **color-aware on page 4576**

committed-burst-size

Syntax committed-burst-size *bytes*;

Hierarchy Level [edit firewall three-color-policer *policer-name* single-rate],
[edit firewall three-color-policer *policer-name* two-rate]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the maximum number of bytes allowed for incoming traffic to burst above the committed information rate and still be marked with low packet loss priority (green).

NOTE: When you include the **committed-burst-size** statement in the configuration, you must also include the **committed-information-rate** statement at the same hierarchy level.

Options *bytes*—Number of bytes. You can specify a value in bytes either as a complete decimal number or as a decimal number followed by the abbreviation **k** (1000), **m** (1,000,000), or **g** (1,000,000,000).

Range: 512 bytes through 268435456 bytes (268 MB)

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

committed-information-rate

Syntax committed-information-rate *bits-per-second*;

Hierarchy Level [edit firewall three-color-policer *policer-name* single-rate],
[edit firewall three-color-policer *policer-name* two-rate]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the guaranteed bandwidth under normal line conditions and the average rate up to which packets are marked with low packet loss priority (green).

NOTE: When you include the **committed-information-rate** statement in the configuration, you must also include the **committed-burst-size** statement at the same hierarchy level.

Options *bits-per-second*—Number of bits per second. You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation **k** (1000), **m** (1,000,000), or **g** (1,000,000,000).

Range: 32,000 bps through 10,000,000,000 bps (10 gbps)

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

excess-burst-size

Syntax excess-burst-size *bytes*;

Hierarchy Level [edit firewall three-color-policer *policer-name* single-rate]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the maximum number of bytes allowed for incoming traffic to burst above the committed information rate and still be marked with medium-high packet loss priority (yellow). Packets that exceed the excess burst size (EBS) are marked with high packet loss priority (red).

NOTE: When you include the **excess-burst-size** statement in the configuration, you must also include the **committed-burst-size** and **committed-information-rate** statements at the same hierarchy level.

Options *bytes*—Number of bytes. You can specify a value in bytes either as a complete decimal number or as a decimal number followed by the abbreviation **k** (1000), **m** (1,000,000), or **g** (1,000,000,000).

Range: 512 bytes through 268435456 bytes (268 MB)

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

filter-specific

Syntax filter-specific;

Hierarchy Level [edit firewall policer *policer-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a policer to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. If you use a filter-specific policer in multiple terms, both of the following are true:

- Traffic is policed at the aggregate rate. For example, if you create a policer that has a bandwidth limit of 100 Mbps and use the policer in two terms, the total allowed bandwidth for both terms is 100 Mbps—not 100 Mbps for each term.
- The implicit counter counts all the packets are that matched by any of the terms. For example, if you reference the same filter-specific policer in term1 and term2, and term1 matches 1000 packets and term2 matches 500 packets, the implicit counter shows 1500 matches for the policer.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

firewall

Syntax

```
firewall {
  family family-name {
    filter filter-name {
      interface-specific;
      term term-name {
        from {
          match-conditions;
        }
        then {
          action;
          action-modifiers;
        }
      }
    }
  }
  policer policer-name {
    filter-specific;
    if-exceeding {
      bandwidth-limit bps;
      burst-size-limit bytes;
    }
    then {
      policer-action;
    }
  }
  three-color-policer policer-name {
    action {
      loss-priority high then discard;
    }
    single-rate {
      (color-aware | color-blind);
      committed-information-rate bps;
      committed-burst-size bytes;
      excess-burst-size bytes;
    }
    two-rate {
      (color-aware | color-blind);
      committed-information-rate bps;
      committed-burst-size bytes;
      peak-information-rate bps;
      peak-burst-size bytes;
    }
  }
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure firewall filters and policers.

The remaining statements are explained separately.

Required Privilege Level

firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Firewall Filter Match Conditions and Actions on page 4419
- Configuring Firewall Filters on page 4531
- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Firewall Filters on page 4409

if-exceeding

Syntax

```
if-exceeding {
  bandwidth-limit bps;
  burst-size-limit bytes;
}
```

Hierarchy Level [edit firewall policer *policer-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure policer rate limits.

The remaining statements are explained separately.

Required Privilege Level

firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

loss-priority high then discard (Three-Color Policer)

Syntax loss-priority high then discard;

Hierarchy Level [edit firewall three-color-policer *policer-name* action]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For packets with high loss priority, discard the packets. The loss priority setting is not configurable. Include this statement if you do not want the switch to forward packets that have high packet-loss priority.

For single-rate three-color policers, Junos OS assigns high loss priority to packets that exceed the committed information rate and the excess burst size.

For two-rate three-color policers, Junos OS assigns high loss priority to packets that exceed the peak information rate and the peak burst size.

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

peak-burst-size

Syntax peak-burst-size *bytes*;

Hierarchy Level [edit firewall three-color-policer *policer-name* two-rate]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the maximum number of bytes allowed for incoming packets to burst above the peak information rate (PIR) and still be marked with medium-high packet loss priority (yellow). Packets that exceed the peak burst size (PBS) are marked with high packet loss priority (red).

NOTE: When you include the **peak-burst-size** statement in the configuration, you must also include the **committed-burst-size** and **peak-information-rate** statements at the same hierarchy level.

Options *bytes*—Number of bytes. You can specify a value in bytes either as a complete decimal number or as a decimal number followed by the abbreviation **k** (1000), **m** (1,000,000), or **g** (1,000,000,000).

Range: 1500 bytes through 100,000,000,000 bytes (100 GB)

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

peak-information-rate

Syntax peak-information-rate *bits-per-second*;

Hierarchy Level [edit firewall three-color-policer *policer-name* two-rate]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the maximum achievable rate. Packets that exceed the committed information rate (CIR) but are below the peak information rate (PIR) are marked with medium-high packet loss priority (yellow). Packets that exceed the PIR are marked with high packet loss priority (red). You can configure a discard action for packets that exceed the PIR.

NOTE: When you include the **peak-information-rate** statement in the configuration, you must also include the **committed-information-rate** and **peak-burst-size** statements at the same hierarchy level.

Options *bits-per-second*—Number of bits per second. You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation **k** (1000), **m** (1,000,000), or **g** (1,000,000,000).

Range: 32,000 bps through 10,000,000,000 bps (10 gbps)

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

policer

Syntax

```
policer policer-name {
  filter-specific;
  if-exceeding {
    bandwidth-limit bps;
    burst-size-limit bytes;
  }
  then {
    policer-action;
  }
}
```

Hierarchy Level [edit firewall]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure policer rate limits and actions. To activate a policer, you must include the **policer** action modifier in the **then** statement in a firewall filter term.

Each policer that you configure includes an implicit counter that counts the number of packets that exceed the rate limits that are specified for the policer. If you use the same policer in multiple terms—either within the same filter or across filters—the policer's implicit counter is used to count packets that are policed in all of these terms. If you want to obtain separate packet counts for each term, use these approaches:

- Configure a unique policer for each term.
- Configure only one policer, but use a unique, explicit counter in each term.

Options ***policer-name***—Name that identifies the policer. The name can contain letters, numbers, hyphens (-), and can be up to 64 characters long.

The remaining statements are explained separately.

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Configuring Firewall Filters on page 4531
- Overview of Policers on page 4441

single-rate

Syntax

```
single-rate {
  (color-aware | color-blind);
  committed-information-rate bps;
  committed-burst-size bytes;
  excess-burst-size bytes;
}
```

Hierarchy Level [edit firewall three-color-policer *policer-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a single-rate three-color policer in which marking is based on the committed information rate (CIR), committed burst size (CBS), and excess burst size (EBS).

Packets that conform to the CIR or the CBS are assigned low loss priority (green). Packets that exceed the CIR and the CBS but are within the EBS are assigned medium-high loss priority (yellow). Packets that exceed the EBS are assigned high loss priority (red).

Green and yellow packets are always forwarded; this action is not configurable. You can configure red packets to be discarded. By default, red packets are forwarded.

The remaining statements are explained separately.

Options *policer-name*—Name of the three-color policer. Use this name when you apply the policer to an interface.

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

then (Policers)

Syntax

```
then {
  policer-action;
}
```

Hierarchy Level [edit firewall policer *policer-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a policer action.

Options *policer-action*—Allowed policer actions are **discard**, **loss-priority high**, and **loss-priority low**. **discard** causes the system to drop traffic that exceeds the rate limits defined by the policer. Use **loss-priority high** to allow the system to forward matching traffic in some cases.

NOTE: **If you specify a policer in an egress firewall filter, the only supported action is discard.**

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Configuring Firewall Filters on page 4531
- Overview of Policers on page 4441

three-color-policer

Syntax

```
three-color-policer policer-name {
  action {
    loss-priority high then discard;
  }
  single-rate {
    (color-aware | color-blind);
    committed-information-rate bps;
    committed-burst-size bytes;
    excess-burst-size bytes;
  }
  two-rate {
    (color-aware | color-blind);
    committed-information-rate bps;
    committed-burst-size bytes;
    peak-information-rate bps;
    peak-burst-size bytes;
  }
}
```

Hierarchy Level

[edit firewall],
[edit logical-systems *logical-system-name* firewall]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure a three-color policer.

Options

policer-name—Name of the three-color policer. Use this name when you apply the policer to an interface.

The remaining statements are explained separately.

Required Privilege Level

firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Overview of Policers on page 4441

two-rate

Syntax

```
two-rate {
  (color-aware | color-blind);
  committed-information-rate bps;
  committed-burst-size bytes;
  peak-information-rate bps;
  peak-burst-size bytes;
}
```

Hierarchy Level [edit firewall three-color-policer *policer-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a two-rate three-color policer in which marking is based on the committed information rate (CIR), committed burst size (CBS), peak information rate (PIR), and peak burst size (PBS).

Packets that conform to the CIR or the CBS are assigned low loss priority (green). Packets that exceed the CIR and the CBS but are within the PIR or the PBS are assigned medium-high loss priority (yellow). Packets that exceed the PIR and the PBS are assigned high loss priority (red).

Green and yellow packets are always forwarded; this action is not configurable. You can configure red packets to be discarded. By default, red packets are forwarded.

The remaining statements are explained separately.

Required Privilege Level firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Configuration Statements for Port Security

circuit-id

Syntax

```
circuit-id {
  prefix hostname;
  use-interface-description;
  use-vlan-id;
}
```

Hierarchy Level

- For platforms with ELS:

  [edit vlans *vlan-name* forwarding-options dhcp-security option-82]

- For platforms without ELS:

  [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*) dhcp-option82],
  [edit forwarding-options helpers bootp dhcp-option82] ,
  [edit forwarding-options helpers bootp interface *interface-name* dhcp-option82]

Release Information

Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Hierarchy level **[edit vlans *vlan-name* forwarding-options dhcp-security]** introduced in Junos OS Release 13.2X50-D10. (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)

Description

Configure the **circuit-id** suboption (suboption 1) of DHCP option 82 (the DHCP relay agent information option) in DHCP packets destined for a DHCP server. This suboption identifies the circuit (the interface, the VLAN, or both) on which the DHCP request arrived.

The remaining statements are explained separately.

Default

If DCHP option 82 is enabled on the switch, the circuit ID is supplied by default in the format ***interface-name*:*vlan-name*** or, on a Layer 3 interface, just ***interface-name***.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server on page 4521
- Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server on page 4525
- Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4557
- Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4560
- *Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)*
- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.

dhcp-snooping-file

Syntax

```
dhcp-snooping-file {
  location local_pathname | remote_URL;
  timeout seconds;
  write-interval seconds;
}
```

Hierarchy Level

For platforms without ELS:

[edit ethernet-switching-options secure-access-port]

For platforms with ELS:

[edit system processes] dhcp-service]

Release Information

Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Specify a local pathname or remote URL for the DHCP snooping database file to maintain persistence of IP-MAC bindings.

The remaining statements are explained separately.

Default

The IP-MAC bindings in the DHCP snooping database file are not persistent. If the switch is rebooted, the bindings are lost.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding DHCP Snooping for Port Security on page 4456

fc-map

Syntax fc-map *fc-map-value*;

Hierarchy Level Original CLI

[edit ethernet-switching options secure-access-port vlan (all | *vlan-name*) examine-fip]

ELS CLI for Platforms that Support FCoE

[edit vlans *vlan-name* forwarding-options fip-security]

NOTE: The fc-map configuration statement is in a different hierarchy on the original CLI than on the Enhanced Layer 2 Software (ELS) CLI.

QFX Series that Support FCoE-FC Gateway Configuration

[edit fc-fabrics *fc-fabric-name* protocols fip]

Release Information Statement introduced in Junos OS Release 10.4 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.

Description Set the FCoE mapped address prefix (FC-MAP) value for the FCoE VLAN to match the FC switch (or FCoE forwarder) FC-MAP value for the FC fabric. The FC-MAP value is a unique MAC address prefix an FC switch uses to identify FCoE traffic for a given FC fabric (traffic on a particular FCoE VLAN).

You can configure the FC-MAP value or use the default value. The default FC-MAP value is different for VN_Port to VF_Port (VN2VF_Port) FIP snooping (0x0EFC00) than for VN_Port to VN_Port (VN2VN_Port) FIP snooping.

The FC switch provides the FC-MAP value to FCoE nodes (ENodes) in the FIP discovery advertisement message. If the EX Series switch or the QFX Series FCoE VLAN FC-MAP value does not match the FC switch FC-MAP value, neither device discovers the FC switch on that VLAN, and the ENodes on that VLAN cannot access the FC switch. The FC switch accepts only FCoE traffic that uses the correct FC-MAP value as part of the VN_Port MAC address.

When the QFX Series acts as an FCoE-FC gateway, the FC-MAP value for the gateway and the FCoE devices must match the FC switch FC-MAP value in order to communicate with the FC switch.

NOTE: Changing the FC-MAP value causes all logins to drop and forces the ENodes to log in again.

Options *fc-map-value*—FC-MAP value, hexadecimal value preceded by “0x”.

Range: 0x0EFC00 through 0x0EFCFF

Default: 0x0EFC00 for VN2VF_Port FIP snooping0x0EFD00 for VN2VN_Port FIP snooping

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **examine-fip on page 4613**
- **show fip snooping on page 5254**
- *Example: Configuring an FCoE Transit Switch*
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069

fcoe-trusted

Syntax

fcoe-trusted;

Hierarchy Level

Original CLI

[edit ethernet-switching-options secure-access-port interface *interface-name*]

ELS CLI for Platforms that Support FCoE

[edit vlans *vlan-name* forwarding-options fip-security interface *interface-name*]

NOTE: The **fcoe-trusted** configuration statement is in a different hierarchy on the original CLI than on the Enhanced Layer 2 Software (ELS) CLI.

QFX Series that Support FCoE-FC Gateway Configuration

[edit fc-fabrics *fc-fabric-name* protocols fip]

Release Information

Statement introduced in Junos OS Release 10.4 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced for the FC fabric in Junos OS Release 11.3 for the QFX Series.
Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.

Description

Configure the specified 10-Gigabit Ethernet interface to trust Fibre Channel over Ethernet (FCoE) traffic. If an interface is connected to another switch such as an FCoE forwarder (FCF) or a transit switch, you can configure the interface as trusted so that the interface forwards FCoE traffic from the switch to the FCoE devices without installing FIP snooping filters.

(QFX Series FCoE-FC gateway) Configure the specified local Fibre Channel fabric to trust FCoE traffic on all ports in the fabric. Changing the fabric ports from untrusted to trusted removes any existing FIP snooping filters from the ports. Changing the fabric ports from trusted to untrusted by removing the **fcoe-trusted** configuration from the fabric forces all of the FCoE sessions on those ports to log out so that when the ENodes and VN_Ports log in again, the switch can build the appropriate FIP snooping filters.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show fip snooping on page 5254**
- *Example: Configuring an FCoE Transit Switch*
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069

mac-move-limit

Syntax mac-move-limit *limit* <fabric-limit *limit*> action *action*;

Hierarchy Level For platforms without ELS:

[edit ethernet-switching-options secure-access-port (all | *vlan-name*)]

For platforms with ELS:

[edit vlans *vlan-name* switch-options],

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify the number of times a MAC address can move to a new interface (port) in 1 second and the action to be taken by the switch if the MAC address move limit is exceeded.

Default The default move limit is unlimited. The default action is **drop**.

Options **fabric-limit**—Specify the maximum number of moves in a QFabric system. If you do not specify a fabric limit, the value for **mac-move-limit** applies to the QFabric system.

limit—Maximum number of moves to a new interface per second.

action ***action***—(Optional) Action to take when the MAC address move limit is reached:

- **drop**—Drop the packet and generate an alarm, an SNMP trap, or a system log entry. This is the default.
- **log**—Do not drop the packet but generate an alarm, an SNMP trap, or a system log entry.
- **none**—No action.
- **shutdown**—Disable the interface and generate an alarm. If you have configured the switch with the **port-error-disable** statement, the disabled interfaces recover automatically upon expiration of the specified disable timeout. If you have not configured the switch for autorecovery from port error disabled conditions, you can bring up the disabled interfaces by running the **clear-ethernet-switch-port** command.

Required Privilege Level system—To view this statement in the configuration.
system–control—To add this statement to the configuration.

Related Documentation

- **mac-limit on page 4617**
- Example: Configuring Basic Port Security Features on page 4488
- Configuring MAC Move Limiting (CLI Procedure) on page 4547
- *Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)*

no-allowed-mac-log

Syntax no-allowed-mac-log;

Hierarchy Level

- For platforms without ELS:

  [edit ethernet-switching-options secure-access-port interface (all | *interface-name*)]

- For platforms with ELS:

  [edit switch-options interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify that the switch should not log messages when it receives packets from invalid MAC addresses on an interface that has been configured for allowed MAC addresses.

Default The switch logs messages when it receives packets from invalid MAC addresses on an interface that has been configured for particular allowed (specific) MAC addresses.

Required Privilege Level routing—To view this statement in the configuration.
routing–control—To add this statement to the configuration.

Related Documentation

- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Configuring MAC Limiting on page 4545
- allowed-mac on page 4605
- mac-limit on page 4617

no-gratuitous-arp-request

Syntax no-gratuitous-arp-request;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces interface-range *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the switch not to respond to gratuitous ARP requests. You can disable responses to gratuitous ARP requests on both Layer 2 Ethernet switching interfaces and routed VLAN interfaces (RVIs).

Default Gratuitous ARP responses are enabled on all Ethernet switching interfaces and RVIs.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Routed VLAN Interfaces on page 1532

persistent-learning

Syntax persistent-learning;

Hierarchy Level

- For platforms without ELS:

  [edit ethernet-switching-options secure-access-port interface (all | *interface-name*)]

- For platforms with ELS:

  [edit switch-options interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.4 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Hierarchy level [edit switch-options interface interface-name] introduced in Junos OS Release 13.2X50-D10

Description Specify that learned MAC addresses persist on the specified interfaces across restarts of the switch and link-down conditions. This feature is also known as sticky MAC.

Required Privilege Level system—To view this statement in the configuration.
system–control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Basic Port Security Features on page 4488
- *Configuring Persistent MAC Learning (CLI Procedure)*
- *Configuring Persistent MAC Learning (CLI Procedure)*

port-error-disable

Syntax

```
port-error-disable {
  (disable-timeout seconds | recovery-timeout seconds);
}
```

Hierarchy Level

- For platforms without ELS:

  [edit ethernet-switching-options]

- For platforms with ELS:

  [edit switch-options]

Release Information Statement introduced in Junos OS Release 11.1 on the QFX Series.

Description Disable rather than block an interface when enforcing MAC limiting, MAC move limiting, and storm control, and allow the interface to recover automatically from the error condition after a specified period of time:

NOTE: The **port-error-disable** configuration does not apply to preexisting error conditions. It affects only error conditions that are detected after you enable and commit the **port-error-disable** statement. To clear a preexisting error condition and restore the interface to service, use the clear ethernet-switching port-error command.

- If you enable the mac-limit statement with the **shutdown** option and also enable the **port-error-disable** statement, the switch disables (rather than shuts down) the interface when the MAC address limit is reached.
- If you have enabled the mac-move-limit statement with the **shutdown** option and you enable the **port-error-disable** statement, the switch disables (rather than shuts down) the interface when the maximum number of moves to a new interface is reached.
- If you enable the storm-control statement with the **action-shutdown** option and you also enable **port-error-disable**, the switch disables (rather than shuts down) the interface when broadcast traffic and unknown unicast traffic exceed the specified levels.

Default Not enabled.

Required Privilege Level routing—To view this statement in the configuration.
routing–control—To add this statement to the configuration.

Related Documentation

- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Understanding Storm Control on page 4471
- Example: Configuring Storm Control to Prevent Network Outages on page 4527

- Configuring Autorecovery for MAC Limited or Storm Control Interfaces (CLI Procedure) on page 4549
- **action-shutdown on page 4650**
- **disable-timeout on page 4609**
- **clear ethernet-switching port-error on page 4686**

vendor-id

Syntax vendor-id <*string*>;

Hierarchy Level

- For platforms with ELS:

  [edit vlans *vlan-name* forwarding-options dhcp-security option-82]

- For platforms without ELS:

  [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*) dhcp-option82],
  [edit forwarding-options helpers bootp dhcp-option82],
  [edit forwarding-options helpers bootp interface *interface-name* dhcp-option82]

Release Information Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Hierarchy level **[edit vlans *vlan-name* forwarding-options dhcp-security]** introduced in Junos OS Release 13.2X50-D10. (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)

Description Insert a vendor ID in the DHCP option 82 information in a DHCP request packet header before forwarding or relaying the request to a DHCP server.

Default If **vendor-id** is not explicitly configured for DHCP option 82, then no vendor ID is set.

Options ***string***—(Optional) A single string that designates the vendor ID.

Range: 1–255 characters

Default: If you specify **vendor-id** with no ***string*** value, then the default vendor ID **Juniper Networks** is configured.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server on page 4521
- Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server on page 4525
- Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4557
- *Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)*
- Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4560

write-interval

Syntax write-interval *seconds*;

Hierarchy Level For platforms without ELS:

[edit ethernet-switching-options secure-access-port dhcp-snooping-file]

For platforms with ELS:

[edit system processes] dhcp-service dhcp-snooping-file]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify how frequently the switch writes the database entries from memory into the specified DHCP snooping database file.

Default None

Options *seconds*—Value in seconds.

Range: 60 through 86400

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding DHCP Snooping for Port Security on page 4456

Configuration Statements for Port Security (Original CLI Only)

allowed-mac

Syntax allowed-mac *mac-address-list*

Hierarchy Level [edit ethernet-switching-options secure-access-port interface (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify particular MAC addresses to be added to the MAC address cache.

NOTE: Although this configuration restricts the addresses that can be added to the MAC address cache, it does not block the switch from receiving Layer 2 control packets—such as Link Layer Discovery Protocol (LLDP) packets—transmitted from MAC addresses that are not specified in the list of allowed MAC addresses. Control packets do not undergo the MAC address check, and they are therefore included in the statistics of packets received, though, they are not forwarded to another destination.

Default Allowed MAC addresses take precedence over dynamic MAC values. For example, if the **mac-limit** statement is set to four and three allowed MACs are configured, only one dynamic MAC can be learned on that interface.

Options *mac-address-list*—One or more MAC addresses configured as allowed MAC addresses for a specified interface or all interfaces.

Required Privilege Level routing—To view this statement in the configuration.
routing–control—To add this statement to the configuration.

Related Documentation

- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Configuring MAC Limiting on page 4545
- Configuring MAC Move Limiting (CLI Procedure) on page 4547
- **mac-limit on page 4617**
- **no-allowed-mac-log on page 4598**

arp-inspection

Syntax

```
(arp-inspection | no-arp-inspection) {
  forwarding-class (for DHCP Snooping or DAI Packets) class-name;
}
```

Hierarchy Level [editethernet-switching-options secure-access-port vlan (all | *vlan-name*)]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Perform dynamic ARP inspection on all VLANs or on the specified VLAN.

- **arp-inspection**—Enable ARP inspection.

NOTE: When ARP inspection is enabled, the switch logs ARP request packets that it rejects.

- **no-arp-inspection**—Disable ARP inspection.

Default Disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Enabling Dynamic ARP Inspection (CLI Procedure) on page 4553
- Example: Configuring Basic Port Security Features on page 4488Example: Configuring DHCP Snooping, DAI , and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch on page 4506
- Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks on page 4513

dhcp-trusted

Syntax (dhcp-trusted | no-dhcp-trusted);

Hierarchy Level [edit ethernet-switching-options secure-access-port interface (Access Port Security) (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Allow or deny DHCP responses from the specified interfaces (ports) or all interfaces.

- **dhcp-trusted**—Allow DHCP responses.
- **no-dhcp-trusted**—Deny DHCP responses.

Default Trusted for trunk ports, untrusted for access ports.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Overview of Access Port Protection on page 4451
- Enabling a Trusted Port for DHCP on page 4556

dhcp-option82

Syntax

```
dhcp-option82 {
  circuit-id {
    prefix hostname;
    use-interface-description;
    use-vlan-id;
  }
  remote-id {
    prefix hostname | mac | none;
    use-interface-description;
    use-string string;
  }
  vendor-id <string>;
}
```

Hierarchy Level

[edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*)]
[edit forwarding-options helpers bootp]
[edit forwarding-options helpers bootp interface *interface-name*]

Release Information

Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

When the switch receives a DHCP request from a DHCP client connected on one of the switch's interfaces, have the switch insert DHCP option 82 (also known as the DHCP relay agent information option) information in the DHCP request packet header before it forwards or relays the request to a DHCP server. The server uses the option 82 information, which provides details about the circuit and host the request came from, in formulating the reply; the server does not, however, make any changes to the option 82 information in the packet header. The switch receives the reply and then removes the DHCP option 82 information before forwarding the reply to the client.

The remaining statements are explained separately.

Default

Insertion of DHCP option 82 information is not enabled.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server on page 4521
- Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server on page 4525
- Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4557
- Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4560
- *[edit forwarding-options] Configuration Statement Hierarchy on EX Series Switches*

- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.

disable-timeout (Port Error Disable)

Syntax disable-timeout *timeout*;

Hierarchy Level [edit ethernet-switching-options port-error-disable]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify how long Ethernet switching interfaces remain in a disabled state due to MAC limiting, MAC move limiting, or storm control errors.

NOTE: If you modify an existing timeout value, the new timeout value does not affect currently disabled interfaces are configured for automatic recovery. The new timeout value applies only to subsequent port errors. Run the clear ethernet-switching port-error command to restore currently disabled interfaces.

Default The disable timeout statement is not enabled.

Options *timeout*—Time, in seconds, that an interface remains disabled. The disabled interface automatically returns to service when the specified time expires.

Range: 10 through 3600 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Understanding Storm Control on page 4471
- Example: Configuring Storm Control to Prevent Network Outages on page 4527
- Configuring Autorecovery for MAC Limited or Storm Control Interfaces (CLI Procedure) on page 4549
- action-shutdown on page 4650

ethernet-switching-options

Syntax

```
ethernet-switching-options {
  analyzer {
    name {
      input {
        egress {
          interface (all | interface-name);
        }
        ingress {
          interface (all | interface-name);
          vlan (vlan-id | vlan-name);
        }
      output {
        interface interface-name;
        ip-address ip-address;
        vlan (vlan-id | vlan-name);
      }
    }
  }
  bpdu-block {
    interface (all | [interface-name]);
    disable-timeout timeout;
  }
  dot1q-tunneling {
    ether-type (0x8100 | 0x88a8 | 0x9100)
  }
  interfaces interface-name {
    no-mac-learning;
  }
  mac-table-aging-time seconds {
  }
  port-error-disable {
    disable-timeout timeout;
  }
  secure-access-port {
    dhcp-snooping-file {
      location local_pathname | remote_URL;
      timeout seconds;
      write-interval seconds;
    }
    interface (all | interface-name) {
      allowed-mac {
        mac-address-list;
      }
      (dhcp-trusted | no-dhcp-trusted);
      fcoe-trusted;
      mac-limit limit action action;
      no-allowed-mac-log;
    }
    vlan (all | vlan-name) {
      (arp-inspection | no-arp-inspection) [
        forwarding-class (for DHCP Snooping or DAI Packets) class-name;
      }
```

```
        dhcp-option82 {
          circuit-id {
            prefix (Circuit ID for Option 82) hostname;
            use-interface-description;
            use-vlan-id;
          }
          remote-id {
            prefix (Remote ID for Option 82) hostname | mac | none;
            use-interface-description;
            use-string string;
          }
          vendor-id <string>;
        }
        (examine-dhcp | no-examine-dhcp) {
          forwarding-class (for DHCP Snooping or DAI Packets) class-name;
        }
        examine-fip {
          examine-vn2vn {
            beacon-period milliseconds;
          }
          fc-map fc-map-value;
        }
        mac-move-limit limit <fabric-limit limit action action;
      }
    }
    static {
      vlan vlan-id {
        mac mac-address next-hop interface-name;
      }
    }
    storm-control {
      interface (all | interface-name) {
        bandwidth bandwidth;
        no-broadcast;
        no-multicast;
        no-unknown-unicast;
      }
    }
    traceoptions {
      file filename <files number> <no-stamp> <replace> <size size> <world-readable |
        no-world-readable>;
      flag flag <disable>;
    }
    unknown-unicast-forwarding {
      vlan (all | vlan-name) {
        interface interface-name;
      }
    }
  }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Ethernet switching options.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Overview of Access Port Protection on page 4451
- Understanding Storm Control on page 4471

examine-dhcp

Syntax (examine-dhcp | no-examine-dhcp);

Hierarchy Level [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*)]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series

Description Enable DHCP snooping on all VLANs or on the specified VLAN.

- examine-dhcp—Enable DHCP snooping.

NOTE: When DHCP snooping is enabled, the switch logs DHCPDISCOVER packets that it rejects.

- no-examine-dhcp—Disable DHCP snooping.

Default Disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Basic Port Security Features on page 4488
- Example: Configuring DHCP Snooping, DAI , and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch on page 4506
- Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks on page 4513
- Enabling DHCP Snooping (CLI Procedure) on page 4551

examine-fip

Syntax

```
examine-fip {
  examine-vn2vn {
    beacon-period milliseconds;
  }
  fc-map fc-map-value;
}
```

Hierarchy Level [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*)]

Release Information

Statement introduced in Junos OS Release 10.4 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement **examine-vn2vn** introduced in Junos OS Release 12.2 for the QFX Series.

Description

NOTE: This statement supports the original CLI. If your switch runs the Enhanced Layer 2 Software (ELS) CLI, see examine-vn2vf for VN_Port to VF_Port (VN2VF_Port) FIP snooping, and see examine-vn2vn for VN_Port to VN_Port (VN2VN_Port) FIP snooping. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

Enable FIP snooping on a specified VLAN. Ensure that the VLAN is a dedicated FCoE VLAN that transports only FCoE traffic.

(QFX Series only) Enable VN2VN_Port FIP snooping on the specified VLAN. The VLAN must be a dedicated FCoE VLAN that transports only VN2VN_Port traffic. One FCoE VLAN cannot support both VN2VF_Port FIP snooping and VN2VN_Port FIP snooping. Configure separate, dedicated FCoE VLANs for VN2VN_Port FIP snooping and VN2VN_Port FIP snooping.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *vlan*
- *Example: Configuring an FCoE Transit Switch*
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069

forwarding-class (for DHCP Snooping or DAI Packets)

Syntax forwarding-class class *class-name*;

Hierarchy Level [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*) (examine-dhcp | arp-inspection)]

Release Information Statement introduced in Junos OS Release 11.2 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Assign a user-defined or a predefined forwarding class to the packets that have been checked for DHCP snooping or dynamic ARP inspection (DAI).

NOTE: To assign a user-defined class, you must first configure the user-defined class by using the *forwarding-classes* configuration statement at the [edit *class-of-service*] hierarchy level.

Default Disabled.

Options ***class-name***—Name of the forwarding class. The forwarding class can be one of the predefined forwarding classes (best-effort, assured-forwarding, expedited-forwarding, network-control) or it can be a user-defined forwarding class.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic*
- *Understanding Junos OS CoS Components for EX Series Switches*
- Understanding DHCP Snooping for Port Security on page 4456
- Understanding DAI for Port Security on page 4463

interface (Secure Access Port)

Syntax

```
interface (all | interface-name) {
  allowed-mac mac-address-list;
  (dhcp-trusted | no-dhcp-trusted);
  mac-limit limit action action;
  no-allowed-mac-log;
  static-ip  ip-address {
    vlan vlan-name;
    mac mac-address;
  }
}
```

Hierarchy Level

[edit ethernet-switching-options secure-access-port]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Apply port security features to all interfaces or to the specified interface.

The remaining statements are explained separately.

Options

all—Apply port security features to all interfaces. Does not apply to QFabric systems.

interface-name—Apply port security features to the specified interface.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Overview of Access Port Protection on page 4451
- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Understanding Trusted and Untrusted Ports on page 4467
- Configuring MAC Limiting on page 4545
- Enabling a Trusted Port for DHCP on page 4556

location

Syntax location *local_pathname* | *remote_URL*;

Hierarchy Level [edit ethernet-switching-options secure-access-port dhcp-snooping-file]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify either a local pathname or a remote URL as the location in which to store the DHCP snooping database.

Options ***local_pathname* | *remote_URL*** —Location for storing the DHCP snooping database.

- ***local_pathname*** —Use ***/path*** to store the database on a local switch.
- ***remote_URL*** —Use **ftp://*ip-address*** or **ftp:// *hostname*/*path*** to store the database at a remote location.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

mac

Syntax mac *mac-address*;

Hierarchy Level [edit ethernet-switching-options secure-access-port interface (Access Port Security) (all | *interface-name*) static-ip *ip-address* vlan (DHCP Bindings on Access Ports) *vlan-name*]
[edit vlans *vlan-name* forwarding-options dhcp-security group *group-name* interface *interface-name* static-ip *ip-address*]

Release Information Statement introduced in Junos OS Release 11.1 on the QFX Series switches.

Description Specify a media access control (MAC) address (hardware address) for the specified static IP address.

Options ***mac-address***—Value in hexadecimal format.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

mac-limit

Syntax

```
mac-limit limit {
  <action action>;
}
```

Hierarchy Level [edit ethernet-switching-options secure-access-port interface (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the number of MAC addresses that can be dynamically added to the MAC address cache for this access interface (port) and the action to be taken if the limit is exceeded.

Default The default action is **drop**.

Options *limit*—Maximum number of MAC addresses.

action ***action***—(Optional) Action to take when the MAC address limit is exceeded:

- **drop**—Drop the packet and generate a system log entry. This is the default.
- **log**—Do not drop the packet but generate a system log entry.
- **none**—No action.
- **shutdown**—Disable the interface and generate an alarm. If you configure the switch with the port-error-disable statement, the disabled interface recovers automatically upon expiration of the specified timeout. If this statement is not configured, you can bring up the disabled interfaces by running the clear ethernet-switching port-error command.

Required Privilege Level routing—To view this statement in the configuration.
routing–control—To add this statement to the configuration.

Related Documentation

- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Configuring MAC Limiting on page 4545
- allowed-mac on page 4605

no-dhcp-trusted

Syntax (dhcp-trusted | no-dhcp-trusted);

Hierarchy Level [edit ethernet-switching-options secure-access-port interface (Access Port Security) (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Port security features, such as DHCP snooping and dynamic ARP inspection inspect packets only on untrusted interfaces.

Allow or deny DHCP responses from the specified interfaces (ports) or all interfaces.

- **dhcp-trusted**—Allow DHCP responses.
- **no-dhcp-trusted**—Deny DHCP responses.

Default Trusted for trunk ports, untrusted for access ports.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Overview of Access Port Protection on page 4451
- Enabling a Trusted Port for DHCP on page 4556

prefix (Remote ID for Option 82)

Syntax prefix hostname | mac | none;

Hierarchy Level [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*) dhcp-option82 remote-id]
[edit forwarding-options helpers bootp dhcp-option82 remote-id]
[edit forwarding-options helpers bootp interface *interface-name* dhcp-option82 remote-id]

Release Information Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure an optional prefix for the remote ID suboption in the DHCP option 82 information that is inserted by the switch into the packet header of a DHCP request before it forwards or relays the request to a DHCP server.

Default If **prefix** is not explicitly specified, no prefix is appended to the remote ID.

Options **hostname**—Name of the host system (the switch) that is forwarding or relaying the DHCP request from the DHCP client to the DHCP server.

mac—MAC address of the host system (the switch) that is forwarding or relaying the DHCP request from the DHCP client to the DHCP server.

none—No prefix is applied to the remote ID.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server on page 4521
- Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server on page 4525
- Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4557
- Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4560
- *[edit forwarding-options] Configuration Statement Hierarchy on EX Series Switches*
- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.

remote-id

Syntax

```
remote-id {
  host-name host-name;
  prefix hostname | mac | none; | host
  use-interface-description;
  use-string string;
}
```

Hierarchy Level

- For platforms with ELS:

  [edit vlans *vlan-name* forwarding-options dhcp-security option-82]

- For platforms without ELS:

  [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*) dhcp-option82],
  [edit forwarding-options helpers bootp dhcp-option82],
  [edit forwarding-options helpers bootp interface *interface-name* dhcp-option82]

Release Information

Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Hierarchy level **[edit vlans *vlan-name* forwarding-options dhcp-security option-82]** introduced in Junos OS Release 13.2X50-D10. (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)

Description

Insert the **remote-id** suboption of DHCP option 82 (also known as the DHCP relay agent information option) in DHCP request packet headers before forwarding or relaying requests to a DHCP server. This suboption provides a trusted identifier for the host system that has forwarded or relayed requests to the server.

The remaining statements are explained separately, and their availability depends on the hierarchy level at which **remote-id** is specified, as follows:

- The statement prefix is *not* supported at the **[edit vlans *vlan-name* forwarding-options dhcp-security option-82]** hierarchy level.
- The statement **host-name** is supported *only* at the **[edit vlans *vlan-name* forwarding-options dhcp-security option-82]** hierarchy level.

Default

If **remote-id** is not explicitly set, no remote ID value is inserted in the DHCP request packet header.

If **remote-id** is explicitly set, but is not qualified by a keyword:

- At the **[edit vlans *vlan-name* forwarding-options dhcp-security]** hierarchy level, the default keyword value is *interface-name*.
- At all other hierarchy levels, the **remote-id** default keyword value of is the MAC address of the switch.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server on page 4521
- Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server on page 4525
- Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4557
- *Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)*
- Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4560
- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.

secure-access-port

Syntax

```
secure-access-port {
  deactivate;
    dhcp-snooping-file {
    location (local_pathname | remote_URL);
    timeout seconds;
    write-interval seconds;
  }
  interface (all | interface-name) {
    allowed-mac mac-address-list;
    (dhcp-trusted | no-dhcp-trusted);
    fcoe-trusted;
    mac-limit limit {
      <action action>;
    }
    no-allowed-mac-log;
    persistent-learning;
    static-ip  ip-address {
      vlan vlan-name;
      mac mac-address;
    }
  }
  vlan (all | vlan-name) {
    (arp-inspection | no-arp-inspection) [
      forwarding-class (for DHCP Snooping or DAI Packets) class-name;
    }
    dhcp-option82 {
      circuit-id {
        prefix (Circuit ID for Option 82) hostname;
        use-interface-description;
        use-vlan-id;
      }
      remote-id {
        prefix (Remote ID for Option 82) hostname | mac | none;
        use-interface-description;
        use-string string;
      }
      vendor-id <string>;
    }
    (examine-dhcp | no-examine-dhcp) {
      forwarding-class (for DHCP Snooping or DAI Packets) class-name;
    }
    examine-fip {
      examine-vn2vn {
        beacon-period milliseconds;
      }
      fc-map fc-map-value;
    }
    mac-move-limit limit action action;
  }
```

Hierarchy Level [edit ethernet-switching-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure port security features, including MAC limiting and whether interfaces can receive DHCP responses, and apply dynamic ARP inspection, DHCP snooping, DHCP option 82, and MAC move limiting on no VLANs, specific VLANs, or all VLANs.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Overview of Access Port Protection on page 4451
- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Understanding Trusted and Untrusted Ports on page 4467
- Configuring MAC Limiting on page 4545
- Enabling a Trusted Port for DHCP on page 4556

static-ip

Syntax

```
static-ip ip-address;
  mac mac-address;
  vlan vlan-name;
}
```

Hierarchy Level [edit ethernet-switching-optionssecure-access-port interface (all | *interface-name*)]
[edit vlans *vlan-name* forwarding-options dhcp-security group *group-name* interface *interface-name*]

Release Information Statement introduced in Junos OS Release 12.1 on the QFX Series.

Description Bind a static IP address to a MAC address in the DHCP snooping database.

Options *ip-address*—IP address assigned to the device connected on the specified interface.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Static IP Addresses for DHCP Bindings on Access Ports (CLI Procedure) on page 4550

timeout (DHCP Snooping)

Syntax timeout *seconds*;

Hierarchy Level [edit ethernet-switching-options secure-access-port dhcp-snooping-file]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify a timeout value for remote read and write operations. This value determines the amount of time that the switch waits for a remote system to respond when the DHCP snooping database is stored on a remote FTP site.

Default None

Options ***seconds*** —Value in seconds.

Range: 10 through 3600

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding DHCP Snooping for Port Security on page 4456

use-interface-description

Syntax use-interface-description;

Hierarchy Level

- For platforms with ELS:

  [edit vlans *vlan-name* forwarding-options dhcp-security option-82 circuit-id]

- For platforms without ELS:

  [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*) dhcp-option82 circuit-id],
  [edit forwarding-options helpers bootp dhcp-option82 circuit-id],
  [edit forwarding-options helpers bootp interface *interface-name* dhcp-option82 circuit-id],
  [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*) dhcp-option82 remote-id],
  [edit forwarding-options helpers bootp dhcp-option82 remote-id],
  [edit forwarding-options helpers bootp interface *interface-name* dhcp-option82 remote-id]

Release Information Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Hierarchy level **[edit vlans *vlan-name* forwarding-options dhcp-security]** introduced in Junos OS Release 13.2X50-D10. (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)

Description Use the interface description rather than the interface name (which is the default value) in the circuit ID or remote ID value in the DHCP option 82 information.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server on page 4521
- Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server on page 4525
- Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4557
- Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4560
- *Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)*
- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.

use-string

Syntax use-string *string*;

Hierarchy Level

- For platforms with ELS:

  [edit vlans *vlan-name* forwarding-options dhcp-security option-82 remote-id]

- For platforms without ELS:

  [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*) dhcp-option82 remote-id],
  [edit forwarding-options helpers bootp dhcp-option82 remote-id] ,
  [edit forwarding-options helpers bootp interface *interface-name* dhcp-option82 remote-id]

Release Information Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Hierarchy level **[edit vlans *vlan-name* forwarding-options dhcp-security]** introduced in Junos OS Release 13.2X50-D10. (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)

Description Use a string rather than the MAC address of the host system (the default) in the remote ID value in the DHCP option 82 information.

Options ***string***—Character string used as the remote ID value.

Range: 1–255 characters

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server on page 4521
- Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server on page 4525
- Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4557
- Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4560
- *Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)*
- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.

use-vlan-id

Syntax

use-vlan-id;

Hierarchy Level

- For platforms with ELS:

  [edit vlans *vlan-name* forwarding-options dhcp-security option-82 circuit-id]

- For platforms without ELS:

  [edit forwarding-options helpers bootp dhcp-option82-circuit-id],
  [edit forwarding-options helpers bootp interface *interface-name* dhcp-option82-circuit-id]

Release Information

Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Hierarchy level **[edit vlans *vlan-name* forwarding-options dhcp-security]** introduced in Junos OS Release 13.2X50-D10. (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)

Description

Use the VLAN ID rather than the VLAN name (the default) in the circuit ID value in the DHCP option 82 information.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server on page 4521
- Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server on page 4525
- Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4557
- Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure) on page 4560
- *Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)*
- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.

vlan (Static IP)

Syntax vlan *vlan-name*;

Hierarchy Level [edit ethernet-switching-options secure-access-port interface (all | *interface-name*) static-ip *ip-address*]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series switches.

Description Associate a static IP address with the specified VLAN.

Options ***vlan-name***—Name of a VLAN associated with the specified interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Static IP Addresses for DHCP Bindings on Access Ports (CLI Procedure) on page 4550

vlan (Secure Access Port)

Syntax

```
vlan (all | vlan-name) {
  examine-fip {
    examine-vn2vn {
      beacon-period milliseconds;
    }
    fc-map fc-map-value;
  }
  dhcp-option82
    circuit-id {
      prefix (Circuit ID for Option 82) hostname;
      use-interface-description;
      use-vlan-id;
    }
    remote-id {
      prefix (Remote ID for Option 82) hostname | mac | none;
      use-interface-description;
      use-string string;
    }
    vendor-id <string>;
  }
  (arp-inspection | no-arp-inspection);
    circuit-id {
      prefix (Circuit ID for Option 82) hostname;
      use-interface-description;
      use-vlan-id;
    }
    remote-id {
      prefix (Remote ID for Option 82) hostname | mac | none;
      use-interface-description;
      use-string string;
    }
  vendor-id <string>;
  }
  (examine-dhcp | no-examine-dhcp);
  mac-move-limitlimit action action;
}
```

Hierarchy Level [edit ethernet-switching-options secure-access-port]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Apply DHCP snooping, dynamic ARP inspection (DAI), DHCP option 82, and MAC move limiting.

TIP: To display a list of all configured VLANs on the system, including VLANs that are configured but not committed, type **?** after **vlan** or **vlans** in your configuration mode command line. Note that only one VLAN is displayed for a VLAN range.

The remaining statements are explained separately.

Options **all**—Apply DHCP snooping, DAI, DHCP option 82, and MAC move limiting to all VLANs.

vlan-name —Apply DHCP snooping, DAI, DHCP option 82, and MAC move limiting to the specified VLAN.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Overview of Access Port Protection on page 4451
- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- Understanding Trusted and Untrusted Ports on page 4467
- Configuring MAC Limiting on page 4545
- Enabling a Trusted Port for DHCP on page 4556

Configuration Statements for Port Security (ELS CLI Only)

accept-source-mac

Syntax

```
accept-source-mac {
  mac-address mac-address {
    policer {
      input cos-policer-name;
      output cos-policer-name;
    }
  }
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Packet Transport Routers.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description For Gigabit Ethernet intelligent queuing (IQ) interfaces only, accept traffic from and to the specified remote media access control (MAC) address.

The **accept-source-mac** statement is equivalent to the **source-address-filter** statement, which is valid for aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces only. To allow the interface to receive packets from specific MAC addresses, include the **accept-source-mac** statement.

On untagged Gigabit Ethernet interfaces, you should not configure the **source-address-filter** statement and the **accept-source-mac** statement simultaneously. On tagged Gigabit Ethernet interfaces, you should not configure the **source-address-filter** statement and the **accept-source-mac** statement with an identical MAC address specified in both filters.

The statements are explained separately.

NOTE: The policer statement is not supported on PTX Series Packet Transport Routers.

NOTE: On QFX platforms, if you configure source MAC addresses for an interface using the static-mac or persistent-learning statements and later configure a different MAC address for the same interface using the **accept-source-mac** statement, the MAC addresses that you previously configured for the interface remain in the ethernet-switching table and can still be used to send packets to the interface.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring MAC Address Filtering*
- *Configuring MAC Filtering on PTX Series Packet Transport Routers*
- *source-filtering*

arp-inspection

Syntax

```
arp-inspection {
  forwarding-class class-name;
}
```

Hierarchy Level

- For platforms with ELS:

  [edit vlans *vlan-name* forwarding-options dhcp-security],
  [edit forwarding-options dhcp-relay]

- For platforms without ELS:

  [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*)],
  [edit forwarding-options dhcp-relay]

Release Information

Statement introduced in Junos OS Release 9.0 for EX Series switches.
Hierarchy level **[edit vlans *vlan-name* forwarding-options dhcp-security]** introduced in Junos OS Release 13.2X50-D10. (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description

Perform dynamic ARP inspection (DAI) on all VLANs or on the specified VLAN.

When DAI is enabled, the switch logs invalid ARP packets that it receives on each interface, along with the sender's IP and MAC addresses. ARP probe packets are not subjected to dynamic ARP inspection. The switch always forwards such packets.

NOTE: If you configure DAI at the **[edit vlans *vlan-name* forwarding-options dhcp-security]** hierarchy level:

- DAI can be configured only for a specific VLAN, not for a list or a range of VLAN IDs.
- DHCP snooping is automatically enabled on the specified VLAN.
- The **forwarding-class** statement is not available at the **[edit vlans *vlan-name* forwarding-options dhcp-security]** hierarchy level.

See *Enabling Dynamic ARP Inspection (CLI Procedure)* for more information about this configuration.

NOTE: On EX9200 switches, DAI is not supported in an MC-LAG scenario.

The remaining statement is explained separately.

Default

Disabled.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring DHCP Snooping, DAI , and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch on page 4506
- Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks on page 4513
- *Example: Configuring IP Source Guard and Dynamic ARP Inspection to Protect the Switch from IP Spoofing and ARP Spoofing*
- *Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic*
- Enabling Dynamic ARP Inspection (CLI Procedure) on page 4553
- *Enabling Dynamic ARP Inspection (J-Web Procedure)*

dhcp-security

Syntax

```
dhcp-security {
  arp-inspection;
  group group-name {
    interface interface-name {
      static-ip ip-address {
        mac mac-address;
      }
    }
    overrides {
      no-option82;
      trusted;
      untrusted;
    }
  }
  ip-source-guard;
  ipv6-source-guard;
  nd-inspection;
  no-dhcp-snooping;
  option-82 {
    circuit-id {
      prefix {
        host-name;
        logical-system-name;
        routing-instance-name;
      }
      use-interface-description (device | logical);
      use-vlan-id;
    }
    remote-id {
      host-name hostname;
      use-interface-description (device | logical);
      use-string string;
    }
    vendor-id {
      use-string string;
    }
  }
}
```

Hierarchy Level [edit vlans *vlan-name* forwarding-options]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Configure port security features on the switch. DHCP snooping is enabled automatically if you configure any of the following port security features within this hierarchy:

- Dynamic ARP inspection (DAI)
- IP source guard
- DHCP option 82

- Static IP

For switches that support DHCPv6, both DHCP snooping and DHCPv6 snooping are enabled automatically if you configure any of the features listed above or any of the following IPv6 features:

- IPv6 Neighbor Discovery inspection
- IPv6 source guard
- Static IPv6

NOTE: On EX9200 switches, DHCP snooping, DAI, and IP source guard are not supported in an MC-LAG scenario.

The remaining statements are explained separately.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Enabling Dynamic ARP Inspection (CLI Procedure)*
- *Configuring IP Source Guard (CLI Procedure)*
- *Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)*
- *Configuring Static IP Addresses for DHCP Bindings on Access Ports (CLI Procedure)*

dhcp-service

Syntax

```
dhcp-service {
  dhcp-snooping-file (local_pathname | remote_URL);
    write-interval interval;
  }
```

Hierarchy Level [edit system processes]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Enable DHCP services on the switch. DHCP services automate network-parameter assignment to network devices. The DHCP service process is enabled by default on your switch. However, by default, IP-MAC bindings in the DHCP snooping database do not persist. You can configure the IP-MAC bindings in the DHCP database to persist through switch reboots by configuring a storage location for the DHCP database file. When specifying the location for the DHCP database, you must also specify how frequently the switch writes the database entries into the DHCP snooping database file.

The remaining statements are explained separately.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring Persistent Bindings in the DHCP or DHCPv6 Snooping Database (CLI Procedure)*

group (DHCP Security)

Syntax

```
group group-name {
  interface interface-name {
    static-ip ip-address {
      mac mac-address;
    }
    static-ipv6 ip-address {
      mac mac-address;
    }
  }
  overrides {
    no-option37;
    no-option-82;
    trusted;
    untrusted;
  }
}
```

Hierarchy Level [edit vlans *vlan-name* forwarding-options dhcp-security]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX series.
Support for the **static-ipv6** and **no-option37** statements introduced in Junos OS Release 13.2X51-D20 for EX Series switches.

Description Specify the name of a group of access interfaces that you want to configure for DHCP security attributes that are different from the attributes set for other interfaces in the VLAN. A group must contain at least one interface. The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Static IP Addresses for DHCP Bindings on Access Ports (CLI Procedure)*
- *Enabling a Trusted DHCP Server (CLI Procedure)*
- Understanding DHCP Snooping for Port Security on page 4456

interface (DHCP Security)

Syntax

```
interface interface-name {
  static-ip ip-address {
    mac mac-address;
  }
  static-ipv6 ip-address {
    mac mac-address;
  }
}
```

Hierarchy Level [edit vlans *vlan-name* forwarding-options dhcp-security group *group-name*]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.
Support for the **static-ipv6** statement introduced in Junos OS Release 13.2X51-D20 for EX Series switches.

Description Configure an interface for a static IPv4 or IPv6 address to MAC address binding (IP-MAC binding) or configure an interface to belong to a group within the VLAN that has DHCP security attributes that are different from the attributes of other interfaces in the VLAN.

The remaining statement is explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring Static IP Addresses for DHCP Bindings on Access Ports (CLI Procedure)*
- *Enabling a Trusted DHCP Server (CLI Procedure)*
- *Configuring Port Security (CLI Procedure)*

interface-mac-limit

Syntax

```
interface-mac-limit limit {
  packet-action action;
}
```

Hierarchy Level

[edit bridge-domains *bridge-domain-name* bridge-options],
[edit bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* switch-options interface *interface-name*],
[edit logical-systems *logical-system-name* switch-options],
[edit logical-systems *logical-system-name* switch-options interface *interface-name*],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options],
[edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name* bridge-options interface *interface-name*],
[edit routing-instances *routing-instance-name* switch-options],
[edit routing-instances *routing-instance-name* switch-options interface *interface-name*],
[edit switch-options],
[edit switch-options],
[edit switch-options interface *interface-name*],
[edit switch-options interface *interface-name*],
[edit vlans *vlan-name* switch-options],
[edit vlans *vlan-name* switch-options interface *interface-name*]

Release Information

Statement introduced in Junos OS Release 8.4.
Support for the **switch-options** statement added in Junos OS Release 9.2.
Support for top-level configuration for the **virtual-switch** type of routing instance added in Junos OS Release 9.2. In Junos OS Release 9.1 and earlier, the routing instances hierarchy supported this statement only for a VPLS instance or a bridge domain configured within a virtual switch.
Support for logical systems added in Junos OS Release 9.6.
Support at [edit switch-options], [edit switch-options interface *interface-name*], [edit vlans *vlan-name* switch-options], and [edit vlans *vlan-name* switch-options interface *interface-name*] hierarchy levels introduced in Junos OS Release 12.3R2 for EX Series switches.
Support at hierarchy levels under **[edit vlans *vlan-name*]** introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description (MX Series routers, EX Series switches, and the QFX Series) Configure a limit to the number of MAC addresses that can be learned from a bridge domain or VLAN, virtual switch, or set of bridge domains or VLANs.

Default All devices except the EX Series switches: 1024 MAC addresses for each logical interface; EX Series switches: 65,536 MAC addresses for each interface and VLAN.

Options ***limit***—Maximum number of MAC addresses learned from an interface.

Range: 1 through 131,071 MAC addresses per interface, or 1 through 65,535 MAC addresses per interface

The remaining statement is explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Layer 2 Learning and Forwarding for Bridge Domains Overview*
- Layer 2 Learning and Forwarding for VLANs Overview on page 1401
- *Layer 2 Learning and Forwarding for Bridge Domains Functioning as Switches with Layer 2 Trunk Ports*
- Configuring MAC Limiting (CLI Procedure) on page 1539

no-dhcp-snooping

Syntax no-dhcp-snooping;

Hierarchy Level [edit vlans *vlan-name* forwarding-options dhcp-security]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Disable DHCP snooping for the specified VLAN.

NOTE: Explicitly disabling DHCP snooping also disables any other port security features that you have enabled under **[edit vlans *vlan-name* forwarding-options dhcp-security]**, including dynamic ARP inspection (DAI) and IP source guard for the specified VLAN.

There is no configuration statement that explicitly enables DHCP snooping.

Default DHCP snooping is not enabled.

NOTE: Junos OS for EX Series switches with support for the Enhanced Layer 2 Software (ELS) configuration style does not have a configuration statement that explicitly enables DHCP snooping.

DHCP snooping is enabled automatically by Junos OS if any of the following is configured at the **[edit vlans *vlan-name* forwarding-options dhcp-security]** hierarchy level:

- DAI
- IP source guard
- Static IP
- DHCP option 82

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Understanding DHCP Snooping for Port Security on page 4456

no-option-82

Syntax

no-option-82;

Hierarchy Level

[edit vlans *vlan-name* forwarding-options dhcp-security group *group-name* overrides]

Release Information

Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description

Configure a specific group of one or more access interfaces within the VLAN *not* to transmit DHCP option 82 information, even if the VLAN is configured to use option 82.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- option-82 on page 4644
- *Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)*
- *Understanding DHCP Option 82 for Port Security on EX Series Switches*
- Understanding DHCP Snooping for Port Security on page 4456

option-82

Syntax

```
option-82 {
  circuit-id {
    prefix (host-name | routing-instance-name);
    use-interface-description;
    use-vlan-id;
  }
  remote-id {
    host-name;
    use-interface-description;
    use-string string;
  }
  vendor-id;
    use-string string;
  }
```

Hierarchy Level

[edit vlans *vlan-name* forwarding-options dhcp-security]

Release Information

Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description

When the switch receives a DHCP request from a DHCP client connected on one of the switch's interfaces, have the switch insert DHCP option 82 (also known as the DHCP relay agent information option) information in the DHCP request packet header before it forwards or relays the request to a DHCP server. The server uses the option 82 information, which provides details about the circuit and host the request came from, in formulating the reply; the server does not, however, make any changes to the option 82 information in the packet header. The switch receives the reply and then removes the DHCP option 82 information before forwarding the reply to the client.

The remaining statements are explained separately.

Default

Insertion of DHCP option 82 information is not enabled.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)*
- no-option-82 on page 4643
- *Understanding DHCP Option 82 for Port Security on EX Series Switches*
- Understanding DHCP Snooping for Port Security on page 4456
- RFC 3046, *DHCP Relay Agent Information Option*, at http://tools.ietf.org/html/rfc3046.

overrides (DHCP Security)

Syntax overrides (trusted | untrusted |no-option37 | no-option-82);

Hierarchy Level [edit vlans *vlan-name* forwarding-options dhcp-security group *group-name*]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX series.
Support for the **no-option37** option introduced in Junos OS Release 13.2X51-D20 for EX Series switches.

Description Modify selected attributes of a specific interface within a group of interfaces that is configured within a specified VLAN.

Options **no-option37**—The interface specified in this group does not support DHCPv6 option 37.

no-option82—The interface specified in this group does not support DHCP option 82.

trusted—The interface specified in this group is trusted. DHCP snooping does not apply to the trusted interface. Likewise, DAI and IP source guard—even if they are enabled for the VLAN—do not apply to the interface that is configured with the **overrides** and the **trusted** options. Access interfaces are untrusted by default.

untrusted—(Only for EX9200) The interface specified in this group is untrusted. Trunk interface are trusted by default. Access interfaces are untrusted by default.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Enabling a Trusted DHCP Server (CLI Procedure)*
- Understanding DHCP Snooping for Port Security on page 4456
- *Understanding DHCP Option 82 for Port Security on EX Series Switches*

recovery-timeout

Syntax recovery-timeout *seconds*;

Hierarchy Level [edit interfaces *interface-name* family ethernet-switching]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Disable rather than block an interface when enforcing MAC limiting, MAC move limiting, or rate-limiting configuration options for shutting down the interface, and allow the interface to recover automatically from the error condition after the specified period of time:

- If you have enabled MAC limiting with the **shutdown** option and you enable **recovery-timeout**, the switch disables (rather than shuts down) the interface when the MAC address limit is reached.
- If you have enabled MAC move limiting (Not supported on EX9200) with the **shutdown** option and you enable **recovery-timeout**, the switch disables (rather than shuts down) the interface when the maximum number of moves to a new interface is reached.
- If you have enabled storm control with the **action-shutdown** option and you enable **recovery-timeout** the switch disables (rather than shuts down) the interface when applicable traffic exceeds the specified levels. Depending upon the configuration, applicable traffic could include broadcast, unknown unicast, and multicast traffic.

NOTE: The recovery-timeout configuration does not apply to pre-existing error conditions. It impacts only error conditions that are detected after recovery-timeout has been enabled and committed. To clear a pre-existing error condition and restore the interface to service, use the operational mode command clear ethernet-switching recovery-timeout.

Default Not enabled.

Options *seconds*— Number of seconds that the interface remains in a disabled state due to a port error prior to automatic recovery.

Range: **10** through **3600**

Required Privilege Level system—To view this statement in the configuration.
system–control—To add this statement to the configuration.

Related Documentation

- *action-shutdown*
- Configuring MAC Limiting (CLI Procedure) on page 1539
- *Configuring MAC Move Limiting (CLI Procedure)*

- *Configuring or Disabling Storm Control (CLI Procedure)*

static-ip

Syntax

```
static-ip ip-address {
  vlan  vlan-name;
  mac mac-address;
}
```

Hierarchy Level

- For platforms with ELS:

  [edit vlans *vlan-name* forwarding-options dhcp-security group *group-name* interface *interface-name*]

- For platforms without ELS:

  [edit ethernet-switching-options secure-access-port interface (all | *interface-name*)]

Release Information

Statement introduced in Junos OS Release 9.2 for EX Series switches.
Hierarchy level **[edit vlans *vlan-name* forwarding-options dhcp-security]** introduced in Junos OS Release 13.2X50-D10. (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)

Description

Configure a static IP address to MAC address (IP-MAC) binding to be added to the DHCP snooping database.

NOTE: The VLAN is specified at the higher hierarchy level when **static-ip** is configured at **[edit vlans *vlan-name* forwarding-options dhcp-security group *group-name* interface *interface-name*]**.

Options

ip-address—Static IP address assigned to a device connected on the specified interface.

mac*mac-address*—Static MAC address assigned to a device connected on the specified interface.

The remaining statements are explained separately.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring Static IP Addresses for DHCP Bindings on Access Ports (CLI Procedure) on page 4550
- *Configuring Static IP Addresses for DHCP Bindings on Access Ports (CLI Procedure)*

switch-options

Syntax

```
switch-options {
  interface interface-name {
    interface-mac-limit limit {
      packet-action drop;
    }
    no-mac-learning;
    static-mac static-mac-address {
      vlan-id number;
    }
  }
  interface-mac-limit limit {
    packet-action drop;
  }
  mac-statistics;
  mac-table-size limit {
    packet-action drop;
  }
  no-mac-learning;
  service-id number;
}
```

Hierarchy Level

[edit *number*],
[edit vlans *vlan--name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* vlans *vlan-name*],
[edit routing-instances *routing-instance-name* vlans *vlan-name*]

Release Information

Statement introduced in Junos OS Release 12.3R2 for EX Series switches and MX Series routers.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description

Configure Layer 2 learning and forwarding properties for a VLAN or a virtual switch.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

trusted

Syntax trusted;

Hierarchy Level [edit vlans *vlan-name* forwarding-options dhcp-security group *group-name* overrides]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Allow DHCP responses from the specified interface. The interface is not subject to DHCP snooping, even if the VLAN is enabled for DHCP snooping.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Enabling a Trusted DHCP Server (CLI Procedure)*
- Understanding Trusted DHCP Servers for Port Security on page 4467
- Understanding DHCP Snooping for Port Security on page 4456

untrusted

Syntax untrusted;

Hierarchy Level [edit vlans *vlan-name* forwarding-options dhcp-security group *group-name* overrides]

Release Information Statement introduced in Junos OS Release 13.2 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Override the default behavior of a trunk interface from trusted to untrusted.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Enabling a Trusted DHCP Server (CLI Procedure)*
- Understanding Trusted DHCP Servers for Port Security on page 4467
- Understanding DHCP Snooping for Port Security on page 4456

Configuration Statements for Device Security

- rpf-check on page 4655
- unknown-unicast-forwarding on page 4656

action-shutdown

Syntax action-shutdown;

Hierarchy Level For platforms without ELS:

[edit ethernet-switching-options storm-control]

For platforms with ELS:

[edit forwarding-options storm-control-profiles]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Shut down or disable interfaces when the storm control level is exceeded, as follows:

- If you set both the **action-shutdown** and the **port-error-disable** statements, the affected interfaces are disabled temporarily and recover automatically when the disable timeout expires.
- If you set the **action-shutdown** statement and do not set the **port-error-disable** statement, the affected interfaces are shut down when the storm control level is exceeded, and they do not recover automatically. You must issue the **clear ethernet-switching port-error** command to clear the port error and restore the interfaces to service.

Default The **action-shutdown** feature is disabled. If the storm control level is exceeded, the switch drops broadcast and unknown unicast messages on the specified interfaces.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Storm Control on page 4471
- Example: Configuring Storm Control to Prevent Network Outages on page 4527
- port-error-disable on page 4600
- disable-timeout on page 4609
- clear ethernet-switching port-error on page 4686

interface (Unknown Unicast Forwarding)

Syntax interface *interface-name*;

Hierarchy Level

- For platforms with ELS:

  [edit switch-options unknown-unicast-forwarding vlan *vlan-name*]

- For platforms without ELS:

  [edit ethernet-switching-options unknown-unicast-forwarding vlan *vlan-name*]

Release Information Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.
Hierarchy level **[edit switch-options]** introduced in Junos OS Release 13.2X50-D10. (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)

Description Specify the interface to which unknown unicast packets will be forwarded.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *show vlans*
- *show ethernet-switching table*
- *Configuring Unknown Unicast Forwarding (CLI Procedure)*
- Understanding Unknown Unicast Forwarding on page 4477

no-broadcast

Syntax no-broadcast;

Hierarchy Level For platforms without ELS:

[edit ethernet-switching-options storm-control interface (all | *interface-name*)]

For platforms with ELS:

[edit forwarding-options storm-control-profiles]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For interfaces configured for storm control, disable broadcast traffic storm control on the interface.

Default When storm control is enabled on an interface, it is enabled for both unknown unicast traffic and broadcast traffic.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Storm Control on page 4471
- Example: Configuring Storm Control to Prevent Network Outages on page 4527

no-multicast

Syntax no-multicast;

Hierarchy Level For platforms without ELS:

[edit ethernet-switching-options storm-control interface (all | *interface-name*)]

For platforms with ELS:

[edit forwarding-options storm-control-profiles]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Disable storm control for all multicast traffic (both registered multicast and unregistered multicast) for the specified interface or for all interfaces.

Default Storm control is enabled for unknown unicast traffic, multicast traffic, and broadcast traffic.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Understanding Storm Control on page 4471
- Example: Configuring Storm Control to Prevent Network Outages on page 4527

no-unknown-unicast

Syntax no-unknown-unicast;

Hierarchy Level For platforms without ELS:

[edit ethernet-switching-options storm-control interface (all | *interface-name*)]

For platforms with ELS:

[edit forwarding-options storm-control-profiles]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For interfaces configured for storm control, disable unknown unicast traffic storm control on the interface.

Default When storm control is enabled on an interface, it is enabled for both unknown unicast traffic and broadcast traffic.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Storm Control on page 4471
- Example: Configuring Storm Control to Prevent Network Outages on page 4527

rpf-check

Syntax rpf-check;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit interfaces *interface-name* unit *logical-unit-number* family inet6]

Release Information Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description On EX3200 and EX4200 switches, enable a reverse-path forwarding (RPF) check on unicast traffic (except ECMP packets) on all ingress interfaces.

On EX4300 switches, enable a reverse-path forwarding (RPF) check on unicast traffic, including ECMP packets, on all ingress interfaces.

On EX8200 and EX6200 switches, enable an RPF check on unicast traffic, including ECMP packets, on the selected ingress interfaces.

On QFX Series switches, enable an RPF check on unicast traffic (except ECMP packets) on the selected ingress interfaces.

Default Unicast RPF is disabled on all interfaces.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Unicast RPF on an EX Series Switch*
- Configuring Unicast RPF (CLI Procedure) on page 4562
- Disabling Unicast RPF (CLI Procedure) on page 4564
- Understanding Unicast RPF on page 4473

unknown-unicast-forwarding

Syntax

```
unknown-unicast-forwarding {
  vlan vlan-name {
    interface interface-name;
  }
}
```

Hierarchy Level

- For platforms with ELS:

  [edit switch-options]

- For platforms without ELS:

  [edit ethernet-switching-options]

Release Information

Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.
Hierarchy level **[edit switch-options]** introduced in Junos OS Release 13.2X50-D10. (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)

Description

Configure the switch to forward all unknown unicast packets in a VLAN or on all VLANs to a particular interface.

The remaining statements are explained separately.

Default

Unknown unicast packets are flooded to all interfaces that belong to the same VLAN.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *show vlans*
- *show ethernet-switching table*
- *Configuring Unknown Unicast Forwarding (CLI Procedure)*
- Configuring Unknown Unicast Forwarding (CLI Procedure) on page 4565
- Understanding Unknown Unicast Forwarding on page 4477

Configuration Statements for Device Security (ELS CLI Only)

bandwidth-level

Syntax bandwidth-level *kbps*;

Hierarchy Level [edit forwarding-options storm-control-profiles *profile-name* all]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Configure the storm control level as the bandwidth in kilobits per second of the available bandwidth used by the combined broadcast, multicast, and unknown unicast traffic streams.

NOTE: When you configure storm control level on an aggregated Ethernet interface, the storm control level for each member of the aggregated Ethernet interface is set to that bandwidth. For example, if you configure a storm control level of 15,000 Kbps on ae1, and ae1 has two members, ge-0/0/0 and ge-0/0/1, each member has a storm control level of 15,000 Kbps. Thus, the storm control level on ae1 allows a traffic rate of up to 30,000 Kbps of combined broadcast, multicast, and unknown unicast traffic.

Default On EX4300 switches—If you do not specify the storm control level using either the **bandwidth-level** or the **bandwidth-percentage** statements, the storm control level defaults to 80 percent of the available bandwidth used by the combined broadcast, unknown unicast, and multicast traffic streams.

On EX9200 switches—Storm control is not enabled by default.

Options **bandwidth-level** ***kbps***—Traffic rate in kilobits per second of the combined broadcast, multicast, and unknown unicast traffic streams.

Range: 100 through 10,000,000

Default: None

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- bandwidth-percentage on page 4658
- *Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches*
- *Configuring or Disabling Storm Control (CLI Procedure)*

bandwidth-percentage

Syntax bandwidth-percentage *percentage*;

Hierarchy Level [edit forwarding-options storm-control-profiles *profile-name* all]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Configure the storm control level as the percentage of available bandwidth used by the combined broadcast, multicast, and unknown unicast traffic streams on an interface. The storm control level is configured as part of the storm control profile.

NOTE: When you configure storm control level on an aggregated Ethernet interface, the storm control level for each member of the aggregated Ethernet interface is set to that bandwidth. For example, if you configure a storm control level of 15,000 Kbps on ae1, and ae1 has two members, ge-0/0/0 and ge-0/0/1, each member has a storm control level of 15,000 Kbps. Thus, the storm control level on ae1 allows a traffic rate of up to 30,000 Kbps of combined broadcast, multicast, and unknown unicast traffic.

Default On EX4300 switches—The storm control level is 80 percent of the available bandwidth used by the combined broadcast, unknown unicast, and multicast traffic streams.

On EX9200 switches—Storm control is not enabled by default.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- bandwidth-level on page 4657
- *Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches*
- *Configuring or Disabling Storm Control (CLI Procedure)*

no-registered-multicast

Syntax no-registered-multicast;

Hierarchy Level

- For platforms with ELS:

  [edit forwarding-options storm-control-profiles *profile-name* all]

- For platforms without ELS:

  [edit ethernet-switching-options storm-control interface (all | *interface-name*)],

Release Information Statement introduced in Junos OS Release 10.3 for EX Series switches.
Hierarchy level **[edit forwarding-options]** introduced in Junos OS Release 13.2X50-D10.
(See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description (EX8200 switches only) Disable storm control for registered multicast traffic for the specified interface or for all interfaces.

(EX4300 and EX9200 switches only) Exclude storm control for registered multicast traffic from a storm control profile.

Default EX4300 and EX8200 switches—Storm control is enabled for unknown unicast traffic, multicast traffic, and broadcast traffic. The default storm control level is 80 percent of the available bandwidth used by the combined applicable traffic streams.

EX9200 switches—Storm control is not enabled by default.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *no-multicast*
- **no-unregistered-multicast on page 4660**
- *Understanding Storm Control on EX Series Switches*
- *Understanding Storm Control on EX Series Switches*

no-unregistered-multicast

Syntax

no-unregistered-multicast;

Hierarchy Level

- For platforms with ELS:

  [edit forwarding-options storm-control-profiles *profile-name* all]

- For platforms without ELS:

  [edit ethernet-switching-options storm-control interface (all | *interface-name*)],

Release Information

Statement introduced in Junos OS Release 10.3 for EX Series switches.
Hierarchy level **[edit forwarding-options]** introduced in Junos OS Release 13.2X50-D10. (See "Getting Started with Enhanced Layer 2 Software" on page 58 for information about ELS.)
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description

(EX8200 switches only) Disable storm control for unregistered multicast traffic for the specified interface or for all interfaces.

(EX4300 and EX9200 switches only) Exclude storm control for unregistered multicast traffic from a storm control profile.

Default

EX4300 and EX8200 switches—Storm control is enabled for unknown unicast traffic, multicast traffic, and broadcast traffic. The default storm control level is 80 percent of the available bandwidth used by the combined applicable traffic streams.

EX9200 switches—Storm control is not enabled by default.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *no-multicast*
- **no-registered-multicast on page 4659**
- *Understanding Storm Control on EX Series Switches*
- *Understanding Storm Control on EX Series Switches*

storm-control

Syntax storm-control *storm-control-profile*;

Hierarchy Level [edit interfaces *interface-name* unit *number* family ethernet-switching]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX series.

Description Bind a storm control profile to a logical interface.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches*
- *Understanding Storm Control on EX Series Switches*

storm-control-profiles

Syntax

```
storm-control-profiles profile-name {
  action-shutdown;
  all {
    bandwidth-level;
    bandwidth-percentage;
    no-broadcast;
    no-multicast;
    no-registered-multicast;
    no-unknown-unicast;
    no-unregistered-multicast;
  }
}
```

Hierarchy Level [edit forwarding-options]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure a storm control profile on the switch.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches*
- *Understanding Storm Control on EX Series Switches*

Configuration Statements for Device Security (Original CLI Only)

bandwidth

Syntax bandwidth *bandwidth*;

Hierarchy Level [edit ethernet-switching-options storm-control interface (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For interfaces configured for storm control, configure the storm control level as the bandwidth in kilobits per second (Kbps). If the combination of broadcast and unknown unicast traffic exceeds this level, the switch performs the appropriate action.

Default None.

Options **bandwith**—Broadcast and unknown unicast traffic rate in Kbps.

Range: 100 through 10000000 Kbps

Default: None

NOTE: When you configure storm control bandwidth, the value you configure is rounded off internally to the closest multiple of 64 Kbps, and the rounded-off value represents the bandwidth that is actually enforced. For example, if you configure a bandwidth limit of 150 Kbps, storm control enforces a bandwidth limit of 128 Kbps.

CAUTION: Junos OS allows you to configure a storm control value that exceeds the bandwidth of the interface. If you configure an interface with such a value, storm control does not drop broadcast or unknown unicast packets even if they consume all the available bandwidth.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Storm Control on page 4471
- Example: Configuring Storm Control to Prevent Network Outages on page 4527
- action-shutdown on page 4650
- port-error-disable on page 4600
- disable-timeout on page 4609
- clear ethernet-switching port-error on page 4686

ethernet-switching-options

Syntax

```
ethernet-switching-options {
  analyzer {
    name {
      input {
        egress {
          interface (all | interface-name);
        }
        ingress {
          interface (all | interface-name);
          vlan (vlan-id | vlan-name);
        }
      output {
        interface interface-name;
        ip-address ip-address;
        vlan (vlan-id | vlan-name);
      }
    }
  }
  bpdu-block {
    interface (all | [interface-name]);
    disable-timeout timeout;
  }
  dot1q-tunneling {
    ether-type (0x8100 | 0x88a8 | 0x9100)
  }
  interfaces interface-name {
    no-mac-learning;
  }
  mac-table-aging-time seconds {
  }
  port-error-disable {
    disable-timeout timeout;
  }
  secure-access-port {
    dhcp-snooping-file {
      location local_pathname | remote_URL;
      timeout seconds;
      write-interval seconds;
    }
    interface (all | interface-name) {
      allowed-mac {
        mac-address-list;
      }
      (dhcp-trusted | no-dhcp-trusted);
      fcoe-trusted;
      mac-limit limit action action;
      no-allowed-mac-log;
    }
    vlan (all | vlan-name) {
      (arp-inspection | no-arp-inspection) [
        forwarding-class (for DHCP Snooping or DAI Packets) class-name;
      }
```



```
        dhcp-option82 {
          circuit-id {
            prefix (Circuit ID for Option 82) hostname;
            use-interface-description;
            use-vlan-id;
          }
          remote-id {
            prefix (Remote ID for Option 82) hostname | mac | none;
            use-interface-description;
            use-string string;
          }
          vendor-id <string>;
        }
        (examine-dhcp | no-examine-dhcp) {
          forwarding-class (for DHCP Snooping or DAI Packets) class-name;
        }
        examine-fip {
          examine-vn2vn {
            beacon-period milliseconds;
          }
          fc-map fc-map-value;
        }
        mac-move-limit limit <fabric-limit limit action action;
      }
    }
    static {
      vlan vlan-id {
        mac mac-address next-hop interface-name;
      }
    }
    storm-control {
      interface (all | interface-name) {
        bandwidth bandwidth;
        no-broadcast;
        no-multicast;
        no-unknown-unicast;
      }
    }
    traceoptions {
      file filename <files number> <no-stamp> <replace> <size size> <world-readable |
        no-world-readable>;
      flag flag <disable>;
    }
    unknown-unicast-forwarding {
      vlan (all | vlan-name) {
        interface interface-name;
      }
    }
  }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Ethernet switching options.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Overview of Access Port Protection on page 4451
- Understanding Storm Control on page 4471

interface (Storm Control)

Syntax

```
interface (all | interface-name) {
  bandwidth bandwidth;
  no-broadcast;
  no-multicast;
  no-unknown-unicast;
}
```

Hierarchy Level [edit ethernet-switching-options storm-control]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Apply storm control to all interfaces or to the specified interface.

The remaining statement is explained separately.

Default Storm control is disabled.

Options **all**—Apply storm control to all interfaces.

interface-name—Apply storm control to the specified interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Storm Control on page 4471
- Example: Configuring Storm Control to Prevent Network Outages on page 4527

storm-control

Syntax

```
storm-control {
  action-shutdown;
  interface (all | interface-name) {
    bandwidth bandwidth;
    no-broadcast;
    no-multicast;
    no-unknown-unicast;
  }
}
```

Hierarchy Level [edit ethernet-switching-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Apply storm control to all interfaces or to the specified interfaces.

The statements are explained separately.

NOTE: **The no-multicast option is not supported on QFabric systems.**

Default By default, storm control is enabled on all switch interfaces at a level of 80 percent of the combined broadcast, multicast, and unknown unicast streams. You can change the storm control level by configuring it as a specific bandwidth value.

When you configure storm control bandwidth on an aggregated Ethernet interface, each member of the aggregated interface is assigned that bandwidth. For example, if you configure 7000000 Kbps on aggregated interface **ae1**, and **ae1** has two members, **xe-2:0/0/0** and **xe-2:0/0/1**, each member is allowed a bandwidth level of 7000000 Kbps. Thus, the storm control bandwidth on **ae1** could be as much as 14000000 Kbps of combined broadcast and unknown unicast traffic.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Storm Control on page 4471
- Example: Configuring Storm Control to Prevent Network Outages on page 4527
- port-error-disable on page 4600
- disable-timeout on page 4609
- clear ethernet-switching port-error on page 4686

CHAPTER 52

Administration

Routine Monitoring

Monitoring Firewall Filter Traffic

You can use operational mode commands to monitor firewall filter traffic.

Monitoring Traffic for All Firewall Filters and Policers That Are Configured

Purpose Monitor the number of packets and bytes that matched the firewall filters and monitor the number of packets that exceeded policer rate limits:

Action Use the **show firewall** operational mode command:

```
user@switch> show firewall
```

```
Filter: egress-vlan-watch-employee
Counters:
Name                                                  Bytes              Packets
counter-employee-web                                   3348                   27
Filter: ingress-port-limit-tcp-icmp
Counters:
Name                                                  Bytes              Packets
icmp-counter                                            560                   10
Policers:
Name                                                Packets
icmp-connection-policer                                  10
tcp-connection-policer                                    0
Filter: ingress-vlan-rogue-block
Filter: ingress-vlan-limit-guest
```

Meaning The **show firewall** command displays the names of all firewall filters, counters, and policers that are configured. For each counter that is specified in a filter configuration, the output field shows the byte count and packet count for the term in which the counter is specified. For each policer that is specified in a filter configuration, the output field shows the packet count for packets that exceed the specified rate limits.

Monitoring Traffic for a Specific Firewall Filter

Purpose Monitor the number of packets and bytes that matched a firewall filter and monitor the number of packets that exceeded policer rate limits.

Action Use the **show firewall filter *filter-name*** operational mode command:

```
user@switch> show firewall filter ingress-port-limit-tcp-icmp
Filter: ingress-port-limit-tcp-icmp
Counters:
Name                                                  Bytes              Packets
icmp-counter                                            560                   10
```

Meaning The **show firewall filter *filter-name*** command limits the display information to the counters and policers that are defined for the specified filter.

Monitoring Traffic for a Specific Policer

Purpose Monitor the number of packets that exceeded the rate limits of a policer:

Action Use the **show firewall policer *policer-name*** operational mode command:

```
user@switch> show firewall policer icmp-connection-policer
Filter: ingress-port-limit-tcp-icmp
Policers:
Name                                                Packets
icmp-connection-policer                                  10
```

Meaning The **show firewall policer *policer-name*** command displays the number of packets that exceeded the rate limits for the specified policer.

Related Documentation

- Configuring Firewall Filters on page 4531
- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Verifying That Firewall Filters Are Operational on page 4672

Monitoring Port Security

Purpose Use the monitoring functionality to view these port security details:

- DHCP snooping database for a VLAN or all VLANs
- ARP inspection details for all interfaces

Action To monitor port security in the J-Web interface, select **Monitor** > **Security** > **Port Security**.

To monitor and manipulate the DHCP snooping database and ARP inspection statistics in the CLI, enter the following commands:

- **show dhcp snooping binding**
- **clear dhcp snooping binding**—In addition to clearing the whole database, you can clear database entries for specified VLANs or MAC addresses.
- **show arp inspection statistics**
- **clear arp inspection statistics**

NOTE: On EX4300 switches, to monitor and manipulate the DHCP snooping database and ARP inspection statistics in the CLI, enter the following commands:

- **show dhcp-security binding**
- **clear dhcp-security binding**—In addition to clearing the whole database, you can clear database entries for specified VLANs or IP Address.
- **show dhcp-security arp inspection statistics**
- **clear arp inspection statistics**

Meaning The J-Web Port Security Monitoring page comprises two sections:

- DHCP Snooping Details—Displays the DHCP snooping database for all the VLANs for which DHCP snooping is enabled. To view the DHCP snooping database for a specific VLAN, select the specific VLAN from the list.
- ARP Inspection Details—Displays the ARP inspection details for all interfaces. The information includes details of the number of packets that passed ARP inspection and the number of packets that failed the inspection. The pie chart graphically represents these statistics when you select an interface. To view ARP inspection statistics for a specific interface, select the interface from the list.

You can use the following options on the page to clear DHCP snooping and ARP inspection details:

- Clear All—Clears the DHCP snooping database, either for all VLANs if the option **ALL** has been selected in the Select VLANs list or for the specific VLAN that has been selected in that list.
- Clear—Deletes a specific IP address from the DHCP snooping database.

To clear ARP inspection details on the page, click **Clear All** in the ARP inspection details section.

NOTE: **Clear All button in the ARP inspection details section is not supported on EX4300 switches.**

Use the CLI commands to show and clear DHCP snooping database and ARP inspection statistics details.

Related Documentation

- Configuring Port Security (CLI Procedure) on page 4543
- *Configuring Port Security (J-Web Procedure)*
- Example: Configuring Basic Port Security Features on page 4488

Verifying That Firewall Filters Are Operational

Purpose Verify that firewall filters are working properly after you apply them to ports, VLANs, or Layer 3 interfaces.

Action Use the **show firewall** operational mode command to verify that the firewall filters are working properly:

```
user@switch> show firewall
Filter: egress-vlan-watch-employee
Counters:
Name                                                 Bytes                Packets
counter-employee-web                                     0                      0
Filter: ingress-port-limit-tcp-icmp
Counters:
Name                                                 Bytes                Packets
icmp-counter                                           560                     10
Policers:
Name                                               Packets
icmp-connection-policer                                 10
tcp-connection-policer                                   0
Filter: ingress-vlan-rogue-block
Filter: ingress-vlan-limit-guest
```

Meaning The **show firewall** command displays the names of all firewall filters, counters, and policers that are configured. For each counter that is specified in a filter configuration, the output field shows the byte count and packet count for the term in which the counter is specified. In the above example, the **icmp-counter** in the filter **ingress-port-limit-tcp-icmp** shows that the filter matched 10 packets. For each policer that is specified in a filter configuration, the output field shows the packet count for packets that exceed the specified rate limits. The policer **icmp-connection-policer** shows that 10 ICMP packets were policed.

Related Documentation

- Configuring Firewall Filters on page 4531
- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Monitoring Firewall Filter Traffic on page 4669

Verifying That DAI Is Working Correctly

Purpose Verify that dynamic ARP inspection (DAI) is working on the switch.

Action Send some ARP requests from network devices connected to the switch.

Display the DAI information:

```
user@switch> show arp inspection statistics
ARP inspection statistics:
Interface        Packets received  ARP inspection pass   ARP inspection failed
---------------  ---------------   --------------------  ---------------------
ge-0/0/1.0                     7                      5                      2
ge-0/0/2.0                    10                     10                      0
ge-0/0/3.0                    12                     12                      0
```

Meaning The sample output shows the number of ARP packets received and inspected per interface, with a listing of how many packets passed and how many failed the inspection on each interface. The switch compares the ARP requests and replies against the entries in the DHCP snooping database. If a MAC address or IP address in the ARP packet does not match a valid entry in the database, the packet is dropped.

Related Documentation

- Enabling Dynamic ARP Inspection (CLI Procedure) on page 4553
- *Enabling Dynamic ARP Inspection (J-Web Procedure)*
- Example: Configuring Basic Port Security Features on page 4488
- Example: Configuring DHCP Snooping, DAI , and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch on page 4506
- Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks on page 4513
- Monitoring Port Security on page 4671

Verifying That DHCP Snooping Is Working Correctly

Purpose Verify that DHCP snooping is working on the switch and that the DHCP snooping database is correctly populated with both dynamic and static bindings.

Action Send some DHCP requests from network devices (here they are DHCP clients) connected to the switch.

Display the DHCP snooping information when the interface on which the DHCP server connects to the switch is trusted. The following output results when requests are sent from the MAC addresses and the server has provided the IP addresses and leases:

```
user@switch>  show dhcp snooping binding
DHCP Snooping Information:
MAC address        IP address  Lease (seconds) Type     VLAN      Interface

00:05:85:3A:82:77  192.0.2.17  600             dynamic  employee  ge-0/0/1.0
00:05:85:3A:82:79  192.0.2.18  653             dynamic  employee  ge-0/0/1.0
00:05:85:3A:82:80  192.0.2.19  720             dynamic  employee  ge-0/0/2.0
00:05:85:3A:82:81  192.0.2.20  932             dynamic  employee  ge-0/0/2.0
00:05:85:3A:82:83  192.0.2.21  1230            dynamic  employee  ge-0/0/2.0
00:05:85:27:32:88  192.0.2.22  –               static   data      ge-0/0/4.0
```

Meaning When the interface on which the DHCP server connects to the switch has been set to trusted, the output (see preceding sample) shows, for each MAC address, the assigned IP address and lease time—that is, the time, in seconds, remaining before the lease expires. Static IP addresses have no assigned lease time. The statically configured entry never expires.

If the DHCP server had been configured as untrusted, no entries would be added to the DHCP snooping database and nothing would be shown in the output of the **show dhcp snooping binding** command.

Related Documentation

- Enabling DHCP Snooping (CLI Procedure) on page 4551
- *Enabling DHCP Snooping (J-Web Procedure)*
- Configuring Static IP Addresses for DHCP Bindings on Access Ports (CLI Procedure) on page 4550
- Example: Configuring Basic Port Security Features on page 4488
- Example: Configuring DHCP Snooping, DAI , and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch on page 4506
- Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks on page 4513
- Monitoring Port Security on page 4671
- *Troubleshooting Port Security*

Verifying That MAC Limiting Is Working Correctly

MAC limiting protects against flooding of the Ethernet switching table by setting a limit on the number of MAC addresses that can be learned on a single Layer 2 access interface (port).

Junos OS provides two MAC limiting methods:

- Maximum number of MAC addresses—You configure the maximum number of dynamic MAC addresses allowed per interface. When the limit is exceeded, incoming packets with new MAC addresses can be ignored, dropped, or logged. You can also specify that the interface be shut down or temporarily disabled.
- Allowed MAC addresses—You configure specific “allowed” MAC addresses for the access interface. Any MAC address that is not in the list of configured addresses is not learned, and the switch logs an appropriate message. The allowed MAC method binds MAC addresses to a VLAN so that the address is not registered outside the VLAN. If an allowed MAC setting conflicts with a dynamic MAC setting, the allowed MAC setting takes precedence.

This topic includes the following tasks:

Verifying That MAC Limiting for Dynamic MAC Addresses Is Working Correctly

Purpose Verify that MAC limiting for dynamic MAC addresses is working.

Action Display the MAC addresses that have been learned. The following sample output shows the results of sending two packets from hosts connected to **xe-1:0/0/1** and five packets from hosts connected to **xe-1:0/0/2**, with both interfaces configured with a MAC limit of **4** and the action **drop**:

```
user@switch> show ethernet-switching table
Ethernet-switching table:  7 entries, 6 learned
  VLAN                    MAC address         Type         Age    Interfaces

  employee-vlan           *                   Flood          -    xe-1:0/0/2.0
  employee-vlan           00:05:85:3A:82:77   Learn          0    xe-1:0/0/1.0
  employee-vlan           00:05:85:3A:82:79   Learn          0    xe-1:0/0/1.0
  employee-vlan           00:05:85:3A:82:80   Learn          0    xe-1:0/0/2.0
  employee-vlan           00:05:85:3A:82:81   Learn          0    xe-1:0/0/2.0
  employee-vlan           00:05:85:3A:82:83   Learn          0    xe-1:0/0/2.0
  employee-vlan           00:05:85:3A:82:85   Learn          0    xe-1:0/0/2.0
```

Meaning The output shows that the fifth packet received on the **xe-1:0/0/2** interface was dropped because it exceeded the MAC limit for that interface. The address was not learned, and thus an asterisk (*) rather than an address appears in the MAC address column in the first line of the sample output.

Verifying That Allowed MAC Addresses Are Working Correctly

Purpose Verify that allowed MAC addresses are working.

Action Display the MAC cache information after allowed MAC addresses have been configured on an interface. The following sample shows the MAC cache after four allowed MAC addresses had been configured on interface **xe-1:0/0/2** and a fifth MAC address appeared on the interface.

```
user@switch> show ethernet-switching table
Ethernet-switching table:  5 entries, 4 learned
  VLAN                 MAC address        Type         Age    Interfaces

  employee-vlan        00:05:85:3A:82:80  Learn          0    xe-1:0/0/2.0
  employee-vlan        00:05:85:3A:82:81  Learn          0    xe-1:0/0/2.0
  employee-vlan        00:05:85:3A:82:83  Learn          0    xe-1:0/0/2.0
  employee-vlan        00:05:85:3A:82:85  Learn          0    xe-1:0/0/2.0
  employee-vlan        *                  Flood          -    xe-1:0/0/2.0
```

Meaning Because the fifth address was not allowed it was not learned, and an asterisk (*) rather than an address appears in the MAC address column in the last line of the sample output.

Verifying That Interfaces Are Shut Down

Purpose Verify that an interface is shut down when the MAC limit is exceeded.

Action For more information about interfaces that have been shut down because the MAC limit was exceeded, use the **show ethernet-switching interfaces** command.

```
user@switch> show ethernet-switching interfaces
Interface     State   VLAN members       Tag    Tagging  Blocking



bme0.32770      down    mgmt      untagged unblocked

xe-0/0/0.0      down    v1        untagged MAC limit exceeded

xe- 0/0/1.0       up      v1        untagged unblocked

xe-0/0/2.0       up      v1        untagged unblocked

me0.0           up      mgmt      untagged unblocked
```


NOTE: You can configure interfaces to recover automatically when the MAC limit has been exceeded by specifying the **port-error-disable** statement with a **disable timeout** value. The switch automatically restores the disabled interface to service when the disable timeout expires. The **port-error-disable** configuration does not apply to preexisting error conditions—it affects only error conditions that are detected after the **port-error-disable** statement has been enabled and the configuration has been committed. To clear a preexisting error condition and restore the interface to service, use the clear ethernet-switching port-error command.

Customizing the Ethernet Switching Table Display to View Information for a Specific Interface

Purpose You can use the **show ethernet-switching table** command to view information for a specific interface.

Action For example, to display the MAC addresses that have been learned on the **xe-0/0/2** interface, enter:

```
user@switch> show ethernet-switching table interface xe-0/0/2.0
Ethernet-switching table: 1 unicast entries

  VLAN              MAC address       Type         Age Interfaces

  v1                *                 Flood          - All-members

  v1                00:00:06:00:00:00 Learn          0 xe-0/0/2.0
```

Meaning The MAC limit value for the **xe-0/0/2** interface had been set to **1**, and the output shows that only one MAC address was learned and added to the MAC cache.

Related Documentation

- Configuring MAC Limiting on page 4545
- Monitoring Port Security on page 4671
- *Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)*
- Example: Configuring Allowed MAC Addresses to Protect the Switch from DHCP Snooping Database Alteration Attacks on page 4518
- Example: Configuring MAC Limiting to Protect the Switch from DHCP Starvation Attacks on page 4495

Verifying That MAC Move Limiting Is Working Correctly

Purpose Verify that MAC move limiting is working on the switch.

Action Display the MAC addresses in the Ethernet switching table when MAC move limiting has been configured for a VLAN. The following sample shows the results after two of the hosts on **ge-0/0/2** sent packets after the MAC addresses for those hosts had moved to other interfaces more than five times in 1 second. The VLAN, **employee-vlan**, was set to a MAC move limit of **5** with the action **drop**:

```
user@switch> show ethernet-switching table

Ethernet-switching table:  7 entries, 4 learned
  VLAN                  MAC address         Type          Age    Interfaces

  employee-vlan         00:05:85:3A:82:77   Learn           0    ge-0/0/1.0
  employee-vlan         00:05:85:3A:82:79   Learn           0    ge-0/0/1.0
  employee-vlan         00:05:85:3A:82:80   Learn           0    ge-0/0/2.0
  employee-vlan         00:05:85:3A:82:81   Learn           0    ge-0/0/2.0
  employee-vlan         *                   Flood           -    ge-0/0/2.0
  employee-vlan         *                   Flood           -    ge-0/0/2.0
```

Meaning The last two lines of the sample output show that MAC addresses for two hosts on **ge-0/0/2** were not learned, because the hosts had been moved back and forth from the original interfaces more than five times in 1 second.

Related Documentation

- Configuring MAC Move Limiting (CLI Procedure) on page 4547
- *Configuring MAC Move Limiting (J-Web Procedure)*
- *Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)*
- Example: Configuring Basic Port Security Features on page 4488
- Monitoring Port Security on page 4671

Verifying That the Port Error Disable Setting Is Working Correctly

Purpose Verify that the port error disable setting is working as expected for MAC limited and storm control interfaces.

Action Display information about interfaces:

```
user@switch> show ethernet-switching interfaces
Interface        State     VLAN members          Blocking
xe-2:0/0/0.0  up       T1122                  unblocked
xe-2:0/0/1.0  down     default                MAC limit exceeded
xe-2:0/0/2.0  down     default                Storm control in effect
xe-2:0/0/3.0  down     default                unblocked
xe-2:0/0/4.0  down     default                unblocked
xe-2:0/0/5.0  down     default                unblocked
xe-2:0/0/6.0  down     default                unblocked
```

Meaning For interfaces disabled by port security features, the sample output from the **show ethernet-switching interfaces** command specifies the reasons that the interfaces are disabled:

- **MAC limit exceeded**—The interface is temporarily disabled because of a **mac-limit** error. The disabled interface is automatically restored to service when the **disable-timeout (Port Error Disable)** expires.
- **MAC move limit exceeded**—The interface is temporarily disabled because of a *mac-move-limit* error. The disabled interface is automatically restored to service when the *disable-timeout* expires.
- **Storm control in effect**—The interface is temporarily disabled because of a **storm-control** error. The disabled interface is automatically restored to service when the **disable-timeout (Port Error Disable)** expires.

Related Documentation

- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 4465
- **port-error-disable on page 4600**
- Configuring Autorecovery for MAC Limited or Storm Control Interfaces (CLI Procedure) on page 4549

Verifying Unicast RPF Status

Purpose Verify that unicast reverse-path forwarding (RPF) is enabled and is working on the interface.

Action Use one of the **show interfaces** ***interface-name*** commands with either the **extensive** or **detail** options to verify that unicast RPF is enabled and working on the switch. The following example displays output from the **show interfaces ge- extensive** command.

```
user@switch> show interfaces ge-1/0/10 extensive
Physical interface: ge-1/0/10, Enabled, Physical link is Down
  Interface index: 139, SNMP ifIndex: 58, Generation: 140
  Link-level type: Ethernet, MTU: 1514, Speed: Auto, MAC-REWRITE Error: None,
  Loopback: Disabled, Source filtering: Disabled, Flow control: Enabled,
  Auto-negotiation: Enabled, Remote fault: Online
  Device flags   : Present Running
  Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:19:e2:50:95:ab, Hardware address: 00:19:e2:50:95:ab
  Last flapped   : Never
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :                    0                    0 bps
   Input  packets:                    0                    0 pps
   Output packets:                    0                    0 pps
   IPv6 transit statistics:
    Input  bytes  :                   0
    Output bytes  :                   0
    Input  packets:                   0
    Output packets:                   0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
    L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
    FIFO errors: 0, Resource errors: 0
```



```
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,

  FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 4 in use
Queue counters:       Queued packets  Transmitted packets      Dropped packets

  0 best-effort                    0                    0                    0

  1 assured-forw                   0                    0                    0

  5 expedited-fo                   0                    0                    0

  7 network-cont                   0                    0                    0

Active alarms  : LINK
Active defects : LINK
MAC statistics:                      Receive         Transmit
  Total octets                             0                0
  Total packets                            0                0
  Unicast packets                          0                0
  Broadcast packets                        0                0
  Multicast packets                        0                0
  CRC/Align errors                         0                0
  FIFO errors                              0                0
  MAC control frames                       0                0
  MAC pause frames                         0                0
  Oversized frames                         0
  Jabber frames                            0
  Fragment frames                          0
  VLAN tagged frames                       0
  Code violations                          0
Filter statistics:
  Input packet count                       0
  Input packet rejects                     0
  Input DA rejects                         0
  Input SA rejects                         0
  Output packet count                                       0
  Output packet pad count                                   0
  Output packet error count                                 0
  CAM destination filters: 0, CAM source filters: 0
Autonegotiation information:
  Negotiation status: Incomplete
Packet Forwarding Engine configuration:
  Destination slot: 1

Logical interface ge-1/0/10.0 (Index 69) (SNMP ifIndex 59) (Generation 135)
  Flags: Device-Down SNMP-Traps 0x0 Encapsulation: ENET2
  Traffic statistics:
   Input  bytes  :                    0
   Output bytes  :                    0
   Input  packets:                    0
   Output packets:                    0
   IPv6 transit statistics:
    Input  bytes  :                   0
    Output bytes  :                   0
    Input  packets:                   0
    Output packets:                   0
  Local statistics:
   Input  bytes  :                    0
   Output bytes  :                    0
```



```
 Input  packets:                   0
 Output packets:                   0
Transit statistics:
 Input  bytes  :                   0                    0 bps
 Output bytes  :                   0                    0 bps
 Input  packets:                   0                    0 pps
 Output packets:                   0                    0 pps
 IPv6 transit statistics:
  Input  bytes  :                  0
  Output bytes  :                  0
  Input  packets:                  0
  Output packets:                  0
    Protocol inet, Generation: 144, Route table: 0
  Flags: uRPF
  Addresses, Flags: Is-Preferred Is-Primary
```

Meaning The **show interfaces ge-1/0/10 extensive** command (and the **show interfaces ge-1/0/10 detail** command) displays in-depth information about the interface. The **Flags:** output field near the bottom of the display reports the unicast RPF status. If unicast RPF has not been enabled, the **uRPF** flag is not displayed.

On EX3200, EX4200, and EX4300 switches, unicast RPF is implicitly enabled on *all* switch interfaces, including aggregated Ethernet interfaces (also referred to as link aggregation groups or LAGs), integrated routing and bridging (IRB) interfaces, and routed VLAN interfaces (RVIs) when you enable unicast RPF on a single interface. However, the unicast RPF status is shown as enabled only on interfaces for which you have explicitly configured unicast RPF. Thus, the **uRPF** flag is not displayed on interfaces for which you have not explicitly configured unicast RPF even though unicast RPF is implicitly enabled on all interfaces on EX3200 and EX4200 switches.

Related Documentation

- *show interfaces xe-*
- *Example: Configuring Unicast RPF on an EX Series Switch*
- Configuring Unicast RPF (CLI Procedure) on page 4562
- Disabling Unicast RPF (CLI Procedure) on page 4564
- *Troubleshooting Unicast RPF*

Verifying That a Trusted DHCP Server Is Working Correctly

Purpose Verify that a DHCP trusted server is working on the switch. See what happens when the DHCP server is trusted and then untrusted.

Action Send some DHCP requests from network devices (here they are DHCP clients) connected to the switch.

Display the DHCP snooping information when the interface on which the DHCP server connects to the switch is trusted. The following output results when requests are sent from the MAC addresses and the server has provided the IP addresses and leases:

```
user@switch> show dhcp snooping binding
DHCP Snooping Information:
MAC Address        IP Address    Lease    Type      VLAN            Interface
-----------------  ----------    -----    ----      ----            ---------
00:05:85:3A:82:77   192.0.2.17    600    dynamic  employee—vlan    ge-0/0/1.0
00:05:85:3A:82:79   192.0.2.18    653    dynamic  employee—vlan    ge-0/0/1.0
00:05:85:3A:82:80   192.0.2.19    720    dynamic  employee—vlan    ge-0/0/2.0
00:05:85:3A:82:81   192.0.2.20    932    dynamic  employee—vlan    ge-0/0/2.0
00:05:85:3A:82:83   192.0.2.21   1230    dynamic  employee—vlan    ge-0/0/2.0
00:05:85:27:32:88   192.0.2.22   3200    dynamic  employee—vlan    ge-0/0/2.0
```

Meaning When the interface on which the DHCP server connects to the switch has been set to trusted, the output (see preceding sample) shows, for each MAC address, the assigned IP address and lease time—that is, the time, in seconds, remaining before the lease expires.

If the DHCP server had been configured as untrusted, no entries would be added to the DHCP snooping database and nothing would be shown in the output of the **show dhcp snooping binding** command.

Related Documentation

- Enabling a Trusted DHCP Server (CLI Procedure) on page 4555
- Enabling a Trusted Port for DHCP on page 4556
- *Enabling a Trusted DHCP Server (J-Web Procedure)*
- Example: Configuring Basic Port Security Features on page 4488
- Example: Configuring a DHCP Server Interface as Untrusted to Protect the Switch from Rogue DHCP Server Attacks on page 4503
- Monitoring Port Security on page 4671
- *Troubleshooting Port Security*

Verifying That Three-Color Policers Are Operational

Purpose Verify that three-color policers in firewall filter configurations are working properly.

Action Use the following operational mode commands to verify that a three-color policer is working properly:

- **show class-of-service forwarding-table classifiers**
- **show interfaces *interface-name* extensive**

- **show interfaces queue *interface-name***

Related Documentation

- Overview of Policers on page 4441
- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538

Verifying That Two-Color Policers Are Operational

Purpose Verify that two-color policers in firewall filter configurations are working properly.

Action Use the **show firewall policer** operational mode command to verify that the policers are working properly:

```
user@switch> show firewall policer
Filter: egress-vlan-watch-employee
Filter: ingress-port-filter
Filter: ingress-port-limit-tcp-icmp
Policers:
Name                                              Packets
icmp-connection-policer                                10
tcp-connection-policer                                539
Filter: ingress-vlan-rogue-block
Filter: ingress-vlan-limit-guest
```

Meaning The **show firewall policer** command displays the names of all firewall filters and policers that are configured. For each policer that is specified in a filter configuration, the output field shows the current packet count for all packets that exceed the specified rate limits.

Related Documentation

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538
- Configuring Firewall Filters on page 4531
- Monitoring Firewall Filter Traffic on page 4669

Monitoring Commands

- clear arp inspection statistics
- clear dhcp snooping binding
- clear ethernet-switching port-error
- clear firewall
- show arp inspection statistics
- show dhcp snooping binding
- show firewall
- show firewall policer
- show interfaces filters

clear arp inspection statistics

Syntax clear arp inspection statistics
<interface *interface*>

Release Information Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description Clear ARP inspection statistics.

Options **none**—Clears ARP statistics on all interfaces.

interface *interface-names*—(Optional) Clear ARP statistics on one or more interfaces.

Required Privilege Level clear

Related Documentation

- **show arp inspection statistics on page 4688**
- Example: Configuring Basic Port Security Features on page 4488
- Verifying That DAI Is Working Correctly on page 4673

List of Sample Output **clear arp inspection statistics on page 4684**

Output Fields This command produces no output.

Sample Output

clear arp inspection statistics

```
user@switch> clear arp inspection statistics
```


clear dhcp snooping binding

Syntax

clear dhcp snooping binding
<mac (all | *mac-address*)>
<vlan (all | *vlan-name*)>
<vlan (all | *vlan-name*) mac (all | *mac-address*)>

Release Information

Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Clear the DHCP snooping database information.

Options

mac (all | *mac-address*)—(Optional) Clear DHCP snooping information for the specified MAC address or all MAC addresses.

vlan (all | *vlan-name*)—(Optional) Clear DHCP snooping information for the specified VLAN or all VLANs.

Required Privilege Level

clear

Related Documentation

- Example: Configuring Basic Port Security Features on page 4488
- **show dhcp snooping binding on page 4689**

List of Sample Output

clear dhcp snooping binding on page 4685

Output Fields

This command produces no output.

Sample Output

clear dhcp snooping binding

`user@switch>` **clear dhcp snooping binding**

clear ethernet-switching port-error

Syntax

clear ethernet-switching port-error
<interface *interface-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Clear all MAC limiting, MAC move limiting, and storm control errors from all the Ethernet switching interfaces on the switch or from the specified interface, and restore the interfaces or the specified interface to service.

Options

none—Clear all MAC limiting, MAC move limiting, and storm control errors from all the Ethernet switching interfaces on the switch and restore the interfaces to service.

interface *interface-name*—(Optional) Clear all MAC limiting, MAC move limiting, and storm control errors from the specified interface and restore the interface to service.

Required Privilege Level

clear

Related Documentation

- Configuring MAC Limiting on page 4545
- Example: Configuring Storm Control to Prevent Network Outages on page 4527
- Configuring Port Security (CLI Procedure) on page 4543
- **port-error-disable on page 4600**
- Configuring Autorecovery for MAC Limited or Storm Control Interfaces (CLI Procedure) on page 4549

Output Fields

This command produces no output.

clear firewall

Syntax clear firewall (all | counter *counter-name* | filter *filter-name*)

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear statistics provided by firewall filters.

When you clear the counters of a filter, this not only impacts the counters shown by the CLI, but also the ones tracked by SNMP 2.

Options **all**—Clear the packet and byte counts for all firewall filter counters and clear the packet counts for all policer counters.

counter *counter-name*—Clear the packet and byte counts for the specified firewall filter counter.

filter *filter-name*—Clear the packet and byte counts for the specified firewall filter.

Required Privilege Level clear

Related Documentation

- Verifying That Firewall Filters Are Operational on page 4672
- Verifying That Two-Color Policers Are Operational on page 4683
- Overview of Firewall Filters on page 4409
- Overview of Policers on page 4441

Sample Output

clear firewall all

user@switch> **clear firewall all**

clear firewall counter

user@switch> **clear firewall counter port-filter-counter**

clear firewall filter

user@switch> **clear firewall filter ingress-port-filter**

show arp inspection statistics

Syntax show arp inspection statistics

Release Information Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description Display ARP inspection statistics.

Required Privilege Level view

Related Documentation

- clear arp inspection statistics on page 4684
- Example: Configuring Basic Port Security Features on page 4488
- Verifying That DAI Is Working Correctly on page 4673

List of Sample Output show arp inspection statistics on page 4688

Output Fields Table 360 on page 4688 lists the output fields for the **show arp inspection statistics** command. Output fields are listed in the approximate order in which they appear.

Table 360: show arp inspection statistics Output Fields

Field Name	Field Description	Level of Output
Interface	Interface on which ARP inspection has been applied.	All levels
Packets received	Total number of packets total that underwent ARP inspection.	All levels
ARP inspection pass	Total number of packets that passed ARP inspection.	All levels
ARP inspection failed	Total number of packets that failed ARP inspection.	All levels

Sample Output

show arp inspection statistics

```
user@switch> show arp inspection statistics

Interface     Packets received     ARP inspection pass  ARP inspection failed
---------     -----------------    -------------------  ---------------------
  ge-0/0/0                    0                      0                      0
  ge-0/0/1                    0                      0                      0
  ge-0/0/2                    0                      0                      0
  ge-0/0/3                    0                      0                      0
  ge-0/0/4                    0                      0                      0
  ge-0/0/5                    0                      0                      0
  ge-0/0/6                    0                      0                      0
  ge-0/0/7                  703                    701                      2
```


show dhcp snooping binding

Syntax

show dhcp snooping binding
<**interface** *interface-name*>
<**vlan** *vlan-name*>

Release Information

Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display the DHCP snooping database information.

Options

interface *interface-name*—(Optional) Display the DHCP snooping database information for an interface.

vlan *vlan-name*—(Optional) Display the DHCP snooping database information for a VLAN.

Required Privilege Level

view

Related Documentation

- *clear dhcp snooping binding*
- Example: Configuring Basic Port Security Features on page 4488
- Verifying That DHCP Snooping Is Working Correctly on page 4673

List of Sample Output

show dhcp snooping binding on page 4689

Output Fields

Table 361 on page 4689 lists the output fields for the **show dhcp snooping binding** command. Output fields are listed in the approximate order in which they appear.

Table 361: show dhcp snooping binding Output Fields

Field Name	Field Description	Level of Output
MAC Address	MAC address of the network device; bound to the IP address.	All levels
IP Address	IP address of the network device; bound to the MAC address.	All levels
Lease	Lease granted to the IP address.	All levels
Type	How the MAC address was acquired.	All levels
VLAN	VLAN name of the network device whose MAC address is shown.	All levels
Interface	Interface address (port).	All levels

Sample Output

show dhcp snooping binding

```
user@switch> show dhcp snooping binding
```



```
DHCP Snooping Information:
MAC Address             IP Address Lease   Type     VLAN    Interface
-----------------       ---------- -----   -------  ----    ---------
00:00:01:00:00:03       192.0.2.0  640     dynamic  guest    ge-0/0/12.0
00:00:01:00:00:04       192.0.2.1  720     dynamic  guest    ge-0/0/12.0
00:00:01:00:00:05       192.0.2.5  800     dynamic  guest    ge-0/0/13.0
```


show firewall

Syntax

show firewall
<counter *counter-name*>
<filter *filter-name*>
<log <detail | interface *interface-name*>>
<terse>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display statistics about configured firewall filters.

Options

counter *counter-name*—(Optional) Display statistics about a particular firewall filter counter.

filter *filter-name*—(Optional) Display statistics about a particular firewall filter.

log—(Optional) Display log entries for all firewall filter activity.

terse—(Optional) Display firewall filter names only.

Required Privilege Level view

Related Documentation

- Verifying That Firewall Filters Are Operational on page 4672
- Verifying That Two-Color Policers Are Operational on page 4683
- Overview of Firewall Filters on page 4409
- Overview of Policers on page 4441

List of Sample Output

show firewall on page 4692
show firewall filter filter-name on page 4693
show firewall counter counter-name on page 4693
show firewall log on page 4693
show firewall log detail on page 4693

Output Fields Table 362 on page 4691 lists the output fields for the **show firewall** command. Output fields are listed in the approximate order in which they appear.

Table 362: show firewall Output Fields

Field Name	Field Description	Level of Output
Filter	Name of the filter that is configured at the **[edit firewall family *family-name* filter]** hierarchy level.	All levels

Table 362: show firewall Output Fields *(continued)*

Field Name	Field Description	Level of Output
Counters	Display filter counter information: • Name—Name of a filter counter that has been configured with the **count** firewall filter action modifier. • Bytes—Number of bytes that match the filter term where the **count** action modifier was specified. • Packets—Number of packets that matched the filter term where the **count** action modifier was specified.	All levels
Policers	Display policer information: • Name—Name of the policer that is configured at the **[edit firewall policer]** hierarchy level. • Packets—Number of packets that matched the filter term where the **policer** action modifier was specified. This is the number of packets that exceeded the rate limits that the policer specifies.	All levels
Action	Filter action: • **A**—Accept • **D**—Discard	All levels
Interface	Interface on which the firewall filter is applied.	All levels
Protocol	Name of the packet protocol.	All levels
Packet Length	Length of the packet.	All levels
Src Addr	Source address of the packet.	All levels
Dest Addr	Destination address of the packet.	All levels

Sample Output

show firewall

```
user@switch> show firewall
Filter: egress-vlan-watch-employee
Counters:
Name                                                Bytes              Packets
counter-employee-web                                    0                    0
Filter: ingress-port-limit-tcp-icmp
Counters:
Name                                                Bytes              Packets
icmp-counter                                          560                   10
Policers:
Name                                              Packets
icmp-connection-policer                                10
tcp-connection-policer                                  0
Filter: ingress-vlan-rogue-block
Filter: ingress-vlan-limit-guest
```


show firewall filter filter-name

```
user@switch> show firewall filter ingress-port-limit-tcp-icmp
Filter: ingress-port-limit-tcp-icmp
Counters:
Name                                                Bytes              Packets
icmp-counter                                          560                   10
Policers:
Name                                              Packets
icmp-connection-policer                                10
tcp-connection-policer                                  0
```

show firewall counter counter-name

```
user@switch> show firewall counter icmp-counter
Filter: ingress-port-voip-class-filter
Counters:
Name                                                Bytes              Packets
icmp-counter                                          560                   10
```

show firewall log

```
user@switch> show firewall log
Log :

Time      Filter    Action Interface     Protocol        Src Addr
          Dest Addr
08:00:53  pfe       R      ge-1/0/6.0    ICMP            192.168.3.5
         192.168.3.4
08:00:52  pfe       R      ge-1/0/6.0    ICMP            192.168.3.5
         192.168.3.4
08:00:51  pfe       R      ge-1/0/6.0    ICMP            192.168.3.5
         192.168.3.4
08:00:50  pfe       R      ge-1/0/6.0    ICMP            192.168.3.5
         192.168.3.4
08:00:49  pfe       R      ge-1/0/6.0    ICMP            192.168.3.5
         192.168.3.4
08:00:48  pfe       R      ge-1/0/6.0    ICMP            192.168.3.5
         192.168.3.4
08:00:47  pfe       R      ge-1/0/6.0    ICMP            192.168.3.5
         192.168.3.4
```

show firewall log detail

```
user@switch> show firewall log detail
Log :

Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of
interface: fxp0.0Name of protocol: TCP, Packet Length: 50824, Source address:
172.17.22.108:829,
Destination address: 192.168.70.66:513
Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of
interface: fxp0.0
Name of protocol: TCP, Packet Length: 1020, Source address: 172.17.22.108:829,
Destination address: 192.168.70.66:513
Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of
interface: fxp0.0
Name of protocol: TCP, Packet Length: 49245, Source address: 172.17.22.108:829,
Destination address: 192.168.70.66:513
Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of
```

```
interface: fxp0.0
Name of protocol: TCP, Packet Length: 49245, Source address: 172.17.22.108:829,
Destination address: 192.168.70.66:513
Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of
interface: fxp0.0
Name of protocol: TCP, Packet Length: 49245, Source address: 172.17.22.108:829,
Destination address: 192.168.70.66:513
Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of
interface: fxp0.0
Name of protocol: TCP, Packet Length: 49245, Source address: 172.17.22.108:829,
Destination address: 192.168.70.66:513
```


show firewall policer

Syntax show firewall policer
<*policer-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display statistics about configured policers.

Options **none**—Display the count of policed packets for all configured policers.

policer-name—(Optional) Display the count of policed packets for the specified policer.

Required Privilege Level view

Related Documentation

- Verifying That Firewall Filters Are Operational on page 4672
- Verifying That Two-Color Policers Are Operational on page 4683
- Overview of Firewall Filters on page 4409
- Overview of Policers on page 4441

List of Sample Output

show firewall policer on page 4695
show firewall policer policer-name on page 4696

Output Fields Table 363 on page 4695 lists the output fields for the **show firewall policer** command. Output fields are listed in the approximate order in which they appear.

Table 363: show firewall policer Output Fields

Field Name	Field Description	Level of Output
Filter	Name of the filter that is configured at the **[edit firewall family *family-name* filter]** hierarchy level.	All levels
Policers	Display policer information: • Filter—Name of filter that specifies the **policer** action modifier. • Name—Name of policer. • Packets—Number of packets that matched the filter term in which the **policer** action modifier is specified. This is the number of packets that exceed the rate limits that the policer specifies.	All levels

Sample Output

show firewall policer

```
user@switch> show firewall policer
Filter: egress-vlan-filter
Filter: ingress-port-filter
Policers:
Name                                                Packets
```

```
icmp-connection-policer                                   0
tcp-connection-policer                                    0
Filter: ingress-vlan-rogue-block
```

show firewall policer policer-name

```
user@switch> show firewall policer tcp-connection-policer
Filter: ingress-port-filter
Policers:
Name                                                Packets
tcp-connection-policer                                    0
```


show interfaces filters

Syntax

show interfaces filters
<*interface-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display firewall filters that are configured on each interface in a switch.

Options

none—Display firewall filter information about all interfaces.

interface-name—(Optional) Display firewall filter information about a particular interface.

Required Privilege Level view

Related Documentation

- show firewall on page 4691

List of Sample Output

show interfaces filters on page 4697
show interfaces filters interface-name on page 4698

Output Fields Table 364 on page 4697 lists the output fields for the **show interfaces filters** command. Output fields are listed in the approximate order in which they appear.

Table 364: show interfaces filters Output Fields

Field Name	Field Description	Level of Output
Interface	Name of the physical interface.	All levels
Admin	Interface state: **up** or **down**.	All levels
Link	Link state: **up** or **down**.	All levels
Proto	Protocol that is configured on the interface.	All levels
Input Filter	Name of the firewall filter to be evaluated when packets are received on the interface.	All levels
Output Filter	Name of the firewall filter to be evaluated when packets are transmitted on the interface.	All levels

Sample Output

show interfaces filters

```
user@switch> show interfaces filters
Interface        Admin Link Proto Input Filter         Output Filter
ge-0/0/6         up    up
ge-0/0/6.0       up    up   eth-switch ingress-port-limit-tcp-icmp
ge-0/0/7         up    down
ge-0/0/8         up    down
```



```
ge-0/0/9        up    down
ge-0/0/10       up    down
ge-0/0/10.0     up    down
```

show interfaces filters interface-name

```
user@switch> show interfaces filters ge-0/0/6
Interface       Admin Link Proto Input Filter         Output Filter
ge-0/0/6        up    up
ge-0/0/6.0      up    up eth-switch ingress-port-limit-tcp-icmp
```


CHAPTER 53

Troubleshooting

Troubleshooting Procedures

Troubleshooting Firewall Filter Configuration

Use the following information to troubleshoot your firewall filter configuration.

Firewall Filter Configuration Returns a No Space Available in TCAM Message

Problem When a firewall filter configuration exceeds the amount of available Ternary Content Addressable Memory (TCAM) space, the system returns the following **syslogd** message:

```
No space available in tcam.
Rules for filter filter-name will not be installed.
```

A switch returns this message during the commit operation if the firewall filter that has been applied to a port, VLAN, or Layer 3 interface exceeds the amount of space available in the TCAM table. The filter is not applied, but the commit operation for the firewall filter configuration is completed in the CLI module.

Solution When a firewall filter configuration exceeds the amount of available TCAM table space, you must configure a new firewall filter with fewer filter terms so that the space requirements for the filter do not exceed the available space in the TCAM table.

You can perform either of the following procedures to correct the problem:

To delete the filter and its binding and apply the new smaller firewall filter to the same binding:

1. Delete the filter and its binding to ports, VLANs, or Layer 3 interfaces. For example:

```
[edit]
user@switch# delete firewall family ethernet-switching filter ingress-vlan-rogue-block
user@switch# delete vlans employee-vlan description "filter to block rogue devices on employee-vlan"
user@switch# delete vlans employee-vlan filter input ingress-vlan-rogue-block
```
2. Commit the changes:

```
[edit]
user@switch# commit
```
3. Configure a smaller filter with fewer terms that does not exceed the amount of available TCAM space. For example:

```
[edit]
user@switch# set firewall family ethernet-switching filter new-ingress-vlan-rogue-block ...
```
4. Apply (bind) the new firewall filter to a port, VLAN , or Layer 3 interface. For example:

```
[edit]
user@switch# set vlans employee-vlan description "filter to block rogue devices on employee-vlan"
user@switch# set vlans employee-vlan filter input new-ingress-vlan-rogue-block
```
5. Commit the changes:

```
[edit]
user@switch# commit
```

To apply a new firewall filter and overwrite the existing binding but not delete the original filter:

1. Configure a firewall filter with fewer terms than the original filter:

```
[edit]
user@switch# set firewall family ethernet-switching filter new-ingress-vlan-rogue-block...
```
2. Apply the firewall filter to the port, VLAN, or Layer 3 interfaces to overwrite the binding of the original filter—for example:

```
[edit]
user@switch# set vlans employee-vlan description "smaller filter to block rogue devices on employee-vlan"
user@switch# set vlans employee-vlan filter input new-ingress-vlan-rogue-block
```
   Because you can apply no more than one firewall filter per VLAN per direction, the binding of the original firewall filter to the VLAN is overwritten with the new firewall filter **new-ingress-vlan-rogue-block**.

3. Commit the changes:

```
[edit]
user@switch# commit
```


NOTE: The original filter is not deleted and is still available in the configuration.

Filter Counts Previously Dropped Packet

Problem If you configure two or more filters in the same direction for a physical interface and one of the filters includes a counter, the counter will be incorrect if the following circumstances apply:

- You configure the filter that is applied to packets first to discard certain packets. For example, imagine that you have a VLAN filter that accepts packets sent to 10.10.1.0/24 addresses and implicitly discards packets sent to any other addresses. You apply the filter to the **admin** VLAN in the output direction, and interface xe-0/0/1 is a member of that VLAN.
- You configure a subsequent filter to accept and count packets that are dropped by the first filter. In this example, you have a port filter that accepts and counts packets sent to 192.168.1.0/24 addresses that is also applied to xe-0/0/1 in the output direction.

The egress VLAN filter is applied first and correctly discards packets sent to 192.168.1.0/24 addresses. The egress port filter is applied next and counts the discarded packets as matched packets. The packets are not forwarded, but the counter displayed by the egress port filter is incorrect.

Remember that the order in which filters are applied depends on the direction in which they are applied, as indicated here:

Ingress filters:

1. Port (Layer 2) filter
2. VLAN filter
3. Router (Layer 3) filter

Egress filters:

1. Router (Layer 3) filter
2. VLAN filter
3. Port (Layer 2) filter

Solution This is expected behavior.

Matching Packets Not Counted

Problem If you configure two egress filters with counters for a physical interface and a packet matches both of the filters, only one of the counters includes that packet.

For example:

- You configure an egress port filter with a counter for interface xe-0/0/1.
- You configure an egress VLAN filter with a counter for the **admin**VLAN, and interface xe-0/0/1 is a member of that VLAN.
- A packet matches both filters.

In this case, the packet is counted by only one of the counters even though it matched both filters.

Solution This is expected behavior.

Counter Reset When Editing Filter

Problem If you edit a firewall filter term, the value of any counter associated with any term in the same filter is set to 0, including the implicit counter for any policer referenced by the filter. Consider the following examples:

- Assume that your filter has **term1**, **term2**, and **term3**, and each term has a counter that has already counted matching packets. If you edit any of the terms in any way, the counters for all the terms are reset to 0.
- Assume that your filter has **term1** and **term2**. Also assume that **term2** has a **policer** action modifier and the implicit counter of the policer has already counted 1000 matching packets. If you edit **term1** or **term2** in any way, the counter for the policer referenced by **term2** is reset to 0.

Solution This is expected behavior.

Cannot Include loss-priority and policer Actions in Same Term

Problem You cannot include both of the following actions in the same firewall filter term in a QFX Series switch:

- **loss-priority**
- **policer**

If you do so, you see the following error message when you attempt to commit the configuration: “cannot support policer action if loss-priority is configured.”

Solution This is expected behavior.

Cannot Egress Filter Certain Traffic Originating on QFX Switch

Problem On a QFX Series switch, you cannot filter certain traffic with a firewall filter applied in the output direction if the traffic originates on the QFX switch. This limitation applies to control traffic for protocols such as ICMP (ping), STP, LACP, and so on.

Solution This is expected behavior.

Firewall Filter Match Condition Not Working with Q-in-Q Tunneling

Problem If you create a firewall filter that includes a match condition of **dot1q-tag** or **dot1q-user-priority** and apply the filter on input to a trunk port that participates in a service VLAN, the match condition does not work if the Q-in-Q EtherType is not 0x8100. (When Q-in-Q tunneling is enabled, trunk interfaces are assumed to be part of the service provider or data center network and therefore participate in service VLANs.)

Solution This is expected behavior. To set the Q-in-Q EtherType to 0x8100, enter the **set dot1q-tunneling ethertype 0x8100** statemen at the **[edit ethernet-switching-options]** hierarchy level. You must also configure the other end of the link to use the same Ethertype.

Egress Firewall Filters with Private VLANs

Problem If you apply a firewall filter in the output direction to a primary VLAN, the filter also applies to the secondary VLANs that are members of the primary VLAN when the traffic egresses with the primary VLAN tag or isolated VLAN tag, as listed below:

- Traffic forwarded from a secondary VLAN trunk port to a promiscuous port (trunk or access)
- Traffic forwarded from a secondary VLAN trunk port that carries an isolated VLAN to a PVLAN trunk port.
- Traffic forwarded from a promiscuous port (trunk or access) to a secondary VLAN trunk port
- Traffic forwarded from a PVLAN trunk port. to a secondary VLAN trunk port
- Traffic forwarded from a community port to a promiscuous port (trunk or access)

If you apply a firewall filter in the output direction to a primary VLAN, the filter does *not* apply to traffic that egresses with a community VLAN tag, as listed below:

- Traffic forwarded from a community trunk port to a PVLAN trunk port
- Traffic forwarded from a secondary VLAN trunk port that carries a community VLAN to a PVLAN trunk port
- Traffic forwarded from a promiscuous port (trunk or access) to a community trunk port
- Traffic forwarded from a PVLAN trunk port. to a community trunk port

If you apply a firewall filter in the output direction to a community VLAN, the following behaviors apply:

- The filter is applied to traffic forwarded from a promiscuous port (trunk or access) to a community trunk port (because the traffic egresses with the community VLAN tag).
- The filter is applied to traffic forwarded from a community port to a PVLAN trunk port (because the traffic egresses with the community VLAN tag).

- The filter is *not* applied to traffic forwarded from a community port to a promiscuous port (because the traffic egresses with the primary VLAN tag or untagged).

Solution These are expected behaviors. They occur only if you apply a firewall filter to a private VLAN in the output direction and do not occur if you apply a firewall filter to a private VLAN in the input direction.

Egress Filtering of L2PT Traffic Not Supported

Problem Egress filtering of L2PT traffic is not supported on the QFX3500 switch. That is, if you configure L2PT to tunnel a protocol on an interface, you cannot also use a firewall filter to filter traffic for that protocol on that interface in the output direction. If you commit a configuration for this purpose, the firewall filter is not applied to the L2PT-tunneled traffic.

Solution This is expected behavior.

Cannot Drop BGP Packets in Certain Circumstances

Problem BGP packets with a time-to-live (TTL) value greater than 1 cannot be discarded using a firewall filter applied to a loopback interface or applied on input to a Layer 3 interface. BGP packets with TTL value of 1 or 0 can be discarded using a firewall filter applied to a loopback interface or applied on input to a Layer 3 interface.

Solution This is expected behavior.

Invalid Statistics for Policer

Problem If you apply a single-rate two-color policer in more than 128 terms in a firewall filter, the output of the **show firewall** command displays incorrect data for the policer.

Solution This is expected behavior.

Policers can Limit Egress Filters

Problem The number of egress policers that you configure can affect the total number of allowed egress firewall filters. Every policer has two implicit counters that consume two entries in a 1024-entry TCAM that is used for counters, including counters that are configured as action modifiers in firewall filter terms. (Policers consume two entries because one is used for green packets and one is used for nongreen packets regardless of policer type.) If the TCAM becomes full, you cannot commit any more egress firewall filters that have terms with counters. For example, if you configure and commit 512 egress policers (two-color, three-color, or a combination of both policer types), all of the memory entries for counters are used up. If later in your configuration file you insert additional egress firewall filters with terms that also include counters, *none* of the terms in those filters are committed because there is no available memory space for the counters.

Here are some additional examples:

- Assume that you configure egress filters that include a total of 512 policers and no counters. Later in your configuration file you include another egress filter with 10 terms, 1 of which has a counter action modifier. None of the terms in this filter are committed because there is not enough TCAM space for the counter.
- Assume that you configure egress filters that include a total of 500 policers, so 1000 TCAM entries are occupied. Later in your configuration file you include the following two egress filters:
  - Filter A with 20 terms and 20 counters. All the terms in this filter are committed because there is enough TCAM space for all the counters.
  - Filter B comes after Filter A and has five terms and five counters. *None* of the terms in this filter are committed because there is not enough memory space for *all* the counters. (Five TCAM entries are required but only four are available.)

Solution You can prevent this problem by ensuring that egress firewall filter terms with counter actions are placed earlier in your configuration file than terms that include policers. In this circumstance, Junos OS commits policers even if there is not enough TCAM space for the implicit counters. For example, assume the following:

- You have 1024 egress firewall filter terms with counter actions.
- Later in your configuration file you have an egress filter with 10 terms. None of the terms have counters but one has a policer action modifier.

You can successfully commit the filter with 10 terms even though there is not enough TCAM space for the implicit counters of the policer. The policer is committed without the counters.

Related Documentation

- Understanding FIP Snooping, FBF, and MVR Filter Scalability on page 4872
- Configuring Firewall Filters on page 4531
- Verifying That Firewall Filters Are Operational on page 4672

Troubleshooting Policer Configuration

Incomplete Count of Packet Drops

Problem Under certain circumstances, Junos OS might display a misleading number of packets dropped by an ingress policer.

If packets are dropped because of ingress admission control, policer statistics might not show the number of packet drops you would expect by calculating the difference between ingress and egress packet counts. This might happen if you apply an ingress policer to multiple interfaces, and the aggregate ingress rate of those interfaces exceeds the line rate of a common egress interface. In this case, packets might be dropped from the ingress buffer. These drops are not included in the count of packets dropped by the policer, which causes policer statistics to underreport the total number of drops.

Solution This is expected behavior.

Counter Reset When Editing Filter

Problem If you edit a firewall filter term, the value of any counter associated with any term in the same filter is set to 0, including the implicit counter for any policer referenced by the filter. Consider the following examples:

- Assume that your filter has **term1**, **term2**, and **term3**, and each term has a counter that has already counted matching packets. If you edit any of the terms in any way, the counters for all the terms are reset to 0.
- Assume that your filter has **term1** and **term2**. Also assume that **term2** has a **policer** action modifier and the implicit counter of the policer has already counted 1000 matching packets. If you edit **term1** or **term2** in any way, the counter for the policer referenced by **term2** is reset to 0.

Solution This is expected behavior.

Invalid Statistics for Policer

Problem If you apply a single-rate two-color policer in more than 128 terms in a firewall filter, the output of the **show firewall** command displays incorrect data for the policer.

Solution This is expected behavior.

Egress Policers on QFX3500 Devices Might Allow More Throughput Than Is Configured

Problem If you configure a policer to rate-limit throughput and apply it on egress to multiple interfaces on a QFX3500 switch or Node, the measured aggregate policed rate might be twice the configured rate, depending on which interfaces you apply the policer to. The doubling of the policed rate occurs if you apply a policer to multiple interfaces and *both* of the following are true:

- There is at least one policed interface in the range xe-0/0/0 to xe-0/0/23 or the range xe-0/1/1 to xe-0/1/7.
- There is at least one policed interface in the range xe-0/0/24 to xe-0/0/47 or the range xe-0/1/8 to xe-0/1/15.

For example, if you configure a policer to rate-limit traffic at 1 Gbps and apply the policer (by using a firewall filter) to xe-0/0/0 and xe-0/0/24 in the output direction, each interface is rate-limited at 1 Gbps, for a total allowed throughput of 2 Gbps. The same behavior occurs if you apply the policer to xe-0/1/1 and xe-0/0/24—each interface is rate-limited at 1 Gbps.

If you apply the same policer on egress to multiple interfaces in these groups, each *group* is rate-limited at 1 Gbps. For example, if you apply the policer to xe-0/0/0 through xe-0/0/4 (five interfaces) and xe-0/0/24 through xe-0/0/33 (ten interfaces), each group is rate-limited at 1 Gbps, for a total allowed throughput of 2 Gbps.

Here is another example: If you apply the policer to xe-0/0/0 through xe-0/0/4 and xe-0/1/1 through xe-0/1/5 (a total of ten interfaces), that group is rate-limited at 1 Gbps in aggregate. If you also apply the policer to xe-0/0/24, that one interface is rate-limited at 1 Gbps while the other ten are still rate-limited at 1 Gbps in aggregate.

Interfaces xe-0/1/1 through xe-0/1/15 are physically located on the QSFP+ uplink ports, according to the following scheme:

- xe-0/1/1 through xe-0/1/3 are on Q0.
- xe-0/1/4 through xe-0/1/7 are on Q1.
- xe-0/1/8 through xe-0/1/11 are on Q2.
- xe-0/1/2 through xe-0/1/15 are on Q3.

The doubling of the policed rate occurs only if the policer is applied in the output direction. If you configure a policer as described above but apply it in the input direction, the total allowed throughput for all interfaces is 1 Gbps.

Solution This is expected behavior.

Filter-Specific Egress Policers on QFX3500 Devices Might Allow More Throughput Than Is Configured

Problem You can configure policers to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. When you do this, rate limiting is applied in aggregate, so if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, the total bandwidth allowed by the filter is 1 Gbps. However, the behavior of a filter-specific policer is affected by how the firewall filter terms that reference the policer are stored in ternary content addressable memory (TCAM). If you create a filter-specific policer and reference it in multiple firewall filter terms, the policer allows more traffic than expected if the terms are stored in different TCAM slices. For example, if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms that are stored in three separate memory slices, the total bandwidth allowed by the filter is 3 Gbps, not 1 Gbps.

Solution To prevent this unexpected behavior, use the information about TCAM slices presented in “Planning the Number of Firewall Filters to Create” on page 4435 to organize your configuration file so that all the firewall filter terms that reference a given filter-specific policer are stored in the same TCAM slice.

Policers Can Limit Egress Filters

Problem The number of egress policers that you configure can affect the total number of allowed egress firewall filters. Every policer has two implicit counters that consume two entries in a 1024-entry TCAM that is used for counters, including counters that are configured as action modifiers in firewall filter terms. (Policers consume two entries because one is used for green packets and one is used for nongreen packets regardless of policer type.) If the TCAM becomes full, you cannot commit any more egress firewall filters that have terms with counters. For example, if you configure and commit 512 egress policers (two-color, three-color, or a combination of both policer types), all of the memory entries for counters are used up. If later in your configuration file you insert additional egress firewall filters with terms that also include counters, *none* of the terms in those filters are committed because there is no available memory space for the counters.

Here are some additional examples:

- Assume that you configure egress filters that include a total of 512 policers and no counters. Later in your configuration file you include another egress filter with 10 terms, 1 of which has a counter action modifier. None of the terms in this filter are committed because there is not enough TCAM space for the counter.
- Assume that you configure egress filters that include a total of 500 policers, so 1000 TCAM entries are occupied. Later in your configuration file you include the following two egress filters:
  - Filter A with 20 terms and 20 counters. All the terms in this filter are committed because there is enough TCAM space for all the counters.
  - Filter B comes after Filter A and has five terms and five counters. *None* of the terms in this filter are committed because there is not enough memory space for *all* the counters. (Five TCAM entries are required but only four are available.)

Solution You can prevent this problem by ensuring that egress firewall filter terms with counter actions are placed earlier in your configuration file than terms that include policers. In this circumstance, Junos OS commits policers even if there is not enough TCAM space for the implicit counters. For example, assume the following:

- You have 1024 egress firewall filter terms with counter actions.
- Later in your configuration file you have an egress filter with 10 terms. None of the terms have counters but one has a policer action modifier.

You can successfully commit the filter with 10 terms even though there is not enough TCAM space for the implicit counters of the policer. The policer is committed without the counters.

PART 17

Services

CHAPTER 54

Overview

Port Mirroring

Understanding Port Mirroring

Port Mirroring Overview

Port mirroring copies packets entering or exiting a port or entering a VLAN and sends the copies to a local interface for local monitoring or to a VLAN for remote monitoring. Use port mirroring to send traffic to applications that analyze traffic for purposes such as monitoring compliance, enforcing policies, detecting intrusions, monitoring and predicting traffic patterns, correlating events, and so on.

Port mirroring is needed for traffic analysis on a switch because a switch normally sends packets only to the port to which the destination device is connected. You configure port mirroring on the switch to send copies of unicast traffic to a local interface or a VLAN and run an analyzer application on a device connected to the interface or VLAN. You configure port mirroring by using the **analyzer** statement.

Keep performance in mind when configuring port mirroring. For example, If you mirror traffic from multiple ports, the mirrored traffic may exceed the capacity of the output interface. We recommend that you limit the amount of copied traffic by selecting specific interfaces instead of using the **all** keyword. You can also limit the amount of mirrored traffic by using a firewall filter. Mirroring only the necessary packets reduces the possibility of a performance impact.

You can use port mirroring to copy any of the following:

- All packets entering or exiting an interface (in any combination)—For example, you can send copies of the packets entering some interfaces and the packets exiting other interfaces to the same local interface or VLAN. If you configure port mirroring to copy packets exiting an interface, traffic that originates on that switch or Node device (in a QFabric system) is not copied when it egresses. Only switched traffic is copied on egress. (See the limitation on egress mirroring below.)
- All packets entering a VLAN—You cannot use port mirroring to copy packets exiting a VLAN.
- Firewall-filtered sample—Sample of packets entering a port or VLAN. Configure a firewall filter to select certain packets for mirroring.

NOTE: **Firewall filters are not supported on egress ports; therefore, you cannot specify policy-based sampling of packets exiting an interface.**

Port-Mirroring Terminology

Table 365 on page 4714 lists the terms used in the documentation about port mirroring and provides definitions.

Table 365: Port Mirroring Terms and Definitions

Term	Description
Analyzer	Port-mirroring configuration. The analyzer includes a name, source interfaces or source VLAN, and a destination for mirrored packets (either a local access interface or a VLAN).
Output interface (also known as monitor interface)	Access interface to which packet copies are sent and to which a device running an analyzer application is connected. The following limitations apply to an output interface: • Cannot also be a source port. • Cannot be used for switching. • Cannot be an aggregated Ethernet interface (LAG). • Does not participate in Layer 2 protocols, such as Spanning Tree Protocol (STP). • Loses any existing VLAN associations when you configure it as an analyzer output interface. If the capacity of the output interface is insufficient to handle the traffic from the source ports, overflow packets are dropped.

Table 365: Port Mirroring Terms and Definitions *(continued)*

Output IP address	IP address of the device running an analyzer application. The device can be on a remote network. When you use this feature, the mirrored packets are GRE-encapsulated. The analyzer device must be able to de-encapsulate GRE-encapsulated packets, or the GRE-encapsulated packets must be de-encapsulated before reaching the analyzer device. (You can use a network sniffer to de-encapsulate the packets.) • An output IP address cannot be in the same subnetwork as any of the switch's management interfaces. • If you create virtual routing instances and also create an analyzer configuration that includes an output IP address, the output address belongs to the default virtual routing instance (inet.0 routing table).
Output VLAN (also known as monitor or analyzer VLAN)	VLAN to which copies are sent and to which a device running an analyzer application is connected. The analyzer VLAN can span multiple switches. The following limitations apply to an output VLAN: • Cannot be a private VLAN or VLAN range. • Cannot be shared by multiple **analyzer** statements. • An output VLAN interface cannot be a member of any other VLAN. • An output VLAN interface cannot be an aggregated Ethernet interface (LAG). • On the source (monitored) switch, only one interface can be a member of the analyzer VLAN.
Input interface (also known as mirrored or monitored interface)	Interface that provides traffic to be mirrored. This traffic can be entering or exiting the interface. (Ingress or egress traffic can be mirrored.) An input interface cannot also be an output interface for an analyzer.
Monitoring station	Computer running an analyzer application.
Local port mirroring	Port-mirroring configuration in which the mirrored packets are sent to an interface on the same switch.
Remote port mirroring	Flooding mirrored packets to an analyzer VLAN that you create to receive mirror traffic or sending the mirrored packets to a remote IP address. (You cannot send mirrored packets to a remote IP address on a QFabric system.)
Policy-based mirroring	Mirroring of packets that match the match a firewall filter term. The action **analyzer *analyzer-name*** is used in the firewall filter to send the packets to the analyzer.

Port Mirroring Constraints and Limitations

- Local and Remote Port Mirroring on page 4715
- Remote Port Mirroring Only on page 4717

Local and Remote Port Mirroring

The following constraints and limitations apply to local and remote port mirroring with the QFX Series:

- You can create a total of four port-mirroring configurations on a QFX Series standalone switch.

- You can create a total of four port-mirroring configurations on each Node group in a QFabric system, subject to the following constraints:
  - As many as four of the configurations can be for local port mirroring.
  - As many as three of the configurations can be for remote port mirroring.
- Regardless of whether you are configuring a standalone switch or a Node group, the following limits apply:
  - There can be no more than two configurations that mirror ingress traffic. (If you configure a firewall filter to send traffic to a port mirror—that is, you use the **analyzer** action modifier in a filter term—this counts as an ingress mirroring configuration for switch or Node group on which the filter is applied.)
  - There can be no more than two configurations that mirror egress traffic.

NOTE: **On QFabric systems, there is no system-wide limit on the total number of mirror sessions.**

- You can configure no more than one type of output in one port-mirroring configuration. That is, you can use no more than one of the following to complete a **set analyzer *name* output** statement:
  - **interface**
  - **ip-address**
  - **vlan**
- If you configure Junos OS to mirror egress packets, do not configure more than 2000 VLANs on a QFX3500 device or QFabric system. If you do so, some VLAN packets might contain incorrect VLAN IDs. This applies to any VLAN packets—not only the mirrored copies.
- The **ratio** and **loss-priority** options are not supported.
- Packets with physical layer errors are filtered out and are not sent to the output port or VLAN.
- If you use sFlow monitoring to sample traffic, it does not sample the mirror copies when they exit from the output interface.
- You cannot mirror packets exiting or entering the following ports:
  - Dedicated Virtual Chassis interfaces
  - Management interfaces (me0 or vme0)
  - Fibre Channel interfaces
  - Routed VLAN interfaces
- An aggregated Ethernet interface cannot be an output interface.

- Do not include an 802.1Q subinterface that has a unit number other than 0 in a port mirroring configuration. Port mirroring does not work with subinterfaces if their unit number is not 0. (You configure 802.1Q subinterfaces using the **vlan-tagging** statement.)
- When packet copies are sent out the output interface, they are not modified for any changes that are normally applied on egress, such as CoS rewriting.
- An interface can be the input interface for only one mirroring configuration. Do not use the same interface as the input interface for multiple mirroring configurations.
- CPU-generated packets (such as ARP, ICMP, BPDU, and LACP packets) cannot be mirrored on egress.
- VLAN-based mirroring is not supported for STP traffic.
- (QFabric systems only) If you configure a QFabric analyzer to mirror egress traffic and the input and output interfaces are on different Node devices, the mirrored copies have incorrect VLAN IDs. This limitation does not apply if you configure a QFabric analyzer to mirror egress traffic and the input and output interfaces are on the *same* Node device. In this case the mirrored copies have the correct VLAN IDs (as long as you do not configure more than 2000 VLANs on the QFabric system).

Remote Port Mirroring Only

The following constraints and limitations apply to remote port mirroring with the QFX Series:

- If you configure an output IP address, the address cannot be in the same subnetwork as any of the switch's management interfaces.
- If you create virtual routing instances and also create an analyzer configuration that includes an output IP address, the output address belongs to the default virtual routing instance (inet.0 routing table).
- An output VLAN cannot be a private VLAN or VLAN range.
- An output VLAN cannot be shared by multiple **analyzer** statements.
- An output VLAN interface cannot be a member of any other VLAN.
- An output VLAN interface cannot be an aggregated Ethernet interface.
- On the source (monitored) switch, only one interface can be a member of the analyzer VLAN.

Related Documentation

- Configuring Port Mirroring on page 4730
- Example: Configuring Port Mirroring for Local Analysis on page 4721
- Example: Configuring Port Mirroring for Remote Analysis on page 4726
- Troubleshooting Port Mirroring on page 4779

Understanding Layer 3 Logical Interfaces

A Layer 3 logical interface is a logical division of a physical interface that operates at the network level and therefore can receive and forward 802.1Q VLAN tags. You can use Layer 3 logical interfaces to route traffic among multiple VLANs along a single trunk line that connects a Juniper Networks QFX3500 Switch to a Layer 2 switch. Only one physical connection is required between the switches.

To create Layer 3 logical interfaces on a switch, enable VLAN tagging, partition the physical interface into logical partitions, and bind the VLAN ID to the logical interface.

We recommend that you use the VLAN ID as the logical interface number when you configure the logical interface. QFX Series systems support a maximum of 4089 VLANs, which includes the default VLAN. You can, however, assign a VLAN ID in the range of 1 to 4094, but five of these VLAN IDs are reserved for internal use.

VLAN tagging places the VLAN ID in the frame header, allowing each physical interface to handle multiple VLANs. Double-tagging, which is assigning more than one VLAN ID in the frame header, is not supported. When you configure multiple VLANs on an interface, you must also enable tagging on that interface. Junos OS on switches supports a subset of the 802.1Q standard for receiving and forwarding routed or bridged Ethernet frames with single VLAN tags and running Virtual Router Redundancy Protocol (VRRP) over 802.1Q-tagged interfaces.

Related Documentation

- Interfaces Overview on page 1839
- Configuring a Layer 3 Logical Interface on page 2019
- Configuring DHCP and BOOTP Relay on page 4733
- *Junos OS Network Interfaces Library for Routing Devices*

DHCP Relay

DHCP and BOOTP Relay Overview

You can configure a Juniper Networks switch to act as a Dynamic Host Configuration Protocol (DHCP) or Bootstrap Protocol (BOOTP) relay agent. This means that if the switch receives a broadcast DHCP or BOOTP request from a locally attached host (client), it relays the message to a specified DHCP or BOOTP server. You should configure the switch to be a DHCP/BOOTP relay agent if you have locally attached hosts and a distant DHCP or BOOTP server.

NOTE: Because DHCP and BOOTP messages are broadcast and are not directed to a specific server, switch, or router, Juniper switches cannot function as both a DHCP server and a DHCP/BOOTP relay agent at the same time. The Junos operating system (Junos OS) generates a commit error if both options are configured at the same time, and the commit operation does not succeed until one of the options is removed.

Related Documentation

- Configuring DHCP and BOOTP Relay on page 4733
- **bootp on page 4768**

CHAPTER 55

Configuration

Configuration Examples

Example: Configuring Port Mirroring for Local Analysis

Use port mirroring to send traffic to applications that analyze traffic for purposes such as monitoring compliance, enforcing policies, detecting intrusions, monitoring and predicting traffic patterns, correlating events, and so on. Port mirroring copies packets entering or exiting an interface or entering a VLAN and sends the copies to a local interface for local monitoring.

This example describes how to configure port mirroring to copy traffic sent by employee computers to a switch to an access interface on the same switch.

Requirements

This example uses the following hardware and software components:

- Junos OS Release 11.1
- A switch

Overview and Topology

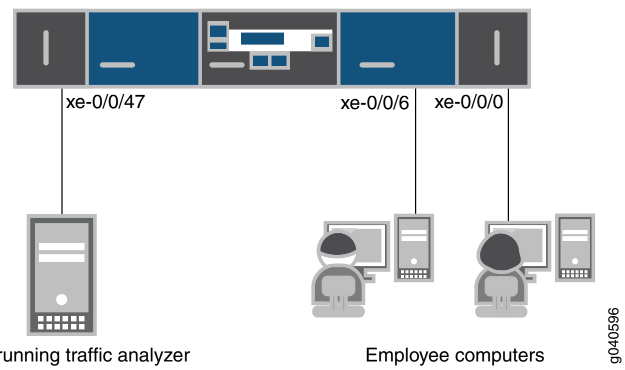
This topic includes two related examples that describe how to mirror traffic entering interfaces on the switch to an access interface on the same switch. The first example shows how to mirror all traffic sent by employee computers to the switch. The second example includes a filter to mirror only the employee traffic going to the Web.

In this example, **xe-0/0/0** and **xe-0/0/6** serve as connections for employee computers. Interface **xe-0/0/47** is connected to a device running an analyzer application.

NOTE: **Multiple ports mirrored to one interface can cause buffer overflow and dropped packets.**

Figure 169 on page 4722 shows the network topology for this example.

Figure 169: Network Topology for Local Port Mirroring Example



Mirroring All Employee Traffic for Local Analysis

To configure port mirroring for all traffic sent by employee computers for local analysis, perform the tasks explained in this section.

CLI Quick Configuration

To quickly configure local port mirroring for ingress traffic to the two ports connected to employee computers, copy the following commands and paste them into a switch terminal window:

```
[edit]
set interfaces xe-0/0/0 unit 0 family ethernet-switching
set interfaces xe-0/0/6 unit 0 family ethernet-switching
set interfaces xe-0/0/47 unit 0 family ethernet-switching
set ethernet-switching options analyzer employee-monitor input ingress interface xe-0/0/0.0
set ethernet-switching options analyzer employee-monitor input ingress interface xe-0/0/6.0
set ethernet-switching options analyzer employee-monitor output interface xe-0/0/47.0
```

Step-by-Step Procedure

To configure an analyzer called **employee-monitor** and specify the input (source) interfaces and the output interface:

1. Configure the interfaces connected to employee computers as input interfaces for the port-mirror analyzer **employee-monitor**:

```
[edit ethernet-switching-options]
user@switch# set analyzer employee-monitor input ingress interface xe–0/0/0.0
user@switch# set analyzer employee-monitor input ingress interface xe–0/0/6.0
```

2. Configure the output analyzer interface for the **employee-monitor** analyzer. This will be the destination interface for the mirrored packets:

```
[edit ethernet-switching-options]
user@switch# set analyzer employee-monitor output interface xe-0/0/47.0
```

Results Check the results of the configuration:

```
[edit]
user@switch# show ethernet-switching-options
  analyzer employee-monitor {
    input {
      ingress {
        interface xe-0/0/0.0;
        interface xe-0/0/6.0;
      }
    }
    output {
      interface {
        xe-0/0/47.0;
      }
    }
  }
}
```

Mirroring Employee-to-Web Traffic for Local Analysis

To mirror only traffic sent by employees to the Web for local analysis, perform the tasks explained in this section.

CLI Quick Configuration To quickly configure local port mirroring of traffic from employee computers that is destined for the Web, copy the following commands and paste them into a switch terminal window:

```
[edit]
set ethernet-switching-options analyzer employee–web–monitor output interface xe-0/0/47.0
set firewall family ethernet-switching filter watch-employee term employee-to-corp from destination-address 192.0.2.16/28
set firewall family ethernet-switching filter watch-employee term employee-to-corp from source-address 192.0.2.16/28
set firewall family ethernet-switching filter watch-employee term employee-to-corp then accept
set firewall family ethernet-switching filter watch-employee term employee-to-web from destination-port 80
set firewall family ethernet-switching filter watch-employee term employee-to-web then analyzer employee-web-monitor
set interfaces xe-0/0/0 unit 0 family ethernet-switching filter input watch-employee
set interfaces xe-0/0/6 unit 0 family ethernet-switching filter input watch-employee
```

Step-by-Step Procedure

To configure local port mirroring of employee-to-web traffic from the two ports connected to employee computers:

1. Configure the output interface:

```
[edit interfaces]
user@switch# set xe-0/0/47 unit 0 family ethernet-switching
```

2. Configure the **employee-web-monitor** analyzer output. (Configure only the output—the input comes from the filter.)

```
[edit ethernet-switching-options]
user@switch# set analyzer employee-web-monitor output interface xe-0/0/47.0
```

3. Configure a firewall filter called **watch-employee** that includes a term to match traffic sent to the Web and send it to the analyzer **employee-web-monitor**. Traffic to and from the corporate subnet (destination or source address of **192.0.2.16/28**) does not need to be copied, so create another term to accept that traffic before it reaches the term that sends Web traffic to the analyzer:

```
[edit firewall family ethernet-switching]
user@switch# set filter watch-employee term employee-to-corp from destination-address
192.0.2.16/28
user@switch# set filter watch-employee term employee-to-corp from source-address
192.0.2.16/28
user@switch# set filter watch-employee term employee-to-corp then accept
user@switch# set filter watch-employee term employee-to-web from destination-port 80
user@switch# set filter watch-employee term employee-to-web then analyzer
employee-web-monitor
```

4. Apply the firewall filter to the appropriate interfaces as an ingress filter (egress filters do not allow analyzers):

```
[edit interfaces]
user@switch# set xe-0/0/0 unit 0 family ethernet-switching filter input watch-employee
user@switch# set xe-0/0/6 unit 0 family ethernet-switching filter input watch-employee
```

Results

Check the results of the configuration:

```
[edit]
user@switch# show ethernet-switching-options
  analyzer employee-web-monitor {
    output {
      interface xe-0/0/47.0;
      }
    }
}
...
firewall family ethernet-switching {
  filter watch-employee {
    term employee-to-web {
      from {
        destination-port 80;
      }
      then analyzer employee-web-monitor;
    }
  }
}
...
interfaces {
```



```
    xe-0/0/0 {
      unit 0 {
        family ethernet-switching {
          filter {
            input watch-employee;
          }
        }
      }
    }
    xe-0/0/6 {
      family ethernet-switching {
        filter {
          input watch-employee;
        }
      }
    }
  }
```

Verification

Verifying That the Analyzer Has Been Correctly Created

Purpose Verify that the analyzer named **employee-monitor** or **employee-web-monitor** has been created on the switch with the appropriate input interfaces and appropriate output interface.

Action You can verify that the port mirror analyzer has been configured as expected using the **show analyzer** command.

```
user@switch> show analyzer
  Analyzer name                : employee-monitor
  Output interface             : xe-0/0/47.0
  Mirror ratio                 : 1
  Loss priority                : Low
  Ingress monitored interfaces : xe-0/0/0.0
  Ingress monitored interfaces : xe-0/0/6.0
  Egress monitored interfaces  : None
```

Meaning This output shows that the **employee-monitor** analyzer:

- Has a ratio of 1 (mirroring every packet, the default setting)
- Has a loss priority of low (set this option to high only when the analyzer output is to a VLAN)
- Is mirroring the traffic entering the **xe-0/0/0** and **xe-0/0/6** interfaces
- Is sending the mirrored traffic to the **xe-0/0/47** interface

Related Documentation

- Understanding Port Mirroring on page 4713
- Configuring Port Mirroring on page 4730

Example: Configuring Port Mirroring for Remote Analysis

Use port mirroring to send traffic to applications that analyze traffic for purposes such as monitoring compliance, enforcing policies, detecting intrusions, monitoring and predicting traffic patterns, correlating events, and so on. Port mirroring copies packets entering or exiting an interface or entering a VLAN and sends the copies either to a local interface for local monitoring or to a VLAN for remote monitoring. This example describes how to configure port mirroring for remote analysis.

Requirements

This example uses the following hardware and software components:

- Junos OS Release 12.1 for the QFX Series
- A switch

Overview and Topology

This topic includes two related examples that describe how to mirror traffic entering ports on the switch to an analyzer VLAN so that you can perform analysis using a remote device. The first example shows how to mirror all traffic sent by employee computers to the switch. The second example includes a filter to mirror only the employee traffic going to the Web.

In this example:

- Interfaces **ge-0/0/0** and **ge-0/0/1** are Layer 2 interfaces that connect to employee computers.
- Interface **ge-0/0/10** is a Layer 2 interface that connects to another switch.
- VLAN **remote-analyzer** is configured on all switches in the topology to carry the mirrored traffic.

NOTE: In addition to performing the configuration steps described here, you must also configure the analyzer VLAN (**remote-analyzer** in this example) on the other switches that are used to connect the source switch (the one in this configuration) to the one that the monitoring station is connected to.

Mirroring All Employee Traffic for Remote Analysis

CLI Quick Configuration

To quickly configure this section of the example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **edit** hierarchy level:

```
[edit]
set vlans remote-analyzer vlan-id 999
set interfaces ge-0/0/10 unit 0 family ethernet-switching port-mode trunk
set interfaces ge-0/0/10 unit 0 family ethernet-switching vlan members 999
set ethernet-switching-options analyzer employee-monitor input ingress interface ge-0/0/0.0
set ethernet-switching-options analyzer employee-monitor input ingress interface ge-0/0/1.0
set ethernet-switching-options analyzer employee-monitor output vlan remote-analyzer
```

Step-by-Step Procedure

To configure basic remote port mirroring:

1. Configure the analyzer VLAN (called **remote-analyzer** in this example):

   ```
   [edit vlans]
   user@switch# set vlans remote-analyzer vlan-id 999
   ```

2. Configure the interface connected to another switch for trunk mode and associate it with the **remote-analyzer** VLAN:

   ```
   [edit interfaces]
   user@switch# set ge-0/0/10 unit 0 family ethernet-switching port-mode trunk
   user@switch# set ge-0/0/10 unit 0 family ethernet-switching vlan members 999
   ```

3. Configure the **employee-monitor** analyzer:

   ```
   [edit ethernet-switching-options]
   user@switch# set analyzer employee–monitor
   user@switch# set analyzer employee-monitor input ingress interface ge-0/0/0.0
   user@switch# set analyzer employee-monitor input ingress interface ge-0/0/1.0
   user@switch# set analyzer employee-monitor output vlan remote-analyzer
   ```

4. Configure the **remote-analyzer** VLAN on the switches that connect this switch to the monitoring workstation.

Results

Check the results of the configuration:

```
[edit]
user@switch# show
ethernet-switching-options {
  analyzer employee-monitor {
    input {
      ingress {
        interface ge-0/0/0.0;
        interface ge-0/0/1.0;
      }
    }
    output {
      vlan {
        remote-analyzer;
      }
    }
  }
}
```

Mirroring Employee-to-Web Traffic for Remote Analysis

CLI Quick Configuration

To quickly configure this section of the example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **edit** hierarchy level:

```
[edit]
set vlans remote-analyzer vlan-id 999
set interfaces ge-0/0/10 unit 0 family ethernet-switching port mode trunk
set interfaces ge-0/0/10 unit 0 family ethernet-switching vlan members 999set
ethernet-switching-options analyzer employee-web-monitor loss-priority high output vlan 999
set firewall family ethernet-switching filter watch-employee term employee-to-web from
destination-port 80
set firewall family ethernet-switching filter watch-employee term employee-to-web then analyzer
employee-web-monitor
set ge-0/0/0 unit 0 family ethernet-switching filter input watch-employee
set interfaces ge-0/0/1 unit 0 family ethernet-switching filter input watch-employee
```

Step-by-Step Procedure

1. Configure the analyzer VLAN (called **remote-analyzer** in this example):

```
[edit vlans]
user@switch# set remote-analyzer vlan-id 999
```

2. Configure an interface to associate it with the **remote-analyzer** VLAN:

```
[edit interfaces]
user@switch# set interfaces ge-0/0/10 unit 0 family ethernet-switching port mode trunk
user@switch# set ge-0/0/10 unit 0 family ethernet-switching vlan members 999
```

3. Configure the **employee-web-monitor** analyzer. (Configure only the output—the input comes from the filter.)

```
[edit ethernet-switching-options]
user@switch# set ethernet-switching-optionsanalyzer employee-web-monitor output
vlan 999
```

4. Configure a firewall filter called **watch-employee** to match traffic sent to the Web and send it to the analyzer **employee-web-monitor**:

```
[edit firewall family ethernet-switching]
user@switch# set filter watch-employee term employee-to-web from destination-port 80
user@switch# set filter watch-employee term employee-to-web then analyzer
employee-web-monitor
```

5. Apply the firewall filter to the appropriate interfaces as an ingress filter:

```
[edit interfaces]
user@switch# set ge-0/0/0 unit 0 family ethernet-switching filterinput watch-employee
user@switch# set ge-0/0/1 unit 0 family ethernet-switching filter input watch-employee
```

6. Configure the **remote-analyzer** VLAN on the switches that connect this switch to the monitoring workstation.

Results

Check the results of the configuration:

```
[edit]
user@switch# show
interfaces {
  ...
  ge-0/0/10 {
    unit 0 {
      family ethernet-switching {
```

```
                port-mode trunk;
                vlan {
                    members remote-analyzer;
                }
            }
        }
    }
    ge-0/0/0 {
        unit 0 {
            family ethernet-switching {
                filter {
                    input watch-employee;
                }
            }
        }
    }
    ge-0/0/1 {
        unit 0 {
            family ethernet-switching {
                filter {
                    input watch-employee;
                }
            }
        }
    }
}
...
firewall {
    family ethernet-switching {
        ...
        filter watch-employee {
            term employee-to-web {
                from {
                    destination-port 80;
                }
                then analyzer employee-web-monitor;
            }
        }
    }
}
ethernet-switching-options {
    analyzer employee-web-monitor {
        output {
            vlan {
                999;
            }
        }
    }
vlans {
    remote-analyzer {
        vlan-id 999;
    }
}
```

Verification

Verifying That the Analyzer Has Been Correctly Created

Purpose Verify that the analyzer named **employee-monitor** or **employee-web-monitor** has been created on the switch with the appropriate input interfaces and appropriate output interface.

Action You can verify the port mirror analyzer is configured as expected using the **show analyzer** command.

```
user@switch> show analyzer
 Analyzer name                : employee-monitor
 Output VLAN                  : remote-analyzer
 Ingress monitored interfaces : ge-0/0/0.0
 Ingress monitored interfaces : ge-0/0/1.0
```

Meaning This output shows that the **employee-monitor** analyzer is mirroring the traffic entering **ge-0/0/0** and **ge-0/0/1** and is sending the mirror traffic to the analyzer **remote-analyzer**.

Related Documentation

- Understanding Port Mirroring on page 4713
- Configuring Port Mirroring on page 4730
- Example: Configuring Port Mirroring for Local Analysis on page 4721
- Overview of Firewall Filters on page 4409

Configuration Tasks

Configuring Port Mirroring

You use port mirroring to copy packets and send the copies to a device running an application such as a network analyzer or intrusion detection application so that you can analyze traffic without delaying it. You can mirror traffic entering or exiting a port or entering a VLAN, and you can send the copies to a local access interface or to a VLAN through a trunk interface.

We recommend that you disable port mirroring when you are not using it. To avoid creating a performance issue If you do enable port mirroring, we recommend that you select specific input interfaces instead of using the **all** keyword. You can also limit the amount of mirrored traffic by using a firewall filter.

NOTE: If you want to create additional analyzers without deleting an existing analyzer, first disable the existing analyzer using the **disable analyzer *analyzer-name*** command.

NOTE: You must configure port mirroring output interfaces as **family ethernet-switching**.

- Configuring Port Mirroring for Local Analysis on page 4731
- Configuring Port Mirroring for Remote Analysis on page 4731
- Filtering the Traffic Entering an Analyzer on page 4732

Configuring Port Mirroring for Local Analysis

To mirror interface traffic to a local interface on the switch:

1. If you want to mirror traffic that is ingressing or egressing specific interfaces, choose a name for the port-mirroring configuration and configure what traffic should be mirrored by specifying the interfaces and direction of traffic:

   `[edit ethernet-switching-options]`
   `user@switch#` **set analyzer *analyzer-name* input (ingress | egress) interface *interface-name***

   NOTE: If you configure Junos OS to mirror egress packets, do not configure more than 2000 VLANs. If you do so, some VLAN packets might contain incorrect VLAN IDs.

   NOTE: If you configure mirroring for packets that egress an access interface, the original packets lose any VLAN tags when they exit the access interface, but the mirrored (copied) packets retain the VLAN tags when they are sent to the analyzer system.

2. If you want to specify that all traffic entering a VLAN should be mirrored, choose a name for the port-mirroring configuration and specify the VLAN:

   `[edit ethernet-switching-options]`
   `user@switch#` **set analyzer *analyzer-name* input ingress vlan *vlan-name***

   NOTE: You cannot configure port mirroring to copy traffic that egresses a VLAN.

3. Configure the destination interface for the mirrored packets:

   `[edit ethernet-switching-options]`
   `user@switch#` **set analyzer *analyzer-name* output interface *interface-name***

Configuring Port Mirroring for Remote Analysis

To mirror traffic to a VLAN for analysis at a remote location:

1. Configure a VLAN to carry the mirrored traffic:

   `[edit]`

`user@switch#` **set vlans *vlan-name* vlan-id *number***

2. Configure the interface that connects to another switch (the uplink interface) to trunk mode and associate it with the appropriate VLAN:

   `[edit]`
   `user@switch#` **set interfaces *interface-name* unit 0 family ethernet-switching port-mode trunk vlan members (*vlan-name* | *vlan-id*)**

3. Configure the analyzer:

   a. Choose a name for the analyzer:

      `[edit ethernet-switching-options]`
      `user@switch#` **set analyzer *analyzer-name***

   b. Specify the interface to be mirrored and whether the traffic should be mirrored on ingress or egress:

      `[edit ethernet-switching-options]`
      `user@switch#` **set analyzer *analyzer-name* input (ingress | egress) interface *interface-name***

   c. Specify the appropriate IP address or VLAN as the output (a VLAN is specified in this example:

      `[edit ethernet-switching-options]`
      `user@switch#` **set analyzer *analyzer-name* output vlan (*vlan-name* | *vlan-id*)**

      If you specify an IP address as the output, note the following constraints:

      - The address cannot be in the same subnetwork as any of the switch's management interfaces.
      - If you create virtual routing instances and also create an analyzer configuration that includes an output IP address, the output address belongs to the default virtual routing instance (**inet.0** routing table).
      - The analyzer device must be able to de-encapsulate GRE-encapsulated packets, or the GRE-encapsulated packets must be de-encapsulated before reaching the analyzer device. (You can use a network sniffer to de-encapsulate the packets.)

Filtering the Traffic Entering an Analyzer

In addition to specifying which traffic to mirror by configuring an analyzer, you can also use a firewall filter to exercise more control over which packets are copied. For example, you might use a filter to specify that only traffic from certain applications be mirrored. The filter can use any of the available match conditions and must have an action of **analyzer *analyzer-name***. If you use the same analyzer in multiple filters or terms, the output packets are copied only once.

NOTE: **You can include the action analyzer in ingress firewall filters only. You can apply ingress filters with this action to ports (Layer 2 interfaces), Layer 3 interfaces, and VLANs.**

When you use a firewall filter as the input to an analyzer, you output the copied traffic to a local interface or a VLAN just as you do when a firewall is not involved.

To configure port mirroring with filters:

1. Configure an analyzer for local or remote analysis. Configure only the output. For example, for local analysis enter:

   [edit ethernet-switching-options]
   user@switch# **set analyzer *analyzer-name* output interface *interface-name***

   NOTE: Do not configure input to this analyzer.

2. Create a firewall filter using any of the available match conditions and specify the action as **analyzer *analyzer-name***.

3. Apply the firewall filter to the interfaces or VLAN that should provide the input to the analyzer:

   [edit]
   user@switch# **set interfaces *interface-name* unit 0 family ethernet-switching filter input *filter-name***
   [edit]
   user@switch# **set vlan (*vlan-name* | *vlan-id*) filter input *filter-name***

Related Documentation

- Understanding Port Mirroring on page 4713
- Example: Configuring Port Mirroring for Local Analysis on page 4721
- Example: Configuring Port Mirroring for Remote Analysis on page 4726
- Overview of Firewall Filters on page 4409

Configuring DHCP and BOOTP Relay

You can configure the QFX Series to act as a Dynamic Host Configuration Protocol (DHCP) and Bootstrap Protocol (BOOTP) relay agent. This means that if a locally attached host can issue a DHCP or BOOTP request as a broadcast message and the switch relays the message to a specified DHCP or BOOTP server. You should configure a switch to be a DHCP and BOOTP relay agent if you have locally attached hosts and a remote DHCP or BOOTP server.

If you configure a switch to be a DHCP relay agent, you can also enable smart DHCP relay, which allows you to configure alternative gateway addresses for a DHCP server so that if the server fails to reply to the requests sent using the primary gateway address, the switch can resend the requests via the alternative gateway addresses. To use this feature, you must configure a routed VLAN interface or Layer 3 logical interface with multiple IP addresses and configure that interface to be a relay agent.

- Configuring a DHCP and BOOTP Relay Agent on page 4733
- Configuring DHCP Smart Relay on page 4735

Configuring a DHCP and BOOTP Relay Agent

To configure a switch to act as a DHCP and BOOTP relay agent, include the **bootp** statement at the **[edit forwarding-options helpers]** hierarchy level:

```
[edit forwarding-options helpers]
bootp {
  apply-secondary-as-giaddr text-description;
  client-response-ttl number;
  description text-description;
  interface (interface-name | interface-group) {
    client-response-ttl number;
    description text-description;
    maximum-hop-count number;
    minimum-wait-time seconds;
    no-listen;
    server address
    apply-secondary-as-giaddr
  }
  maximum-hop-count number;
  minimum-wait-time seconds;
  relay-agent-option;
  server server-identifier
}
```

To include a description of the BOOTP service, DHCP service, or interface, use the **description** statement.

To configure a logical interface or a group of logical interfaces with a specific DHCP relay or BOOTP configuration, include the **interface** statement.

To stop packets from being forwarded, include the **no-listen** statement.

To set the maximum allowed number in the hops field of the BOOTP message, include the **maximum-hop-count** statement. BOOTP messages that have a larger number in the hops field than the maximum allowed are not forwarded. If you omit the **maximum-hop-count** statement, the default maximum number of hops is four.

To set the minimum allowed number of seconds in the **secs** field of the BOOTP message, include the **minimum-wait-time** statement. This setting configures a minimum number of seconds since the client sent its first BOOTP request. BOOTP messages that have a smaller number in the **secs** field than the allowed minimum are not forwarded. The default value for the minimum wait time is zero (0).

To set the IP address that specify the DHCP or BOOTP server for the router, switch, or interface, include the **server** statement. You can include multiple **server** statements.

To set an IP time-to-live (TTL) value for DHCP response packets sent to a DHCP client, include the **client-response-ttl** statement.

The following example demonstrates a BOOTP relay agent configuration.

```
user@host# show forwarding-options
helpers {
  bootp {
    description "dhcp relay agent global parameters";
    server 192.168.55.44;
    server 172.16.0.3 routing-instance c3;
    maximum-hop-count 10;
    minimum-wait-time 8;
```



```
        interface {
          xe-0/0/1 {
            description "use this info for this interface";
            server 10.10.10.10;
            server 192.168.14.14;
            maximum-hop-count 11;
            minimum-wait-time 3;
          }
          xe-0/0/2 {
            no-listen; ###ignore DHCPDISCOVER messages on this interface
          }
          all {
            description "globals apply to all other interfaces";
          }
        }
      }
    }
```

Configuring DHCP Smart Relay

You can use DHCP smart relay to provide redundancy and resiliency to your DHCP relay configuration. Smart relay provides additional relay functionality and requires all of the configuration settings required by DHCP relay. To use DHCP smart relay, you also need an interface with multiple IP addresses assigned to it. You can achieve this by doing either of the following tasks:

- Create a routed VLAN interface and assign at least two IP addresses to it. See "Configuring Routed VLAN Interfaces" on page 1532 and "Example: Configuring Routing Between VLANs on One Switch" on page 1428 for information about this approach.
- Create a Layer 3 logical interface (by using VLAN tagging) and assign at least two IP addresses to it. See "Understanding Layer 3 Logical Interfaces" on page 1851 and "Configuring a Layer 3 Logical Interface" on page 2019 for information about this approach.

Once you have created an interface with multiple IP addresses, complete the smart relay configuration by entering one of the following statements:

- **set forwarding-options helpers bootp smart-relay-global**: Use this statement to enable smart relay on all the interfaces that are configured as relay agents.
- **set forwarding-options helpers bootp interface *interface-name* smart-relay-agent**: Use this statement to enable smart relay on a specific interface.

When smart relay is configured for an interface, the switch initially sends DHCP request (discover) messages out of that interface using the primary address of the interface as the gateway IP address (in the giaddr field) for the DHCP message. If no DHCP offer message is received from a server in reply, the switch allows the client to send as many as three more discover messages using the same gateway IP address. If no DHCP offer message is received after three retries, the switch resends the discover message using the alternate IP address as the gateway IP address. If you configure more than two IP addresses on the relay agent interface, the switch repeats this process until a DHCP offer message is received or all of the IP addresses have been used without success.

Configuration Statements for Port Mirroring

analyzer

Syntax

```
analyzer {
  name {
    input {
      egress {
        interface (all | interface-name);
      }
      ingress {
        interface (all | interface-name);
        vlan (vlan-id | vlan-name);
      }
    output {
      interface interface-name;
      ip-address ip-address;
      vlan (vlan-id | vlan-name);
    }
  }
}
```

Hierarchy Level

For platforms without ELS:

[edit ethernet-switching-options]

For platforms with ELS:

[edit forwarding-options]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.
Option **output vlan** added in Junos OS Release 12.1 for the QFX Series.
Option **output ip-address** added in Junos OS Release 12.3 for the QFX Series.

Description

Configure port mirroring. You can create a total of four port-mirroring configurations on the QFX Series, subject to the following limits:

- There can be no more than two configurations that mirror ingress traffic.
- There can be no more than two configurations that mirror egress traffic.

Default

Port mirroring is disabled, and Junos OS creates no default analyzers.

Options

all—Mirror all the access interfaces. Using this option does not cause the QSFP+ or management interfaces to be mirrored.

CAUTION: Configuring the **all** option in a QFabric system causes all the access interfaces on all the nodes to be mirrored. Be cautious about using this option on a QFabric system.

name—Name of the analyzer. The name can include as many as 125 characters; must begin with a letter; and can include uppercase letters, lowercase letters, numbers, dashes, and underscores. No other special characters are allowed.

The remaining statements are explained separately.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Configuring Port Mirroring on page 4730
- Example: Configuring Port Mirroring for Local Analysis on page 4721

egress

Syntax

```
egress {
  interface (all | interface-name);
}
```

Hierarchy Level
For platforms without ELS:

[edit ethernet-switching-options analyzer *name* input]

For platforms with ELS:

[edit forwarding-options analyzer *name* input]

Release Information
Statement introduced in Junos OS Release 11.2 for the QFX Series.

Description
Specify interfaces for which egressing traffic is mirrored.

The statement is explained separately.

NOTE: If you configure Junos OS to mirror egress packets, do not configure more than 2000 VLANs. If you do so, some of the mirrored packets might contain incorrect VLAN IDs.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Configuring Port Mirroring on page 4730
- Example: Configuring Port Mirroring for Local Analysis on page 4721

ethernet-switching-options

Syntax

```
ethernet-switching-options {
  analyzer {
    name {
      input {
        egress {
          interface (all | interface-name);
        }
        ingress {
          interface (all | interface-name);
          vlan (vlan-id | vlan-name);
        }
      output {
        interface interface-name;
        ip-address ip-address;
        vlan (vlan-id | vlan-name);
      }
    }
  }
  bpdu-block {
    interface (all | [interface-name]);
    disable-timeout timeout;
  }
  dot1q-tunneling {
    ether-type (0x8100 | 0x88a8 | 0x9100)
  }
  interfaces interface-name {
    no-mac-learning;
  }
  mac-table-aging-time seconds {
  }
  port-error-disable {
    disable-timeout timeout;
  }
  secure-access-port {
    dhcp-snooping-file {
      location local_pathname | remote_URL;
      timeout seconds;
      write-interval seconds;
    }
    interface (all | interface-name) {
      allowed-mac {
        mac-address-list;
      }
      (dhcp-trusted | no-dhcp-trusted);
      fcoe-trusted;
      mac-limit limit action action;
      no-allowed-mac-log;
    }
    vlan (all | vlan-name) {
      (arp-inspection | no-arp-inspection) [
        forwarding-class (for DHCP Snooping or DAI Packets) class-name;
      }
```

```
          dhcp-option82 {
            circuit-id {
              prefix (Circuit ID for Option 82) hostname;
              use-interface-description;
              use-vlan-id;
            }
            remote-id {
              prefix (Remote ID for Option 82) hostname | mac | none;
              use-interface-description;
              use-string string;
            }
            vendor-id <string>;
          }
          (examine-dhcp | no-examine-dhcp) {
            forwarding-class (for DHCP Snooping or DAI Packets) class-name;
          }
          examine-fip {
            examine-vn2vn {
              beacon-period milliseconds;
            }
            fc-map fc-map-value;
          }
          mac-move-limit limit <fabric-limit limit action action;
        }
      }
      static {
        vlan vlan-id {
          mac mac-address next-hop interface-name;
        }
      }
      storm-control {
        interface (all | interface-name) {
          bandwidth bandwidth;
          no-broadcast;
          no-multicast;
          no-unknown-unicast;
        }
      }
      traceoptions {
        file filename <files number> <no-stamp> <replace> <size size> <world-readable |
          no-world-readable>;
        flag flag <disable>;
      }
      unknown-unicast-forwarding {
        vlan (all | vlan-name) {
          interface interface-name;
        }
      }
    }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure Ethernet switching options.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Overview of Access Port Protection on page 4451
- Understanding Storm Control on page 4471

ingress (ethernet-switching-options)

Syntax

```
ingress {
  interface (all | interface-name);
  vlan (vlan-id | vlan-name);
}
```

Hierarchy Level For platforms without ELS:

[edit ethernet-switching-options analyzer *name* input]

For platforms with ELS:

[edit forwarding-options analyzer *name* input]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the interfaces or VLANs for which incoming traffic is mirrored as part of a port mirroring configuration.

The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Configuring Port Mirroring on page 4730
- Example: Configuring Port Mirroring for Local Analysis on page 4721

input

Syntax

```
input {
  ingress {
    interface (all | interface-name);
    vlan (vlan-id | vlan-name);
  }
  egress {
    interface (all | interface-name);
  }
}
```

Hierarchy Level

For platforms without ELS:

[edit ethernet-switching-options analyzer *name*]

For platforms with ELS:

[edit forwarding-options analyzer *name*]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Define the traffic to be mirrored. The definition can be a combination of traffic entering or exiting specific ports or VLANs.

The statements are explained separately.

Default

No default.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Configuring Port Mirroring on page 4730
- Example: Configuring Port Mirroring for Local Analysis on page 4721

interface (Port Mirroring)

Syntax interface (all | *interface-name*);

Hierarchy Level For platforms without ELS:

[edit ethernet-switching-options analyzer *name* input (egress | ingress)],
[edit ethernet-switching-options analyzer *name* output]

For platforms with ELS:

[edit forwarding-options analyzer *name* input (egress | ingress)]
[edit forwarding-options analyzer *name* output]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the interfaces for which ingressing traffic is mirrored. Specify the interface that mirrored traffic should be copied to (the output interface).

Options all—Apply port mirroring to all interfaces on the switch (except the output interface). Mirroring a high volume of traffic can cause performance issues, so you should generally select specific input interfaces.

CAUTION: Configuring all in a QFabric system causes all the access interfaces on all the nodes to be mirrored. Be cautious about using this option on a QFabric system.

interface-name—Apply port mirroring to the specified interface only.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Configuring Port Mirroring on page 4730
- Example: Configuring Port Mirroring for Local Analysis on page 4721

ip-address (Port Mirroring)

Syntax ip-address *ip-address*;

Hierarchy Level [edit ethernet-switching-options analyzer *name* output]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Specify the IP address to which traffic should be mirrored (the IP address of the analyzer system). The device can be on a remote network. The analyzer device must be able to de-encapsulate GRE-encapsulated packets, or the GRE-encapsulated packets must be de-encapsulated before reaching the analyzer device. (You can use a network sniffer to de-encapsulate the packets.) This statement is not supported on QFabric systems.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Configuring Port Mirroring on page 4730
- Example: Configuring Port Mirroring for Local Analysis on page 4721

output

Syntax

```
output {
  interface interface-name;
  ip-address ip-address;
  vlan (vlan-id | vlan-name);
}
```

Hierarchy Level

For platforms without ELS:

[edit ethernet-switching-options analyzer *name*]

For platforms with ELS:

[edit forwarding-options analyzer *name*]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.
Option **output vlan** added in Junos OS Release 12.1 for the QFX Series.

Description

Configure the destination for mirrored traffic, either an interface on the switch (for local monitoring) or a VLAN (for remote monitoring).

The statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Configuring Port Mirroring on page 4730
- Example: Configuring Port Mirroring for Local Analysis on page 4721

vlan (Port Mirroring)

Syntax

vlan (*vlan-id* | *vlan-name*);

Hierarchy Level

For platforms without ELS:

[edit ethernet-switching-options analyzer *name* input ingress],
[edit ethernet-switching-options analyzer *name* output]

For platforms with ELS:

[edit forwarding-options analyzer *name* input (egress | ingress)]
[edit forwarding-options analyzer *name* output]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.
Option**output vlan** added in Junos OS Release 12.1 for the QFX Series.

Description

Specify that traffic entering into a VLAN should be mirrored. Configure mirrored traffic to be sent to a VLAN for remote monitoring (output).

Options

vlan-id—Numeric VLAN identifer.

vlan-name—Name of the VLAN.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Port Mirroring on page 4713
- Configuring Port Mirroring on page 4730
- Example: Configuring Port Mirroring for Local Analysis on page 4721

Configuration Statements for Encryption

authentication-key-chains

Syntax

```
authentication-key-chains {
  key-chain key-chain-name {
    description text-string;
    key key {
      algorithm (md5 | hmac-sha-1);
      options (basic | isis-enhanced);
      secret secret-data;
      start-time yyyy-mm-dd.hh:mm:ss;
    }
    tolerance seconds;
  }
}
```

Hierarchy Level [edit security]

Release Information

Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the BFD protocol introduced in Junos OS Release 9.6.
Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.
Support for IS-IS introduced in JUNOS OS Release 11.2.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure authentication key updates for the Border Gateway Protocol (BGP), the Label Distribution Protocol (LDP) routing protocols, the Bidirectional Forwarding Detection (BFD) protocol, and the Intermediate System-to-Intermediate System (IS-IS) protocol. When the **authentication-key-chains** statement is configured at the **[edit security]** hierarchy level, and is associated with the BGP, LDP, or IS-IS protocols at the **[edit protocols]** hierarchy level or with the BFD protocol using the **bfd-liveness-detection** statement, authentication key updates can occur without interrupting routing and signaling protocols such as Open Shortest Path First (OSPF) and Resource Reservation Setup Protocol (RSVP).

The remaining statements are explained separately.

Required Privilege Level

admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols*
- Example: Configuring BFD Authentication for Static Routes on page 2332
- Example: Configuring Hitless Authentication Key Rollover for IS-IS on page 3211

cache-size

Syntax cache-size *bytes*;

Hierarchy Level [edit security certificates]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Configure the cache size for digital certificates.

Options ***bytes***—Cache size for digital certificates.

Range: 64 through 4,294,967,295

Default: 2 megabytes (MB)

NOTE: **We recommend that you limit your cache size to 4 MB.**

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration

Related Documentation

- *Configuring Digital Certificates for an ES PIC*

cache-timeout-negative

Syntax cache-timeout-negative *seconds*;

Hierarchy Level [edit security certificates]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Configure a negative cache for digital certificates.

Options ***seconds***—Negative time to cache digital certificates, in seconds.

Range: 10 through 4,294,967,295

Default: 20

CAUTION: **Configuring a large negative cache value can lead to a denial-of-service attack.**

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration

Related Documentation
- *Configuring Digital Certificates for an ES PIC*

ca-name

Syntax ca-name *ca-identity*;

Hierarchy Level [edit security certificates certification-authority]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Specify the certificate authority (CA) identity to use in the certificate request.

Options ***ca-identity***—CA identity to use in the certificate request.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation
- *Configuring Digital Certificates for an ES PIC*

certificates

Syntax

```
certificates {
  cache-size bytes;
  cache-timeout-negative seconds;
  certification-authority ca-profile-name {
    ca-name ca-identity;
    crl file-name;
    encoding (binary | pem);
    enrollment-url url-name;
    file certificate-filename;
    ldap-url url-name;
  }
  enrollment-retry attempts;
  local certificate-name {
    certificate-key-string;
    load-key-file URL filename;
  }
  maximum-certificates number;
  path-length certificate-path-length;
}
```

Hierarchy Level [edit security]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Configure the digital certificates for IPsec.

The remaining statements are explained separately.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring Digital Certificates for an ES PIC*

certification-authority

Syntax

```
certification-authority ca-profile-name {
  ca-name ca-identity;
  crl file-name;
  encoding (binary | pem);
  enrollment-url url-name;
  file certificate-filename;
  ldap-url url-name;
}
```

Hierarchy Level [edit security certificates]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Configure a certificate authority profile name.

The remaining statements are explained separately.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration

Related Documentation

- *Configuring Digital Certificates for an ES PIC*

crl (Encryption Interface)

Syntax crl *file-name*;

Hierarchy Level [edit security certificates]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Configure the certificate revocation list (CRL). A CRL is a time-stamped list identifying revoked certificates, which is signed by a CA and made available to the participating IPsec peers on a regular periodic basis.

Options ***file-name***—Specify the file from which to read the CRL.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration

Related Documentation

- *Configuring Digital Certificates for an ES PIC*

encoding

Syntax encoding (binary | pem);

Hierarchy Level [edit security ike policy *ike-peer-address*],
[edit security certificates certification-authority *ca-profile-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Specify the file format used for the **local-certificate** and **local-key-pair** statements.

Options **binary**—Binary file format.

pem—Privacy-enhanced mail (PEM), an ASCII base 64 encoded format.

Default: **binary**

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring Digital Certificates for an ES PIC*
- *Configuring an IKE Policy for Digital Certificates for an ES PIC*

enrollment-retry

Syntax enrollment-retry *attempts*;

Hierarchy Level [edit security certificates]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Specify how many times a router or switch can resend a digital certificate request.

Options ***attempts***—Number of enrollment retries.

Range: 0 through 100

Default: 0

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring Digital Certificates for an ES PIC*

enrollment-url

Syntax enrollment-url *url-name*;

Hierarchy Level [edit security certificates certification-authority *ca-profile-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Specify where your router or switch sends Simple Certificate Enrollment Protocol-based (SCEP-based) certificate enrollment requests (certificate authority URL).

Options *url-name*—Certificate authority URL.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring Digital Certificates for an ES PIC*

file

Syntax file *certificate-filename*;

Hierarchy Level [edit security certificates certification-authority *ca-profile-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Specify the file from which to read the digital certificate.

Options *certificate-filename*—File from which to read the digital certificate.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring Digital Certificates for an ES PIC*

key (Authentication Keychain)

Syntax

```
key key {
  algorithm (md5 | hmac-sha-1);
  options (basic | isis-enhanced);
  secret secret-data;
  start-time yyyy-mm-dd.hh:mm:ss;
}
```

Hierarchy Level [edit security authentication-key-chains key-chain *key-chain-name*]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the BFD protocol introduced in Junos OS Release 9.6.
Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.
Support for IS-IS introduced in JUNOS OS Release 11.2.
Statement introduced in Junos OS Release 11.3 for QFX Series switches.

Description Configure the authentication element.

Options ***key***—Each key within a keychain is identified by a unique integer value.

Range: 0 through 63

The remaining statements are explained separately.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols*
- Example: Configuring BFD Authentication for Static Routes on page 2332
- Example: Configuring Hitless Authentication Key Rollover for IS-IS on page 3211

key-chain (Security)

Syntax

```
keychain key-chain-name {
  description text-string;
  key key {
    algorithm (md5 | hmac-sha-1);
    options (basic | isis-enhanced);
    secret secret-data;
    start-time yyyy-mm-dd.hh:mm:ss;
  }
  tolerance seconds;
}
```

Hierarchy Level

[edit security authentication-key-chains]

Release Information

Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the BFD protocol introduced in Junos OS Release 9.6.
Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.
Support for IS-IS introduced in Junos OS Release 11.2.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Create the key-chain configuration for the Border Gateway Protocol (BGP), the Label Distribution Protocol (LDP) routing protocols, the Bidirectional Forwarding Detection (BFD) protocol, and the Intermediate System-to-Intermediate System (IS-IS) protocol.

Options

key-chain-name—Authentication keychain name. It can be up to 126 characters. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (“ ”).

Required Privilege Level

admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- authentication-key-chains on page 4748
- *Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols*
- Example: Configuring BFD Authentication for Static Routes on page 2332
- Example: Configuring Hitless Authentication Key Rollover for IS-IS on page 3211

ldap-url

Syntax <ldap-url *url-name*>;

Hierarchy Level [edit security certificates certification-authority *ca-profile-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) (Optional) Specify the Lightweight Directory Access Protocol (LDAP) URL for digital certificates.

Options ***url-name***—Name of the LDAP URL.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation
- *Configuring Digital Certificates for an ES PIC*

local

Syntax

```
local certificate-name {
  certificate-key-string;
  load-key-file URL filename;
}
```

Hierarchy Level [edit security certificates]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Import a paired X.509 private key and authentication certificate, to enable Junos XML protocol client applications to establish Secure Sockets Layer (SSL) connections to the router or switch.

Options ***certificate-namecertificate-key-string***—String of alphanumeric characters that constitute the private key and certificate.

certificate-name—Name that uniquely identifies the certificate.

load-key-file *URL filename*—File that contains the private key and certificate. It can be one of two types of values:

- Pathname of a file on the local disk (assuming you have already used another method to copy the certificate file to the router's or switch's local disk)
- URL to the certificate file location (for instance, on the computer where the Junos XML protocol client application runs)

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Importing SSL Certificates for Junos XML Protocol Support*

maximum-certificates

Syntax maximum-certificates *number*;

Hierarchy Level [edit security certificates]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Configure the maximum number of peer digital certificates to be cached.

Options ***number***—Maximum number of peer digital certificates to be cached.

Range: 64 through 4,294,967,295 peer certificates

Default: 1024 peer certificates

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring Digital Certificates for an ES PIC*

path-length

Syntax path-length *certificate-path-length*;

Hierarchy Level [edit security certificates]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description (Encryption interface on M Series and T Series routers and EX Series switches only) Configure the digital certificate path length.

Options ***certificate-path-length***—Digital certificate path length.

Range: 2 through 15 certificates

Default: 15 certificates

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring Digital Certificates for an ES PIC*

secret

Syntax secret *secret-data*;

Hierarchy Level [edit security authentication-key-chains key-chain *key-chain-name* key *key*]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the BFD protocol introduced in Junos OS Release 9.6.
Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.
Support for IS-IS introduced in JUNOS OS Release 11.2.
Statement introduced in Junos OS Release 11.3 for QFX Series switches.

Description Specify a password in encrypted text or plain text format. The secret password always appears in encrypted format.

Options ***secret-data***—Password to use; it can include spaces if the character string is enclosed in quotation marks.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols*
- Example: Configuring BFD Authentication for Static Routes on page 2332
- Example: Configuring Hitless Authentication Key Rollover for IS-IS on page 3211

security

Syntax

```
security {
  authentication-key-chains {
    key-chain key-chain-name {
      key key {
        secret secret-data;
        start-time yyyy-mm-dd.hh:mm:ss;
      }
    }
  certificates {
    cache-size bytes;
    cache-timeout-negative seconds;
    certification-authority ca-profile-name {
      ca-name ca-identity;
      crl file-name;
      encoding (binary | pem);
      enrollment-url url-name;
      file certificate-filename;
      ldap-url url-name;
    }
    enrollment-retry attempts;
    local certificate-filename {
      certificate-key-string;
      load-key-file key-file-name;
    }
    maximum-certificates number;
    path-length certificate-path-length;
  }
  ssh-known-hosts {
    host {
      fetch-from-server host-name;
      load-key-file file-name;
    }
  }
  traceoptions {
    file filename <files number> <size size>;
    flag flag;
    level level;
    no-remote-trace
  }
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure security services. Most of the configuration statements do not have default values. If you do not specify an identifier for a statement that does not have a default value, you cannot commit the configuration.

Required Privilege Level

Related Documentation

ssh-known-hosts

Syntax

```
ssh-known-hosts {
  host host-name {
    fetch-from-server host-name;
    load-key-file file-name;
  }
}
```

Hierarchy Level [edit security ssh-known-hosts]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure SSH support for known hosts and for administering SSH host key updates.

Options **host *host-name***—Hostname of the SSH known host entry. This option has the following suboptions:

- **fetch-from-server *host-name***—Retrieve SSH public host key information from a specified server.
- **load-key-file *filename***—Import SSH host key information from the **/var/tmp/ssh-known-hosts** file.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Understanding Security Features on the QFabric System*
- Configuring SSH Host Keys for Secure Copying of Data on page 1241

start-time (Authentication Key Transmission)

Syntax start-time (now | *yyyy-mm-dd.hh:mm:ss*);

Hierarchy Level [edit security authentication-key-chains key-chain *key-chain-name* key *key*]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for the BFD protocol introduced in Junos OS Release 9.6.
Support for the BFD protocol introduced in Junos OS Release 9.6 for EX Series switches.
Support for IS-IS introduced in JUNOS OS Release 11.2.
Statement introduced in Junos OS Release 11.3 for QFX Series switches.

Description Specify a start time for key transmission. You do not need to specify an end time for the key. If a new key is present with a new start time, the keychain rolls over to the new one. The start time must be unique within the keychain.

Options **now**—Start time as the current year, month, day, hour, minute, and second.

***day*days**—Start time as the specified number of days after the current day. For example, if the current day is the 12th and you configure **start-time 2day**, the start time will be on the 14th, exactly two days after the configuration is entered.

***hour*hours**—Start time as the specified number of hours after the current hour. For example, if the current hour is 9:00 and you configure **start-time 3hour**, the start time will be in 12:00, exactly three hours after the configuration is entered.

***minute*minutes**—Start time as the specified number of minutes after the current minute. For example, if the current minute is 27 minutes after the hour and you configure **start-time 5min**, the start time will be in 32 minutes after the hour, exactly five minutes after the configuration is entered.

***month*months**—Start time as the specified number of months after the current month. For example, if the current month is March and you configure **start-time 4month**, the start time will be in July, exactly four months after the configuration is entered.

***second*seconds**—Start time as the specified number of seconds after the current second. For example, if the current second is 10:20:40 and you configure **start-time 10seconds**, the start time will be 10:20:50, exactly 10 seconds after the configuration is entered.

***year*years**—Start time as the specified number of years after the current year. For example, if the current year is 2011 and you configure **start-time 1year**, the start time will be in 2012, exactly one year after the configuration is entered.

yyyy–mm-dd.hh:mm:ss—Start time in UTC (Coordinated Universal Time). The start time must be unique within the keychain.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols*
- Example: Configuring BFD Authentication for Static Routes on page 2332
- Example: Configuring BFD Authentication for Static Routes on page 2332
- Example: Configuring Hitless Authentication Key Rollover for IS-IS on page 3211

traceoptions

Syntax

traceoptions {
  file *filename* <files *number*> <size *size*>;
  flag all;
  flag certificates;
  flag database;
  flag general;
  flag ike;
  flag parse;
  flag policy-manager;
  flag routing-socket;
  flag timer;
  level
  no-remote-trace
}

Hierarchy Level

[edit security],
[edit services ipsec-vpn]

Trace options can be configured at either the **[edit security]** or the **[edit services ipsec-vpn]** hierarchy level, but not at both levels.

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure security trace options.

To specify more than one trace option, include multiple **flag** statements. Trace option output is recorded in the **/var/log/kmd** file.

NOTE: **The traceoptionsstatement is not supported on QFabric systems.**

Options

files ***number***—(Optional) Maximum number of trace files. When a trace file (for example, **kmd**) reaches its maximum size, it is renamed **kmd.0**, then **kmd.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 0 files

size ***size***—(Optional) Maximum size of each trace file, in kilobytes (KB). When a trace file (for example, **kmd**) reaches this size, it is renamed, **kmd.0**, then **kmd.1** and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

Default: 1024 KB

flag ***flag***—Trace operation to perform. To specify more than one trace operation, include multiple **flag** statements.

- **all**—Trace all security events.
- **certificates**—Trace certificate events.
- **database**—Trace database events.
- **general**—Trace general events.
- **ike**—Trace IKE module processing.
- **parse**—Trace configuration processing.
- **policy-manager**—Trace policy manager processing.
- **routing-socket**—Trace routing socket messages.
- **timer**—Trace internal timer events.

level ***level***—(Optional) Set traceoptions level.

- **all**—match all levels.
- **error**—Match error conditions.
- **info**—Match informational messages.
- **notice**—Match conditions that should be handled specially.
- **verbose**—Match verbose messages.
- **warning**—Match warning messages.

no-remote-trace—(Optional) Disable remote tracing

Required Privilege Level

admin—To view the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- *Configuring Tracing Operations for Security Services*

CHAPTER 56

Administration

Monitoring Commands for Port Mirroring

- show analyzer

show analyzer

Syntax show analyzer <*analyzer-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display information about port mirroring.

Options *analyzer-name*—(Optional) Displays the status of a specific analyzer (port-mirroring configuration).

Required Privilege Level view

Related Documentation

- *Layer 2 Port Mirroring Overview*
- Port Mirroring Constraints and Limitations on page 4715
- Example: Configuring Port Mirroring for Local Analysis on page 4721
- Example: Configuring Port Mirroring for Remote Analysis on page 4726

List of Sample Output show analyzer on page 4776

Output Fields Table 366 on page 4776 describes the output fields for the **show analyzer** command. Output fields are listed in the approximate order in which they appear.

Table 366: show analyzer Output Fields

Field Name	Field Description
Analyzer name	Name of the analyzer.
Output interface	Local interface to which mirror packets are sent. If you configure an output interface, you cannot also configure an output VLAN.
Output VLAN	VLAN to which mirror packets are sent. If you configure an output VLAN, you cannot also configure an output interface.
Egress monitored interfaces	Interfaces for which egress traffic is mirrored.
Ingress monitored interfaces	Interfaces for which ingress traffic is mirrored.
Ingress monitored VLANs	VLANs for which ingress traffic is mirrored.

Sample Output

show analyzer

```
user@switch> show analyzer
Analyzer name                : employee-monitor
  Output interface           : ge-0/0/10.0
  Output VLAN                : remote-analyzer
```

```
Egress monitored interfaces  : ge-0/0/7.0
Ingress monitored interfaces : ge-0/0/8.0
Ingress monitored interfaces : ge-0/0/9.0
```

CHAPTER 57

Troubleshooting

Troubleshooting Procedures

Troubleshooting Port Mirroring

Port Mirroring Constraints and Limitations

Local and Remote Port Mirroring

The following constraints and limitations apply to local and remote port mirroring with the QFX Series:

- You can create a total of four port-mirroring configurations on a QFX Series standalone switch.
- You can create a total of four port-mirroring configurations on each Node group in a QFabric system, subject to the following constraints:
  - As many as four of the configurations can be for local port mirroring.
  - As many as three of the configurations can be for remote port mirroring.
- Regardless of whether you are configuring a standalone switch or a Node group, the following limits apply:
  - There can be no more than two configurations that mirror ingress traffic. (If you configure a firewall filter to send traffic to a port mirror—that is, you use the **analyzer** action modifier in a filter term—this counts as an ingress mirroring configuration for switch or Node group on which the filter is applied.)
  - There can be no more than two configurations that mirror egress traffic.

NOTE: On QFabric systems, there is no system-wide limit on the total number of mirror sessions.

- You can configure no more than one type of output in one port-mirroring configuration. That is, you can use no more than one of the following to complete a **set analyzer *name* output** statement:
  - **interface**
  - **ip-address**
  - **vlan**
- If you configure Junos OS to mirror egress packets, do not configure more than 2000 VLANs on a QFX3500 device or QFabric system. If you do so, some VLAN packets might contain incorrect VLAN IDs. This applies to any VLAN packets—not only the mirrored copies.
- The **ratio** and **loss-priority** options are not supported.
- Packets with physical layer errors are filtered out and are not sent to the output port or VLAN.
- If you use sFlow monitoring to sample traffic, it does not sample the mirror copies when they exit from the output interface.
- You cannot mirror packets exiting or entering the following ports:
  - Dedicated Virtual Chassis interfaces
  - Management interfaces (me0 or vme0)
  - Fibre Channel interfaces
  - Routed VLAN interfaces
- An aggregated Ethernet interface cannot be an output interface.
- Do not include an 802.1Q subinterface that has a unit number other than 0 in a port mirroring configuration. Port mirroring does not work with subinterfaces if their unit number is not 0. (You configure 802.1Q subinterfaces using the **vlan-tagging** statement.)
- When packet copies are sent out the output interface, they are not modified for any changes that are normally applied on egress, such as CoS rewriting.
- An interface can be the input interface for only one mirroring configuration. Do not use the same interface as the input interface for multiple mirroring configurations.
- CPU-generated packets (such as ARP, ICMP, BPDU, and LACP packets) cannot be mirrored on egress.
- VLAN-based mirroring is not supported for STP traffic.
- (QFabric systems only) If you configure a QFabric analyzer to mirror egress traffic and the input and output interfaces are on different Node devices, the mirrored copies have incorrect VLAN IDs. This limitation does not apply if you configure a QFabric analyzer

to mirror egress traffic and the input and output interfaces are on the *same* Node device. In this case the mirrored copies have the correct VLAN IDs (as long as you do not configure more than 2000 VLANs on the QFabric system).

Remote Port Mirroring Only

The following constraints and limitations apply to remote port mirroring with the QFX Series:

- If you configure an output IP address, the address cannot be in the same subnetwork as any of the switch's management interfaces.
- If you create virtual routing instances and also create an analyzer configuration that includes an output IP address, the output address belongs to the default virtual routing instance (inet.0 routing table).
- An output VLAN cannot be a private VLAN or VLAN range.
- An output VLAN cannot be shared by multiple **analyzer** statements.
- An output VLAN interface cannot be a member of any other VLAN.
- An output VLAN interface cannot be an aggregated Ethernet interface.
- On the source (monitored) switch, only one interface can be a member of the analyzer VLAN.

Egress Port Mirroring with VLAN Translation

Problem If you create a port-mirroring configuration that mirrors customer VLAN (CVLAN) traffic on egress and the traffic undergoes VLAN translation before being mirrored, the VLAN translation does not apply to the mirrored packets. That is, the mirrored packets retain the service VLAN (SVLAN) tag that should be replaced by the CVLAN tag on egress. The original packets are unaffected—on these packets VLAN translation works properly, and the SVLAN tag is replaced with the CVLAN tag on egress.

Solution This is expected behavior.

Egress Port Mirroring with Private VLANs

Problem If you create a port-mirroring configuration that mirrors private VLAN (PVLAN) traffic on egress, the mirrored traffic (the traffic that is sent to the analyzer system) has the VLAN tag of the ingress VLAN instead of the egress VLAN. For example, assume the following PVLAN configuration:

- Promiscuous trunk port that carries primary VLANs pvlan100 and pvlan400.
- Isolated access port that carries secondary VLAN isolated200. This VLAN is a member of primary VLAN pvlan100.
- Community port that carries secondary VLAN comm300. This VLAN is also a member of primary VLAN pvlan100.
- Output interface (monitor interface) that connects to the analyzer system. This interface forwards the mirrored traffic to the analyzer.

If a packet for pvlan100 enters on the promiscuous trunk port and exits on the isolated access port, the original packet is untagged on egress because it is exiting on an access port. However, the mirror copy retains the tag for pvlan100 when it is sent to the analyzer.

Here is another example: If a packet for comm300 ingresses on the community port and egresses on the promiscuous trunk port, the original packet carries the tag for pvlan100 on egress, as expected. However, the mirrored copy retains the tag for comm300 when it is sent to the analyzer.

Solution This is expected behavior.

Related Documentation

- Understanding Port Mirroring on page 4713
- Example: Configuring Port Mirroring for Local Analysis on page 4721
- Example: Configuring Port Mirroring for Remote Analysis on page 4726

PART 18

Storage

CHAPTER 58

Overview

Software Features Overview

Overview of Fibre Channel on the QFX Series

Fibre Channel (FC) is a high-speed network technology that interconnects network elements and allows them to communicate with one another. The International Committee for Information Technology Standards (INCITS) T11 Technical Committee sets FC standards.

FC networks provide high-performance characteristics such as lossless transport combined with flexible network topology. FC is primarily used in storage area networks (SANs) because it provides reliable, lossless, in-order frame transport between initiators and targets. FC components include initiators, targets, and FC-capable switches that interconnect FC devices and may also interconnect FC devices with Fibre Channel over Ethernet (FCoE) devices. Initiators originate I/O commands. Targets receive I/O commands. For example, a server can initiate an I/O request to a storage device target.

Juniper Networks QFX Series can function as an FCoE-FC gateway or as an FCoE transit switch.

FCoE transports native FC frames over an Ethernet network by encapsulating the unmodified frames in Ethernet. It also provides protocol extensions to discover FCoE devices through the Ethernet network. FCoE requires that the Ethernet network support data center bridging (DCB) extensions that ensure lossless transport and allow the Layer 2 Ethernet domain to meet the requirements of FC transport.

The FCoE-FC gateway functionality is a licensed feature on the QFX Series. As an FCoE-FC gateway, the switch connects FCoE devices on an Ethernet network to a SAN FC switch.

You do not need a license to use the switch as an FCoE transit switch. As an FCoE transit switch, the switch:

- Is a Layer 2 data center bridging (DCB) switch that can transport FCoE frames.
- Implements FCoE Initialization Protocol (FIP) snooping.
- Connects multiple FCoE endpoints to the FC network.

NOTE: **The QFX3600 switch does not support FC because it does not support native FC port configuration. The QFX3600 switch supports FCoE.**

QFX3500 and QFX3600 Virtual Chassis switches do not support FC or FCoE

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This topic describes:

- Fibre Channel Transport Protocol on page 4787
- How FC Works on the QFX Series on page 4787
- Supported FC Features and Functions on page 4789
- Lossless Transport Support on page 4789

Fibre Channel Transport Protocol

The Fibre Channel Protocol is a transport protocol that consists of five layers as shown in Table 367 on page 4787:

Table 367: Fibre Channel Protocol Layers

FC Protocol Layer	Description
FC-0	Physical (cabling, connectors, and so on)
FC-1	Data link layer
FC-2	Network layer (defines the main protocols)
FC-3	Common services
FC-4	Protocol mapping

The FC protocol layers are generally split into three groups:

- FC-0 and FC-1 are the physical layers.
- FC-2 is the protocol layer, similar to OSI Layer 3.
- FC-3 and FC-4 are the services layers.

The FCoE-FC gateway operates the physical layers and the protocol layer, and provides FIP and service redirection at the services layer.

How FC Works on the QFX Series

The switch connects devices that support FC and Ethernet (such as FCoE servers on an Ethernet network) to an FC SAN, thus converging the Ethernet and FC networks on a single physical network infrastructure. The switch provides the class-of-service (CoS) features needed to handle the different types of traffic appropriately.

To converge FC and Ethernet networks, you can configure the switch as an:

- FCoE-FC Gateway on page 4787
- FCoE Transit Switch on page 4788
- FCoE VLANs on page 4788

FCoE-FC Gateway

When the switch functions as an FCoE-FC gateway, the switch aggregates FCoE traffic and performs the encapsulation and de-encapsulation of native FC frames in Ethernet as it transports the frames between FCoE devices in the Ethernet network and the FC switch. In effect, the switch translates Ethernet to FC and FC to Ethernet.

The gateway receives FC frames encapsulated in Ethernet from FCoE devices through an FCoE VLAN interface composed of one or more 10-Gigabit Ethernet interfaces. The gateway removes the Ethernet encapsulation from the FC frames, and then sends the native FC frames to the FC switch through a native FC interface.

The gateway receives native FC frames from the FC switch on the gateway's native FC interfaces. The gateway encapsulates the native FC frames in Ethernet, and then sends the encapsulated frames to the appropriate FCoE device through the FCoE VLAN interface.

To FCoE devices, the gateway behaves like an FC switch and can present multiple virtual F_Ports (VF_Ports) on a single interface. To an FC switch, the gateway behaves like an FC node that is doing N_Port ID virtualization (NPIV).

FCoE Transit Switch

When the switch functions as an FCoE transit switch, it forwards traffic (including FCoE traffic) based on Layer 2 media access control (MAC) forwarding and is a normal DCB-enabled Layer 2 switch that also performs FIP snooping. The switch aggregates FCoE traffic and passes it through to an FCF. The switch does not remove the Ethernet encapsulation from the FC frames, but it does preserve the class of service (CoS) required to transport FC frames.

The switch inspects (snoops) FIP information in order to create filters that permit only valid FCoE traffic to flow through the switch between FCoE devices and the FCF. The switch does not use native FC ports because the FC frames are encapsulated in Ethernet when they flow between the FCoE devices and the FCF. Virtual point-to-point links between each FCoE device and the FCF pass transparently through the switch, so the switch is not seen as a terminating point or an intermediate point by FCoE devices or by the FCF.

FCoE VLANs

On the QFX Series, all FCoE traffic must travel in a VLAN dedicated to transporting only FCoE traffic. Only FCoE interfaces should be members of an FCoE VLAN. Ethernet traffic that is not FCoE or FIP traffic must travel in a different VLAN.

NOTE: On a QFX3500 or QFabric system Node device, the same VLAN cannot be used in both transit switch mode and FCoE-FC gateway mode.

NOTE: FCoE VLANs (any VLAN that carries FCoE traffic) support only Spanning Tree Protocol (STP) and link aggregation group (LAG) Layer 2 features. IGMP snooping is enabled by default on all VLANs; be sure to disable IGMP snooping on FCoE VLANs.

You can configure more than one FCoE VLAN, but any given virtual link must be in only one FCoE VLAN.

NOTE: All 10-Gigabit Ethernet interfaces that connect to FCoE devices must have a native VLAN configured in order to transport FIP traffic, because FIP VLAN discovery and notification frames are exchanged as untagged packets.

BEST PRACTICE: Only FCoE traffic is permitted on the FCoE VLAN. A native VLAN might need to carry untagged traffic of different types and protocols. Therefore, it is a good practice to keep the native VLAN separate from FCoE VLANs.

Supported FC Features and Functions

QFX Series supports the following features and functionality:

- As an FCoE-FC gateway:
  - DCB, including Data Center Bridging Capability Exchange protocol (DCBX), priority-based flow control (PFC), enhanced transmission service (ETS), and 10-Gigabit Ethernet interfaces
  - FCoE Initialization Protocol (FIP)
  - Proxy for FCoE devices when communicating with FC switches and acts as a proxy for FC switches when communicating with FCoE devices
  - Up to 12 native FC interfaces per QFX3500 switch (each interface can be configured as a 2-Gigabit, 4-Gigabit, or 8-Gigabit Ethernet interface)
- As an FCoE transit switch:
  - DCB functions
  - FIP snooping
  - Transparent Layer 2 MAC forwarding of FCoE frames

Lossless Transport Support

The QFX Series supports up to six lossless forwarding classes. For lossless transport, you must enable PFC on the IEEE 802.1p code point of lossless forwarding classes. The following limitations apply to support lossless transport:

- The external cable length from the QFX3500 or QFabric system Node device to other devices cannot exceed 300 meters.
- The internal cable length from the QFabric system Node device to the QFabric system Interconnect device cannot exceed 150 meters.
- For FCoE traffic, the interface maximum transmission unit (MTU) must be at least 2180 bytes to accommodate the packet payload, headers, and checks.

Related Documentation

- Understanding Fibre Channel on page 4792
- Understanding an FCoE-FC Gateway on page 4808
- Understanding FCoE Transit Switch Functionality on page 4804
- Understanding FCoE on page 4799
- Understanding DCB Features and Requirements on page 4795

Overview of FIP

Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) is a Layer 2 protocol that establishes and maintains Fibre Channel (FC) virtual links between pairs of FCoE devices such as server FCoE Nodes (ENodes) and FC switches. FIP can also establish and maintain virtual links between FCoE devices and an FCoE-FC gateway such as the QFX Series, where the gateway acts on behalf of the FC switch.

FIP enables FCoE devices to discover one another and to initialize and maintain virtual links over a physical Ethernet network. This allows FCoE devices in the Ethernet network to access storage devices in the FC storage area network (SAN).

FIP solves the problem presented by the FC requirement for point-to-point connections (FC does not permit point-to-multipoint connections) by creating a unique virtual link for each connection between an ENode VN_Port and an FC switch VF_Port. Multiple virtual links can use a single physical link and virtual links can traverse Ethernet transit (passthrough) switches while appearing to be direct point-to-point connections to the FC switch.

FIP has its own EtherType (0x8914) to distinguish its traffic from payload-carrying FCoE traffic and other Ethernet traffic. FIP operations occur on a per-VLAN basis.

For more details about FIP, see the Technical Committee T11 organization document *Fibre Channel Backbone - 5 (FC-BB-5) Rev 2.00* available at http://www.t11.org/ftp/t11/pub/fc/bb-5/09-056v5.pdf.

Related Documentation

Fibre Channel, FCoE, FIP, and FIP Snooping

Understanding Fibre Channel

Fibre Channel (FC) is a serial I/O interconnect network technology capable of supporting multiple protocols. It is used primarily for storage area networks (SANs). The committee standardizing FC is the International Committee for Information Technology Standards (INCITS).

When configured as a Fibre Channel over Ethernet (FCoE)-FC gateway, the QFX Series supports the transport of native FC traffic between FC switches and the gateway's native FC interfaces.

NOTE: **The QFX3600 switch does not support FC because it does not support native FC port configuration. In addition, QFX3500 and QFX3600 Virtual Chassis switches do not support FC.**

FC concepts include:

FC Fabrics

An FC fabric is a switched network topology that interconnects FC devices using FC switches, usually to create a SAN. An FC switch is a Layer 3 network switch that is compatible with the FC protocol, forwards FC traffic, and provides FC services to the components of the FC fabric. FC devices are usually servers or storage devices such as disk arrays.

Switches called FCoE forwarders (FCFs) perform a subset of FC switch functions. An FCF is a Layer 3 network switch that is compatible with the FC protocol and forwards FC traffic, but does not provide network services.

When configured as an FCoE-FC gateway, the QFX Series acts a proxy for the FCF functionality of an FC switch. The gateway provides FCoE devices on the Ethernet network access to the FC network without requiring the FC switches in the SAN to support Ethernet interfaces. The gateway is not an FCF and does not provide FC services.

FC network design often uses two fabrics (dual-rail topology) for redundancy. The two fabrics connect to edge devices but are otherwise unconnected, so that if one fabric goes down, the other fabric can continue to provide connectivity.

FC Port Types

The QFX Series supports the following FC port types:

- N_Port—An N_Port is a port on the node of an FC device such as a server or a storage device and is also known as a node port.
- F_Port—An F_Port is a port on an FC switch that connects to an FC device N_Port in a point-to-point connection. F_Ports are also known as fabric ports.

These port types are a subset of the existing FC port types that can be supported in an FC fabric.

FC Switches

FC switches provide FC services to the FC network. FC switches forward Layer 3 traffic. They may transport a combination of native FC traffic and other traffic, such as Internet Small Computer Systems Interface (iSCSI) or FCoE, or they may transport only native FC traffic. When an FC switch supports FCoE, it combines FCoE termination functions with the FC stack on an FC switching element. This is also known as a dual-stack switch.

When FC switches support FCoE, they present virtual FC interfaces in the form of virtual F_Ports (VF_Ports) to the FCoE nodes (ENodes) on FCoE devices. A VF_Port is an endpoint in a virtual point-to-point connection with an ENode virtual N_Port (VN_Port). A VF_Port emulates a native FC F_Port and performs similar functions. A VF_Port is an intermediate port in a connection between an FCoE device such as a server in the Ethernet network and a storage device in the FC SAN.

FC switches that support FCoE contain at least one lossless Ethernet media access controller (MAC) paired with an FCoE controller. The lossless Ethernet MAC implements Ethernet extensions to avoid frame loss due to congestion. The FCoE controller instantiates and terminates virtual port instances as they are needed. Each VF_Port instance has one unique virtual link to an ENode VN_Port.

FCoE support also requires one FCoE Link End Point (LEP) for each VF_Port connection. An FCoE LEP is a virtual FC interface mapped onto the physical Ethernet interface. It transmits and receives FCoE frames on the virtual link, and handles FC frame encapsulation for traffic going from the FC switch to the FCoE device and frame de-encapsulation of traffic received from the FCoE device.

When you configure the QFX Series as an FCoE-FC gateway, the gateway performs these FC-to-Ethernet and Ethernet-to-FC conversion functions so that the FC switch does not need Ethernet (FCoE) ports.

Adapters

FC host bus adapters (HBAs) in FC switches and devices perform functions similar to those of Ethernet adapters in Ethernet switches and devices. Switches that perform FCoE functions and FCoE devices have converged network adapters (CNAs) that support both native FC and Ethernet functionality.

N_Port ID Virtualization (NPIV)

FC requires a unique point-to-point link between the FC switch (F_Port) and each host N_Port. In order to avoid using one physical link for each F_Port to N_Port connection, the port connections must be virtualized so that they can share a physical link while maintaining logical separation.

FC accomplishes this by enabling you to create an independent virtual link for each FC session by mapping each session to a virtualized N_Port. This process is called N_Port ID virtualization (NPIV).

NPIV makes each virtual link look like a dedicated point-to-point link. In this way, multiple FC devices and multiple applications or virtual machines (VMs) on a single FC device can connect to an FC switch using one physical port instead of using a physical port for each connection. The virtual link creates a secure boundary between traffic from different sources on a single physical connection.

NPIV works by creating a unique virtual port identifier for each logical connection on a physical port. Conceptually, this is similar to splitting a single physical interface into multiple logical interfaces or subinterfaces. A virtual port identifier consists of the port's unique worldwide name (WWN) combined with a Fibre Channel ID (FCID) that the FC switch assigns to the virtual connection. This creates a virtual host bus adapter (HBA) for each virtual link that uniquely identifies the link to the FC switch.

FC Services

When you configure the QFX Series as an FCoE-FC gateway, the gateway connects FCoE devices in the Ethernet network to the FC fabric. The gateway does not provide FC services directly. The gateway logs in to the FC fabric and obtains FC services from the FC fabric, including:

- Management servers
  - Zone server—Defines which devices can connect to each other in the FC fabric.
  - Fabric configuration server—Discovers FC fabric topology and attributes.
  - Policy server—Distributes the rules for administering, managing, and controlling access to FC fabric resources.
  - HBA management server—Registers HBA information with the FC fabric.
- Domain manager—Allocates domain IDs to virtual switches.
- Fabric login server—Provides login services to the gateway so that the native FC ports on the gateway can perform initial fabric login (FLOGI) to the FC fabric and subsequent fabric discovery (FDISC) logins for the physical and virtual ports on the FCoE devices in the Ethernet network. This includes allocating Fibre Channel IDs (FCIDs) to ports.
- Name server—Discovers, registers, and unregisters N_Port attributes, including the attributes of the native FC ports on the gateway that connect to the FC fabric.
- Event server—Validates incoming events to ensure transaction integrity.
- Time server—Maintains a common time for devices in the FC fabric.
- Fabric controller
  - Fabric Shortest Path First (FSPF)—The FC fabric provides link-state path selection to the gateway.

- State change notification (SCN) / registered state change notification server (RSCN)—Notifies the appropriate nodes when new devices come online, when other nodes fail, or when changes on an online node affect system operation.

Related Documentation

- Overview of Fibre Channel on the QFX Series on page 4786
- Understanding FCoE on page 4799
- Understanding an FCoE-FC Gateway on page 4808
- Understanding Fibre Channel Terminology on page 4895

Understanding DCB Features and Requirements

Data center bridging (DCB) is a set of enhancements to the IEEE 802.1 bridge specifications. DCB modifies and extends Ethernet behavior to support I/O convergence in the data center. I/O convergence includes but is not limited to the transport of Ethernet LAN traffic and Fibre Channel (FC) storage area network (SAN) traffic on the same physical Ethernet network infrastructure.

A converged architecture saves cost by reducing the number of networks and switches required to support both types of traffic, reducing the number of interfaces required, reducing cable complexity, and reducing administration activities.

The Juniper Networks QFX Series supports the DCB features required to transport converged Ethernet and FC traffic while providing the class-of-service (CoS) and other characteristics FC requires for transmitting storage traffic. To accommodate FC traffic, DCB specifications provide:

- A flow control mechanism called priority-based flow control (PFC, described in IEEE 802.1Qbb) to help provide lossless transport.
- A discovery and exchange protocol for conveying configuration and capabilities among neighbors to ensure consistent configuration across the network, called Data Center Bridging Capability Exchange protocol (DCBX), which is an extension of Link Layer Data Protocol (LLDP, described in IEEE 802.1AB).
- A bandwidth management mechanism called enhanced transmission selection (ETS, described in IEEE 802.1Qaz).
- A congestion management mechanism called quantized congestion notification (QCN, described in IEEE 802.1Qau).

The switch supports the PFC, DCBX, and ETS standards but does not support QCN. The switch also provides the high-bandwidth interfaces (10-Gbps minimum) required to support DCB and converged traffic.

This topic describes the DCB standards and requirements the switch supports:

- Lossless Transport on page 4796
- ETS on page 4797
- DCBX on page 4797

Lossless Transport

FC traffic requires lossless transport (defined as no frames dropped because of congestion). Standard Ethernet does not support lossless transport, but the DCB extensions to Ethernet along with proper buffer management enable an Ethernet network to provide the level of class of service (CoS) necessary to transport FC frames encapsulated in Ethernet over an Ethernet network.

This section describes these factors in creating lossless transport over Ethernet:

PFC

PFC is a link-level flow control mechanism similar to Ethernet PAUSE (described in IEEE 802.3x). Ethernet PAUSE stops all traffic on a link for a period of time. PFC enables you to divide traffic on a link into eight priorities and stop the traffic of a selected priority without stopping the traffic assigned to other priorities on the link.

Pausing the traffic of a selected priority enables you to provide lossless transport for traffic assigned that priority and at the same time use standard lossy Ethernet transport for the rest of the link traffic.

Buffer Management

Buffer management is critical to the proper functioning of PFC, because if buffers are allowed to overflow, frames are dropped and transport is not lossless.

For each lossless flow priority, the switch requires sufficient buffer space to:

- Store frames sent during the time it takes to send the PFC pause frame across the cable between devices.
- Store the frames that are already on the wire when the sender receives the PFC pause frame.

The propagation delay due to cable length and speed, as well as processing speed, determines the amount of buffer space needed to prevent frame loss due to congestion.

The switch automatically sets the threshold for sending PFC pause frames to accommodate delay from cables as long as 150 meters (492 feet) and to accommodate large frames that might be on the wire when the switch sends the pause frame. This ensures that the switch sends pause frames early enough to allow the sender to stop transmitting before the receive buffers on the switch overflow.

Physical Interfaces

The switch supports 10-Gbps, full-duplex interfaces. The switch enables DCB capability only on 10-Gbps (or faster) Ethernet interfaces.

ETS

PFC divides traffic into up to eight separate streams (priorities, configured on the switch as forwarding classes) on a physical link. ETS enables you to manage the link bandwidth by:

- Grouping the priorities into priority groups (configured on the switch as forwarding class sets).
- Specifying the bandwidth available to each of the priority groups as a percentage of the total available link bandwidth.
- Allocating the bandwidth to the individual priorities in the priority group.

The available link bandwidth is the bandwidth remaining after servicing strict priority flows.

Managing link bandwidth with ETS provides several advantages:

- There is uniform management of all types of traffic on the link, both congestion-managed traffic and standard Ethernet traffic.
- When a priority group does not use all of its allocated bandwidth, other priority groups on the link can use that bandwidth as needed.

  When a priority in a priority group does not use all of its allocated bandwidth, other priorities in the group can use that bandwidth.

  The result is better bandwidth utilization, because priorities that consist of bursty traffic can share bandwidth during periods of low traffic transmission instead of consuming their entire bandwidth allocation when traffic loads are light.
- You can assign traffic types with different service needs to different priorities so that each traffic type receives appropriate treatment.
- Strict priority traffic retains its allocated bandwidth.

DCBX

DCB devices use DCBX to exchange configuration information with directly connected peers (switches and endpoints such as servers). DCBX is an extension of LLDP. If you disable LLDP on an interface, that interface cannot run DCBX. If you attempt to enable DCBX on an interface on which LLDP is disabled, the configuration commit fails.

DCBX can:

- Discover the DCB capabilities of peers.
- Detect DCB feature misconfiguration or mismatches between peers.
- Configure DCB features on peers.

You can configure DCBX operation for PFC, ETS, and for Layer 2 and Layer 4 applications such as FCoE and iSCSI. DCBX is enabled or disabled on a per-interface basis.

Related Documentation

- Overview of Fibre Channel on the QFX Series on page 4786
- Understanding FCoE on page 4799
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding DCBX on page 4905
- Understanding Fibre Channel Terminology on page 4895
- Example: Configuring CoS PFC for FCoE Traffic on page 4921

Understanding FCoE

Fibre Channel over Ethernet (FCoE) is a method of supporting converged Fibre Channel (FC) and Ethernet traffic on a data center bridging (DCB) network. FCoE encapsulates unmodified FC frames in Ethernet to transport the FC frames over a physical Ethernet network. The T11 Technical Committee, which is the International Committee for Information Technology Standards (INCITS) committee responsible for FC interfaces, developed the FCoE standard to provide a method for transporting FC frames over a DCB network. The T11 document *Fibre Channel Backbone - 5 (FC-BB-5) Rev 2.00* at http://www.t11.org/ftp/t11/pub/fc/bb-5/09-056v5.pdf provides details about the FCoE version 1 standard.

NOTE: The switch does not support T11 Annex F *FCoE Pre-FIP Virtual Link Instantiation Protocol*.

To the Ethernet network, an FCoE frame is the same as any other Ethernet frame because the Ethernet encapsulation provides the header information needed to forward the frames. However, to achieve the lossless behavior that FC transport requires, the Ethernet network must conform to DCB standards.

DCB standards create an environment over which FCoE can transport native FC traffic encapsulated in Ethernet while preserving the mandatory class of service (CoS) and other characteristics that FC traffic requires.

Supporting FCoE in a DCB network requires that the FCoE devices in the Ethernet network and the FC switches at the edge of the SAN network handle both Ethernet and native FC traffic. To handle Ethernet traffic, an FC switch does one of two things:

- Incorporates FCoE interfaces.
- Uses an FCoE-FC gateway such as a QFX Series to de-encapsulate FCoE traffic from FCoE devices into native FC and to encapsulate native FC traffic from the FC switch into FCoE and forward it to FCoE devices through the Ethernet network.

NOTE: QFX3500 and QFX3600 Virtual Chassis switches do not support FCoE .

FCoE concepts include:

- FCoE Devices on page 4800
- FCoE Frames on page 4801
- Virtual Links on page 4802
- FCoE VLANs on page 4802

FCoE Devices

Each FCoE device has a converged network adapter (CNA) that combines the functions of an FC host bus adapter (HBA) and a lossless Ethernet network interface card (NIC) with 10-Gbps Ethernet ports. The portion of the CNA that handles FCoE traffic is called an FCoE Node (ENode). An ENode combines FCoE termination functions and the client part of the FC stack on the CNA.

ENodes present virtual FC interfaces to FC switches in the form of virtual N_Ports (VN_Ports). A VN_Port is an endpoint in a virtual point-to-point connection called a virtual link. The other endpoint of the virtual link is an FC switch (or FCF) port. A VN_Port emulates a native FC N_Port and performs similar functions: handling the creation, detection, and flow of messages to and from the FC switch. A single ENode can host multiple VN_Ports. Each VN_Port has a separate, unique virtual link with a FC switch.

ENodes contain at least one lossless Ethernet media access controller (MAC). Each Ethernet MAC is paired with an FCoE controller. The lossless Ethernet MAC is a full-duplex Ethernet MAC that implements Ethernet extensions to avoid frame loss due to congestion and supports frames of at least 2500 bytes. The FCoE controller instantiates and terminates VN_Port instances dynamically as they are needed for FCoE sessions. Each VN_Port instance has a unique virtual link to an FC switch.

NOTE: **A *session* is a fabric login (FLOGI) or fabric discovery (FDISC) login to the FC SAN fabric. Session does not refer to end-to-end server-to-storage sessions.**

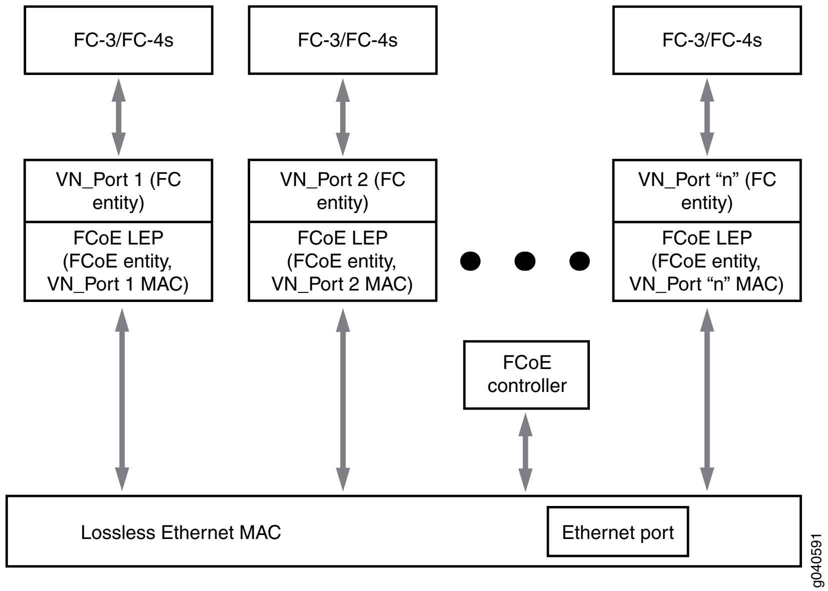
ENodes also contain one FCoE link end point (LEP) for each VN_Port connection. An FCoE LEP is a virtual FC interface mapped onto the physical Ethernet interface.

An FCoE LEP:

- Transmits and receives FCoE frames on the virtual link.
- Handles FC frame encapsulation for traffic going from the server to the FC switch.
- Performs frame de-encapsulation of traffic received from the FC switch.

Figure 170 on page 4801 shows a block diagram of the major ENode components.

Figure 170: ENode Components



FCoE Frames

The FCoE protocol specification replaces the FC0 and FC1 layers of the FC stack with Ethernet, but retains the FC frame header. Retaining the FC frame header enables the FC frame to pass directly to a native FC SAN after de-encapsulation. The FCoE header carries the FC start of file (SOF) bits and end of file (EOF) bits in an encoded format. FCoE supports two frame types, control frames and data frames. FCoE Initialization Protocol (FIP) carries all of the discovery and fabric login frames.

FIP control frames handle FCoE device discovery, initializing communication, and maintaining communication. They do not carry a data payload. FIP has its own EtherType (0x8914) to distinguish FIP traffic from FCoE traffic and other Ethernet traffic. To establish communication, the ENode uses the globally unique MAC address assigned to it by the CNA manufacturer.

After FIP establishes a connection between FCoE devices, the FCoE data frames handle the transport of the FC frames encapsulated in Ethernet. FCoE also has its own EtherType (0x8906) to distinguish FCoE frames from other Ethernet traffic and ensure the in-order frame handling that FC requires. FCoE frames include:

- 2112 bytes FC payload
- 24 bytes FC header
- 14 bytes standard Ethernet header
- 14 bytes FCoE header
- 8 bytes cyclic redundancy check (CRC) plus EOF
- 4 bytes VLAN header
- 4 bytes frame check sequence (FCS)

The payload, headers, and checks add up to 2180 bytes. Therefore, interfaces that carry FCoE traffic should have a configured maximum transmission unit (MTU) of 2180 or larger. An MTU size of 2180 bytes is the minimum size; some network administrators prefer an MTU of 2240 or 2500 bytes.

Virtual Links

Native FC uses point-to-point physical links between FC devices. In FCoE, virtual links replace the physical links. A virtual link emulates a point-to-point link between two FCoE device endpoints, such as a server VN_Port and an FC switch (or FCF) VF_Port.

Each FCoE interface can support multiple virtual links. The MAC addresses of the FCoE endpoints (the VN_Port and the VF_Port) uniquely identify each virtual link and allow traffic for multiple virtual links to share the same physical link while maintaining data separation and security.

A virtual link exists in one FCoE VLAN and cannot belong to more than one VLAN. Although the FC switch and the FCoE device detect a virtual link as a point-to-point connection, virtual links do not need to be direct connections between a VF_Port and a VN_Port. A virtual link can traverse one or more transit switches, also known as passthrough switches. A transit switch can transparently aggregate virtual links while still appearing and functioning as a point-to-point connection to the FCoE devices. However, a virtual link must remain within a single Layer 2 domain.

FCoE VLANs

On the QFX Series, all FCoE traffic must travel in a VLAN dedicated to transporting only FCoE traffic. Only FCoE interfaces should be members of an FCoE VLAN. Ethernet traffic that is not FCoE or FIP traffic must travel in a different VLAN.

NOTE: **On a QFX3500 or QFabric system Node device, the same VLAN cannot be used in both transit switch mode and FCoE-FC gateway mode.**

NOTE: **FCoE VLANs (any VLAN that carries FCoE traffic) support only Spanning Tree Protocol (STP) and link aggregation group (LAG) Layer 2 features. IGMP snooping is enabled by default on all VLANs; be sure to disable IGMP snooping on FCoE VLANs.**

You can configure more than one FCoE VLAN, but any given virtual link must be in only one FCoE VLAN.

NOTE: All 10-Gigabit Ethernet interfaces that connect to FCoE devices must have a native VLAN configured in order to transport FIP traffic, because FIP VLAN discovery and notification frames are exchanged as untagged packets.

On QFX5100 switches that use the Enhanced Layer 2 Software (ELS) CLI, it is not sufficient only to configure the native VLAN on the interface, the interface must also be configured as a member of the native VLAN. (This is because the ELS CLI does not support tagged-access interface mode, so interfaces that are members of FCoE VLANs must use trunk mode, and trunk port interfaces must be explicitly included as members of a native VLAN.)

In addition, the VLAN ID must match the native VLAN ID that you configure on the physical interface. For example, to configure a native VLAN with an ID of 20 on interface xe-0/0/15 that is a member of an FCoE VLAN, you must include both of the following statements in the configuration:

1. Configure the native VLAN on the interface:

   `user@switch#` **set interfaces xe-0/0/15 native-vlan-id 20**

   (The equivalent configuration statement on a non-ELS device such as a QFX3500 or QFX3600 switch would be **set interfaces xe-0/0/15 unit 0 family ethernet-switching native-vlan-id 20**.)

2. Configure the port as a member of the native VLAN (this step is not required on QFX3500 and QFX3600 switches):

   `user@switch#` **set interfaces xe-0/0/15 unit 0 family ethernet-switching vlan members 20**

BEST PRACTICE: Only FCoE traffic is permitted on the FCoE VLAN. A native VLAN might need to carry untagged traffic of different types and protocols. Therefore, it is a good practice to keep the native VLAN separate from FCoE VLANs.

Related Documentation

- Overview of Fibre Channel on the QFX Series on page 4786
- Understanding Fibre Channel on page 4792
- Understanding DCB Features and Requirements on page 4795
- Understanding FCoE Transit Switch Functionality on page 4804
- Understanding VN_Port to VF_Port FIP Snooping on an FCoE Transit Switch on page 4858
- Understanding Fibre Channel Terminology on page 4895
- Configuring VLAN Interfaces for FCoE Traffic on an FCoE Transit Switch on page 5066
- Example: Configuring CoS PFC for FCoE Traffic on page 4921

Understanding FCoE Transit Switch Functionality

You can use the QFX Series as a Fibre Channel over Ethernet (FCoE) transit switch. An FCoE transit switch is a Layer 2 data center bridging (DCB) switch that can transport FCoE frames and implements FCoE Initialization Protocol (FIP) snooping. A DCB switch transports both FCoE and Ethernet LAN traffic over the same network infrastructure while preserving the class of service (CoS) that Fibre Channel (FC) traffic requires.

An FCoE transit switch does not encapsulate or de-encapsulate FC frames in Ethernet. It is an access switch that transports FC frames that have already been encapsulated in Ethernet between FCoE initiators such as servers and a storage area network (SAN) FC switch that supports both Ethernet and native FC traffic on its interfaces. The transit switch acts as a passthrough switch and is transparent to the FC switch, which detects each connection to an FCoE device as a direct point-to-point link.

When a QFX Series acts as a transit switch, the VLANs you configure for FCoE traffic can use any of the switch ports on the QFX Series or QFabric system Node device because the traffic in both directions is standard Ethernet traffic, not native FC traffic.

NOTE: The Ethernet interfaces that connect to FCoE devices must include a native VLAN to transport FIP traffic, because FIP VLAN discovery and notification frames are exchanged as untagged packets. It is a good practice to keep the native VLAN separate from the VLANs that carry FCoE traffic. FCoE VLANs should carry only FCoE traffic, but other types of untagged traffic might use the native VLAN.

QFX3500 and QFX3600 switches and QFabric system Node devices only require that you configure the native VLAN on the FCoE interfaces that belong to the FCoE VLAN by including the [**set interfaces** ***interface-name*** **unit** ***unit*** **family ethernet-switching native-vlan-id** ***native-vlan-id***] statement in the configuration.

QFX5100 switches require that you include two statements in the configuration to configure a native VLAN on FCoE interfaces. Include the [**set interfaces** ***interface-name*** **native-vlan-id** ***vlan-id***] statement in the configuration to configure the native VLAN on the interface, and also include the [**set interfaces** ***interface-name*** **unit** ***unit*** **family ethernet-switching native-vlan-id** ***vlan-id***] statement in the configuration to configure the port as a member of the native VLAN.

FCoE traffic should use a VLAN dedicated only to FCoE traffic. Do not mix FCoE traffic with standard Ethernet traffic on a VLAN on the switch.

NOTE: FCoE VLANs (any VLAN that carries FCoE traffic) support only Spanning Tree Protocol (STP) and link aggregation group (LAG) Layer 2 features. IGMP snooping is enabled by default on all VLANs; be sure to disable IGMP snooping on FCoE VLANs.

NOTE: **On a QFX3500 switch or on a QFabric system Node device, the same VLAN cannot be used in both transit switch mode and FCoE-FC gateway mode. If you configure both a transit switch and an FCoE-FC gateway on the same QFX3500 switch or QFabric system Node device, configure different FCoE VLANs for the transit switch and the FCoE-FC gateway.**

Transit switch architecture differs from FCoE-FC gateway architecture. As an FCoE-FC gateway, the system transports traffic to the FC SAN as native FC frames, and the VLAN must use an FCoE VLAN interface and native FC interfaces to transport that traffic. As a transit switch, the system forwards Ethernet traffic, and requires DCB configuration for lossless transport of that traffic and FIP snooping at FCoE device access ports, but not the FCoE-FC gateway features necessary for transporting FC traffic.

The QFX Series complies with DCB standards for ensuring lossless transport and low latency, and provides 10-Gbps ports for FCoE traffic. For lossless transport to function correctly, you must use priority-based flow control (PFC, described in IEEE 802.1Qbb) to create bandwidth reservations and ensure proper CoS for FCoE traffic.

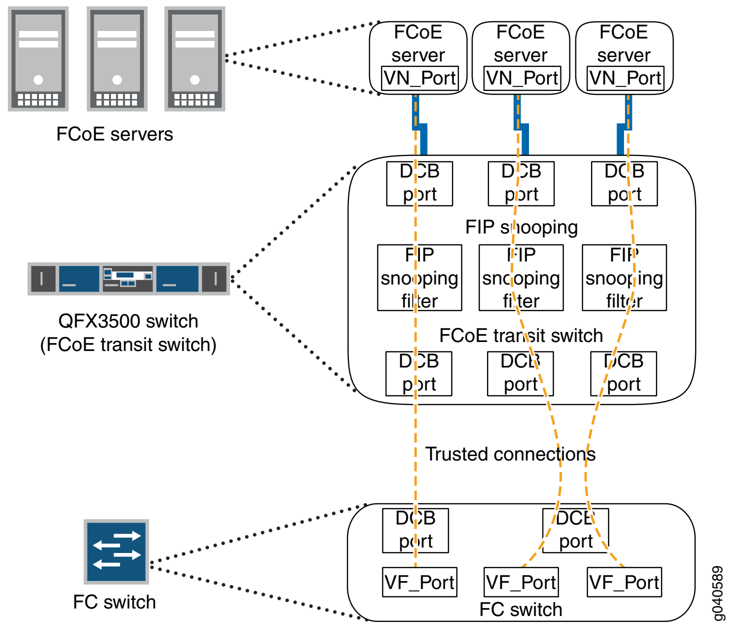
FIP snooping adds security by filtering access so that only traffic from servers that have successfully logged in to the FC network passes through the transit switch and reaches the FC network. The Technical Committee T11 organization specifications describe two types of FIP snooping:

- The FC-BB-5 specification describes VN_Port to VF_Port (VN2VF_Port) FIP snooping, which provides security for communication between FCoE device VN_Ports on the Ethernet network and FCF or FC switch VF_Ports.
- The FC-BB-6 specification describes VN_Port to VN_Port (VN2VN_Port) FIP snooping, which provides security for communication between FCoE device VN_Ports on the Ethernet network.

To accommodate the larger size of Ethernet-encapsulated frames, FCoE interfaces should be configured with a maximum transmission unit (MTU) size of at least 2180 bytes.

The transit switch transparently connects FCoE-capable devices such as servers in an Ethernet LAN to an FC switch or to a gateway switch (hereafter referred to as the FC switch), as shown in Figure 171 on page 4806. The transit switch acts as a transparent DCB access layer between FCoE servers and the FC switch.

Figure 171: FCoE Transit Switch Connecting FCoE Devices to an FC Switch



The transit switch performs FIP snooping at the ports connected to the FCoE devices. For VN2VF_Port FIP snooping, at the SAN edge, the FC switch must be able to convert the FCoE traffic to native FC traffic. (VN2VN_Port FIP snooping switches traffic between VN_Ports directly through the transit switch, without going through the FC switch, so no conversion of FCoE traffic to native FC traffic is needed.)

Encapsulated FCoE traffic flows through the transit switch to the FCoE ports on the FC switch. The FC switch removes the Ethernet encapsulation from the FCoE frames to restore the native FC frames. Native FC traffic travels out native FC ports to storage devices in the FC SAN.

Native FC traffic from storage devices flows to the FC switch FC ports, and the FC switch encapsulates that traffic in Ethernet as FCoE traffic. The FCoE traffic flows through the transit switch to the appropriate FCoE device.

NOTE: The FC switch and FC fabric apply appropriate zoning checks on traffic to and from each ENode and provide FC services (for example, name server, fabric login server, or event server).

NOTE: The QFX3500 switch supports VN_Port to VN_Port FIP snooping to allow FCoE initiators and targets to communicate directly through the switch without going through an FCoE forwarder (FCF) or an FC switch. An FCoE VLAN can support either VN2VF_Port FIP snooping (FC-BB-5) or VN2VN_Port FIP snooping (FC-BB-6), but not both. The same QFX3500 switch can have multiple FCoE VLANs configured, some FCoE VLANs for VN2VF FIP snooping traffic and others for VN2VN FIP snooping traffic.

For load balancing, increasing available bandwidth, and port failover protection, you can configure the 10-Gigabit Ethernet interfaces that belong to an FCoE VLAN as a link aggregation group (LAG). In addition, creating a LAG prevents spanning tree algorithms from blocking physical links and wasting bandwidth.

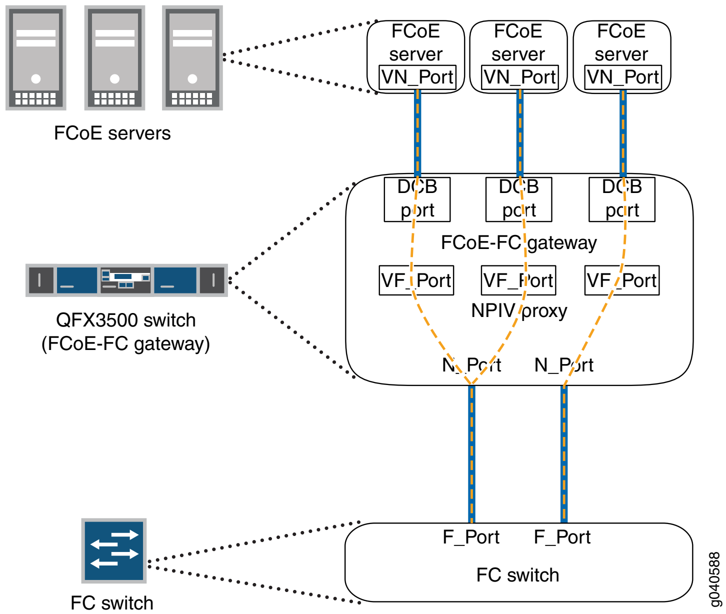
Related Documentation

- Overview of Fibre Channel on the QFX Series on page 4786
- Understanding DCB Features and Requirements on page 4795
- Understanding an FCoE-FC Gateway on page 4808
- Understanding FCoE on page 4799
- Understanding VN_Port to VF_Port FIP Snooping on an FCoE Transit Switch on page 4858
- Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch on page 4865
- Understanding Fibre Channel Terminology on page 4895
- Configuring VLAN Interfaces for FCoE Traffic on an FCoE Transit Switch on page 5066

Understanding an FCoE-FC Gateway

A Fibre Channel over Ethernet (FCoE)-Fibre Channel (FC) gateway connects FCoE devices on an Ethernet network to an FC switch in an FC storage area network (SAN) as shown in Figure 172 on page 4808. To FCoE devices such as servers, the FCoE-FC gateway presents virtual fabric ports (VF_Ports) and appears to be an FCoE forwarder (FCF). To the FC switch, the FCoE-FC gateway presents a proxy node port (NP_Port) and appears to be an FC device.

Figure 172: FCoE-FC Gateway Topology



The FCoE-FC gateway handles FCoE Initialization Protocol (FIP) and FCoE traffic on the interfaces connected to FCoE devices. The gateway forwards native FC traffic on the interfaces to the FC switch. The gateway does not provide FC services (such as fabric login server or name server). It is a proxy for an FCF, not an FCF or an FC switch. The gateway transparently substitutes for the FC switch when communicating with FCoE devices and transparently substitutes for FCoE devices when communicating with the FC switch.

The gateway does not use an FC domain ID, so it extends the SAN fabric while saving domain resources. Using the gateway also means that the FC switch does not have to handle FCoE traffic (and therefore requires no FCoE blades or ports). The gateway converges Ethernet and FC backbones to leverage existing resources.

- Gateway FC Fabric on page 4809
- Fabric Services on page 4810
- FCoE-FC Gateway Traffic Switching on page 4810

Gateway FC Fabric

A gateway FC fabric is a QFX Series configuration construct. It is not the same thing as an FC fabric in the SAN; the gateway FC fabric is local to the switch. It creates associations that connect FCoE devices with converged network adapters (CNAs) on the Ethernet network to an FC switch on the Fibre Channel network. A gateway FC fabric consists of:

- A unique fabric name.
- A unique fabric ID.
- At least one dedicated VLAN for FCoE traffic. VLANs that carry FCoE traffic should not carry any other type of traffic.

  NOTE: **On a QFX3500 or QFabric system Node device, the same VLAN cannot be used in both transit switch mode and FCoE-FC gateway mode.**

- At least one FCoE VLAN interface (Layer 3 VLAN interface) that includes one or more 10-Gigabit Ethernet interfaces connected to FCoE devices. The FCoE VLANs transport traffic between the FCoE servers and the FCoE-FC gateway. Each FCoE VLAN must carry only FCoE traffic. You cannot mix FCoE traffic and standard Ethernet traffic on the same VLAN.

  The 10-Gigabit Ethernet interfaces that connect to FCoE devices must include a native VLAN to transport FIP traffic because FIP VLAN discovery and notification frames are exchanged as untagged packets.

  Each FCoE VLAN interface can present multiple VF_Port interfaces to the FCoE network.

  NOTE: **Storm control must be disabled on all Ethernet interfaces that belong to the FCoE VLAN to prevent FCoE traffic from being dropped.**

- One or more native FC interfaces. The native FC interfaces transport traffic between the gateway and the FC switch.

  TIP: **If the network does not use a dual-rail architecture for redundancy, configure more than one native FC interface for each FC fabric to create redundant connections between the FCoE devices and the FC switch. If one physical link goes down, any sessions it carried can log in again and connect to the FC switch on a different interface. Even in dual-rail architecture networks, creating redundant connections between the QFabric system and the FC switch is the best practice.**

You can also configure FIP parameters for the fabric or accept the default FIP parameters. VN_Port to VF_Port (VN2VF_Port) FIP snooping is automatically enabled on all server-facing ports because all ports are untrusted by default. You can disable VN2VF_Port FIP snooping on a port-by-port basis by marking a port as an FCoE trusted interface. You can disable VN2VF_Port FIP snooping on all Ethernet ports in an FC fabric by configuring the fabric as FCoE trusted.

Because the switch has 12 native FC ports and each FC fabric requires a minimum of one native FC port, the switch supports a maximum of 12 FC fabrics. However, as a best practice for redundancy, we recommend that you assign at least two native FC interfaces to each FC fabric.

On a QFabric system, all of the FC and FCoE traffic that belongs to a particular gateway FC fabric must ingress and egress the same gateway Node device. Gateway FC fabrics do not span across Node devices. All of the native FC interfaces and the Ethernet interfaces that belong to the FCoE VLAN must reside on the same gateway Node device to be included in an FC fabric on that Node device.

Traffic from FC and FCoE devices that are not in the same FC fabric remain separate and cannot communicate with each other through the gateway.

Fabric Services

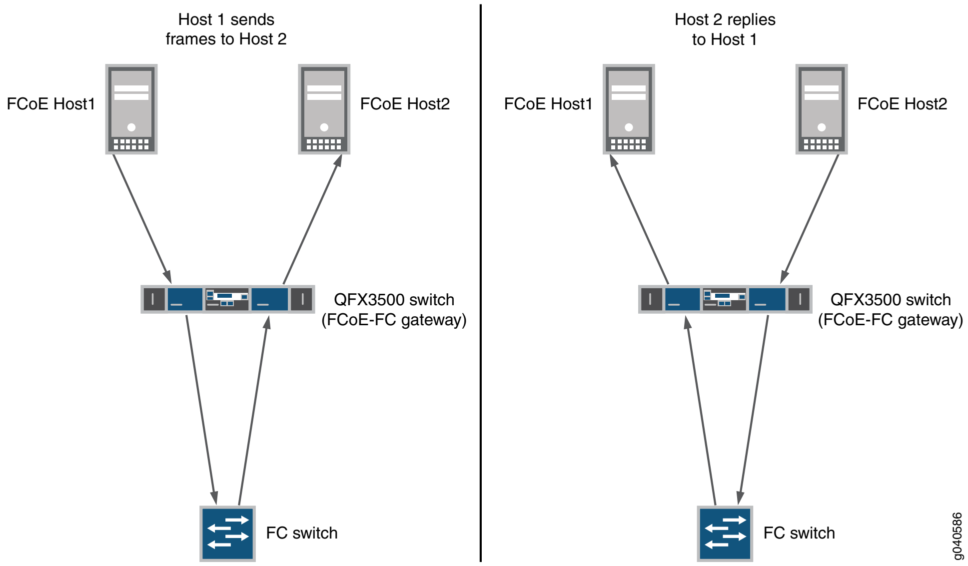
The FC switch provides all FC services (domain manager, name server, fabric login server, and so on) except FIP to the FCoE devices. The FC switch assigns all FCIDs (through N_Port ID virtualization) and fabric attributes to FCoE device VN_Ports.

The FCoE-FC gateway does not provide FC services (except FIP). The gateway relays communication between the FC switch and the FCoE devices, encapsulates and de-encapsulates native FC frames, converges Ethernet and FC backbones, and aggregates FCoE device VN_Port sessions.

FCoE-FC Gateway Traffic Switching

All traffic that flows through the gateway FC fabric is switched through the FC switch. Even if two hosts on the Ethernet FCoE network connect directly to the gateway, FCoE communication between them goes through the FC switch, as shown in Figure 173 on page 4811.

Figure 173: Traffic Switching Between FCoE Hosts Connected to the FC Network by an FCoE-FC Gateway



For example, FCoE host server *Host1* sends frames destined for FCoE host server *Host2*. Both *Host1* and *Host2* are directly connected to the gateway. The communication path looks like this:

1. *Host1* sends FCoE frames destined for *Host2* to the gateway .
2. The gateway de-encapsulates the FCoE frames from *Host1* into native FC frames and switches them to the FC switch.
3. The FC switch processes the native FC frames and sends them back to the gateway destined for *Host2*.
4. The gateway encapsulates the FC frames in Ethernet and sends the resulting FCoE frames to *Host2*.
5. When *Host2* replies, the FCoE reply goes to the gateway. The gateway de-encapsulates the reply and switches it to the FC switch for processing. The FC switch then sends it back to the gateway, which encapsulates the FC frames and sends them to *Host1*.

Related Documentation

- Overview of Fibre Channel on the QFX Series on page 4786
- Understanding Fibre Channel on page 4792
- Understanding FCoE-FC Gateway Functions on page 4812
- Overview of FIP on page 4790
- Understanding Interfaces on an FCoE-FC Gateway on page 4829
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Disabling Storm Control on FCoE Interfaces on an FCoE-FC Gateway on page 5056

- Understanding Fibre Channel Terminology on page 4895

Understanding FCoE-FC Gateway Functions

When it functions as a Fibre Channel over Ethernet (FCoE)-Fibre Channel (FC) gateway, the QFX Series provides the following functions:

Login and Logout

Each of the native FC interfaces on the gateway performs a fabric login (FLOGI) to the FC switch when each interface initializes. This establishes the link between each gateway FC interface and the FC switch.

When FCoE devices on the Ethernet network send an FCoE Initialization Protocol (FIP) login (FIP FLOGI) or FIP discovery (FIP FDISC) request to the gateway, the gateway acts on behalf of those devices and converts their FIP FLOGI and FIP FDISC requests to FC FDISC requests. The gateway then sends the FC FDISC requests to the FC switch. When the FC switch responds to an FDISC request, the gateway converts the FC response into a FIP response and sends it to the appropriate FCoE device.

The gateway also converts FIP logout (LOGO) requests from FCoE devices into FC LOGO requests to the FC switch, and converts the FC switch response into a FIP response for the FCoE device.

FCoE and FC Frame Handling

When it receives FCoE frames from FCoE devices, the gateway strips away the Ethernet encapsulation from the FC frame before sending the native FC frame to the FC switch.

When it receives native FC frames from the FC switch, the gateway encapsulates the native FC frames in Ethernet before sending the resulting FCoE frames to the appropriate VN_Port.

Data Center Bridging

The Ethernet ports connected to the FCoE devices are 10-Gbps Ethernet ports and support data center bridging (DCB) specifications:

- Priority-based flow control (PFC, described in IEEE 802.1Qbb)
- Data Center Bridging Capability Exchange protocol (DCBX), which is an extension of Link Layer Data Protocol (LLDP, described in IEEE 802.1AB)
- Enhanced transmission selection (ETS, described in IEEE 802.1Qaz)
- 10-Gigabit Ethernet ports

Disabling the Fabric WWN Verification Check

The gateway connects to a SAN fabric using the gateway NP_Ports (native FC ports). When the NP_Ports initialize, each port sends a FLOGI to the FC switch to which it is connected in the SAN fabric. The FC switch sends a FLOGI accept (FLOGI-ACC) message back to each NP_Port. The FLOGI-ACC message includes the SAN fabric worldwide name (WWN). The gateway uses the SAN fabric WWN in the multicast discovery advertisement (MDA) that the gateway sends to the ENodes in the FCoE network.

Some FC switches substitute their own WWN (often the FC switch's virtual WWN) for the SAN fabric WWN in the FLOGI-ACC message. When the FC switch substitutes its own WWN for the fabric WWN, gateway NP_Ports that log in to the same SAN fabric might receive different fabric WWNs in the FLOGI-ACC messages if the NP_Ports are connected to different FC switches in that SAN fabric. This creates a problem, because different fabric WWNs indicate different SAN fabrics. But in this scenario, the different fabric WWNs come from different FC switches in the same SAN fabric.

If the gateway receives different fabric WWNs on NP_Ports that are connected to the same SAN fabric, the gateway uses the first fabric WWN it receives in the MDA it sends to the ENodes. The gateway isolates the NP_Ports connected to that fabric that receive a different fabric WWN in the FLOGI-ACC message. No ENode sessions are assigned to the isolated NP_Ports. FC traffic is assigned only to NP_Ports that receive a fabric WWN that matches the fabric WWN received by the first NP_Port to log in to the FC fabric. (If an NP_Port receives a fabric WWN that does not match the fabric WWN received by the first NP_Port to log in to the FC fabric, it does not carry traffic to the SAN fabric.)

In summary, the scenario is:

1. The gateway has multiple NP_Ports connected to more than one FC switch in a SAN fabric.
2. When the NP_Ports initialize, each NP_Port sends a FLOGI to the FC switch to which it is connected.
3. The FC switches substitute their own WWNs for the fabric WWN in the FLOGI-ACC message, so different NP_Ports receive different fabric WWNs.
4. In the MDA the gateway sends to FCoE devices, the gateway uses the fabric WWN that the first NP_Port to log in to the fabric receives in the FLOGI-ACC message. If other NP_Ports receive a different fabric WWN from other FC switches in the SAN fabric, that fabric WWN is not advertised.
5. NP_Ports that receive a fabric WWN that does not match the first received fabric WWN are isolated, and the ENode sessions cannot use those ports.

To prevent this from happening, you can disable the gateway fabric WWN verification check so that all NP_Ports connected to a SAN fabric are used to carry traffic between the gateway and the FC switch, regardless of the fabric WWN the NP_Port receives in the FLOGI-ACC message.

NOTE: Disabling or enabling the fabric WWN verification check logs out all FCoE sessions.

Load Balancing

The switch performs automatic link load balancing for the connections between the gateway and the FC SAN and can also perform load balancing for the connections between the gateway and the FCoE devices in the Ethernet network. On the native FC links (NP_Ports) between the gateway and the FC SAN, the gateway can use one of the following three load-balancing algorithms:

- Simple load balancing—The switch assigns each ENode FLOGI session and VN_Port FDISC session to the least-loaded link. The switch can place FDISC sessions on a different link than the parent FLOGI session (an ENode FLOGI session and its subsequent FDISC sessions can be placed on different links). Simple load balancing is the default load-balancing algorithm. Rebalancing the link load disrupts only selected sessions to minimize the impact (the switch uses an algorithm to log out only the sessions that need to be moved to other links to balance the load when those sessions log in again).
- ENode-based load balancing—When an ENode logs in to the fabric, the switch places all subsequent VN_Port FDISC sessions associated with that ENode on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link. The switch calculates the link load based on the combined total of FLOGIs and FDISCs on each NP_Port link. Rebalancing the link load disrupts all sessions (all sessions log out and then log in again).
- FLOGI-based load balancing—Similar to ENode-based load balancing; when an ENode logs in to the fabric, the switch places all subsequent VN_Port FDISC sessions associated with that ENode on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link.

NOTE: Changing the load-balancing algorithm when FCoE sessions are running forces the FCoE sessions to log out, then log in again.

You can balance the load on the Ethernet ports facing the FCoE devices by configuring those ports as a link aggregation group (LAG).

Related Documentation

- Understanding Fibre Channel on page 4792
- Understanding an FCoE-FC Gateway on page 4808
- Understanding DCB Features and Requirements on page 4795
- Understanding Load Balancing in an FCoE-FC Gateway Proxy Fabric on page 4841
- Understanding Interfaces on an FCoE-FC Gateway on page 4829
- Disabling the Fabric WWN Verification Check on page 5047
- Monitoring Fibre Channel Interface Load Balancing on page 5147

Understanding FCoE and FIP Session High Availability

The QFX Series provides high availability features to maintain storage network sessions when a system process is terminated and during certain types of upgrades:

High Availability for Fibre Channel Process Termination (FCoE-FC Gateway Mode)

In FCoE-FC gateway mode, the QFX3500 switch provides high availability to restore the FCoE sessions running on the switch in case the Fibre Channel (FC) process is terminated. A session is a fabric login (FLOGI) or fabric discovery (FDISC) login to the FC SAN fabric, not an end-to-end server-to-storage session.

The switch stores FCoE session data in a persistent storage module. If the FC process terminates, the switch restores the existing FCoE sessions on the same interfaces that they were on before the FC process terminated. Data traffic for existing sessions is not affected during session restoration.

For a brief time, the system does not process control traffic because of the FC process restart and session restoration. During this brief time, no new FCoE sessions can be established, and no existing sessions can log out.

NOTE: During the restoration process, if the FC process does not receive an *interface up* notification from a particular interface within a certain time, the switch times out the restore operation and discards the data on that interface. The previously existing FCoE sessions on that interface are not restored, and the ENodes must log in again.

NOTE: An FC process restart and session restoration resets the Fibre Channel statistics.

If the FC process terminates repeatedly, the operating system disables the process until you manually restart it. To restart the FC process manually, issue the **restart fibre-channel** command.

High Availability for FIP Snooping

You can configure the system to perform FIP snooping on Ethernet interfaces that are connected to FCoE devices that have ENodes. The QFX Series provides high availability to restore running FIP snooping sessions in case the Ethernet switching process is terminated.

The Ethernet switching process stores the FIP snooping state in a persistent storage module. If the Ethernet switching process terminates, the QFX Series restores the existing FIP snooping sessions on the same interfaces that they were on before the Ethernet switching process terminated. The high availability features preserve:

- Logged in ENodes
- Discovered FCFs
- Existing sessions
- Existing FIP snooping filters

The complete restoration process, including reconciling all valid states, takes a maximum of 8 seconds. During the restoration process, the switch can learn a new FCF or a new FC switch, and new ENodes can log in to the FC network. However, FDISC messages from an ENode that is already logged in to the network might be dropped if the ENode has not yet been restored.

When the Ethernet switching process terminates ungracefully, the FIP keepalive timer is reset to the normal initial value, not the value at the time of the Ethernet switching process termination.

In the event of an Ethernet switching process termination, ENodes remain logged in, and existing sessions are not interrupted.

NOTE: An Ethernet switching process restart and session restoration resets the FIP snooping statistics.

Nonstop Software Upgrade (QFabric Systems)

On QFabric system Node groups that have more than one Node device, nonstop software upgrade (NSSU) enables you to upgrade the Node devices with minimal packet loss and maximum uptime. NSSU automates software upgrades on the QFabric system components in an orderly and consistent manner to maximize system uptime.

The system upgrades components with redundant architectures, such as redundant server Node groups and network Node groups that have two or more members, in stages. While the system upgrades one component, the redundant component continues to function.

For example, while one member of a redundant server Node group is upgraded, the other member continues to forward traffic. When the first Node group member completes the upgrade, it comes online while the system upgrades the second member.

NSSU provides high availability for the lossless traffic forwarding required to support storage networks. If your system design includes redundancy (redundant Node devices in Node groups, LAGs, and so on) so that an alternate traffic path is available, when you upgrade a Node device, traffic is not impacted.

In fully redundant topologies, NSSU preserves FIP session, FIP snooping filter, VN2VF_Port session, and VN2VN_Port session information and prevents traffic loss in most cases. An exception is that Node devices that are directly connected to ENodes experience momentary traffic loss when the Node device reboots.

Related Documentation

- Understanding an FCoE-FC Gateway on page 4808
- Understanding FCoE on page 4799
- *Understanding Nonstop Software Upgrade for QFabric Systems*
- *Performing a Nonstop Software Upgrade on the QFabric System*

Understanding FIP Functions

Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) performs four major functions:

- FIP VLAN discovery: FCoE device FCoE nodes (ENodes) discover the FCoE VLANs on which to transmit and receive FIP and FCoE traffic.
- FIP discovery: FCoE devices discover Fibre Channel (FC) switches to which they can connect.
- Initialization: FCoE devices perform fabric login (FLOGI) and fabric discovery (FDISC) to create a virtual link with an FC switch.
- Maintenance: The QFX Series ensures that the virtual link between the FCoE device and the FC switch remains valid, and also that the link termination logout (LOGO) functions properly.

When you configure the switch as an FCoE-FC gateway, it converts FIP requests and information from FCoE devices into FC requests and information and relays them to the FC switch. To FCoE devices, the gateway appears to be an FCoE forwarder (FCF) and presents virtual fabric port (VF_Port) interfaces to the server ENode. To FC switches, the gateway appears to be an FC device that supports N_Port ID virtualization (NPIV) and presents an N_Port interface to the FC switch F_Port interface. When you configure the QFX Series as an FCoE transit switch, you do not configure FIP parameters on the switch.

FIP FLOGI, FDISC, and LOGO are similar to the same processes in the native FC protocol.

This topic describes:

FIP VLAN Discovery

The gateway supports FIP VLAN discovery. Host ENodes use FIP VLAN discovery to discover the FCoE VLANs on which they will send and receive FIP and FCoE traffic and on which they will establish a virtual link with the FC switch. This means FCoE devices do not need manually configured FCoE VLANs.

FIP VLAN discovery and notification takes place on the native VLAN that the FCoE device uses for Ethernet traffic:

1. The ENode sends a FIP VLAN discovery request to a multicast address called *ALL-FCF-MACs* to which all FC switches and FCFs on the VLAN listen.
2. The FC switches and FCFs respond on the native VLAN with a list of the FCoE VLANs that are available for login.
3. The ENode selects an FCoE VLAN and continues the FIP process on that VLAN.

Except for FIP VLAN discovery, all other FIP and FCoE traffic runs on an FCoE VLAN.

BEST PRACTICE: **Only FCoE traffic is permitted on the FCoE VLAN. A native VLAN might need to carry untagged traffic of different types and protocols. Therefore, it is a good practice to keep the native VLAN separate from FCoE VLANs.**

FIP Discovery

The FIP discovery process allows an FCoE device ENode MAC to locate (discover) the FC switches in the FCoE VLAN to which it belongs. The ENode selects an FC switch to log in to from the available FC switches. Either the ENode MAC or the FC switch can initiate the FIP discovery process.

Server ENode MACs initiate FIP discovery:

1. When an ENode MAC comes online, it sends a multicast discovery solicitation message on its FCoE VLAN to a multicast address called *ALL-FCF-MACs* to which all FCFs (including the FCF functionality of FC switches) on the VLAN listen. The discovery solicitation message includes the ENode's addressing mode and the maximum protocol data unit (PDU) size the ENode MAC uses for FCoE traffic.

   The ENode uses the globally unique ENode MAC address assigned to it by the converged network adapter (CNA) manufacturer as an identifier in the FIP frame header.
2. The FCFs on the VLAN that have a similar supported addressing mode, match the maximum FCoE size, and can accept a login from the ENode reply to the discovery solicitation message by sending a solicited unicast discovery advertisement message to the soliciting ENode MAC.
3. The ENode MAC compiles a list of FCFs that are available for login, selects an FCF (the FCF with the highest priority setting), and is then ready to log in to the FCF.

The FIP discovery process is similar when the FC switch or FCF initiates discovery:

1. FCF MACs periodically send unsolicited multicast discovery advertisements on the FCoE VLAN to the *ALL-ENode-MACs* multicast address, to which all ENode MACs on the VLAN listen. The FIP keepalive advertisement period timer (FKA_ADV_PERIOD) controls the interval between multicast discovery advertisements. The multicast discovery advertisements inform ENodes on the VLAN that FCF VF_Ports are available for establishing virtual links with ENode VN_Ports.
2. ENodes on the FCoE VLAN create an entry for the FCF-MAC in their FCF-MAC lists.
3. An ENode can respond to the unsolicited multicast discovery advertisement with a unicast discovery solicitation message to the FCF.
4. Upon receiving the ENode's unicast discovery solicitation, the FCF replies with a unicast discovery advertisement sent to the ENode MAC.

After the ENode MAC selects an FCF to log in to, FIP initialization begins. To proceed from discovery to initialization, the server ENode addressing mode must match the FCF addressing mode and maximum FCoE size. In addition, the FCF must be configured to allow FIP FLOGI from that ENode.

FIP FLOGI

FIP initialization is the server ENode login process to the FCF after the ENode discovers the FCFs (including FC switches) on the FCoE VLAN:

1. The ENode sends a fabric login (FLOGI) request message to the FCF.
2. The FCF replies to confirm the ENode login and provides the ENode a locally unique MAC address to use for FCoE frame transactions. The locally unique MAC address identifies the VN_Port interface of the ENode for the session the login establishes. (The ENode continues to use the globally unique ENode MAC address for FIP frame transactions.)

The locally unique ENode MAC address for FCoE operations depends on whether the ENode address mode is configured as a fabric-provided MAC address (FPMA) or as a server-provided MAC address (SPMA; the gateway does not support ENodes in SPMA mode and rejects login attempts from ENodes in SPMA mode):

- For FPMA mode, the FCF provides a MAC address to the ENode during the FIP FLOGI exchange. The FPMA MAC address is a 48-bit value that is unique to the local fabric and consists of a 24-bit FCoE mapped address prefix (FC-MAP) and a 24-bit FC identifier (FCID). You can configure the FC-MAP value on the FCF or use the default value of 0EFC00h. The FCoE device must use the same FC-MAP value as the FCF, or else discovery and login fail.
- For SPMA mode, the server provides its MAC address to the FCF. The FCF compares the server MAC address to a list of addresses approved for FCoE access. The gateway does not support ENodes in SPMA mode.

Successful login instantiates a secure virtual link between the ENode and the FCF and terminates the FIP virtual link instantiation phase. The initiating server behind the ENode can exchange FC payloads with storage devices in the FC SAN by sending FCoE frames over the virtual link.

FIP FDISC

After an ENode successfully logs in to an FCF and establishes a virtual link, the ENode can request more virtual links (sessions) over the same physical link by sending a FIP fabric discovery (FDISC) request. FDISC allows the creation of multiple separate secure VN_Port virtual links on one physical link. Each virtual link receives a locally unique identifier from the FCF to enable security and separation between the VN_Port virtual links sharing a physical ENode port. This is called N_Port ID virtualization (NPIV).

FDISC is similar to FLOGI in that it requests a login and a unique ID from the FCF. The difference is that FLOGI obtains the initial login and ID for the physical link, whereas FDISC obtains additional logins and IDs so that multiple virtual links can share one physical link securely.

After a VN_Port FDISC is complete, the application using that VN_Port can send FCoE frames over the virtual link.

FIP Maintenance (Keepalive Messages)

Although FCoE protocol handles the payload communication between the initiating ENode and the target FC device, FIP continues to run in the background. FIP constantly updates ENode FCF lists by listening to the periodic FCF multicast discovery advertisements, and it verifies the ability to reach the FCF by transmitting periodic FIP keepalive advertisements.

The ENode sends periodic ENode FIP keepalive advertisements to the FCF with the ENode MAC address as the identifier. The ENode also sends periodic VN_Port FIP keepalive advertisements on behalf of each VN_Port on the ENode, using the VN_Port MAC address as the source MAC. The VN_Port FIP keepalive advertisements occur every 90 seconds. The keepalive advertisements reset the session timer for the virtual link connection to the FCF. If the FCF does not receive a keepalive advertisement for a logged-in ENode or VN_Port before the session timer expires, the virtual link is terminated.

The periodic unsolicited multicast discovery advertisements the FCF sends to the *ALL-ENode-MACs* address continuously verify that the FCF is still reachable. The ENode and the FCF periodic unsolicited multicast discovery advertisements occur at the configured FIP keepalive advertisement period interval (FKA_ADV_PERIOD) plus or minus a random offset to prevent a flood of simultaneous keepalive advertisements.

If the FCF does not receive the ENode keepalive advertisements before the FCF's FIP keepalive timer expires, the FCF considers the virtual link to the ENode as "down" and terminates the virtual link to the ENode. The keepalive timer expires in 2.5 times the configured timer value. This also terminates any VN_Port virtual links instantiated by that ENode.

If the FCF does not receive a VN_Port keepalive advertisement before the FCF's FIP keepalive timer expires, the FCF considers the virtual link to the VN_Port as "down" and terminates the virtual link to that VN_Port. The VN_Port keepalive timer expires in 2.5 times the configured timer value.

If the ENode does not receive the FCF unsolicited multicast discovery advertisement before the ENode's FIP keepalive timer expires, the ENode considers the virtual link to the FCF as "down" and all of the VN_Port virtual links to that FCF on the ENode are terminated.

FIP LOGO

FIP handles ENode and VN_Port logout when a session is finished.

Related Documentation

- Overview of FIP on page 4790
- Understanding FIP Implementation on page 4821
- Understanding FIP Parameters on an FCoE-FC Gateway on page 4825
- Understanding Fibre Channel Virtual Links on page 4828
- Understanding FCoE on page 4799

Understanding FIP Implementation

In a network that converges Fibre Channel (FC) and Ethernet traffic, when you configure the QFX Series as a Fibre Channel over Ethernet (FCoE)-FC gateway, it translates FCoE Initialization Protocol (FIP) frames from FCoE nodes (ENodes) into native FC frames for FC switches and translates native FC frames from FC switches into FIP frames for ENodes. To an FCoE device, the gateway appears to be an FCoE forwarder (FCF) and presents a fabric port (F_Port) interface to the FCoE device ENode. To an FC switch, the gateway appears to be an FC host capable of N_Port ID virtualization (NPIV) and presents a node port (N_Port) interface to the FC switch F_Port interface.

NOTE: The N_Ports that the gateway presents to the FC switch are called proxy N_Ports (NP_Ports). To the FC switch, the gateway NP_Ports appear to be native FC N_Ports that are capable of performing NPIV. The NP_Ports are proxies for the FCoE devices in the Ethernet network. The NP_Ports convert FCoE traffic from the FCoE devices into native FC traffic for the FC switch. The NP_Ports also convert native FC traffic from the FC switch into FCoE traffic for the FCoE devices on the Ethernet network.

FIP Basics

FIP is enabled by default on all VLAN interfaces that belong to each FC fabric configured on the gateway. You can configure FIP parameters at a global level or on an individual interface. When you configure a parameter on an interface, it overrides the global configuration only for that interface. If you do not explicitly configure a FIP parameter, the gateway uses the default value.

In order for the gateway to connect FCoE devices with FCFs, the FIP parameters you configure on the gateway must be compatible with the parameters configured on the FC switch (for example, the FC-MAP values of the FC switch and of the FC fabric FIP configuration on the gateway must match, or the FC switch drops the frames).

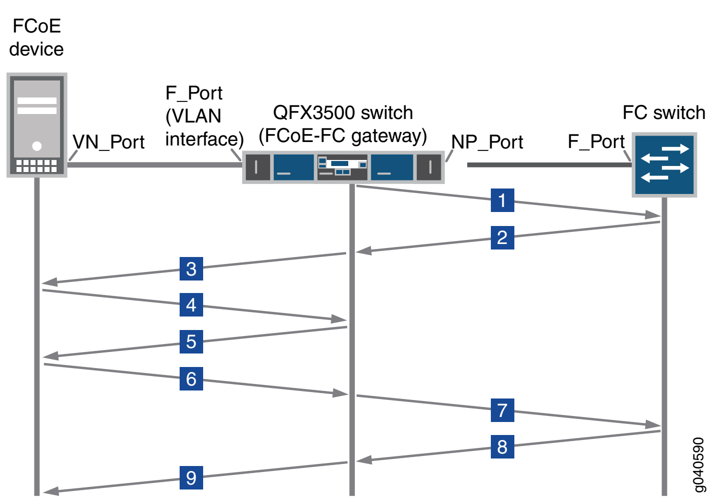
When the NP_Ports on the gateway come up, they perform an FC FLOGI to the connected FC switch. Successful login establishes communication between the gateway and the FC switch, and gateway NP_Ports are marked for sending FDISC messages. Successful login also creates a next-hop entry in the gateway for the FC switch. If the FC switch rejects the FLOGI request, no link is established. The gateway maintains a list of valid FCF-MACs with which ENodes can connect.

After establishing communication with an FC switch, the gateway can connect FCoE devices in the Ethernet network to the FC switch. All of the subsequent connections the gateway makes with FC switches as a proxy for ENodes (on behalf of ENodes) are virtualized (NPIV) connections.

Fabric Login and FIP Login Overview

Figure 174 on page 4822 provides a brief overview of the FCoE-FC gateway fabric login to the FC switch and the FCoE device FIP login to the gateway.

Figure 174: FCoE-FC Gateway Fabric Login and FIP Login



The numbers in the following list correspond to the numbers in Figure 174 on page 4822 and briefly describe each step of the login process:

1. The FCoE-FC gateway NP_Port sends an FC fabric login (FLOGI) request to the FC switch F_Port.
2. The FC switch accepts the gateway FLOGI.
3. The gateway sends FIP multicast discovery advertisements on the FCoE VLAN (the gateway F_Port interface) to all connected FCoE device ENodes.

4. The FCoE device ENode sends a discovery solicitation message to the gateway.
5. The gateway responds with a unicast discovery advertisement to the ENode.

NOTE: The gateway limits the number of discovery solicitations it accepts from FCoE devices to a maximum of 100 outstanding requests at any given time. If the gateway has 100 discovery solicitations outstanding, the gateway does not respond to new discovery solicitations. Instead, the gateway drops new discovery solicitations and reports the number of dropped discovery solicitations in the **Dropped** field of the **show fibre-channel fip statistics** command output. When there are fewer than 100 outstanding discovery solicitations, the system responds to new requests as usual with a discovery advertisement.

6. The FCoE device sends a FIP FLOGI or FIP FDISC message to the gateway.
7. The gateway converts the FIP FLOGI or FIP FDISC to an FC FDISC and forwards it to the FC switch to obtain a login for the FCoE device.
8. The FC switch responds to the FC FDISC by sending a new ID for the NPIV session to the gateway.
9. The gateway converts the FC FDISC response from the FC switch to a FIP FDISC response and forwards it to the FCoE device.

The following sections describe some of these steps in greater detail.

Proxy FIP Discovery

After the gateway establishes a connection with an FC switch:

1. The gateway sends periodic FIP multicast discovery advertisements on the FCoE VLAN so that ENodes can add the gateway to their FCF lists.
2. The ENode initializes and sends a multicast discovery solicitation message on the FCoE VLAN. If the ENode has already initialized and has a list of FCFs, it can send a unicast discovery solicitation message to a particular FCF such as the gateway.

   NOTE: The gateway limits the number of discovery solicitations it accepts from FCoE devices to a maximum of 100 outstanding requests at any given time. If the gateway has 100 discovery solicitations outstanding, the gateway does not accept new discovery solicitations until there are fewer than 100 discovery solicitations outstanding.

3. When the gateway receives a multicast discovery solicitation from an ENode, it responds by sending a unicast discovery advertisement to that ENode.

   When the gateway receives a unicast discovery solicitation from an ENode, it also responds with a unicast discovery advertisement to the ENode.

   To the ENode, the gateway appears to be an FCF.

The FIP discovery process adds the ENode to the gateway ENode database.

Proxy FIP Initialization

1. If the ENode chooses to log in to the gateway, it responds to the gateway's unicast discovery advertisement by sending a login request in the form of a FIP FLOGI if it is the initial connection to the gateway. If the ENode already has an established session with the gateway and another application or virtual machine wants to connect to the gateway, the ENode sends a FIP FDISC to the gateway.
2. The gateway receives the FIP FLOGI or FIP FDISC from the ENode, converts it into an FC FDISC, and sends it through the least-loaded NP_Port to the FC switch on behalf of the ENode. The FC FDISC message requests an FCID for the new virtual link.

   NOTE: **The gateway converts both ENode FIP FLOGI and FIP FDISC messages into FC FDISC messages, because the gateway has already performed FC FLOGI with the FC switch, so all subsequent connection requests on the gateway NP_Port are FDISC requests for virtual (NPIV) connections. FDISC messages request a virtual N_Port connection over an existing physical N_Port connection.**

3. The FC switch processes the request, accepts it, assigns a unique FCID for the connection, and then sends the response to the gateway. If the FC switch rejects the FDISC request, no virtual link is established.
4. The gateway maps the FC switch response to the ENode VN_Port, converts the FC acceptance message to a FIP FLOGI or FIP FDISC response, and sends it to the ENode VN_Port.
5. The ENode VN_Port accepts the FCID, and the virtual link is established.

If an ENode sends an FDISC, the proxy gateway switch checks whether the ENode has already performed a FLOGI to create the initial connection. If the ENode has not performed a FLOGI, the FDISC request is dropped.

The FC protocol does not recognize multipoint-to-point connections. Although the gateway can aggregate traffic from multiple FCoE servers on one NP_Port, each virtual link appears to be an individual point-to-point link between an FCoE ENode VN_Port and the FC switch, not as an aggregated multipoint-to-point link. The gateway is essentially invisible to the FC protocol, so the virtual link looks and acts like a point-to-point link from the FCoE device to the FC switch.

Proxy FIP Maintenance

The gateway sends and receives periodic FIP keepalive messages to and from ENode VN_Ports to maintain the connection between the gateway and the ENodes.

Proxy FIP Logout

As with FIP discovery and FIP FLOGI, the gateway represents the FCoE device in transactions with the FC switch and represents the FC switch in transactions with the FCoE device:

1. An ENode VN_Port sends a FIP LOGO message to log off and terminate the virtual link connection.
2. The gateway converts the FIP LOGO to an FC LOGO and relays it to the FC switch.
3. The FC switch responds to the LOGO request.
4. The gateway converts the FC LOGO response to a FIP LOGO response and relays it to the VN_Port, completing the logout and terminating the virtual link.

Related Documentation

- Overview of FIP on page 4790
- Understanding FIP Functions on page 4817
- Understanding FIP Parameters on an FCoE-FC Gateway on page 4825
- Understanding Fibre Channel Virtual Links on page 4828
- Understanding FCoE on page 4799
- Configuring FIP on an FCoE-FC Gateway on page 5059

Understanding FIP Parameters on an FCoE-FC Gateway

By default, FIP is enabled, and the default FIP settings are valid on all FCoE interfaces that are part of the gateway FC fabric. You can configure some FIP parameters at a global level or on a specific interface. Some FIP parameters can be configured only at the global level or only at the individual interface level. When you configure a parameter at the interface level, the configuration overrides the global setting for that interface only.

FIP Keepalive Advertisement Period

The FIP keepalive advertisement period (fka-adv-period) is the time interval between messages that verify the connection is still valid and the device at the other end of the virtual link is still reachable. The ENode sends an ENode FIP keepalive advertisement to the gateway with the ENode MAC address as the source address to verify its reachability. The ENode also sends VN_Port FIP keepalive messages for every VN_Port on the ENode that is logged in to the gateway, with the VN_Port MAC address as the source address.

The FIP keepalive advertisement period also determines the time interval between unsolicited multicast discovery advertisements from the gateway to the *ALL-ENode-MACs* multicast address. Unsolicited multicast discovery advertisements serve as keepalive messages from the gateway to the ENodes and also advertise the gateway's presence on the network.

The gateway sends the periodic unsolicited multicast discovery advertisements to the ENodes. On the gateway, you can configure a global FIP keepalive advertisement period for an FC fabric and you can configure a FIP keepalive advertisement period for individual interfaces to override the global setting.

Addressing Mode

For FIP transactions, the ENode identifies itself using the globally unique MAC address assigned to the CNA by the manufacturer. After FIP has established a virtual link between an ENode VN_Port and the gateway, for FCoE transactions, the VN_Port identifies itself using a locally unique MAC address. The format of the locally unique MAC address depends on the addressing mode the fabric supports and the addressing mode the ENode is programmed to use.

The addressing mode is not a configurable parameter on the gateway. FC fabrics on the gateway support only the fabric provided MAC address (FPMA) addressing mode for FCoE transactions. The gateway does not support the server provided MAC address (SPMA) addressing mode. ENodes that use SPMA cannot log in to the gateway.

The FC switch assigns a locally unique FPMA to an ENode MAC through the FLOGI or FDISC process:

1. During the FIP discovery process, the ENode compiles a list of compatible FCFs (including the gateway) in the fabric. A compatible addressing mode is one of the criteria an FCF must meet to be added to an ENode's compatible FCFs list.
2. The ENode MAC transmits a FLOGI or FDISC to the FCF that includes the addressing modes the ENode supports.
3. If the FCF supports an addressing mode the ENode uses, the FCF accepts the FLOGI or FDISC and assigns the FPMA in the accept message (FIP FLOGI LS_ACC or FIP NPIV FDISC LS_ACC). If the ENode uses an addressing mode that is incompatible with the FCF, the FLOGI or FDISC is rejected.

The FPMA uniquely identifies a single VN_Port at that ENode MAC in FCoE transactions with the FCF. Each VN_Port connection receives its own unique FPMA to identify its virtual link connection. When an ENode uses NPIV to create multiple VN_Ports, each VN_Port virtual link receives its own unique FPMA to identify its traffic.

An FPMA consists of two concatenated 24-bit values:

1. The upper 24 bits are the FCF's FC-MAP value, which is a MAC address prefix that is unique to the fabric.
2. The lower 24 bits are the locally unique FCID that the FCF (FC switch) assigns to the VN_Port.

The combination of these values guarantees that each FPMA is unique within a fabric.

FC-MAP

The FCoE mapped address prefix (FC-MAP) value is a MAC address prefix used by the FCF that is unique within a given fabric. The FCF uses the FC-MAP for FCoE traffic within that fabric. The FCF rejects FCoE traffic that uses an FC-MAP value that does not match the FCF's FC-MAP value. In most cases, the FCF uses the default FC-MAP value (0EFC00), but a pool of 256 values is available (0EFC00 through 0EFCFF).

The gateway learns FC switches in the fabric that match the gateway fabric's FC-MAP value. To learn and communicate with an FC switch, the FC-MAP value for a fabric (or for the fabric's FCoE VLAN) on the gateway must match the FC switch's FC-MAP value. If the FC-MAP values do not match, no connection is established.

NOTE: Changing the FC-MAP value causes all logins to drop and forces the ENodes to log in again.

FCoE Trusted Fabric

By default, all interfaces are untrusted interfaces. You can globally configure all of the ports in a specified gateway FC fabric to be FCoE trusted. This reduces system overhead by eliminating the need for filters. The total number of FCoE sessions (ENode to FCF sessions) the system can support is 2500 sessions. Sessions are defined as the combined number of VN_Port to VF_Port sessions and VN_Port to VN_Port sessions. (Although VN2VF and VN2VN sessions run in different FCoE VLANs, the session limit is a system limit, not a per-VLAN limit.)

NOTE: A session is a FLOGI or FDISC login to the FC SAN fabric. Session does not refer to end-to-end server-to-storage sessions. There is no limit to the number of end-to-end server-to-storage sessions.

NOTE: Changing the fabric ports from untrusted to trusted removes any existing FIP snooping filters from the ports and terminates the existing sessions. Changing the fabric ports from trusted to untrusted forces all of the FCoE sessions on those ports to log out so that when the ENodes and VN_Ports log in again, the switch can build the appropriate FIP snooping filters.

Maximum Number of FCoE Sessions Per ENode

You can configure the maximum number of FCoE session logins from each ENode that are permitted on the gateway FC fabric. The number of sessions is the ENode FLOGI session plus the VN_Port FDISC sessions on that ENode. Regardless of whether the fabric is trusted or untrusted, the maximum number of FCoE sessions per ENode is

2500 sessions. The total number of sessions cannot exceed the gateway fabric's maximum limit of 2500 sessions.

The maximum number of FCoE sessions per ENode is a global configuration for all members of the gateway FC fabric and cannot be configured on a per-interface basis.

NOTE: Session does not refer to end-to-end server-to-storage sessions. There is no limit to the number of end-to-end server-to-storage sessions.

Priority

When the FIP discovery process offers an ENode the choice of more than one FCF-MAC on a given FCF to use for login, the ENode chooses the FCF-MAC to which to send a login request based on the FCF-MAC priority. The lower the priority number, the higher the FCF-MAC's priority. The ENode selects the highest-priority (lowest priority number) FCF-MAC for the login request.

An ENode can receive multiple FCF-MAC advertisements from the same FCF in two ways:

- During the FIP discovery process, an FCF can receive an ENode MAC's multicast discovery solicitation on multiple FCF-MACs. Each FCF-MAC replies with a unicast discovery advertisement to the ENode. The ENode determines that the advertisements are from the same FCF, because the value in the Name_Identifier descriptor is the same in each advertisement.
- During the FIP discovery process, an ENode MAC can receive unsolicited multicast discovery advertisements from multiple FCF-MACs on the same FCF. The ENode determines that the advertisements are from the same FCF, because the value in the Name_Identifier descriptor is the same in each advertisement.

On the gateway, you can configure the priority value for an entire fabric or for an individual interface. The default value for both the fabric and the individual interfaces is 128 (the highest priority is 0; the lowest priority is 255).

Related Documentation

- Overview of FIP on page 4790
- Understanding FIP Functions on page 4817
- Understanding FIP Implementation on page 4821
- Understanding Fibre Channel Virtual Links on page 4828
- Understanding FCoE on page 4799
- Configuring FIP on an FCoE-FC Gateway on page 5059

Understanding Fibre Channel Virtual Links

A virtual link emulates a secure point-to-point connection between the virtual node port (VN_Port) of a Fibre Channel over Ethernet (FCoE) node (ENode) and the virtual fabric port (VF_Port) of an FCoE forwarder (FCF). The combination of the FCF media access control (MAC) address and the VN_Port MAC address uniquely identifies each virtual link. Uniquely identifying each virtual link enables the logical separation of traffic that belongs to each virtual link. A single physical link between an ENode and an FCF can carry multiple virtual links and maintain secure, separate transport of traffic on the different virtual links.

Virtual links are necessary because Fibre Channel protocol does not recognize multipoint-to-point connections. Even when multiple connections are aggregated on one physical port, FCoE Initialization Protocol (FIP) presents each virtual link as an individual point-to-point link between an ENode VN_Port and an FCF VF_Port.

Related Documentation

- Overview of FIP on page 4790
- Understanding FIP Functions on page 4817
- Understanding FIP Implementation on page 4821
- Understanding FIP Parameters on an FCoE-FC Gateway on page 4825
- Understanding FCoE on page 4799

Understanding Interfaces on an FCoE-FC Gateway

When the QFX Series functions as an FCoE-FC gateway to connect FCoE devices on an Ethernet network to a Fibre Channel (FC) switch in a storage area network (SAN), it handles FCoE traffic from hosts and native FC traffic from the FC switch. To support this architecture, each local FC fabric configured on the gateway (in the **fc-fabrics** configuration hierarchy) must have:

- An Ethernet-network-facing F_Port interface for the FCoE VLAN to connect to FCoE device VN_Ports in the form of an FCoE VLAN interface. Multiple VF_Ports are initiated on the F_Port interface, one VF_Port for each ENode that logs in to the FC network.
- One or two blocks of six proxy N_Port (NP_Port) interfaces to connect to FC switch fabric ports (F_Ports).

Each FC fabric is local to the gateway on which you configure it. This means that both the FC switch and the FCoE devices must be connected to the same gateway (QFX3500 switch or QFabric system Node device), and that all of the interfaces configured for the local fabric also must be on that gateway. FC fabric traffic does not flow between different Node devices in a QFabric system.

This topic describes:

Native FC Interfaces to the FC Switch

You must configure either 6 or 12 of the physical interfaces on the gateway as native FC NP_Port interfaces to connect to FC switch F_Port interfaces. By default, all of the gateway interfaces are Ethernet interfaces, so you must explicitly configure the interfaces that you want to use as FC interfaces.

You can configure the FC-capable ports xe-0/0/0 through xe-0/0/5 as fc-0/0/0 through fc-0/0/5, and ports xe-0/0/42 through xe-0/0/47 as fc-0/0/42 through fc-0/0/47 to create blocks of native FC interfaces. You cannot individually configure a single port as a native FC interface. Within these port blocks, you cannot mix FC interfaces with Ethernet interfaces. All of the ports in a block must be either native FC interfaces or Ethernet interfaces.

You cannot configure ports xe-0/0/6 through xe-0/0/41 and ports xe-0/1/1 through xe-0/1/15 as native FC ports; they can only be Ethernet ports. Native FC ports do not handle Ethernet traffic (including FCoE traffic); they handle only native FC traffic and must connect to native FC ports.

You can configure:

- Six native FC interfaces by configuring either ports xe-0/0/0 through xe-0/0/5 as fc-0/0/0 through fc-0/0/5 *or* ports xe-0/0/42 through xe-0/0/47 as fc-0/0/42 through fc-0/0/47.
- Twelve native FC interfaces by configuring ports xe-0/0/0 through xe-0/0/5 as fc-0/0/0 through fc-0/0/5 *and* ports xe-0/0/42 through xe-0/0/47 as fc-0/0/42 through fc-0/0/47.
- No native FC interfaces by leaving ports xe-0/0/0 through xe-0/0/5 and ports xe-0/0/42 through xe-0/0/47 in their default state as Ethernet interfaces.

Each native FC interface can belong to only one local FC fabric configured on the gateway. You can configure up to 12 FC fabrics on a gateway, but each FC fabric must use different native FC interfaces to connect to an FCF. (Although the native FC ports are configured in blocks, each individual port can belong to a different FC fabric.) Native FC interfaces can be configured as loopback interfaces.

Port Mode

The gateway presents a proxy N_Port (NP_Port) interface to the FC switch. An NP_Port connects to a single FC switch F_Port using a point-to-point link (in other architectures an N_Port can also connect in a point-to-point link to another N_Port, but that is not a valid configuration on the gateway).

You must explicitly configure each native FC interface connected to an FC switch as an NP_Port. The gateway NP_Ports act as a proxy for the FCoE device virtual N_Ports (VN_Ports) when the VN_Ports attempt to connect to the FC switch.

When the FC switch is a trusted switch, configure the fabric as **fcoe-trusted** to reduce overhead caused by the VN_Port to VF_Port (VN2VF_Port) FIP snooping filters that are automatically installed on untrusted ports.

NPIV

FC requires a unique point-to-point link between the FC switch and each host N_Port. The gateway creates an independent virtual link for each FCoE device session by mapping each FCoE device to a virtualized N_Port through the gateway's proxy function. This process is called N_Port ID virtualization (NPIV).

NPIV makes each virtual link look like a dedicated point-to-point link to the FC switch. In this way, multiple FCoE devices, multiple applications, and multiple virtual machines on an FCoE device can connect to an FC switch using one physical port instead of using a physical port for each host connection. The virtual link creates a secure boundary between traffic from different sources that are on a single physical port.

FCoE-FC gateway mode implements NPIV as follows:

1. An NP_Port on the gateway comes up and logs in to the attached F_Port on the FC switch. The FC switch sees the gateway port as a physical FC device N_Port and assigns it a unique FCID. This establishes the physical point-to-point link between the gateway and the FC switch.
2. The gateway receives a FIP discovery message from an FCoE device that seeks to log in to the FC network. To the FCoE device, the gateway presents a virtual F_Port (VF_Port) interface and appears to be an FCF.
3. The gateway converts the FCoE device's message into an FC fabric discovery (FDISC) message and sends it through the least-loaded physical NP_Port to the FC switch. The FDISC message requests an FCID for the new virtual link.
4. The FC switch processes the request, accepts it, assigns a unique FCID for the connection, and sends the response.
5. The gateway maps the FC switch response to the host FCoE device's VN_Port and sends a FIP acceptance advertisement to the FCoE device.
6. The FCoE device accepts the FCID.

If the FC switch rejects the FDISC, the gateway relays the rejection to the FCoE device VN_Port.

Port Speed

The gateway supports configuring FC port speeds of 2 Gbps, 4 Gbps, or 8 Gbps. FC ports can also autonegotiate the port speed to 2, 4, or 8 Gbps.

FIP Login Session Limits

A FIP login session is a fabric login (FLOGI) or fabric discovery (FDISC) login to the FC SAN fabric. (A session here does not refer to an end-to-end server-to-storage session; there is no limit to the number of end-to-end server-to-storage sessions.) You can limit the maximum number of FIP login sessions on each gateway Node device (QFX3500 switch or QFabric system Node device configured in FCoE-FC gateway mode), on each local gateway FC fabric, and on each individual NP_Port interface in a local FC fabric:

- Gateway Node devices and Node groups—The total number of FIP login sessions on the gateway Node or Node group (the sum of the sessions on all of the NP_Port interfaces in all of the local FC fabrics on the gateway Node or Nodes) cannot exceed the limit. When a gateway reaches the maximum session limit, the gateway sends subsequent multicast discovery advertisements (MDAs) with the availability bit set to 0 (zero) to prevent additional ENode login attempts. If the maximum number of sessions is running on the gateway, ENodes cannot use the gateway to log in new sessions to the FC switch. When the number of sessions falls below the maximum, the gateway sets the availability bit in MDAs to 1 so that ENodes can again log in new sessions. When a session slot becomes available, the system accepts the first session request to fill the slot.
- FC fabric—The total number of FIP login sessions on an FC fabric (the sum of the sessions on all of the NP_Port interfaces that belong to the fabric) cannot exceed the limit. When a fabric reaches the maximum session limit, the gateway sends MDAs associated with that fabric with the availability bit set to 0 to prevent additional ENode login attempts.

  NOTE: **Other FC fabrics on the same gateway can still accept ENode logins as long as the maximum session limit for those fabrics and the maximum session limit for the gateway (the Node device) have not been met.**

- NP_Port interfaces—The total number of FIP login sessions cannot exceed the interface's limit. When an interface reaches the maximum session limit, the gateway removes it from the load-balancing list for that FC fabric to prevent the gateway from attempting to assign new sessions to the interface. Other interfaces in the FC fabric can still accept logins until the FC fabric or gateway reaches its maximum session limit. However, the interface that reached the maximum session limit cannot be assigned new sessions until the number of sessions on the interface falls below the limit.

  BEST PRACTICE: **Configure a maximum session limit for each NP_Port interface that is less than or equal to the number of FIP sessions the directly connected FC switch port is configured to support. This prevents the gateway from attempting to assign new login sessions to an interface when the connected FC switch port reaches its maximum number of sessions.**

FCoE Trusted and Untrusted Interface Session Limits

The maximum number of VN2VF_Port FCoE login sessions that each gateway can support is 2500 sessions, regardless of whether interfaces are trusted or untrusted. (In software releases earlier than Junos OS Release 12.3, the session limit on untrusted interfaces and untrusted fabrics was 376 sessions.)

Configuring Consistent Session Limits

The system does not perform commit checks to enforce consistent session limit configuration. For example, the system does not prevent you from configuring a higher limit for ENode sessions than the total session limit for the gateway Node device, or from configuring a higher limit on an interface than on the fabric to which the interface belongs.

To prevent unexpected FIP login rejections, you should configure consistent Node device, fabric, and interface session limits. For example:

- The session limit of an interface should not exceed the session limit of the fabric to which it belongs.
- For interfaces that belong to the same fabric, the sum of the interface session limits should not exceed the fabric session limit.
- The fabric session limit should not exceed the session limit of the gateway Node device.
- For fabrics that belong to the same gateway Node device, the sum of the fabric session limits should not exceed the Node device session limit.

Session limit configuration considerations include:

- The fabric session limit restricts how many sessions can run on the NP_Port interfaces that belong to that fabric. If the combined session limits of the interfaces exceed the fabric session limit, the total number of sessions on the interfaces is the fabric limit.

  For example, if a fabric has three NP_Port interfaces, and each NP_Port interface has a limit of 500 sessions (total of 1500 sessions for the three interfaces), but the fabric has a limit of 1000 sessions, the combined number of sessions on the three interfaces is limited to 1000 sessions.
- The gateway Node device session limit restricts how many sessions can run on the fabrics that belong to that gateway. If the combined session limits of the fabrics exceed the gateway Node device session limit, the total number of sessions on the fabrics is the gateway Node device limit.

  For example, if a gateway has two fabrics, and each fabric has a limit of 1000 sessions (total of 2000 sessions for the two fabrics), but the gateway has a limit of 1500 sessions, the combined number of sessions on the two fabrics is limited to 1500 sessions.

Hierarchically, the gateway Node device session limit is the maximum limit for all sessions on the gateway, regardless of fabric and interface session limits. In the same way, the fabric session limit supersedes the interface session limit.

When session limits are exceeded, no new logins are accepted until a session slot becomes free.

Decreasing Session Limits

If you decrease the session limit, the currently logged in sessions are terminated as follows:

- Gateway Node devices and Node groups—Decreasing the session limit terminates all of the sessions on the Node device (all sessions on all interfaces on all fabrics). If the gateway Node device is part of a Node group, all sessions on all members of the Node group are terminated.
- Fabric—Decreasing the session limit terminates all of the sessions on all of the interfaces that belong to the fabric.
- NP_Port interfaces—Decreasing the session limit terminates all of the sessions on the interface and also terminates all of the sessions on any other interfaces that belong to the same fabric.

After you decrease a session limit, the sessions are terminated even if the new session limit is greater than the number of currently active sessions. For example:

- An interface has 300 active sessions.
- The current session limit is 1000 sessions.
- You decrease the session limit to 500 sessions and commit the new configuration.
- All 300 sessions are logged out, even though the new session limit is greater than the number of sessions running.

After the session limit change takes effect, the ENodes log in again and establish new sessions, up to the new session limits.

Increasing Session Limits

Increasing the session limits does not disrupt logged in sessions.

Effect of Deactivating and Then Reactivating the Configuration on Session Limits

If you decrease session limits, all ENodes are logged out. Deactivating and then reactivating the configuration can have the same effect as decreasing the session limit, which results in the ENodes being logged out.

The ENode logouts occur because when you deactivate the configuration, the system reverts to the default session limit of 2500 sessions (the maximum number of sessions). When you reactivate the configuration, the system uses the configured session limit. Unless the configured session limit is equal to the maximum session limit, reactivating the configuration decreases the session limit, which causes the ENodes to be logged out.

For example, if you:

1. Configure and commit a limit of 400 sessions.
2. Allow ENodes to log in and start sessions.
3. Deactivate the configuration.

4. Reactivate the configuration.
5. The ENode sessions are logged out because deactivating the session increased the session limit from 400 to 2500.

Because an increase in the session limit does not affect existing sessions, the running ENode sessions are not affected. However, reactivating the configuration decreased the session limit from 2500 back to 400. The session limit decrease causes the ENode sessions to be logged out.

Trusted and Untrusted Interfaces

By default, gateway fabric interfaces are untrusted interfaces. If you do not configure a gateway fabric as an FCoE trusted fabric to set all of the gateway fabric interfaces as trusted interfaces, the gateway installs VN2VF_Port FIP snooping filters on the fabric ports.

If you configure a gateway fabric as an FCoE trusted fabric, the gateway does not install VN2VF_Port FIP snooping filters on the fabric interfaces. This is usually done when the gateway is connected to an FCoE transit switch that has VN2VF_Port FIP snooping enabled.

Regardless of whether an interface is trusted or untrusted, the maximum session limit is 2500 sessions.

NOTE: **The session limit for a Node group is the same as the session limit for an individual Node device, 2500 sessions. Even if more than one Node device in a Node group is acting as an FCoE-FC gateway, the total maximum number of sessions on all Node devices in the Node group is 2500 sessions.**

The default maximum login session value for Node devices (on QFabric systems, the maximum applies to each Node device), trusted fabrics, and interfaces in trusted fabrics is 2500 sessions.

Buffer-to-Buffer Credit Recovery

Buffer-to-buffer credits represent the number of receive buffers an interface can use to store FC frames. Buffer-to-buffer credit determines buffer-to-buffer flow control. When an interface transmits a frame, it decrements its buffer-to-buffer credit count by one. When the destination interface forwards the frame and frees a buffer, it sends a receiver ready (R_RDY) primitive to the transmitting interface. Each R_RDY primitive the transmitting interface receives increments its buffer-to-buffer credit count by one.

Both interfaces on an FC link track buffer-to-buffer credits. As long as buffer-to-buffer credits are available, the transmitter continues to send frames. If the number of buffer-to-buffer credits reaches zero (0), transmission stops until buffer-to-buffer credits are available, as indicated by the reception of an R_RDY primitive. Buffer-to-buffer credits can compensate for long cable distances to limit throughput and prevent buffer overflow.

However, if frame corruption or errors transmitting R_RDY primitives occur, the buffer-to-buffer credit counters on the sending and receiving interfaces do not have the same values. This causes the permanent loss of buffer-to-buffer credits. When credits are lost, the buffer credit count can decrement to zero and indicate that there is no available buffer space even if buffer space is actually available. This can result in unnecessary link idle time.

To recover lost buffer-to-buffer credits, you can configure a buffer-to-buffer credit state change number (BB_SC_N). BB_SC_N must be configured on both ends of the connection. If only one end of the connection is configured for BB_SC_N, the feature is disabled. The two directly connected FC interfaces communicate the BB_SC_N value during fabric login (FLOGI).

When you enable BB_SC_N on the interfaces on both ends of an FC link, the interfaces exchange buffer-to-buffer state change send (BB_SCs) and buffer-to-buffer state change receive (BB_SCr) primitives to track the number of frames sent and the number of R_RDY primitives received. The state change number determines the number of frames and R_RDY primitives the interfaces exchange between consecutive BB_SCn primitives and between consecutive BB_SCr primitives. The state change primitives inform each interface of the other interface's frame count and R_RDY count states.

The state counters should match so that each interface knows and agrees with the other interface's state. If the interface at either end of the link detects a discrepancy, it knows that a frame or an R_RDY primitive was corrupted or dropped.

For example, if a receiving interface has sent two R_RDY primitives but the BB_SCr that the interface receives from the sending interface only counts one R_RDY primitive received, it reveals that one R_RDY primitive was not delivered successfully and that one buffer-to-buffer credit was lost. When one of the interfaces on the link detects a discrepancy, the interfaces can take corrective action and recover the lost buffer-to-buffer credits.

Enabling the buffer-to-buffer credit recovery feature does not impact buffer resources and has an insignificant impact on processing resources.

If buffer-to-buffer credit recovery is not used, then when there is no buffer credit on a port, a timeout and recovery mechanism prevents buffer overflow.

FCoE VLAN Interface to FCoE Devices

Each FC fabric configured on the gateway includes at least one FCoE VLAN interface to connect the FCoE devices on the FCoE VLAN to the FC switch. (Including the FCoE VLAN interface and the native FC interfaces in the FC fabric configuration connects them.) FCoE VLANs can include any Ethernet interface on the switch that is in tagged-access or trunk mode. The best practice is to configure Ethernet interfaces that belong to FCoE VLANs in **tagged-access** port mode.

NOTE: The Ethernet interfaces that connect to FCoE devices must include a native VLAN to transport FIP traffic, because FIP VLAN discovery and notification frames are exchanged as untagged packets.

FCoE VLANs should carry only FCoE traffic. You should not mix FCoE traffic and standard Ethernet traffic on the same VLAN.

NOTE: FCoE VLANs (any VLAN that carries FCoE traffic) support only Spanning Tree Protocol (STP) and link aggregation group (LAG) Layer 2 features.

Each FCoE VLAN interface can belong to only one FC fabric configured on the gateway. A gateway FC fabric can have more than one FCoE VLAN, but each FCoE VLAN in the FC fabric must belong only to that FC fabric. You can configure more than one FC fabric on a gateway; each FC fabric must use different FCoE VLAN interfaces to connect to FCoE devices.

NOTE: Storm control must be disabled on all Ethernet interfaces that belong to the FCoE VLAN to prevent FCoE traffic from being dropped.

Port Mode

You must explicitly configure the FCoE VLAN interface in F_Port mode. All members of the FCoE VLAN use the FCoE VLAN interface as the connection to the gateway NP_Port interfaces and ultimately to the FC switch.

All of the 10-Gigabit Ethernet interfaces that are members of an FCoE VLAN should be configured as **tagged-access** port mode interfaces. However, the system also supports configuring these interfaces in **trunk** port mode.

BEST PRACTICE: Use **tagged-access** port mode for Ethernet interfaces that are connected to converged network adapters (CNAs) in FCoE access devices.

Use **trunk** port mode when an Ethernet interface is an interswitch link (ISL)—that is, when the port is connected to another switch. For example, if a port is connected to a transit switch that is performing VN2VF_Port FIP snooping, configure the port in **trunk** mode and as an FCoE trusted port.

The **tagged-access** port mode was not available in Junos OS Release 11.3 and earlier releases. In Release 11.3 and earlier, only **trunk** port mode was used for Ethernet interfaces that belong to an FCoE VLAN. Because **tagged-access** mode is now available, using **trunk** mode for interfaces connected to FCoE CNAs is not recommended.

If an existing configuration uses **trunk** mode for ports connected to FCoE CNAs, you can change the port mode to **tagged-access** without disrupting traffic. Although we recommend changing the port mode of these ports from **trunk** mode to **tagged-access** mode as a best practice, it is not mandatory. New configurations should use **tagged-access** mode for interfaces that connect to FCoE devices.

There are several advantages of configuring Ethernet ports connected to FCoE devices in **tagged-access** mode instead of in **trunk** mode:

- It is standard practice to configure ISL ports as trunk ports.
- It is standard practice not to configure ports that connect to servers as trunk ports.
- When an interface goes down, if that interface is in **trunk** mode, then the FCoE sessions on that interface are terminated only after the gateway stops receiving FIP keepalive messages from the ENode and exceeds 2.5 times the FIP keepalive timeout advertisement value. If the interface is in **tagged-access** mode and the interface goes down, the gateway sends a FIP message to terminate the sessions on the interface.
- Similarly, if an ENode session moves from one interface to another interface, if the original interface is in **trunk** mode, the session is not removed from the interface until the gateway stops receiving FIP keepalive messages and exceeds 2.5 times the FIP keepalive advertisement timeout value. But if the interface is in **tagged-access** mode, the gateway detects that the session is no longer on the interface, does not refresh the FIP keepalive timer, and thus ages out the session.

NOTE: FIP is enabled on the FCoE VLAN, which is a Layer 3 interface. As with other Layer 3 interfaces under Junos OS, when the last member (10-Gigabit Ethernet interface) of the FCoE VLAN is deleted, the FCoE VLAN interface is internally marked as “down.” When the Layer 3 FCoE VLAN interface is marked as “down”, FIP stops running on it. When the last member interface is deleted from an FCoE VLAN and FIP stops running, the result could be an immediate timeout for the VN_Ports that were connected on that interface, regardless of whether the port mode is **tagged-access** or **trunk**.

Disabling Storm Control on FCoE Interfaces

Storm control is not supported on the FCoE interfaces of an FCoE-FC gateway VLAN. Enabling storm control on an FCoE-FC gateway VLAN interface may cause FCoE packet loss. Storm control is disabled by default on all interfaces. However, if you enabled storm control globally on all switch interfaces or on any interfaces that are part of the FCoE VLAN interface, you must disable storm control on the Ethernet interfaces of the FCoE VLAN.

If storm control is enabled on only a few interfaces of the FCoE VLAN, you can disable storm control on individual interfaces by including the **delete ethernet-switching-options**

storm-control interface ***interface-name*** statement in the configuration, where ***interface-name*** is the name of the interface on which you want to disable storm control.

If storm control is enabled globally on the switch when the switch is acting as an FCoE-FC gateway, it is often easiest to disable storm control on all interfaces, then enable storm control only on Ethernet interfaces that are not part of the FCoE VLAN interface.

If storm control is enabled globally, you can disable storm control in either of two ways:

- Disable storm control on all interfaces, then enable storm control on the interfaces you want to use storm control. (From the default configuration, you cannot disable storm control on individual interfaces because the default configuration enables storm control on **all** interfaces, not on individual interfaces.)

  For example, if you want interfaces xe-0/0/20, xe-0/0/21, and xe-0/0/22 to use storm control, disable storm control on all interfaces, then enable storm control on those three interfaces:

  1. Disable storm control on all interfaces:

     `user@switch#` **delete ethernet-switching-options storm-control interface all**

  2. Enable storm control on interfaces xe-0/0/20, xe-0/0/21, and xe-0/0/22:

     `user@switch#` **set ethernet-switching-options storm-control interface xe-0/0/20**
     `user@switch#` **set ethernet-switching-options storm-control interface xe-0/0/21**
     `user@switch#` **set ethernet-switching-options storm-control interface xe-0/0/22**

- Disable storm control for all unknown unicast traffic on all interfaces by including the following statement in your configuration:

  `user@switch#` **set ethernet-switching-options storm-control interface all no-unknown-unicast**

NPIV Support

The gateway supports FCoE device NPIV. For example, a single physical FCoE device can have multiple virtual machines running on it. Each virtual machine can instantiate a separate virtual connection to the gateway, which results in its own virtual link to the FC switch. In this way, an FCoE device can have multiple separate connections to the FC SAN on a single physical port.

This is similar to the NPIV function the gateway performs with the FC switch to support multiple virtual FCoE device connections on one physical NP_Port.

The gateway presents multiple VF_Port interfaces on each FCoE VLAN interface to support the requirement for unique, secure virtual links.

VN2VF_Port FIP Snooping

The FCoE-facing ports that belong to an FCoE VLAN on a gateway are enabled for VN2VF_Port FIP snooping automatically. You can disable VN2VF_Port FIP snooping on any individual interface by configuring it as a trusted interface.

Assigning Interfaces to a Fibre Channel Fabric

You assign at least one FCoE VLAN interface and at least one native FC interface to each FC fabric you configure on the gateway. All of the interfaces that belong to an FC fabric must reside on the same gateway device. Interfaces on different gateways cannot belong to the same FC fabric, because an FC fabric is local to a single gateway device.

Deleting a Fibre Channel Interface

To delete an FC interface or an FCoE VLAN interface, you must delete the interface from the fabric first and then delete the interface from the switch.

Related Documentation

- Overview of Fibre Channel on the QFX Series on page 4786
- Understanding Fibre Channel on page 4792
- Understanding Load Balancing in an FCoE-FC Gateway Proxy Fabric on page 4841
- Configuring a Physical Fibre Channel Interface on page 5048
- Configuring a Fibre Channel Interface on page 5049
- Disabling VN2VF_Port FIP Snooping on an FCoE-FC Gateway Switch Interface on page 5072
- Assigning Interfaces to a Fibre Channel Fabric on page 5054
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Disabling Storm Control on FCoE Interfaces on an FCoE-FC Gateway on page 5056
- Disabling VN2VF_Port FIP Snooping on an FCoE-FC Gateway Switch Interface on page 5072
- Deleting a Fibre Channel Interface on page 5055
- Setting the Maximum Number of FIP Login Sessions per FC Interface on page 5063
- Setting the Maximum Number of FIP Login Sessions per FC Fabric on page 5064
- Setting the Maximum Number of FIP Login Sessions per Node Device on page 5065
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Understanding Fibre Channel Terminology on page 4895

Understanding Load Balancing in an FCoE-FC Gateway Proxy Fabric

You can balance or rebalance the load on the ports in an FCoE-FC gateway proxy fabric in order to avoid overutilizing or underutilizing the links. Load balancing is distributing sessions across the available native Fibre Channel (FC) interfaces (NP_Ports) that belong to a local gateway FC fabric to create a relatively equal load on all the fabric links. Load rebalancing is redistributing the existing sessions across the available NP_Port links on a local gateway FC fabric.

NOTE: **A session is a fabric login (FLOGI) or fabric discovery (FDISC) login to the FC SAN fabric. Session does not refer to end-to-end server-to-storage sessions.**

The fabric-facing NP_Port links of an FCoE-FC gateway use different load-balancing methods than the FCoE-network-facing Ethernet links. You can balance the load on the FCoE-network facing Ethernet port members of the FCoE-FC gateway by configuring the ports in a link aggregation group (LAG). This topic focuses on NP_Port load balancing.

Balancing the load on FCoE-FC gateway NP_Port links consists of two steps:

1. Choosing the algorithm used to balance and rebalance the link load
2. Choosing whether to rebalance link loads automatically or only when you explicitly request a rebalance (load-rebalancing method)

You can configure a different load-balancing algorithm and use a different rebalancing method for each local FC fabric on the FCoE-FC gateway. The load-balancing algorithm and automated rebalancing, if configured, apply to all NP_Port interfaces in the local FC fabric.

This topic describes:

Load-Balancing Algorithms

You can choose one of three load-balancing algorithms to configure the way the switch balances the link loads. The switch uses the configured algorithm to balance the link loads when NP_Ports are initialized and whenever link loads are rebalanced. Regardless of whether you configure automated load rebalancing or use on-demand load rebalancing, the switch uses the configured algorithm to balance the link load:

- Simple load balancing—The switch assigns each ENode FLOGI session and VN_Port FDISC session to the least-loaded link. The switch can place FDISC sessions on a different link than the parent FLOGI session (an ENode FLOGI session and its subsequent FDISC sessions can be placed on different links). Simple load balancing is the default load-balancing algorithm. Rebalancing the link load disrupts only selected sessions to minimize the impact (the switch uses an algorithm to log out only the sessions that need to be moved to other links to balance the load when those sessions log in again).
- ENode-based load balancing—When an ENode logs in to the fabric, the switch places all subsequent VN_Port FDISC sessions associated with that ENode on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link. The switch calculates the link load based on the combined total of FLOGIs and FDISCs on each NP_Port link. Rebalancing the link load disrupts all sessions (all sessions log out and then log in again).
- FLOGI-based load balancing—Similar to ENode-based load balancing; when an ENode logs in to the fabric, the switch places all subsequent VN_Port FDISC sessions associated with that ENode on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link.

  One difference between ENode-based load balancing and FLOGI-based load balancing is that the switch calculates the link load based only on the number of FLOGIs on each NP_Port link. The algorithm does not count FDISCs. Another difference is that instead of disrupting all sessions on a link load rebalance, the system disrupts only selected sessions to minimize the impact (the switch uses an algorithm to log out only the sessions that need to be moved to other links to balance the load when those sessions log in again).

NOTE: **Changing the load-balancing algorithm when FCoE sessions are running forces the FCoE sessions to log out and then log in again.**

If you do not explicitly configure the load-balancing algorithm, the switch uses simple load balancing by default on the all NP_Port interfaces that belong to a given local FC fabric.

The following sections describe how each algorithm works, its advantages and disadvantages, and what happens when NP_Port links come up for the first time, when an NP_Port link is added to existing links, and when you rebalance the link load:

Simple Load Balancing

Simple load balancing provides the most equal load balancing across links because each VN_Port FDISC session can be assigned to the least-loaded link, regardless of whether the parent ENode FLOGI session is on that link. (The parent ENode is the ENode that originates the logins to the fabric. After the parent ENode logs in, the VN_Ports on that ENode can log in to the fabric using FDISC.)

The FCoE-FC gateway performs simple load balancing by default on the NP_Ports that connect the gateway to the FC SAN. When an ENode sends a FLOGI request to the gateway, the gateway checks the NP_Ports that connect it to the FC SAN and assigns the new session to the least-loaded link.

Every time an ENode sends a FLOGI or an FDISC request, the gateway assigns the new session to the least-loaded NP_Port link. After the gateway assigns an ENode FLOGI session to an NP_Port, subsequent FDISC requests by the same ENode can result in sessions being assigned to different NP_Ports, because the gateway always assigns the new session to the least-loaded interface.

NOTE: **Because VN_Port sessions might be placed on a different link than their parent ENode, if the link that contains the ENode goes down, only the ENode session and any of its VN_Port sessions that are on that link go down. VN_Port sessions on other links remain active as long as the link is up and the VN_Port is not logged out.**

When a new link comes up, the switch logs out enough sessions so that when the sessions log in again, they are placed on the new link and the link loads are balanced. The switch uses an algorithm to log out sessions in the least disruptive manner by first logging out FDISCs whose FLOGI is not on the same link, then the least-loaded FLOGIs (loaded in terms of related FDISC logins).

Similarly, when you rebalance an existing link load, the switch logs out only enough sessions so that when the sessions log in again, they balance the load on the existing links. In this case (rebalance without a new link up), the switch takes into account the dependencies between FLOGIs and FDISCs when selecting sessions to log out.

The simple load-balancing algorithm uses the sum of the FLOGI and FDISC sessions to determine the session load on each link for both initial load balancing and load rebalancing.

ENode-Based Load Balancing

ENode-based load balancing can result in a less balanced load across the NP_Port links because the VN_Port FDISC sessions are assigned to the same link as the parent ENode FLOGI session, regardless of how many FDISC sessions are associated with the ENode. However, ENode-based load balancing has the advantage of keeping all of the sessions associated with a particular ENode on one link, which provides better control and predictability.

When you use the ENode-based load-balancing algorithm, the gateway assigns the ENode to an NP_Port link when the ENode sends its FLOGI message to the gateway. The gateway places the ENode session on the least-loaded link at that time. The VN_Port FDISC sessions associated with an ENode are placed on the same link as the ENode FLOGI session, regardless of the link load. Essentially, the ENode sessions are load-balanced, but the VN_Port sessions are not.

ENode-based load balancing ensures that each ENode and its associated VN_Port sessions are assigned to the same NP_Port link. ENode-based load balancing provides more control and predictability and ensures that if the link carrying an ENode goes down, all of the ENodes associated VN_Port sessions also go down.

The disadvantage of ENode-based load balancing is that if one ENode has a large number of sessions and the other ENodes do not, the link that carries the ENode with the large number of sessions might have a much larger load than the other NP_Port links in the gateway proxy fabric.

For example, if a gateway fabric has two NP_Ports connected to the FC fabric, and two ENodes log in to the fabric, one ENode session is placed on each link. If two VN_Port sessions are initiated on one of the ENodes, those sessions are placed on the same link as the parent ENode. If 1000 VN_Port sessions are initiated on the other ENode, all of the 1000 VN_Port sessions are placed on the same link as that ENode. In this case, one link has 3 sessions (1 ENode FLOGI session and 2 VN_Port FDISC sessions) and the other link has 1001 sessions (1 ENode FLOGI session and 1000 VN_Port FDISC sessions).

When a new link comes up or when you rebalance an existing load, the switch logs out all sessions (FLOGIs and FDISCs) in the fabric. As the sessions log in again, the switch assigns them to NP_Ports in a balanced manner, with all FDISCs assigned to the same link as the parent FLOGI. A new link coming up or a rebalance disrupts all of the existing sessions.

The ENode-based load-balancing algorithm uses the sum of the FLOGI and FDISC sessions to determine the session load on each link for both initial load balancing and load rebalancing.

FLOGI-Based Load Balancing

FLOGI-based load balancing is similar to ENode-based load balancing in most ways:

- It can result in a less balanced load across the NP_Port links because the VN_Port FDISC sessions are assigned to the same link as the parent ENode FLOGI session, regardless of how many FDISC sessions are associated with the ENode.
- When an ENode logs in with a FLOGI, the gateway places the session on the least-loaded link, and the FDISC logins associated with the FLOGI are placed on the same link, regardless of link load.
- Provides control and predictability because each ENode and its associated VN_Port (FDISC) sessions are assigned to the same link, so if the link an ENode is on goes down, all of its associated sessions also go down.
- If one ENode has a large number of sessions and the other ENodes do not, the link that carries the ENode with the large number of sessions might have a much larger load than the other NP_Port links in the gateway proxy fabric.

FLOGI-based load balancing differs from ENode-based load balancing in two important ways:

1. The switch uses the sum of the FLOGI sessions on a link to determine the link load. The switch does not use FDISC sessions when calculating the number of sessions on a link. (ENode-based load balancing uses the sum of the FLOGI and FDISC sessions to calculate the number of sessions on a link.)
2. When a new link comes up or when you rebalance an existing load, the switch logs out enough FLOGI (and FDISC) sessions so that when the FLOGI sessions log in again, the load is balanced. The switch balances the load based only on the number of FLOGI sessions, not the sum of FLOGI and FDISC sessions. However, the FDISC sessions associated with a FLOGI follow the FLOGI to the new link if the FLOGI session is part of the rebalancing.

The FLOGI-based load-balancing algorithm uses only the FLOGI sessions to determine the session load on each link for both initial load balancing and load rebalancing.

Load-Balancing Algorithm Comparison

Table 368 on page 4845 compares the three load-balancing algorithms and summarizes their differences, advantages, and disadvantages.

Table 368: Load-Balancing Algorithm Comparison

Load-Balancing Algorithm	Session Assignment	Session Disruption on Rebalance	Session Count Method	Advantages	Disadvantages
Simple (default algorithm)	FDISC sessions can be placed on different links than the parent FLOGI session	Minimum number of selected sessions logged out (FDISC sessions can be logged out independent of the parent FLOGI session)	Sum of FLOGI and FDISC sessions	• Most equal session distribution across links • Minimum number of sessions logged out when rebalancing • Least disruptive algorithm	• Less session control and predictability

Table 368: Load-Balancing Algorithm Comparison *(continued)*

Load-Balancing Algorithm	Session Assignment	Session Disruption on Rebalance	Session Count Method	Advantages	Disadvantages
ENode-based	FDISC sessions are always placed on the same link as the parent FLOGI session	All sessions are logged out	Sum of FLOGI and FDISC sessions	• Better session control and predictability (on link down, all sessions associated with an ENode go down)	• Most disruptive algorithm; all sessions logged out on rebalance • Might result in less balanced link load because FDISCs are placed on the same link as parent FLOGI
FLOGI-based	FDISC sessions are always placed on the same link as the parent FLOGI session	Minimum number of selected sessions logged out (but FDISC sessions logged out when parent FLOGI session is logged out)	FLOGI sessions only (FDISC sessions not included in the session count)	• Better session control and predictability (on link down, all sessions associated with an ENode go down) • Minimum number of sessions logged out when rebalancing	• Might result in less balanced link load because FDISCs are placed on the same link as parent FLOGI

Load-Rebalancing Methods

The load-rebalancing method determines the way the system redistributes sessions to balance the load on the NP_Ports that belong to a local FC fabric on an FCoE-FC gateway.

You can rebalance the existing load on existing NP_Port links using either of two methods:

- Automated load rebalancing—When a load rebalancing trigger occurs, the switch automatically rebalances the link loads by redistributing the sessions across the active NP_Port links. There are three possible load rebalancing triggers:

  1. When you enable automated load rebalancing, the switch checks the load balance on the existing NP_Port links. If the links are already balanced, the switch does not rebalance the link load. If the links are not balanced, the switch rebalances the link loads using the configured load-balancing algorithm.

     Enabling automated load rebalancing causes sessions to be logged out in accordance with the configured load-balancing algorithm if the link load is unbalanced. If the link load is already balanced when you enable automated load rebalancing, the links are not rebalanced. (Disabling automated load rebalancing is not disruptive because the link load is already balanced.)

  2. When a new NP_Port link comes up on a local FCoE-FC gateway fabric, the switch rebalances the link load using the configured load-balancing algorithm if automated load balancing is enabled.

  3. When the port speed is changed (unless the port speed change does not change the actual port speed, for example, changing the port speed from auto to 8 Gbps).

Use automated load rebalancing if you want link loads to be rebalanced automatically when a load-balancing trigger occurs, instead of at times of your choosing. Keep in mind that load rebalancing is a disruptive event (sessions are logged out).

- On-demand load rebalancing—You choose when to rebalance the NP_Port links by explicitly requesting a load rebalance using an operational command. The system rebalances the link load only when you issue the rebalancing command.

  Use on-demand load rebalancing if you only want to rebalance the link load once or if you want to rebalance the link loads at controlled times instead of automatically.

  You can also request a load rebalancing *dry run*. A dry run simulates rebalancing and lists the sessions that might be affected if you choose to perform an actual load-rebalancing operation. The link loads are not rebalanced when you request a dry run.

NP_Port Interface FIP Session Limit Effect on Load Balancing

The maximum number of FIP login sessions configured for each NP_Port interface affects load balancing. When an interface reaches its maximum number of FIP login sessions, that interface is removed from the list of interfaces used for load balancing. The other interfaces in the gateway fabric continue to accept ENode login sessions until they reach their configured maximum session limit. Only interfaces that have not reached their maximum session limit are included in the load-balancing calculations.

NOTE: **If all NP_Port interfaces in a gateway fabric reach their FIP login session limits, the fabric sends subsequent multicast discovery advertisements (MDAs) with the availability bit set to 0 (zero) to prevent additional ENode login attempts. While the maximum number of sessions is running on the gateway fabric, ENodes cannot use that fabric to log in to the FC switch. When the number of sessions falls below the maximum, the gateway sets the availability bit in MDAs to 1 so that ENodes can log in to the fabric again.**

Load-Balancing Triggers and Timing

Several events trigger load balancing. Some of the events trigger load balancing only when automated load balancing is enabled. Other events trigger load rebalancing whether or not automated rebalancing is enabled.

This section describes the load-balancing triggers, what happens when the trigger action occurs, and how the switch determines if and when to balance the link load:

- Load-Balancing Triggers on page 4847
- Load-Balancing Timer on page 4848

Load-Balancing Triggers

Table 369 on page 4848 describes the four different events can trigger load balancing or load rebalancing. In every case, link load rebalancing uses the configured load-balancing algorithm to determine the placement of sessions on links.

Table 369: Load-Balancing Triggers and Actions

Trigger Event	Action
New link comes up	Triggers a load-rebalancing operation regardless of whether or not automated load rebalancing is enabled. (The new link has no sessions, so the sessions on other links must be redistributed to balance the load.) The link load is not rebalanced if there are no sessions on the existing links or if there are so few sessions on the existing links that they cannot be redistributed.
On-demand load rebalancing request issued from CLI	The switch checks the NP_Port link load. If the load is not balanced across the links, the switch rebalances the link load. If the load is already balanced, nothing happens. NOTE: Requesting a dry run displays sessions that might be disrupted if you rebalance the link load, but does not rebalance the link load.
Automated load balancing configured for the first time	The switch checks the NP_Port link load. If the load is not balanced across the links, the switch rebalances the link load. If the load is already balanced, nothing happens.
NP_Port speed change	If automated rebalancing is enabled, changing the port speed brings the port up and down (flaps the port) and causes the switch to rebalance the link loads. If the port speed change does not change the actual port speed (for example, changing the port speed from *auto* to 8 Gbps), the link loads are not rebalanced. If automated rebalancing is not enabled, port speed changes do not cause link load rebalancing.

NOTE: When an NP_Port link goes down, it does not trigger load rebalancing. The loads on the remaining active links are already balanced, and as the sessions logged out from the down link log in again, they are they assigned to links in a balanced manner determined by the configured load-balancing algorithm.

Load-Balancing Timer

When you trigger load balancing from the CLI, the load-balancing action occurs immediately after you execute the command. However, when a load-balancing trigger occurs that is not a CLI command, the switch does not balance the link loads immediately. Instead, the switch follows an intelligent timer process:

1. The switch checks the current load balance on the NP_Port links in the local gateway FC fabric. If the load is already balanced, the switch does nothing, and there is no session disruption.
2. If the check shows that the link load is not balanced, the switch starts a 10-second timer. If no other load-balancing triggers occur during the 10-second interval, the switch rebalances the load.

If another load-balancing trigger occurs during the 10-second interval, the timer resets to 10 seconds. The 10-second timer prevents the switch from performing multiple disruptive load-rebalancing actions in a short period of time.

NOTE: The switch processes new sessions that log in after the timer starts in the normal manner. The new sessions are considered in the load-balancing evaluation and operation.

3. At a maximum of 30 seconds after the first load-balancing trigger occurs, the switch checks the link load balance again. If the links are already balanced, the switch cancels the load-rebalancing operation. If the links are not balanced, the switch rebalances the link loads.

NOTE: If the trigger event that started the load-rebalancing timer is no longer valid when the timer elapses, the switch cancels the rebalancing operation. For example, if a new NP_Port link comes up and triggers the timer, then goes down before the timer expires, the original link up event is no longer valid, and the switch cancels the rebalancing operation (unless another valid rebalancing trigger occurs in that time frame).

When a link load rebalancing operation is in progress, the switch defers any load-rebalancing triggers that occur until the load-rebalancing operation is complete. The new rebalancing operation begins after the current rebalancing operation finishes if a check shows that rebalancing is required.

If you explicitly request load rebalancing from the CLI using the **request fibre-channel proxy load-rebalance** operational command, the switch rejects the command and displays an error message stating that rebalancing is already in progress.

Load Rebalancing Behavior When a Link Goes Down

If an NP_Port link goes down, the ENode and VN_Port sessions on that link are logged out. The ENodes and VN_Port sessions log in again and are assigned to NP_Port links based on the link load and the load-balancing algorithm. If a link goes down, the switch does not rebalance the remaining load on the remaining links to avoid disrupting the existing ENode and VN_Port sessions. (Also, it is not necessary to rebalance the links in that manner because after a link goes down, the sessions on the remaining links are already balanced. As the logged out sessions log back in, the switch places them on the remaining active links in a balanced manner, according to the configured load-balancing algorithm.)

NOTE: When you use the simple load-balancing algorithm, an ENode and its associated VN_Port sessions might be on different links. In that case, if the NP_Port with the ENode goes down, only the VN_Ports on the same link are logged out. VN_Ports on other links remain up and running.

Interface Load Calculation Algorithm

A weighted round-robin (WRR) algorithm determines the interface load based on:

- The current number of sessions on the interface

NOTE: The configured load-balancing algorithm determines how the switch counts the number of sessions. For simple and ENode-based load balancing, the number of sessions is the sum of the FLOGI and FDISC sessions on each link. For FLOGI-based load balancing, the number of sessions is the sum of the FLOGI sessions on each link.

- The interface weight, which is the speed of the Fibre Channel link (2 Gbps, 4 Gbps, or 8 Gbps)

The interface load algorithm is:

(number-of-sessions * max-weight) / weight

where *max-weight* is an internal constant.

If the load on the FC interfaces is equal, the session is assigned to the interface with the highest link speed (the greatest weight).

For example, if the three FC interfaces have the characteristics shown in Table 370 on page 4850, the loads of the interfaces are not equal:

Table 370: FC Interface Session-Based Load-Balancing Characteristics for Unequal Loads

Interface	Number of Sessions	Weight (Speed)
fc-0/0/0	4	4 Gbps
fc-0/0/1	1	2 Gbps
fc-0/0/2	8	8 Gbps

In this example, interfaces fc-0/0/0 and fc-0/0/2 have a greater load than fc-0/0/1. For simple load balancing, the gateway assigns the next new FLOGI or FDISC to fc-0/0/1 because it is the least-loaded interface. For both ENode-based and FLOGI-based load balancing, the gateway assigns the next new FLOGI to fc-0/0/1 because it is the least-loaded interface. Then all VN_Port FDISCs from that ENode follow the ENode FLOGI and are also assigned to fc-0/0/1 regardless of the link load.

For another example, if the three FC interfaces have the characteristics shown in Table 371 on page 4851, the loads of the interfaces are equal:

Table 371: FC Interface Session-Based Load-Balancing Characteristics for Equal Loads

Interface	Number of Sessions	Weight (Speed)
fc-0/0/0	4	4 Gbps
fc-0/0/1	2	2 Gbps
fc-0/0/2	8	8 Gbps

In this case, all interfaces have the same relative load. For simple load balancing, the gateway assigns the next new FLOGI or FDISC to fc-0/0/2 because although the loads of the three interfaces are equal, fc-0/0/2 has the greatest weight. For both ENode-based and FLOGI-based load balancing, the gateway assigns the next new FLOGI to fc-0/0/2, and all VN_Port FDISCs from that ENode follow the ENode FLOGI and are also assigned to fc-0/0/2 regardless of the link load.

After the gateway establishes a session between an ENode or a VN_Port and an FC switch on an NP_Port, the session remains on that NP_Port until the ENode or VN_Port performs a LOGO.

If the physical FC interface link goes down, the FLOGI and FDISC sessions on the down link are logged out. The ENodes and VN_Ports log in again to start new sessions on other NP_Ports in the local gateway FC fabric in accordance with the configured load-balancing algorithm (assuming there is more than one NP_Port connected to the FC fabric).

Load-Balancing Scenarios

The configured load-balancing algorithm, the sequence in which ENodes log in to the FC network, the current session count (number of sessions per interface) and the interface speed determine the way the session load is balanced across the native FC interfaces (NP_Ports) in a gateway FC fabric. Whether you are balancing the link load for the first time or rebalancing an existing link load, the way the load is distributed across the active links is the same.

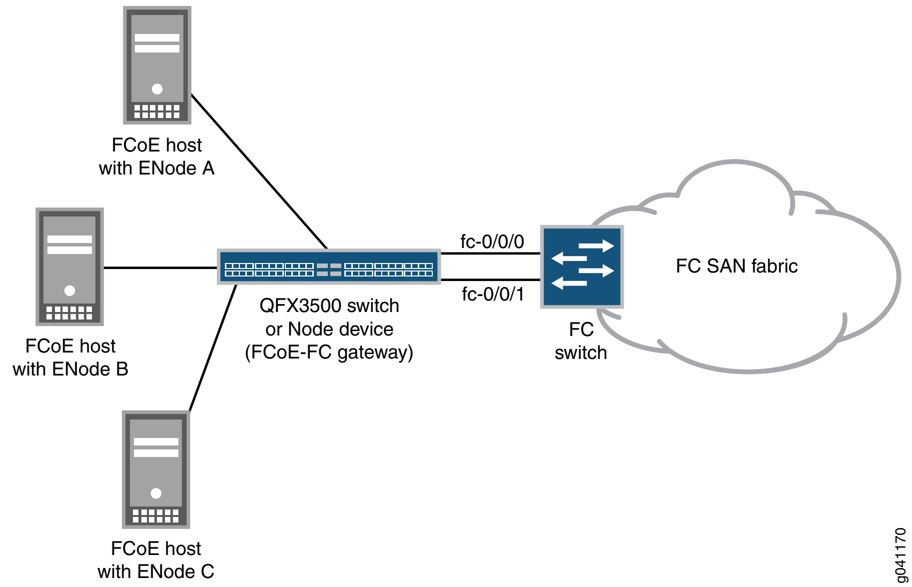
NOTE: **The way the switch counts the number of sessions on a port depends on the load-balancing algorithm. For simple and ENode-based load balancing, the sum of the FLOGI and FDISC sessions equals the session count. For FLOGI-based load balancing, only the FLOGI sessions are counted in the total session count.**

The following scenarios demonstrate how sessions are assigned to links for each load-balancing algorithm:

- Simple Load-Balancing Algorithm Scenario on page 4852
- ENode-Based Load-Balancing Algorithm Scenarios on page 4853
- FLOGI-Based Load-Balancing Algorithm Scenarios on page 4854

All of the scenarios use the topology shown in Figure 175 on page 4852.

Figure 175: Sample Load-Balancing Topology



Simple Load-Balancing Algorithm Scenario

Simple load balancing results in the most equal load distribution among the NP_Ports connected to an FC SAN fabric because VN_Port FDISC sessions do not need to "follow" the parent ENode FLOGI session on the same link between the gateway and the FC fabric. When a new FLOGI or FDISC session is initiated, it is assigned to the least-loaded link.

The simple load-balancing algorithm example uses the topology shown in Figure 175 on page 4852 and has the following characteristics:

- QFX Series configured as an FCoE-FC gateway
- Two gateway NP_Ports, **fc-0/0/0** and **fc-0/0/1**, connected to an FC SAN fabric switch at a speed of 8 Gbps
- Three ENodes, ENode_A, ENode_B, and ENode_C connected to the gateway
- NP_Ports **fc-0/0/0** and **fc-0/0/1**, and ENode_A, ENode_B, and ENode_C, belong to the same local FC fabric on the gateway

When the NP_Ports initialize, they send FLOGI messages to the FC switch and log in to the FC SAN fabric. The gateway then advertises the fabric to the ENodes on the Ethernet side of the network. At this point, the load on both of the NP_Ports is equal. Now the ENodes and VN_Ports start to log in to the fabric:

1. ENode_A sends a FLOGI to log in to the fabric. Because the loads on the two NP_Ports are equal, the session for ENode_A is randomly placed on one of the links. In this example, the ENode_A FLOGI session is placed on port **fc-0/0/0**.
2. Enode_B logs in. Because the load is less on port **fc-0/0/1**, the Enode_B FLOGI session is placed on port **fc-0/0/1**.

3. ENode_C logs in. Because the link loads are equal, the ENode_C login session is randomly placed on one of the links. In this example, the ENode_C login session is placed on port **fc-0/0/0**.
4. A VN_Port on ENode_A sends an FDISC to log in to the fabric. Because port **fc-0/0/1** currently is the least-loaded link, the VN_Port session is placed on port **fc-0/0/1**, even though its parent ENode session is on port **fc-0/0/0**.
5. As each new VN_Port session comes up, it is placed on the least-loaded link, regardless of the link on which its parent ENode session is placed.

ENode-Based Load-Balancing Algorithm Scenarios

ENode-based load balancing ensures that VN_Port FDISC sessions are placed on the same link as their parent ENode FLOGI sessions, regardless of the link load. ENode-based load balancing can result in a less-balanced load among the NP_Port links, but it provides the control and predictability of keeping ENodes and their VN_Port sessions on the same link.

The examples in this section use the topology shown in Figure 175 on page 4852.

- QFX Series configured as an FCoE-FC gateway
- Two gateway NP_Ports, **fc-0/0/0** and **fc-0/0/1**, connected to an FC SAN fabric switch at a speed of 8 Gbps
- Three ENodes connected to the gateway:
  - ENode_A, which has 2 VN_Port FDISC sessions
  - ENode_B, which has 20 VN_Port FDISC sessions
  - ENode_C, which has 100 VN_Port FDISC sessions
- NP_Ports **fc-0/0/0** and **fc-0/0/1**, and ENode_A, ENode_B, and ENode_C, belong to the same local FC fabric on the gateway

When the NP_Ports initialize, they send FLOGI messages to the FC switch and log in to the FC SAN fabric. The gateway then advertises the fabric to the ENodes on the Ethernet side of the network. At this point, the load on both of the NP_Ports is equal. Now the ENodes and VN_Ports start to log in to the fabric. As the following two scenarios show, how these sessions are placed on the links depends on the sequence in which they log in to the fabric.

Scenario 1:

1. ENode_A sends a FLOGI to log in to the fabric. Because the loads on the two NP_Ports are equal, the session for ENode_A is randomly placed on one of the links. In this example, the ENode_A FLOGI session is placed on port **fc-0/0/0**.
2. ENode_B logs in. Because the load is less on port **fc-0/0/1**, the ENode_B FLOGI session is placed on port **fc-0/0/1**.
3. The two VN_Ports on ENode_A log in to the fabric. Their sessions are placed on port **fc-0/0/0**, following ENode_A on the link. Now port **fc-0/0/0** has a greater load (one FLOGI session plus two FDISC sessions) than port **fc-0/0/1** (one FLOGI session).

4. The 20 VN_Ports on ENode_B log in to the fabric. Their sessions are placed on port **fc-0/0/1**, following ENode_B on the link. Now port **fc-0/0/0** has a lesser load (one FLOGI, two FDISC) than port **fc-0/0/1**.
5. ENode_C logs in. Because the load is less on port **fc-0/0/0**, the ENode_C FLOGI session is placed on port **fc-0/0/0**.
6. The 100 VN_Ports on ENode_C log in to the fabric. Their sessions follow the ENode_C session onto port **fc-0/0/0**.
7. If more VN_Ports come up, their FDISC sessions are placed on the same link as the corresponding parent ENode session.

Scenario 2:

1. ENode_A sends a FLOGI to log in to the fabric. Because the loads on the two NP_Ports are equal, the session for ENode_A is randomly placed on one of the links. In this example, the ENode_A FLOGI session is placed on port **fc-0/0/0**.
2. ENode_B logs in. Because the load is less on port **fc-0/0/1**, the ENode_B FLOGI session is placed on port **fc-0/0/1**.
3. The two VN_Ports on ENode_A log in to the fabric. Their sessions are placed on port **fc-0/0/0**, following ENode_A on the link. Now port **fc-0/0/0** has a greater load (one FLOGI session plus two FDISC sessions) than port **fc-0/0/1** (one FLOGI session).
4. In this step, the login sequence in Scenario 2 differs from the login sequence in Scenario 1, resulting in a different placement of sessions on the links, and therefore a different load on the links. ENode_C logs in before the ENode_B VN_Ports log in, which changes the session count on the links compared to the first scenario. Because the load in this scenario is less on port **fc-0/0/1**, the ENode_C FLOGI session is placed on port **fc-0/0/1** (instead of port **fc-0/0/0** as in the first scenario).
5. The 20 VN_Ports on ENode_B log in to the fabric. Their sessions are placed on port **fc-0/0/1**, following ENode_B on the link. Now port **fc-0/0/0** carries one FLOGI and two FDISC sessions, and port **fc-0/0/1** carries two FLOGI and 20 FDISC sessions.
6. The 100 VN_Ports on ENode_C log in to the fabric. Their sessions follow the ENode_C session onto port **fc-0/0/1**. Now port **fc-0/0/1** carries 2 FLOGI and 120 FDISC sessions, whereas port **fc-0/0/0** carries one FLOGI and two FDISC sessions.
7. If more VN_Ports come up, their FDISC sessions are placed on the same link as the corresponding parent ENode session.

Because of the sequence of ENode logins in Scenario 2, port **fc-0/0/1** carries a greater load than port **fc-0/0/0**. If the simple load-balancing algorithm had been used, the FLOGI and FDISC sessions would be allocated to the two links evenly. However, because the FDISC sessions are placed on the same link as their parent FLOGI sessions, this example demonstrates how using the ENode-based load-balancing algorithm can lead to scenarios in which the link loads are not equal.

FLOGI-Based Load-Balancing Algorithm Scenarios

FLOGI-based load balancing is similar in many ways to ENode-based load balancing. An important difference that affects how the switch places sessions on links is that for

FLOGI-based load balancing, only the FLOGI sessions are counted when the link load is calculated. FDISC sessions are not counted to determine the link load. Because ENode-based load balancing uses the sum of the FLOGI and FDISC sessions to determine the link load, an interface with exactly the same combination of FLOGI and FDISC sessions can have a different session count depending on the algorithm used. A different session count can change the interface to which the switch assigns the next session.

As with ENode-based load balancing, FLOGI-based load balancing ensures that VN_Port FDISC sessions are placed on the same link as their parent ENode FLOGI sessions, regardless of the link load. FLOGI-based load balancing can result in a less-balanced load among the NP_Port links, but it provides the control and predictability of keeping ENodes and their VN_Port sessions on the same link.

The examples in this section use the topology shown in Figure 175 on page 4852.

- QFX Series configured as an FCoE-FC gateway
- Two gateway NP_Ports, **fc-0/0/0** and **fc-0/0/1**, connected to an FC SAN fabric switch at a speed of 8 Gbps
- Three ENodes connected to the gateway:
  - ENode_A, which has 2 VN_Port FDISC sessions
  - ENode_B, which has 20 VN_Port FDISC sessions
  - ENode_C, which has 100 VN_Port FDISC sessions
- NP_Ports **fc-0/0/0** and **fc-0/0/1**, and ENode_A, ENode_B, and ENode_C, belong to the same local FC fabric on the gateway

When the NP_Ports initialize, they send FLOGI messages to the FC switch and log in to the FC SAN fabric. The gateway then advertises the fabric to the ENodes on the Ethernet side of the network. At this point, the load on both of the NP_Ports is equal. Now the ENodes and VN_Ports start to log in to the fabric.

Because FLOGI-based load balancing does not count FDISC sessions when calculating the link load, how the sessions are placed on the link depends only on the number of FLOGI sessions per interface, not on the number of FLOGI sessions plus FDISC sessions. This means that an ENode with a FLOGI session and many FDISC sessions is counted as having the same load as an ENode with a FLOGI session and no FDISC sessions.

Scenario 1:

1. ENode_A sends a FLOGI to log in to the fabric. Because the loads on the two NP_Ports are equal, the session for ENode_A is randomly placed on one of the links. In this example, the ENode_A FLOGI session is placed on port **fc-0/0/0**.
2. ENode_B logs in. Because the load is less on port **fc-0/0/1**, the ENode_B FLOGI session is placed on port **fc-0/0/1**.
3. The two VN_Ports on ENode_A log in to the fabric. Their sessions are placed on port **fc-0/0/0**, following ENode_A on the link. However, unlike simple load balancing or ENode-based load balancing, the session count of the two ports is still equal (one session each) because the FDISC sessions are not used in the session count.

4. The 20 VN_Ports on ENode_B log in to the fabric. Their sessions are placed on port **fc-0/0/1**, following ENode_B on the link. Again, unlike simple load balancing or ENode-based load balancing, the session count of the two ports is still equal (one session each) because the FDISC sessions are not used in the session count.
5. ENode_C logs in. Because the link loads are counted as equal, the ENode_C login session is randomly placed on one of the links. In this example, the ENode_C login session is placed on port **fc-0/0/0**.
6. The 100 VN_Ports on ENode_C log in to the fabric. Their sessions follow the ENode_C session onto port **fc-0/0/0**.
7. If more VN_Ports come up, their FDISC sessions are placed on the same link as the corresponding parent ENode session.

If a fourth ENode, ENode_D, sends a FLOGI to log in to the fabric, it is placed on port **fc-0/0/1** because port **fc-0/0/0** has a session count of two (two FLOGIs from ENode_A and ENode_C, FDISCs not counted) and port **fc-0/0/1** has a session count of one (one FLOGI from ENode_B, FDISCs not counted), so port **fc-0/0/1** is the least-loaded port.

With FLOGI-based load balancing, it is possible for ENodes with many FDISC sessions to be placed on the same link, whereas ENodes with few FDISC sessions are placed on different links because only FLOGIs are used in the session count.

Load Balancing on the FCoE Interfaces (Ethernet Links)

You can achieve load balancing on the 10-Gigabit Ethernet interfaces that belong to an FCoE VLAN by configuring them in one or more link aggregation groups (LAGs). In addition to load balancing, LAGs offer the advantages of protecting against port failover, increasing available link bandwidth, and preventing spanning-tree algorithms from blocking physical links and wasting bandwidth.

Related Documentation

- Understanding an FCoE-FC Gateway on page 4808
- Understanding FCoE-FC Gateway Functions on page 4812
- Understanding Interfaces on an FCoE-FC Gateway on page 4829
- Defining the Proxy Load-Balancing Algorithm on page 5056
- Simulating On-Demand Fibre Channel Link Load Rebalancing (Dry Run Test) on page 5058
- Example: Configuring Automated Fibre Channel Interface Load Rebalancing on page 4999
- **show fibre-channel proxy fabric-state on page 5241**
- **request fibre-channel proxy load-rebalance on page 5164**
- Monitoring Fibre Channel Interface Load Balancing on page 5147

Understanding OxID Hash Control for FCoE Traffic Load Balancing

The originator exchange identifier (OxID) field is one of several fields that the switch can use in its hash function computation for FCoE traffic load balancing over multiple outgoing links in an Ethernet link aggregation group (LAG). The originator of an exchange between a pair of Fibre Channel (FC) endpoints (such as an FCoE host and an FC storage device) uses the OxID field as an identifier for that exchange. The originator also uses the OxID field to track the progress of the series of sequences that comprise the exchange.

When FCoE traffic traverses a LAG, it can take multiple different links between the source and destination endpoints. The idea is to distribute the FCoE traffic across the LAG links, thus balancing the link load. The switch creates a hash value from some of the packet header fields, and uses the hash value to assign each packet to one of the LAG links. The switch always uses five packet header fields to compute the hash value:

- Source ID (SID)
- Destination ID (DID)
- Fabric ID (FID)
- Source Port ID (SPID)
- Source Module ID (SMID)

In addition, the OxID field is included by default in the FCoE load-balancing hash computation. However, if you do not want to use the OxID field in the FCoE load-balancing hash computation, you can remove it from the computation by using the **set forwarding-options hash-key family fcoe oxid disable** command.

Including the OxID field in the load-balancing hash computation allows different exchanges between a pair of Fibre Channel (FC) endpoints (such as an FCoE host and an FC storage device) to take different paths across the network, thus improving the aggregate network throughput.

However, if the paths between different sets of FC endpoints have common links, congestion on one set of FC endpoints can affect the other set of endpoints. Such congestion can happen if the FCoE traffic on the two sets of endpoints uses the same priority (IEEE 802.1p code point). It is common for networks to use priority 3 (IEEE 802.1p code point 011) for FCoE traffic. However, on the QFX3500 switch, you can assign different IEEE priorities to different lossless FCoE flows as described in “Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows” on page 5427 to further separate the traffic flows.

Related Documentation

- Enabling and Disabling CoS OxID Hash Control on page 5059

Understanding VN_Port to VF_Port FIP Snooping on an FCoE Transit Switch

Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) snooping is a security mechanism that is designed to prevent unauthorized access and data transmission to a Fibre Channel (FC) network. It works by filtering traffic to permit only servers that have logged in to an FC network to access that network.

You explicitly enable VN_Port to VF_Port (VN2VF_Port) FIP snooping (FC-BB-5) on FCoE VLANs when the QFX Series is an FCoE transit switch at the access edge that connects FCoE devices on the Ethernet network to FC switches or gateways at the FC storage area network (SAN) edge. The transit switch applies FIP snooping filters at the ports associated with the FCoE VLANs on which you enable VN2VF_Port FIP snooping. An FCoE transit switch is a data center bridging (DCB) switch with FIP snooping capability.

An FCoE device that has a converged network adapter (CNA) uses the FIP process to log in to the FC network as an FCoE Node (ENode). The login process establishes a dedicated virtual link between a virtual N_Port (VN_Port) on the ENode and a virtual F_Port (VF_Port) on the FC switch. This dedicated virtual link emulates a point-to-point connection. The emulated connection is called a virtual link.

Virtual links pass transparently through the switch. The ENode VN_Port and the FC switch VF_Port do not detect the transit switch, and virtual links appear to be direct point-to-point links.

The QFX Series applies VN2VF_Port FIP snooping firewall filters at the directly attached edge ports associated with the FCoE VLANs on which you enable VN2VF_Port FIP snooping. FIP snooping provides security for virtual links by creating firewall filters based on information gathered (snooped) about FC devices during FIP transactions.

The QFX Series also supports VN_Port to VN_Port (VN2VN_Port) FIP snooping (FC-BB-6) to allow FCoE initiators and targets to communicate directly through the switch without going through an FCoE forwarder (FCF) or an FC switch, as described in "Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch" on page 4865.

NOTE: An FCoE VLAN can support either VN2VF_Port FIP snooping (FC-BB-5) or VN2VN_Port FIP snooping (FC-BB-6), but not both. The same QFX Series switch can have multiple FCoE VLANs configured, some for VN2VF_Port FIP snooping traffic and others for VN2VN_Port FIP snooping traffic. On FCoE VLANs that are configured as VN2VN_Port snooping VLANs, VN2VF_Port FIP snooping traffic is dropped.

When you enable VN2VF_Port FIP snooping, the system snoops VN_Port to VF_Port packets and enforces security only on VN2VF_Port virtual links. When you enable VN2VN_Port FIP snooping, the system snoops VN_Port to VN_Port packets and enforces security only on VN2VN_Port virtual links.

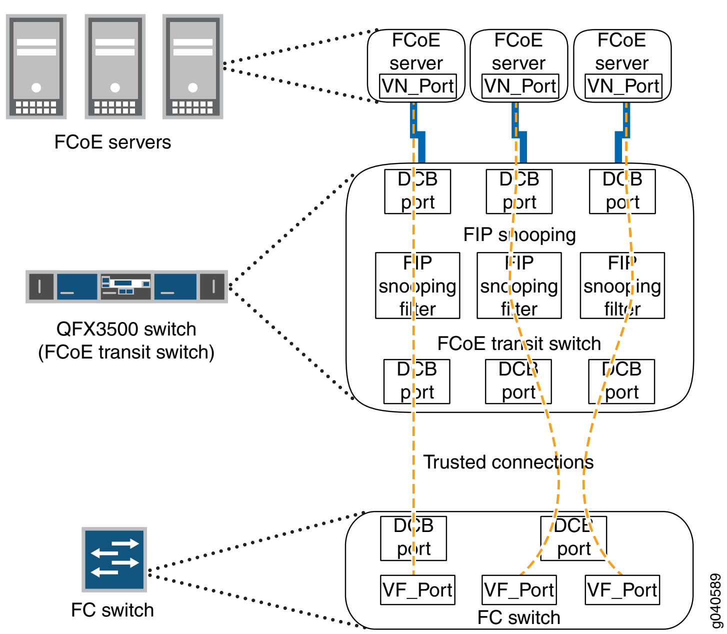
This topic describes:

FC Network Security

In traditional FC networks, the FC switch is usually a trusted entity, and server ENodes connect directly to its VF_Ports. After an ENode gains access to the network through the fabric login (FLOGI) process, the FC switch enforces zoning configurations, ensures that the ENode uses valid addresses, monitors the connection, and performs other security functions to prevent unauthorized access.

However, FCoE exposes FC frames to Ethernet networks, which do not have the same level of security as native FC networks. VN2VF_Port FIP snooping firewall filters emulate the native FC network security functions by preventing unauthorized access to the FC switch through the transit switch and by ensuring the security of the virtual link between each ENode and the FC switch, as shown in Figure 176 on page 4859. VN2VF_Port FIP snooping also prevents man-in-the-middle attacks.

Figure 176: FCoE Transit Switch Performs VN2VF_Port FIP Snooping



The transit switch performs VN2VF_Port FIP snooping at the ports connected to the FCoE devices. At the SAN edge, the FC switch must be able to convert the FCoE traffic to native FC traffic.

VN2VF_Port FIP Snooping Functions

When VN2VF_Port FIP snooping is enabled, the QFX3500 transit switch sets and applies filters to block all FCoE traffic by default. The transit switch monitors FIP logins, solicitations, and advertisements that pass through it and gathers information about the ENode address and the address of the port on the FC switch. The transit switch uses the information to construct firewall filters that permit access only to logged-in ENodes. All other traffic on the VLAN is denied.

For example, when an ENode on an FCoE VLAN performs a successful login to an FC switch port, the transit switch snoops the FIP information and constructs a firewall filter that provides access for the ENode to that port on the FC switch.

The firewall filters enable FCoE frames to pass through the transit switch only on a virtual link established between an FCoE device ENode VN_Port and the FC switch VF_Port to which it has logged in. The firewall filters ensure that ENodes can only connect to the FC switches they have successfully logged in to and that only valid FCoE traffic along valid paths is transmitted. VN2VF_Port FIP snooping maintains the filters by tracking FCoE sessions (ENode to FCF sessions).

FIP Snooping Firewall Filters

The effect of the firewall filters is to protect the FCoE ports. VN2VF_Port FIP snooping performs the following actions and checks to ensure that FCoE traffic is valid:

- Denies ENodes that use the FC switch media access control (MAC) address as the source address.
- Enables ENodes to transmit FIP and FCoE frames to the FC switch address.
- Ensures that the FCoE source address the FC switch assigns or accepts is only used for FCoE traffic.
- Ensures that FCoE frames are only addressed to the accepting FC switch.

Session Scalability

The system supports up to 2500 total FIP snooping sessions on an interface, a gateway FC fabric, a QFX Series switch, a QFabric Node device, or a QFabric Node group. For example, you can:

- Place all 2500 sessions on one FCoE interface.
- Split the 2500 sessions among multiple FCoE interfaces on one FCoE VLAN.
- Split the 2500 sessions among multiple FCoE interfaces on multiple FCoE VLANs.
- Split the 2500 sessions among the FCoE interfaces on multiple gateway FC fabrics on a switch.
- Split the 2500 sessions among the FCoE interfaces on multiple gateway FC fabrics on multiple Node devices in a QFabric Node group.

Regardless of how you allocate the sessions among interfaces and local FC fabrics on a QFX Series switch or on a QFabric system Node device or Node group, the combined FIP session limit is a maximum of 2500 sessions.

NOTE: **The total number of sessions the system can support is the combined number of VN2VF_Port sessions and VN2VN_Port sessions. If VN2VN_Port sessions are active, the total number of available VN2VF_Port sessions is reduced.**

VN2VF_Port FIP Snooping Implementation

You enable VN2VF_Port FIP snooping on a per-VLAN basis on VLANs that carry FCoE traffic. The switch snoops FIP frames at the ports associated with FCoE VLANs enabled for VN2VF_Port FIP snooping. The switch then installs the resulting firewall filters on the ports to ensure that all VN2VF_Port FIP snooping occurs on the switch network edge.

VN2VF_Port FIP snooping FCoE VLANs must meet the following criteria:

- An FCoE VLAN should be dedicated to FCoE traffic only.
- An FCoE VLAN cannot support both VN2VF_Port FIP snooping and VN2VN_Port FIP snooping simultaneously. You must configure separate FCoE VLANs for VN2VF_Port FIP snooping traffic and for VN2VN_Port FIP snooping traffic.

  NOTE: **Changing an FCoE VLAN from VN2VF_Port FIP snooping mode to VN2VN_Port snooping mode terminates the existing virtual links on the VLAN. The transit switch removes the existing FIP snooping filters, creates the new FIP snooping filters, and applies them to the FIP snooping ports. If you downgrade the software to Junos OS Release 12.1 or earlier, VLANs configured for VN2VN_Port FIP snooping revert to VN2VF_Port FIP snooping VLANs.**

- For QFX3500 switches, QFX3600 switches, and QFabric system Node devices, configure all access ports that belong to an FCoE VLAN (ports connected to a converged network adapter [CNA] in an FCoE device) in **tagged-access** port mode. Access ports associated with an FCoE VLAN should not be configured as access ports or trunk ports on these platforms, although trunk port configuration is supported.

  However, on QFX5100 switches that run the Enhanced Layer 2 Software (ELS) CLI, configure access ports that belong to an FCoE VLAN in **trunk** interface mode.
- All ports connected to an FC switch (or FCoE forwarder) must be configured in **trunk** port mode. Ports connected to an FC switch must be configured as trusted ports.
- FIP traffic uses the native VLAN (FIP VLAN discovery and notification frames are exchanged as untagged packets).
- All FCoE VLAN traffic must be tagged and cannot belong to the native VLAN.
- FCoE VLAN traffic cannot be untagged or priority-tagged.

When you enable VN2VF_Port FIP snooping, the switch inspects FIP frames.

The VN2VF_Port FIP snooping implementation includes these considerations:

- ENode-Facing Interfaces on page 4862
- Network-Facing Interfaces on page 4863
- FC-MAP on page 4863

ENode-Facing Interfaces

When the interfaces that belong to an FCoE VLAN connect directly to FCoE devices (there is no other transit switch between the FCoE devices and the QFX Series switch), we recommend that you enable VN2VF_Port FIP snooping on all FCoE VLANs that connect VN_Ports to VF_Ports. Enabling FIP snooping ensures secure connections between server ENodes and FC switches. (Enabling VN2VN_Port FIP snooping ensures secure connections on FCoE VLANs that connect VN_Ports to other VN_Ports). FIP snooping should always be enabled at the access edge.

Systems that run Enhanced Layer 2 Software (ELS) such as the QFX5100 switch support a slightly different configuration on ENode-facing interfaces than systems that do not run ELS. This section describes:

- Non-ELS Port Mode for FCoE Interfaces on page 4862
- ELS Interface Mode for FCoE Interfaces on page 4862
- Trusted and Untrusted FCoE Interfaces on page 4863

Non-ELS Port Mode for FCoE Interfaces

The interfaces that belong to FCoE VLANs (interfaces that connect to CNAs in FCoE devices) on systems that do not support ELS should be configured in **tagged-access** port mode. After you enable VN2VF_Port FIP snooping on an FCoE VLAN, the transit switch denies FCoE traffic from any ENode on that VLAN until the ENode performs a valid fabric login with an FC switch.

The **tagged-access** port mode was not available in Junos OS Release 11.3 and prior releases. In Release 11.3 and earlier, **trunk** port mode was used for Ethernet interfaces that connected to FCoE access devices. Because **tagged-access** mode is now available, using **trunk** mode for interfaces connected to FCoE CNAs is not recommended.

If an existing configuration uses **trunk** mode for ports connected to FCoE CNAs, you can change the port mode to **tagged-access** without disrupting traffic. Although we recommend changing the port mode of these ports from **trunk** to **tagged-access** as a best practice, it is not mandatory. New configurations should use **tagged-access** mode for interfaces that connect to FCoE devices.

ELS Interface Mode for FCoE Interfaces

The interfaces that belong to FCoE VLANs (interfaces that connect to CNAs in FCoE devices) on systems that support ELS should be configured in **trunk** interface mode. After you enable VN2VF_Port FIP snooping on an FCoE VLAN, the transit switch denies FCoE traffic from any ENode on that VLAN until the ENode performs a valid fabric login with an FC switch.

Trusted and Untrusted FCoE Interfaces

Do not configure ENode-facing interfaces as FCoE trusted interfaces when VN2VF_Port FIP snooping is enabled on those interfaces. If you enable VN2VF_Port FIP snooping on an FCoE VLAN and you configure ENode-facing interfaces that are members of the FIP snooping VLAN as **fcoe-trusted**, then FCoE devices might not be able to log in to the FC network.

Changing ports from untrusted to trusted removes any existing VN2VF_Port FIP snooping filters from the ports and terminates the existing sessions. Changing the fabric ports from trusted to untrusted forces all of the FCoE sessions on those ports to log out so that when the ENodes and VN_Ports log in again, the switch can build the appropriate VN2VF_Port FIP snooping filters.

Network-Facing Interfaces

When the switch acts an FCoE transit switch, you must configure any interface that is connected to a switch as an FCoE trusted interface in **trunk** port mode and as a 10-Gigabit Ethernet interface.

Switch-facing Ethernet interfaces have the following requirements and behaviors:

- You must explicitly configure switch-facing trunk ports on an FCoE transit switch as FCoE trusted interfaces.
- After you configure an FC switch-facing trunk port as a trusted interface, the FCoE transit switch always processes FC switch frames because they come from a source on a trusted interface.
- All ports in an FCoE VLAN must be configured as tagged access or trunk ports.

FC-MAP

When the switch acts as an FCoE transit switch and you enable VN2VF_Port FIP snooping on an FCoE VLAN, you can optionally specify a 24-bit FCoE mapped address prefix (FC-MAP) value. On a given VLAN, the transit switch learns only those FC switches that have a matching FC-MAP value. If the transit switch FCoE VLAN FC-MAP value does not match the FC switch FC-MAP value, the transit switch does not discover the FC switch on that VLAN, and the ENodes on that VLAN cannot access the FC switch. An FCoE VLAN can have one and only one FC-MAP value.

The FC-MAP value is a MAC address prefix unique to an FC switch in the FC SAN fabric that the FC switch uses to identify FCoE traffic for a given FC fabric (traffic on a particular FCoE VLAN). The FC switch combines the FC-MAP value with a unique 24-bit FCID value for the ENode VN_Port during the login process. This creates a 48-bit identifier that is unique to the fabric. The FC switch assigns this 48-bit value to the ENode VN_Port as its MAC address and unique identifier for the session. Each VN_Port session the ENode establishes with the FC switch receives a unique FCID from the FC switch, so an FCoE device can host multiple virtual links (one for each VN_Port) to an FC switch, each with a 48-bit MAC address that is unique to the fabric.

The VN2VF_Port FIP snooping filter compares the configured FC-MAP value with the FC-MAP value in the header of frames coming from the ENode VN_Port. If the values do not match, the transit switch denies access.

NOTE: Changing the FC-MAP value causes all logins to be dropped and forces ENodes to log in again.

NOTE: Do not configure static MAC addresses with the FC-MAP value as a prefix (the first 24 bits of the MAC address). If you configure a static MAC address that uses the FC-MAP value as a prefix, the system deletes the static MAC address automatically after you enable FIP snooping. The static MAC address configuration is not restored even if you disable FIP snooping later. (The system considers a static MAC address with the FC-MAP value as the prefix to be a misconfiguration.) Do not use a MAC address with the FC-MAP value as the prefix for any traffic other than the FIP snooping traffic when the QFX Series is acting as a transit switch.

T11 VN2VF_Port FIP Snooping Specification

For more details about VN2VF_Port FIP snooping, see http://www.t11.org/ftp/t11/pub/fc/bb-5/08-264v3.pdf for the Technical Committee T11 organization document *Increasing FCoE Robustness using FIP Snooping*.

Related Documentation

- Overview of Fibre Channel on the QFX Series on page 4786
- Understanding DCB Features and Requirements on page 4795
- Understanding FCoE Transit Switch Functionality on page 4804
- Understanding an FCoE-FC Gateway on page 4808
- Overview of FIP on page 4790
- Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch on page 4865
- Understanding FIP Snooping, FBF, and MVR Filter Scalability on page 4872
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- Disabling VN2VF_Port FIP Snooping on an FCoE-FC Gateway Switch Interface on page 5072
- Configuring VLAN Interfaces for FCoE Traffic on an FCoE Transit Switch on page 5066
- Understanding Fibre Channel Terminology on page 4895

Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch

VN_Port to VN_Port (VN2VN_Port) Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) snooping (FC-BB-6) on an FCoE transit switch is conceptually similar to VN_Port to VF_Port (VN2VF_Port) FIP snooping (FC-BB-5) on an FCoE transit switch. An FCoE transit switch is a data center bridging (DCB) switch with FIP snooping capability. VN2VN_Port FIP snooping provides security in the form of filters. The filters help prevent unauthorized access and data transmission on a bridge that connects ENodes on the Ethernet network.

The main difference between VN2VN_Port FIP snooping and VN2VF_Port FIP snooping is that you use VN2VN_Port FIP snooping when the FCoE devices reside on the Ethernet network, so there is no need to forward traffic between FCoE devices to the Fibre Channel (FC) network, and you use VN2VF_Port FIP snooping when FCoE devices on the Ethernet network need to access targets on the FC network, so FCoE traffic must be forwarded to the FC network. See "Understanding VN_Port to VF_Port FIP Snooping on an FCoE Transit Switch" on page 4858 for information about VN2VF_Port FIP snooping.

You enable VN2VN_Port FIP snooping on the FCoE VLAN that transports the VN2VN traffic. The transit switch applies VN2VN_Port FIP snooping filters at the ports associated with the FCoE VLANs on which you enable VN2VN FIP snooping.

A key benefit of VN2VN_Port FIP snooping is that it enables FCoE initiators and targets to communicate directly through the switch without going through an FCoE forwarder (FCF) or an FC switch. The transit switch does not differentiate between initiators and targets because the transit switch sees both VN_Ports as FIP virtual link end points. Direct VN2VN_Port communication requires secure access (FIP snooping filters) because ENodes are not trusted entities.

This topic describes:

VN2VN_Port FIP Snooping and FIP Snooping Virtual Links

FIP snooping under the T11 FC-BB-5 specification requires that an FC switch or an FCF be in the path between two VN_Ports when they communicate. Introduced in the T11 FC-BB-6 specification (see http://www.t11.org/ftp/t11/pub/fc/bb-6/10-019v3.pdf), VN2VN_Port FIP snooping allows the FCoE transit switch to connect two VN_Ports to each other directly, without going through an FC switch or an FCF, provided that the ENodes have logged in to the FC network.

In VN2VF_Port FIP snooping, when an ENode logs in to the FC network, the FCoE transit switch snoops the FIP communication between the ENode and the FC switch. In VN2VN_Port FIP snooping mode, the transit switch creates filters on the switch access ports to control VN_Port access to other VN_Ports on the Ethernet network. The VN2VN_Port FIP snooping filters allow the switch to establish a dedicated virtual link that emulates a point-to-point connection between two VN_Ports, through the switch.

Virtual links pass transparently through the transit switch. The VN_Ports do not detect the transit switch, and virtual links appear to be direct point-to-point links.

You explicitly enable VN2VN_Port FIP snooping on FCoE VLANs when the QFX Series switch or QFabric system is an FCoE transit switch connecting FCoE devices on the Ethernet network to each other and to FC switches or gateways at the FC storage area network (SAN) edge.

NOTE: An FCoE VLAN can support either VN2VF_Port FIP snooping or VN2VN_Port FIP snooping, but not both. Configure separate FCoE VLANs for VN2VF_Port FIP snooping traffic and for VN2VN_Port FIP snooping traffic. On FCoE VLANs that are configured as VN2VN_Port FIP snooping VLANs, VN_Port to VF_Port traffic is dropped.

When you enable FIP snooping, the system snoops VN2VF_Port packets and enforces security only on VN_Port to VF_Port virtual links. When you enable VN2VN_Port FIP snooping, the system snoops VN_Port to VN_Port FIP packets and enforces security only on VN_Port to VN_Port virtual links.

The transit switch applies VN2VN_Port FIP snooping filters at the ports associated with the FCoE VLANs on which you enable VN2VN_Port FIP snooping. VN2VN_Port FIP snooping provides security for virtual links by creating filters based on information gathered (snooped) about FCoE devices during FIP transactions.

VN2VN_Port Communication Modes

The transit switch supports two VN2VN_Port communication modes:

- Point-to-point mode
- Multipoint mode

In point-to-point mode, two ENodes are connected to the network and form a single VN_Port to VN_Port virtual link. This is analogous to the point-to-point FC link between an FC initiator and an FC target.

In multipoint mode, multiple ENodes are connected to the network and form multiple virtual links. Each virtual link is created between one pair of VN_Ports. This is analogous to loop mode in traditional FC networks.

The VN2VN_Port communication mode is not configured; it is determined by the number of ENodes connected to the network.

Network Security

In traditional FC networks, the FC switch is usually a trusted entity and the server ENodes are untrusted entities. The ENodes connect directly to the FC switch VF_Ports. After an ENode gains access to the network through the fabric login (FLOGI) process, the FC switch enforces zoning configurations, ensures that the ENode uses valid addresses, monitors the connection, and performs other security functions to prevent unauthorized access.

However, FCoE exposes FC frames to Ethernet networks, which do not have the same level of security as native FC networks. VN2VN_Port FIP snooping filters emulate the native FC network security functions by preventing unauthorized access and by ensuring the security of the virtual link between ENode VN_Ports. The transit switch performs VN2VN_Port FIP snooping at the ports connected to the FCoE VN_Port devices.

VN2VN_Port FIP Snooping Functions

When you enable VN2VN_Port FIP snooping, the transit switch sets and applies filters to block all FCoE traffic on the VLAN by default. The transit switch monitors FIP logins, solicitations, and advertisements that pass through it and gathers information about the ENode address. The transit switch uses the information to construct filters that permit access only to logged-in ENodes. All other traffic on the VLAN is denied.

The filters enable FCoE frames to pass through the transit switch only on a virtual link established between two VN_Ports. The filters ensure that ENodes can only connect to other ENodes if they have successfully logged in to each other, and that only valid FCoE traffic along valid paths is transmitted. VN2VN_Port FIP snooping maintains the filters by tracking VN_Port to VN_Port sessions.

Scalability

Because ENodes are untrusted and the system needs to apply filters to untrusted FIP snooping interfaces, the total number of combined VN2VN_Port FIP snooping sessions per switch is 376 sessions (ENode to ENode sessions) on untrusted interfaces. On interfaces that are configured as trusted interfaces, no FIP snooping filters are applied.

NOTE: **The total number of sessions the system can support is the combined number of VN2VF_Port sessions and VN2VN_Port sessions. If VN2VF_Port sessions are active, the total number of available VN2VN_Port sessions is reduced.**

VN2VN_Port FIP Snooping Implementation

You enable VN2VN_Port FIP snooping on a per-VLAN basis on VLANs that carry FCoE traffic. The switch snoops FIP frames at the ports associated with FCoE VLANs enabled for VN2VN_Port FIP snooping. The switch then installs the resulting filters on the ENode-facing ports to ensure that all FIP snooping occurs on the switch network edge.

VN2VN_Port FIP snooping FCoE VLANs must meet the following criteria:

- An FCoE VLAN should be dedicated to FCoE traffic only.
- An FCoE VLAN cannot support both VN2VF_Port FIP snooping (FC-BB-5) and VN2VN_Port FIP snooping (FC-BB-6) simultaneously. You must configure separate FCoE VLANs for FIP snooping traffic and for VN2VN_Port FIP snooping traffic.

NOTE: **Changing an FCoE VLAN from VN2VF_Port FIP snooping mode to VN2VN_Port FIP snooping mode terminates the existing virtual links on the VLAN. The transit switch removes the existing FIP snooping filters, creates the new FIP snooping filters, and applies them to the FIP snooping ports. If you downgrade the software to Junos OS Release 12.1 or earlier, VLANs configured for VN2VN_Port FIP snooping revert to VN2VF_Port FIP snooping VLANs.**

- For QFX3500 switches, QFX3600 switches, and QFabric system Node devices, as a best practice, you should configure all access ports that belong to an FCoE VLAN (ports connected to a converged network adapter [CNA] in an FCoE device) in **tagged-access** port mode. However, access and trunk port modes are also supported. For QFX5100 switches, configure access ports that belong to an FCoE VLAN in **trunk** interface mode.
- Access ports should be configured as untrusted ports.
- All ports connected to another transit switch must be configured in **trunk** port mode.
- FIP traffic uses the native VLAN.
- You can enable VN2VN_Port FIP snooping on a native VLAN.

ENode-Facing Interfaces

When the interfaces that belong to an FCoE VLAN connect directly to FCoE devices (there is no other transit switch between the FCoE devices and the QFX Series switch), we recommend that you either enable VN2VN_Port FIP snooping on all FCoE VLANs to ensure secure connections between VN_Ports, or enable VN2VF_Port FIP snooping on FCoE VLANs that connect ENodes to an FC switch. FIP snooping should always be enabled at the access edge.

Systems that run Enhanced Layer 2 Software (ELS) such as the QFX5100 switch support a slightly different configuration on ENode-facing interfaces than systems that do not run ELS. This section describes:

Non-ELS Port Mode for FCoE Interfaces

The interfaces that belong to FCoE VLANs (interfaces that connect to CNAs in FCoE devices) should be configured in **tagged-access** port mode, unless your CNA does not support tagged VN2VN traffic. After you enable VN2VN_Port FIP snooping on an FCoE

VLAN, the transit switch denies FCoE traffic from any ENode on that VLAN until the ENode performs a valid fabric login (FIP FLOGI) with another ENode.

The **tagged-access** port mode was not available in Junos OS Release 11.3 and prior releases. In Release 11.3 and earlier, **trunk** port mode was used for Ethernet interfaces that connected to FCoE access devices. Because **tagged-access** mode is now available, using **trunk** mode for interfaces connected to FCoE CNAs is not recommended.

If an existing configuration uses **trunk** mode for ports connected to FCoE CNAs, you can change the port mode to **tagged-access** without disrupting traffic. Although we recommend changing the port mode of these ports from **trunk** to **tagged-access** as a best practice, it is not mandatory. New configurations should use **tagged-access** mode for interfaces that connect to FCoE devices.

ELS Interface Mode for FCoE Interfaces

The interfaces that belong to FCoE VLANs (interfaces that connect to CNAs in FCoE devices) on systems that support ELS should be configured in **trunk** interface mode. After you enable VN2VF_Port FIP snooping on an FCoE VLAN, the transit switch denies FCoE traffic from any ENode on that VLAN until the ENode performs a valid fabric login with an FC switch.

Trusted and Untrusted FCoE Interfaces

Do not configure ENode-facing interfaces as FCoE trusted interfaces when VN2VF_Port FIP snooping is enabled on those interfaces. If you enable VN2VF_Port FIP snooping on an FCoE VLAN and you configure ENode-facing interfaces that are members of the FIP snooping VLAN as **fcoe-trusted**, then FCoE devices might not be able to log in to the FC network.

Changing ports from untrusted to trusted removes any existing VN2VF_Port FIP snooping filters from the ports and terminates the existing sessions. Changing the fabric ports from trusted to untrusted forces all of the FCoE sessions on those ports to log out so that when the ENodes and VN_Ports log in again, the switch can build the appropriate VN2VF_Port FIP snooping filters.

Network-Facing Interfaces (Connecting to Another Transit Switch)

Configure any interface that is connected to another transit switch (not to an ENode) as an FCoE trusted interface, in **trunk** port mode, and as a 10-Gigabit Ethernet interface.

Network-facing Ethernet interfaces have the following requirements and behaviors:

- You must explicitly configure network-facing trunk ports on an FCoE transit switch as FCoE trusted interfaces.
- After you configure a network-facing trunk port as a trusted interface, the FCoE transit switch always processes frames from the connected switch because they come from a source on a trusted interface.
- As a best practice, configure ports in an FCoE VLAN as tagged access ports, but access and trunk port modes are also supported to accommodate whatever types of VN2VN traffic your CNA supports.

Beacon Period (VN2VN_Port FIP Snooping Link Maintenance)

The transit switch needs to maintain the virtual links between VN_Ports, and needs to know when sessions begin and end, and when to install and remove the FIP snooping filters. FIP snooping uses a FIP keepalive advertisement to accomplish this task. VN2VN_Port FIP snooping does not exchange FIP keepalive timer information. Instead, you configure a *beacon period*, which performs the same function as a keepalive timer.

The beacon period is the time interval between messages which verify that the connection is still valid and that the device at the other end of the virtual link is still reachable. You set the beacon period value for each FCoE VLAN that you configure to do VN2VN_Port FIP snooping.

NOTE: **Explicitly set the beacon period when you configure VN2VN_Port FIP snooping. VN_Ports do not automatically send beacons.**

ENodes transmit periodic multicast N_Port_ID beacons to the ALL-VN2VN-ENode-MACs address. The transmission period varies by a random delay of between 0 ms and 100 ms to avoid synchronized bursts of multicast traffic on the network.

If the transit switch does not receive a beacon message from an ENode within 2.5 times the configured beacon period, the transit switch considers the virtual link to be down and terminates the virtual link to that ENode.

QFabric System Differences in VN2VN_Port FIP Snooping Traffic Handling

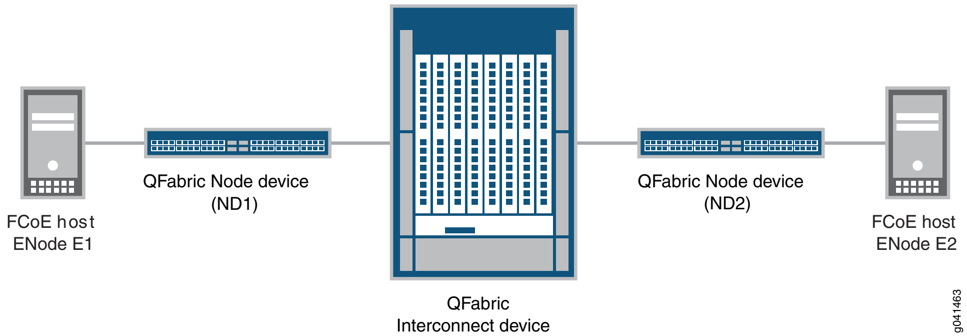
Configuring VN2VN_Port FIP snooping on a QFabric system is the same as configuring VN2VN_Port FIP snooping on the QFX Series. However, there are internal differences in the way a QFabric system handles VN2VN_Port FIP snooping traffic compared to the way a QFX Series switch handles VN2VN_Port FIP snooping traffic. The internal differences are transparent. Whether you configure VN2VN_Port FIP snooping on a QFabric system or on the QFX Series, the proper FIP snooping filters and forwarding information are installed on each device.

On the QFX Series, the VN2VN_Port FIP snooping traffic does not cross a fabric (Interconnect device). VN2VN_Port traffic enters and exits ports on a single switch, so the ingress port and the egress port have access to the same *local* forwarding and FIP snooping databases.

However, on a QFabric system, VN2VN_Port FIP snooping traffic might enter on the ingress port of one Node device, traverse the Interconnect device fabric, and exit on the egress port of a different Node device. In this case, the QFabric system must ensure that the FIP snooping database and forwarding information for the VN2VN_Port traffic is installed correctly on both of the Node devices so that traffic is correctly filtered and forwarded.

For example, Figure 177 on page 4871 shows that VN2VN_Port traffic from FCoE host ENode E1 enters the QFabric system at Node device ND1, traverses the Interconnect device fabric, and then exits from Node device ND2 before arriving at FCoE host ENode E2. Similarly, VN2VN_Port traffic from FCoE host ENode E2 enters the QFabric system at Node device ND2, traverses the Interconnect device fabric, and then exits from Node device ND1 before arriving at FCoE host ENode E1.

Figure 177: VN2VN_Port Traffic Across a QFabric Interconnect Device



When the QFabric system receives a FLOGI ACC from either ENode E1 or ENode E2, the QFabric system creates and installs the correct VN2VN_Port FIP snooping filters on both Node devices, and updates the forwarding tables accordingly.

In addition, the QFabric system must also ensure that the VN2VN_Port FIP snooping session statistics are correctly counted. Even though a session is running on each of the two Node devices, the QFabric system counts the complete VN2VN_Port connection as one session because the two Node devices belong to the same session. This ensures that VN2VN_Port sessions that traverse the Interconnect device fabric are counted as one unique session, not as two separate sessions.

Related Documentation

- Understanding DCB Features and Requirements on page 4795
- Understanding FCoE Transit Switch Functionality on page 4804
- Understanding VN_Port to VF_Port FIP Snooping on an FCoE Transit Switch on page 4858
- Overview of FIP on page 4790
- Understanding Fibre Channel Terminology on page 4895
- Understanding FIP Snooping, FBF, and MVR Filter Scalability on page 4872
- Configuring VLAN Interfaces for FCoE Traffic on an FCoE Transit Switch on page 5066
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 4977
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 4982
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 4990
- Enabling VN2VN_Port FIP Snooping and Configuring the Beacon Period on an FCoE Transit Switch on page 5073

Understanding FIP Snooping, FBF, and MVR Filter Scalability

The VLAN filter processor (VFP) ternary content addressable memory (TCAM) stores the VLAN filter configuration for three filter types:

- Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) snooping—FIP snooping filters prevent an FCoE device from gaining unauthorized access to a Fibre Channel (FC) storage device or to another FCoE device. VN2VF_Port FIP snooping filters prevent an FCoE device from gaining unauthorized access to devices on an FC network. VN2VN_Port FIP snooping filters prevent an FCoE device from gaining unauthorized access to another FCoE device directly through the QFX Series or QFabric system, without traversing the FC network.

  The VFP TCAM stores the VN2VF_Port and VN2VN_Port FIP snooping filters that the switch automatically creates when you enable FIP snooping on a VLAN that carries FCoE traffic. See "Understanding VN_Port to VF_Port FIP Snooping on an FCoE Transit Switch" on page 4858 and "Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch" on page 4865 for more information.

- Filter-based forwarding (FBF)—FBF enables you to use firewall filters to direct packets to virtual routing instances. The switch then forwards the matching packets based on the configuration of the routing instances. The VFP TCAM stores the terms you configure for FBF filters. See "Understanding Filter-Based Forwarding" on page 4412 for more information.

- Multicast VLAN registration (MVR)—MVR enables you to configure a multicast source VLAN (MVLAN) that is shared across a Layer 2 network. An MVLAN distributes IPTV multicast streams across different VLANs without having to create a separate multicast stream for each VLAN, and without compromising the security and separation of traffic in the different VLANs. The VFP TCAM stores the MVR rules you configure for MVLANs. See "Understanding Multicast VLAN Registration" on page 3974 for more information.

FIP snooping filters, FBF filters, and MVR rules share the VFP TCAM memory space. In most use cases, the VFP TCAM memory is sufficient to store filter terms and information for all three applications.

VFP TCAM Architecture and Allocation

When packets arrive at an ingress interface, the VFP TCAM is the first TCAM in the packet pipeline. The VFP TCAM stores a total of 1024 entries. The 1024 entries are partitioned into four equal *slices* of 256 entries.

The VFP TCAM allocates entries to three filter types (FIP snooping filters, FBF filter terms, and MVR rules) in 256-entry slices. The VFP TCAM dynamically allocates the minimum number of memory slices required to store the filters for a particular filter type, as needed.

The TCAM does not allocate partial slices to a filter type, and slices cannot be shared among filter types. At any given time, each slice contains entries for one and only one filter type.

For example, if you configure one MVR rule, the system allocates a whole slice to MVR rules, even if the MVR rule consumes only one TCAM entry. The remaining 256 entries in the slice allocated to MVR rules can store subsequently configured MVR rules, but not FIP snooping or FBF filters. Similarly, if FIP snooping filters consume 50 entries of a 256-entry slice, the remaining 206 entries in the FIP snooping slice are available only to store more FIP snooping filters, not to store FBF filter terms or MVR rules.

The VFP TCAM allocates slices to a filter type only if there is at least one configured filter or rule for that filter type. If no filters exist for a filter type, then the VFP TCAM does not allocate a slice to that filter type.

NOTE: **The VFP TCAM rejects partial filters. For example, if an FBF filter contains six terms, but there is only space in the TCAM for four of those terms, the whole filter is not committed.**

Each filter type can use from zero slices to all four slices of VFP TCAM space. However, if one filter type uses three slices, then only one slice remains, so only one other filter type can use the remaining slice. In that situation, if you configure filters for all three filter types, the last filter type that you configure receives no TCAM space for its filter entries. Filters that receive no TCAM entry space are not implemented.

VFP TCAM Entry Consumption

FIP snooping filters, FBF filters, and MVR rules consume VFP TCAM entry space in different ways:

- FIP Snooping Filter VFP TCAM Consumption on page 4873
- FBF Filter VFP TCAM Consumption on page 4874
- MVR Filter VFP TCAM Consumption on page 4875
- VFP TCAM Consumption Summary Table on page 4875

FIP Snooping Filter VFP TCAM Consumption

VN2VF_Port FIP snooping filters consume VFP TCAM entry space differently than VN2VN_Port FIP snooping filters:

- VN2VF_Port FIP Snooping Filter VFP TCAM Consumption on page 4874
- VN2VN_Port FIP Snooping Filter VFP TCAM Consumption on page 4874

NOTE: **One FCoE VLAN cannot support both VN2VF_Port traffic and VN2VN_Port traffic. Configure separate FCoE VLANs for VN2VF_Port traffic and for VN2VN_Port traffic.**

VN2VF_Port FIP Snooping Filter VFP TCAM Consumption

The switch uses an algorithm that allows one 256-entry slice of the VFP TCAM to store the maximum possible number of VN2VF_Port FIP snooping filters (2500 filters). VN2VF_Port FIP snooping filters never consume more than one slice of the VFP TCAM.

Regardless of whether there is one VN2VF_Port FIP snooping session or there are 2500 VN2VF_Port FIP snooping sessions, VN2VF_Port FIP snooping filters consume one slice of the VFP TCAM. (If there are no VN2VF_Port or VN2VN_Port FIP snooping sessions, the TCAM does not allocate a slice for FIP snooping filters.)

VN2VN_Port FIP Snooping Filter VFP TCAM Consumption

VN2VN_Port FIP snooping filters consume one VFP TCAM entry for each VN2VN_Port session. The maximum number of VN2VN_Port FIP snooping sessions is 376 sessions per switch. (If you configure an interface that carries VN2VN_Port FIP snooping traffic as a trusted interface, the switch does not apply filters on the trusted interface.)

Because the switch can have up to 376 VN2VN_Port sessions running simultaneously, with each session consuming one entry, VN2VN_Port FIP snooping filters consume VFP TCAM space as follows:

- 1–256 filters consume one slice
- 257–376 filters consume two slices

FBF Filter VFP TCAM Consumption

Each FBF filter term is double-wide, so each FBF filter term consumes two entries in the VFP TCAM. One 256-entry slice can contain up to 128 FBF filter terms. FBF filters consume VFP TCAM space as follows:

- 1–128 entries consume one slice
- 129–256 entries consume two slices
- 257–384 entries consume three slices
- 385–512 entries consume four slices

NOTE: In practice, FBF filters can consume only three slices of the VFP TCAM because FBF filters are also stored simultaneously in the ingress filter processor (IFP) TCAM, and the IFP TCAM can store only 384 FBF filter terms (768 entries, or 3 TCAM slices).

For example, if you configure FBF filters that contain 200 terms, then the FBF filters require 400 VFP TCAM entries and consume 2 slices.

FBF filter entries are simultaneously stored in the VFP TCAM and the IFP TCAM. The IFP TCAM can only contain up to 768 entries—256 fewer entries (1 slice) than the VFP TCAM. As with the VFP TCAM, FBF filters consume two IFP TCAM entries per filter term. In addition to FBF filter terms, the IFP TCAM stores filter entries for firewall filters.

CAUTION: There must be enough space in the VFP TCAM *and* the IFP TCAM for the FBF filter entries. If both TCAMs do not have enough space for the FBF filters, the switch rejects the portion of the configuration that it cannot store and sends a syslog message to notify you.

For example, if you configure FBF filters that have 400 terms, even though the VFP TCAM has enough space to store the resulting 800 entries, the switch rejects a portion of the configuration because the IFP TCAM can store a maximum of only 768 entries. If the IFP TCAM stores no other filter entries, the switch rejects 32 FBF filter entries.

In another example, if you configure firewall filters that have a total of 200 terms, which consume 200 entries in the IFP TCAM, and you then configure FBF filters that have a total of 300 terms, the switch rejects a portion of the configuration because the FBF filters require 600 entries. Combined with the 200 entries required for the firewall filters, the total number of 800 entries exceeds the maximum of 768 entries that the IFP TCAM can store. In this case, the switch accepts the first 768 entries and rejects the rest of the filter entries. The switch installs the filter entries in the order that they are committed; the rejected entries are the last entries the switch attempts to commit after the TCAM space is exhausted.

The IFP TCAM limit of 768 entries means that the true maximum number of FBF filter terms is 384 terms, even though the VFP TCAM can store up to 512 FBF terms.

MVR Filter VFP TCAM Consumption

Each MVR rule consumes one entry in the VFP TCAM, so MVR rules consume VFP TCAM space as follows:

- 1–256 rules consume one slice
- 257–512 rules consume two slices
- 513–758 rules consume three slices
- 759–1024 rules consume four slices

VFP TCAM Consumption Summary Table

Table 372 on page 4876 summarizes VFP TCAM consumption.

NOTE: FBF filters are simultaneously stored in the VFP TCAM and in the IFP TCAM. Due to the IFP TCAM limit of 768 entries (384 FBF filters), which is 256 entries fewer than the VFP TCAM, the effective VFP TCAM consumption limit for FBF filters is lower than the total amount of VFP TCAM entry space, even when no other filters consume VFP TCAM space.

Table 372: VFP TCAM Entry Consumption Summary

Filter Type	VPF TCAM Entry Consumption	Maximum VFP TCAM Slices Consumed	Other Limitations
VN2VF_Port FIP snooping filters	Never consumes more than one slice	One slice (regardless of number of sessions)	2500 session maximum
VN2VN_Port FIP snooping filters	One entry per session	Two	376 session maximum
FBF filters	Two entries per filter	Three (due to IFP TCAM limitation)	384 filters (due to IFP TCAM limitation)
MVR rules	One entry per rule	Four	1024 rule maximum

Rejected Filter Configurations (No Available VFP TCAM Space)

If there is not enough space available in the VFP TCAM to store the FIP snooping filters, the configured FBF filters, and the MVR rules, the switch rejects only the portion of the configuration that it cannot store. Any portion of the filter configuration that the TCAM can store, is stored. In most cases, even if the switch rejects part of the configuration, part of the configuration is also stored.

If the switch rejects any portion of a configuration, the switch sends a syslog message to notify you of the failure. The switch does not generate a commit error, and the rejected portion of the configuration remains on the switch, even though the rejected configuration does not function. (The accepted portions of the configuration function as expected.) The syslog message shows you the filter configuration that the switch rejected.

We strongly recommend that you always delete rejected filter configurations from the switch. It is important to delete rejected filter configurations because:

- Even though the rejected configuration remains on the switch, it does not function.
- After a reboot, there is no guarantee that the same filters will be rejected. The previously rejected filters might be accepted, and other filters that had previously been accepted might be rejected. Therefore, the functioning filter configuration could be changed inadvertently and unexpectedly.
- Even if a VFP TCAM slice becomes available, the switch does not automatically allocate the available slice to the rejected configuration. To use the available slice, you must delete and reconfigure the rejected configuration.

  For example, you configure FBF filters and MVR rules on a switch, and that switch also transports FCoE traffic with VN2VF_Port FIP snooping (never consumes more than one slice) enabled on FCoE access interfaces. After you commit the configuration, you check the syslog. You find that the VN2VF_Port FIP snooping and FBF filters consume all four slices of the VFP TCAM, and the MVR configuration was rejected. Instead of deleting the MVR configuration, you leave it on the switch. Subsequently, all VN2VF_Port FIP snooping sessions end, the FIP snooping filters time out and are removed from the VFP TCAM, so the slice that was allocated to VN2VF_Port FIP snooping filters becomes free. However, the MVR rules do *not* automatically receive the free slice.

To force the switch to allocate the free slice to the MVR rules, you should delete the MVR rules from the configuration and then reconfigure the MVR rules. When you commit the new configuration, check the syslog messages to ensure that the MVR rule configuration was accepted.

In this example, you could also choose to free a VFP TCAM slice for MVR rule storage by deleting some of the FBF filters. To do this, you delete both the unneeded FBF filters and the MVR rule configuration. Then you reconfigure the MVR rules, and check the syslog to ensure that the configuration was successful.

VFP TCAM Allocation and Consumption (Scaling) Examples

The following examples illustrate how FIP snooping entries, FBF filter entries, and MVR rule entries consume VFP TCAM slices:

- Example 1: Three Filter Types Consume Three Slices on page 4877
- Example 2: Three Filter Types Consume Four Slices on page 4877
- Example 3: Two Filter Types Consume Four Slices on page 4878
- Example 4: Three Filter Types Oversubscribe the VFP TCAM on page 4878

Example 1: Three Filter Types Consume Three Slices

Filters and rules are configured in the following sequence:

- 100 VN2VN_Port FIP snooping filters (1 slice)
- 2 MVR rules (1 slice, 2 entries)
- 60 FBF filter terms (1 slice, 120 entries)

One slice remains free. The slice allocated to VN2VN_Port FIP snooping filters can store 156 more filters before another slice is required. The slice allocated to MVR rules can store 254 more rules before another slice is required. The slice allocated to FBF filters can store 68 more filter terms (136 entries) before another slice is required. Providing that the IFP TCAM has space for the FBF filter terms, the switch accepts this configuration and rejects no filters.

Example 2: Three Filter Types Consume Four Slices

Filters and rules are configured in the following sequence:

- 2000 VN2VF_Port FIP snooping filters (always 1 slice)
- 18 MVR rules (1 slice, 18 entries)
- 150 FBF filter terms (2 slices, 300 entries)

All four slices are allocated to filter types. The slice allocated to MVR rules can store 238 more rules before it is full. The slice allocated to FBF filters can store 106 more filter terms (212 entries) before it is full. Providing that the IFP TCAM has space for the FBF filter terms, the switch accepts this configuration and rejects no filters.

NOTE: If you configure more MVR rules or FBF filters than entry space remaining in the slices, the switch rejects those rules and filters because no slice is available. The switch installs filters in the order that they were configured, so if filters are rejected, the filters configured last are rejected.

Example 3: Two Filter Types Consume Four Slices

Filters and rules are configured in the following sequence:

- 50 VN2VF_Port FIP snooping filters (always 1 slice)
- 300 FBF filter terms (3 slices, 600 entries)

All four slices are allocated to filter types. No slices are available for MVR rules. The third slice allocated to FBF filters can store 84 more filter terms (168 entries) before it consumes all of its entry space. Providing that the IFP TCAM has space for the FBF filter terms, the switch accepts this configuration and rejects no filters.

NOTE: If you configure MVR rules or if you configure more than 84 more FBF filters, the switch rejects those rules and filters because no slice is available for the MVR rules, and the FBF filter slice has entry space for only 84 more filter terms.

Example 4: Three Filter Types Oversubscribe the VFP TCAM

Filters and rules are configured in the following sequence:

- 1750 VN2VF_Port FIP snooping filters (always 1 slice)
- 10 MVR rules (1 slice, 10 entries)
- 275 FBF filter terms (2 slices, 512 accepted entries, 38 rejected entries)

All four slices are allocated to filter types. The slice allocated to MVR rules can store 246 more rules before it is full, but the number of FBF filter terms exceeds the amount of available VFP TCAM storage space. (The 275 FBF filter terms consume 550 VFP TCAM entries. However, there are only two available slices, for a total of 512 available entry spaces, so only 256 FBF filter terms can be stored, leaving 19 rejected FBF filter terms.)

The switch accepts the VN2VF_Port FIP snooping filters, the MVR rules, and 256 FBF filter terms. The switch retains the excess FBF filters in the configuration, but does not install those filters in the VFP TCAM. In this case, you delete the rejected FBF filter terms from the configuration. Alternatively, you could delete the MVR rules from the configuration to free a slice of the TCAM, and then delete and reconfigure the rejected FBF filters so that the system allocates the freed slice to the FBF filters.

NOTE: The sequence of configuration makes a difference; if there is not enough VFP TCAM space for a given filter type, the switch installs the filters that fit in the order they are configured. For example, if you configure the FBF filters before you configure the MVR rules, the VFP TCAM allocates one slice to FIP snooping filters, three slices to FBF filters (assuming the IFP TCAM has available space), and no slices to MVR rules, because all four slices are allocated before the switch attempts to install the MVR rules in the VFP TCAM.

Filter Configuration Recommendations

To utilize the VFP TCAM space most efficiently:

- Configure and Maintain the Fewest Number of Filters Needed on page 4879
- Always Delete Rejected Filter Configurations on page 4880

Configure and Maintain the Fewest Number of Filters Needed

To conserve VFP TCAM entry space, and because FBF filter storage also depends on the availability of IFP TCAM space, we recommend that you configure as few FBF filters and MVR rules as is practical to serve your network needs. The more filters you configure, the greater the possibility of exceeding TCAM storage capacity.

Several factors determine VFP TCAM consumption:

- Type of filters configured—Different filter types consume different amounts of VFP TCAM space. VN2VF_Port FIP snooping filters never consume more than one slice. MVR rules and VN2VN_Port FIP snooping filters consume entries in a slice at a rate of one entry per MVR rule or VN2VN_Port session. FBF filter terms consume entries in a slice at a rate of two entries per FBF filter term.
- Number of filters configured—Although the number of filters does not affect the number of slices allocated to the VN2VF_Port FIP snooping filter type (it is always one slice for one or more VN2VF_Port FIP snooping filters and no slice for no FIP snooping filters), the number of VN2VN_Port FIP snooping filters, MVR rules, and FBF filter terms that you configure determine how many VFP TCAM slices are required for each filter type.

  For example, if you configure 257 MVR rules, the MVR rule entries consume 2 slices. One slice stores 256 MVR rules (entries), and one slice stores 1 MVR rule (entry). In this case, if you can eliminate one MVR rule, you can free a slice to allocate to other filter types.
- Sequence of filter configuration—If you configure too many filters for the VFP TCAM to store, the last filters you configure are not stored in the TCAM.

  Always check the syslog after you configure FBF filters or MVR rules to ensure that the configuration was not rejected. If you enable FIP snooping on access ports, check the syslog to ensure that the configuration was not rejected due to lack of VFP TCAM space.

  If you check the syslog and a filter configuration has been rejected, delete the filters that were rejected from the configuration.

TIP: If you no longer need an FBF filter or an MVR rule, delete it from the configuration to conserve VFP TCAM space. Enable VN2VF_Port or VN2VN_Port FIP snooping on access ports only if the switch port is directly connected to FCoE devices. (FIP snooping should be performed at the access edge. FIP snooping should not be performed on traffic that has already been snooped and filtered at the access edge. If another switch between the QFX Series or QFabric system and the FCoE devices already performs FIP snooping, do not enable FIP snooping on the QFX Series or QFabric system.)

Always Delete Rejected Filter Configurations

The switch does not return a commit error if it rejects any portion of a configuration. Instead, the switch sends a syslog message to report the rejected portion of the configuration. The rejected portion of the configuration remains on the switch, but does not function.

After you configure FBF filters or MVR rules, or enable FIP snooping, check the syslog messages to ensure that the switch accepted the configuration. If the switch rejected any portion of the configuration, delete that portion of the configuration. (You do not need to delete the portion of the configuration that was accepted, unless you want to reconfigure those filters or rules.)

CAUTION: If you do not delete rejected filter configurations, and if you reboot the system, you cannot predict which filters the system installs after the reboot. For example, a switch with the following configuration has more configured filters than the VFP TCAM can support:

- VN2VF_Port FIP snooping sessions (always consumes one slice)
- 20 MVR rules (consume one slice)
- 300 FBF filters (attempt to consume three slices, but because only two slices are available, 256 filters consume two slices, and the remaining 44 filters are rejected)

If you do not delete the 44 rejected FBF filters, then if the switch reboots, the 44 FBF filters that were rejected might be accepted, and 44 different FBF filters might be rejected. This unpredictable behavior is the reason that you should check the syslog messages after you configure filters, and if any filters were rejected, you should always delete the rejected filters from the configuration.

Related Documentation

- Understanding VN_Port to VF_Port FIP Snooping on an FCoE Transit Switch on page 4858
- Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch on page 4865
- Understanding Filter-Based Forwarding on page 4412
- Understanding Multicast VLAN Registration on page 3974

- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 4977
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 4982
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 4990
- Example: Using Filter-Based Forwarding to Route Application Traffic to a Security Device on page 4479
- Configuring Multicast VLAN Registration (CLI Procedure) on page 4053

Understanding MC-LAGs on an FCoE Transit Switch

Multichassis link aggregation groups (MC-LAGs) provide redundancy and load balancing between two QFX Series switches, multihoming support for client devices such as servers, and a loop-free Layer 2 network without running Spanning Tree Protocol (STP).

You can use an MC-LAG to provide a redundant aggregation layer for Fibre Channel over Ethernet (FCoE) traffic. To support lossless transport of FCoE traffic across an MC-LAG, you must configure the appropriate class of service (CoS) on both of the QFX Series switches with MC-LAG port members. The CoS configuration must be the same on both of the MC-LAG switches because MC-LAGs do not carry forwarding class and IEEE 802.1p priority information.

Ports that are part of an FCoE-FC gateway configuration (a virtual FCoE-FC gateway fabric) do not support MC-LAGs. Ports that are members of an MC-LAG act as passthrough transit switch ports.

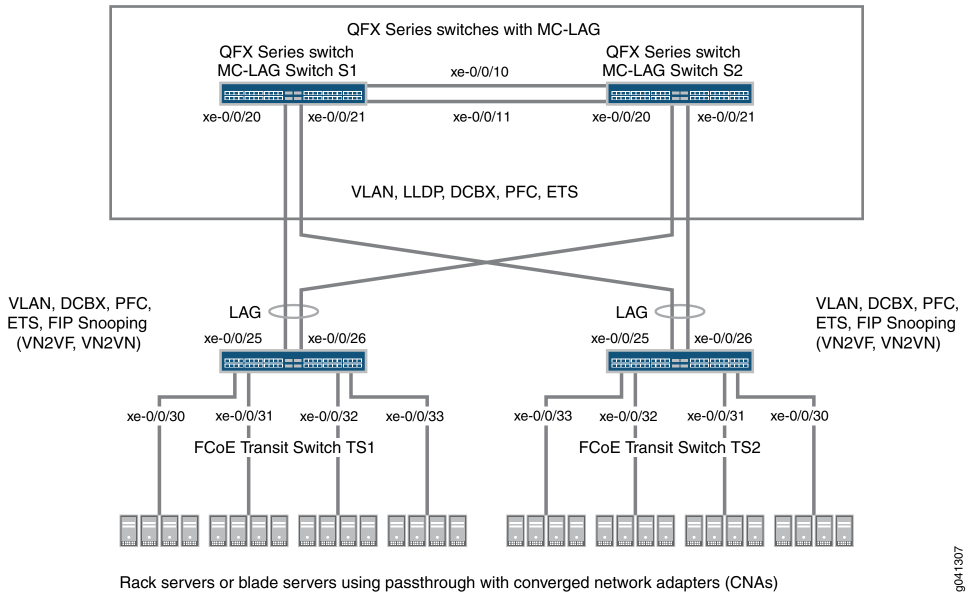
QFX Series switches support MC-LAGs. QFabric system Node devices do not support MC-LAGs, and QFX3500 and QFX3600 Virtual Chassis switches do not support FCoE.

This topic describes:

Supported Topology

QFX Series switches that are not directly connected to FCoE hosts and that act as passthrough transit switches support MC-LAGs for FCoE traffic in an *inverted-U* network topology. Figure 178 on page 4882 shows an inverted-U topology using QFX3500 switches.

Figure 178: Supported Topology for an MC-LAG on an FCoE Transit Switch



The following rules and guidelines apply to MC-LAGs when used for FCoE traffic. The rules and guidelines help ensure the proper handling and lossless transport characteristics required for FCoE traffic:

- The two QFX Series switches that form the MC-LAG (Switches S1 and S2) cannot use ports that are part of an FCoE-FC gateway fabric. The MC-LAG switch ports must be passthrough transit switch ports (used as part of an intermediate transit switch that is not directly connected to FCoE hosts).
- MC-LAG Switches S1 and S2 cannot be not directly connected to the FCoE hosts.
- The two QFX Series switches that serve as access devices for FCoE hosts (FCoE Transit Switches TS1 and TS2) use standard LAGs to connect to MC-LAG Switches S1 and S2. FCoE Transit Switches TS1 and TS2 can be standalone QFX Series switches or they can be Node devices in a QFabric system.
- Transit Switches TS1 and TS2 must use transit switch ports for the FCoE hosts and for the standard LAGs to MC-LAG Switches S1 and S2.
- Enable FIP snooping on the FCoE VLAN on Transit Switches TS1 and TS2. You can configure either VN_Port to VF_Port (VN2VF_Port) FIP snooping or VN_Port to VN_Port (VN2VN_Port) FIP snooping, depending on whether the FCoE hosts need to access targets in the FC SAN (VN2VF_Port FIP snooping) or targets in the Ethernet network (VN2VN_Port FIP snooping).

  FIP snooping should be performed at the access edge and is not supported on MC-LAG switches. Do not enable FIP snooping on MC-LAG Switches S1 and S2. (Do not enable FIP snooping on the MC-LAG ports that connect Switches S1 and S2 to Switches TS1 and TS2 or on the LAG ports that connect Switch S1 to S2.)
- The CoS configuration must be consistent on the MC-LAG switches. Because MC-LAGs carry no forwarding class or priority information, each MC-LAG switch needs to have

the same CoS configuration to support lossless transport. (On each MC-LAG switch, the name, egress queue, and CoS provisioning of each forwarding class must be the same, and the priority-based flow control (PFC) configuration must be the same.)

Transit Switches (Server Access)

The role of FCoE Transit Switches TS1 and TS2 is to connect FCoE hosts in a multihomed fashion to the MC-LAG switches. In essence, Transit Switches TS1 and TS2 act as access switches for the FCoE hosts. (FCoE hosts are directly connected to Transit Switches TS1 and TS2.)

The transit switch configuration depends on whether you want to do VN2VF_Port FIP snooping or VN2VN_Port FIP snooping, and whether the QFX Series transit switches also have ports configured as part of an FCoE-FC gateway virtual fabric. Ports that the QFX Series switch uses in an FCoE-FC gateway virtual fabric cannot be included in the transit switch LAG connection to the MC-LAG switches. (Ports cannot belong to both a transit switch and an FCoE-FC gateway; you must use different ports for each mode of operation.)

MC-LAG Switches (FCoE Aggregation)

The role of MC-LAG Switches S1 and S2 is to provide redundant, load-balanced connections between FCoE transit switches. In essence, MC-LAG Switches S1 and S2 act as aggregation switches. FCoE hosts are not directly connected to the MC-LAG switches.

The MC-LAG switch configuration is the same regardless of which type of FIP snooping that FCoE Transit Switches TS1 and TS2 perform.

FIP Snooping and FCoE Trusted Ports

To maintain secure access, enable VN2VF_Port FIP snooping or VN2VN_Port FIP snooping at the transit switch access ports connected directly to the FCoE hosts. FIP snooping should be performed at the access edge of the network to prevent unauthorized access. For example, in Figure 178 on page 4882, you enable FIP snooping on the FCoE VLANs on Transit Switches TS1 and TS2 that include the access ports connected to the FCoE hosts.

Do not enable FIP snooping on the switches used to create the MC-LAG. For example, in Figure 178 on page 4882, you would not enable FIP snooping on the FCoE VLANs on Switches S1 and S2.

Configure links between switches as FCoE trusted ports to reduce FIP snooping overhead and ensure that the system performs FIP snooping only at the access edge. In the sample topology, configure the Transit Switch TS1 and TS2 LAG ports connected to the MC-LAG switches as FCoE trusted ports, configure the Switch S1 and S2 MC-LAG ports connected to Switches TS1 and TS2 as FCoE trusted ports, and configure the ports in the LAG that connects Switches S1 to S2 as FCoE trusted ports.

CoS and Data Center Bridging (DCB)

The MC-LAG links do not carry forwarding class or priority information. The following CoS properties must have the same configuration on each MC-LAG switch or on each MC-LAG interface to support lossless transport:

- FCoE forwarding class name—For example, the forwarding class for FCoE traffic could use the default **fcoe** forwarding class on both MC-LAG switches.
- FCoE output queue—For example, the **fcoe** forwarding class could be mapped to queue 3 on both MC-LAG switches (queue 3 is the default mapping for the **fcoe** forwarding class).
- Classifier—The forwarding class for FCoE traffic must be mapped to the same IEEE 802.1p code point on each member interface of the MC-LAG on both MC-LAG switches. For example, the FCoE forwarding class **fcoe** could be mapped to IEEE 802.1p code point **011** (code point **011** is the default mapping for the **fcoe** forwarding class).
- Priority-based flow control (PFC)—PFC must be enabled on the FCoE code point on each MC-LAG switch and applied to each MC-LAG interface using a congestion notification profile.

You must also configure enhanced transmission selection (ETS) on the MC-LAG interfaces to provide sufficient scheduling resources (bandwidth, priority) for lossless transport. The ETS configuration can be different on each MC-LAG switch, as long as enough resources are scheduled to support lossless transport for the expected FCoE traffic.

LLDP and DCBX must be enabled on each MC-LAG member interface (LLDP and DCBX are enabled by default on all interfaces).

NOTE: As with all other FCoE configurations, FCoE traffic requires a dedicated VLAN that carries only FCoE traffic, and IGMP snooping must be disabled on the FCoE VLAN.

Related Documentation

- Understanding Multichassis Link Aggregation on page 1853
- Example: Configuring CoS for FCoE Transit Switch Traffic Across an MC-LAG on page 4940
- Example: Configuring Multichassis Link Aggregation on page 1904

Understanding CoS Flow Control (Ethernet PAUSE and PFC)

Flow control supports lossless transmission by regulating traffic flows to avoid dropping frames during periods of congestion. Flow control stops and resumes the transmission of network traffic between two connected peer nodes on a full-duplex Ethernet physical link. Controlling the flow by pausing and restarting it prevents buffers on the nodes from overflowing and dropping frames. You configure flow control on a per-interface basis.

The QFX Series supports two methods of flow control:

- IEEE 802.3X Ethernet PAUSE
- IEEE 802.1Qbb priority-based flow control (PFC)

Ethernet PAUSE and PFC are link-level flow control mechanisms.

Ethernet PAUSE pauses transmission of all traffic on a physical Ethernet link.

PFC decouples the pause function from the physical Ethernet link and enables you to divide traffic on one link into eight priorities. You can think of the eight priorities as eight “lanes” of traffic that are mapped to forwarding classes and output queues. Each priority is mapped to a 3-bit IEEE 802.1p CoS code point flag in the VLAN header. You can enable PFC on one or more priorities (IEEE 802.1p code points) on a link. When PFC-enabled traffic is paused on a link, traffic that is not PFC-enabled continues to flow (or is dropped if congestion is severe enough).

Use Ethernet PAUSE when you want to prevent packet loss on all of the traffic on a link. Use PFC to prevent traffic loss only on specified types of traffic (for example, Fibre Channel over Ethernet traffic).

NOTE: **Depending on the amount of traffic on a link or assigned to a priority, pausing traffic can cause ingress port congestion and spread congestion through the network.**

Attempting to configure both Ethernet PAUSE and PFC on a link causes a commit error. Ethernet PAUSE and PFC are mutually exclusive configurations on an interface.

By default, all forms of flow control are disabled. You must explicitly enable flow control on interfaces to pause traffic.

Ethernet PAUSE

Ethernet PAUSE is a congestion relief feature that works by providing link-level flow control for all traffic on a full-duplex Ethernet link. Ethernet PAUSE works in both directions on the link. In one direction, an interface generates and sends Ethernet PAUSE messages to stop the connected peer from sending more traffic. In the other direction, the interface responds to Ethernet PAUSE messages it receives from the connected peer to stop sending traffic. Ethernet PAUSE also works on aggregated Ethernet interfaces. For example, if the connected peer interfaces are called Node A and Node B:

- When the receive buffers on interface Node A reach a certain level of fullness, the interface generates and sends an Ethernet PAUSE message to the connected peer (interface Node B) to tell the peer to stop sending frames. The Node B buffers store frames until the time period specified in the Ethernet PAUSE frame elapses; then Node B resumes sending frames to Node A.
- When interface Node A receives an Ethernet PAUSE message from interface Node B, interface Node A stops transmitting frames until the time period specified in the Ethernet PAUSE frame elapses; then Node A resumes transmission. (The Node A transmit buffers store frames until Node A resumes sending frames to Node B.)

  In this scenario, if Node B sends an Ethernet PAUSE frame with a time value of 0 to Node A, the 0 time value indicates to Node A that it can resume transmission. This happens when the Node B buffer empties to below a certain threshold and the buffer can once again accept traffic.

Symmetric flow control means an interface has the same Ethernet PAUSE configuration in both directions. The Ethernet PAUSE generation and Ethernet PAUSE response functions are both configured as enabled, or they are both disabled. You configure symmetric flow control by including the **flow-control** statement at the **[edit interfaces *interface-name* ether-options]** hierarchy level.

Asymmetric flow control allows you to configure the Ethernet PAUSE functionality in each direction independently on an interface. The configuration for generating Ethernet PAUSE messages and for responding to Ethernet PAUSE messages does not have to be the same. It can be enabled in both directions, disabled in both directions, or enabled in one direction and disabled in the other direction. You configure asymmetric flow control by including the **configured-flow-control** statement at the **[edit interfaces *interface-name* ether-options]** hierarchy level.

On any particular interface, symmetric and asymmetric flow control are mutually exclusive. Asymmetric flow control overrides and disables symmetric flow control. (If PFC is configured on an interface, the PFC configuration overrides Ethernet PAUSE flow control.) The QFX Series supports both symmetric and asymmetric flow control.

- Symmetric Flow Control on page 4886
- Asymmetric Flow Control on page 4887

Symmetric Flow Control

Symmetric flow control configures both the receive and transmit buffers in the same state. The interface can both send Ethernet PAUSE messages and respond to them (flow control is enabled), or the interface cannot send Ethernet PAUSE messages or respond to them (flow control is disabled).

When you enable symmetric flow control on an interface, the Ethernet PAUSE behavior depends on the configuration of the connected peer. With symmetric flow control enabled, the interface can perform any Ethernet PAUSE functions that the connected peer can perform. (When symmetric flow control is disabled, the interface does not send or respond to Ethernet PAUSE messages.)

Asymmetric Flow Control

Asymmetric flow control enables you to specify independently whether or not the interface receive buffer generates and sends Ethernet PAUSE messages to stop the connected peer from transmitting traffic, and whether or not the interface transmit buffer responds to Ethernet PAUSE messages it receives from the connected peer and stops transmitting traffic. The receive buffer configuration determines if the interface transmits Ethernet PAUSE messages, and the transmit buffer configuration determines if the interface receives and responds to Ethernet PAUSE messages:

- Receive buffers on—Enable Ethernet PAUSE transmission (generate and send Ethernet PAUSE frames)
- Transmit buffers on—Enable Ethernet PAUSE reception (respond to received Ethernet PAUSE frames)

You must explicitly set the flow control for both the receive buffer and the transmit buffer (**on** or **off**) to configure asymmetric Ethernet PAUSE. Table 373 on page 4887 describes the configured flow control state when you set the receive (Rx) and transmit (Tx) buffers on an interface:

Table 373: Asymmetric Ethernet PAUSE Flow Control Configuration

Receive (Rx) Buffer	Transmit (Tx) Buffer	Configured Flow Control State
On	Off	Interface generates and sends Ethernet PAUSE messages. Interface does not respond to Ethernet PAUSE messages (interface continues to transmit even if peer requests that the interface stop sending traffic).
Off	On	Interface responds to Ethernet PAUSE messages received from the connected peer, but does not generate or send Ethernet PAUSE messages. (The interface does not request that the connected peer stop sending traffic.)
On	On	Same functionality as symmetric Ethernet PAUSE. Interface generates and sends Ethernet PAUSE messages and responds to received Ethernet PAUSE messages.
Off	Off	Ethernet PAUSE flow control is disabled.

The configured flow control is the Ethernet PAUSE state configured on the interface.

On 1-Gigabit Ethernet interfaces, the QFX Series supports autonegotiation of Ethernet PAUSE with the connected peer. (The QFX Series does not support autonegotiation on 10-Gigabit Ethernet interfaces.) Autonegotiation enables the interface to exchange state advertisements with the connected peer so that the two devices can agree on the Ethernet PAUSE configuration. Each interface advertises its flow control state to the connected peer using a combination of the Ethernet PAUSE and ASM_DIR bits, as described in Table 374 on page 4888:

Table 374: Flow Control State Advertised to the Connected Peer (Autonegotiation)

Rx Buffer State	Tx Buffer State	PAUSE Bit	ASM_DIR Bit	Description
Off	Off	0	0	The interface advertises no Ethernet PAUSE capability. This is equivalent to disabling flow control on an interface.
On	On	1	0	The interface advertises symmetric flow control (both the transmission of Ethernet PAUSE messages and the ability to receive and respond to Ethernet PAUSE messages).
On	Off	0	1	The interface advertises asymmetric flow control (the transmission of Ethernet PAUSE messages, but not the ability to receive and respond to Ethernet PAUSE messages).
Off	On	1	1	The interface advertises both symmetric and asymmetric flow control. Although the interface does not generate and send Ethernet PAUSE requests to the peer, the interface supports both symmetric and asymmetric Ethernet PAUSE configuration on the peer because the peer is not affected if the peer does not receive Ethernet PAUSE requests. (If the interface responds to the peer's Ethernet PAUSE requests, that is sufficient to support either symmetric or asymmetric flow control on the peer.)

The flow control configuration on each switch interface interacts with the flow control configuration of the connected peer. Each peer advertises its state to the other peer. The interaction of the flow control configuration of the peers determines the flow control behavior (resolution) between them, as shown in Table 375 on page 4889. The first four columns show the Ethernet PAUSE configuration on the local QFX Series and on the connected peer (also known as the link partner). The last two columns show the Ethernet PAUSE resolution that results from the local and peer configurations on each interface. This illustrates how the Ethernet PAUSE configuration of each interface affects the Ethernet PAUSE behavior on the other interface.

NOTE: In the Resolution columns of the table, disabling Ethernet PAUSE transmit means that the interface receive buffers do not generate and send Ethernet PAUSE messages to the peer. Disabling Ethernet PAUSE receive means that the interface transmit buffers do not respond to Ethernet PAUSE messages received from the peer.

Table 375: Asymmetric Ethernet PAUSE Behavior on Local and Peer Interfaces

Local Interface (QFX Series)		Peer Interface			
PAUSE Bit	ASM_DIR Bit	PAUSE Bit	ASM_DIR Bit	Local Resolution	Peer Resolution
0	0	Don’t care	Don’t care	Disable Ethernet PAUSE transmit and receive	Disable Ethernet PAUSE transmit and receive
0	1	0	Don’t care	Disable Ethernet PAUSE transmit and receive	Disable Ethernet PAUSE transmit and receive
0	1	1	0	Disable Ethernet PAUSE transmit and receive	Disable Ethernet PAUSE transmit and receive
0	1	1	1	Enable Ethernet PAUSE transmit and disable Ethernet PAUSE receive	Disable Ethernet PAUSE transmit and enable Ethernet PAUSE receive
1	0	0	Don’t care	Disable Ethernet PAUSE transmit and receive	Disable Ethernet PAUSE transmit and receive
1	0	1	Don’t care	Enable Ethernet PAUSE transmit and receive	Enable Ethernet PAUSE transmit and receive
1	1	0	0	Disable Ethernet PAUSE transmit and receive	Disable Ethernet PAUSE transmit and receive
1	1	0	1	Enable Ethernet PAUSE receive and disable Ethernet PAUSE transmit	Enable Ethernet PAUSE transmit and disable Ethernet PAUSE receive
1	1	Don’t care	Don’t care	Enable Ethernet PAUSE transmit and receive	Enable Ethernet PAUSE transmit and receive

NOTE: For your convenience, Table 375 on page 4889 replicates Table 28B-3 of Section 2 of the IEEE 802.X specification.

PFC

PFC is a lossless transport and congestion relief feature that works by providing granular link-level flow control for each IEEE 802.1p code point (priority) on a full-duplex Ethernet link. When the receive buffer on a switch interface fills to a threshold, the switch transmits a pause frame to the sender (the connected peer) to temporarily stop the sender from transmitting more frames. The buffer threshold must be low enough so that the sender has time to stop transmitting frames and the receiver can accept the frames already on the wire before the buffer overflows. The switch automatically sets queue buffer thresholds to prevent frame loss.

When congestion forces one priority on a link to pause, all of the other priorities on the link continue to send frames. Only frames of the paused priority are not transmitted. When the receive buffer empties below another threshold, the switch sends a message that starts the flow again.

You configure PFC using a congestion notification profile (CNP). A CNP has two parts:

- Input—Specify the code point (or code points) on which to enable PFC, and optionally specify the maximum receive unit (MRU) and the cable length between the interface and the connected peer interface.
- Output—Specify the output queue or output queues that respond to pause messages from the connected peer.

You apply a PFC configuration by configuring a CNP on one or more interfaces. Each interface that uses a particular CNP is enabled to pause traffic with the priorities (code points) specified in that CNP. You can configure one CNP on an interface, and you can configure different CNPs on different interfaces. When you configure a CNP on an interface, ingress traffic that is mapped to a priority that the CNP enables for PFC is paused whenever the queue buffer fills to the pause threshold. (The pause threshold is not user-configurable.)

Configure PFC for a priority end to end along the entire data path to create a lossless lane of traffic on the network. You can selectively pause the traffic in any queue without pausing the traffic for other queues on the same link. You can create lossless lanes for traffic such as Fibre Channel over Ethernet (FCoE), LAN backup, or management, while using standard frame-drop congestion management for IP traffic on the same link.

Potential consequences of link-level flow control are:

- Ingress port congestion (configuring too many lossless flows can cause ingress port congestion)
- A paused priority that causes upstream devices to pause the same priority, thus spreading congestion back through the network

By definition, PFC supports symmetric pause only (as opposed to Ethernet PAUSE, which supports symmetric and asymmetric pause). With symmetric pause, a device can:

- Transmit pause frames to pause incoming traffic. (You configure this using the input stanza of a congestion notification profile.)
- Receive pause frames and stop sending traffic to a device whose buffer is too full to accept more frames. (You configure this using the output stanza of a congestion notification profile.)

Receiving a PFC frame from a connected peer pauses traffic on egress queues based on the IEEE 802.1p priorities that the PFC pause frame identifies. The priorities are 0 through 7. By default, the priorities map to queue numbers 0 through 7, respectively, and to specific forwarding classes, as shown in Table 376 on page 4891:

Table 376: Default PFC Priority to Queue and Forwarding Class Mapping

IEEE 802.1p Priority (Code Point)	Queue	Forwarding Class
0 (000)	0	best-effort
1 (001)	1	best-effort
2 (010)	2	best-effort
3 (011)	3	fcoe
4 (100)	4	no-loss
5 (101)	5	best-effort
6 (110)	6	network-control
7 (111)	7	network-control

For example, a received PFC pause frame that pauses priority 3 pauses output queue 3. If you do not want to use the default configuration, you can configure customized mapping of priorities to queues and forwarding classes.

NOTE: By convention, deployments with converged server access typically use IEEE 802.1p priority 3 for FCoE traffic. The default forwarding class configuration sets the **fcoe** forwarding class as a lossless forwarding class that is mapped to queue 3. The default classifier maps incoming priority 3 traffic to the **fcoe** forwarding class. *However, you must apply PFC to the entire FCoE data path to configure the end-to-end lossless behavior that FCoE traffic requires.*

If your network uses priority 3 for FCoE traffic, we recommend that you use the default configuration. If your network uses a priority other than 3 for FCoE traffic, you can configure lossless FCoE transport on any IEEE 80.21p priority as described in "Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows" on page 5427 and "Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway" on page 5446.

You enable PFC on a priority by:

1. Specifying the IEEE 802.1p code point to pause in the input stanza of a CNP
2. Applying the CNP to the ingress interfaces on which you want to pause the traffic

CAUTION: Any change to the PFC configuration on a port temporarily blocks the entire port (not just the priorities affected by the PFC change) so that the port can implement the change, then unblocks the port. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

A change to the PFC configuration means any change to a CNP, including changing the input portion of the CNP (enabling or disabling PFC on a priority, or changing the MRU or cable-length values) or changing the output portion the CNP that enables or disables output flow control on a queue. A PFC configuration change only affects ports that use the changed CNP.

The following actions change the PFC configuration:

- Deleting or disabling a PFC configuration (input or output) in a CNP that is in use on one or more interfaces. For example:
    1. An existing CNP with an input stanza that enables PFC on priorities 3, 5, and 6 is configured on interfaces xe-0/0/20 and xe-0/0/21.
    2. We disable the PFC configuration for priority 6 in the input CNP, and then commit the configuration.
    3. The PFC configuration change causes all traffic on interfaces xe-0/0/20 and xe-0/0/21 to stop until the PFC change has been implemented. When the PFC change has been implemented, traffic resumes.
- Configuring a CNP on an interface. (This changes the PFC state by enabling PFC on one or more priorities.)
- Deleting a CNP from an interface. (This changes the PFC state by disabling PFC on one or more priorities.)

When you associate the CNP with an interface, the interface uses PFC to send pause requests when the output queue buffer for the lossless traffic fills to the pause threshold.

Although unicast traffic and multidestination (multicast, broadcast, and destination lookup fail) traffic must use different classifiers, you can map a unicast queue (queue 0 through 7) and a multidestination queue (queue 8, 9, 10, or 11) to the same PFC priority so that both unicast and multicast traffic use that priority. Do not map multidestination traffic to lossless priorities. Starting with Junos OS Release 12.3, you can map one priority to multiple output queues.

NOTE: You can attach a maximum of one CNP to an interface, but you can create an unlimited number of CNPs that explicitly configure only the input stanza and use the default output stanza.

The output stanza of the CNP maps to a profile that interfaces use to respond to pause messages received from the connected peer. On standalone QFX3500 switches and QFX3600 switches, you can create two CNPs with an explicitly configured output stanza.

When a QFX3500 switch or a QFX3600 switch is a Node device in a QFabric system, you can create one CNP with an explicitly configured output stanza. (One fewer profile is available on QFabric systems because the system needs a default profile for fabric interfaces, which are not used as fabric interfaces when the switches are not part of a QFabric system. "Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows" on page 5427 describes configuring output flow control.

Lossless Transport Support Summary

The QFX Series supports up to six lossless forwarding classes. For lossless transport, you must enable PFC on the IEEE 802.1p priorities (code points) mapped to lossless forwarding classes.

CAUTION: Any change to the PFC configuration on a port temporarily blocks the entire port (not just the priorities affected by the PFC change) so that the port can implement the change, then unblocks the port. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

The following limitation applies to support lossless transport on QFabric systems only:

- The internal fiber cable length from the QFabric system Node device to the QFabric system Interconnect device cannot exceed 150 meters.

The default CoS configuration provides two lossless forwarding classes, *fcoe* and *no-loss*. If you explicitly configure lossless forwarding classes, you must include the **no-loss** packet drop attribute to enable lossless behavior, or the traffic is not lossless. For both default and explicit lossless forwarding class configuration, you must configure CNP input stanzas to enable PFC on the priority of the lossless traffic and apply the CNPs to ingress interfaces.

NOTE: Junos OS Release 12.2 introduced changes to the way the QFX Series handles lossless forwarding classes (including the default **fcoe** and **no-loss** forwarding classes).

In Junos OS Release 12.1, either explicitly configuring the **fcoe** and **no-loss** forwarding classes or using the default configuration for these forwarding classes resulted in the same lossless behavior for traffic mapped to those forwarding classes.

However, in Junos OS Release 12.2, if you explicitly configure the **fcoe** or the **no-loss** forwarding class, that forwarding class is no longer treated as a lossless forwarding class. Traffic mapped to these forwarding classes is treated as lossy (best-effort) traffic. This is true even if the explicit configuration is exactly the same as the default configuration.

If your CoS configuration from Junos OS Release 12.1 or earlier includes the explicit configuration of the **fcoe** or the **no-loss** forwarding class, then when you upgrade to Junos OS Release 12.2, those forwarding classes are not lossless. To preserve the lossless treatment of these forwarding classes, delete the the explicit **fcoe** and **no-loss** forwarding class configuration before you upgrade to Junos OS Release 12.2.

See "Overview of CoS Changes Introduced in Junos OS Release 12.2" on page 5304 for detailed information about this change and how to delete an existing lossless configuration.

In Junos OS Release 12.3, the default behavior of the **fcoe** and **no-loss** forwarding classes is the same as in Junos OS Release 12.2. However, in Junos OS Release 12.3, you can configure up to six lossless forwarding classes. All explicitly configured lossless forwarding classes must include the new **no-loss** packet drop attribute or the forwarding class is lossy.

"Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows" on page 5427 provides detailed information about the explicit configuration of lossless priorities and about the default configuration of lossless priorities, including the input and output stanzas of the CNP.

NOTE: PFC and Ethernet PAUSE are used only on Ethernet interfaces. Fabric (fte) ports on QFabric systems (Node device fabric ports and Interconnect device fabric ports) use link-layer flow control (LLFC) to ensure the appropriate treatment of lossless traffic.

Related Documentation

- Overview of CoS Changes Introduced in Junos OS Release 12.2 on page 5304
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427
- Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5446

Understanding Fibre Channel Terminology

To understand the Fibre Channel (FC) and Fibre Channel over Ethernet (FCoE) capabilities of the QFX Series, you should become familiar with the terms defined in Table 377 on page 4895.

Table 377: Fibre Channel Terms

Term	Definition
addressing mode	Format for the locally unique MAC address the FC switch assigns to FCoE devices for FCoE transactions after FIP establishes a connection between an FCoE device and the FC switch. The two addressing modes are *fabric-provided MAC address (FPMA)* and *server-provided MAC address (SPMA)*. The QFX Series supports only FPMA. During FLOGI or FDISC, the ENode advertises the addressing modes it supports. If the FC switch supports an addressing mode that the ENode uses, the virtual link can be established, and the devices can communicate. See also *fabric-provided MAC address (FPMA)* and *server-provided MAC address (SPMA)*.
ALL-ENode-MACs	Well-known multicast MAC address to which all FCoE ENodes listen. FCFs send multicast *FIP discovery advertisement* messages and *FIP keepalive* messages to the ALL-ENode-MACs address so that ENodes can discover and maintain connections to FCFs. The hexadecimal format of the address is **01:10:18:01:00:01**. See also *well-known address (WKA)*.
ALL-FCF-MACs	Well-known multicast MAC address to which all FCFs listen. ENodes send multicast *FIP discovery solicitation* messages to the ALL-FCF-MACs address to find out which FCFs can accept a login. The hexadecimal format of the address is **01:10:18:01:00:02**. See also *well-known address (WKA)*.
congestion notification	See *quantized congestion notification (QCN)*.
converged network adapter (CNA)	Physical adapter that combines the functions of a Fibre Channel *host bus adapter (HBA)* to process FCoE frames and a *lossless Ethernet network interface card (NIC)* to process non-FCoE Ethernet frames. CNAs have one or more Ethernet ports. CNAs encapsulate Fibre Channel frames in Ethernet for FCoE transport and de-encapsulate Fibre Channel frames from FCoE to native Fibre Channel. See also *host bus adapter (HBA)*.

Table 377: Fibre Channel Terms *(continued)*

Term	Definition
data center bridging (DCB)	Set of IEEE specifications that enhance Ethernet to allow it to support converged Ethernet (LAN) and Fibre Channel (SAN) traffic on one Ethernet network. DCB features include *priority-based flow control (PFC)*, *enhanced transmission selection (ETS)*, *Data Center Bridging Capability Exchange protocol (DCBX)*, *quantized congestion notification (QCN)*, and full-duplex 10-Gigabit Ethernet ports. See also *priority-based flow control (PFC)*, *Ethernet PAUSE*, *enhanced transmission selection (ETS)*, *Data Center Bridging Capability Exchange protocol (DCBX)*, and *quantized congestion notification (QCN)*.
expansion port (E_Port)	An expansion port in an FC switch/FCF that connects the FC switch/FCF to the E_Port of another FC switch/FCF to form an *Interswitch Link (ISL)* in a common FC fabric.
Data Center Bridging Capability Exchange protocol (DCBX)	Discovery and exchange protocol for conveying configuration and capabilities among neighbors to ensure consistent configuration across the network. It is an extension of the Link Layer Data Protocol (LLDP, described in IEEE 802.1AB) See also *data center bridging (DCB)*.
enhanced transmission selection (ETS)	Mechanism that provides finer granularity of bandwidth management within a link. See also *data center bridging (DCB)*.
ENode	See *FCoE Node (ENode)*
ENode MAC	*Lossless Ethernet MAC* paired with an *FCoE controller* in an ENode. See also *FCoE node (ENode)*.
ENode MAC address	Globally unique address assigned to the CNA by the manufacturer and used to identify the node for FIP transactions.
Ethernet PAUSE	As defined in IEEE 802.3X, a flow control mechanism that temporarily stops the transmission of Ethernet frames on a link for a specified period. A receiving element sends an Ethernet PAUSE frame when a sender transmits data faster than the receiver can accept it. Ethernet PAUSE affects the entire link, not just an individual flow. An Ethernet PAUSE frame temporarily stops all traffic transmission on the link and allows the receiver's input buffer to empty sufficiently to restart traffic on the link. Ethernet PAUSE messages are sent to the previous hop and do not automatically propagate to the source of the congestion. See also *priority-based flow control (PFC)*.
fabric	Interconnection of network nodes using one or more network switches that function as a network single logical entity.

Table 377: Fibre Channel Terms *(continued)*

Term	Definition
fabric discovery (FDISC)	Subsequent logins from the same ENode for different users, applications, or virtual machines after an ENode performs an initial FLOGI to log in to a switch. FC and FIP FDISC messages serve the same function in FC and FCoE networks, respectively. N_Ports send FC FDISC messages to the FC switch and VN_Ports send FIP FDISC messages to the FCF. After an N_Port acquires its initial N_Port ID through the FC FLOGI process, it can acquire additional N_Port IDs by sending an FC FDISC with a new worldwide port name and a source ID of 0x000000. The new port name and blank source ID tell the FC switch to assign a new N_Port ID to the N_Port. The different N_Port IDs allow multiple virtual machines or users on the N_Port to have separate, secure virtual links on the same physical N_Port. These additional ports are also referred to as VN_Ports. FIP FDISC works the same way, except the VN_Port logs in using a FIP FLOGI message. See also *fabric login (FLOGI)* and *N_Port ID*.
fabric login (FLOGI)	Creation of a logical connection to the FC switch and establishment of a node's operating environment. For FC devices, an N_Port logs in to the FC network by sending an FC FLOGI message to the F_Port of an FC switch. For FCoE devices, a VN_Port logs in to the FC network by sending a FIP FLOGI message to the VF_Port of an FC switch.
fabric port (F_Port)	FC port on an FC switch or an FCF that connects point-to-point to an FC node port (N_Port) on an FC host (server or storage device). An F_Port provides access to fabric services for FC devices. F_Ports are intermediate ports in a connection between FC device end-point N_Ports. For example, a connection between an FC host server and an FC storage device through an FC switch looks like this: FC server N_Port to FC switch ingress F_Port to FC switch egress F_Port to FC storage device N_Port. See also *node port (N_Port)*.
fabric-provided MAC address (FPMA)	MAC address that an FCF assigns to a single ENode MAC through the FLOGI or FDISC process that is unique to the local fabric. The FPMA uniquely identifies a single VN_Port at that ENode MAC in FCoE transactions with the FCF. Because an ENode can have more than one ENode MAC, an FCF can assign multiple FPMAs to an ENode, one FPMA per ENode MAC. An FPMA is a 48-bit value that consists of two 24-bit values, the N_Port ID and the FC-MAP value. The N_Port ID uniquely identifies the VN_Port and the FC-MAP value identifies the FCF. See also *FCoE node (ENode)*, *N_Port ID*, and *FCoE mapped address prefix (FC-MAP)*.
FCF-MAC	Lossless Ethernet MAC paired with an FCoE controller in an FCF. The FCF-MAC enables the FCF to handle FCoE traffic.

Table 377: Fibre Channel Terms *(continued)*

Term	Definition
FCoE controller	Instantiates and terminates VN_Port and VF_Port instances on an ENode. An ENode can have more than one FCoE controller. Each FCoE controller is paired with a lossless Ethernet MAC on the ENode. See also *lossless Ethernet MAC*.
FC forwarder (FCF)	Alternative term and acronym to refer to an FC switch that has all physical Fibre Channel ports and the necessary set of services as defined in the T11 Organization *Fibre Channel Switched Fabric* (FC-SW) standards.
FCoE forwarder (FCF)	Defined by the *Fibre Channel Backbone - 5 (FC-BB-5) Rev 2.00* specification available at http://www.t11.org/ftp/t11/pub/fc/bb-5/09-056v5.pdf as a device that has the necessary set of services as defined in FC-SW and the FCoE capabilities to act as an FCoE-based FC switch.
FCoE Initialization Protocol (FIP)	Layer 2 protocol for endpoint discovery, fabric login, and fabric association. FIP enables FCoE devices and FC switches to discover one another. Through FIP, FCoE nodes can log in to an FC switch, access the SAN FC fabric, and communicate with target FC devices. FIP messages also maintain the connection between the FCoE initiator and the FCF. FIP has its own EtherType (0x8914) to distinguish its traffic from payload-carrying FCoE traffic and other Ethernet traffic.
FCoE link endpoint (LEP)	Virtual FC interface mapped onto a physical Ethernet interface to handle FC frame encapsulation and de-encapsulation and transmission and reception of FC frames encapsulated in Ethernet through a single virtual link.
FCoE mapped address prefix (FC-MAP)	24-bit value that identifies the FC switch and is half of the 48-bit FPMA MAC address. The FC-MAP value can be configured on the FC switch and has a default value of 0EFC00h. The FC-MAP value was originally called the Fibre Channel Organizationally Unique Identifier (FC-OUI). See also *fabric-provided MAC address (FPMA)*.
FCoE node (ENode)	Fibre Channel node that has one or more lossless Ethernet MACs, each paired with an *FCoE Controller* in order to transmit FCoE frames. An ENode combines FCoE termination functions and the FC stack on a CNA. ENodes present virtual FC interfaces to FC switches or FCFs in the form of VN_Ports, which can establish FCoE virtual links with FC switch/FCF VF_Ports. ENodes perform FCoE related functions in a *converged network adapter (CNA)*. See also *converged network adapter (CNA)*.
FCoE-FC gateway	A form of N_Port virtualizer in which the node-facing ports are FCoE ports and the FC switch-facing ports are FC ports.
FCoE-FCoE gateway	A form of N_Port virtualizer in which the node-facing ports are FCoE ports and the FC switch-facing ports are FCoE ports.
FC-FC gateway	A form of N_Port virtualizer in which the node-facing ports are FC ports and the FC switch-facing ports are FC ports.

Table 377: Fibre Channel Terms *(continued)*

<table>
<tr><th>Term</th><th>Definition</th></tr>
<tr><td>FCoE transit switch (also known as a FIP snooping bridge)</td><td>Switch with a minimum set of features designed to support FCoE Layer 2 forwarding and FCoE security. The switch can also have optional additional features.

Minimum feature support is:

• Priority-based flow control (PFC)
• Enhanced transmission selection (ETS)
• Data Center Bridging Capability Exchange Protocol (DCBX), including the FCoE application TLV
• FIP snooping (minimum support is FIP automated filter programming at the ENode edge)

Additional FIP snooping capabilities can include learning the virtual FC connection paths (VN2VF, VN2VN, or VE2VE) and monitoring the FIP keepalive mechanisms. Other optional capabilities can also enhance FCoE within the standards. FIP snooping is typically configurable on a per-VLAN basis.

A transit switch has an FC stack even though it is not an FC switch or an FCF.</td></tr>
<tr><td>FCoE VLAN</td><td>VLAN dedicated to carrying only FCoE traffic. FCoE traffic must travel in a VLAN. Only FCoE interfaces should be members of an FCoE VLAN. Ethernet traffic that is not FCoE traffic must travel in a different VLAN.</td></tr>
<tr><td>Fibre Channel</td><td>High-speed network technology used for storage area networks (SANs).</td></tr>
<tr><td>Fibre Channel fabric</td><td>Network of Fibre Channel devices that allows communication among devices, device name lookup, security, and redundancy.

Also a local fabric on a QFX3500 switch with FCoE interfaces connected to FCoE devices on the Ethernet network and native FC interfaces connected to an FC switch in a SAN.</td></tr>
<tr><td>Fibre Channel ID (FCID)</td><td>24-bit value the FC switch assigns to the N_Port or VN_Port as a unique identifier within the local FC network. The FCID consists of an 8-bit domain value, an 8-bit area value, and an 8-bit port value. The FCID is sometimes called an N_Port ID.

See also N_Port ID.</td></tr>
<tr><td>Fibre Channel over Ethernet (FCoE)</td><td>Standard for transporting FC frames over Ethernet networks. FCoE encapsulates Fibre Channel frames in Ethernet so that the same high-speed Ethernet physical infrastructure can transport both data and storage traffic while preserving the lossless CoS that FC requires. FCoE has its own EtherType (0x8906) to differentiate it from other Ethernet traffic.

FCoE runs on a DCB network. FCoE servers connect to a switch that supports both FCoE and native FC protocols. This allows FCoE servers on the Ethernet network to access FC storage devices in the SAN fabric on one converged network.

See also data center bridging (DCB).</td></tr>
</table>

Table 377: Fibre Channel Terms *(continued)*

Term	Definition
Fibre Channel services	Functions required for establishing FC network connectivity among devices and for managing devices on the FC network, such as login servers, domain managers, name servers, and zone servers.
FC stack	FC or FCoE protocol capability implemented on a device to support the FC or FCoE functionality. Having an FC stack does not imply consuming a domain ID. Each FC or FCoE enabled server or storage device has an FC stack. Similarly, an FC or FCoE switch, an FCF, an FCoE-FC gateway, and an FCoE transit switch have FC stacks.
Fibre Channel switch	Network switch that implements the Fibre Channel protocol.
FIP discovery advertisement	Multicast or unicast message that the FC switch (or FCF) transmits to ENodes to advertise the switch's presence on the network so that ENodes can discover the switch and request to log in to the FC fabric. The FC switch periodically sends multicast FIP discovery advertisements to the ALL-ENode-MACs address, a well-known address to which all ENodes listen. The multicast messages advertise the FC switch to all ENodes on the VLAN and serve as keepalive messages to maintain connectivity between the FC switch and ENodes. When an ENode sends a FIP discovery solicitation message to the FC switch, the FC switch responds with a unicast FIP discovery advertisement to that ENode.
FIP discovery solicitation	Multicast or unicast message that an ENode transmits to FC switches (or FCFs) to find compatible switches in the network. When an ENode initializes, it sends a multicast FIP discovery solicitation to the ALL-FCF-MACs address, a well-known address to which all FC switches and FCFs listen. Compatible switches reply with a unicast FIP discovery advertisement. The ENode compiles a list of compatible switches, selects a switch, and logs in to that switch.
FIP keepalive	Periodic multicast FIP discovery advertisement sent from the FC switch or FCF to all ENodes to maintain connectivity.

Table 377: Fibre Channel Terms *(continued)*

Term	Definition
FIP snooping	For VN_Port to VF_Port (VN2VF) paths (Technical Committee T11 BB-FC-5 specification), FIP snooping is a security feature enabled for FCoE VLANs on an Ethernet switch that connects ENodes to FC switches or FCFs. FIP snooping inspects data in FIP frames and uses that data to create firewall filters. The filters permit only traffic from sources that perform a successful FLOGI to the FC switch. All other traffic on the VLAN is denied. FIP snooping filters are installed on the ports in the FCoE VLAN. For VN_Port to VN_Port (VN2VN) paths (Technical Committee T11 BB-FC-6 specification), the FIP snooping security feature filters access between VN_Ports in a similar manner to VN2VF_Port FIP snooping. FIP snooping can also apply similarly to VE_Port to VE_Port (VE2VE) paths. FIP snooping can also snoop to provide additional visibility of FCoE Layer 2 operation. See also *FCoE node (ENode)*.
FIP snooping bridge	See *FCoE transit switch* and *FIP snooping*.
host bus adapter (HBA)	Physical mechanism that connects a host system to other FC network and storage devices. HBAs have a unique worldwide node name (WWNN) for the HBA node, which all of the ports on the HBA share, and each port on an HBA has a unique worldwide port name (WWPN).
initiator	System component that originates an I/O command over an I/O bus or network. An FCoE server sending a request to an FC storage device is an example of an initiator.
iSCSI transit switch	Layer 2 Ethernet switch with a minimum set of best-practice Ethernet features to support iSCSI, along with optional enhancements. Minimum feature support is: • IEEE 802.3X asymmetric and symmetric flow control on ports not running in DCB mode • Priority-based flow control (PFC) • Enhanced transmission selection (ETS) • Data Center Bridging Capability Exchange Protocol (DCBX), including the iSCSI application TLV Other capabilities such as Internet storage name service (iSNS) are optional.
interswitch link (ISL)	Link between the *E_Ports* of two FC switches in a common FC fabric. When two FCoE-based FC switches are connected together, there is a virtual ISL through Layer 2.
logout (LOGO)	For FC devices, an N_Port logs out from the FC network by sending an FC LOGO message to the F_Port of an FC switch. The switch can also send a LOGO message to an N_Port to terminate its connection. For FCoE devices, a VN_Port logs out from the FC network by sending a FIP LOGO message to the VF_Port of an FC switch. The switch can also send a LOGO message to a VN_Port to terminate its connection.

Table 377: Fibre Channel Terms *(continued)*

Term	Definition
lossless Ethernet MAC	Full-duplex Ethernet MAC that implements Ethernet extensions to avoid Ethernet frame loss due to congestion and supports at least 2.5-KB jumbo frames. Each lossless Ethernet MAC combines with an FCoE Controller to perform FCoE termination functions on an ENode. See also *priority-based flow control (PFC)*, *quantized congestion notification (QCN)*, *FCoE controller*, and *FCoE node (ENode)*.
lossless Ethernet network	Ethernet network composed of only full-duplex links and lossless Ethernet MACs and with CoS and flow control to prevent dropping of frames.
lossless transport	In DCB networks, the ability to switch FCoE frames over an Ethernet network without dropping any frames. Lossless transport uses mechanisms such as priority-based flow control and quantized congestion notification to control traffic flows and avoid congestion.
N_Port ID	See *Fibre Channel ID (FCID)*.
N_Port ID virtualizer	Presents itself as an FC or FCoE switch to external devices, but connects to an actual FC or FCoE switch in the other direction to provide the FC-SW services. An N_Port ID virtualizer logs in to the actual FC or FCoE switch in the same way as a normal node device and uses the NPIV mechanism to proxy incoming FLOGIs to FDISCs on the actual FC or FCoE switch. An N_Port ID virtualizes has an FC stack even though it is not an FC switch or an FCF. The acronym *NPV* is commonly used for N_Port ID virtualizer even though the acronym is not defined in the standards.
N_Port ID Virtualization (NPIV)	NPIV enables a physical N_Port to acquire multiple N_Port IDs. Each N_Port ID maps to a different application (such as a virtual machine) or to a different user. This allows you to associate one F_Port with many N_Port IDs and create multiple discrete, secure virtual links over one physical point-to-point connection. NPIV increases resource and bandwidth utilization and allows the implementation of access control, zoning, and port security on a per-application or per-user basis. After an N_Port performs a FLOGI and receives its first N_Port ID, it can request more N_Port IDs by sending FDISC messages. See also *fabric login (FLOGI)*, *fabric discovery (FDISC)*, and *virtual link*.

Table 377: Fibre Channel Terms *(continued)*

Term	Definition
node port (N_Port)	N_Ports can be in two modes: • Fabric N_Port—Node port that is an FC host or storage device end port in a point-to-point link between the device and the F_Port of an FC switch. The point-to-point link can be virtual or physical. • Point-to-point N_Port—Node port that connects to another N_Port. The QFX3500 switch does not support this configuration. N_Ports handle creation, detection, and flow of messages to and from the connected devices.
node worldwide name (NWWN)	WWN that is unique worldwide and is assigned to an FC node. An NWWN is valid for multiple ports that are on that node (this identifies the ports as network interfaces of a particular node).
port mode	Role that the port plays in the FC fabric (endpoint device, FC switch connection to endpoint devices, interswitch link). See also *node port (N_Port)*, *virtual node port (VN_Port)*, *proxy node port (NP_Port)*, *fabric port (F_Port)*, and *virtual fabric port (VF_Port)*.
port worldwide name (PWWN)	WWN that is unique worldwide and is assigned to an FC port.
priority-based flow control (PFC)	Link-level flow control mechanism defined by IEEE 802.1Qbb that allows independent flow control for each class of service (as defined in the 3-bit CoS field of the Ethernet header by IEEE 802.1Q tags) to ensure that no frame loss from congestion occurs in DCB networks. PFC is an enhancement of the Ethernet PAUSE mechanism, but PFC controls classes of flows, whereas Ethernet PAUSE indiscriminately pauses all of the traffic on a link. With PFC, a receiving device can signal a transmitting device to pause transmission based on traffic class. PFC provides application-specific bandwidth reservations so you can ensure that time-critical protocols and applications such as FCoE receive the priority necessary to prevent frame loss. PFC allows the same physical link to carry FCoE traffic and provide lossless service while also carrying loss-tolerant Ethernet traffic. See also *Ethernet PAUSE*.
proxy gateway mode	Connects FCoE initiators to FC switches in a converged Ethernet and Fibre Channel network and acts as an intermediary for these devices. The FCoE-FC gateway represents and acts for the FCoE initiators in transactions from the FCoE initiators destined for an FC switch, including converting FIP and FCoE frames to FC frames. The gateway represents and acts for an FC switch in transactions from the FC switch destined for an FCoE initiator, including converting FC frames to FIP frames and encapsulating FC frames in Ethernet.
proxy node port (NP_Port)	N_Port on the QFX Series that performs proxy functions when it is configured as an FCoE-FC gateway. The NP_Port acts as a proxy for the FCoE device VN_Ports in transactions with the FC switch.

Table 377: Fibre Channel Terms *(continued)*

Term	Definition
quantized congestion notification (QCN)	Mechanism defined by IEEE 802.1Qau that manages network congestion within a Layer 2 domain. When a queue reaches a configured threshold, QCN throttles traffic at the source of the congestion by transmitting messages that propagate back to the source and temporarily stop the source from transmitting. When the queue crosses the threshold that indicates the congestion has dissipated, QCN sends a message to allow the source to resume transmitting frames.
session	Fabric login (FLOGI) or fabric discovery (FDISC) login to the FC SAN fabric. Session does not refer to end-to-end server-to-storage sessions.
server-provided MAC address (SPMA)	MAC address that an ENode assigns to one of its ENode MACs and is not assigned to any other ENode MAC in the same FCoE VLAN. An SPMA can be associated with more than one VN_Port at that ENode MAC. The QFX Series does not support SPMA. See also *ENode MAC* and *fabric-provided MAC address (FPMA)*.
storage area network (SAN)	Network whose primary purpose is the transfer of data between computer systems and storage devices. This term is most commonly used in the context of any network that supports block storage, usually iSCSI, FC, and FCoE networks.
target	System component that receives an I/O command. An FC storage device that receives a request from a server is an example of a target.
VE_Port	Virtual ports created to form a connection (an *interswitch link*) between two FCoE-based FC switches as part of a common FC fabric.
VE2VE (VE_Port to VE_Port)	The *Fibre Channel Backbone - 5 (FC-BB-5) Rev 2.00* specification capability of FCFs to connect to each other as a single FCoE FC SAN.
VN2VF (VN_Port to VF_Port)	The *Fibre Channel Backbone - 5 (FC-BB-5) Rev 2.00* specification capability of an ENode to connect to an FCF or to an FCoE-enabled FC SAN.
VN2VN (VN_Port to VN_Port)	The *Fibre Channel Backbone - 6 (FC-BB-6)* specification capability of an ENode to connect directly over Layer 2 to another ENode without the need of any FC-related services. This capability is most often used in small-scale FCoE SANs.
virtual fabric port (VF_Port)	Data-forwarding component that emulates an F_Port. A VF_Port is dynamically instantiated on successful completion of a FIP FLOGI exchange and connects to one or more VN_Ports. The term *virtual* indicates the use of a non-FC link such as an FCoE link. See also *fabric port (F_Port)*.
virtual link	Logical link connecting two FCoE Link End Points (LEPs) over a lossless Ethernet network, for example, the link between a VF_Port and a VN_Port. The MAC addresses of the two LEPs identifies a virtual link. See also *FCoE link end point (LEP)* and *lossless Ethernet network*.

Table 377: Fibre Channel Terms *(continued)*

Term	Definition
virtual node port (VN_Port)	Data-forwarding component that emulates an N_Port. With FCoE, a VN_Port is dynamically instantiated on successful completion of a FIP FLOGI exchange and connects to one or more VF_Ports. The term *virtual* indicates the use of a non-FC link such as an FCoE link. VN_Port is also used for the virtual N_Ports created in both FC and FCoE when additional NPIV-based logins occur over a previously created N_Port-to-VN_Port or N_Port-to-VF_Port connection. See also *node port (N_Port)*.
well-known address (WKA)	Address identifier used to access a service provided by an FC fabric. The service can be distributed in many elements throughout a fabric, or it can be centralized in one element. A WKA is always accessible, regardless of zoning. An example of a WKA is the *ALL-FCF-MACs* address to which all FCFs listen.
worldwide name (WWN)	64-bit identifier that is similar to a MAC address except that it is not used for forwarding. It uniquely identifies an FC device. The WWN is derived from the IEEE organizationally unique identifier (OUI) and vendor-supplied information. A WWN is unique worldwide.
worldwide node name (WWNN)	See *node worldwide name (NWWN)*.
worldwide port name (WWPN)	See *port worldwide name (PWWN)*.

Related Documentation

- Overview of Fibre Channel on the QFX Series on page 4786
- *Understanding QFabric System Terminology*

DCBX

Understanding DCBX

Data Center Bridging Capability Exchange protocol (DCBX) is an extension of Link Layer Data Protocol (LLDP). If you disable LLDP on an interface, that interface cannot run DCBX. If you attempt to enable DCBX on an interface on which LLDP is disabled, the configuration commit operation fails. Data center bridging (DCB) devices use DCBX to exchange configuration information with directly connected peers.

This topic describes:

- DCBX and PFC on page 4912
- DCBX and ETS on page 4912

DCBX Basics

DCBX can:

- Discover the DCB capabilities of peers.
- Detect DCB feature misconfiguration or mismatches between peers.
- Configure DCB features on peers.

You can configure DCBX operation for priority-based flow control (PFC), Layer 2 and Layer 4 applications such as FCoE and iSCSI, and ETS. DCBX is enabled or disabled on a per-interface basis.

By default, for PFC and ETS, DCBX automatically negotiates administrative state and configuration with each interface's connected peer. To enable DCBX negotiation for applications, you must configure the applications, map them to IEEE 802.1p code points in an application map, and apply the application map to interfaces.

The FCoE application only needs to be included in an application map when you want an interface to exchange type, length, and values (TLVs) for other applications in addition to FCoE. If FCoE is the only application you want an interface to advertise, then you do not need to use an application map. For ETS, DCBX pushes the switch configuration to peers if they are set to learn the configuration from the switch (unless you disable sending the ETS recommendation TLV on interfaces in IEEE DCBX mode).

You can override the default behavior for PFC, for ETS, or for all applications mapped to an interface by turning off autonegotiation to force an interface to enable or disable that feature. You can also disable DCBX autonegotiation for applications on an interface by excluding those applications from the application map you apply to that interface or by deleting the application map from the interface.

The default autonegotiation behavior for applications that are mapped to an interface is:

- DCBX is enabled on the interface if the connected peer device also supports DCBX.
- DCBX is disabled on the interface if the connected peer device does not support DCBX.

During negotiation of capabilities, the switch can push the PFC configuration to an attached peer if the peer is configured as “willing” to learn the PFC configuration from other peers. The Juniper Networks switch does not support self autoprovisioning and does not change its configuration during autonegotiation to match the peer configuration. (The Juniper switch is not “willing” to learn the PFC configuration from peers.)

NOTE: When a port with DCBX enabled begins to exchange type, length, and value (TLV) entries, optional LLDP TLVs on that port are not advertised to neighbors, so that the switch can interoperate with a wider variety of converged network adapters (CNAs) and Layer 2 switches that support DCBX.

DCBX Modes and Support

This section describes DCBX support on the QFX Series:

- DCBX Modes (Versions) on page 4907
- Autonegotiation on page 4909
- CNA Support for DCBX Modes on page 4909
- Interface Support for DCBX on page 4909

DCBX Modes (Versions)

The QFX Series supports the two most common DCBX modes:

- IEEE DCBX—The newest DCBX version. Different TLVs have different subtypes (for example, the subtype for the ETS configuration TLV is 9); the IEEE DCBX Organizationally Unique Identifier (OUI) is 0x0080c2.
- DCBX version 1.01—The Converged Enhanced Ethernet (CEE) version of DCBX. It has a subtype of 2 and an OUI of 0x001b21.

IEEE DCBX and DCBX version 1.01 differ mainly in frame format. DCBX version 1.01 uses one TLV that includes all DCBX attribute information, which is sent as sub-TLVs. IEEE DCBX uses a unique TLV for each DCB attribute.

NOTE: **The QFX Series does not support pre-CEE (pre-DCB) DCBX versions. Unsupported older versions of DCBX have a subtype of 1 and an OUI of 0x001b21. The QFX Series drops LLDP frames that contain pre-CEE DCBX TLVs.**

Table 378 on page 4907 summarizes the differences between IEEE DCBX and DCBX version 1.01, including show command output:

Table 378: Summary of Differences Between IEEE DCBX and DCBX Version 1.01

Characteristic	IEEE DCBX	DCBX Version 1.01
OUI	0x0080c2	0x001b21
Frame Format	Sends a separate, unique TLV for each DCBX attribute. For example, IEEE DCBX uses separate TLVs for ETS, PFC, and each application. Configuration and Recommendation information is sent in different TLVs	Sends one TLV that includes all DCBX attribute information organized in sub-TLVs. The “willing” bit determines whether or not an interface can change its configuration to match the connected peer.
Symmetric/asymmetric configuration with peer	Asymmetric or symmetric	Symmetric only

Table 378: Summary of Differences Between IEEE DCBX and DCBX Version 1.01 *(continued)*

Characteristic	IEEE DCBX	DCBX Version 1.01
Differences in the **show dcbx interface** ***interface-name*** operational command	• Synchronization information is not shown because symmetric configuration is not required. • Operational state information is not shown because the operational states do not have to be symmetric. • TLV type is shown because unique TLVs are sent for each DCBX attribute. • ETS peer Configuration TLV and Recommendation TLV information is shown separately because they are different TLVs.	• Synchronization information is shown because symmetric configuration is required. • Operational state information is shown because the operational states do have to be symmetric. • TLV type is not shown because one TLV is used for all attribute information. • Recommendation TLV is not sent (DCBX Version 1.01 uses the “willing” bit to determine whether or not an interface uses the peer interface configuration).

For more information about how each DCBX mode exchanges TLVs, see the following specifications:

- For DCBX version 1.01—http://www.ieee802.org/1/files/public/docs2008/az-wadekar-dcbx-capability-exchange-discovery-protocol-1108-v1.01.pdf
- For IEEE DCBX—http://www.ieee802.org/1/files/private/az-drafts/d2/802-1az-d2-4.pdf

NOTE: **As of Junos OS Release 12.2, this document is located in a private area of the IEEE website, and access requires a password from the IEEE organization. If you are not an IEEE member, you might not be able to access this document until it moves to the public area of the IEEE website.**

You can configure interfaces to use the following DCBX modes:

- IEEE DCBX—The interface uses IEEE DCBX regardless of the configuration on the connected peer.
- DCBX version 1.01—The interface uses DCBX version 1.01 regardless of the configuration on the connected peer.
- Autonegotiation—The interface automatically negotiates with the connected peer to determine the DCBX version the peers use. Autonegotiation is the default DCBX mode.

If you configure a DCBX mode on an interface, the interface ignores DCBX protocol data units (PDUs) it receives from the connected peer if the PDUs do not match the DCBX version configured on the interface. For example, if you configure an interface to use IEEE DCBX and the connected peer sends DCBX version 1.01 LLDP PDUs, the interface ignores the version 1.01 PDUs. If you configure an interface to use DCBX version 1.01 and the peer sends IEEE DCBX LLDP PDUs, the interface ignores the IEEE DCBX PDUs.

NOTE: On interfaces that use the IEEE DCBX mode, the **show dcbx neighbors interface** *interface-name* operational command does not include application, PFC, or ETS operational state in the output.

Autonegotiation

Autonegotiation is the default DCBX mode. Each interface automatically negotiates with its connected peer to determine the DCBX version that both interfaces use to exchange DCBX information.

When an interface connects to its peer interface, the interface advertises IEEE DCBX TLVs to the peer. If the interface receives one IEEE DCBX PDU from the peer, the interface sets the DCBX mode as IEEE DCBX. If the interface receives three DCBX version 1.01 TLVs from the peer, the interface sets DCBX version 1.01 as the DCBX mode.

Autonegotiation works slightly differently on QFX3500 switches and QFabric systems:

- QFX3500 switch—When an interface connects to its peer interface, the interface advertises IEEE DCBX TLVs to the peer. If the interface receives an IEEE DCBX TLV from the peer, the interface sets IEEE DCBX as the DCBX mode. If the interface receives three consecutive DCBX version 1.01 TLVs from the peer, the interface sets DCBX version 1.01 as the DCBX mode.
- QFabric system—When an interface connects to its peer interface, the interface advertises DCBX version 1.01 TLVs to the peer. If the interface receives an IEEE DCBX TLVs from the peer, the interface sets IEEE DCBX as the DCBX mode. If the interface receives three consecutive DCBX version 1.01 TLVs from the peer, the interface retains DCBX version 1.01 as the DCBX mode.

NOTE: If the link flaps or the LLDP process restarts, the interface starts the autonegotiation process again. The interface does not use the last received DCBX communication mode.

CNA Support for DCBX Modes

Different CNA vendors support different versions and capabilities of DCBX. The DCBX configuration you use on QFX Series interfaces depends on the DCBX features that the CNAs in your network support.

Interface Support for DCBX

You can configure DCBX on 10-Gigabit Ethernet interfaces and on link aggregation group (LAG) interfaces whose member interfaces are all 10-Gigabit Ethernet interfaces.

DCBX Attribute Types

DCBX has three attribute types:

- Informational—These attributes are exchanged using LLDP, but do not affect DCBX state or operation; they only communicate information to the peer. For example, application priority TLVs are informational TLVs.
- Asymmetric—The values for these types of attributes do not have to be the same on the connected peer interfaces. Peers exchange asymmetric attributes when the attribute values can differ on each peer interface. The peer interface configurations might match or they might differ. For example, ETS Configuration and Recommendation TLVs are asymmetric TLVs.
- Symmetric—The intention is that the values for these types of attributes should be the same on both of the connected peer interfaces. Peer interfaces exchange symmetric attributes to ensure symmetric DCBX configuration for those attributes. For example, PFC Configuration TLVs are symmetric TLVs.

The following sections describe asymmetric and symmetric DCBX attributes:

Asymmetric Attributes

DCBX passes asymmetric attributes between connected peer interfaces to communicate parameter information about those attributes (features). The resulting configuration for an attribute might be different on each peer, so the parameters configured on one interface might not match the parameters on the connected peer interface.

There are two types of asymmetric attribute TLVs:

- Configuration TLV—Configuration TLVs communicate the current operational state and the state of the “willing” bit. The “willing” bit communicates whether or not the interface is willing to accept and use the configuration from the peer interface. If an interface is “willing,” the interface uses the configuration it receives from the peer interface. (The peer interface configuration can override the configuration on the “willing” interface.) If an interface is “not willing”, the configuration on the interface cannot be overridden by the peer interface configuration.
- Recommendation TLV—Recommendation TLVs communicate the parameters the interface recommends that the connected peer interface should use. When an interface sends a Recommendation TLV, if the connected peer is “willing,” the connected peer changes its configuration to match the parameters in the Recommendation TLV.

Symmetric Attributes

DCBX passes symmetric attributes between connected peer interfaces to communicate parameter information about those attributes (features), with the objective that both interfaces should use the same configuration. The intent is that the parameters configured on one interface should match the parameters on the connected peer interface.

There is one type of symmetric attribute TLV, the Configuration TLV. As with asymmetric attributes, symmetric attribute Configuration TLVs communicate the current operational state and the state of the “willing” bit. “Willing” interfaces use the peer interface parameter values for the attribute. (The attribute configuration of the peer overrides the configuration on the “willing” interface.)

DCBX Application Protocol TLV Exchange

DCBX advertises the switch’s capabilities for Layer 2 applications such as FCoE and Layer 4 applications such as iSCSI:

Application Protocol TLV Exchange

For all applications, DCBX advertises the application’s state and IEEE 802.1p code points on the interfaces to which the application is mapped. If an application is not mapped to an interface, that interface does not advertise the application’s TLVs. There is an exception for FCoE application protocol TLV exchange when FCoE is the only application you want DCBX to advertise on an interface.

FCoE Application Protocol TLV Exchange

Protocol TLV exchange for the FCoE application depends on whether FCoE is the only application you want the interface to advertise or whether you want the interface to exchange other application TLVs in addition to FCoE TLVs.

If FCoE is the only application you want DCBX to advertise on an interface, DCBX exchanges FCoE application protocol TLVs by default if the interface:

- Carries FCoE traffic (traffic mapped by CoS configuration to the FCoE forwarding class)
- Has a congestion notification profile with PFC enabled on the FCoE priority (IEEE 802.1p code point)
- Does *not* have an application map

NOTE: **If no CoS configuration for FCoE is mapped to an interface, that interface does not exchange FCoE application protocol TLVs.**

If you want DCBX to advertise FCoE and other applications on an interface, you must specify all of the applications, including FCoE, in an application map, and apply the application map to the desired interfaces.

NOTE: **If an application map is applied to an interface, the FCoE application must be explicitly configured in the application map, or the interface does not exchange FCoE TLVs.**

When DCBX advertises the FCoE application, it advertises the FCoE state and IEEE 802.1p code points. If a peer device connected to a switch interface does not support FCoE, DCBX uses autonegotiation to mark the interface as "FCoE down," and FCoE is disabled on that interface.

Disabling Application Protocol TLV Exchange

To disable DCBX application protocol exchange for all applications on an interface, issue the **set protocols dcbx interface** ***interface-name*** **applications no-auto-negotiation** command.

You can also disable DCBX application protocol exchange for applications on an interface by deleting the application map from the interface, or by deleting a particular application from the application map. However, when you delete an application from an application map, the application protocol is no longer exchanged on any interface which uses that application map.

DCBX and PFC

After you enable PFC on a switch interface, DCBX uses autonegotiation to control the operational state of the PFC functionality.

If the peer device connected to the interface supports PFC and is provisioned compatibly with the switch, DCBX sets the PFC operational state to enabled. If the peer device connected to the interface does not support PFC or is not provisioned compatibly with the switch, DCBX sets the operational state to disabled. (PFC must be symmetrical.)

If the peer advertises that it is "willing" to learn its PFC configuration from the switch, DCBX pushes the switch's PFC configuration to the peer and does not check the peer's administrative state.

You can manually override DCBX control of the PFC operational state on a per-interface basis by disabling autonegotiation. If you disable autonegotiation on an interface on which you have configured PFC, then PFC is enabled on that interface regardless of the peer configuration. To disable PFC on an interface, do not configure PFC on that interface.

DCBX and ETS

This section describes:

Default DCBX ETS Advertisement

If you do not configure ETS on an interface, the switch automatically creates a default priority group that contains all of the priorities (forwarding classes, which represent output queues) and assigns 100 percent of the port output bandwidth to that priority group. The default priority group is transparent. It does not appear in the configuration and is used for DCBX advertisement. DCBX advertises the default priority group, its priorities, and the assigned bandwidth.

If you configure ETS on an interface, DCBX advertises:

- Each priority group on the interface

- The priorities in each priority group
- The bandwidth properties of each priority group and priority

Any priority on that interface that is not part of an explicitly configured priority group (forwarding class set) is assigned to the automatically generated default priority group and receives no bandwidth. If you configure ETS on an interface, every forwarding class (priority) on that interface for which you want to forward traffic must belong to a forwarding class set (priority group).

ETS Advertisement and Peer Configuration

DCBX does not control the switch's ETS (hierarchical scheduling) operational state. If the connected peer is configured as "willing," DCBX pushes the switch's ETS configuration to the switch's peers if the ETS Recommendation TLV is enabled (it is enabled by default). If the peer does not support ETS or is not consistently provisioned with the switch, DCBX does not change the ETS operational state on the switch. The ETS operational state remains enabled or disabled based only on the switch hierarchical scheduling configuration and is enabled by default.

When ETS is configured, DCBX advertises the priority groups, the priorities in the priority groups, and the bandwidth configuration for the priority groups and priorities. Any priority (essentially a forwarding class or queue) that is not part of a priority group has no scheduling properties and receives no bandwidth.

You can manually override whether DCBX advertises the ETS state to the peer on a per-interface basis by disabling autonegotiation. This does not affect the ETS state on the switch or on the peer , but it does prevent the switch from sending the Recommendation TLV or the Configuration TLV to the connected peer. To disable ETS on an interface, do not configure priority groups (forwarding class sets) on the interface.

ETS Recommendation TLV

The ETS Recommendation TLV communicates the ETS settings that the switch wants the connected peer interface to use. If the peer interface is "willing," it changes its configuration to match the configuration in the ETS Recommendation TLV. By default, the switch interfaces send the ETS Recommendation TLV to the peer. The settings communicated are the egress ETS settings defined by configuring hierarchical scheduling on the interface.

We recommend that you use the same ETS settings on the connected peer that you use on the switch interface and that you leave the ETS Recommendation TLV enabled. However, on interfaces that use IEEE DCBX as the DCBX mode, if you want an asymmetric configuration between the switch interface and the connected peer, you can disable the ETS Recommendation TLV by including the **no-recommendation-tlv** statement at the **[edit protocols dcbx interface *interface-name* enhanced-transmission-selection]** hierarchy level.

NOTE: You can disable the ETS Recommendation TLV only when the DCBX mode on the interface is IEEE DCBX. Disabling the ETS Recommendation TLV has no effect if the DCBX mode on the interface is DCBX version 1.01. (IEEE DCBX uses separate application attribute TLVs, but DCBX version 1.01 sends all application attributes in the same TLV and uses sub-TLVs to separate the information.)

If you disable the ETS Recommendation TLV, the switch still sends the ETS Configuration TLV to the connected peer. The result is that the connected peer is informed about the switch DCBX ETS configuration, but even if the peer is “willing,” the peer does not change its configuration to match the switch configuration. This is asymmetric configuration—the two interfaces can have different parameter values for the ETS attribute.

For example, if you want a CNA connected to a switch interface to have different bandwidth allocations than the switch ETS configuration, you can disable the ETS Recommendation TLV and configure the CNA for the desired bandwidth. The switch interface and the CNA exchange configuration parameters, but the CNA does not change its configuration to match the switch interface configuration.

Related Documentation

- Understanding DCBX Application Protocol TLV Exchange on page 4915
- Understanding DCB Features and Requirements on page 4795
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Understanding FCoE on page 4799
- Configuring the DCBX Mode on page 5075
- Configuring DCBX Autonegotiation on page 5076
- Disabling the ETS Recommendation TLV on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929

Understanding DCBX Application Protocol TLV Exchange

Data Center Bridging Capability Exchange protocol (DCBX) discovers the data center bridging (DCB) capabilities of connected peers. DCBX also advertises the capabilities of applications on interfaces by exchanging application protocol information through application type, length, and value (TLV) elements. DCBX is an extension of Link Layer Discovery Protocol (LLDP). LLDP must remain enabled on every interface on which you want to use DCBX.

NOTE: **LLDP and DCBX are enabled by default on all interfaces.**

Setting up application protocol exchange consists of:

- Defining applications
- Mapping the applications to IEEE 802.1p code points in an *application map*
- Configuring classifiers to prioritize incoming traffic and map the incoming traffic to the application by the traffic code points
- Applying the application maps and classifiers to interfaces

You need to explicitly define the applications that you want an interface to advertise. The FCoE application is a special case (see "Applications" on page 4915) and only needs to be defined on an interface if you want DCBX to exchange application protocol TLVs for other applications in addition to FCoE on that interface.

You also need to explicitly map all defined applications that you want an interface to advertise to IEEE 802.1p code points in an application map. The FCoE application is a special case (see "Application Maps" on page 4916) and only requires inclusion in an application map when you want an interface to use DCBX for other applications in addition to FCoE, as described later in this topic.

This topic describes:

Applications

Before an interface can exchange application protocol information, you need to define the applications that you want to advertise, except FCoE if FCoE is the only application that you want the interface to advertise.

NOTE: If FCoE is the only application that you want DCBX to advertise on an interface, DCBX exchanges FCoE application protocol TLVs by default if the interface:

- Carries FCoE traffic (traffic mapped by CoS configuration to the FCoE forwarding class and applied to the interface)
- Has a congestion notification profile with PFC enabled on the FCoE priority (IEEE 802.1p code point)
- Does *not* have an application map

If you apply an application map to an interface, then all applications that you want DCBX to advertise must be defined and configured in the application map, including the FCoE application.

If no CoS configuration for FCoE is mapped to an interface, that interface does not exchange FCoE application protocol TLVs.

You can define:

- Layer 2 applications by EtherType
- Layer 4 applications by a combination of protocol (TCP or UDP) and destination port number

The EtherType is a two-octet field in the Ethernet frame that denotes the protocol encapsulated in the frame. For a list of common EtherTypes, see http://standards.ieee.org/develop/regauth/ethertype/eth.txt on the IEEE standards organization website. For a list of port numbers and protocols, see the *Service Name and Transport Protocol Port Number Registry* at http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xml on the Internet Assigned Numbers Authority (IANA) website.

You must explicitly define each application that you want to advertise, except FCoE. The FCoE application is defined by default (EtherType 0x8906).

Application Maps

An application map maps defined applications to one or more IEEE 802.1p code points. Each application map contains one or more applications. DCBX includes the configured application code points in the protocol TLVs exchanged with the connected peer.

To exchange protocol TLVs for an application, you must include the application in an application map. The FCoE application is a special case:

- If you want DCBX to exchange application protocol TLVs for more than one application on a particular interface, you must configure the applications, define an application map to map the applications to code points, and apply the application map to the interface. In this case, you must also define the FCoE application and add it to the application map.

This is the same process and treatment required for all other applications. In addition, for DCBX to exchange FCoE application TLVs, you must enable priority-based flow control (PFC) on the FCoE priority (the FCoE IEEE 802.1p code point) on the interface.

- If FCoE is the only application that you want DCBX to advertise on an interface, then you do not need to configure an application map and apply it to the interface. By default, when an interface has no application map, and the interface carries traffic mapped to the FCoE forwarding class, and PFC is enabled on the FCoE priority, the interface advertises FCoE TLVs (autonegotiation mode). DCBX exchanges FCoE application protocol TLVs by default until you apply an application map to the interface, remove the FCoE traffic from the interface (you can do this by removing the or editing the classifier for FCoE traffic), or disable PFC on the FCoE priority.

  If you apply an application map to an interface that did not have an application map and was exchanging FCoE application TLVs, and you do not include the FCoE application in the application map, the interface stops exchanging FCoE TLVs. Every interface that has an application map must have FCoE included in the application map (and PFC enabled on the FCoE priority) in order for DCBX to exchange FCoE TLVs.

Mapping an application to code points does two things:

- Maps incoming traffic with the same code points to that application
- Allows you to configure classifiers that map incoming application traffic, by code point, to a forwarding class and a loss priority, in order to apply class of service (CoS) to application traffic and prioritize application traffic

You apply an application map to an interface to enable DCBX application protocol exchange on that interface for each application specified in the application map. All of the applications that you want an interface to advertise must be configured in the application map that you apply to the interface, with the previously noted exception for the FCoE application when FCoE is the only application for which you want DCBX to exchange protocol TLVs on an interface.

Classifying and Prioritizing Application Traffic

When traffic arrives at an interface, the interface classifies the incoming traffic based on its code points. Classifiers map code points to loss priorities and forwarding classes. The loss priority prioritizes the traffic. The forwarding class determines the traffic output queue and CoS service level.

When you map an application to an IEEE 802.1p code point in an application map and apply the application map to an interface, incoming traffic on the interface that matches the application code points is mapped to the appropriate application. The application receives the loss priority and the CoS associated with the forwarding class for those code points, and is placed in the output queue associated with the forwarding class.

You can use the default classifier or you can configure a classifier to map the application code points defined in the application map to forwarding classes and loss priorities.

Enabling Interfaces to Exchange Application Protocol Information

Each interface with the **fcoe** forwarding class and PFC enabled on the FCoE code point is enabled for FCoE application protocol exchange by default until you apply an application map to the interface. If you apply an application map to an interface and you want that interface to exchange FCoE application protocol TLVs, you must include the FCoE application in the application map. (In all cases, to achieve lossless transport, you must also enable PFC on the FCoE code point or code points.)

Except when FCoE is the only protocol you want DCBX to advertise on an interface, interfaces on which you want to exchange application protocol TLVs must include the following two items:

- The application map that contains the application(s)
- A classifier

NOTE: You must also enable PFC on the code point of any traffic for which you want to achieve lossless transport.

Disabling DCBX Application Protocol Exchange

To disable DCBX application protocol exchange for all applications on an interface, issue the **set protocols dcbx interface** ***interface-name*** **applications no-auto-negotiation** command.

You can also disable DCBX application protocol exchange for applications on an interface by deleting the application map from the interface, or by deleting a particular application from the application map. However, when you delete an application from an application map, the application protocol is no longer exchanged on any interface which uses that application map.

On interfaces that use IEEE DCBX mode to exchange DCBX parameters, you can disable sending the enhanced transmission selection (ETS) Recommendation TLV to the peer if you want an asymmetric ETS configuration between the peers.

Related Documentation

- Understanding DCBX on page 4905
- Understanding CoS Classifiers on page 5334
- Configuring DCBX Autonegotiation on page 5076
- Disabling the ETS Recommendation TLV on page 5079
- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929

- Example: Configuring Unicast Classifiers on page 5495

CHAPTER 59

Configuration

Configuration Examples

Example: Configuring CoS PFC for FCoE Traffic

Priority-based flow control (PFC, described in IEEE 802.1Qbb) is a link-level flow control mechanism that you apply at ingress interfaces. PFC enables you to divide traffic on one physical link into eight priorities. You can think of the eight priorities as eight “lanes” of traffic that correspond to queues (forwarding classes). Each priority is mapped to a 3-bit IEEE 802.1p CoS flag in the VLAN header.

You can selectively apply PFC to the traffic in any queue without pausing the traffic in other queues on the same link. You must apply PFC to FCoE traffic to ensure lossless transport.

To configure PFC on FCoE traffic, use the default FCoE forwarding-class-to-queue mapping and:

- Configure a classifier that associates the FCoE forwarding class with FCoE traffic.
- Configure a congestion notification profile to apply PFC to the FCoE traffic.
- Apply the classifier and the PFC configuration to ingress interfaces.
- Configure the bandwidth scheduling for the FCoE forwarding class output queue.

- Create a forwarding class set (priority group) that includes the FCoE forwarding class; this is required to configure enhanced transmission selection (ETS) and support data center bridging (DCB).
- Configure the bandwidth scheduling for the FCoE priority group.
- Apply the scheduling to the egress interfaces.

NOTE: If you are using Junos OS Release 12.2 or later, use the default forwarding classes for the lossless **fcoe** forwarding class. If you explicitly configure default lossless forwarding classes, the traffic mapped to those forwarding classes is treated as lossy (**best-effort**) traffic and does *not* receive lossless treatment.

In Junos OS Release 12.3 and later, you can include the *no-loss* packet drop attribute in explicit forwarding class configurations to configure a lossless forwarding class.

This example describes how to configure PFC for FCoE traffic:

Requirements

This example uses the following hardware and software components:

- A Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

FCoE traffic requires PFC to ensure lossless packet transport. This example shows you how to:

- Assign FCoE traffic to the FCoE priority at the ingress.
- Create and apply CoS for the FCoE traffic using ETS (hierarchical port scheduling).
- Apply PFC to the FCoE traffic.
- Apply the configuration to ingress and egress interfaces.

NOTE: Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

Each interface in this example is configured as both an ingress interface and an egress interface, so the classifier, congestion notification profile, and port scheduling are applied to all of the interfaces.

Topology

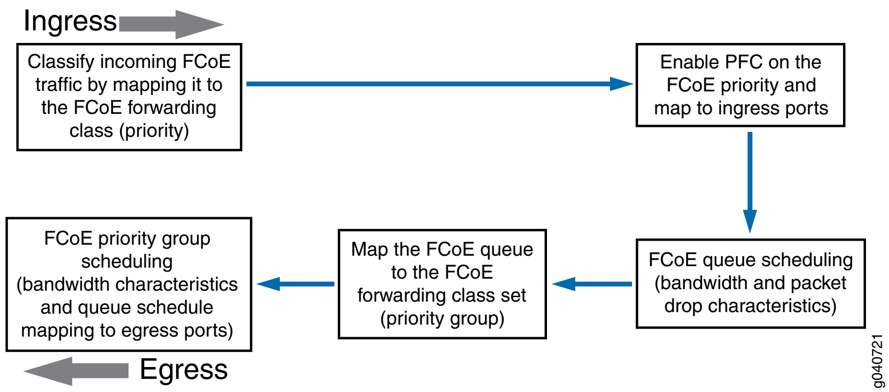
Table 379 on page 4923 shows the configuration components for this example.

Table 379: Components of the PFC for FCoE Traffic Configuration Topology

Component	Settings
Hardware	QFX3500 switch
Behavior aggregate classifier (maps the FCoE forwarding class to incoming packets by IEEE 802.1 code point)	Code point **011** to forwarding class **fcoe** and loss priority **low** Ingress interfaces: **xe-0/0/31**, **xe-0/0/32**, **xe-0/0/33**, **xe-0/0/34**
PFC congestion notification profile	**fcoe-cnp**: Code point **011** Ingress interfaces: **xe-0/0/31**, **xe-0/0/32**, **xe-0/0/33**, **xe-0/0/34**
FCoE queue scheduler	**fcoe-sched**: Minimum bandwidth **3g** Maximum bandwidth **100%** Priority **low**
Forwarding class-to-scheduler mapping	Scheduler map **fcoe-map**: Forwarding class **fcoe** Scheduler **fcoe-sched**
Forwarding class set (FCoE priority group)	**fcoe-pg**: Forwarding class **fcoe** Egress interfaces: **xe-0/0/31**, **xe-0/0/32**, **xe-0/0/33**, **xe-0/0/34**
Traffic control profile	**fcoe-tcp**: Scheduler map **fcoe-map** Minimum bandwidth **3g** Maximum bandwidth **100%**

Figure 179 on page 4924 shows a block diagram of the configuration components and the configuration flow of the CLI statements used in the example.

Figure 179: PFC for FCoE Traffic Configuration Components Block Diagram



Configuration

CLI Quick Configuration

To quickly configure PFC for FCoE traffic, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level:

```
[edit class-of-service]
set classifiers ieee-802.1 fcoe-classifier forwarding-class fcoe loss-priority low code-points 011
set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
set interfaces xe-0/0/31 unit 0 classifiers ieee-802.1 fcoe-classifier
set interfaces xe-0/0/32 unit 0 classifiers ieee-802.1 fcoe-classifier
set interfaces xe-0/0/33 unit 0 classifiers ieee-802.1 fcoe-classifier
set interfaces xe-0/0/34 unit 0 classifiers ieee-802.1 fcoe-classifier
set interfaces xe-0/0/31 congestion-notification-profile fcoe-cnp
set interfaces xe-0/0/32 congestion-notification-profile fcoe-cnp
set interfaces xe-0/0/33 congestion-notification-profile fcoe-cnp
set interfaces xe-0/0/34 congestion-notification-profile fcoe-cnp
set schedulers fcoe-sched priority low transmit-rate 3g
set schedulers fcoe-sched shaping-rate percent 100
set scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
set forwarding-class-sets fcoe-pg class fcoe
set traffic-control-profiles fcoe-tcp scheduler-map fcoe-map guaranteed-rate 3g
set traffic-control-profiles fcoe-tcp shaping-rate percent 100
set interfaces xe-0/0/31 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp
set interfaces xe-0/0/32 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp
set interfaces xe-0/0/33 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp
set interfaces xe-0/0/34 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp
```

Step-by-Step Procedure

To configure the FCoE forwarding class (priority), ingress classifier, output queue scheduling, forwarding class set (priority group) and its output port scheduling, PFC application, and interfaces to set up PFC for FCoE traffic:

1. Configure a classifier to set the loss priority and IEEE 802.1 code point assigned to the FCoE forwarding class at the ingress:

   ```
   [edit class-of-service]
   user@switch# set classifiers ieee-802.1 fcoe-classifier forwarding-class fcoe loss-priority low code-points 011
   ```

2. Configure PFC on the FCoE queue by applying FCoE to the IEEE 802.1 code point **011**:

```
[edit class-of-service]
user@switch# set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point
011 pfc
```

3. Apply the PFC configuration to the ingress interfaces:

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/31 congestion-notification-profile fcoe-cnp
user@switch# set interfaces xe-0/0/32 congestion-notification-profile fcoe-cnp
user@switch# set interfaces xe-0/0/33 congestion-notification-profile fcoe-cnp
user@switch# set interfaces xe-0/0/34 congestion-notification-profile fcoe-cnp
```

4. Assign the classifier to the ingress interfaces:

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/31 unit 0 classifiers ieee-802.1 fcoe-classifier
user@switch# set interfaces xe-0/0/32 unit 0 classifiers ieee-802.1 fcoe-classifier
user@switch# set interfaces xe-0/0/33 unit 0 classifiers ieee-802.1 fcoe-classifier
user@switch# set interfaces xe-0/0/34 unit 0 classifiers ieee-802.1 fcoe-classifier
```

5. Configure output scheduling for the FCoE queue:

```
[edit class-of-service]
user@switch# set schedulers fcoe-sched priority low transmit-rate 3g
user@switch# set schedulers fcoe-sched shaping-rate percent 100
```

6. Map the FCoE forwarding class to the FCoE scheduler:

```
[edit class-of-service]
user@switch# set scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
```

7. Configure the forwarding class set for the FCoE traffic:

```
[edit class-of-service]
user@switch# set forwarding-class-sets fcoe-pg class fcoe
```

8. Define the traffic control profile for the FCoE forwarding class set:

```
[edit class-of-service]
user@switch# set traffic-control-profiles fcoe-tcp scheduler-map fcoe-map
guaranteed-rate 3g
user@switch# set traffic-control-profiles fcoe-tcp shaping-rate percent 100
```

9. Apply the FCoE forwarding class set and traffic control profile to the egress ports:

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/31 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
user@switch# set interfaces xe-0/0/32 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
user@switch# set interfaces xe-0/0/33 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
user@switch# set interfaces xe-0/0/34 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
```

Results

Display the results of the configuration (the system shows only the explicitly configured parameters; it does not show default parameters such as the **fcoe** lossless forwarding class):

```
user@switch> show configuration class-of-service
classifiers {
```

```
ieee-802.1 fcoe-classifier {
   forwarding-class fcoe {
      loss-priority low code-points 011;
   }
}
traffic-control-profiles {
   fcoe-tcp {
      scheduler-map fcoe-map;
      shaping-rate percent 100;
      guaranteed-rate 3000000000;
   }
}
forwarding-class-sets {
   fcoe-pg {
      class fcoe;
   }
}
congestion-notification-profile {
   fcoe-cnp {
      input {
         ieee-802.1 {
            code-point 011 {
               pfc;
            }
         }
      }
   }
}
interfaces {
   xe-0/0/31 {
      congestion-notification-profile fcoe-cnp;
      forwarding-class-set {
         fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
         }
      }
      unit 0 {
         classifiers {
            ieee-802.1 fcoe-classifier;
         }
      }
   }
   xe-0/0/32 {
      congestion-notification-profile fcoe-cnp;
      forwarding-class-set {
         fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
         }
      }
      unit 0 {
         classifiers {
            ieee-802.1 fcoe-classifier;
         }
      }
   }
   xe-0/0/33 {
```



```
        congestion-notification-profile fcoe-cnp;
        forwarding-class-set {
          fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
          }
        }
        unit 0 {
          classifiers {
            ieee-802.1 fcoe-classifier;
          }
        }
      }
      xe-0/0/34 {
        congestion-notification-profile fcoe-cnp;
        forwarding-class-set {
          fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
          }
        }
        unit 0 {
          classifiers {
            ieee-802.1 fcoe-classifier;
          }
        }
      }
    }
    scheduler-maps {
      fcoe-map {
        forwarding-class fcoe scheduler fcoe-sched;
      }
    }
    schedulers {
      fcoe-sched {
        transmit-rate 3000000000;
        shaping-rate percent 100;
        priority low;
      }
    }
```

TIP: To quickly configure the interfaces, issue the **load merge terminal** command and then copy the hierarchy and paste it into the switch terminal window.

Verification

To verify that the PFC configuration for FCoE traffic components has been created and is operating properly, perform these tasks:

- Verifying That Priority-Based Flow Control Has Been Enabled on page 4928
- Verifying the Ingress Interface PFC Configuration on page 4928

Verifying That Priority-Based Flow Control Has Been Enabled

Purpose Verify that PFC is enabled on the FCoE queue to enable lossless transport.

Action List the congestion notification profiles using the operational mode command **show class-of-service congestion-notification**:

```
user@switch> show class-of-service congestion-notification
Type: Input, Name: fcoe-cnp, Index: 51697
Cable Length: 100 m
  Priority     PFC         MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Enabled      2500
  100          Disabled
  101          Disabled
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  000
               0
  001
               1
  010
               2
  011
               3
  100
               4
  101
               5
  110
               6
  111
               7
```

Meaning The **show class-of-service congestion-notification** operational command lists all of the congestion notification profiles and which IEEE 802.1p code points have PFC enabled. The command output shows that PFC is enabled on code point **011** for the **fcoe-cnp** congestion notification profile.

The command also shows the default cable length (100 meters), the default maximum receive unit (2500 bytes), and the default mapping of priorities to output queues because this example does not include configuring these options.

Verifying the Ingress Interface PFC Configuration

Purpose Verify that the classifier **fcoe-classifier** and the congestion notification profile **fcoe-cnp** are configured on ingress interfaces **xe-0/0/31**, **xe-0/0/32**, **xe-0/0/33**, and **xe-0/0/34**.

Action List the ingress interfaces using the operational mode command **show configuration class-of-service interfaces**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/31
```



```
congestion-notification-profile fcoe-cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe-classifier;
    }
}
```

```
user@switch> show configuration class-of-service interfaces xe-0/0/32
congestion-notification-profile fcoe-cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe-classifier;
    }
}
```

```
user@switch> show configuration class-of-service interfaces xe-0/0/33
congestion-notification-profile fcoe-cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe-classifier;
    }
}
```

```
user@switch> show configuration class-of-service interfaces xe-0/0/34
congestion-notification-profile fcoe-cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe-classifier;
    }
}
```

Meaning The **show configuration class-of-service interfaces** commands list the congestion notification profile that is mapped to the interface (**fcoe-cnp**) and the IEEE 802.1p classifier associated with the interface (**fcoe-classifier**).

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Overview of CoS Changes Introduced in Junos OS Release 12.2 on page 5304
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

Example: Configuring DCBX Application Protocol TLV Exchange

Data Center Bridging Capability Exchange protocol (DCBX) discovers the data center bridging (DCB) capabilities of connected peers by exchanging application configuration information. DCBX detects feature misconfiguration and mismatches and can configure DCB on peers. DCBX is an extension of the Link Layer Discovery Protocol (LLDP). LLDP must remain enabled on every interface on which you want to use DCBX.

NOTE: LLDP and DCBX are enabled by default on all interfaces.

The switch supports DCBX application protocol exchange for Layer 2 and Layer 4 applications such as the Internet Small Computer System Interface (iSCSI). You specify applications by EtherType (for Layer 2 applications) or by the destination port and protocol (for Layer 4 applications; the protocol can be either TCP or UDP).

The QFX Series handles Fibre Channel over Ethernet (FCoE) application protocol exchange differently than other protocols in some cases:

- If FCoE is the only application for which you want to enable DCBX application protocol TLV exchange on an interface, you do not have to explicitly configure the FCoE application or an application map. By default, the QFX Series exchanges FCoE application protocol TLVs on all interfaces that carry FCoE traffic (traffic mapped to the **fcoe** forwarding class) and have priority-based flow control (PFC) enabled on the FCoE priority (the FCoE IEEE 802.1p code point). The default priority mapping for the FCoE application is IEEE 802.1p code point 011 (the default **fcoe** forwarding class code point).
- If you want an interface to use DCBX to exchange application protocol TLVs for any other applications in addition to FCoE, you must configure the applications (including FCoE), define an application map (including FCoE), and apply the application map to the interface. If you apply an application map to an interface, you must explicitly configure the FCoE application, or the interface does not exchange FCoE application protocol TLVs.

This example shows how to configure interfaces to exchange both Layer 2 and Layer 4 applications by configuring one interface to exchange iSCSI and FCoE application protocol information and configuring another interface to exchange iSCSI and Precision Time Protocol (PTP) application protocol information.

- Requirements on page 4930
- Overview on page 4930
- Configuration on page 4934
- Verification on page 4936

Requirements

This example uses the following hardware and software components:

- Juniper Networks QFX Series device
- Junos OS Release 12.1 or later for the QFX Series

Overview

The switch supports DCBX application protocol exchange for:

- Layer 2 applications, defined by EtherType
- Layer 4 applications, defined by destination port and protocol

NOTE: DCBX also advertises PFC and enhanced transmission selection (ETS) information. See "Configuring DCBX Autonegotiation" on page 5076 for how DCBX negotiates and advertises configuration information for these features and for the applications.

DCBX is configured on a per-interface basis for each supported feature or application. For applications that you want to enable for DCBX application protocol exchange, you must:

- Define the application name and configure the EtherType or the destination port and protocol (TCP or UDP) of the application. Use the EtherType for Layer 2 applications, and use the destination port and protocol for Layer 4 protocols.
- Map the application to an IEEE 802.1p code point in an application map.
- Add the application map to DCBX interface.

In addition, for all applications (including FCoE, even when you do not use an application map), you either must create an IEEE 802.1p classifier and apply it to the appropriate ingress interfaces or use the default classifier. A classifier maps the code points of incoming traffic to a forwarding class and a loss priority so that ingress traffic is assigned to the correct class of service (CoS). The forwarding class determines the output queue on the egress interface.

If you do not create classifiers, trunk and tagged-access ports use the unicast IEEE 802.1 default trusted classifier. Table 380 on page 4931 shows the default mapping of IEEE 802.1 code-point values to unicast forwarding classes and loss priorities for ports in trunk mode or tagged-access mode. Table 381 on page 4932 shows the default untrusted classifier IEEE 802.1 code-point values to unicast forwarding class mapping for ports in access mode.

Table 380: Default IEEE 802.1 Classifiers for Trunk Ports and Tagged-Access Ports (Default Trusted Classifier)

Code Point	Forwarding Class	Loss Priority
be (000)	best-effort	low
be1 (001)	best-effort	low
ef (010)	best-effort	low
ef1 (011)	fcoe	low
af11 (100)	no-loss	low
af12 (101)	best-effort	low
nc1 (110)	network-control	low

Table 380: Default IEEE 802.1 Classifiers for Trunk Ports and Tagged-Access Ports (Default Trusted Classifier) *(continued)*

Code Point	Forwarding Class	Loss Priority
nc2 (111)	network-control	low

Table 381: Default IEEE 802.1 Unicast Classifiers for Access Ports (Default Untrusted Classifier)

Code Point	Forwarding Class	Loss Priority
000	best-effort	low
001	best-effort	low
010	best-effort	low
011	best-effort	low
100	best-effort	low
101	best-effort	low
110	best-effort	low
111	best-effort	low

Topology

This example shows how to configure DCBX application protocol exchange for three protocols (iSCSI, PTP, and FCoE) on two interfaces. One interface exchanges iSCSI and FCoE application protocol information, and the other interface exchanges iSCSI and PTP application protocol information.

NOTE: You must map FCoE traffic to the interfaces on which you want to forward FCoE traffic. You must also enable PFC on the FCoE interfaces and create an ingress classifier for FCoE traffic, or else use the default classifier.

Table 382 on page 4932 shows the configuration components for this example.

Table 382: Components of DCBX Application Protocol Exchange Configuration Topology

Component	Settings
Hardware	QFX Series device
LLDP	Enabled by default on Ethernet interfaces

Table 382: Components of DCBX Application Protocol Exchange Configuration Topology *(continued)*

Component	Settings
DCBX	Enabled by default on Ethernet interfaces
iSCSI application (Layer 4)	Application name—**iscsi** protocol—**TCP** destination-port—**3260** code-points—**111**
PTP application (Layer 2)	Application name—**ptp** ether-type—**0x88F7** code-points—**001**, **101**
FCoE application (Layer 2)	Application name—**fcoe** ether-type—**0x8906** code-points—**011** NOTE: You explicitly configure the FCoE application because you are applying an application map to the interface. When you apply an application map to an interface, all applications must be explicitly configured and included in the application map.
Application maps	**dcbx-iscsi-fcoe-app-map**—Maps the iSCSI and FCoE applications to IEEE 802.1p code points **dcbx-iscsi-ptp-app-map**—Maps iSCSI and PTP applications to IEEE 802.1p code points
Interfaces	**xe-0/0/10**—Configured to exchange FCoE and iSCSI application TLVs (uses application map **dcbx-iscsi-fcoe-app-map**, carries FCoE traffic, and has PFC enabled on the FCoE priority) **xe-0/0/11**—Configured to exchange iSCSI and PTP application TLVs (uses application map **dcbx-iscsi-ptp-app-map**)
PFC congestion notification profile for FCoE application exchange	**fcoe-cnp**: • Code point—**011** • Interface—**xe-0/0/10**

Table 382: Components of DCBX Application Protocol Exchange Configuration Topology *(continued)*

Component	Settings
Behavior aggregate classifiers (map forwarding classes to incoming packets by the packet's IEEE 802.1 code point)	**fcoe-iscsi-cl1**: • Maps the **fcoe** forwarding class to the IEEE 802.1p code point used for the FCoE application (**011**) and a loss priority of **high** • Maps the **network-control** forwarding class to the IEEE 802.1p code point used for the iSCSI application (**111**) and a loss priority of **high** • Applied to interface **xe-0/0/10** **iscsi-ptp-cl2**: • Maps the **network-control** forwarding class to the IEEE 802.1p code point used for the iSCSI application (**111**) and a loss priority of **low** • Maps the **best-effort** forwarding class to the IEEE 802.1p code points used for the PTP application (**001** and **101**) and a loss priority of **low** • Applied to interface **xe-0/0/11**

NOTE: This example does not include scheduling (bandwidth allocation) configuration or lossless configuration for the iSCSI forwarding class.

Configuration

CLI Quick Configuration

To quickly configure DCBX application protocol exchange, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set applications application iSCSI protocol tcp destination-port 3260
set applications application FCoE ether-type 0x8906
set applications application PTP ether-type 0x88F7
set policy-options application-maps dcbx-iscsi-fcoe-app-map application iSCSI code-points 111
set policy-options application-maps dcbx-iscsi-fcoe-app-map application FCoE code-points 011
set policy-options application-maps dcbx-iscsi-ptp-app-map application iSCSI code-points 111
set policy-options application-maps dcbx-iscsi-ptp-app-map application PTP code-points [001
101]
set protocols dcbx interface xe-0/0/10 application-map dcbx-iscsi-fcoe-app-map
set protocols dcbx interface xe-0/0/11 application-map dcbx-iscsi-ptp-app-map
set class-of-service congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
set class-of-service interfaces xe-0/0/10 congestion-notification-profile fcoe-cnp
set class-of-service classifiers ieee-802.1 fcoe-iscsi-cl1 import default forwarding-class fcoe
loss-priority high code-points 011
set class-of-service classifiers ieee-802.1 fcoe-iscsi-cl1 import default forwarding-class
network-control loss-priority high code-points 111
set class-of-service classifiers ieee-802.1 iscsi-ptp-cl2 import default forwarding-class
network-control loss-priority low code-points 111
set class-of-service classifiers ieee-802.1 iscsi-ptp-cl2 import default forwarding-class best-effort
loss-priority low code-points [001 101]
set class-of-service interfaces xe-0/0/10 unit 0 classifiers ieee-802.1 fcoe-iscsi-cl1
```


set class-of-service interfaces xe-0/0/11 unit 0 classifiers ieee-802.1 iscsi-ptp-cl2

Configuring DCBX Application Protocol TLV Exchange

Step-by-Step Procedure

To define the applications, map the applications to IEEE 802.1p code points, apply the applications to interfaces, and create classifiers for DCBX application protocol exchange:

1. Define the iSCSI application by specifying its protocol and destination port, and define the FCoE and PTP applications by specifying their EtherTypes.

   ```
   [edit applications]
   user@switch# set application iSCSI protocol tcp destination-port 3260
   user@switch# set application FCoE ether-type 0x8906
   user@switch# set application PTP ether-type 0x88F7
   ```

2. Define an application map that maps the iSCSI and FCoE applications to IEEE 802.1p code points.

   ```
   [edit policy-options]
   user@switch# set application-maps dcbx-iscsi-fcoe-app-map application iSCSI code-points 111
   user@switch# set application-maps dcbx-iscsi-fcoe-app-map application FCoE code-points 011
   ```

3. Define the application map that maps the iSCSI and PTP applications to IEEE 802.1p code points.

   ```
   [edit policy-options]
   user@switch# set application-maps dcbx-iscsi-ptp-app-map application iSCSI code-points 111
   user@switch# set application-maps dcbx-iscsi-ptp-app-map application PTP code-points [001 101]
   ```

4. Apply the iSCSI and FCoE application map to interface **xe-0/0/10**, and apply the iSCSI and PTP application map to interface **xe-0/0/11**.

   ```
   [edit protocols dcbx]
   user@switch# set interface xe-0/0/10 application-map dcbx-iscsi-fcoe-app-map
   user@switch# set interface xe-0/0/11 application-map dcbx-iscsi-ptp-app-map
   ```

5. Create the congestion notification profile to enable PFC on the FCoE code point (**011**), and apply the congestion notification profile to interface **xe-0/0/10**.

   ```
   [edit class-of-service]
   user@switch# set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
   user@switch# set interfaces xe-0/0/10 congestion-notification-profile fcoe-cnp
   ```

6. Configure the classifier to apply to the interface that exchanges iSCSI and FCoE application information.

   ```
   [edit class-of-service classifiers]
   user@switch# set ieee-802.1 fcoe-iscsi-cl1 import default forwarding-class fcoe loss-priority high code-points 011
   user@switch# set ieee-802.1 fcoe-iscsi-cl1 import default forwarding-class network-control loss-priority high code-points 111
   ```

7. Configure the classifier to apply to the interface that exchanges iSCSI and PTP application information.

   ```
   [edit class-of-service classifiers]
   ```

```
user@switch# set ieee-802.1 iscsi-ptp-cl2 import default forwarding-class network-control loss-priority low code-points 111
user@switch# set ieee-802.1 iscsi-ptp-cl2 import default forwarding-class best-effort loss-priority low code-points [001 101]
```

8. Apply the classifiers to the appropriate interfaces.

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/10 unit 0 classifiers ieee-802.1 fcoe-iscsi-cl1
user@switch# set interfaces xe-0/0/11 unit 0 classifiers ieee-802.1 iscsi-ptp-cl2
```

Verification

To verify that DCBX application protocol exchange configuration has been created and is operating properly, perform these tasks:

Verifying the Application Configuration

Purpose Verify that DCBX applications have been configured.

Action List the applications by using the configuration mode command **show applications**:

```
user@switch# show applications
application iSCSI {
   protocol tcp;
   destination-port 3260;
}

application fcoe {
   ether-type 0x8906;
}

application ptp {
   ether-type 0x88F7;
}
```

Meaning The **show applications** configuration mode command lists all of the configured applications and either their protocol and destination port (Layer 4 applications) or their EtherType (Layer 2 applications). The command output shows that the iSCSI application is configured with the **tcp** protocol and destination port **3260**, the FCoE application is configured with the EtherType **0x8906**, and that the PTP application is configured with the EtherType **0x88F7**.

Verifying the Application Map Configuration

Purpose Verify that the application maps have been configured.

Action List the application maps by using the configuration mode command **show policy-options application-maps**:

```
user@switch# show policy-options application-maps
dcbx-iscsi-fcoe-app-map {
   application iSCSI code-points 111;
   application FCoE code-points 011;
}

dcbx-iscsi-ptp-app-map {
   application iSCSI code-points 111;
   application PTP code-points [001 101];
}
```

Meaning The **show policy-options application-maps** configuration mode command lists all of the configured application maps and the applications that belong to each application map. The command output shows that there are two application maps, **dcbx-iscsi-fcoe-app-map** and **dcbx-iscsi-ptp-app-map**.

The application map **dcbx-iscsi-fcoe-app-map** consists of the iSCSI application, which is mapped to IEEE 802.1p code point **111**, and the FCoE application, which is mapped to IEEE 802.1p code point **011**.

The application map **dcbx-iscsi-ptp-app-map** consists of the iSCSI application, which is mapped to IEEE 802.1p code point **111**, and the PTP application, which is mapped to IEEE 802.1p code points **001** and **101**.

Verifying DCBX Application Protocol Exchange Interface Configuration

Purpose Verify that the application maps have been applied to the correct interfaces.

Action List the application maps by using the configuration mode command **show protocols dcbx**:

```
user@switch# show protocols dcbx
interface xe-0/0/10.0 {
   application-map dcbx-iscsi-fcoe-app-map;
}

interface xe-0/0/11.0 {
   application-map dcbx-iscsi-ptp-app-map;
}
```

Meaning The **show protocols dcbx** configuration mode command lists whether the interfaces are enabled for DCBX and lists the application map applied to each interface. The command output shows that interfaces **xe-0/0/10.0** and **xe-0/0/11.0** are enabled for DCBX, and that interface **xe-0/0/10.0** uses application map **dcbx-iscsi-fcoe-app-map**, and interface **xe-0/0/11.0** uses application map **dcbx-iscsi-ptp-app-map**.

Verifying the PFC Configuration

Purpose Verify that PFC has been enabled on the FCoE code point and applied to the correct interface.

Action Display the PFC configuration to verify that PFC is enabled on the FCoE code point (**011**) in the congestion notification profile **fcoe-cnp** by using the configuration mode command **show class-of-service congestion-notification-profile**:

```
user@switch# show class-of-service congestion-notification-profile
fcoe-cnp {
    input {
        ieee-802.1 {
            code-point 011 {
                pfc;
            }
        }
    }
}
```

Display the class-of-service (CoS) interface information to verify that the correct interface has PFC enabled for the FCoE application by using the configuration mode command **show class-of-service interfaces**:

```
user@switch# show class-of-service interfaces
xe-0/0/10 {
    congestion-notification-profile fcoe-cnp;
}
```

NOTE: The sample output does not include all of the information this command can show. The output is abbreviated to focus on verifying the PFC configuration.

Meaning The **show class-of-service congestion-notification-profile** configuration mode command lists the configured congestion notification profiles. The command output shows that the congestion notification profile **fcoe-cnp** has been configured and has enabled PFC on the IEEE 802.1p code point **011** (the default FCoE code point).

The **show class-of-service interfaces** configuration mode command shows the interface CoS configuration. The command output shows that the congestion notification profile **fcoe-cnp**, which enables PFC on the FCoE code point, is applied to interface **xe-0/0/10**.

Verifying the Classifier Configuration

Purpose Verify that the classifiers have been configured and applied to the correct interfaces.

Action Display the classifier configuration by using the configuration mode command **show class-of-service**:

```
user@switch# show class-of-service
classifiers {
    ieee-802.1 fcoe-iscsi-cl1 {
        import default;
        forwarding-class network-control {
            loss-priority high code-points 111;
        }
        forwarding-class fcoe {
            loss-priority high code-points 011;
```



```
            }
        }
        ieee-802.1 iscsi-ptp-cl2 {
            import default;
            forwarding-class network-control {
                loss-priority low code-points 111;
            }
            forwarding-class best-effort {
                loss-priority low code-points [ 001 101 ];
            }
        }
    }
    interfaces {
        xe-0/0/10 {
            congestion-notification-profile fcoe-cnp;
            unit 0 {
                classifiers {
                    ieee-802.1 fcoe-iscsi-cl1;
                }
            }
        }
        xe-0/0/11 {
            unit 0 {
                classifiers {
                    ieee-802.1 iscsi-ptp-cl2;
                }
            }
        }
    }
```

NOTE: The sample output does not include all of the information this command can show. The output is abbreviated to focus on verifying the classifier configuration.

Meaning The **show class-of-service** configuration mode command lists the classifier and CoS interface configuration, as well as other information not shown in this example. The command output shows that there are two classifiers configured, **fcoe-iscsi-cl1** and **iscsi-ptp-cl2**.

Classifier **fcoe-iscsi-cl1** uses the **default** classifier as a template and edits the template as follows:

- The forwarding class **network-control** is set to a loss priority of **high** and is mapped to code point **111** (the code point mapped to the iSCSI application).
- The forwarding class **fcoe** is set to a loss priority of **high** and is mapped to code point **011** (the code point mapped by default to the FCoE application).

Classifier **iscsi-ptp-cl2** uses the **default** classifier as a template and edits the template as follows:

- The forwarding class **network-control** is set to a loss priority of **low** and is mapped to IEEE 802.1p code point **111** (the code point mapped to the iSCSI application).

- The forwarding class **best-effort** is set to a loss priority of **low** and is mapped to IEEE 802.1p code points **001** and **101** (the code points mapped by default to the PTP application).

The command output also shows that classifier **fcoe-iscsi-cl1** is mapped to interface **xe-0/0/10.0** and that classifier **iscsi-ptp-cl2** is mapped to interface **xe-0/0/11.0**.

Related Documentation

- Example: Configuring Unicast Classifiers on page 5495
- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082
- Configuring DCBX Autonegotiation on page 5076
- **show dcbx on page 5176**
- **show dcbx neighbors on page 5177**
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Using DCBX Protocol to Lower Costs*

Configuration Examples (Original CLI Only)

Example: Configuring CoS for FCoE Transit Switch Traffic Across an MC-LAG

Multichassis link aggregation groups (MC-LAGs) provide redundancy and load balancing between two QFX Series switches, multihoming support for client devices such as servers, and a loop-free Layer 2 network without running Spanning Tree Protocol (STP).

NOTE: This example uses Junos OS without support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see “Example: Configuring CoS for FCoE Transit Switch Traffic Across an MC-LAG” on page 5002.

You can use an MC-LAG to provide a redundant aggregation layer for Fiber Channel over Ethernet (FCoE) traffic in an *inverted-U* topology. To support lossless transport of FCoE traffic across an MC-LAG, you must configure the appropriate class of service (CoS) on both of the QFX Series switches with MC-LAG port members. The CoS configuration must be the same on both of the MC-LAG switches because an MC-LAG does not carry forwarding class and IEEE 802.1p priority information.

NOTE: This example describes how to configure CoS to provide lossless transport for FCoE traffic across an MC-LAG that connects two QFX Series switches. It also describes how to configure CoS on the FCoE transit switches that connect FCoE hosts to the QFX Series switches that form the MC-LAG.

This example does *not* describe how to configure the MC-LAG itself. For a detailed example of MC-LAG configuration, see "Example: Configuring Multichassis Link Aggregation" on page 1904. However, this example includes a subset of MC-LAG configuration that only shows how to configure interface membership in the MC-LAG.

Ports that are part of an FCoE-FC gateway configuration (a virtual FCoE-FC gateway fabric) do not support MC-LAGs. Ports that are members of an MC-LAG act as FCoE passthrough transit switch ports.

QFX Series switches support MC-LAGs. QFabric system Node devices do not support MC-LAGs, and QFX3500 and QFX3600 Virtual Chassis switches do not support FCoE.

This topic describes:

Requirements

This example uses the following hardware and software components:

- Two Juniper Networks QFX3500 Switches that form an MC-LAG for FCoE traffic.
- Two Juniper Networks QFX3500 Switches that provide FCoE server access in transit switch mode and that connect to the MC-LAG switches. These switches can be standalone QFX3500 switches or they can be Node devices in a QFabric system.
- FCoE servers (or other FCoE hosts) connected to the transit switches.
- Junos OS Release 12.2 or later for the QFX Series.

Overview

FCoE traffic requires lossless transport. This example shows you how to:

- Configure CoS for FCoE traffic on the two QFX3500 switches that form the MC-LAG, including priority-based flow control (PFC) and enhanced transmission selection (ETS; hierarchical scheduling of resources for the FCoE forwarding class priority and for the forwarding class set priority group).

  NOTE: **Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.**

- Configure CoS for FCoE on the two FCoE transit switches that connect FCoE hosts to the MC-LAG switches and enable FIP snooping on the FCoE VLAN at the FCoE transit switch access ports.
- Disable IGMP snooping on the FCoE VLAN.
- Configure the appropriate port mode, MTU, and FCoE trusted or untrusted state for each interface to support lossless FCoE transport.

Topology

QFX3500 switches that act as transit switches support MC-LAGs for FCoE traffic in an inverted-U network topology, as shown in Figure 180 on page 4942.

Figure 180: Supported Topology for an MC-LAG on an FCoE Transit Switch

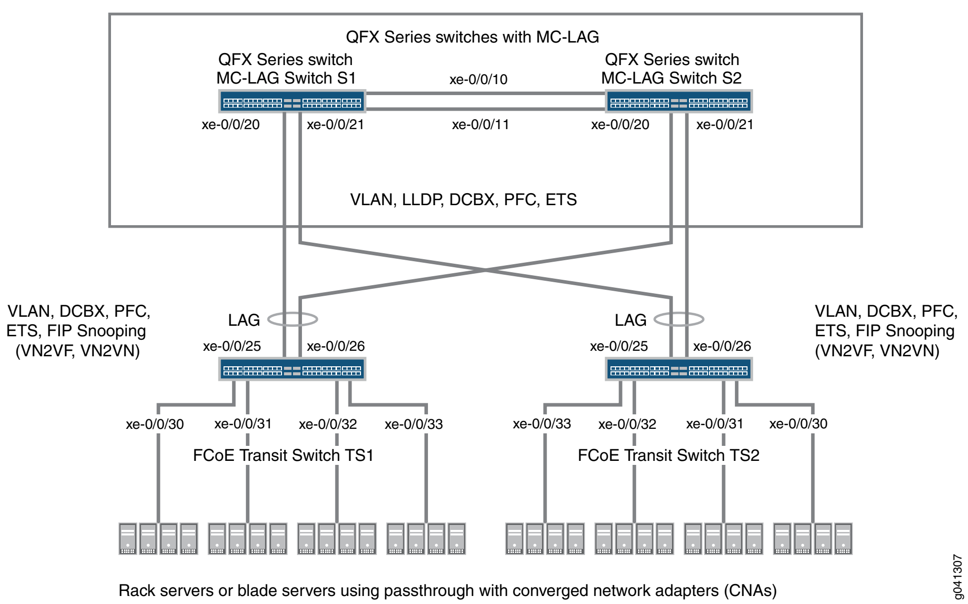


Table 383 on page 4943 shows the configuration components for this example.

Table 383: Components of the CoS for FCoE Traffic Across an MC-LAG Configuration Topology

Component	Settings
Hardware	Four QFX3500 switches (two to form the MC-LAG as passthrough transit switches and two transit switches for FCoE access).
Forwarding class (all switches)	Default **fcoe** forwarding class.
Classifier (forwarding class mapping of incoming traffic to IEEE priority)	Default IEEE 802.1p trusted classifier on all FCoE interfaces.
LAGs and MC-LAG	S1—Ports xe-0/0/10 and x-0/0/11 are members of LAG **ae0**, which connects Switch S1 to Switch S2. Ports xe-0/0/20 and xe-0/0/21 are members of MC-LAG **ae1**. All ports are configured in **trunk** port mode, as **fcoe-trusted**, and with an MTU of **2180**. S2—Ports xe-0/0/10 and x-0/0/11 are members of LAG **ae0**, which connects Switch S2 to Switch S1. Ports xe-0/0/20 and xe-0/0/21 are members of MC-LAG **ae1**. All ports are configured in **trunk** port mode, as **fcoe-trusted**, and with an MTU of **2180**. NOTE: Ports xe-0/0/20 and xe-0/0/21 on Switches S1 and S2 are the members of the MC-LAG. TS1—Ports xe-0/0/25 and x-0/0/26 are members of LAG **ae1**, configured in **trunk** port mode, as **fcoe-trusted**, and with an MTU of **2180**. Ports xe-0/0/30, xe-0/0/31, xe-0/0/32, and xe-0/0/33 are configured in **tagged-access** port mode, with an MTU of **2180**. TS2—Ports xe-0/0/25 and x-0/0/26 are members of LAG **ae1**, configured in **trunk** port mode, as **fcoe-trusted**, and with an MTU of **2180**. Ports xe-0/0/30, xe-0/0/31, xe-0/0/32, and xe-0/0/33 are configured in **tagged-access** port mode, with an MTU of **2180**.
FCoE queue scheduler (all switches)	**fcoe-sched**: Minimum bandwidth **3g** Maximum bandwidth **100%** Priority **low**
Forwarding class-to-scheduler mapping (all switches)	Scheduler map **fcoe-map**: Forwarding class **fcoe** Scheduler **fcoe-sched**

Table 383: Components of the CoS for FCoE Traffic Across an MC-LAG Configuration Topology *(continued)*

Component	Settings
Forwarding class set (FCoE priority group, all switches)	**fcoe-pg**: Forwarding class **fcoe** Egress interfaces: • S1—LAG **ae0** and MC-LAG **ae1** • S2—LAG **ae0** and MC-LAG **ae1** • TS1—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33** • TS2—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33**
Traffic control profile (all switches)	**fcoe-tcp**: Scheduler map **fcoe-map** Minimum bandwidth **3g** Maximum bandwidth **100%**
PFC congestion notification profile (all switches)	**fcoe-cnp**: Code point **011** Ingress interfaces: • S1—LAG **ae0** and MC-LAG **ae1** • S2—LAG **ae0** and MC-LAG **ae1** • TS1—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33** • TS2—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33**
FCoE VLAN name and tag ID	Name—**fcoe_vlan** ID—**100** Include the FCoE VLAN on the interfaces that carry FCoE traffic on all four switches. Disable IGMP snooping on the interfaces that belong to the FCoE VLAN on all four switches.
FIP snooping	Enable FIP snooping on Transit Switches TS1 and TS2 on the FCoE VLAN. Configure the LAG interfaces that connect to the MC-LAG switches as FCoE trusted interfaces so that they do not perform FIP snooping. This example enables VN2VN_Port FIP snooping on the FCoE transit switch interfaces connected to the FCoE servers. The example is equally valid with VN2VF_Port FIP snooping enabled on the transit switch access ports. The method of FIP snooping you enable depends on your network configuration.

NOTE: This example uses the default IEEE 802.1p trusted BA classifier, which is automatically applied to trunk mode and tagged access mode ports if you do not apply an explicitly configured classifier.

To configure CoS for FCoE traffic across an MC-LAG:

- Use the default FCoE forwarding class and forwarding-class-to-queue mapping (do not explicitly configure the FCoE forwarding class or output queue). The default FCoE forwarding class is **fcoe**, and the default output queue is queue **3**.

  NOTE: In Junos OS Release 12.2, traffic mapped to explicitly configured forwarding classes, even lossless forwarding classes such as **fcoe**, is treated as lossy (**best-effort**) traffic and does *not* receive lossless treatment. To receive lossless treatment in Release 12.2, traffic must use one of the default lossless forwarding classes (**fcoe** or **no-loss**).

  In Junos OS Release 12.3 and later, you can include the *no-loss* packet drop attribute in the explicit forwarding class configuration to configure a lossless forwarding class.

- Use the default trusted BA classifier, which maps incoming packets to forwarding classes by the IEEE 802.1p code point (CoS priority) of the packet. The trusted classifier is the default classifier for interfaces in trunk and tagged-access port modes. The default trusted classifier maps incoming packets with the IEEE 802.1p code point 3 (**011**) to the FCoE forwarding class. If you choose to configure the BA classifier instead of using the default classifier, you must ensure that FCoE traffic is classified into forwarding classes in exactly the same way on both MC-LAG switches. Using the default classifier ensures consistent classifier configuration on the MC-LAG ports.
- Configure a congestion notification profile that enables PFC on the FCoE code point (code point **011** in this example). The congestion notification profile configuration must be the same on both MC-LAG switches.
- Apply the congestion notification profile to the interfaces.
- Configure enhanced transmission selection (ETS, also known as hierarchical scheduling) on the interfaces to provide the bandwidth required for lossless FCoE transport. Configuring ETS includes configuring bandwidth scheduling for the FCoE forwarding class, a forwarding class set (priority group) that includes the FCoE forwarding class, and a traffic control profile to assign bandwidth to the forwarding class set that includes FCoE traffic.
- Apply the ETS scheduling to the interfaces.
- Configure the port mode, MTU, and FCoE trusted or untrusted state for each interface to support lossless FCoE transport.

In addition, this example describes how to enable FIP snooping on the Transit Switch TS1 and TS2 ports that are connected to the FCoE servers and how to disable IGMP snooping on the FCoE VLAN. To provide secure access, FIP snooping must be enabled on the FCoE access ports.

This example focuses on the CoS configuration to support lossless FCoE transport across an MC-LAG. This example does not describe how to configure the properties of MC-LAGs and LAGs, although it does show you how to configure the port characteristics required to support lossless transport and how to assign interfaces to the MC-LAG and to the LAGs.

Before you configure CoS, configure:

- The MC-LAGs that connect Switches S1 and S2 to Switches TS1 and TS2. ("Example: Configuring Multichassis Link Aggregation" on page 1904 describes how to configure MC-LAGs.)
- The LAGs that connect the Transit Switches TS1 and TS2 to MC-LAG Switches S1 and S2. ("Configuring Link Aggregation" on page 2019 describes how to configure LAGs.)
- The LAG that connects Switch S1 to Switch S2.

Configuration

To configure CoS for lossless FCoE transport across an MC-LAG, perform these tasks:

- Configuring MC-LAG Switches S1 and S2 on page 4948
- Configuring FCoE Transit Switches TS1 and TS2 on page 4949
- Results on page 4952

CLI Quick Configuration

To quickly configure CoS for lossless FCoE transport across an MC-LAG, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI for MC-LAG Switch S1 and MC-LAG Switch S2 at the **[edit]** hierarchy level. The configurations on Switches S1 and S2 are identical because the CoS configuration must be identical, and because this example uses the same ports on both switches.

Switch S1 and Switch S2

```
set class-of-service schedulers fcoe-sched priority low transmit-rate 3g
set class-of-service schedulers fcoe-sched shaping-rate percent 100
set class-of-service scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
set class-of-service forwarding-class-sets fcoe-pg class fcoe
set class-of-service traffic-control-profiles fcoe-tcp scheduler-map fcoe-map guaranteed-rate
3g
set class-of-service traffic-control-profiles fcoe-tcp shaping-rate percent 100
set class-of-service interfaces ae0 forwarding-class-set fcoe-pg output-traffic-control-profile
fcoe-tcp
set class-of-service interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile
fcoe-tcp
set class-of-service congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
set class-of-service interfaces ae0 congestion-notification-profile fcoe-cnp
set class-of-service interfaces ae1 congestion-notification-profile fcoe-cnp
set vlans fcoe_vlan vlan-id 100
set protocols igmp-snooping vlan fcoe_vlan disable
set interfaces xe-0/0/10 ether-options 802.3ad ae0
```



```
set interfaces xe-0/0/11 ether-options 802.3ad ae0
set interfaces xe-0/0/20 ether-options 802.3ad ae1
set interfaces xe-0/0/21 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan
set interfaces ae0 mtu 2180
set interfaces ae1 mtu 2180
set ethernet-switching-options secure-access-port interface ae0 fcoe-trusted
set ethernet-switching-options secure-access-port interface ae1 fcoe-trusted
```

To quickly configure CoS for lossless FCoE transport across an MC-LAG, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI for Transit Switch TS1 and Transit Switch TS2 at the **[edit]** hierarchy level. The configurations on Switches TS1 and TS2 are identical because the CoS configuration must be identical, and because this example uses the same ports on both switches.

Switch TS1 and Switch TS2

```
set class-of-service schedulers fcoe-sched priority low transmit-rate 3g
set class-of-service schedulers fcoe-sched shaping-rate percent 100
set class-of-service scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
set class-of-service forwarding-class-sets fcoe-pg class fcoe
set class-of-service traffic-control-profiles fcoe-tcp scheduler-map fcoe-map guaranteed-rate
3g
set class-of-service traffic-control-profiles fcoe-tcp shaping-rate percent 100
set class-of-service interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile
fcoe-tcp
set class-of-service interfaces xe-0/0/30 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service interfaces xe-0/0/31 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service interfaces xe-0/0/32 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service interfaces xe-0/0/33 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
set class-of-service interfaces ae1 congestion-notification-profile fcoe-cnp
set class-of-service interfaces xe-0/0/30 congestion-notification-profile fcoe-cnp
set class-of-service interfaces xe-0/0/31 congestion-notification-profile fcoe-cnp
set class-of-service interfaces xe-0/0/32 congestion-notification-profile fcoe-cnp
set class-of-service interfaces xe-0/0/33 congestion-notification-profile fcoe-cnp
set vlans fcoe_vlan vlan-id 100
set protocols igmp-snooping vlan fcoe_vlan disable
set interfaces xe-0/0/25 ether-options 802.3ad ae1
set interfaces xe-0/0/26 ether-options 802.3ad ae1
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan
set interfaces xe-0/0/30 unit 0 family ethernet-switching port-mode tagged-access vlan members
fcoe_vlan
set interfaces xe-0/0/31 unit 0 family ethernet-switching port-mode tagged-access vlan members
fcoe_vlan
set interfaces xe-0/0/32 unit 0 family ethernet-switching port-mode tagged-access vlan members
fcoe_vlan
set interfaces xe-0/0/33 unit 0 family ethernet-switching port-mode tagged-access vlan members
fcoe_vlan
set interfaces ae1 mtu 2180
set interfaces xe-0/0/30 mtu 2180
set interfaces xe-0/0/31 mtu 2180
```

set interfaces xe-0/0/32 mtu 2180
set interfaces xe-0/0/33 mtu 2180
set ethernet-switching-options secure-access-port interface ae1 fcoe-trusted
set ethernet-switching-options secure-access-port vlan fcoe_vlan examine-fip examine-vn2v2 beacon-period 90000

Configuring MC-LAG Switches S1 and S2

Step-by-Step Procedure

To configure CoS resource scheduling (ETS), PFC, the FCoE VLAN, and the LAG and MC-LAG interface membership and characteristics to support lossless FCoE transport across an MC-LAG (this example uses the default **fcoe** forwarding class and the default classifier to map incoming FCoE traffic to the FCoE IEEE 802.1p code point **011**, so you do not configure them):

1. Configure output scheduling for the FCoE queue:

   ```
   [edit class-of-service]
   user@switch# set schedulers fcoe-sched priority low transmit-rate 3g
   user@switch# set schedulers fcoe-sched shaping-rate percent 100
   ```

2. Map the FCoE forwarding class to the FCoE scheduler (**fcoe-sched**):

   ```
   [edit class-of-service]
   user@switch# set scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
   ```

3. Configure the forwarding class set (**fcoe-pg**) for the FCoE traffic:

   ```
   [edit class-of-service]
   user@switch# set forwarding-class-sets fcoe-pg class fcoe
   ```

4. Define the traffic control profile (**fcoe-tcp**) to use on the FCoE forwarding class set:

   ```
   [edit class-of-service]
   user@switch# set traffic-control-profiles fcoe-tcp scheduler-map fcoe-map
   guaranteed-rate 3g
   user@switch# set traffic-control-profiles fcoe-tcp shaping-rate percent 100
   ```

5. Apply the FCoE forwarding class set and traffic control profile to the LAG and MC-LAG interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces ae0 forwarding-class-set fcoe-pg output-traffic-control-profile
   fcoe-tcp
   user@switch# set interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile
   fcoe-tcp
   ```

6. Enable PFC on the FCoE priority by creating a congestion notification profile (**fcoe-cnp**) that applies FCoE to the IEEE 802.1 code point **011**:

   ```
   [edit class-of-service]
   user@switch# set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point
   011 pfc
   ```

7. Apply the PFC configuration to the LAG and MC-LAG interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces ae0 congestion-notification-profile fcoe-cnp
   user@switch# set interfaces ae1 congestion-notification-profile fcoe-cnp
   ```

8. Configure the VLAN for FCoE traffic (**fcoe_vlan**):

   ```
   [edit vlans]
   user@switch# set fcoe_vlan vlan-id 100
   ```


9. Disable IGMP snooping on the FCoE VLAN:

   [edit protocols]
   user@switch# **set igmp-snooping vlan fcoe_vlan disable**

10. Add the member interfaces to the LAG between the two MC-LAG switches:

    [edit interfaces]
    user@switch# **set xe-0/0/10 ether-options 802.3ad ae0**
    user@switch# **set xe-0/0/11 ether-options 802.3ad ae0**

11. Add the member interfaces to the MC-LAG:

    [edit interfaces]
    user@switch# **set xe-0/0/20 ether-options 802.3ad ae1**
    user@switch# **set xe-0/0/21 ether-options 802.3ad ae1**

12. Configure the port mode as **trunk** and membership in the FCoE VLAN (**fcoe_vlan**)for the LAG (**ae0**) and for the MC-LAG (**ae1**):

    [edit interfaces]
    user@switch# **set interfaces ae0 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan**
    user@switch# **set interfaces ae1 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan**

13. Set the MTU to **2180** for the LAG and MC-LAG interfaces. 2180 bytes is the minimum size required to handle FCoE packets because of the payload and header sizes; you can configure the MTU to a higher number of bytes if desired, but not less than 2180 bytes:

    [edit interfaces]
    user@switch# **set ae0 mtu 2180**
    user@switch# **set ae1 mtu 2180**

14. Set the LAG and MC-LAG interfaces as FCoE trusted ports. Ports that connect to other switches should be trusted and should not perform FIP snooping:

    [edit]
    user@switch# **set ethernet-switching-options secure-access-port interface ae0 fcoe-trusted**
    user@switch# **set ethernet-switching-options secure-access-port interface ae1 fcoe-trusted**

Configuring FCoE Transit Switches TS1 and TS2

Step-by-Step Procedure

The CoS configuration on FCoE Transit Switches TS1 and TS2 is similar to the CoS configuration on MC-LAG Switches S1 and S2. However, the port configurations differ, and you must enable FIP snooping on the Switch TS1 and Switch TS2 FCoE access ports.

To configure resource scheduling (ETS), PFC, the FCoE VLAN, and the LAG interface membership and characteristics to support lossless FCoE transport across the MC-LAG (this example uses the default **fcoe** forwarding class and the default classifier to map incoming FCoE traffic to the FCoE IEEE 802.1p code point **011**, so you do not configure them):

1. Configure output scheduling for the FCoE queue:

   [edit class-of-service]
   user@switch# **set schedulers fcoe-sched priority low transmit-rate 3g**
   user@switch# **set schedulers fcoe-sched shaping-rate percent 100**

2. Map the FCoE forwarding class to the FCoE scheduler (**fcoe-sched**):

```
[edit class-of-service]
user@switch# set scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
```

3. Configure the forwarding class set (**fcoe-pg**) for the FCoE traffic:

```
[edit class-of-service]
user@switch# set forwarding-class-sets fcoe-pg class fcoe
```

4. Define the traffic control profile (**fcoe-tcp**) to use on the FCoE forwarding class set:

```
[edit class-of-service]
user@switch# set traffic-control-profiles fcoe-tcp scheduler-map fcoe-map
guaranteed-rate 3g
user@switch# set traffic-control-profiles fcoe-tcp shaping-rate percent 100
```

5. Apply the FCoE forwarding class set and traffic control profile to the LAG interface and to the FCoE access interfaces:

```
[edit class-of-service]
user@switch# set interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile
fcoe-tcp
user@switch# set class-of-service interfaces xe-0/0/30 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
user@switch# set class-of-service interfaces xe-0/0/31 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
user@switch# set class-of-service interfaces xe-0/0/32 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
user@switch# set class-of-service interfaces xe-0/0/33 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
```

6. Enable PFC on the FCoE priority by creating a congestion notification profile (**fcoe-cnp**) that applies FCoE to the IEEE 802.1 code point **011**:

```
[edit class-of-service]
user@switch# set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point
011 pfc
```

7. Apply the PFC configuration to the LAG interface and to the FCoE access interfaces:

```
[edit class-of-service]
user@switch# set interfaces ae1 congestion-notification-profile fcoe-cnp
user@switch# set class-of-service interfaces xe-0/0/30 congestion-notification-profile
fcoe-cnp
user@switch# set class-of-service interfaces xe-0/0/31 congestion-notification-profile
fcoe-cnp
user@switch# set class-of-service interfaces xe-0/0/32 congestion-notification-profile
fcoe-cnp
user@switch# set class-of-service interfaces xe-0/0/33 congestion-notification-profile
fcoe-cnp
```

8. Configure the VLAN for FCoE traffic (**fcoe_vlan**):

```
[edit vlans]
user@switch# set fcoe_vlan vlan-id 100
```

9. Disable IGMP snooping on the FCoE VLAN:

```
[edit protocols]
user@switch# set igmp-snooping vlan fcoe_vlan disable
```

10. Add the member interfaces to the LAG:

```
[edit interfaces]
user@switch# set xe-0/0/25 ether-options 802.3ad ae1
```


user@switch# **set xe-0/0/26 ether-options 802.3ad ae1**

11. On the LAG (**ae1**), configure the port mode as **trunk** and membership in the FCoE VLAN (**fcoe_vlan**):

    [edit interfaces]
    user@switch# **set interfaces ae1 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan**

12. On the FCoE access interfaces (**xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, **xe-0/0/33**), configure the port mode as **tagged-access** and membership in the FCoE VLAN (**fcoe_vlan**):

    [edit interfaces]
    user@switch# **set interfaces xe-0/0/30 unit 0 family ethernet-switching port-mode tagged-access vlan members fcoe_vlan**
    user@switch# **set interfaces xe-0/0/31 unit 0 family ethernet-switching port-mode tagged-access vlan members fcoe_vlan**
    user@switch# **set interfaces xe-0/0/32 unit 0 family ethernet-switching port-mode tagged-access vlan members fcoe_vlan**
    user@switch# **set interfaces xe-0/0/33 unit 0 family ethernet-switching port-mode tagged-access vlan members fcoe_vlan**

13. Set the MTU to **2180** for the LAG and FCoE access interfaces. 2180 bytes is the minimum size required to handle FCoE packets because of the payload and header sizes; you can configure the MTU to a higher number of bytes if desired, but not less than 2180 bytes:

    [edit interfaces]
    user@switch# **set ae1 mtu 2180**
    user@switch# **set xe-0/0/30 mtu 2180**
    user@switch# **set xe-0/0/31 mtu 2180**
    user@switch# **set xe-0/0/32 mtu 2180**
    user@switch# **set xe-0/0/33 mtu 2180**

14. Set the LAG interface as an FCoE trusted port. Ports that connect to other switches should be trusted and should not perform FIP snooping:

    [edit]
    user@switch# **set ethernet-switching-options secure-access-port interface ae1 fcoe-trusted**

    NOTE: Access ports xe-0/0/30, xe-0/0/31, xe-0/0/32, and xe-0/0/33 are not configured as FCoE trusted ports. The access ports remain in the default state as untrusted ports because they connect directly to FCoE devices and must perform FIP snooping to ensure network security.

15. Enable FIP snooping on the FCoE VLAN to prevent unauthorized FCoE network access (this example uses VN2VN_Port FIP snooping; the example is equally valid if you use VN2VF_Port FIP snooping):

    [edit]
    user@switch# **set ethernet-switching-options secure-access-port vlan fcoe_vlan examine-fip examine-vn2vn beacon-period 90000**

Results

Display the results of the CoS configuration on MC-LAG Switch S1 and on MC-LAG Switch S2 (the results on both switches are the same):

```
user@switch> show configuration class-of-service
traffic-control-profiles {
   fcoe-tcp {
      scheduler-map fcoe-map;
      shaping-rate percent 100;
      guaranteed-rate 3000000000;
   }
}
forwarding-class-sets {
   fcoe-pg {
      class fcoe;
   }
}
congestion-notification-profile {
   fcoe-cnp {
      input {
         ieee-802.1 {
            code-point 011 {
               pfc;
            }
         }
      }
   }
}
interfaces {
   ae0 {
      forwarding-class-set {
         fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
         }
      }
      congestion-notification-profile fcoe-cnp;
   }
   ae1 {
      forwarding-class-set {
         fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
         }
      }
      congestion-notification-profile fcoe-cnp;
   }
}
scheduler-maps {
   fcoe-map {
      forwarding-class fcoe scheduler fcoe-sched;
   }
}
schedulers {
   fcoe-sched {
      transmit-rate 3000000000;
```

```
        shaping-rate percent 100;
        priority low;
    }
}
```

NOTE: The forwarding class and classifier configurations are not shown because the show command does not display default portions of the configuration.

For MC-LAG verification commands, see "Example: Configuring Multichassis Link Aggregation" on page 1904.

Display the results of the CoS configuration on FCoE Transit Switch TS1 and on FCoE Transit Switch TS2 (the results on both transit switches are the same):

```
user@switch> show configuration class-of-service
traffic-control-profiles {
    fcoe-tcp {
        scheduler-map fcoe-map;
        shaping-rate percent 100;
        guaranteed-rate 3000000000;
    }
}
forwarding-class-sets {
    fcoe-pg {
        class fcoe;
    }
}
congestion-notification-profile {
    fcoe-cnp {
        input {
            ieee-802.1 {
                code-point 011 {
                    pfc;
                }
            }
        }
    }
}
interfaces {
    xe-0/0/30 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
    xe-0/0/31 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
```



```
        }
        congestion-notification-profile fcoe-cnp;
    }
    xe-0/0/32 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
    xe-0/0/33 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
    ae1 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
}
scheduler-maps {
    fcoe-map {
        forwarding-class fcoe scheduler fcoe-sched;
    }
}
schedulers {
    fcoe-sched {
        transmit-rate 3000000000;
        shaping-rate percent 100;
        priority low;
    }
}
```

NOTE: The forwarding class and classifier configurations are not shown because the **show** command does not display default portions of the configuration.

Verification

To verify that the CoS components and FIP snooping have been configured and are operating properly, perform these tasks. Because this example uses the default **fcoe** forwarding class and the default IEEE 802.1p trusted classifier, the verification of those configurations is not shown:

Verifying That the Output Queue Schedulers Have Been Created

Purpose Verify that the output queue scheduler for FCoE traffic has the correct bandwidth parameters and priorities, and is mapped to the correct forwarding class (output queue). Queue scheduler verification is the same on each of the four switches.

Action List the scheduler map using the operational mode command **show class-of-service scheduler-map fcoe-map**:

```
user@switch> show class-of-service scheduler-map fcoe-map
Scheduler map: fcoe-map, Index: 9023

  Scheduler: fcoe-sched, Forwarding class: fcoe, Index: 37289
    Transmit rate: 3000000000 bps, Rate Limit: none, Buffer size: remainder,
    Buffer Limit: none, Priority: low
    Excess Priority: unspecified
    Shaping rate: 100 percent,
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    <default-drop-profile>
      Medium high     any             1    <default-drop-profile>
      High            any             1    <default-drop-profile>
```

Meaning The **show class-of-service scheduler-map fcoe-map** command lists the properties of the scheduler map **fcoe-map**. The command output includes:

- The name of the scheduler map (**fcoe-map**)
- The name of the scheduler (**fcoe-sched**)
- The forwarding classes mapped to the scheduler (**fcoe**)
- The minimum guaranteed queue bandwidth (transmit rate **3000000000 bps**)
- The scheduling priority (**low**)

- The maximum bandwidth in the priority group the queue can consume (shaping rate **100 percent**)
- The drop profile loss priority for each drop profile name. This example does not include drop profiles because you do not apply drop profiles to FCoE traffic.

Verifying That the Priority Group Output Scheduler (Traffic Control Profile) Has Been Created

Purpose Verify that the traffic control profile **fcoe-tcp** has been created with the correct bandwidth parameters and scheduler mapping. Priority group scheduler verification is the same on each of the four switches.

Action List the FCoE traffic control profile properties using the operational mode command **show class-of-service traffic-control-profile fcoe-tcp**:

```
user@switch> show class-of-service traffic-control-profile fcoe-tcp
Traffic control profile: fcoe-tcp, Index: 18303
  Shaping rate: 100 percent
  Scheduler map: fcoe-map
  Guaranteed rate: 3000000000
```

Meaning The **show class-of-service traffic-control-profile fcoe-tcp** command lists all of the configured traffic control profiles. For each traffic control profile, the command output includes:

- The name of the traffic control profile (**fcoe-tcp**)
- The maximum port bandwidth the priority group can consume (shaping rate **100 percent**)
- The scheduler map associated with the traffic control profile (**fcoe-map**)
- The minimum guaranteed priority group port bandwidth (guaranteed rate **3000000000** in bps)

Verifying That the Forwarding Class Set (Priority Group) Has Been Created

Purpose Verify that the FCoE priority group has been created and that the **fcoe** priority (forwarding class) belongs to the FCoE priority group. Forwarding class set verification is the same on each of the four switches.

Action List the forwarding class sets using the operational mode command **show class-of-service forwarding-class-set fcoe-pg**:

```
user@switch> show class-of-service forwarding-class-set fcoe-pg
Forwarding class set: fcoe-pg, Type: normal-type, Forwarding class set index:
31420
  Forwarding class                       Index
  fcoe                                     1
```

Meaning The **show class-of-service forwarding-class-set fcoe-pg** command lists all of the forwarding classes (priorities) that belong to the **fcoe-pg** priority group, and the internal index number of the priority group. The command output shows that the forwarding class set **fcoe-pg** includes the forwarding class **fcoe**.

Verifying That Priority-Based Flow Control Has Been Enabled

Purpose Verify that PFC is enabled on the FCoE code point. PFC verification is the same on each of the four switches.

Action List the FCoE congestion notification profile using the operational mode command **show class-of-service congestion-notification fcoe-cnp**:

```
user@switch> show class-of-service congestion-notification fcoe-cnp
Type: Input, Name: fcoe-cnp, Index: 6879
Cable Length: 100 m
  Priority     PFC         MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Enabled     2500
  100          Disabled
  101          Disabled
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  000
               0
  001
               1
  010
               2
  011
               3
  100
               4
  101
               5
  110
               6
  111
               7
```

Meaning The **show class-of-service congestion-notification fcoe-cnp** command lists all of the IEEE 802.1p code points in the congestion notification profile that have PFC enabled. The command output shows that PFC is enabled on code point **011** (**fcoe** queue) for the **fcoe-cnp** congestion notification profile.

The command also shows the default cable length (100 meters), the default maximum receive unit (2500 bytes), and the default mapping of priorities to output queues because this example does not include configuring these options.

Verifying That the Interface Class of Service Configuration Has Been Created

Purpose Verify that the CoS properties of the interfaces are correct. The verification output on MC-LAG Switches S1 and S2 differs from the output on FCoE Transit Switches TS1 and TS2.

Action List the interface CoS configuration on MC-LAG Switches S1 and S2 using the operational mode command **show configuration class-of-service interfaces**:

```
user@switch> show configuration class-of-service interfaces
ae0 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}

ae1 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
```

List the interface CoS configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show configuration class-of-service interfaces**:

```
user@switch> show configuration class-of-service interfaces
xe-0/0/30 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
xe-0/0/31 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
xe-0/0/32 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
xe-0/0/33 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
ae1 {
    forwarding-class-set {
```



```
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
```

Meaning The **show configuration class-of-service interfaces** command lists the class of service configuration for all interfaces. For each interface, the command output includes:

- The name of the interface (for example, **ae0** or **xe-0/0/30**)
- The name of the forwarding class set associated with the interface (**fcoe-pg**)
- The name of the traffic control profile associated with the interface (output traffic control profile, **fcoe-tcp**)
- The name of the congestion notification profile associated with the interface (**fcoe-cnp**)

NOTE: Interfaces that are members of a LAG are not shown individually. The LAG or MC-LAG CoS configuration is applied to all interfaces that are members of the LAG or MC-LAG. For example, the interface CoS configuration output on MC-LAG Switches S1 and S2 shows the LAG CoS configuration but does not show the CoS configuration of the member interfaces separately. The interface CoS configuration output on FCoE Transit Switches TS1 and TS2 shows the LAG CoS configuration but also shows the configuration for interfaces xe-0/0/30, xe-0/0/31, xe-0/0/32, and xe-0/0/33, which are not members of a LAG.

Verifying That the Interfaces Are Correctly Configured

Purpose Verify that the LAG membership, MTU, VLAN membership, and port mode of the interfaces are correct. The verification output on MC-LAG Switches S1 and S2 differs from the output on FCoE Transit Switches T1 and T2.

Action List the interface configuration on MC-LAG Switches S1 and S2 using the operational mode command **show configuration interfaces**:

```
user@switch> show configuration interfaces
xe-0/0/10 {
    ether-options {
        802.3ad ae0;
    }
}
xe-0/0/11 {
    ether-options {
        802.3ad ae0;
    }
}
xe-0/0/20 {
    ether-options {
        802.3ad ae1;
```

```
    }
}
xe-0/0/21 {
    ether-options {
        802.3ad ae1;
    }
}
ae0 {
    mtu 2180;
    unit 0 {
        family ethernet-switching {
            port-mode trunk;
            vlan {
                members fcoe_vlan;
            }
        }
    }
}
ae1 {
    mtu 2180;
    unit 0 {
        family ethernet-switching {
            port-mode trunk;
            vlan {
                members fcoe_vlan;
            }
        }
    }
}
```

List the interface configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show configuration interfaces**:

```
user@switch> show configuration interfaces
xe-0/0/25 {
    ether-options {
        802.3ad ae1;
    }
}
xe-0/0/26 {
    ether-options {
        802.3ad ae1;
    }
}
xe-0/0/30 {
    mtu 2180;
    unit 0 {
        family ethernet-switching {
            port-mode tagged-access;
            vlan {
                members fcoe_vlan;
            }
        }
    }
}
xe-0/0/31 {
    mtu 2180;
    unit 0 {
        family ethernet-switching {
            port-mode tagged-access;
```



```
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }
    xe-0/0/32 {
        mtu 2180;
        unit 0 {
            family ethernet-switching {
                port-mode tagged-access;
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }
    xe-0/0/33 {
        mtu 2180;
        unit 0 {
            family ethernet-switching {
                port-mode tagged-access;
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }

    ae1 {
        mtu 2180;
        unit 0 {
            family ethernet-switching {
                port-mode trunk;
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }
```

Meaning The **show configuration interfaces** command lists the configuration of each interface by interface name.

For each interface that is a member of a LAG, the command lists only the name of the LAG to which the interface belongs.

For each LAG interface and for each interface that is not a member of a LAG, the command output includes:

- The MTU (**2180**)
- The unit number of the interface (**0**)
- The port mode (**trunk** mode for interfaces that connect two switches, **tagged-access** mode for interfaces that connect to FCoE hosts)
- The name of the VLAN in which the interface is a member (**fcoe_vlan**)

Verifying That FIP Snooping Is Enabled on the FCoE VLAN on FCoE Transit Switches TS1 and TS2 Access Interfaces

Purpose Verify that FIP snooping is enabled on the FCoE VLAN access interfaces. FIP snooping is enabled only on the FCoE access interfaces, so it is enabled only on FCoE Transit Switches TS1 and TS2. FIP snooping is not enabled on MC-LAG Switches S1 and S2 because FIP snooping is done at the Transit Switch TS1 and TS2 FCoE access ports.

Action List the port security configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show configuration ethernet-switching-options secure-access-port**:

```
user@switch> show configuration ethernet-switching-options secure-access-port
interface ae1.0 {
    fcoe-trusted;
}
vlan fcoe_vlan {
    examine-fip {
        examine-vn2vn {
            beacon-period 90000;
        }
    }
}
```

Meaning The **show configuration ethernet-switching-options secure-access-port** command lists port security information, including whether a port is trusted. The command output shows that:

- LAG port **ae1.0**, which connects the FCoE transit switch to the MC-LAG switches, is configured as an FCoE trusted interface. FIP snooping is not performed on the member interfaces of the LAG (**xe-0/0/25** and **xe-0/0/26**).
- FIP snooping is enabled (**examine-fip**) on the FCoE VLAN (**fcoe_vlan**), the type of FIP snooping is VN2VN_Port FIP snooping (**examine-vn2vn**) and the beacon period is set to 90000 milliseconds. On Transit Switches TS1 and TS2, all interface members of the FCoE VLAN perform FIP snooping unless the interface is configured as FCoE trusted. On Transit Switches TS1 and TS2, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33** perform FIP snooping because they are not configured as FCoE trusted. The interface members of LAG **ae1** (**xe-0/0/25** and **xe-0/0/26**) do not perform FIP snooping because the LAG is configured as FCoE trusted.

Verifying That the FIP Snooping Mode Is Correct on FCoE Transit Switches TS1 and TS2

Purpose Verify that the FIP snooping mode is correct on the FCoE VLAN. FIP snooping is enabled only on the FCoE access interfaces, so it is enabled only on FCoE Transit Switches TS1 and TS2. FIP snooping is not enabled on MC-LAG Switches S1 and S2 because FIP snooping is done at the Transit Switch TS1 and TS2 FCoE access ports.

Action List the FIP snooping configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show fip snooping brief**:

```
user@switch> show fip snooping brief
```



```
VLAN: fcoe_vlan,    Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
…
```

NOTE: The output has been truncated to show only the relevant information.

Meaning The **show fip snooping brief** command lists FIP snooping information, including the FIP snooping VLAN and the FIP snooping mode. The command output shows that:

- The VLAN on which FIP snooping is enabled is **fcoe_vlan**
- The FIP snooping mode is VN2VN_Port FIP snooping (**VN2VN Snooping**)

Verifying That IGMP Snooping Is Disabled on the FCoE VLAN

Purpose Verify that IGMP snooping is disabled on the FCoE VLAN on all four switches.

Action List the IGMP snooping protocol information on each of the four switches using the **show configuration protocols igmp-snooping** command:

```
user@switch> show configuration protocols igmp-snooping
vlan fcoe_vlan {
    disable;
}
```

Meaning The **show configuration protocols igmp-snooping** command lists the IGMP snooping configuration for the VLANs configured on the switch. The command output shows that IGMP snooping is disabled on the FCoE VLAN (**fcoe_vlan**).

Related Documentation

- Example: Configuring Multichassis Link Aggregation on page 1904
- Configuring Link Aggregation on page 2019
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Understanding Multichassis Link Aggregation on page 1853
- Understanding MC-LAGs on an FCoE Transit Switch on page 4881

Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric

To transmit Fibre Channel (FC) traffic between FCoE devices and a storage area network (SAN) FC switch, you configure a local FC fabric on the gateway. The gateway FC fabric includes FCoE and native FC interfaces, and a VLAN to carry FCoE traffic from FCoE-capable devices. The gateway FC fabric creates the path between the FCoE devices and the SAN.

This example describes how to configure the interfaces, VLAN, and FC fabric to connect FCoE devices to the FC switch and route traffic between the VLAN and FC interfaces:

Requirements

This example uses the following hardware and software components:

- A configured and provisioned Juniper Networks QFX3500 Switch to act as an FCoE-FC gateway
- FCoE-capable devices in an Ethernet network equipped with converged network adapters (CNAs)
- An FC switch to transmit and receive native FC traffic
- FC storage devices in the SAN
- Junos OS Release 11.1 or later for the QFX Series

Overview

No interfaces are configured for FC network connectivity by default. You need to configure the FC fabric and its interfaces explicitly. Each FC fabric consists of a combination of at least one FCoE VLAN interface between the FCoE-FC gateway and the FCoE devices, and one or more native FC interfaces between the FCoE-FC gateway and the FC switch.

An FCoE VLAN interface connects the FCoE-FC gateway to FCoE devices. FCoE traffic between the devices and the FCoE-FC gateway requires a dedicated VLAN used only for FCoE traffic. You cannot mix standard Ethernet traffic and FCoE traffic on the FCoE VLAN.

NOTE: **IGMP snooping is not supported on FCoE VLANs. Disable IGMP snooping on FCoE VLANs.**

Storm control is not supported on Ethernet interfaces that belong to the FCoE VLAN. Ensure that storm control is disabled on all Ethernet interfaces that belong to the FCoE VLAN to prevent FCoE traffic from being dropped.

When FCoE frames enter the FCoE-FC gateway, the gateway:

1. Strips the Ethernet encapsulation from the FCoE frames.
2. Sends the resulting native FC frames to the FC switch through the gateway's native FC interfaces.

Each FC interface and FCoE VLAN interface can belong to only one FC fabric. Different FC fabrics must use different native FC interfaces and different FCoE VLAN interfaces.

Multiple FC fabrics on the FCoE-FC gateway can connect to the same FC switch, but they must use different FC interfaces and different FCoE VLAN interfaces.

The Ethernet interfaces that belong to the FCoE VLAN should be configured in tagged-access port mode and must include the native VLAN because FIP VLAN discovery and notification frames are exchanged as untagged packets. These Ethernet interfaces require a maximum transmission unit (MTU) size of at least 2180 bytes to accommodate the FC payload and FCoE encapsulation. (Sometimes the MTU is rounded up to 2500 bytes. If larger frames are expected on the interface, set the MTU size accordingly.)

This example shows a simple configuration to illustrate the basic steps for creating:

- The FCoE-device-facing VLAN and its 10-Gigabit Ethernet interfaces
- The VLAN interface
- The FC-switch-facing native FC interfaces
- One FC fabric on the FCoE-FC gateway

Configuring these elements results in traffic being routed between the VLAN and FC interfaces, thus connecting the FCoE devices to the FC switch through the FCoE-FC gateway.

A VLAN called **blue** transports FCoE traffic between FCoE devices and the FCoE-FC gateway using an FCoE VLAN interface called **vlan.100**. The FCoE-FC gateway's **vlan.100** interface presents an F_Port interface to the FCoE devices on the VLAN. For each FCoE device ENode that logs in to the FCoE-FC gateway, the gateway instantiates a virtual F_Port (VF_Port) interface. This creates a virtual link between the ENode VN_Port and the FCoE-FC gateway. The FCoE-FC gateway's native FC interfaces transport FC traffic between the gateway and the FC switch.

Configuring both the FCoE VLAN interface and the native FC interfaces as part of a gateway fabric associates them in the switch and makes the connection between the FCoE servers and the FC switch.

Topology

The topology for this example consists of one QFX3500 switch with FC-capable ports to connect to the FC switch and with Ethernet ports in tagged-access mode to connect to the FCoE devices. Table 384 on page 4965 and Figure 181 on page 4966 show the configuration components of this example.

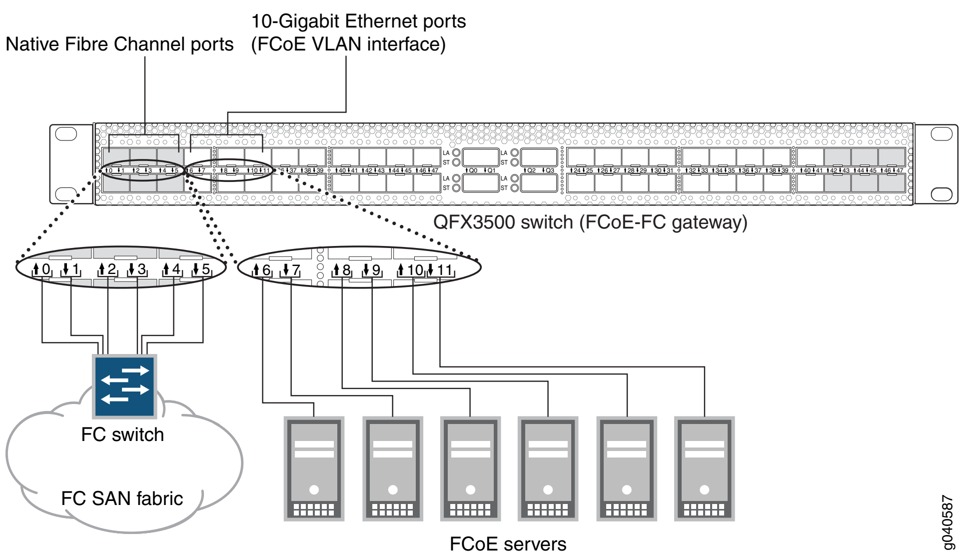
Table 384: Components of the Fibre Channel Interface Configuration Topology

Property	Settings
Switch hardware	QFX3500 switch in gateway mode
FCoE VLAN name and tag ID	**blue**, tag **100** IGMP snooping disabled on the FCoE VLAN.

Table 384: Components of the Fibre Channel Interface Configuration Topology *(continued)*

Property	Settings
Interfaces in VLAN **blue**	Interfaces: **xe-0/0/6**, **xe-0/0/7**, **xe-0/0/8**, **xe-0/0/9**, **xe-0/0/10**, **xe-0/0/11** Port mode: **tagged-access** MTU: **2180** Native VLAN: **1** NOTE: You can bundle two or more of the VLAN interfaces in a link aggregation group (LAG) if you wish. NOTE: FCoE VLANs (any VLAN that carries FCoE traffic) support only Spanning Tree Protocol (STP) and link aggregation group (LAG) Layer 2 features.
FCoE VLAN interface	**vlan.100** Port mode: **f-port**
Native Fibre Channel interfaces	Interfaces: **fc-0/0/0**, **fc-0/0/1**, **fc-0/0/2**, **fc-0/0/3**, **fc-0/0/4**, **fc-0/0/5** Port mode: **np-port** Speed: **4 Gbps**
Fibre Channel fabric **fcproxy1**	Fabric type: **proxy** Fabric ID: **1** FC interfaces: **fc-0/0/0**, **fc-0/0/1**, **fc-0/0/2**, **fc-0/0/3**, **fc-0/0/4**, **fc-0/0/5**

Figure 181: Fibre Channel Interface Configuration Topology



This configuration example creates a VLAN for FCoE traffic and routes its traffic to an FCoE VLAN interface that is part of the FC fabric. It also creates the FC interfaces needed to connect to the FC switch.

To set up FC interfaces and FCoE VLAN interfaces:

- Configure a VLAN to use as a dedicated FCoE VLAN:
  - Configure the interfaces the FCoE VLAN uses as Ethernet switching interfaces in tagged-access port mode.
  - If storm control is enabled, disable it on the interfaces.
  - Configure the interfaces the FCoE VLAN uses with the native VLAN.
  - Configure the FCoE VLAN to use the desired Ethernet interfaces.
  - Disable IGMP snooping on the FCoE VLAN. (IGMP snooping is enabled by default on all VLANs, but is not supported on FCoE VLANs).
- Configure the FCoE VLAN interface.
- Define the interface for the FCoE VLAN (associate the VLAN with the FCoE VLAN interface).
- Configure the physical FC interfaces (either one or two 6-port blocks) that connect to the FC switch.
- Configure the logical FC interfaces that connect to the FC switch.
- Configure the FCoE-FC gateway fabric:
  - Configure the fabric ID.
  - Configure the fabric as a proxy fabric.
  - Add the FCoE VLAN interface and the native FC interfaces to the fabric.

To keep the example simple, the configuration steps show six Ethernet interfaces in the FCoE VLAN and six native FC interfaces in the FC fabric. Use the same configuration procedure to add more interfaces to the FCoE VLAN or to the FC fabric.

Configuration

CLI Quick Configuration

To quickly configure FCoE and native FC interfaces on an FCoE-FC gateway and route traffic between the FCoE VLAN and FC interfaces, copy the following commands and paste them into the switch terminal window:

```
[edit]
set vlans blue vlan-id 100
set vlans native vlan-id 1
set interfaces xe-0/0/6 unit 0 family ethernet-switching port-mode tagged-access vlan members blue
set interfaces xe-0/0/7 unit 0 family ethernet-switching port-mode tagged-access vlan members blue
set interfaces xe-0/0/8 unit 0 family ethernet-switching port-mode tagged-access vlan members blue
set interfaces xe-0/0/9 unit 0 family ethernet-switching port-mode tagged-access vlan members blue
set interfaces xe-0/0/10 unit 0 family ethernet-switching port-mode tagged-access vlan members blue
set interfaces xe-0/0/11 unit 0 family ethernet-switching port-mode tagged-access vlan members blue
set interfaces xe-0/0/6 unit 0 family ethernet-switching native-vlan-id 1
set interfaces xe-0/0/7 unit 0 family ethernet-switching native-vlan-id 1
set interfaces xe-0/0/8 unit 0 family ethernet-switching native-vlan-id 1
```



```
set interfaces xe-0/0/9 unit 0 family ethernet-switching native-vlan-id 1
set interfaces xe-0/0/10 unit 0 family ethernet-switching native-vlan-id 1
set interfaces xe-0/0/11 unit 0 family ethernet-switching native-vlan-id 1
set interfaces xe-0/0/6 mtu 2180
set interfaces xe-0/0/7 mtu 2180
set interfaces xe-0/0/8 mtu 2180
set interfaces xe-0/0/9 mtu 2180
set interfaces xe-0/0/10 mtu 2180
set interfaces xe-0/0/11 mtu 2180
set vlans blue interface xe-0/0/6.0
set vlans blue interface xe-0/0/7.0
set vlans blue interface xe-0/0/8.0
set vlans blue interface xe-0/0/9.0
set vlans blue interface xe-0/0/10.0
set vlans blue interface xe-0/0/11.0
set protocols igmp-snooping vlan blue disable
set interfaces vlan unit 100 family fibre-channel port-mode f-port
set vlans blue l3-interface vlan.100
set chassis fpc 0 pic 0 fibre-channel port-range 0 5
set interfaces fc-0/0/0 unit 0 family fibre-channel port-mode np-port
set interfaces fc-0/0/1 unit 0 family fibre-channel port-mode np-port
set interfaces fc-0/0/2 unit 0 family fibre-channel port-mode np-port
set interfaces fc-0/0/3 unit 0 family fibre-channel port-mode np-port
set interfaces fc-0/0/4 unit 0 family fibre-channel port-mode np-port
set interfaces fc-0/0/5 unit 0 family fibre-channel port-mode np-port
set interfaces fc-0/0/0 fibrechannel-options speed 4g
set interfaces fc-0/0/1 fibrechannel-options speed 4g
set interfaces fc-0/0/2 fibrechannel-options speed 4g
set interfaces fc-0/0/3 fibrechannel-options speed 4g
set interfaces fc-0/0/4 fibrechannel-options speed 4g
set interfaces fc-0/0/5 fibrechannel-options speed 4g
set fc-fabrics fcproxy1 fabric-id 1
set fc-fabrics fcproxy1 fabric-type proxy
set fc-fabrics fcproxy1 interface vlan.100
set fc-fabrics fcproxy1 interface fc-0/0/0.0
set fc-fabrics fcproxy1 interface fc-0/0/1.0
set fc-fabrics fcproxy1 interface fc-0/0/2.0
set fc-fabrics fcproxy1 interface fc-0/0/3.0
set fc-fabrics fcproxy1 interface fc-0/0/4.0
set fc-fabrics fcproxy1 interface fc-0/0/5.0
```

Step-by-Step Procedure

Configure FCoE and FC interfaces in an FCoE-FC gateway FC fabric and set up traffic routing between the FCoE VLAN and FC interfaces:

1. Configure the VLAN for FCoE traffic:

   ```
   [edit vlans]
   user@switch# set blue vlan-id 100
   ```

2. Configure the native VLAN:

   ```
   [edit vlans]
   user@switch# set native vlan-id 1
   ```

3. Configure the Ethernet interfaces for the FCoE VLAN in tagged-access mode and as members of the FCoE VLAN (VLAN **blue**):

   ```
   [edit interfaces]
   user@switch# set xe-0/0/6 unit 0 family ethernet-switching port-mode tagged-access
   vlan members blue
   ```


user@switch# **set xe-0/0/7 unit 0 family ethernet-switching port-mode tagged-access vlan members blue**
user@switch# **set xe-0/0/8 unit 0 family ethernet-switching port-mode tagged-access vlan members blue**
user@switch# **set xe-0/0/9 unit 0 family ethernet-switching port-mode tagged-access vlan members blue**
user@switch# **set xe-0/0/10 unit 0 family ethernet-switching port-mode tagged-access vlan members blue**
user@switch# **set xe-0/0/11 unit 0 family ethernet-switching port-mode tagged-access vlan members blue**

4. Configure the native VLAN on the Ethernet interfaces in the FCoE VLAN:

```
[edit interfaces]
user@switch# set xe-0/0/6 unit 0 family ethernet-switching native-vlan-id 1
user@switch# set xe-0/0/7 unit 0 family ethernet-switching native-vlan-id 1
user@switch# set xe-0/0/8 unit 0 family ethernet-switching native-vlan-id 1
user@switch# set xe-0/0/9 unit 0 family ethernet-switching native-vlan-id 1
user@switch# set xe-0/0/10 unit 0 family ethernet-switching native-vlan-id 1
user@switch# set xe-0/0/11 unit 0 family ethernet-switching native-vlan-id 1
```

5. Set the MTU to 2180 for each Ethernet interface:

```
[edit interfaces]
user@switch# set xe-0/0/6 mtu 2180
user@switch# set xe-0/0/7 mtu 2180
user@switch# set xe-0/0/8 mtu 2180
user@switch# set xe-0/0/9 mtu 2180
user@switch# set xe-0/0/10 mtu 2180
user@switch# set xe-0/0/11 mtu 2180
```

6. Assign the Ethernet interfaces to the FCoE VLAN:

```
[edit vlans blue interface]
user@switch# set xe-0/0/6.0
user@switch# set xe-0/0/7.0
user@switch# set xe-0/0/8.0
user@switch# set xe-0/0/9.0
user@switch# set xe-0/0/10.0
user@switch# set xe-0/0/11.0
```

7. Disable IGMP snooping on the FCoE VLAN:

```
[edit protocols]
user@switch# set igmp-snooping vlan blue disable
```

8. Configure the FCoE VLAN interface and port mode for the FCoE traffic:

```
[edit interfaces]
user@switch# set vlan unit 100 family fibre-channel port-mode f-port
```

9. Define the FCoE VLAN interface as the interface for the FCoE VLAN:

```
[edit vlans]
user@switch# set blue l3-interface vlan.100
```

10. Configure the physical FC interfaces the fabric uses to connect to the FC switch:

```
[edit chassis fpc 0 pic 0]
user@switch# set fibre-channel port-range 0 5
```

NOTE: When you configure ports as FC ports, the port designation changes from **xe-n/n/n.n** format to **fc-n/n/n.n** format to indicate that the interface is an FC interface. FC interfaces do not support 10-Gbps interface speed but instead conform to FC interface speeds of 2 Gbps, 4 Gbps, or 8 Gbps.

11. Configure the native FC interfaces and port mode:

```
[edit interfaces]
user@switch# set fc-0/0/0 unit 0 family fibre-channel port-mode np-port
user@switch# set fc-0/0/1 unit 0 family fibre-channel port-mode np-port
user@switch# set fc-0/0/2 unit 0 family fibre-channel port-mode np-port
user@switch# set fc-0/0/3 unit 0 family fibre-channel port-mode np-port
user@switch# set fc-0/0/4 unit 0 family fibre-channel port-mode np-port
user@switch# set fc-0/0/5 unit 0 family fibre-channel port-mode np-port
```

12. Configure the native FC interface port speed:

```
[edit interfaces]
user@switch# set fc-0/0/0 fibrechannel-options speed 4g
user@switch# set fc-0/0/1 fibrechannel-options speed 4g
user@switch# set fc-0/0/2 fibrechannel-options speed 4g
user@switch# set fc-0/0/3 fibrechannel-options speed 4g
user@switch# set fc-0/0/4 fibrechannel-options speed 4g
user@switch# set fc-0/0/5 fibrechannel-options speed 4g
```

13. Configure the FC fabric name and unique ID:

```
[edit fc-fabrics]
user@switch# set fcproxy1 fabric-id 1
```

14. Define the FC fabric as an FCoE-FC gateway:

```
[edit fc-fabrics]
user@switch# set fcproxy1 fabric-type proxy
```

15. Assign the FCoE VLAN interface to the fabric:

```
[edit fc-fabrics]
user@switch# set fcproxy1 interface vlan.100
```

16. Assign the native FC interfaces to the fabric:

```
[edit fc-fabrics]
user@switch# set fcproxy1 interface fc-0/0/0.0
user@switch# set fcproxy1 interface fc-0/0/1.0
user@switch# set fcproxy1 interface fc-0/0/2.0
user@switch# set fcproxy1 interface fc-0/0/3.0
user@switch# set fcproxy1 interface fc-0/0/4.0
user@switch# set fcproxy1 interface fc-0/0/5.0
```

Results Display the results of the configuration:

```
user@switch> show configuration
fc-0/0/0 {
  fibrechannel-options {
    speed 4g;
  }
```



```
    unit 0 {
        family fibre-channel {
            port-mode np-port;
        }
    }
}
fc-0/0/1 {
    fibrechannel-options {
        speed 4g;
    }
    unit 0 {
        family fibre-channel {
            port-mode np-port;
        }
    }
}
fc-0/0/2 {
    fibrechannel-options {
        speed 4g;
    }
    unit 0 {
        family fibre-channel {
            port-mode np-port;
        }
    }
}
fc-0/0/3 {
    fibrechannel-options {
        speed 4g;
    }
    unit 0 {
        family fibre-channel {
            port-mode np-port;
        }
    }
}
fc-0/0/4 {
    fibrechannel-options {
        speed 4g;
    }
    unit 0 {
        family fibre-channel {
            port-mode np-port;
        }
    }
}
fc-0/0/5 {
    fibrechannel-options {
        speed 4g;
    }
    unit 0 {
        family fibre-channel {
            port-mode np-port;
        }
    }
}
```

```
xe-0/0/6 {
   mtu 2180;
   unit 0 {
      family ethernet-switching {
         port-mode tagged-access;
         vlan {
            members blue;
         }
         native-vlan-id 1;
      }
   }
}
xe-0/0/7 {
   mtu 2180;
   unit 0 {
      family ethernet-switching {
         port-mode tagged-access;
         vlan {
            members blue;
         }
         native-vlan-id 1;
      }
   }
}
xe-0/0/8 {
   mtu 2180;
   unit 0 {
      family ethernet-switching {
         port-mode tagged-access;
         vlan {
            members blue;
         }
         native-vlan-id 1;
      }
   }
}
xe-0/0/9 {
   mtu 2180;
   unit 0 {
      family ethernet-switching {
         port-mode tagged-access;
         vlan {
            members blue;
         }
         native-vlan-id 1;
      }
   }
}
xe-0/0/10 {
   mtu 2180;
   unit 0 {
      family ethernet-switching {
         port-mode tagged-access;
         vlan {
            members blue;
         }
```



```
          native-vlan-id 1;
        }
      }
    }
    xe-0/0/11 {
      mtu 2180;
      unit 0 {
        family ethernet-switching {
          port-mode tagged-access;
          vlan {
            members blue;
          }
          native-vlan-id 1;
        }
      }
    }
    vlan {
      unit 100 {
        family fibre-channel {
          port-mode f-port;
        }
      }
    }
    fc-fabrics {
      fcproxy1 {
        fabric-id 1
        fabric-type proxy
        interface {
          vlan.100
          fc-0/0/0.0;
          fc-0/0/1.0;
          fc-0/0/2.0;
          fc-0/0/3.0;
          fc-0/0/4.0;
          fc-0/0/5.0;
        }
      }
    }
    protocols {
      igmp-snooping {
        vlan blue {
          disable;
        }
      }
    }
    vlans {
      blue {
        vlan-id 100
        interface {
          xe-0/0/6.0;
          xe-0/0/7.0;
          xe-0/0/8.0;
          xe-0/0/9.0;
          xe-0/0/10.0;
          xe-0/0/11.0;
        }
```

```
        l3-interface vlan.100
    }
    native {
        vlan-id 1;
    }
}
```

TIP: To quickly configure the interfaces, issue the **load merge terminal** command and then copy the hierarchy and paste it into the switch terminal window.

Verification

To verify that the native FC interfaces and FCoE VLAN interface have been created, added to the FC fabric, and are operating properly, perform these tasks:

Verifying That the Native FC Interfaces and the FCoE VLAN Interface Have Been Created

Purpose Verify that the six native FC interfaces and the FCoE VLAN interface have been created on the switch and are configured in the correct mode.

Action List all of the FC interfaces configured on the switch using the **show fibre-channel interfaces** command:

```
user@switch> show fibre-channel interfaces
                          Native            Config   Oper
Interface     Idx   Type  Fabric-id    NPIV Mode     Mode     State
fc-0/0/0.0    70    FC    1            YES  NP       NP       up
fc-0/0/1.0    71    FC    1            YES  NP       NP       up
fc-0/0/2.0    72    FC    1            YES  NP       NP       up
fc-0/0/3.0    73    FC    1            YES  NP       NP       up
fc-0/0/4.0    74    FC    1            YES  NP       NP       up
fc-0/0/5.0    75    FC    1            YES  NP       NP       up
vlan.100      67    FCOE  1            YES  F        F        up
```

Meaning The **show fibre-channel interfaces** command lists all native FC interfaces and FCoE VLAN interfaces configured on the switch. The command output shows that the FC interfaces **fc-0/0/0.0**, **fc-0/0/1.0**, **fc-0/0/2.0**, **fc-0/0/3.0**, **fc-0/0/4.0**, and **fc-0/0/5.0** have been created and that those six interfaces:

- Are native Fibre Channel interfaces (type **FC**).
- Belong to the FC fabric with a configured fabric ID of **1**.

- Are capable of N_Port ID virtualization (NPIV).
- Have a configured mode and an operational mode of proxy N_Port (**NP**), which means that they should be connected to an FCF or an FC switch, not to an FCoE device, and that they carry native FC traffic.
- Show an operational state of **up**.

The command output also shows that the FCoE VLAN interface **vlan.100** has been created and that interface:

- Is an FCoE VLAN interface (type **FCOE)**.
- Belongs to the FC fabric with a configured fabric ID of **1**.
- Is capable of N_Port ID virtualization (NPIV).
- Has a configured mode and an operational mode of F_Port (**F**), which means that its interfaces connect to FCoE devices and carry FCoE traffic.
- Shows an operational state of **up**.

Verifying That the FCoE VLAN Includes the Correct Ethernet Interfaces

Purpose Verify that the FCoE VLAN **blue** has been created with the correct VLAN tag (**100**) and with the correct Ethernet interfaces.

Action List all of the interfaces configured on the switch in VLAN **blue** using the **show vlans** command:

```
user@switch> show vlans blue
Name           Tag     Interfaces
blue           100
                     xe-0/0/6.0, xe-0/0/7.0, xe-0/0/8.0, xe-0/0/9.0, xe-0/0/10.0

                       xe-0/0/11.0
```

Meaning The **show vlans blue** command lists the interfaces that are members of the FCoE VLAN **blue**. The command output shows that the **blue** VLAN has a tag ID of 100 and includes the interfaces **xe-0/0/6.0**, **xe-0/0/7.0**, **xe-0/0/8.0**, **xe-0/0/9.0**, **xe-0/0/10.0**, and **xe-0/0/11.0**.

Verifying That the FC Fabric Includes the Correct Interfaces

Purpose Verify that the FC fabric configuration is configured on the switch with the correct native FC and FCoE VLAN interfaces.

Action List all of the interfaces configured on FC fabrics on the switch using the **show fibre-channel fabric** command:

```
user@switch> show fibre-channel fabric
Name           Fabric-id     Type     Interfaces
fcproxy1       1             PROXY
                                      fc-0/0/0.0
                                      fc-0/0/1.0
                                      fc-0/0/2.0
```



```
fc-0/0/3.0
fc-0/0/4.0
fc-0/0/5.0
vlan.100
```

Meaning The **show fibre-channel fabric** command lists the interfaces that are members of each FC fabric. The command output shows that the only fabric configured on the switch is named **fcproxy1**, has a fabric-id of **1**, and is a **proxy** fabric in an FCoE-FC gateway. The command output also shows that the native FC interfaces **fc-0/0/0.0**, **fc-0/0/1.0**, **fc-0/0/2.0**, **fc-0/0/3.0**, **fc-0/0/4.0**, and **fc-0/0/5.0**, and the FCoE VLAN interface **vlan.100** belong to **fcproxy1**.

Verifying Native FC Interface Operation

Purpose Verify that the native FC interfaces are online and display the number of FC sessions on each interface.

Action List all of the native FC NP_Port interface states and sessions by FC fabric using the **show fibre-channel proxy np-port** command:

```
user@switch> show fibre-channel proxy np-port
Fabric: fcproxy1, Fabric-id: 1
NP-Port     State              Sessions      LB state   LB weight
fc-0/0/0.0  online             3             ON         4
fc-0/0/1.0  online             3             ON         4
fc-0/0/2.0  online             2             ON         4
fc-0/0/3.0  online             2             ON         4
fc-0/0/4.0  online             2             ON         4
fc-0/0/5.0  online             2             ON         4
```

Meaning The **show fibre-channel proxy np-port** command lists the interfaces that are configured as native FC proxy N_Port interfaces. The command output shows:

- The fabric name is **fcproxy1** and its fabric ID is **1**.
- The interfaces are **online**.
- The number of FC sessions (virtual links) running on each interface.
- The load-balancing (LB) state is **ON** for all of the interfaces.
- The LB weight reflects the port speed of each interface, which is **4** Gbps.

Verifying That IGMP Snooping Has Been Disabled on the FCoE VLAN

Purpose Verify that IGMP snooping is disabled on the FCoE VLAN.

Action List the IGMP snooping protocol information for the FCoE VLAN using the **show configuration protocols igmp-snooping vlan blue** command:

```
user@switch> show configuration protocols igmp-snooping vlan blue
    disable;
```


Meaning The **show configuration protocols igmp-snooping vlan blue** command lists the IGMP snooping configuration for the FCoE VLAN. The command output shows that IGMP snooping is disabled on the FCoE VLAN.

Related Documentation

- Configuring a Fibre Channel Interface on page 5049
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Disabling Storm Control on FCoE Interfaces on an FCoE-FC Gateway on page 5056
- Assigning Interfaces to a Fibre Channel Fabric on page 5054
- Configuring an FCoE-FC Gateway Fibre Channel Fabric on page 5045
- Configuring FIP on an FCoE-FC Gateway on page 5059
- Disabling VN2VF_Port FIP Snooping on an FCoE-FC Gateway Switch Interface on page 5072
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch)

This example shows how to configure VN_Port to VN_Port (VN2VN_Port) FIP snooping when the hosts are directly connected to the same FCoE transit switch.

NOTE: **This example uses Junos OS without support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see** “Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch)” on page 5025.

VN2VN_Port FIP snooping on an FCoE transit switch provides security to help prevent unauthorized access and data transmission on a bridge that connects ENodes in the Ethernet network. VN2VN_Port FIP snooping provides security for virtual links by creating filters based on information gathered (snooped) about FCoE devices during FIP transactions.

VN2VN_Port FIP snooping is conceptually similar to VN2VN_Port FIP snooping between VN_Ports and VF_Ports, but VN2VN_Port FIP snooping does not require traffic between VN_Ports to traverse the Fibre Channel (FC) switch or FCoE forwarder (FCF). Instead, a VN_Port communicates transparently through the transit switch on a virtual link that emulates a direct connection to the VN_Port at the other end of the virtual link.

To configure VN2VN_Port FIP snooping when the hosts are directly connected to the same FCoE transit switch, you must follow these configuration rules:

- VN2VN_Port traffic must use a dedicated FCoE VLAN, and all ENodes that communicate using VN2VN_Port FIP snooping must use that FCoE VLAN. You cannot mix VN2VN_Port FIP snooping traffic with VN2VF_Port FIP snooping traffic in the same FCoE VLAN.

  NOTE: An FCoE VLAN can support either VN2VF_Port FIP snooping or VN2VN_Port FIP snooping, but not both. Configure separate FCoE VLANs for VN2VF_Port FIP snooping traffic and for VN2VN_Port FIP snooping traffic. On FCoE VLANs that are configured as VN2VN_Port FIP snooping VLANs, VN_Port to VF_Port (FIP snooping) traffic is dropped.

- ENode-facing ports must be set in **tagged-access** port mode.
- ENode-facing ports must be untrusted ports.
- Network-facing (switch-facing) ports must be set in **trunk** port mode.
- Network-facing ports must be FCoE trusted ports.
- Explicitly configure the beacon period. The beacon period is essentially a keepalive timer for virtual link maintenance.

When you enable VN2VF_Port FIP snooping, the system snoops VN_Port to VF_Port packets and enforces security only on VN_Port to VF_Port virtual links. When you enable VN2VN_Port FIP snooping, the system snoops VN_Port to VN_Port packets and enforces security only on VN_Port to VN_Port virtual links.

The transit switch applies VN2VN_Port FIP snooping filters at the ports associated with the FCoE VLANs on which you enable VN2VN FIP snooping.

This example describes how to configure VN2VN_Port FIP snooping when the FCoE hosts are directly connected to the same transit switch:

Requirements

This example uses the following hardware and software components:

- One Juniper Networks QFX3500 Switch used as a transit switch
- Junos OS Release 12.2 or later for the QFX Series
- Two FCoE hosts that have ENodes

Overview

This example shows you how to:

- Set the correct interface port modes on the transit switch.
- Configure the interfaces to use the dedicated FCoE VLAN for VN2VN_Port FIP snooping.
- Configure the dedicated FCoE VLAN for VN2VN_Port FIP snooping traffic.
- Enable VN2VN_Port FIP snooping on the FCoE VLAN and configure the beacon period.

Topology

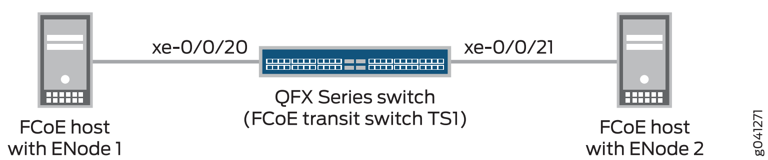
Table 385 on page 4979 shows the configuration components for this example.

Table 385: Components of the VN2VN_Port FIP Snooping Configuration Topology (FCoE Hosts Directly Connected to the Same FCoE Transit Switch)

Component	Settings
Hardware	QFX3500 switch (FCoE transit switch TS1) Two FCoE hosts that have ENodes (ENode1 and ENode2, respectively)
Interfaces and port modes	• Interface **xe-0/0/20**, port mode **tagged-access**, connects directly to the FCoE host with ENode1. • Interface **xe-0/0/21**, port mode **tagged-access**, connects directly to the FCoE host with ENode2.
Interface VLAN membership	Both interfaces use VLAN **vlan200**.
VN2VN_Port FIP snooping VLAN	VLAN name—**vlan200** VLAN ID—200
FIP snooping mode and beacon period	Set **examine-vn2vn** (VN2VN_Port FIP snooping) Beacon period—90000 ms

Figure 182 on page 4979 shows the network topology for this example.

Figure 182: VN2VN_Port FIP Snooping (FCoE Hosts Connected to Same Transit Switch) Topology



Configuration

CLI Quick Configuration

To quickly configure VN2VN_Port FIP snooping for FCoE hosts connected directly to the same transit switch, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level:

set interfaces xe-0/0/20 unit 0 family ethernet-switching port-mode tagged-access
set interfaces xe-0/0/21 unit 0 family ethernet-switching port-mode tagged-access
set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200
set vlans vlan200 vlan-id 200
set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2 beacon-period 90000

Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch)

Step-by-Step Procedure

To configure interface port modes, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the port modes of the interfaces that connect directly to the FCoE host ENodes:

   `user@switch#` **set interfaces xe-0/0/20 unit 0 family ethernet-switching port-mode tagged-access**
   set interfaces xe-0/0/21 unit 0 family ethernet-switching port-mode tagged-access

2. Configure the interface VLAN membership so that the interfaces connected to theENodes are members of the dedicated VN2VN_Port VLAN (**vlan200**):

   `user@switch#` **set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200**
   set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200

3. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   `user@switch#` **set vlans vlan200 vlan-id 200**

4. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   `user@switch#` **set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2 beacon-period 90000**

Verification

To verify that the VN2VN_Port FIP snooping configuration has been created and is operating properly, perform these tasks:

- Verifying That VN2VN_Port FIP Snooping is Enabled on the FCoE VLAN on page 4980
- Verifying the Interface Port Mode on page 4981

Verifying That VN2VN_Port FIP Snooping is Enabled on the FCoE VLAN

Purpose

Verify that VN2VN_Port FIP snooping is enabled on the correct VLAN (**vlan200**), the beacon period is set to **90000** milliseconds, and the correct interfaces (**xe-0/0/20** and **xe-0/0/21**) are members of the VLAN.

Action List the FIP snooping information using the operational mode command **show fip snooping detail**.

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/20
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0a:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0b:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/21
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0b:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0a:01
```

Meaning The **show fip snooping detail** command lists all of the transit switch information about VN2VN_Port FIP snooping and VN2VF_Port FIP snooping. The command shows that:

- The VLAN is **vlan200**.
- The mode is FIP snooping mode **VN2VN**, for VN2VN_Port FIP snooping. (If the Mode field shows **VN2VF**, then the FIP snooping mode is VN2VF_Port FIP snooping.)
- The beacon period is **90000**.
- The interfaces for the ENodes are **xe-0/0/20** and **xe-0/0/21**.

In addition, this useful command shows information about the ENodes and the VN2VN_Port sessions.

Verifying the Interface Port Mode

Purpose Verify that the interface port modes are **tagged-access**.

Action List the Ethernet switching interfaces to confirm the port mode using the **show ethernet-switching interfaces detail** operational command.

Use the operational mode commands **show ethernet-switching interfaces xe-0/0/20.0 detail** and **show ethernet-switching interfaces xe-0/0/21.0 detail** to list the Ethernet switching interface information. The output is truncated to show only the relevant portions:

```
user@switch> show ethernet-switching interfaces xe-0/0/20.0 detail
Interface: xe-0/0/20.0, Index: 75, State: up, Port mode: Tagged-Access
.
.
.
```

```
user@switch> show ethernet-switching interfaces xe-0/0/21.0 detail
Interface: xe-0/0/21.0, Index: 83, State: up, Port mode: Tagged-Access
.
.
.
```

Meaning The **show ethernet-switching interfaces detail** command lists the port mode as **tagged-access** for both interfaces.

Related Documentation

- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 4982
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 4990
- Enabling VN2VN_Port FIP Snooping and Configuring the Beacon Period on an FCoE Transit Switch on page 5073
- Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch on page 4865

Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches)

This example shows how to configure VN_Port to VN_Port (VN2VN_Port) FIP snooping when the hosts are directly connected to different FCoE transit switches, and the transit switches are directly connected to each other.

NOTE: **This example uses Junos OS without support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see** “Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches)” on page 5030.

VN2VN_Port FIP snooping on an FCoE transit switch provides security to help prevent unauthorized access and data transmission on a bridge that connects ENodes in the Ethernet network. VN2VN_Port FIP snooping provides security for virtual links by creating filters based on information gathered (snooped) about FCoE devices during FIP transactions.

VN2VN_Port FIP snooping is conceptually similar to VN2VF_Port FIP snooping between VN_Ports and VF_Ports, but VN2VN_Port FIP snooping does not require traffic between VN_Ports to traverse the Fibre Channel (FC) switch or FCoE forwarder (FCF). Instead, a VN_Port communicates transparently through one or more transit switches on a virtual link that emulates a direct connection to the VN_Port at the other end of the virtual link.

To configure VN2VN_Port FIP snooping when the hosts are directly connected to different FCoE transit switches, and the transit switches are directly connected to each other, you must follow these configuration rules:

- VN2VN_Port traffic must use a dedicated FCoE VLAN, and all ENodes that communicate using VN2VN_Port FIP snooping must use that FCoE VLAN. The FCoE VLAN must be configured on each transit switch. You cannot mix VN2VN_Port FIP snooping traffic with VN2VF_Port FIP snooping traffic in the same FCoE VLAN.

NOTE: **An FCoE VLAN can support either VN2VF_Port FIP snooping or VN2VN_Port FIP snooping, but not both. Configure separate FCoE VLANs for VN2VF_Port FIP snooping traffic and for VN2VN_Port FIP snooping traffic. On FCoE VLANs that are configured as VN2VN_Port FIP snooping VLANs, VN2VF_Port traffic is dropped.**

- ENode-facing ports must be set in **tagged-access** port mode.
- ENode-facing ports must be untrusted ports.
- Network-facing (switch-facing) ports must be set in **trunk** port mode.
- Network-facing ports must be FCoE trusted ports.
- Explicitly configure the beacon period. The beacon period is essentially a keepalive timer for virtual link maintenance.

When you enable VN2VF_Port FIP snooping, the system snoops VN_Port to VF_Port packets and enforces security only on VN_Port to VF_Port virtual links. When you enable VN2VN_Port FIP snooping, the system snoops VN_Port to VN_Port packets and enforces security only on VN_Port to VN_Port virtual links.

The transit switch applies VN2VN_Port FIP snooping filters at the ports associated with the FCoE VLANs on which you enable VN2VN FIP snooping.

This example describes how to configure VN2VN_Port FIP snooping when the FCoE hosts are directly connected to different transit switches, and the transit switches are directly connected to each other:

- Requirements on page 4983
- Overview on page 4984
- Configuration on page 4985
- Verification on page 4986

Requirements

This example uses the following hardware and software components:

- Two Juniper Networks QFX3500 Switches used as transit switches
- Junos OS Release 12.2 or later for the QFX Series
- Two FCoE hosts that have ENodes

Overview

This example shows you how to:

- Set the correct interface port modes on the transit switch.
- Configure the interfaces to use the dedicated FCoE VLAN for VN2VN_Port FIP snooping.
- Configure the network-facing interfaces as FCoE trusted interfaces.
- Configure the dedicated FCoE VLAN for VN2VN_Port FIP snooping traffic.
- Enable VN2VN_Port FIP snooping on the FCoE VLAN and configure the beacon period.

Topology

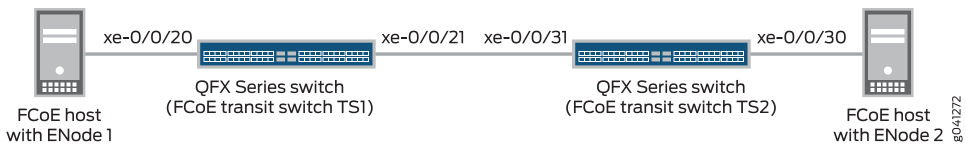
Table 386 on page 4984 shows the configuration components for this example.

Table 386: Components of the VN2VN_Port FIP Snooping Configuration Topology (FCoE Hosts Directly Connected to Different FCoE Transit Switches)

Component	Settings
Hardware	Two QFX3500 switches (FCoE transit switch TS1 and FCoE transit switch TS2) Two FCoE hosts that have ENodes (ENode1 and ENode2, respectively)
Interfaces and port modes	• Interface **xe-0/0/20**, port mode **tagged-access**, connects directly from transit switch TS1 to the FCoE host with ENode1. • Interface **xe-0/0/21**, port mode **trunk**, connects directly from transit switch TS1 to transit switch TS2. • Interface **xe-0/0/31**, port mode **trunk**, connects directly from transit switch TS2 to transit switch TS1. • Interface **xe-0/0/30**, port mode **tagged-access**, connects directly from transit switch TS2 to the FCoE host with ENode2.
Interface VLAN membership	The interfaces on both transit switches use VLAN **vlan200**.
VN2VN_Port FIP snooping VLAN	VLAN name (both transit switches)—**vlan200** VLAN ID—200
FIP snooping mode and beacon period	Set **examine-vn2vn** (VN2VN_Port FIP snooping) Beacon period—90000 ms

Figure 183 on page 4984 shows the network topology for this example.

Figure 183: VN2VN_Port FIP Snooping (FCoE Hosts Connected to Different Transit Switches) Topology



Configuration

To configure VN2VN_Port FIP snooping for VN_Ports that are directly connected to different transit switches (and the transit switches are directly connected to each other), perform these tasks:

- Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS1 on page 4985
- Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS2 on page 4986

CLI Quick Configuration

The configuration for each FCoE transit switch is shown separately.

To quickly configure VN2VN_Port FIP snooping for FCoE hosts connected directly to different transit switches, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level. To configure FCoE transit switch TS1:

```
set interfaces xe-0/0/20 unit 0 family ethernet-switching port-mode tagged-access
set interfaces xe-0/0/21 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200
set ethernet-switching-options secure-access-port interface xe-0/0/21 fcoe-trusted
set vlans vlan200 vlan-id 200
set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2
beacon-period 90000
```

To quickly configure VN2VN_Port FIP snooping for FCoE hosts connected directly to different transit switches, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level. To configure FCoE transit switch TS2:

```
set interfaces xe-0/0/30 unit 0 family ethernet-switching port-mode tagged-access
set interfaces xe-0/0/31 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/30 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/31 unit 0 family ethernet-switching vlan members vlan200
set vlans vlan200 vlan-id 200
set ethernet-switching-options secure-access-port interface xe-0/0/31 fcoe-trusted
set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2
beacon-period 90000
```

Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS1

Step-by-Step Procedure

To configure interface port modes, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, set the network-facing port as FCoE trusted, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the port modes of the interfaces that connect directly to the FCoE host with ENode1 (**xe-0/0/20**) and to FCoE transit switch TS2 (**xe-0/0/21**):

   ```
   user@switch# set interfaces xe-0/0/20 unit 0 family ethernet-switching port-mode
   tagged-access
   set interfaces xe-0/0/21 unit 0 family ethernet-switching port-mode trunk
   ```

2. Configure the interface VLAN membership so that the interfaces are members of the dedicated VN2VN_Port VLAN (**vlan200**):

user@switch# **set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200**
set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200

3. Configure the network-facing port (**xe-0/0/21**) as an FCoE trusted port:

   user@switch# **set ethernet-switching-options secure-access-port interface xe-0/0/21 fcoe-trusted**

4. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   user@switch# **set vlans vlan200 vlan-id 200**

5. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   user@switch# **set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2 beacon-period 90000**

Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS2

Step-by-Step Procedure

To configure interface port modes, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, set the network-facing port as FCoE trusted, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the port modes of the interfaces that connect directly to the FCoE host with ENode2 (**xe-0/0/30**) and to FCoE transit switch TS1 (**xe-0/0/31**):

   user@switch# **set interfaces xe-0/0/30 unit 0 family ethernet-switching port-mode tagged-access**
   set interfaces xe-0/0/31 unit 0 family ethernet-switching port-mode trunk

2. Configure the interface VLAN membership so that the interfaces are members of the dedicated VN2VN_Port VLAN (**vlan200**):

   user@switch# **set interfaces xe-0/0/30 unit 0 family ethernet-switching vlan members vlan200**
   set interfaces xe-0/0/31 unit 0 family ethernet-switching vlan members vlan200

3. Configure the network-facing port (**xe-0/0/31**) as an FCoE trusted port:

   user@switch# **set ethernet-switching-options secure-access-port interface xe-0/0/31 fcoe-trusted**

4. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   user@switch# **set vlans vlan200 vlan-id 200**

5. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   user@switch# **set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2 beacon-period 90000**

Verification

To verify that the VN2VN_Port FIP snooping configuration has been created and is operating properly on both switches, perform these tasks:

- Verifying That VN2VN_Port FIP Snooping is Enabled on the FCoE VLAN (Transit Switches TS1 and TS2) on page 4987
- Verifying the Interface Port Mode on page 4989

Verifying That VN2VN_Port FIP Snooping is Enabled on the FCoE VLAN (Transit Switches TS1 and TS2)

Purpose Verify that VN2VN_Port FIP snooping is enabled on the correct VLAN (**vlan200**), the beacon period is set to **90000** milliseconds, and that the correct interfaces (**xe-0/0/20** and **xe-0/0/21** on TS1, and **xe-0/0/30**and **xe-0/0/31** on TS2) are members of the VLAN.

Action List the FIP snooping information on transit switch TS1 using the operational mode command **show fip snooping detail**

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/20
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0a:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0b:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/21
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0b:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0a:01
```

List the FIP snooping information on transit switch TS2 using the operational mode command **show fip snooping detail**

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/30
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0b:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0a:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/31
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0a:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0b:01
```

Meaning The **show fip snooping detail** command lists all of the transit switch information about VN2VN_Port FIP snooping and VN2VF_Port FIP snooping on each transit switch. The command shows that:

- The VLAN is **vlan200**.
- The mode is FIP snooping mode **VN2VN**, for VN2VN_Port FIP snooping. (If the Mode field shows **VN2VF**, then the FIP snooping mode is VN2VF_Port FIP snooping.)

- The beacon period is **90000**.
- The interfaces connected to the ENodes are **xe-0/0/20** and **xe-0/0/21** on transit switch TS1, and **xe-0/0/30** and **xe-0/0/31** on transit switch TS2. Because the transit switches are transparent passthrough switches, the network-facing trunk ports "see" the FCoE host ENodes at the far end of the VN2VN_Port virtual link.

In addition, this useful command shows information about the ENodes and the VN2VN_Port sessions.

Verifying the Interface Port Mode

Purpose Verify that the interface port modes are **tagged-access** for ENode-facing ports and **trunk** for network-facing ports on each transit switch.

Action List the Ethernet switching interfaces to confirm the port mode using the **show ethernet-switching interfaces detail** operational command.

Use the operational mode commands **show ethernet-switching interfaces xe-0/0/20.0 detail** and **show ethernet-switching interfaces xe-0/0/21.0 detail** to list the Ethernet switching interface information on FCoE transit switch TS1. The output is truncated to show only the relevant portions:

```
user@switch> show ethernet-switching interfaces xe-0/0/20.0 detail
Interface: xe-0/0/20.0, Index: 75, State: up, Port mode: Tagged-Access
.
.
.

user@switch> show ethernet-switching interfaces xe-0/0/21.0 detail
Interface: xe-0/0/21.0, Index: 83, State: up, Port mode: Trunk
.
.
.
```

List the Ethernet switching interface information on FCoE transit switch TS2 using the operational mode commands **show ethernet-switching interfaces xe-0/0/30.0 detail** and **show ethernet-switching interfaces xe-0/0/31.0 detail**:

```
user@switch> show ethernet-switching interfaces xe-0/0/30.0 detail
Interface: xe-0/0/30.0, Index: 56, State: up, Port mode: Tagged-Access
.
.
.

user@switch> show ethernet-switching interfaces xe-0/0/31.0 detail
Interface: xe-0/0/31.0, Index: 59, State: up, Port mode: Trunk
.
.
.
```

Related Documentation

- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 4977
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 4990

- Enabling VN2VN_Port FIP Snooping and Configuring the Beacon Period on an FCoE Transit Switch on page 5073
- Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch on page 4865

Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch)

This example shows how to configure VN_Port to VN_Port (VN2VN_Port) FIP snooping when the hosts are indirectly connected through an aggregation layer FCoE transit switch. Each FCoE host ENode is directly connected to an FCoE transit switch, but the FCoE transit switches are not directly connected to each other. The FCoE transit switches are both connected to a third FCoE transit switch that acts as an aggregation layer switch.

NOTE: This example uses Junos OS without support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see "Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch)" on page 5036.

VN2VN_Port FIP snooping on an FCoE transit switch provides security to help prevent unauthorized access and data transmission on a bridge that connects ENodes in the Ethernet network. VN2VN_Port FIP snooping provides security for virtual links by creating filters based on information gathered (snooped) about FCoE devices during FIP transactions.

VN2VN_Port FIP snooping is conceptually similar to VN2VN_Port FIP snooping between VN_Ports and VF_Ports, but VN2VN_Port FIP snooping does not require traffic between VN_Ports to traverse the Fibre Channel (FC) switch or FCoE forwarder (FCF). Instead, a VN_Port communicates transparently through one or more transit switches on a virtual link that emulates a direct connection to the VN_Port at the other end of the virtual link.

To configure VN2VN_Port FIP snooping when the hosts are indirectly connected, you must follow these configuration rules:

- VN2VN_Port traffic must use a dedicated FCoE VLAN, and all ENodes that communicate using VN2VN_Port FIP snooping must use that FCoE VLAN. The FCoE VLAN must be configured on each transit switch. You cannot mix VN2VN_Port FIP snooping traffic with VN2VF_Port FIP snooping traffic in the same FCoE VLAN.

  NOTE: An FCoE VLAN can support either VN2VF_Port FIP snooping or VN2VN_Port FIP snooping, but not both. Configure separate FCoE VLANs for VN2VF_Port FIP snooping traffic and for VN2VN_Port FIP snooping traffic. On FCoE VLANs that are configured as VN2VN_Port FIP snooping VLANs, VN_Port to VF_Port traffic is dropped.

- ENode-facing ports must be set in **tagged-access** port mode.

- ENode-facing ports must be untrusted ports.
- Network-facing (switch-facing) ports must be set in **trunk** port mode.
- Network-facing ports must be FCoE trusted ports.
- Explicitly configure the beacon period. The beacon period is essentially a keepalive timer for virtual link maintenance.

When you enable FIP snooping, the system snoops VN_Port to VF_Port packets and enforces security only on VN_Port to VF_Port virtual links. When you enable VN2VN_Port FIP snooping, the system snoops VN_Port to VN_Port packets and enforces security only on VN_Port to VN_Port virtual links.

The transit switch applies VN2VN_Port FIP snooping filters at the ports associated with the FCoE VLANs on which you enable VN2VN FIP snooping.

This example describes how to configure VN2VN_Port FIP snooping when the FCoE hosts are indirectly connected across an aggregation layer FCoE transit switch:

- Requirements on page 4991
- Overview on page 4991
- Configuration on page 4993
- Verification on page 4995

Requirements

This example uses the following hardware and software components:

- Three Juniper Networks QFX3500 Switches used as transit switches
- Junos OS Release 12.2 or later for the QFX Series
- Two FCoE hosts that have ENodes

Overview

This example shows you how to:

- Set the correct interface port modes on the transit switch.
- Configure the interfaces to use the dedicated FCoE VLAN for VN2VN_Port FIP snooping.
- Configure the network-facing interfaces as FCoE trusted interfaces.
- Configure the dedicated FCoE VLAN for VN2VN_Port FIP snooping traffic.
- Enable VN2VN_Port FIP snooping on the FCoE VLAN and configure the beacon period.

Topology

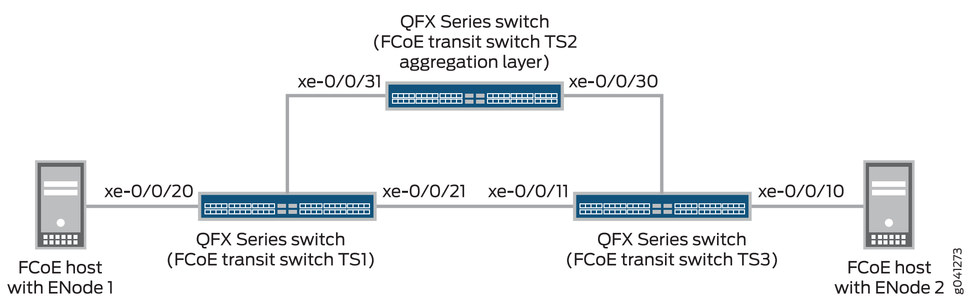
Table 387 on page 4992 shows the configuration components for this example.

Table 387: Components of the VN2VN_Port FIP Snooping Configuration Topology (FCoE Hosts Indirectly Connected Across an Aggregation Layer FCoE Transit Switch)

Component	Settings
Hardware	Three QFX3500 switches, two of which are FCoE transit switches that are directly attached to the FCoE hosts (transit switches TS1 and TS2) and one of which is an aggregation layer FCoE transit switch (TS3) Two FCoE hosts that have ENodes (ENode1 and ENode2, respectively)
Interfaces and port modes	• Interface **xe-0/0/20**, port mode **tagged-access**, connects directly from transit switch TS1 to the FCoE host with ENode1. • Interface **xe-0/0/21**, port mode **trunk**, connects directly from transit switch TS1 to aggregation layer transit switch TS2. • Interface **xe-0/0/31**, port mode **trunk**, connects directly from aggregation layer transit switch TS2 to transit switch TS1. • Interface **xe-0/0/30**, port mode **trunk**, connects directly from aggregation layer transit switch TS2 to transit switch TS3. • Interface **xe-0/0/11**, port mode **trunk**, connects directly from transit switch TS3 to aggregation layer transit switch TS2. • Interface **xe-0/0/10**, port mode **tagged-access**, connects directly from transit switch TS3 to the FCoE host with ENode2.
Interface VLAN membership	The interfaces on all three switches use VLAN **vlan200**.
VN2VN_Port FIP snooping VLAN	VLAN name (all three switches)—**vlan200** VLAN ID—200
FIP snooping mode and beacon period	Set **examine-vn2vn** (VN2VN_Port FIP snooping) Beacon period—90000 ms

Figure 184 on page 4992 shows the network topology for this example.

Figure 184: VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected) Topology



Configuration

To configure VN2VN_Port FIP snooping for VN_Ports that are indirectly connected across an aggregation layer FCoE transit switch, perform these tasks:

- Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS1 on page 4994
- Configuring VN2VN_Port FIP Snooping on Aggregation Layer FCoE Transit Switch TS2 on page 4994
- Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS3 on page 4995

CLI Quick Configuration

The configuration for each FCoE transit switch is shown separately.

To quickly configure VN2VN_Port FIP snooping for FCoE hosts that are indirectly connected across an aggregation layer FCoE transit switch, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level. To configure FCoE transit switch TS1:

```
set interfaces xe-0/0/20 unit 0 family ethernet-switching port-mode tagged-access
set interfaces xe-0/0/21 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200
set ethernet-switching-options secure-access-port interface xe-0/0/21 fcoe-trusted
set vlans vlan200 vlan-id 200
set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2
beacon-period 90000
```

To quickly configure VN2VN_Port FIP snooping for FCoE hosts that are indirectly connected across an aggregation layer FCoE transit switch, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level. To configure FCoE transit switch TS2:

```
set interfaces xe-0/0/30 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/31 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/30 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/31 unit 0 family ethernet-switching vlan members vlan200
set vlans vlan200 vlan-id 200
set ethernet-switching-options secure-access-port interface xe-0/0/30 fcoe-trusted
set ethernet-switching-options secure-access-port interface xe-0/0/31 fcoe-trusted
set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2
beacon-period 90000
```

To quickly configure VN2VN_Port FIP snooping for FCoE hosts that are indirectly connected across an aggregation layer FCoE transit switch, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level. To configure FCoE transit switch TS3:

```
set interfaces xe-0/0/10 unit 0 family ethernet-switching port-mode tagged-access
set interfaces xe-0/0/11 unit 0 family ethernet-switching port-mode trunk
set interfaces xe-0/0/10 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/11 unit 0 family ethernet-switching vlan members vlan200
set vlans vlan200 vlan-id 200
set ethernet-switching-options secure-access-port interface xe-0/0/11 fcoe-trusted
set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2
beacon-period 90000
```


Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS1

Step-by-Step Procedure

To configure interface port modes, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, set the network-facing port as FCoE trusted, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the port modes of the interfaces that connect directly to the FCoE host with ENode1 (**xe-0/0/20**) and to aggregation layer FCoE transit switch TS2 (**xe-0/0/21**):

   `user@switch#` **set interfaces xe-0/0/20 unit 0 family ethernet-switching port-mode tagged-access**
   set interfaces xe-0/0/21 unit 0 family ethernet-switching port-mode trunk

2. Configure the interface VLAN membership so that the interfaces are members of the dedicated VN2VN_Port VLAN (**vlan200**):

   `user@switch#` **set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200**
   set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200

3. Configure the network-facing port (**xe-0/0/21**) as an FCoE trusted port:

   `user@switch#` **set ethernet-switching-options secure-access-port interface xe-0/0/21 fcoe-trusted**

4. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   `user@switch#` **set vlans vlan200 vlan-id 200**

5. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   `user@switch#` **set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2 beacon-period 90000**

Configuring VN2VN_Port FIP Snooping on Aggregation Layer FCoE Transit Switch TS2

Step-by-Step Procedure

To configure interface port modes, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, set the network-facing ports as FCoE trusted, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the port modes of the interfaces that connect directly to FCoE transit switches TS1 (**xe-0/0/31**) and TS3 (**xe-0/0/30**). Both interfaces are network-facing and must be configured as trunk interfaces:

   `user@switch#` **set interfaces xe-0/0/30 unit 0 family ethernet-switching port-mode trunk**
   set interfaces xe-0/0/31 unit 0 family ethernet-switching port-mode trunk

2. Configure the interface VLAN membership so that the interfaces are members of the dedicated VN2VN_Port VLAN (**vlan200**):

   `user@switch#` **set interfaces xe-0/0/30 unit 0 family ethernet-switching vlan members vlan200**
   set interfaces xe-0/0/31 unit 0 family ethernet-switching vlan members vlan200

3. Configure the network-facing ports (**xe-0/0/30** and **xe-0/0/31**) as FCoE trusted ports:

   `user@switch#` **set ethernet-switching-options secure-access-port interface xe-0/0/30 fcoe-trusted** user@switch# **set ethernet-switching-options secure-access-port interface xe-0/0/31 fcoe-trusted**

4. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   user@switch# **set vlans vlan200 vlan-id 200**

5. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   user@switch# **set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2 beacon-period 90000**

Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS3

Step-by-Step Procedure

To configure interface port modes, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, set the network-facing port as FCoE trusted, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the port modes of the interfaces that connect directly to the FCoE host with ENode2 (**xe-0/0/10**) and to aggregation layer FCoE transit switch TS2 (**xe-0/0/11**):

   user@switch# **set interfaces xe-0/0/10 unit 0 family ethernet-switching port-mode tagged-access**
   set interfaces xe-0/0/11 unit 0 family ethernet-switching port-mode trunk

2. Configure the interface VLAN membership so that the interfaces are members of the dedicated VN2VN_Port VLAN (**vlan200**):

   user@switch# **set interfaces xe-0/0/10 unit 0 family ethernet-switching vlan members vlan200**
   set interfaces xe-0/0/11 unit 0 family ethernet-switching vlan members vlan200

3. Configure the network-facing port (**xe-0/0/11**) as an FCoE trusted port:

   user@switch# **set ethernet-switching-options secure-access-port interface xe-0/0/11 fcoe-trusted**

4. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   user@switch# **set vlans vlan200 vlan-id 200**

5. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   user@switch# **set ethernet-switching-options secure-access-port vlan vlan200 examine-fip examine-vn2v2 beacon-period 90000**

Verification

To verify that the VN2VN_Port FIP snooping configuration has been created and is operating properly on all three switches, perform these tasks:

- Verifying That VN2VN_Port FIP Snooping Is Enabled on the FCoE VLAN (All Three Transit Switches) on page 4995
- Verifying the Interface Port Mode on page 4998

Verifying That VN2VN_Port FIP Snooping Is Enabled on the FCoE VLAN (All Three Transit Switches)

Purpose

Verify that VN2VN_Port FIP snooping is enabled on the correct VLAN (**vlan200**), the beacon period is set to **90000** milliseconds, and that the correct interfaces (**xe-0/0/20** and **xe-0/0/21** on TS1, **xe-0/0/30** and **xe-0/0/31** aggregation layer TS2, and **xe-0/0/10** and **xe-0/0/11** on TS3) are members of the VLAN.

Action List the FIP snooping information on transit switch TS1 using the operational mode command **show fip snooping detail**

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/20
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0a:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0b:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/21
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0b:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0a:01
```

List the FIP snooping information on aggregation layer transit switch TS2 using the operational mode command **show fip snooping detail**

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/30
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0b:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0a:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/31
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0a:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0b:01
```

List the FIP snooping information on transit switch TS3 using the operational mode command **show fip snooping detail**

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
```

```
Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/10
  Active VN_Ports : 1
  VN_Port Information
  VN-Port MAC: 0e:fd:00:00:0b:01
     Active Sessions    : 1
     Session Information
 Vlink far-end VN-Port-MAC: 0e:fd:00:00:0a:01
Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/11
  Active VN_Ports : 1
  VN_Port Information
  VN-Port MAC: 0e:fd:00:00:0a:01
     Active Sessions    : 1
     Session Information
 Vlink far-end VN-Port-MAC: 0e:fd:00:00:0b:01
```

Meaning The **show fip snooping detail** command lists all of the transit switch information about VN2VN_Port FIP snooping and VN2VF_Port FIP snooping on each transit switch. The command shows that:

- The VLAN is **vlan200**.
- The mode is FIP snooping mode **VN2VN**, for VN2VN_Port FIP snooping. (If the Mode field shows **VN2VF**, then the FIP snooping mode is VN2VF_Port FIP snooping.)
- The beacon period is **90000**.
- The interfaces connected to the ENodes are **xe-0/0/20** and **xe-0/0/21** on transit switch TS1, **xe-0/0/30** and **xe-0/0/31** on aggregation layer transit switch TS2, and **xe-0/0/10** and **xe-0/0/11** on transit switch TS3. Because the transit switches are transparent passthrough switches, the network-facing trunk ports “see” the FCoE host ENodes at the far end of the VN2VN_Port virtual link.

In addition, this useful command shows information about the ENodes and the VN2VN_Port sessions.

Verifying the Interface Port Mode

Purpose Verify that the interface port modes are **tagged-access** for ENode-facing ports and **trunk** for network-facing ports on each transit switch.

Action List the Ethernet switching interfaces to confirm the port mode using the **show ethernet-switching interfaces detail** operational command for each interface. The output is truncated to show only the relevant portions.

List the Ethernet switching interface information on FCoE transit switch TS1 using the operational mode commands **show ethernet-switching interfaces xe-0/0/20.0 detail** and **show ethernet-switching interfaces xe-0/0/21.0 detail**:

```
user@switch> show ethernet-switching interfaces xe-0/0/20.0 detail
Interface: xe-0/0/20.0, Index: 75, State: up, Port mode: Tagged-Access
.
.
.

user@switch> show ethernet-switching interfaces xe-0/0/21.0 detail
```



```
Interface: xe-0/0/21.0, Index: 83, State: up, Port mode: Trunk
.
.
.
```

List the Ethernet switching interface information on aggregation layer FCoE transit switch TS2 using the operational mode commands **show ethernet-switching interfaces xe-0/0/30.0 detail** and **show ethernet-switching interfaces xe-0/0/31.0 detail**:

```
user@switch> show ethernet-switching interfaces xe-0/0/30.0 detail
Interface: xe-0/0/30.0, Index: 71, State: up, Port mode: Trunk
.
.
.

user@switch> show ethernet-switching interfaces xe-0/0/31.0 detail
Interface: xe-0/0/31.0, Index: 73, State: up, Port mode: Trunk
.
.
.
```

List the Ethernet switching interface information on FCoE transit switch TS3 using the operational mode commands **show ethernet-switching interfaces xe-0/0/10.0 detail** and **show ethernet-switching interfaces xe-0/0/11.0 detail**:

```
user@switch> show ethernet-switching interfaces xe-0/0/10.0 detail
Interface: xe-0/0/10.0, Index: 56, State: up, Port mode: Tagged-Access
.
.
.

user@switch> show ethernet-switching interfaces xe-0/0/11.0 detail
Interface: xe-0/0/11.0, Index: 59, State: up, Port mode: Trunk
.
.
.
```

Related Documentation

- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 4977
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 4982
- Enabling VN2VN_Port FIP Snooping and Configuring the Beacon Period on an FCoE Transit Switch on page 5073
- Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch on page 4865

Example: Configuring Automated Fibre Channel Interface Load Rebalancing

Automated Fibre Channel (FC) interface (NP_Port) load rebalancing configures the switch to rebalance the session loads on the native FC interfaces automatically on a load-rebalancing trigger event. (Alternatively, you can rebalance the link load on the FC interfaces on demand so that you control when the link load is rebalanced.) Rebalancing the FC link load is a disruptive action that causes some or all of the current sessions to log out, then log in again to be placed on the active FC links in a balanced manner.

This example shows you how to configure and verify automated FC link load rebalancing on an FCoE-FC gateway local FC fabric.

Requirements

This example uses the following hardware and software components:

- Juniper Networks QFX3500 Switch
- Junos OS Release 12.3 or later for the QFX Series

Overview

When a load rebalancing trigger occurs, the switch automatically rebalances the link loads by redistributing the sessions across the active NP_Port links.

There are three possible load-rebalancing triggers:

1. When you enable automated load rebalancing, the switch checks the load balance on the existing NP_Port links. If the links are already balanced, the switch does not rebalance the link load. If the links are not balanced, the switch rebalances the link loads using the configured load-balancing algorithm.
2. When a new NP_Port link comes up on a local FCoE-FC gateway fabric, the switch rebalances the link load using the configured load-balancing algorithm if automated load balancing is enabled.
3. When the port speed is changed (unless the port speed change does not change the actual port speed, for example, changing the port speed from auto to 8 Gbps).

Automated load rebalancing logs out sessions in accordance with the configured load-balancing algorithm. Disabling automated load rebalancing is not disruptive because the link load is already balanced.

Use automated load rebalancing if you want link loads to be rebalanced automatically instead of at times of your choosing. Keep in mind that load rebalancing is a disruptive event (sessions are logged out).

Topology

This example configures automated load rebalancing on a local FC fabric on an FCoE-FC gateway. This example does not show you how to configure the load-balancing algorithm or any other load-balancing characteristics. The load-balancing configuration for this example is:

- FC fabric name—fc_fabric_100
- FC fabric ID—100

- FC fabric type—Proxy
- FC fabric interfaces—fc-0/0/0, fc-0/0/1, fc-0/0/42, fc-0/0/43, vlan.100, vlan.20
- Load-balancing algorithm—Simple
- No fabric WWN verify—Configured
- Traceoptions—Configured to log in file fc_fabric_100_proxy.log

Configuration

To configure automated load balancing on a local FC fabric, perform this task:

- [xref target has no title]
- Results on page 5001

CLI Quick Configuration

To quickly configure automated load balancing, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level:

```
[edit]
set fc-fabrics fc_fabric_100 proxy auto-load-rebalance
```

Step-by-Step Procedure

- Configure automated load balancing on FC fabric fc_fabric_100:

  ```
  user@switch# set fc-fabrics fc_fabric_100 proxy auto-load-rebalance
  ```

Results

Display the results of the configuration:

```
user@switch> show configuration fc-fabrics
fc_fabric_100 {
    fabric-id 100;
    fabric-type proxy;
    interface {
        fc-0/0/0.0;
        fc-0/0/1.0;
        vlan.100;
        vlan.20;
        fc-0/0/42.0;
        fc-0/0/43.0;
    }
    proxy {
        traceoptions {
            file fc_fabric_100_proxy.log size 20m;
            flag all;
        }
        load-balance-algorithm simple;
        auto-load-rebalance;
        no-fabric-wwn-verify;
    }
}
```


Verification

Verifying That Automated Load Rebalancing Is Enabled

Purpose Verify that automated load rebalancing is configured on local FC fabric **fc_fabric_100**.

Action Verify the results of the automated load-rebalancing configuration using the operational mode command **show fibre-channel proxy fabric-state fabric fc_fabric_100**:

```
user@switch> show fibre-channel proxy fabric-state fabric fc_fabric_100
Fabric: fc_fabric_100, Fabric-id: 100
Proxy load balance algorithm: Simple, Fabric WWN verification: No
Auto load rebalance enabled  : Yes
Last rebalance start-time    : Never
Last rebalance end-time      : Never
Last rebalance trigger       : None
Last rebalance trigger-time  : Mon Sep 10 21:42:30 2012 usec: 814602
Last rebalance trigger-result: None
```

Meaning The **show fibre-channel proxy fabric-state fabric fc_fabric_100** operational command displays information about the specified local FC fabric. The output shows that the **Auto load rebalance enabled** field value is **Yes**, which indicates that automated load rebalancing is enabled on fabric fc_fabric_100.

Related Documentation

- Defining the Proxy Load-Balancing Algorithm on page 5056
- Simulating On-Demand Fibre Channel Link Load Rebalancing (Dry Run Test) on page 5058
- Understanding Load Balancing in an FCoE-FC Gateway Proxy Fabric on page 4841
- Monitoring Fibre Channel Interface Load Balancing on page 5147

Configuration Examples (ELS CLI for Platforms that Support FCoE Only)

- Example: Configuring CoS for FCoE Transit Switch Traffic Across an MC-LAG on page 5002
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 5025
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 5030
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 5036

Example: Configuring CoS for FCoE Transit Switch Traffic Across an MC-LAG

Multichassis link aggregation groups (MC-LAGs) provide redundancy and load balancing between two QFX Series switches, multihoming support for client devices such as servers, and a loop-free Layer 2 network without running Spanning Tree Protocol (STP).

NOTE: This example uses the Junos OS Enhanced Layer 2 Software (ELS) configuration style for QFX Series switches. If your switch runs software that does not support ELS, see "Example: Configuring CoS for FCoE Transit Switch Traffic Across an MC-LAG" on page 4940. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

You can use an MC-LAG to provide a redundant aggregation layer for Fiber Channel over Ethernet (FCoE) traffic in an *inverted-U* topology. To support lossless transport of FCoE traffic across an MC-LAG, you must configure the appropriate class of service (CoS) on both of the QFX Series switches with MC-LAG port members. The CoS configuration must be the same on both of the MC-LAG switches because an MC-LAG does not carry forwarding class and IEEE 802.1p priority information.

Ports that are members of an MC-LAG act as FCoE passthrough transit switch ports.

NOTE: This example describes how to configure CoS to provide lossless transport for FCoE traffic across an MC-LAG that connects two QFX Series switches. It also describes how to configure CoS on the FCoE transit switches that connect FCoE hosts to the QFX Series switches that form the MC-LAG.

This example does *not* describe how to configure the MC-LAG itself. For a detailed example of MC-LAG configuration, see "Example: Configuring Multichassis Link Aggregation" on page 1904. However, this example includes a subset of MC-LAG configuration that only shows how to configure interface membership in the MC-LAG.

QFX3500 and QFX3600 Virtual Chassis switches do not support FCoE.

This topic describes:

Requirements

This example uses the following hardware and software components:

- Two Juniper Networks QFX5100 Switches running the ELS CLI that form an MC-LAG for FCoE traffic.
- Two Juniper Networks QFX5100 Switches running the ELS CLI that provide FCoE server access in transit switch mode and that connect to the MC-LAG switches.
- FCoE servers (or other FCoE hosts) connected to the transit switches.
- Junos OS Release 13.2 or later for the QFX Series.

Overview

FCoE traffic requires lossless transport. This example shows you how to:

- Configure CoS for FCoE traffic on the two QFX5100 switches that form the MC-LAG, including priority-based flow control (PFC) and enhanced transmission selection (ETS; hierarchical scheduling of resources for the FCoE forwarding class priority and for the forwarding class set priority group).

NOTE: Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

- Configure CoS for FCoE on the two FCoE transit switches that connect FCoE hosts to the MC-LAG switches and enable FIP snooping on the FCoE VLAN at the FCoE transit switch access ports.
- Configure the appropriate port mode, MTU, and FCoE trusted or untrusted state for each interface to support lossless FCoE transport.

NOTE: Do not enabled IGMP snooping on the FCoE VLAN. (IGMP snooping is enabled on the default VLAN by default, but is disabled by default on all other VLANs.)

Topology

QFX5100 switches that act as transit switches support MC-LAGs for FCoE traffic in an inverted-U network topology, as shown in Figure 180 on page 4942.

Figure 185: Supported Topology for an MC-LAG on an FCoE Transit Switch

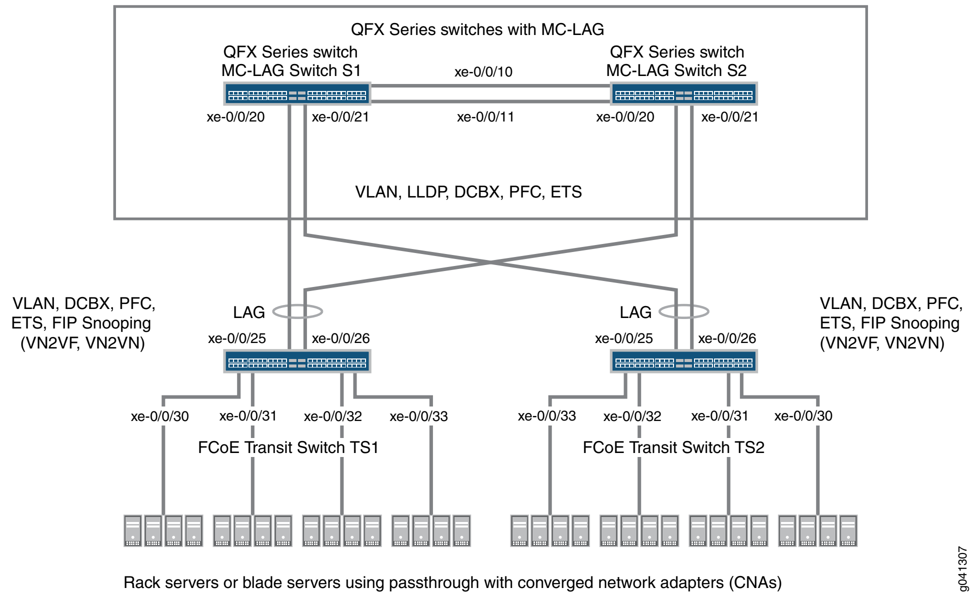


Table 383 on page 4943 shows the configuration components for this example.

Table 388: Components of the CoS for FCoE Traffic Across an MC-LAG Configuration Topology

Component	Settings
Hardware	Four QFX5100 switches running the ELS CLI (two to form the MC-LAG as passthrough transit switches and two transit switches for FCoE access).
Forwarding class (all switches)	Default **fcoe** forwarding class.
Classifier (forwarding class mapping of incoming traffic to IEEE priority)	Default IEEE 802.1p trusted classifier on all FCoE interfaces.

Table 388: Components of the CoS for FCoE Traffic Across an MC-LAG Configuration Topology *(continued)*

Component	Settings
LAGs and MC-LAG	S1—Ports xe-0/0/10 and x-0/0/11 are members of LAG **ae0**, which connects Switch S1 to Switch S2. Ports xe-0/0/20 and xe-0/0/21 are members of MC-LAG **ae1**. All ports are configured in **trunk** interface mode, as **fcoe-trusted**, and with an MTU of **2180**. S2—Ports xe-0/0/10 and x-0/0/11 are members of LAG **ae0**, which connects Switch S2 to Switch S1. Ports xe-0/0/20 and xe-0/0/21 are members of MC-LAG **ae1**. All ports are configured in **trunk** interface mode, as **fcoe-trusted**, and with an MTU of **2180**. NOTE: Ports xe-0/0/20 and xe-0/0/21 on Switches S1 and S2 are the members of the MC-LAG. TS1—Ports xe-0/0/25 and x-0/0/26 are members of LAG **ae1**, configured in **trunk** interface mode, as **fcoe-trusted**, and with an MTU of **2180**. Ports xe-0/0/30, xe-0/0/31, xe-0/0/32, and xe-0/0/33 are configured in **trunk** interface mode, with an MTU of **2180**. TS2—Ports xe-0/0/25 and x-0/0/26 are members of LAG **ae1**, configured in **trunk** interface mode, as **fcoe-trusted**, and with an MTU of **2180**. Ports xe-0/0/30, xe-0/0/31, xe-0/0/32, and xe-0/0/33 are configured in **trunk** interface mode, with an MTU of **2180**.
FCoE queue scheduler (all switches)	**fcoe-sched**: Minimum bandwidth **3g** Maximum bandwidth **100%** Priority **low**
Forwarding class-to-scheduler mapping (all switches)	Scheduler map **fcoe-map**: Forwarding class **fcoe** Scheduler **fcoe-sched**
Forwarding class set (FCoE priority group, all switches)	**fcoe-pg**: Forwarding class **fcoe** Egress interfaces: • S1—LAG **ae0** and MC-LAG **ae1** • S2—LAG **ae0** and MC-LAG **ae1** • TS1—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33** • TS2—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33**
Traffic control profile (all switches)	**fcoe-tcp**: Scheduler map **fcoe-map** Minimum bandwidth **3g** Maximum bandwidth **100%**

Table 388: Components of the CoS for FCoE Traffic Across an MC-LAG Configuration Topology *(continued)*

Component	Settings
PFC congestion notification profile (all switches)	**fcoe-cnp**: Code point **011** Ingress interfaces: • S1—LAG **ae0** and MC-LAG **ae1** • S2—LAG **ae0** and MC-LAG **ae1** • TS1—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33** • TS2—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33**
FCoE VLAN name and tag ID	Name—**fcoe_vlan** ID—**100** Include the FCoE VLAN on the interfaces that carry FCoE traffic on all four switches.
FIP snooping	Enable FIP snooping on Transit Switches TS1 and TS2 on the FCoE VLAN. Configure the LAG interfaces that connect to the MC-LAG switches as FCoE trusted interfaces so that they do not perform FIP snooping. This example enables VN2VN_Port FIP snooping on the FCoE transit switch interfaces connected to the FCoE servers. The example is equally valid with VN2VF_Port FIP snooping enabled on the transit switch access ports. The method of FIP snooping you enable depends on your network configuration.

NOTE: This example uses the default IEEE 802.1p trusted BA classifier, which is automatically applied to trunk mode interfaces if you do not apply an explicitly configured classifier.

To configure CoS for FCoE traffic across an MC-LAG:

- Use the default FCoE forwarding class and forwarding-class-to-queue mapping (do not explicitly configure the FCoE forwarding class or output queue). The default FCoE forwarding class is **fcoe**, and the default output queue is queue **3**.
- Use the default trusted BA classifier, which maps incoming packets to forwarding classes by the IEEE 802.1p code point (CoS priority) of the packet. The trusted classifier is the default classifier for interfaces in trunk interface mode. The default trusted classifier maps incoming packets with the IEEE 802.1p code point 3 (**011**) to the FCoE forwarding class. If you choose to configure the BA classifier instead of using the default classifier, you must ensure that FCoE traffic is classified into forwarding classes in exactly the same way on both MC-LAG switches. Using the default classifier ensures consistent classifier configuration on the MC-LAG ports.

- Configure a congestion notification profile that enables PFC on the FCoE code point (code point **011** in this example). The congestion notification profile configuration must be the same on both MC-LAG switches.
- Apply the congestion notification profile to the interfaces.
- Configure enhanced transmission selection (ETS, also known as hierarchical scheduling) on the interfaces to provide the bandwidth required for lossless FCoE transport. Configuring ETS includes configuring bandwidth scheduling for the FCoE forwarding class, a forwarding class set (priority group) that includes the FCoE forwarding class, and a traffic control profile to assign bandwidth to the forwarding class set that includes FCoE traffic.
- Apply the ETS scheduling to the interfaces.
- Configure the interface mode, MTU, and FCoE trusted or untrusted state for each interface to support lossless FCoE transport.

In addition, this example describes how to enable FIP snooping on the Transit Switch TS1 and TS2 ports that are connected to the FCoE servers. To provide secure access, FIP snooping must be enabled on the FCoE access ports.

This example focuses on the CoS configuration to support lossless FCoE transport across an MC-LAG. This example does not describe how to configure the properties of MC-LAGs and LAGs, although it does show you how to configure the port characteristics required to support lossless transport and how to assign interfaces to the MC-LAG and to the LAGs.

Before you configure CoS, configure:

- The MC-LAGs that connect Switches S1 and S2 to Switches TS1 and TS2. ("Example: Configuring Multichassis Link Aggregation" on page 1904 describes how to configure MC-LAGs.)
- The LAGs that connect the Transit Switches TS1 and TS2 to MC-LAG Switches S1 and S2. ("Configuring Link Aggregation" on page 2019 describes how to configure LAGs.)
- The LAG that connects Switch S1 to Switch S2.

Configuration

To configure CoS for lossless FCoE transport across an MC-LAG, perform these tasks:

CLI Quick Configuration

To quickly configure CoS for lossless FCoE transport across an MC-LAG, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI for MC-LAG Switch S1 and MC-LAG Switch S2 at the **[edit]** hierarchy level. The configurations on Switches S1 and S2 are identical because the CoS configuration must be identical, and because this example uses the same ports on both switches.

Switch S1 and Switch S2

```
set class-of-service schedulers fcoe-sched priority low transmit-rate 3g
set class-of-service schedulers fcoe-sched shaping-rate percent 100
set class-of-service scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
set class-of-service forwarding-class-sets fcoe-pg class fcoe
set class-of-service traffic-control-profiles fcoe-tcp scheduler-map fcoe-map guaranteed-rate
3g
set class-of-service traffic-control-profiles fcoe-tcp shaping-rate percent 100
set class-of-service interfaces ae0 forwarding-class-set fcoe-pg output-traffic-control-profile
fcoe-tcp
set class-of-service interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile
fcoe-tcp
set class-of-service congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
set class-of-service interfaces ae0 congestion-notification-profile fcoe-cnp
set class-of-service interfaces ae1 congestion-notification-profile fcoe-cnp
set vlans fcoe_vlan vlan-id 100
set interfaces xe-0/0/10 ether-options 802.3ad ae0
set interfaces xe-0/0/11 ether-options 802.3ad ae0
set interfaces xe-0/0/20 ether-options 802.3ad ae1
set interfaces xe-0/0/21 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching interface-mode trunk vlan members fcoe_vlan
set interfaces ae1 unit 0 family ethernet-switching interface-mode trunk vlan members fcoe_vlan
set interfaces ae0 mtu 2180
set interfaces ae1 mtu 2180
set vlans fcoe_vlan forwarding-options fip-security interface ae0 fcoe-trusted
set vlans fcoe_vlan forwarding-options fip-security interface ae1 fcoe-trusted
```

To quickly configure CoS for lossless FCoE transport across an MC-LAG, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI for Transit Switch TS1 and Transit Switch TS2 at the **[edit]** hierarchy level. The configurations on Switches TS1 and TS2 are identical because the CoS configuration must be identical, and because this example uses the same ports on both switches.

Switch TS1 and Switch TS2

```
set class-of-service schedulers fcoe-sched priority low transmit-rate 3g
set class-of-service schedulers fcoe-sched shaping-rate percent 100
set class-of-service scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
set class-of-service forwarding-class-sets fcoe-pg class fcoe
set class-of-service traffic-control-profiles fcoe-tcp scheduler-map fcoe-map guaranteed-rate
3g
set class-of-service traffic-control-profiles fcoe-tcp shaping-rate percent 100
set class-of-service interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile
fcoe-tcp
set class-of-service interfaces xe-0/0/30 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service interfaces xe-0/0/31 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service interfaces xe-0/0/32 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service interfaces xe-0/0/33 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
set class-of-service interfaces ae1 congestion-notification-profile fcoe-cnp
set class-of-service interfaces xe-0/0/30 congestion-notification-profile fcoe-cnp
```

```
set class-of-service interfaces xe-0/0/31 congestion-notification-profile fcoe-cnp
set class-of-service interfaces xe-0/0/32 congestion-notification-profile fcoe-cnp
set class-of-service interfaces xe-0/0/33 congestion-notification-profile fcoe-cnp
set vlans fcoe_vlan vlan-id 100
set interfaces xe-0/0/25 ether-options 802.3ad ae1
set interfaces xe-0/0/26 ether-options 802.3ad ae1
set interfaces ae1 unit 0 family ethernet-switching interface-mode trunk vlan members fcoe_vlan
set interfaces xe-0/0/30 unit 0 family ethernet-switching interface-mode trunk vlan members
fcoe_vlan
set interfaces xe-0/0/31 unit 0 family ethernet-switching interface-mode trunk vlan members
fcoe_vlan
set interfaces xe-0/0/32 unit 0 family ethernet-switching interface-mode trunk vlan members
fcoe_vlan
set interfaces xe-0/0/33 unit 0 family ethernet-switching interface-mode trunk vlan members
fcoe_vlan
set interfaces ae1 mtu 2180
set interfaces xe-0/0/30 mtu 2180
set interfaces xe-0/0/31 mtu 2180
set interfaces xe-0/0/32 mtu 2180
set interfaces xe-0/0/33 mtu 2180
set vlans fcoe_vlan forwarding-options fip-security interface ae1 fcoe-trusted
set vlans fcoe_vlan forwarding-options fip-security examine-vn2v2 beacon-period 90000
```

Configuring MC-LAG Switches S1 and S2

Step-by-Step Procedure

To configure CoS resource scheduling (ETS), PFC, the FCoE VLAN, and the LAG and MC-LAG interface membership and characteristics to support lossless FCoE transport across an MC-LAG (this example uses the default **fcoe** forwarding class and the default classifier to map incoming FCoE traffic to the FCoE IEEE 802.1p code point **011**, so you do not configure them):

1. Configure output scheduling for the FCoE queue:

   ```
   [edit class-of-service]
   user@switch# set schedulers fcoe-sched priority low transmit-rate 3g
   user@switch# set schedulers fcoe-sched shaping-rate percent 100
   ```

2. Map the FCoE forwarding class to the FCoE scheduler (**fcoe-sched**):

   ```
   [edit class-of-service]
   user@switch# set scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
   ```

3. Configure the forwarding class set (**fcoe-pg**) for the FCoE traffic:

   ```
   [edit class-of-service]
   user@switch# set forwarding-class-sets fcoe-pg class fcoe
   ```

4. Define the traffic control profile (**fcoe-tcp**) to use on the FCoE forwarding class set:

   ```
   [edit class-of-service]
   user@switch# set traffic-control-profiles fcoe-tcp scheduler-map fcoe-map
   guaranteed-rate 3g
   user@switch# set traffic-control-profiles fcoe-tcp shaping-rate percent 100
   ```

5. Apply the FCoE forwarding class set and traffic control profile to the LAG and MC-LAG interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces ae0 forwarding-class-set fcoe-pg output-traffic-control-profile
   fcoe-tcp
   user@switch# set interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile
   fcoe-tcp
   ```


6. Enable PFC on the FCoE priority by creating a congestion notification profile (**fcoe-cnp**) that applies FCoE to the IEEE 802.1 code point **011**:

```
[edit class-of-service]
user@switch# set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
```

7. Apply the PFC configuration to the LAG and MC-LAG interfaces:

```
[edit class-of-service]
user@switch# set interfaces ae0 congestion-notification-profile fcoe-cnp
user@switch# set interfaces ae1 congestion-notification-profile fcoe-cnp
```

8. Configure the VLAN for FCoE traffic (**fcoe_vlan**):

```
[edit vlans]
user@switch# set fcoe_vlan vlan-id 100
```

9. Add the member interfaces to the LAG between the two MC-LAG switches:

```
[edit interfaces]
user@switch# set xe-0/0/10 ether-options 802.3ad ae0
user@switch# set xe-0/0/11 ether-options 802.3ad ae0
```

10. Add the member interfaces to the MC-LAG:

```
[edit interfaces]
user@switch# set xe-0/0/20 ether-options 802.3ad ae1
user@switch# set xe-0/0/21 ether-options 802.3ad ae1
```

11. Configure the interface mode as **trunk** and membership in the FCoE VLAN (**fcoe_vlan**)for the LAG (**ae0**) and for the MC-LAG (**ae1**):

```
[edit interfaces]
user@switch# set interfaces ae0 unit 0 family ethernet-switching interface-mode trunk vlan members fcoe_vlan
user@switch# set interfaces ae1 unit 0 family ethernet-switching interface-mode trunk vlan members fcoe_vlan
```

12. Set the MTU to **2180** for the LAG and MC-LAG interfaces. 2180 bytes is the minimum size required to handle FCoE packets because of the payload and header sizes; you can configure the MTU to a higher number of bytes if desired, but not less than 2180 bytes:

```
[edit interfaces]
user@switch# set ae0 mtu 2180
user@switch# set ae1 mtu 2180
```

13. Set the LAG and MC-LAG interfaces as FCoE trusted ports. Ports that connect to other switches should be trusted and should not perform FIP snooping:

```
[edit]
user@switch# set vlans fcoe_vlan forwarding-options fip-security interface ae0 fcoe-trusted
user@switch# set vlans fcoe_vlan forwarding-options fip-security interface ae1fcoe-trusted
```

Configuring FCoE Transit Switches TS1 and TS2

Step-by-Step Procedure

The CoS configuration on FCoE Transit Switches TS1 and TS2 is similar to the CoS configuration on MC-LAG Switches S1 and S2. However, the port configurations differ, and you must enable FIP snooping on the Switch TS1 and Switch TS2 FCoE access ports.

To configure resource scheduling (ETS), PFC, the FCoE VLAN, and the LAG interface membership and characteristics to support lossless FCoE transport across the MC-LAG (this example uses the default **fcoe** forwarding class and the default classifier to map incoming FCoE traffic to the FCoE IEEE 802.1p code point **011**, so you do not configure them):

1. Configure output scheduling for the FCoE queue:

   ```
   [edit class-of-service]
   user@switch# set schedulers fcoe-sched priority low transmit-rate 3g
   user@switch# set schedulers fcoe-sched shaping-rate percent 100
   ```

2. Map the FCoE forwarding class to the FCoE scheduler (**fcoe-sched**):

   ```
   [edit class-of-service]
   user@switch# set scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
   ```

3. Configure the forwarding class set (**fcoe-pg**) for the FCoE traffic:

   ```
   [edit class-of-service]
   user@switch# set forwarding-class-sets fcoe-pg class fcoe
   ```

4. Define the traffic control profile (**fcoe-tcp**) to use on the FCoE forwarding class set:

   ```
   [edit class-of-service]
   user@switch# set traffic-control-profiles fcoe-tcp scheduler-map fcoe-map
   guaranteed-rate 3g
   user@switch# set traffic-control-profiles fcoe-tcp shaping-rate percent 100
   ```

5. Apply the FCoE forwarding class set and traffic control profile to the LAG interface and to the FCoE access interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile
   fcoe-tcp
   user@switch# set class-of-service interfaces xe-0/0/30 forwarding-class-set fcoe-pg
   output-traffic-control-profile fcoe-tcp
   user@switch# set class-of-service interfaces xe-0/0/31 forwarding-class-set fcoe-pg
   output-traffic-control-profile fcoe-tcp
   user@switch# set class-of-service interfaces xe-0/0/32 forwarding-class-set fcoe-pg
   output-traffic-control-profile fcoe-tcp
   user@switch# set class-of-service interfaces xe-0/0/33 forwarding-class-set fcoe-pg
   output-traffic-control-profile fcoe-tcp
   ```

6. Enable PFC on the FCoE priority by creating a congestion notification profile (**fcoe-cnp**) that applies FCoE to the IEEE 802.1 code point **011**:

   ```
   [edit class-of-service]
   user@switch# set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point
   011 pfc
   ```

7. Apply the PFC configuration to the LAG interface and to the FCoE access interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces ae1 congestion-notification-profile fcoe-cnp
   ```

```
user@switch# set class-of-service interfaces xe-0/0/30 congestion-notification-profile fcoe-cnp
user@switch# set class-of-service interfaces xe-0/0/31 congestion-notification-profile fcoe-cnp
user@switch# set class-of-service interfaces xe-0/0/32 congestion-notification-profile fcoe-cnp
user@switch# set class-of-service interfaces xe-0/0/33 congestion-notification-profile fcoe-cnp
```

8. Configure the VLAN for FCoE traffic (**fcoe_vlan**):

```
[edit vlans]
user@switch# set fcoe_vlan vlan-id 100
```

9. Add the member interfaces to the LAG:

```
[edit interfaces]
user@switch# set xe-0/0/25 ether-options 802.3ad ae1
user@switch# set xe-0/0/26 ether-options 802.3ad ae1
```

10. On the LAG (**ae1**), configure the interface mode as **trunk** and membership in the FCoE VLAN (**fcoe_vlan**):

```
[edit interfaces]
user@switch# set interfaces ae1 unit 0 family ethernet-switching interface-mode trunk vlan members fcoe_vlan
```

11. On the FCoE access interfaces (**xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, **xe-0/0/33**), configure the interface mode as **trunk** and membership in the FCoE VLAN (**fcoe_vlan**):

```
[edit interfaces]
user@switch# set interfaces xe-0/0/30 unit 0 family ethernet-switching interface-mode trunk vlan members fcoe_vlan
user@switch# set interfaces xe-0/0/31 unit 0 family ethernet-switching interface-mode trunk vlan members fcoe_vlan
user@switch# set interfaces xe-0/0/32 unit 0 family ethernet-switching interface-mode trunk vlan members fcoe_vlan
user@switch# set interfaces xe-0/0/33 unit 0 family ethernet-switching interface-mode trunk vlan members fcoe_vlan
```

12. Set the MTU to **2180** for the LAG and FCoE access interfaces. 2180 bytes is the minimum size required to handle FCoE packets because of the payload and header sizes; you can configure the MTU to a higher number of bytes if desired, but not less than 2180 bytes:

```
[edit interfaces]
user@switch# set ae1 mtu 2180
user@switch# set xe-0/0/30 mtu 2180
user@switch# set xe-0/0/31 mtu 2180
user@switch# set xe-0/0/32 mtu 2180
user@switch# set xe-0/0/33 mtu 2180
```

13. Set the LAG interface as an FCoE trusted port. Ports that connect to other switches should be trusted and should not perform FIP snooping:

```
[edit]
user@switch# set vlans fcoe_vlan forwarding-options fip-security interface ae1 fcoe-trusted
```

NOTE: Access ports xe-0/0/30, xe-0/0/31, xe-0/0/32, and xe-0/0/33 are not configured as FCoE trusted ports. The access ports remain in the default state as untrusted ports because they connect directly to FCoE devices and must perform FIP snooping to ensure network security.

14. Enable FIP snooping on the FCoE VLAN to prevent unauthorized FCoE network access (this example uses VN2VN_Port FIP snooping; the example is equally valid if you use VN2VF_Port FIP snooping):

    ```
    [edit]
    user@switch# set vlans fcoe_vlan forwarding-options fip-security examine-vn2vn beacon-period 90000
    ```

Results

Display the results of the CoS configuration on MC-LAG Switch S1 and on MC-LAG Switch S2 (the results on both switches are the same):

```
user@switch> show configuration class-of-service
traffic-control-profiles {
  fcoe-tcp {
    scheduler-map fcoe-map;
    shaping-rate percent 100;
    guaranteed-rate 3000000000;
  }
}
forwarding-class-sets {
  fcoe-pg {
    class fcoe;
  }
}
congestion-notification-profile {
  fcoe-cnp {
    input {
      ieee-802.1 {
        code-point 011 {
          pfc;
        }
      }
    }
  }
}
interfaces {
  ae0 {
    forwarding-class-set {
      fcoe-pg {
        output-traffic-control-profile fcoe-tcp;
      }
    }
    congestion-notification-profile fcoe-cnp;
  }
  ae1 {
```



```
    forwarding-class-set {
      fcoe-pg {
        output-traffic-control-profile fcoe-tcp;
      }
    }
    congestion-notification-profile fcoe-cnp;
  }
}
scheduler-maps {
  fcoe-map {
    forwarding-class fcoe scheduler fcoe-sched;
  }
}
schedulers {
  fcoe-sched {
    transmit-rate 3000000000;
    shaping-rate percent 100;
    priority low;
  }
}
```

NOTE: The forwarding class and classifier configurations are not shown because the show command does not display default portions of the configuration.

For MC-LAG verification commands, see "Example: Configuring Multichassis Link Aggregation" on page 1904.

Display the results of the CoS configuration on FCoE Transit Switch TS1 and on FCoE Transit Switch TS2 (the results on both transit switches are the same):

```
user@switch> show configuration class-of-service
traffic-control-profiles {
  fcoe-tcp {
    scheduler-map fcoe-map;
    shaping-rate percent 100;
    guaranteed-rate 3000000000;
  }
}
forwarding-class-sets {
  fcoe-pg {
    class fcoe;
  }
}
congestion-notification-profile {
  fcoe-cnp {
    input {
      ieee-802.1 {
        code-point 011 {
          pfc;
        }
      }
    }
```



```
    }
}
interfaces {
    xe-0/0/30 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
    xe-0/0/31 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
    xe-0/0/32 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
    xe-0/0/33 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
    ae1 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
}
scheduler-maps {
    fcoe-map {
        forwarding-class fcoe scheduler fcoe-sched;
    }
}
schedulers {
    fcoe-sched {
        transmit-rate 3000000000;
        shaping-rate percent 100;
        priority low;
    }
}
```

NOTE: The forwarding class and classifier configurations are not shown because the show command does not display default portions of the configuration.

Verification

To verify that the CoS components and FIP snooping have been configured and are operating properly, perform these tasks. Because this example uses the default **fcoe** forwarding class and the default IEEE 802.1p trusted classifier, the verification of those configurations is not shown:

Verifying That the Output Queue Schedulers Have Been Created

Purpose Verify that the output queue scheduler for FCoE traffic has the correct bandwidth parameters and priorities, and is mapped to the correct forwarding class (output queue). Queue scheduler verification is the same on each of the four switches.

Action List the scheduler map using the operational mode command **show class-of-service scheduler-map fcoe-map**:

```
user@switch> show class-of-service scheduler-map fcoe-map
Scheduler map: fcoe-map, Index: 9023

  Scheduler: fcoe-sched, Forwarding class: fcoe, Index: 37289
    Transmit rate: 3000000000 bps, Rate Limit: none, Buffer size: remainder,
    Buffer Limit: none, Priority: low
    Excess Priority: unspecified
    Shaping rate: 100 percent,
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    <default-drop-profile>
      Medium high     any             1    <default-drop-profile>
      High            any             1    <default-drop-profile>
```

Meaning The **show class-of-service scheduler-map fcoe-map** command lists the properties of the scheduler map **fcoe-map**. The command output includes:

- The name of the scheduler map (**fcoe-map**)
- The name of the scheduler (**fcoe-sched**)
- The forwarding classes mapped to the scheduler (**fcoe**)
- The minimum guaranteed queue bandwidth (transmit rate **3000000000 bps**)
- The scheduling priority (**low**)
- The maximum bandwidth in the priority group the queue can consume (shaping rate **100 percent**)
- The drop profile loss priority for each drop profile name. This example does not include drop profiles because you do not apply drop profiles to FCoE traffic.

Verifying That the Priority Group Output Scheduler (Traffic Control Profile) Has Been Created

Purpose Verify that the traffic control profile **fcoe-tcp** has been created with the correct bandwidth parameters and scheduler mapping. Priority group scheduler verification is the same on each of the four switches.

Action List the FCoE traffic control profile properties using the operational mode command **show class-of-service traffic-control-profile fcoe-tcp**:

```
user@switch> show class-of-service traffic-control-profile fcoe-tcp
Traffic control profile: fcoe-tcp, Index: 18303
  Shaping rate: 100 percent
  Scheduler map: fcoe-map
  Guaranteed rate: 3000000000
```

Meaning The **show class-of-service traffic-control-profile fcoe-tcp** command lists all of the configured traffic control profiles. For each traffic control profile, the command output includes:

- The name of the traffic control profile (**fcoe-tcp**)
- The maximum port bandwidth the priority group can consume (shaping rate **100 percent**)
- The scheduler map associated with the traffic control profile (**fcoe-map**)
- The minimum guaranteed priority group port bandwidth (guaranteed rate **3000000000** in bps)

Verifying That the Forwarding Class Set (Priority Group) Has Been Created

Purpose Verify that the FCoE priority group has been created and that the **fcoe** priority (forwarding class) belongs to the FCoE priority group. Forwarding class set verification is the same on each of the four switches.

Action List the forwarding class sets using the operational mode command **show class-of-service forwarding-class-set fcoe-pg**:

```
user@switch> show class-of-service forwarding-class-set fcoe-pg
Forwarding class set: fcoe-pg, Type: normal-type, Forwarding class set index:
31420
  Forwarding class                       Index
  fcoe                                     1
```

Meaning The **show class-of-service forwarding-class-set fcoe-pg** command lists all of the forwarding classes (priorities) that belong to the **fcoe-pg** priority group, and the internal index number of the priority group. The command output shows that the forwarding class set **fcoe-pg** includes the forwarding class **fcoe**.

Verifying That Priority-Based Flow Control Has Been Enabled

Purpose Verify that PFC is enabled on the FCoE code point. PFC verification is the same on each of the four switches.

Action List the FCoE congestion notification profile using the operational mode command **show class-of-service congestion-notification fcoe-cnp**:

```
user@switch> show class-of-service congestion-notification fcoe-cnp
Type: Input, Name: fcoe-cnp, Index: 6879
Cable Length: 100 m
  Priority     PFC         MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Enabled     2500
  100          Disabled
  101          Disabled
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  000
               0
  001
               1
  010
               2
  011
               3
  100
               4
  101
               5
  110
               6
  111
               7
```

Meaning The **show class-of-service congestion-notification fcoe-cnp** command lists all of the IEEE 802.1p code points in the congestion notification profile that have PFC enabled. The command output shows that PFC is enabled on code point **011** (**fcoe** queue) for the **fcoe-cnp** congestion notification profile.

The command also shows the default cable length (100 meters), the default maximum receive unit (2500 bytes), and the default mapping of priorities to output queues because this example does not include configuring these options.

Verifying That the Interface Class of Service Configuration Has Been Created

Purpose Verify that the CoS properties of the interfaces are correct. The verification output on MC-LAG Switches S1 and S2 differs from the output on FCoE Transit Switches TS1 and TS2.

Action List the interface CoS configuration on MC-LAG Switches S1 and S2 using the operational mode command **show configuration class-of-service interfaces**:

```
user@switch> show configuration class-of-service interfaces
ae0 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}

ae1 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
```

List the interface CoS configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show configuration class-of-service interfaces**:

```
user@switch> show configuration class-of-service interfaces
xe-0/0/30 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
xe-0/0/31 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
xe-0/0/32 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
```



```
        congestion-notification-profile fcoe-cnp;
    }
    xe-0/0/33 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
    ae1 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
```

Meaning The **show configuration class-of-service interfaces** command lists the class of service configuration for all interfaces. For each interface, the command output includes:

- The name of the interface (for example, **ae0** or **xe-0/0/30**)
- The name of the forwarding class set associated with the interface (**fcoe-pg**)
- The name of the traffic control profile associated with the interface (output traffic control profile, **fcoe-tcp**)
- The name of the congestion notification profile associated with the interface (**fcoe-cnp**)

NOTE: Interfaces that are members of a LAG are not shown individually. The LAG or MC-LAG CoS configuration is applied to all interfaces that are members of the LAG or MC-LAG. For example, the interface CoS configuration output on MC-LAG Switches S1 and S2 shows the LAG CoS configuration but does not show the CoS configuration of the member interfaces separately. The interface CoS configuration output on FCoE Transit Switches TS1 and TS2 shows the LAG CoS configuration but also shows the configuration for interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33**, which are not members of a LAG.

Verifying That the Interfaces Are Correctly Configured

Purpose Verify that the LAG membership, MTU, VLAN membership, and port mode of the interfaces are correct. The verification output on MC-LAG Switches S1 and S2 differs from the output on FCoE Transit Switches T1 and T2.

Action List the interface configuration on MC-LAG Switches S1 and S2 using the operational mode command **show configuration interfaces**:

`user@switch>` **show configuration interfaces**


```
xe-0/0/10 {
    ether-options {
        802.3ad ae0;
    }
}
xe-0/0/11 {
    ether-options {
        802.3ad ae0;
    }
}
xe-0/0/20 {
    ether-options {
        802.3ad ae1;
    }
}
xe-0/0/21 {
    ether-options {
        802.3ad ae1;
    }
}
ae0 {
    mtu 2180;
    unit 0 {
        family ethernet-switching {
            interface-mode trunk;
            vlan {
                members fcoe_vlan;
            }
        }
    }
}
ae1 {
    mtu 2180;
    unit 0 {
        family ethernet-switching {
            interface-mode trunk;
            vlan {
                members fcoe_vlan;
            }
        }
    }
}
```

List the interface configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show configuration interfaces**:

```
user@switch> show configuration interfaces
xe-0/0/25 {
    ether-options {
        802.3ad ae1;
    }
}
xe-0/0/26 {
    ether-options {
        802.3ad ae1;
    }
}
xe-0/0/30 {
    mtu 2180;
    unit 0 {
```



```
            family ethernet-switching {
                interface-mode trunk;
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }
    xe-0/0/31 {
        mtu 2180;
        unit 0 {
            family ethernet-switching {
                interface-mode trunk;
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }
    xe-0/0/32 {
        mtu 2180;
        unit 0 {
            family ethernet-switching {
                interface-mode trunk;
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }
    xe-0/0/33 {
        mtu 2180;
        unit 0 {
            family ethernet-switching {
                interface-mode trunk;
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }

    ae1 {
        mtu 2180;
        unit 0 {
            family ethernet-switching {
                interface-mode trunk;
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }
```

Meaning The **show configuration interfaces** command lists the configuration of each interface by interface name.

For each interface that is a member of a LAG, the command lists only the name of the LAG to which the interface belongs.

For each LAG interface and for each interface that is not a member of a LAG, the command output includes:

- The MTU (**2180**)
- The unit number of the interface (**0**)
- The interface mode (**trunk** mode both for interfaces that connect two switches and for interfaces that connect to FCoE hosts)
- The name of the VLAN in which the interface is a member (**fcoe_vlan**)

Verifying That FIP Snooping Is Enabled on the FCoE VLAN on FCoE Transit Switches TS1 and TS2 Access Interfaces

Purpose Verify that FIP snooping is enabled on the FCoE VLAN access interfaces. FIP snooping is enabled only on the FCoE access interfaces, so it is enabled only on FCoE Transit Switches TS1 and TS2. FIP snooping is not enabled on MC-LAG Switches S1 and S2 because FIP snooping is done at the Transit Switch TS1 and TS2 FCoE access ports.

Action List the port security configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show configuration vlans fcoe_vlan forwarding-options fip-security**:

```
user@switch> show configuration vlans fcoe_vlan forwarding-options fip-security
interface ae1.0 {
    fcoe-trusted;
}
examine-vn2vn {
    beacon-period 90000;
}
```

Meaning The **show configuration vlans fcoe_vlan forwarding-options fip-security** command lists VLAN FIP security information, including whether a port member of the VLAN is trusted. The command output shows that:

- LAG port **ae1.0**, which connects the FCoE transit switch to the MC-LAG switches, is configured as an FCoE trusted interface. FIP snooping is not performed on the member interfaces of the LAG (**xe-0/0/25** and **xe-0/0/26**).
- VN2VN_Port FIP snooping is enabled (**examine-vn2vn**) on the FCoE VLAN and the beacon period is set to 90000 milliseconds. On Transit Switches TS1 and TS2, all interface members of the FCoE VLAN perform FIP snooping unless the interface is configured as FCoE trusted. On Transit Switches TS1 and TS2, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33** perform FIP snooping because they are not configured as FCoE trusted. The interface members of LAG **ae1** (**xe-0/0/25** and **xe-0/0/26**) do not perform FIP snooping because the LAG is configured as FCoE trusted.

Verifying That the FIP Snooping Mode Is Correct on FCoE Transit Switches TS1 and TS2

Purpose Verify that the FIP snooping mode is correct on the FCoE VLAN. FIP snooping is enabled only on the FCoE access interfaces, so it is enabled only on FCoE Transit Switches TS1 and TS2. FIP snooping is not enabled on MC-LAG Switches S1 and S2 because FIP snooping is done at the Transit Switch TS1 and TS2 FCoE access ports.

Action List the FIP snooping configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show fip snooping brief**:

```
user@switch> show fip snooping brief
VLAN: fcoe_vlan,    Mode: VN2VN Snooping
  FC-MAP: 0e:fc:00
…
```

NOTE: The output has been truncated to show only the relevant information.

Meaning The **show fip snooping brief** command lists FIP snooping information, including the FIP snooping VLAN and the FIP snooping mode. The command output shows that:

- The VLAN on which FIP snooping is enabled is **fcoe_vlan**
- The FIP snooping mode is VN2VN_Port FIP snooping (**VN2VN Snooping**)

Related Documentation

- Example: Configuring Multichassis Link Aggregation on page 1904
- Configuring Link Aggregation on page 2019
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Understanding Multichassis Link Aggregation on page 1853
- Understanding MC-LAGs on an FCoE Transit Switch on page 4881

Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch)

This example shows how to configure VN_Port to VN_Port (VN2VN_Port) FIP snooping when the hosts are directly connected to the same FCoE transit switch.

NOTE: This example uses the Junos OS Enhanced Layer 2 Software (ELS) configuration style for QFX Series switches. If your switch runs software that does not support ELS, see "Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch)" on page 4977. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

VN2VN_Port FIP snooping on an FCoE transit switch provides security to help prevent unauthorized access and data transmission on a bridge that connects ENodes in the Ethernet network. VN2VN_Port FIP snooping provides security for virtual links by creating filters based on information gathered (snooped) about FCoE devices during FIP transactions.

VN2VN_Port FIP snooping is conceptually similar to VN2VN_Port FIP snooping between VN_Ports and VF_Ports, but VN2VN_Port FIP snooping does not require traffic between VN_Ports to traverse the Fibre Channel (FC) switch or FCoE forwarder (FCF). Instead, a VN_Port communicates transparently through the transit switch on a virtual link that emulates a direct connection to the VN_Port at the other end of the virtual link.

To configure VN2VN_Port FIP snooping when the hosts are directly connected to the same FCoE transit switch, you must follow these configuration rules:

- VN2VN_Port traffic must use a dedicated FCoE VLAN, and all ENodes that communicate using VN2VN_Port FIP snooping must use that FCoE VLAN. You cannot mix VN2VN_Port FIP snooping traffic with VN2VF_Port FIP snooping traffic in the same FCoE VLAN.

NOTE: **An FCoE VLAN can support either VN2VF_Port FIP snooping or VN2VN_Port FIP snooping, but not both. Configure separate FCoE VLANs for VN2VF_Port FIP snooping traffic and for VN2VN_Port FIP snooping traffic. On FCoE VLANs that are configured as VN2VN_Port FIP snooping VLANs, VN_Port to VF_Port (FIP snooping) traffic is dropped.**

- ENode-facing ports must be set in **trunk** interface mode.
- ENode-facing ports must be untrusted ports.
- Network-facing (switch-facing) ports must be set in **trunk** interface mode.
- Network-facing ports must be FCoE trusted ports.
- Explicitly configure the beacon period. The beacon period is essentially a keepalive timer for virtual link maintenance.

When you enable VN2VF_Port FIP snooping, the system snoops VN_Port to VF_Port packets and enforces security only on VN_Port to VF_Port virtual links. When you enable VN2VN_Port FIP snooping, the system snoops VN_Port to VN_Port packets and enforces security only on VN_Port to VN_Port virtual links.

The transit switch applies VN2VN_Port FIP snooping filters at the ports associated with the FCoE VLANs on which you enable VN2VN FIP snooping.

This example describes how to configure VN2VN_Port FIP snooping when the FCoE hosts are directly connected to the same transit switch:

Requirements

This example uses the following hardware and software components:

- One Juniper Networks QFX5100 Switch running the ELS CLI and used as a transit switch

- Junos OS Release 13.2 or later for the QFX Series
- Two FCoE hosts that have ENodes

Overview

This example shows you how to:

- Set the correct interface mode on the transit switch.
- Configure the interfaces to use the dedicated FCoE VLAN for VN2VN_Port FIP snooping.
- Configure the dedicated FCoE VLAN for VN2VN_Port FIP snooping traffic.
- Enable VN2VN_Port FIP snooping on the FCoE VLAN and configure the beacon period.

Topology

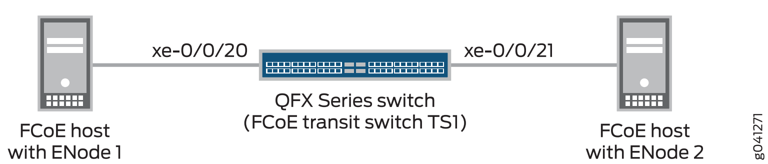
Table 385 on page 4979 shows the configuration components for this example.

Table 389: Components of the VN2VN_Port FIP Snooping Configuration Topology (FCoE Hosts Directly Connected to the Same FCoE Transit Switch)

Component	Settings
Hardware	QFX5100 switch running the ELS CLI (FCoE transit switch TS1) Two FCoE hosts that have ENodes (ENode1 and ENode2, respectively)
Interfaces and interface mode	• Interface **xe-0/0/20**, interface mode **trunk**, connects directly to the FCoE host with ENode1. • Interface **xe-0/0/21**, interface mode **trunk**, connects directly to the FCoE host with ENode2.
Interface VLAN membership	Both interfaces use VLAN **vlan200**.
VN2VN_Port FIP snooping VLAN	VLAN name—**vlan200** VLAN ID—200
FIP snooping mode and beacon period	Set **examine-vn2vn** (VN2VN_Port FIP snooping) Beacon period—90000 ms

Figure 182 on page 4979 shows the network topology for this example.

Figure 186: VN2VN_Port FIP Snooping (FCoE Hosts Connected to Same Transit Switch) Topology



Configuration

CLI Quick Configuration

To quickly configure VN2VN_Port FIP snooping for FCoE hosts connected directly to the same transit switch, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level:

set interfaces xe-0/0/20 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/21 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200
set vlans vlan200 vlan-id 200
set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000

Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch)

Step-by-Step Procedure

To configure interface mode, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the modes of the interfaces that connect directly to the FCoE host ENodes:

   `user@switch#` **set interfaces xe-0/0/20 unit 0 family ethernet-switching interface-mode trunk**
   set interfaces xe-0/0/21 unit 0 family ethernet-switching interface-mode trunk

2. Configure the interface VLAN membership so that the interfaces connected to theENodes are members of the dedicated VN2VN_Port VLAN (**vlan200**):

   `user@switch#` **set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200**
   set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200

3. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   `user@switch#` **set vlans vlan200 vlan-id 200**

4. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   `user@switch#` **set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000**

Verification

To verify that the VN2VN_Port FIP snooping configuration has been created and is operating properly, perform these tasks:

- Verifying That VN2VN_Port FIP Snooping is Enabled on the FCoE VLAN on page 5028

Verifying That VN2VN_Port FIP Snooping is Enabled on the FCoE VLAN

Purpose

Verify that VN2VN_Port FIP snooping is enabled on the correct VLAN (**vlan200**), the beacon period is set to **90000** milliseconds, and the correct interfaces (**xe-0/0/20** and **xe-0/0/21**) are members of the VLAN.

Action List the FIP snooping information using the operational mode command **show fip snooping detail**.

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/20
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0a:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0b:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/21
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0b:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:0o:0a:01
```

Meaning The **show fip snooping detail** command lists all of the transit switch information about VN2VN_Port FIP snooping and VN2VF_Port FIP snooping. The command shows that:

- The VLAN is **vlan200**.
- The mode is FIP snooping mode **VN2VN**, for VN2VN_Port FIP snooping. (If the Mode field shows **VN2VF**, then the FIP snooping mode is VN2VF_Port FIP snooping.)
- The beacon period is **90000**.
- The interfaces for the ENodes are **xe-0/0/20** and **xe-0/0/21**.

In addition, this useful command shows information about the ENodes and the VN2VN_Port sessions.

Related Documentation

- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 5030
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 5036
- Enabling VN2VN_Port FIP Snooping and Configuring the Beacon Period on an FCoE Transit Switch on page 5073
- Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch on page 4865

Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches)

This example shows how to configure VN_Port to VN_Port (VN2VN_Port) FIP snooping when the hosts are directly connected to different FCoE transit switches, and the transit switches are directly connected to each other.

> NOTE: This example uses the Junos OS Enhanced Layer 2 Software (ELS) configuration style for QFX Series switches. If your switch runs software that does not support ELS, see "Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches)" on page 4982. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

VN2VN_Port FIP snooping on an FCoE transit switch provides security to help prevent unauthorized access and data transmission on a bridge that connects ENodes in the Ethernet network. VN2VN_Port FIP snooping provides security for virtual links by creating filters based on information gathered (snooped) about FCoE devices during FIP transactions.

VN2VN_Port FIP snooping is conceptually similar to VN2VF_Port FIP snooping between VN_Ports and VF_Ports, but VN2VN_Port FIP snooping does not require traffic between VN_Ports to traverse the Fibre Channel (FC) switch or FCoE forwarder (FCF). Instead, a VN_Port communicates transparently through one or more transit switches on a virtual link that emulates a direct connection to the VN_Port at the other end of the virtual link.

To configure VN2VN_Port FIP snooping when the hosts are directly connected to different FCoE transit switches, and the transit switches are directly connected to each other, you must follow these configuration rules:

- VN2VN_Port traffic must use a dedicated FCoE VLAN, and all ENodes that communicate using VN2VN_Port FIP snooping must use that FCoE VLAN. The FCoE VLAN must be configured on each transit switch. You cannot mix VN2VN_Port FIP snooping traffic with VN2VF_Port FIP snooping traffic in the same FCoE VLAN.

  > NOTE: An FCoE VLAN can support either VN2VF_Port FIP snooping or VN2VN_Port FIP snooping, but not both. Configure separate FCoE VLANs for VN2VF_Port FIP snooping traffic and for VN2VN_Port FIP snooping traffic. On FCoE VLANs that are configured as VN2VN_Port FIP snooping VLANs, VN2VF_Port traffic is dropped.

- ENode-facing ports must be set in **trunk** interface mode.
- ENode-facing ports must be untrusted ports.
- Network-facing (switch-facing) ports must be set in **trunk** interface mode.

- Network-facing ports must be FCoE trusted ports.
- Explicitly configure the beacon period. The beacon period is essentially a keepalive timer for virtual link maintenance.

When you enable VN2VF_Port FIP snooping, the system snoops VN_Port to VF_Port packets and enforces security only on VN_Port to VF_Port virtual links. When you enable VN2VN_Port FIP snooping, the system snoops VN_Port to VN_Port packets and enforces security only on VN_Port to VN_Port virtual links.

The transit switch applies VN2VN_Port FIP snooping filters at the ports associated with the FCoE VLANs on which you enable VN2VN FIP snooping.

This example describes how to configure VN2VN_Port FIP snooping when the FCoE hosts are directly connected to different transit switches, and the transit switches are directly connected to each other:

Requirements

This example uses the following hardware and software components:

- Two Juniper Networks QFX5100 Switches running the ELS CLI and used as transit switches
- Junos OS Release 13.2 or later for the QFX Series
- Two FCoE hosts that have ENodes

Overview

This example shows you how to:

- Set the correct interface mode on the transit switch.
- Configure the interfaces to use the dedicated FCoE VLAN for VN2VN_Port FIP snooping.
- Configure the network-facing interfaces as FCoE trusted interfaces.
- Configure the dedicated FCoE VLAN for VN2VN_Port FIP snooping traffic.
- Enable VN2VN_Port FIP snooping on the FCoE VLAN and configure the beacon period.

Topology

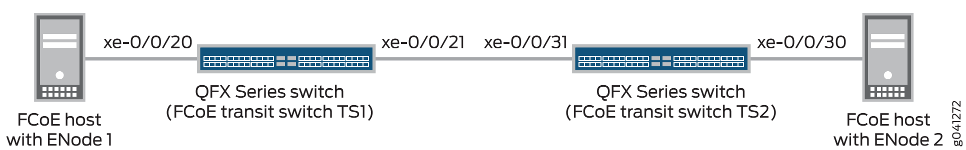
Table 386 on page 4984 shows the configuration components for this example.

Table 390: Components of the VN2VN_Port FIP Snooping Configuration Topology (FCoE Hosts Directly Connected to Different FCoE Transit Switches)

Component	Settings
Hardware	Two QFX5100 switches running the ELS CLI (FCoE transit switch TS1 and FCoE transit switch TS2) Two FCoE hosts that have ENodes (ENode1 and ENode2, respectively)
Interfaces and interface mode	• Interface **xe-0/0/20**, interface mode **trunk**, connects directly from transit switch TS1 to the FCoE host with ENode1. • Interface **xe-0/0/21**, interface mode **trunk**, connects directly from transit switch TS1 to transit switch TS2. • Interface **xe-0/0/31**, interface mode **trunk**, connects directly from transit switch TS2 to transit switch TS1. • Interface **xe-0/0/30**, interface mode **trunk**, connects directly from transit switch TS2 to the FCoE host with ENode2.
Interface VLAN membership	The interfaces on both transit switches use VLAN **vlan200**.
VN2VN_Port FIP snooping VLAN	VLAN name (both transit switches)—**vlan200** VLAN ID—200
FIP snooping mode and beacon period	Set **examine-vn2vn** (VN2VN_Port FIP snooping) Beacon period—90000 ms

Figure 183 on page 4984 shows the network topology for this example.

Figure 187: VN2VN_Port FIP Snooping (FCoE Hosts Connected to Different Transit Switches) Topology



Configuration

To configure VN2VN_Port FIP snooping for VN_Ports that are directly connected to different transit switches (and the transit switches are directly connected to each other), perform these tasks:

- Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS1 on page 5033
- Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS2 on page 5034

CLI Quick Configuration

The configuration for each FCoE transit switch is shown separately.

To quickly configure VN2VN_Port FIP snooping for FCoE hosts connected directly to different transit switches, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level. To configure FCoE transit switch TS1:

FCoE Transit Switch TS1

set interfaces xe-0/0/20 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/21 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200
set vlans vlan200 vlan-id 200
set vlans vlan200 forwarding-options fip-security interface xe-0/0/21 fcoe-trusted
set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000

To quickly configure VN2VN_Port FIP snooping for FCoE hosts connected directly to different transit switches, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level. To configure FCoE transit switch TS2:

FCoE Transit Switch TS2

set interfaces xe-0/0/30 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/31 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/30 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/31 unit 0 family ethernet-switching vlan members vlan200
set vlans vlan200 vlan-id 200
set vlans vlan200 forwarding-options fip-security interface xe-0/0/31 fcoe-trusted
set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000

Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS1

Step-by-Step Procedure

To configure interface mode, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, set the network-facing port as FCoE trusted, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the modes of the interfaces that connect directly to the FCoE host with ENode1 (**xe-0/0/20**) and to FCoE transit switch TS2 (**xe-0/0/21**):

   `user@switch#` **set interfaces xe-0/0/20 unit 0 family ethernet-switching interface-mode trunk**
   set interfaces xe-0/0/21 unit 0 family ethernet-switching interface-mode trunk

2. Configure the interface VLAN membership so that the interfaces are members of the dedicated VN2VN_Port VLAN (**vlan200**):

   `user@switch#` **set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200**
   set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200

3. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   `user@switch#` **set vlans vlan200 vlan-id 200**

4. Configure the network-facing port (**xe-0/0/21**) as an FCoE trusted port:

   `user@switch#` **set vlans vlan200 forwarding-options fip-security interface xe-0/0/21 fcoe-trusted**

5. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   `user@switch#` **set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000**

Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS2

Step-by-Step Procedure

To configure interface mode, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, set the network-facing port as FCoE trusted, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the modes of the interfaces that connect directly to the FCoE host with ENode2 (**xe-0/0/30**) and to FCoE transit switch TS1 (**xe-0/0/31**):

   `user@switch#` **set interfaces xe-0/0/30 unit 0 family ethernet-switching interface-mode trunk**
   set interfaces xe-0/0/31 unit 0 family ethernet-switching interface-mode trunk

2. Configure the interface VLAN membership so that the interfaces are members of the dedicated VN2VN_Port VLAN (**vlan200**):

   `user@switch#` **set interfaces xe-0/0/30 unit 0 family ethernet-switching vlan members vlan200**
   set interfaces xe-0/0/31 unit 0 family ethernet-switching vlan members vlan200

3. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   `user@switch#` **set vlans vlan200 vlan-id 200**

4. Configure the network-facing port (**xe-0/0/31**) as an FCoE trusted port:

   `user@switch#` **set vlans vlan200 forwarding-options fip-security interface xe-0/0/31 fcoe-trusted**

5. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   `user@switch#` **set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000**

Verification

To verify that the VN2VN_Port FIP snooping configuration has been created and is operating properly on both switches, perform these tasks:

- Verifying That VN2VN_Port FIP Snooping is Enabled on the FCoE VLAN (Transit Switches TS1 and TS2) on page 5034

Verifying That VN2VN_Port FIP Snooping is Enabled on the FCoE VLAN (Transit Switches TS1 and TS2)

Purpose

Verify that VN2VN_Port FIP snooping is enabled on the correct VLAN (**vlan200**), the beacon period is set to **90000** milliseconds, and that the correct interfaces (**xe-0/0/20** and **xe-0/0/21** on TS1, and **xe-0/0/30**and **xe-0/0/31** on TS2) are members of the VLAN.

Action List the FIP snooping information on transit switch TS1 using the operational mode command **show fip snooping detail**

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fc:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/20
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fc:00:01:0a:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fc:00:01:0b:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/21
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fc:00:01:0b:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fc:00:01:0a:01
```

List the FIP snooping information on transit switch TS2 using the operational mode command **show fip snooping detail**

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/30
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0b:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0a:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/31
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0a:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0b:01
```

Meaning The **show fip snooping detail** command lists all of the transit switch information about VN2VN_Port FIP snooping and VN2VF_Port FIP snooping on each transit switch. The command shows that:

- The VLAN is **vlan200**.
- The mode is FIP snooping mode **VN2VN**, for VN2VN_Port FIP snooping. (If the Mode field shows **VN2VF**, then the FIP snooping mode is VN2VF_Port FIP snooping.)

- The beacon period is **90000**.
- The interfaces connected to the ENodes are **xe-0/0/20** and **xe-0/0/21** on transit switch TS1, and **xe-0/0/30** and **xe-0/0/31** on transit switch TS2. Because the transit switches are transparent passthrough switches, the network-facing trunk ports “see” the FCoE host ENodes at the far end of the VN2VN_Port virtual link.

In addition, this useful command shows information about the ENodes and the VN2VN_Port sessions.

Related Documentation

- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 5025
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 5036
- Enabling VN2VN_Port FIP Snooping and Configuring the Beacon Period on an FCoE Transit Switch on page 5073
- Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch on page 4865

Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch)

This example shows how to configure VN_Port to VN_Port (VN2VN_Port) FIP snooping when the hosts are indirectly connected through an aggregation layer FCoE transit switch. Each FCoE host ENode is directly connected to an FCoE transit switch, but the FCoE transit switches are not directly connected to each other. The FCoE transit switches are both connected to a third FCoE transit switch that acts as an aggregation layer switch.

NOTE: **This example uses the Junos OS Enhanced Layer 2 Software (ELS) configuration style for QFX Series switches. If your switch runs software that does not support ELS, see** “Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch)” on page 4990**. For ELS details, see** “Getting Started with Enhanced Layer 2 Software” on page 58.

VN2VN_Port FIP snooping on an FCoE transit switch provides security to help prevent unauthorized access and data transmission on a bridge that connects ENodes in the Ethernet network. VN2VN_Port FIP snooping provides security for virtual links by creating filters based on information gathered (snooped) about FCoE devices during FIP transactions.

VN2VN_Port FIP snooping is conceptually similar to VN2VN_Port FIP snooping between VN_Ports and VF_Ports, but VN2VN_Port FIP snooping does not require traffic between VN_Ports to traverse the Fibre Channel (FC) switch or FCoE forwarder (FCF). Instead, a VN_Port communicates transparently through one or more transit switches on a virtual link that emulates a direct connection to the VN_Port at the other end of the virtual link.

To configure VN2VN_Port FIP snooping when the hosts are indirectly connected, you must follow these configuration rules:

- VN2VN_Port traffic must use a dedicated FCoE VLAN, and all ENodes that communicate using VN2VN_Port FIP snooping must use that FCoE VLAN. The FCoE VLAN must be configured on each transit switch. You cannot mix VN2VN_Port FIP snooping traffic with VN2VF_Port FIP snooping traffic in the same FCoE VLAN.

  NOTE: **An FCoE VLAN can support either VN2VF_Port FIP snooping or VN2VN_Port FIP snooping, but not both. Configure separate FCoE VLANs for VN2VF_Port FIP snooping traffic and for VN2VN_Port FIP snooping traffic. On FCoE VLANs that are configured as VN2VN_Port FIP snooping VLANs, VN_Port to VF_Port traffic is dropped.**

- ENode-facing ports must be set in **trunk** interface mode.
- ENode-facing ports must be untrusted ports.
- Network-facing (switch-facing) ports must be set in **trunk** interface mode.
- Network-facing ports must be FCoE trusted ports.
- Explicitly configure the beacon period. The beacon period is essentially a keepalive timer for virtual link maintenance.

When you enable FIP snooping, the system snoops VN_Port to VF_Port packets and enforces security only on VN_Port to VF_Port virtual links. When you enable VN2VN_Port FIP snooping, the system snoops VN_Port to VN_Port packets and enforces security only on VN_Port to VN_Port virtual links.

The transit switch applies VN2VN_Port FIP snooping filters at the ports associated with the FCoE VLANs on which you enable VN2VN FIP snooping.

This example describes how to configure VN2VN_Port FIP snooping when the FCoE hosts are indirectly connected across an aggregation layer FCoE transit switch:

Requirements

This example uses the following hardware and software components:

- Three Juniper Networks QFX5100 Switches running the ELS CLI and used as transit switches
- Junos OS Release 13.2 or later for the QFX Series
- Two FCoE hosts that have ENodes

Overview

This example shows you how to:

- Set the correct interface mode on the transit switch.
- Configure the interfaces to use the dedicated FCoE VLAN for VN2VN_Port FIP snooping.
- Configure the network-facing interfaces as FCoE trusted interfaces.
- Configure the dedicated FCoE VLAN for VN2VN_Port FIP snooping traffic.
- Enable VN2VN_Port FIP snooping on the FCoE VLAN and configure the beacon period.

Topology

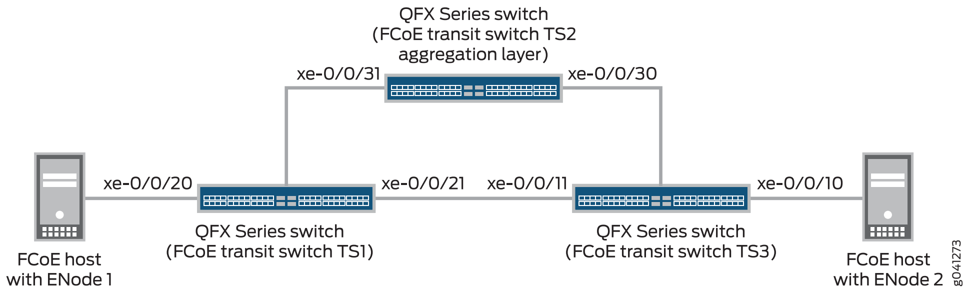
Table 387 on page 4992 shows the configuration components for this example.

Table 391: Components of the VN2VN_Port FIP Snooping Configuration Topology (FCoE Hosts Indirectly Connected Across an Aggregation Layer FCoE Transit Switch)

Component	Settings
Hardware	Three QFX5100 switches running the ELS CLI, two of which are FCoE transit switches that are directly attached to the FCoE hosts (transit switches TS1 and TS2) and one of which is an aggregation layer FCoE transit switch (TS3) Two FCoE hosts that have ENodes (ENode1 and ENode2, respectively)
Interfaces and interface mode	• Interface **xe-0/0/20**, interface mode **trunk**, connects directly from transit switch TS1 to the FCoE host with ENode1. • Interface **xe-0/0/21**, interface mode **trunk**, connects directly from transit switch TS1 to aggregation layer transit switch TS2. • Interface **xe-0/0/31**, interface mode **trunk**, connects directly from aggregation layer transit switch TS2 to transit switch TS1. • Interface **xe-0/0/30**, interface mode **trunk**, connects directly from aggregation layer transit switch TS2 to transit switch TS3. • Interface **xe-0/0/11**, interface mode **trunk**, connects directly from transit switch TS3 to aggregation layer transit switch TS2. • Interface **xe-0/0/10**, interface mode **trunk**, connects directly from transit switch TS3 to the FCoE host with ENode2.
Interface VLAN membership	The interfaces on all three switches use VLAN **vlan200**.
VN2VN_Port FIP snooping VLAN	VLAN name (all three switches)—**vlan200** VLAN ID—200
FIP snooping mode and beacon period	Set **examine-vn2vn** (VN2VN_Port FIP snooping) Beacon period—90000 ms

Figure 184 on page 4992 shows the network topology for this example.

Figure 188: VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected) Topology



Configuration

To configure VN2VN_Port FIP snooping for VN_Ports that are indirectly connected across an aggregation layer FCoE transit switch, perform these tasks:

- Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS1 on page 5040
- Configuring VN2VN_Port FIP Snooping on Aggregation Layer FCoE Transit Switch TS2 on page 5041
- Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS3 on page 5041

CLI Quick Configuration

The configuration for each FCoE transit switch is shown separately.

To quickly configure VN2VN_Port FIP snooping for FCoE hosts that are indirectly connected across an aggregation layer FCoE transit switch, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level. To configure FCoE transit switch TS1:

FCoE Transit Switch TS1

```
set interfaces xe-0/0/20 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/21 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200
set vlans vlan200 vlan-id 200
set vlans vlan200 forwarding-options fip-security interface xe-0/0/21 fcoe-trusted
set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000
```

To quickly configure VN2VN_Port FIP snooping for FCoE hosts that are indirectly connected across an aggregation layer FCoE transit switch, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level. To configure FCoE transit switch TS2:

FCoE Transit Switch TS2

```
set interfaces xe-0/0/30 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/31 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/30 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/31 unit 0 family ethernet-switching vlan members vlan200
set vlans vlan200 vlan-id 200
```



```
set vlans vlan200 forwarding-options fip-security interface xe-0/0/30 fcoe-trusted
set vlans vlan200 forwarding-options fip-security interface xe-0/0/31 fcoe-trusted
set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000
```

To quickly configure VN2VN_Port FIP snooping for FCoE hosts that are indirectly connected across an aggregation layer FCoE transit switch, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level. To configure FCoE transit switch TS3:

FCoE Transit Switch TS3

```
set interfaces xe-0/0/10 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/11 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/10 unit 0 family ethernet-switching vlan members vlan200
set interfaces xe-0/0/11 unit 0 family ethernet-switching vlan members vlan200
set vlans vlan200 vlan-id 200
set vlans vlan200 forwarding-options fip-security interface xe-0/0/11 fcoe-trusted
set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000
```

Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS1

Step-by-Step Procedure

To configure interface mode, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, set the network-facing port as FCoE trusted, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the modes of the interfaces that connect directly to the FCoE host with ENode1 (**xe-0/0/20**) and to aggregation layer FCoE transit switch TS2 (**xe-0/0/21**):

   ```
   user@switch# set interfaces xe-0/0/20 unit 0 family ethernet-switching interface-mode trunk
   set interfaces xe-0/0/21 unit 0 family ethernet-switching interface-mode trunk
   ```

2. Configure the interface VLAN membership so that the interfaces are members of the dedicated VN2VN_Port VLAN (**vlan200**):

   ```
   user@switch# set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan200
   set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan200
   ```

3. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   ```
   user@switch# set vlans vlan200 vlan-id 200
   ```

4. Configure the network-facing port (**xe-0/0/21**) as an FCoE trusted port:

   ```
   user@switch# set vlans vlan200 forwarding-options fip-security interface xe-0/0/21 fcoe-trusted
   ```

5. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   ```
   user@switch# set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000
   ```


Configuring VN2VN_Port FIP Snooping on Aggregation Layer FCoE Transit Switch TS2

Step-by-Step Procedure

To configure interface mode, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, set the network-facing ports as FCoE trusted, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the mode of the interfaces that connect directly to FCoE transit switches TS1 (**xe-0/0/31**) and TS3 (**xe-0/0/30**). Both interfaces are network-facing and must be configured as trunk interfaces:

   `user@switch#` **set interfaces xe-0/0/30 unit 0 family ethernet-switching interface-mode trunk**
   set interfaces xe-0/0/31 unit 0 family ethernet-switching interface-mode trunk

2. Configure the interface VLAN membership so that the interfaces are members of the dedicated VN2VN_Port VLAN (**vlan200**):

   `user@switch#` **set interfaces xe-0/0/30 unit 0 family ethernet-switching vlan members vlan200**
   set interfaces xe-0/0/31 unit 0 family ethernet-switching vlan members vlan200

3. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   `user@switch#` **set vlans vlan200 vlan-id 200**

4. Configure the network-facing ports (**xe-0/0/30** and **xe-0/0/31**) as FCoE trusted ports:

   `user@switch#` **set vlans vlan200 forwarding-options fip-security interface xe-0/0/30 fcoe-trusted**
   `user@switch#` **set vlans vlan200 forwarding-options fip-security interface xe-0/0/31 fcoe-trusted**

5. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   `user@switch#` **set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000**

Configuring VN2VN_Port FIP Snooping on FCoE Transit Switch TS3

Step-by-Step Procedure

To configure interface mode, configure interface VLAN membership in the FCoE VLAN dedicated to VN2VN_Port traffic, set the network-facing port as FCoE trusted, configure the VLAN, set the beacon period, and enable VN2VN_Port FIP snooping:

1. Configure the mode of the interfaces that connect directly to the FCoE host with ENode2 (**xe-0/0/10**) and to aggregation layer FCoE transit switch TS2 (**xe-0/0/11**):

   `user@switch#` **set interfaces xe-0/0/10 unit 0 family ethernet-switching interface-mode trunk**
   set interfaces xe-0/0/11 unit 0 family ethernet-switching interface-mode trunk

2. Configure the interface VLAN membership so that the interfaces are members of the dedicated VN2VN_Port VLAN (**vlan200**):

   `user@switch#` **set interfaces xe-0/0/10 unit 0 family ethernet-switching vlan members vlan200**
   set interfaces xe-0/0/11 unit 0 family ethernet-switching vlan members vlan200

3. Configure the FCoE VLAN dedicated to VN2VN_Port FIP snooping:

   `user@switch#` **set vlans vlan200 vlan-id 200**

4. Configure the network-facing port (**xe-0/0/11**) as an FCoE trusted port:

   `user@switch#` **set vlans vlan200 forwarding-options fip-security interface xe-0/0/11 fcoe-trusted**

5. Enable VN2VN_Port FIP snooping on the VLAN and configure the beacon period:

   `user@switch#` **set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000**

Verification

To verify that the VN2VN_Port FIP snooping configuration has been created and is operating properly on all three switches, perform these tasks:

- Verifying That VN2VN_Port FIP Snooping Is Enabled on the FCoE VLAN (All Three Transit Switches) on page 5042

Verifying That VN2VN_Port FIP Snooping Is Enabled on the FCoE VLAN (All Three Transit Switches)

Purpose Verify that VN2VN_Port FIP snooping is enabled on the correct VLAN (**vlan200**), the beacon period is set to **90000** milliseconds, and that the correct interfaces (**xe-0/0/20** and **xe-0/0/21** on TS1, **xe-0/0/30** and **xe-0/0/31** aggregation layer TS2, and **xe-0/0/10** and **xe-0/0/11** on TS3) are members of the VLAN.

Action List the FIP snooping information on transit switch TS1 using the operational mode command **show fip snooping detail**

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fc:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/20
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fc:00:01:0a:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fc:00:01:0b:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/21
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fc:00:01:0b:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fc:00:01:0a:01
```

List the FIP snooping information on aggregation layer transit switch TS2 using the operational mode command **show fip snooping detail**

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fc:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/30
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fc:00:01:0b:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fc:00:01:0a:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/31
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fc:00:01:0a:01
         Active Sessions    : 1
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fc:00:01:0b:01
```

List the FIP snooping information on transit switch TS3 using the operational mode command **show fip snooping detail**

```
user@switch> show fip snooping detail
VLAN: vlan200,  Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
  Beacon_Period:  90000
  VN2VN Mode: Point-to-Point
    Enode Information
```

```
Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/10
  Active VN_Ports : 1
  VN_Port Information
  VN-Port MAC: 0e:fd:00:00:0b:01
     Active Sessions    : 1
     Session Information
 Vlink far-end VN-Port-MAC: 0e:fd:00:00:0a:01
Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/11
  Active VN_Ports : 1
  VN_Port Information
  VN-Port MAC: 0e:fd:00:00:0a:01
     Active Sessions    : 1
     Session Information
 Vlink far-end VN-Port-MAC: 0e:fd:00:00:0b:01
```

Meaning The **show fip snooping detail** command lists all of the transit switch information about VN2VN_Port FIP snooping and VN2VF_Port FIP snooping on each transit switch. The command shows that:

- The VLAN is **vlan200**.
- The mode is FIP snooping mode **VN2VN**, for VN2VN_Port FIP snooping. (If the Mode field shows **VN2VF**, then the FIP snooping mode is VN2VF_Port FIP snooping.)
- The beacon period is **90000**.
- The interfaces connected to the ENodes are **xe-0/0/20** and **xe-0/0/21** on transit switch TS1, **xe-0/0/30** and **xe-0/0/31** on aggregation layer transit switch TS2, and **xe-0/0/10** and **xe-0/0/11** on transit switch TS3. Because the transit switches are transparent passthrough switches, the network-facing trunk ports “see” the FCoE host ENodes at the far end of the VN2VN_Port virtual link.

In addition, this useful command shows information about the ENodes and the VN2VN_Port sessions.

Related Documentation

- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 5025
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 5030
- Enabling VN2VN_Port FIP Snooping and Configuring the Beacon Period on an FCoE Transit Switch on page 5073
- Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch on page 4865

Configuration Tasks (Fibre Channel, FCoE, FIP, and FIP Snooping)

Configuring an FCoE-FC Gateway Fibre Channel Fabric

Fibre Channel (FC) fabric configuration consists of creating a unique name and identifier for each FC fabric you want to create and configuring it as an FCoE-FC gateway.

You can create a maximum of 12 FC fabrics on a QFX3500 switch. After you create a fabric, you can create and assign interfaces to the fabric, configure FIP parameters for the fabric, and set proxy traceoptions.

To configure an FC fabric using the CLI, specify a unique name and identification number for the fabric:

1. Configure the fabric name and fabric ID:

   ```
   [edit]
   user@switch# set fc-fabrics fabric-name fabric-id fabric-id
   ```

   NOTE: Changing the fabric name or the fabric ID causes all logins to drop and forces the ENodes to log in again.

   For example, to configure an FC fabric with the name **fab_ulous** and the fabric ID **10** (the range of **fabric-id** values is 1 through 4095):

   ```
   [edit]
   user@switch# set fc-fabrics fab_ulous fabric-id 10
   ```
2. Configure the fabric as a gateway fabric:

```
[edit fc-fabrics fabric-name]
user@switch# set fabric-type proxy
```

For example, to configure the FC fabric with the name **fab_ulous** as a gateway fabric:

```
[edit fc-fabrics fab_ulous]
user@switch# set fabric-type proxy
```

Related Documentation

- Configuring a Fibre Channel Interface on page 5049
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Assigning Interfaces to a Fibre Channel Fabric on page 5054
- Configuring FIP on an FCoE-FC Gateway on page 5059
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Understanding an FCoE-FC Gateway on page 4808

Disabling the Fabric WWN Verification Check

When a QFX Series NP_Port sends a fabric login (FLOGI) request to a Fibre Channel (FC) switch, the FLOGI accept (FLOGI-ACC) reply from the FC switch contains the SAN fabric worldwide name (WWN). The QFX Series uses the SAN fabric WWN in the multicast discovery advertisement (MDA) that the QFX Series sends to the ENodes in the FCoE network.

However, some FC switches substitute their own WWN (often the FC switch's virtual WWN) for the SAN fabric WWN in the FLOGI-ACC message. In this case, different NP_Ports that log in to the same FC fabric might receive different fabric WWNs in the FLOGI-ACC messages if the NP_Ports are connected to different FC switches in the SAN fabric.

If the QFX Series receives different fabric WWNs on NP_Ports that are connected to the same SAN fabric, the QFX Series uses the first fabric WWN it receives in the MDA it sends to the ENodes. The QFX Series isolates the NP_Ports that receive a different fabric WWN from other FC switches in that SAN fabric. No ENode sessions are assigned to the isolated NP_Ports. FC traffic is assigned only to NP_Ports that receive a fabric WWN in the FLOGI-ACC message that matches the fabric WWN received by the first NP_Port to log in to the FC fabric. (If an NP_Port receives a fabric WWN that does not match the fabric WWN received by the first NP_Port to log in to the FC fabric, it does not carry traffic to the SAN fabric.)

To prevent ENodes from being isolated due to a mismatched fabric WWN, you can disable the gateway fabric WWN verification check. Disabling the fabric WWN verification check enables all NP_Ports connected to a SAN fabric are used to carry traffic between the gateway and the FC switch, regardless of the fabric WWN the NP_Port receives in the FLOGI-ACC message.

NOTE: **Disabling or enabling the fabric WWN verification check logs out all FCoE sessions.**

To disable the fabric WWN verification check:

- `[edit fc-fabrics` *`fabric-name`* `proxy]`
  `user@switch#` **set no-fabric-wwn-verify**

Related Documentation

- Understanding FCoE-FC Gateway Functions on page 4812
- **show fibre-channel proxy fabric-state on page 5241**

Configuring a Physical Fibre Channel Interface

When you configure the switch as an FCoE-FC gateway, you must configure either 6 or 12 of the physical interfaces as native FC interfaces. Native FC interfaces connect to the storage area network (SAN) FC switch.

You can configure ports xe-0/0/0 through xe-0/0/5 as fc-0/0/0 through fc-0/0/5, and ports xe-0/0/42 through xe-0/0/47 as fc-0/0/42 through fc-0/0/47 to create blocks of native FC interfaces. You cannot individually configure a single port as a native FC interface. Within these port blocks, you cannot mix FC interfaces with Ethernet interfaces. All of the ports in a block must be either native FC interfaces or Ethernet interfaces.

You can configure:

- Six native FC interfaces by configuring either ports xe-0/0/0 through xe-0/0/5 as fc-0/0/0 through fc-0/0/5, or ports xe-0/0/42 through xe-0/0/47 as fc-0/0/42 through fc-0/0/47.
- Twelve native FC interfaces by configuring ports xe-0/0/0 through xe-0/0/5 as fc-0/0/0 through fc-0/0/5 and ports xe-0/0/42 through xe-0/0/47 as fc-0/0/42 through fc-0/0/47.
- No native FC interfaces by leaving ports xe-0/0/0 through xe-0/0/5 and ports xe-0/0/42 through xe-0/0/47 in their default state as Ethernet interfaces.

- To configure physical FC interfaces using the CLI, specify the physical port block you want to configure on the switch as native FC interfaces:

  ```
  [edit chassis]
  user@switch# set fpc fpc pic pic fibre-channel port-range port-range-low port-range-high
  ```

  For example, to configure six native FC interfaces, you can configure ports 0 through 5 as physical FC interfaces:

  ```
  [edit chassis]
  user@switch# set fpc 0 pic 0 fibre-channel port-range 0 5
  ```

  To configure 12 native FC interfaces requires two separate statements:

  ```
  [edit chassis]
  user@switch# set fpc 0 pic 0 fibre-channel port-range 0 5
  user@switch# set fpc 0 pic 0 fibre-channel port-range 42 47
  ```

Related Documentation

- Configuring an FCoE-FC Gateway Fibre Channel Fabric on page 5045
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Configuring a Fibre Channel Interface on page 5049
- Assigning Interfaces to a Fibre Channel Fabric on page 5054
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

Configuring a Fibre Channel Interface

When a QFX3500 acts as an FCoE-FC gateway, native Fibre Channel (FC) traffic flows between the switch and the storage area network (SAN) FC switch. When you configure a port as an FC interface, it transports only FC traffic. It does not transport Ethernet traffic.

You can configure ports xe-0/0/0 through xe-0/0/5 as fc-0/0/0 through fc-0/0/5 and ports xe-0/0/42 through xe-0/0/47 as fc-0/0/42 through fc-0/0/47 to create blocks of native FC interfaces.

Each of these blocks of ports must be configured either as all Ethernet ports or as all native FC ports. Within each block of ports, you cannot mix FC and Ethernet interfaces. This means that you can configure 0, 6, or 12 ports as native FC ports. "Configuring a Physical Fibre Channel Interface" on page 5048 describes how to configure the port blocks as physical FC interfaces.

NOTE: **Do not configure ports that you want to use for native FC traffic as part of an Ethernet VLAN or as Ethernet ports.**

Configure a port as an FC interface when the port connects to the F_Port of an FC switch.

FC interface configuration includes:

- Explicitly specifying one or more ports as an FC family interface in NP_Port mode (mandatory).
- Configuring the FC interface options port speed and buffer-to-buffer credit state change number (BB_SC_N) (optional).
- Configuring the interface as a loopback interface (optional).

The buffer-to-buffer state change number feature prevents the loss of buffer-to-buffer credits between the two interfaces on either end of an FC link. The state change number determines the number of frames and receiver ready (R_RDY) primitives the interfaces exchange between the state change send (BB_SCs) and the state change receive (BB_SCr) primitives used to track these transactions.

Enabling BB_SC_N by configuring BB_SC_N on both of the FC link interfaces:

- Requests that $2^{BB\_SC\_N}$ number of frames be sent between two consecutive BB_SCs primitives, and
- Requests that $2^{BB\_SC\_N}$ number of R_RDY primitives be sent between two consecutive BB_SCr primitives.

When the number of R_RDY primitives received equals $2^{BB\_SC\_N}$, the R_RDY counter resets to zero. When the number of frames received equals $2^{BB\_SC\_N}$, the frame counter resets to zero. The interfaces calculate the number of buffer-to-buffer credits lost based on counter discrepancies and take corrective action to recover the lost credits.

If you enable BB_SC_N, the recommended BB_SC_N setting is eight. Setting the BB_SC_N number to zero (0) disables the feature. If either of the two connected FC interfaces is configured with zero as the BB_SC_N value, then both interfaces disable the feature. If the two connected FC interfaces have different nonzero BB_SC_N numbers configured, both interfaces use the higher number.

For the port to transport FC traffic, you must also set the physical port as an FC port using the **port-range** command.

To configure an FC interface using the CLI:

1. Specify the interface as family FC and set the port mode to NP_Port (setting the port mode to NP_Port is a mandatory configuration):

   ```
   [edit]
   user@switch# set interfaces interface-name unit unit family fibre-channel port-mode np-port
   ```

   For example, to configure the interface **fc-0/0/3** as an FC interface and set the port mode to **np-port**:

   ```
   [edit]
   user@switch# set interfaces fc-0/0/3 unit 0 family fibre-channel port-mode np-port
   ```
2. Configure the FC interface speed option:

   ```
   [edit]
   user@switch: set interfaces interface-name fibrechannel-options speed (auto-negotiation | 2g | 4g | 8g)
   ```

   For example, to set the FC interface speed option to **8g** for the interface **fc-0/0/3**:

   ```
   [edit]
   user@switch: set interfaces fc-0/0/3 fibrechannel-options speed 8g
   ```

   The default port mode is **auto-negotiation**, which sets the port speed to match the speed of the attached FC F_Port interface (2 Gbps, 4 Gbps, or 8 Gbps).

3. Configure the optional buffer-to-buffer credit state change number:

   ```
   [edit]
   user@switch: set interfaces interface-name fibrechannel-options bb-sc-n 0..15
   ```

   For example, to set the FC interface buffer-to-buffer credit state change number to **8** for the interface **fc-0/0/3**:

   ```
   [edit]
   user@switch: set interfaces fc-0/0/3 fibrechannel-options bb-sc-n 8
   ```

After you configure one or more FC interfaces, assign them and an FCoE VLAN to an FC fabric.

Related Documentation

- Assigning Interfaces to a Fibre Channel Fabric on page 5054
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Configuring a Physical Fibre Channel Interface on page 5048
- Deleting a Fibre Channel Interface on page 5055
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963

- Understanding Interfaces on an FCoE-FC Gateway on page 4829
- Understanding an FCoE-FC Gateway on page 4808

Configuring an FCoE VLAN Interface on an FCoE-FC Gateway

When you configure the switch as an FCoE-FC gateway, a Layer 3 FCoE VLAN interface transmits and receives Fibre Channel over Ethernet (FCoE) traffic between the gateway and FCoE-capable servers on the Ethernet network. Configuring a Layer 3 FCoE VLAN interface on the switch creates virtual fabric port (VF_Port) interfaces facing the FCoE server virtual node ports (VN_Ports).

The FCoE VLAN interface is the interface for the dedicated VLAN the FCoE servers use for FCoE traffic. Each FC fabric requires at least one dedicated FCoE VLAN and at least one Layer 3 FCoE VLAN interface to transport FCoE traffic. On QFabric systems, the FCoE VLAN interface, the FCoE VLAN, and the interfaces that are members of the FCoE VLAN must be on the same Node device.

NOTE: FCoE VLANs (any VLANs that carries FCoE traffic) support only Spanning Tree Protocol (STP) and link aggregation group (LAG) Layer 2 features.

NOTE: To configure an FCoE VLAN on a device that you are using as transit switch, you do not an FCoE VLAN interface. Instead, use the procedure described in "Configuring VLAN Interfaces for FCoE Traffic on an FCoE Transit Switch" on page 5066.

Before you configure an FCoE VLAN interface, create the FCoE VLAN and assign 10-Gigabit Ethernet interfaces configured in tagged-access port mode to the VLAN. These 10-Gigabit Ethernet interfaces are the physical interfaces that transport the FCoE traffic to and from the FCoE devices in the Ethernet network.

Each Ethernet interface that connects to FCoE devices must also include the native VLAN to transport FIP traffic, because FIP VLAN discovery and notification frames are exchanged as untagged packets. The FCoE VLAN must carry only FCoE traffic. A VLAN cannot transport a mix of FCoE and standard Ethernet traffic.

FCoE VLAN interface configuration includes:

- Configuring a VLAN to use as a dedicated FCoE VLAN.
- Configuring a native VLAN for FIP traffic.
- Configuring member interfaces for the FCoE VLAN.
- Configuring the FCoE VLAN as a Fibre Channel (family) VLAN and setting the port mode value to **f-port**. Explicitly configuring the FCoE VLAN interface in F_Port mode is

mandatory. The switch interface with which the FCoE server VN_Ports communicate must present a VF_Port to the servers.

- Configuring the FCoE VLAN interface as the Layer 3 interface for FCoE traffic.

To configure an FCoE VLAN interface:

1. Configure a dedicated FCoE VLAN:

   ```
   [edit vlans]
   user@switch# set vlan-name vlan-id vlan-id
   ```

   For example, to configure a VLAN named **fcoe_vlan** with a VLAN ID of **100** as the FCoE VLAN:

   ```
   [edit vlans]
   user@switch# set fcoe_vlan vlan-id 100
   ```

2. Configure a native VLAN for FIP traffic:

   ```
   [edit vlans]
   user@switch# set native vlan-id vlan-id
   ```

   For example, to configure the native VLAN with a VLAN ID of **1**:

   ```
   [edit vlans]
   user@switch# set native vlan-id 1
   ```

3. Configure member interfaces for the FCoE VLAN (use **ethernet-switching** as the family and **tagged-access** as the port mode):

   ```
   [edit interfaces]
   user@switch# set interface-name unit unit family family port-mode mode vlan members
   vlan-name
   ```

   For example, to configure the interface **xe-0/0/10** as a member of the FCoE VLAN **fcoe_vlan**:

   ```
   [edit interfaces]
   user@switch# set xe-0/0/10 unit 0 family ethernet-switching port-mode tagged-access vlan
   members fcoe_vlan
   ```

4. Configure the native VLAN on the FCoE VLAN member interfaces:

   ```
   [edit interfaces]
   user@switch# set interface-name unit unit family family native-vlan-id vlan-id
   ```

   For example, to configure the interface **xe-0/0/10** as a member of the native VLAN with the native VLAN ID **1**:

   ```
   [edit interfaces]
   user@switch# set xe-0/0/10 unit 0 family ethernet-switching native-vlan-id 1
   ```

5. Assign the Ethernet interfaces to the FCoE VLAN:

   ```
   [edit vlans]
   user@switch# set vlan-name interface interface-name
   ```

   For example, to assign the interface **xe-0/0/10.0** to the FCoE VLAN named **fcoe_vlan**:

   ```
   [edit vlans]
   user@switch# set fcoe_vlan interface xe-0/0/10.0
   ```


6. Define an interface as an FCoE VLAN interface in F_Port mode (to present a VF_Port to the FCoE servers):

```
[edit interfaces]
user@switch# set vlan unit unit family fibre-channel port-mode f-port
```

   For example, to configure VLAN unit **100** as an FCoE VLAN interface and set the port mode to **f-port**:

```
[edit interfaces]
user@switch# set vlan unit 100 family fibre-channel port-mode f-port
```

7. Define the Layer 3 FCoE VLAN interface:

```
[edit vlans]
user@switch# set vlan-name l3-interface vlan-interface-name
```

   For example, to configure VLAN interface unit **100** (the FCoE VLAN interface defined earlier in this example) as the Layer 3 FCoE VLAN interface for FCoE VLAN **fcoe_vlan**:

```
[edit vlans]
user@switch# set fcoe_vlan l3-interface vlan.100
```

Related Documentation

- Understanding Interfaces on an FCoE-FC Gateway on page 4829
- Configuring an FCoE-FC Gateway Fibre Channel Fabric on page 5045
- Configuring a Physical Fibre Channel Interface on page 5048
- Configuring a Fibre Channel Interface on page 5049
- Assigning Interfaces to a Fibre Channel Fabric on page 5054
- Disabling VN2VF_Port FIP Snooping on an FCoE-FC Gateway Switch Interface on page 5072
- Configuring VLAN Interfaces for FCoE Traffic on an FCoE Transit Switch on page 5066
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963

Assigning Interfaces to a Fibre Channel Fabric

When you configure the switch as an FCoE-FC gateway, you assign one or more (up to 12) native Fibre Channel (FC) interfaces and at least one FCoE VLAN interface to each FC fabric. FC interfaces transport native FC traffic between the proxy gateway and the storage area network (SAN) FC switch. FCoE VLAN interfaces transport FCoE traffic between FCoE-capable servers and the gateway.

Each FC fabric needs both types of interfaces to transport traffic between FCoE servers on the Ethernet network and FC storage devices in the core FC network behind the FC switch. FCoE traffic between the FCoE servers and the gateway must travel in a dedicated FCoE VLAN. Native FC traffic passes between the gateway and the FC switch on the native FC interfaces.

You must configure the FC interfaces and the FCoE VLAN interfaces that you assign to a particular fabric on the same Juniper Networks QFX3500 Switch. Traffic between an FCoE device and the FC switch must ingress and egress the same gateway.

To assign core-facing native FC interfaces and a server-facing FCoE VLAN interface to an FC fabric, configure a fabric and then specify the interfaces:

1. Assign the native FC interfaces to the FC fabric:

```
[edit fc-fabrics fabric-name]
user@switch: set interface interface-name
user@switch: set interface interface-name
user@switch: set interface interface-name
...
```

2. Assign an FCoE VLAN interface to the FC fabric:

```
[edit fc-fabrics fabric-name]
user@switch: set interface vlan-name
```

For example, to assign the native FC interfaces **fc-0/0/0.0**, **fc-0/0/1.0**, and **fc-0/0/2.0** and the FCoE VLAN interface **vlan.100** to an FC fabric named **san_tana**:

```
user@switch: set fc-fabrics san_tana interface fc-0/0/0.0
user@switch: set fc-fabrics san_tana interface fc-0/0/1.0
user@switch: set fc-fabrics san_tana interface fc-0/0/2.0
user@switch: set fc-fabrics san_tana interface vlan.100
```

Related Documentation

- Configuring a Fibre Channel Interface on page 5049
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Understanding Interfaces on an FCoE-FC Gateway on page 4829
- Understanding an FCoE-FC Gateway on page 4808

Deleting a Fibre Channel Interface

Before you delete a Fibre Channel (FC) interface, you must first delete the interface from the FC fabric configuration. This prevents configuration errors that would result if you deleted an FC interface from the **[edit interfaces]** hierarchy level but did not delete the interface from the FC fabric.

When you configure the switch as an FCoE-FC gateway, FC interfaces transmit and receive native FC traffic between the gateway and the FC switch. You can configure ports xe-0/0/0 through xe-0/0/5 as fc-0/0/0 through fc-0/0/5 and ports xe-0/0/42 through xe-0/0/47 as fc-0/0/42 through fc-0/0/47 to create one or two blocks of six native FC interfaces.

To delete an FC interface using the CLI:

1. Delete the FC interface from the FC fabric to which it belongs:

   ```
   [edit]
   user@switch# delete fc-fabrics fabric-name interface interface-name
   ```

   For example, to delete the FC interface **fc-0/0/3.0** from an FC fabric named **sanfab1**:

   ```
   [edit]
   user@switch# delete fc-fabrics sanfab1 interface fc-0/0/3.0
   ```
2. Delete the FC interface from the switch **[edit interfaces]** hierarchy:

   ```
   [edit]
   user@switch: delete interfaces interface-name
   ```

   For example, to delete the interface **fc-0/0/3.0** from the switch:

   ```
   [edit]
   user@switch: delete interfaces fc-0/0/3.0
   ```

The FC interface has been deleted from the FC fabric and from the switch.

Related Documentation

- Assigning Interfaces to a Fibre Channel Fabric on page 5054
- Configuring a Physical Fibre Channel Interface on page 5048
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

Disabling Storm Control on FCoE Interfaces on an FCoE-FC Gateway

Storm control is not supported on the FCoE interfaces of an FCoE-FC gateway VLAN. Enabling storm control on an FCoE-FC gateway VLAN interface may cause FCoE packet loss. Storm control is disabled by default on all interfaces. However, if you enabled storm control globally on all switch interfaces or on any interfaces that are part of the FCoE VLAN interface, you must disable storm control on the Ethernet interfaces of the FCoE VLAN.

If storm control is enabled on only a few interfaces of the FCoE VLAN, you can disable storm control on individual interfaces by including the **delete ethernet-switching-options storm-control interface *interface-name*** statement in the configuration, where ***interface-name*** is the name of the interface on which you want to disable storm control.

If storm control is enabled globally on the switch when the switch is acting as an FCoE-FC gateway, it is often easiest to disable storm control on all interfaces, then enable storm control only on Ethernet interfaces that are not part of the FCoE VLAN interface.

If storm control is enabled globally, you can disable storm control in either of two ways:

- Disable storm control on all interfaces, then enable storm control on the interfaces you want to use storm control. (From the default configuration, you cannot disable storm control on individual interfaces because the default configuration enables storm control on **all** interfaces, not on individual interfaces.)

  For example, if you want interfaces xe-0/0/20, xe-0/0/21, and xe-0/0/22 to use storm control, disable storm control on all interfaces, then enable storm control on those three interfaces:

  1. Disable storm control on all interfaces:

     ```
     user@switch# delete ethernet-switching-options storm-control interface all
     ```

  2. Enable storm control on interfaces xe-0/0/20, xe-0/0/21, and xe-0/0/22:

     ```
     user@switch# set ethernet-switching-options storm-control interface xe-0/0/20
     user@switch# set ethernet-switching-options storm-control interface xe-0/0/21
     user@switch# set ethernet-switching-options storm-control interface xe-0/0/22
     ```

- Disable storm control for all unknown unicast traffic on all interfaces by including the following statement in your configuration:

  ```
  user@switch# set ethernet-switching-options storm-control interface all no-unknown-unicast
  ```

Related Documentation

- Understanding Interfaces on an FCoE-FC Gateway on page 4829
- Understanding Storm Control on page 4471
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963

Defining the Proxy Load-Balancing Algorithm

When the QFX Series is configured as an FCoE-FC gateway, it balances the FCoE session load assigned to each NP_Port link between the gateway and the FC switch in the FC

SAN to avoid overloading or underutilizing each link. The QFX Series supports three types of load-balancing mechanisms:

- Simple load balancing—Load balancing is based on the weighted utilization (session load) of the NP_Ports connected to an FC fabric. The session load is the sum of the FLOGI and FDISC sessions on each link. Each new ENode fabric login (FLOGI) or VN_Port fabric discovery (FDISC) session is assigned to the least-loaded link, so an FDISC session initiated by the VN_Port on an ENode might not be assigned to the same link as the parent ENode's FLOGI session. Simple load balancing is the default algorithm. Simple load balancing is the default load-balancing algorithm. Rebalancing the link load disrupts only selected sessions to minimize the impact (the switch uses an algorithm to log out only the sessions that need to be moved to other links to balance the load when those sessions log in again).
- ENode-based load balancing—Load balancing is based on the weighted utilization (session load) of the NP_Ports connected to an FC fabric. The session load is the sum of the FLOGI and FDISC sessions on each link. However, when an ENode logs in to the fabric, the switch places all subsequent VN_Port FDISC sessions associated with that ENode on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link. The switch calculates the link load based on the combined total of FLOGIs and FDISCs on each NP_Port link. Rebalancing the link load disrupts all sessions (all sessions log out and then log in again).
- FLOGI-based load balancing—Load balancing is based on the weighted utilization (session load) of the NP_Ports connected to an FC fabric. The session load is the sum of the FLOGI sessions on each link. FDISC sessions are not counted. When an ENode logs in to the fabric, the switch places all subsequent VN_Port FDISC sessions associated with that ENode on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link. Rebalancing the link load disrupts only selected sessions to minimize the impact (the switch uses an algorithm to log out only the sessions that need to be moved to other links to balance the load when those sessions log in again).

To define the proxy load-balancing algorithm for a proxy fabric on the FCoE-FC gateway, set the algorithm as **enode-based**, **simple**, or **flogi-based**:

- `[edit fc-fabrics` *`fabric-name`* `proxy]`
  `user@switch#` **set load-balance-algorithm (enode-based | simple | flogi-based)**

  For example, to configure a gateway fabric named **san_fab1** to use **enode-based** load balancing:

  `user@switch#` **set fc-fabrics san_fab1 proxy load-balance-algorithm enode-based**

Related Documentation

- Example: Configuring Automated Fibre Channel Interface Load Rebalancing on page 4999
- Simulating On-Demand Fibre Channel Link Load Rebalancing (Dry Run Test) on page 5058
- Understanding Load Balancing in an FCoE-FC Gateway Proxy Fabric on page 4841
- Monitoring Fibre Channel Interface Load Balancing on page 5147

Simulating On-Demand Fibre Channel Link Load Rebalancing (Dry Run Test)

On-demand Fibre Channel (FC) link load rebalancing is a disruptive action that causes sessions to log out of the network, then log back in to be placed on FC links (NP_Ports) in a balanced manner. The number of sessions logged out to rebalance the links depends on the load-balancing algorithm used (simple, ENode-based, or FLOGI-based) and whether or not the load is already balanced. (If the link load is already balanced, the switch does not rebalance the loads when you request on-demand load rebalancing.)

You can use the **dry-run** option to list the sessions that might be affected (logged out to be redistributed among the active FC interface links) by on-demand load rebalancing *before* you actually rebalance the link load. (Because new sessions might log in between the time you perform a dry run and the time you request on-demand load rebalancing, the affected sessions may change. Therefore, the sooner that you perform an on-demand load rebalance after you perform a dry run, the more accurate the dry run results are likely to be.)

To request a link load rebalancing dry run:

```
user@switch> request fibre-channel proxy load-rebalance dry-run fabric fabric-name
```

For example, to request a dry run on an FC fabric named *fc_fabric_100* to display a list of sessions that might be disrupted if you request an actual link load rebalance:

```
user@switch> request fibre-channel proxy load-rebalance dry-run fabric fc_fabric_100
Fabric: fc_fabric_100, Fabric-id: 100
F-Port                        FCID     Port-WWN                NP-Port
vlan.100                      0x8a013a 02:01:00:64:00:00:00:2a fc-0/0/1.0
vlan.100                      0x8a013c 02:01:00:64:00:00:00:2b fc-0/0/1.0
vlan.100                      0x8a0146 02:01:00:64:00:00:00:2e fc-0/0/1.0
vlan.100                      0x8a014c 02:01:00:64:00:00:00:2f fc-0/0/1.0
```

Related Documentation

- request fibre-channel proxy load-rebalance on page 5164
- Defining the Proxy Load-Balancing Algorithm on page 5056
- Example: Configuring Automated Fibre Channel Interface Load Rebalancing on page 4999
- Understanding Load Balancing in an FCoE-FC Gateway Proxy Fabric on page 4841
- Monitoring Fibre Channel Interface Load Balancing on page 5147

Enabling and Disabling CoS OxID Hash Control

The originator exchange identifier (OxID) field is one of several fields that the switch can use in its hash function computation for FCoE traffic load balancing over multiple outgoing links. You can configure whether or not the switch uses the OxID in the hash computation.

Including the OxID field in the load-balancing hash computation allows different exchanges between a pair of Fibre Channel (FC) endpoints (such as an FCoE host and an FC storage device) to take different paths across the network, thus improving the aggregate network throughput.

However, if the paths between different sets of FC endpoints have common links, congestion on one set of FC endpoints can affect the other set of endpoints. Such congestion can happen if the FCoE traffic on the two sets of endpoints uses the same priority (IEEE 802.1p code point). It is common for networks to use priority 3 (IEEE 802.1p code point 011) for FCoE traffic. However, on the QFX3500, you can assign different IEEE priorities to different lossless FCoE flows as described in "Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows" on page 5427 to further separate the traffic flows.

OxID hash control is enabled by default.

- To enable OxID hash control field for FCoE traffic load balancing:

```
[edit forwarding-options hash-key]
user@switch# set family fcoe oxid enable
```

- To disable OxID hash control field for FCoE traffic load balancing:

```
[edit forwarding-options hash-key]
user@switch# set family fcoe oxid disable
```

Related Documentation

- Understanding OxID Hash Control for FCoE Traffic Load Balancing on page 4857
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427

Configuring FIP on an FCoE-FC Gateway

Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) establishes and maintains Fibre Channel (FC) virtual links between pairs of FCoE devices. A virtual link emulates the physical point-to-point link that FC requires between two FC devices.

FIP is enabled by default and uses the default FIP settings on all FCoE interfaces that are part of the gateway FC fabric. You can use the default FIP parameter values, or you can configure FIP parameters globally or on a per-interface basis. Configuring FIP on an individual interface overrides the global FIP configuration.

You can configure the following parameters globally for the fabric and per interface:

- FIP keepalive message transmission interval—This interval is the time period between sending FIP keepalive messages.

- Priority—If an FCoE node (ENode) connects to more than one switch, the priority value determines the switch to which the ENode connects. The switch with the lowest priority number has the highest priority.

You can only configure the following parameters globally on an FC fabric:

- FC-MAP—The 24-bit FCoE mapped address prefix that identifies the attached FC switch in the SAN fabric. The FC-MAP value is used in the fabric provided MAC address (FPMA) created for each ENode that logs in. This value must be the same for the FC switch and the QFX Series.

  NOTE: **Changing the FC-MAP value causes all logins to drop and forces the ENodes to log in again.**

- FCoE trusted—You can globally configure all of the Ethernet ports in a specified FC fabric to be FCoE trusted. You might want to configure interfaces as FCoE trusted if the interfaces are connected to a transit switch that is performing FIP snooping. For interfaces that are directly connected to FCoE hosts, FIP snooping should be enabled, and you should not configure the fabric as FCoE trusted.

  NOTE: **Do not configure interfaces with FIP snooping enabled as FCoE trusted.**

  Configuring interfaces as FCoE trusted reduces system overhead by eliminating the need for filters. The total number of sessions the system can support is 2500 sessions. Sessions are defined as the combined number of VN_Port to VF_Port sessions and VN_Port to VN_Port sessions. (Although VN2VF and VN2VN sessions run in different FCoE VLANs, the session limit is a system limit, not a per-VLAN limit.)

  NOTE: **A session is a FLOGI or FDISC login to the FC SAN fabric. Session does not refer to end-to-end storage sessions. There is no limit to the number of end-to-end storage sessions.**

  NOTE: **Changing the fabric ports from untrusted to trusted removes any existing FIP snooping filters from the ports. Changing the fabric ports from trusted to untrusted forces all of the FCoE sessions on those ports to log out so that when the ENodes and VN_Ports log in again, the switch can build the appropriate FIP snooping filters.**

- Maximum number of FCoE sessions per ENode—You can globally configure the maximum number of FCoE sessions (FLOGI plus FDISC) permitted from an ENode. The maximum number of sessions per ENode is 2000 sessions. The total number of sessions (VN2VF_Port sessions and VN2VN_Port sessions combined) cannot exceed the gateway fabric's maximum limit of 2500 sessions.

To configure FIP options globally using the CLI:

1. Specify the fabric on which you want to configure FIP:

```
[edit]
user@switch# set fc-fabrics fabric-name protocols fip
```

2. Configure the FIP keepalive message transmission interval in milliseconds to specify the amount of time between periodic FIP discovery advertisements for the fabric interfaces (the default is 8000 ms; the range is 250 through 90000 ms):

```
[edit fc-fabrics fabric-name protocols fip]
user@switch# set fka-adv-period milliseconds
```

3. Configure the priority value the switch advertises to ENodes in the range from 0 through 255; the default value is 128:

```
[edit fc-fabrics fabric-name protocols fip]
user@switch# set priority priority
```

4. Configure the FC-MAP value to match the FC-MAP value of the attached FC switch in the FC SAN fabric; the range of possible values is 0EFC00 through 0EFCFF, and the default value is 0EFC00:

```
[edit fc-fabrics fabric-name protocols fip]
user@switch# set fc-map fc-map
```

5. Configure the interfaces in the FC fabric as FCoE trusted (in this example, we assume that the interfaces have not been enabled for FIP snooping):

```
[edit fc-fabrics fabric-name protocols fip]
user@switch# set fcoe-trusted
```

6. Configure the maximum number of FCoE sessions for each ENode in the fabric:

```
[edit fc-fabrics fabric-name protocols fip]
user@switch# set max-sessions-per-enode
```

For example, to configure all FCoE interfaces associated with an FC fabric called **movieco_san** with a FIP keepalive interval value of **25000** milliseconds, a priority of **70**, an FC-MAP value of **0EFC01**, as FCoE trusted, and with a maximum number of FCoE sessions per ENode of 200 sessions:

```
[edit fc-fabrics movieco_san protocols fip]
user@switch# set fka-adv-period 25000
user@switch# set priority 70
user@switch# set fc-map 0EFC01
user@switch# set fcoe-trusted
user@switch# set max-sessions-per-enode 200
```

To override the global FC fabric FIP configuration for a specific FCoE interface using the CLI:

1. Specify the fabric and interface on which you want to configure FIP:

```
[edit fc-fabrics fabric-name protocols fip interface interface-name]
```

2. Configure the FIP keepalive message transmission interval and priority:

```
[edit fc-fabrics fabric-name protocols fip interface interface-name]
user@switch# set fka-adv-period milliseconds
user@switch# set priority priority
```

Related Documentation

- Configuring an FCoE-FC Gateway Fibre Channel Fabric on page 5045
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Understanding FIP Parameters on an FCoE-FC Gateway on page 4825

Setting the Maximum Number of FIP Login Sessions per ENode

When the switch acts as an FCoE-FC gateway, FCoE node (ENode) devices in the Ethernet network use the gateway to connect to the Fibre Channel (FC) storage area network (SAN). You can limit the maximum number of FIP login sessions permitted on each ENode. Limiting the number of login sessions can prevent login session rejections caused when the connected FC switch port configuration limits the number of FIP login sessions.

The maximum number of FIP sessions per ENode is 2000 sessions (FLOGI plus FDISC sessions). The limit you set applies to every ENode in the specified gateway fabric. Each ENode in the fabric can have up to the maximum number of sessions, but the total number of active sessions cannot exceed the session limits you apply to the fabric or the Node device.

There are also configurable FIP login session limits that you can apply to the gateway FC fabric, to the QFX3500 switch or QFabric system Node device, and to the interfaces in each FC fabric.

- To set a maximum number of FIP login sessions per ENode using the CLI:

  ```
  [edit fc-fabrics fc-fabric-name protocols fip]
  user@switch# set max-sessions-per-enode max-login-sessions
  ```

  For example, to configure the ENodes on an FC fabric named **sanfab1** with a maximum FIP login session limit of **250** sessions:

  ```
  [edit fc-fabrics sanfab1]
  user@switch# set protocols fip max-sessions-per-enode 250
  ```

Related Documentation

- Setting the Maximum Number of FIP Login Sessions per FC Interface on page 5063
- Setting the Maximum Number of FIP Login Sessions per FC Fabric on page 5064
- Setting the Maximum Number of FIP Login Sessions per Node Device on page 5065
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

Setting the Maximum Number of FIP Login Sessions per FC Interface

When the switch acts as an FCoE-FC gateway, NP_Ports are the native FC interfaces the gateway uses to connect to the FC switch. You can limit the maximum number of FIP login sessions permitted on an NP_Port interface. Limiting the number of login sessions on an interface can prevent login session rejections caused when the connected FC switch port configuration limits the number of FIP login sessions.

TIP: **A good practice is to configure a maximum number of login sessions on each NP_Port that is less than or equal to the maximum number of login sessions permitted on the connected FC switch port.**

The maximum number of FIP sessions is 2500 sessions. (This is the combined total of all VN2VF_Port and VN2VN_Port sessions on the system.)

There are also configurable FIP login session limits that you can apply to the gateway FC fabric, to the QFX3500 switch or QFabric system Node device, and to the ENodes in each FC fabric. To prevent unexpected FIP login rejections, the sum of the maximum FIP login sessions on all of the NP_Port interfaces that belong to an FC fabric should not exceed the maximum number of sessions the FC fabric supports or the device supports.

- To set a maximum number of FIP login sessions on an NP_Port using the CLI:

  ```
  [edit fc-fabrics fc-fabric-name interface interface-name]
  user@switch# set max-login-sessions max-login-sessions
  ```

  For example, to configure NP_Port interface **fc-0/0/5** with a maximum FIP login session limit of **500** sessions on an FC fabric named **sanfab1**:

  ```
  [edit fc-fabrics sanfab1]
  user@switch# set interface fc-0/0/5 max-login-sessions 500
  ```

Related Documentation

- Setting the Maximum Number of FIP Login Sessions per ENode on page 5062
- Setting the Maximum Number of FIP Login Sessions per FC Fabric on page 5064
- Setting the Maximum Number of FIP Login Sessions per Node Device on page 5065
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

Setting the Maximum Number of FIP Login Sessions per FC Fabric

When the QFX Series acts an FCoE-FC gateway, you configure at least one local FC fabric on the gateway. A gateway FC fabric creates associations that connect FCoE devices on an Ethernet network to an FC switch on a Fibre Channel network. Each FC fabric on a gateway includes native FC interfaces (NP_Ports) that connect the gateway to the FC switch. When FCoE devices want to log in to the FC switch, the gateway sends the FIP login requests to the FC switch on the NP_Port links.

You can limit the maximum number of FIP login sessions permitted on a gateway FC fabric. If a QFX3500 switch or QFabric system Node device has more than one FC fabric, limiting the number of login sessions on an FC fabric can prevent one FC fabric from using all of the login sessions available on the device.

The maximum number of FIP sessions is 2500 sessions. (This is the combined total of all VN2VF_Port and VN2VN_Port sessions on the system.)

There are also configurable FIP login session limits that you can apply to the FC fabric NP_Port interfaces, to the QFX3500 switch or QFabric system Node device, and to the ENodes in each FC fabric. To prevent unexpected FIP login rejections:

- The sum of the maximum FIP login sessions on all of the NP_Port interfaces that belong to an FC fabric should not exceed the maximum number of sessions the FC fabric supports or the device supports.
- The sum of the maximum FIP login sessions on all of the FC fabrics on a device should not exceed the maximum number of sessions per device.

- To set a maximum number of FIP login sessions on an FC fabric using the CLI:

  ```
  [edit fc-fabrics fc-fabric-name]
  user@switch# set max-login-sessions max-login-sessions
  ```

  For example, to configure an FC fabric named **sanfab1** with a maximum FIP login session limit of **2000** sessions:

  ```
  [edit fc-fabrics sanfab1]
  user@switch# set fc-fabrics sanfab1 max-login-sessions 2000
  ```

Related Documentation

- Setting the Maximum Number of FIP Login Sessions per ENode on page 5062
- Setting the Maximum Number of FIP Login Sessions per FC Interface on page 5063
- Setting the Maximum Number of FIP Login Sessions per Node Device on page 5065
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

Setting the Maximum Number of FIP Login Sessions per Node Device

When a QFX3500 switch or QFabric system Node device acts an FCoE-FC gateway, it connects FCoE devices on an Ethernet network to an FC switch in a Fibre Channel network. You can limit the maximum number of FIP login sessions for the FCoE devices on each Node device.

For QFX3500 switches, the maximum limit means that the sum of the FIP login sessions on all of the local FC fabrics on that QFX3500 switch cannot exceed the device maximum.

For the QFabric system, the limit applies to each Node device in the QFabric system. For example, if you configure a maximum FIP login session value of 2000 sessions, each Node device in the QFabric system can have a total of up to 2000 FIP login sessions running on its FC fabrics.

The maximum number of FIP sessions a device can support is 2500 sessions. (This is the combined total of all VN2VF_Port and VN2VN_Port sessions on the system.)

There are also configurable FIP login session limits that you can apply to the FC fabrics on the devices, to the NP_Port interfaces in each FC fabric, and to the ENodes in each FC fabric. To prevent unexpected FIP login rejections:

- The sum of the maximum FIP login sessions for all of the FC fabrics on a device should not exceed the maximum number of sessions per device.
- The sum of the maximum FIP login sessions on all of the NP_Port interfaces that belong to an FC fabric should not exceed the maximum number of sessions the FC fabric supports or the device supports.

- To set a maximum number of FIP login sessions for Node devices using the CLI:

  ```
  [edit fc-options]
  user@switch# set max-login-sessions-per-node max-login-sessions-per-node
  ```

  For example, to configure a maximum FIP login limit of **2000** sessions on a QFX3500 switch or on all Node devices in a QFabric system:

  ```
  [edit fc-options]
  user@switch# set max-login-sessions-per-node 2000
  ```

Related Documentation

- Setting the Maximum Number of FIP Login Sessions per ENode on page 5062
- Setting the Maximum Number of FIP Login Sessions per FC Interface on page 5063
- Setting the Maximum Number of FIP Login Sessions per FC Fabric on page 5064
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

Configuring VLAN Interfaces for FCoE Traffic on an FCoE Transit Switch

When you configure a QFX Series as a Fibre Channel over Ethernet (FCoE) transit switch, you must configure a VLAN that transports only FCoE traffic. FCoE traffic requires a dedicated VLAN and cannot share a VLAN with any other type of traffic. Because FCoE traffic is tagged traffic, the port (or interface) mode cannot be access mode, it must be either tagged-access port-mode (for switches that run the original CLI, such as QFX3500 and QFX3600 standalone switches and QFabric system Node devices) or trunk interface-mode (for switches that run the Enhanced Layer 2 Software (ELS) CLI, such as the QFX5100 switch).

However, each interface that belongs to an FCoE VLAN must not only transport the tagged FCoE traffic, it must also transport the untagged FCoE Initialization Protocol (FIP) traffic. FIP communicates with the storage area network (SAN) Fibre Channel (FC) switch to set up the FCoE session for the FCoE client.

To transport untagged traffic on a tagged-access or trunk mode interface, the interface must have a native VLAN configured on it. Therefore, each interface that belongs to an FCoE VLAN must also have a native VLAN on it.

There are slight differences in the way you configure a native VLAN on an interface, depending on whether the switch uses the ELS CLI or the original CLI. This topic describes both methods.

NOTE: FCoE VLANs (any VLANs that carries FCoE traffic) support only Spanning Tree Protocol (STP) and link aggregation group (LAG) Layer 2 features.

NOTE: To configure an FCoE VLAN on a QFX3500 switch or a QFabric system Node device that you are using as an FCoE-FC gateway, you must also configure an FCoE VLAN interface as described in “Configuring an FCoE VLAN Interface on an FCoE-FC Gateway” on page 5051. (QFX3600, QFX5100, and Virtual Chassis switches do not support FCoE-FC gateway configuration.)

FCoE VLAN configuration includes:

- Configuring a VLAN to use as a dedicated FCoE VLAN
- Configuring the interface members of the FCoE VLAN.
- Configuring a native VLAN for FIP traffic.

This topic includes two configuration procedures, one for switches that run the original CLI, and one for switches that run the ELS CLI.

Original CLI Configuration

To configure an FCoE VLAN on a non-ELS switch (QFX3500, QFX3600, QFabric system Node devices):

1. Configure a dedicated FCoE VLAN:

   ```
   [edit vlans]
   user@switch# set vlan-name vlan-id vlan-id
   ```

   For example, to configure a VLAN named **fcoe_vlan** with a VLAN ID of **100** as the FCoE VLAN:

   ```
   [edit vlans]
   user@switch# set fcoe_vlan vlan-id 100
   ```

2. Configure the FCoE VLAN on the interface (use **ethernet-switching** as the family and **tagged-access** as the port mode):

   ```
   [edit interfaces]
   user@switch# set interface-name unit unit family family port-mode mode vlan members
   vlan-name
   ```

   For example, to configure the interface **xe-0/0/10** as a member of the FCoE VLAN **fcoe_vlan**:

   ```
   [edit interfaces]
   user@switch# set xe-0/0/10 unit 0 family ethernet-switching port-mode tagged-access vlan
   members fcoe_vlan
   ```

3. Configure the Ethernet interface membership in the FCoE VLAN:

   ```
   [edit vlans]
   user@switch# set vlan-name interface interface-name
   ```

   For example, to assign the interface **xe-0/0/10.0** to the FCoE VLAN named **fcoe_vlan**:

   ```
   [edit vlans]
   user@switch# set fcoe_vlan interface xe-0/0/10.0
   ```

4. Configure a native VLAN for the untagged FIP traffic:

   ```
   [edit vlans]
   user@switch# set native vlan-id vlan-id
   ```

   For example, to configure the native VLAN with a VLAN ID of **1**:

   ```
   [edit vlans]
   user@switch# set native vlan-id 1
   ```

5. Assign member interfaces to the native VLAN:

   ```
   [edit interfaces]
   user@switch# set interface-name unit unit family family native-vlan-id vlan-id
   ```

   For example, to configure the interface **xe-0/0/10** as a member of the native VLAN with the native VLAN ID **1**:

   ```
   [edit interfaces]
   user@switch# set xe-0/0/10 unit 0 family ethernet-switching native-vlan-id 1
   ```

ELS CLI Configuration

To configure an FCoE VLAN on a QFX5100 switch running ELS:

1. Configure a dedicated FCoE VLAN:

   ```
   [edit vlans]
   user@switch# set vlan-name vlan-id vlan-id
   ```

   For example, to configure a VLAN named **fcoe_vlan** with a VLAN ID of **100** as the FCoE VLAN:

   ```
   [edit vlans]
   user@switch# set fcoe_vlan vlan-id 100
   ```

2. Configure the FCoE VLAN on the interface (use **ethernet-switching** as the family and **trunk** as the interface mode):

   ```
   [edit interfaces]
   user@switch# set interface-name unit unit family family interface-mode mode vlan members vlan-name
   ```

   For example, to configure the interface **xe-0/0/10** as a member of the FCoE VLAN **fcoe_vlan**:

   ```
   [edit interfaces]
   user@switch# set xe-0/0/10 unit 0 family ethernet-switching interface-mode trunk vlan members fcoe_vlan
   ```

3. Configure the Ethernet interface membership in the FCoE VLAN:

   ```
   [edit vlans]
   user@switch# set vlan-name interface interface-name
   ```

   For example, to assign the interface **xe-0/0/10.0** to the FCoE VLAN named **fcoe_vlan**:

   ```
   [edit vlans]
   user@switch# set fcoe_vlan interface xe-0/0/10.0
   ```

4. Configure a native VLAN on the physical Ethernet interface for the untagged FIP traffic:

   ```
   [edit interfaces]
   user@switch# set interface-name native-vlan-id vlan-id
   ```

   For example, to configure the native VLAN on interface **xe-0/0/10** with a VLAN ID of **1**:

   ```
   [edit interfaces]
   user@switch# set xe-0/0/10 native-vlan-id 1
   ```

5. Configure the Ethernet interface as a member of the native VLAN:

   ```
   [edit interfaces]
   user@switch# set interface-name unit unit family family vlan members native-vlan-id
   ```

   NOTE: The *native-vlan-id* number must be the same as the native VLAN ID number that you configured on the physical Ethernet interface (see step 4).

   For example, to configure the interface **xe-0/0/10** as a member of the native VLAN with the native VLAN ID **1**:

   ```
   [edit interfaces]
   ```


`user@switch#` **set xe-0/0/10 unit 0 family ethernet-switching vlan members 1**

Related Documentation

- Understanding FCoE on page 4799
- Understanding FCoE Transit Switch Functionality on page 4804
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- Enabling VN2VN_Port FIP Snooping and Configuring the Beacon Period on an FCoE Transit Switch on page 5073
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051

Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch

VN_Port to VF_Port (VN2VF_Port) Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) snooping uses information gathered during FIP discovery and login to create firewall filters that provide security against unauthorized access to the FC switch or FCoE forwarder (FCF) through the EX4500 or QFX Series when the switch is acting as an FCoE transit switch. The firewall filters allow only FCoE devices that succeed at logging in to the FC fabric to access the FCF through the transit switch. VN2VF_Port FIP snooping provides security for the point-to-point virtual links that connect host FCoE Nodes (ENodes) and FCFs in the FCoE VLAN by denying access to any device that does not successfully log in to the FCF.

VN2VF_Port FIP snooping is disabled by default. You enable VN2VF_Port FIP snooping on a per-VLAN basis for VLANs that carry FCoE traffic. Ensure that a VLAN that carries FCoE traffic carries only FCoE traffic, because enabling VN2VF_Port FIP snooping denies access for all other Ethernet traffic.

NOTE: All of the transit switch ports are untrusted by default. If an ENode on an FCoE device logs in to an FCF before you enable VN2VF_Port FIP snooping on the VLAN and you then enable VN2VF_Port FIP snooping, the transit switch denies traffic from the ENode because the transit switch has not snooped (learned) the ENode state. The following process automatically logs the ENode back in to the FCF to reestablish the connection:

1. VN2VF_Port FIP snooping is enabled on an FCoE VLAN on the switch.
2. The switch denies existing connections between servers and the FCF on the FCoE VLAN by filtering the FCoE traffic and FIP traffic, so no keepalive messages from the ENodes reach the FCF.
3. The FCF port timer for each ENode and for each VN_Port on each ENode expires.
4. The FCF sends each ENode whose port timer has expired a Clear Virtual LInks (CVL) message.
5. The CVL message causes the ENode to log in again.

Because the FCF is a trusted source, you configure interfaces that connect to the FCF as FCoE trusted interfaces. FCoE trusted interfaces do not filter traffic (FIP snooping filtering should occur only at the FCoE access edge), but VN2VF_Port FIP snooping continues to run on trusted interfaces so that the switch learns the FCF state.

NOTE: Do not configure ENode-facing interfaces both with FIP snooping enabled and as trusted interfaces. FCoE VLANs with interfaces that are directly connected to FCoE hosts should be configured with FIP snooping enabled and the interfaces should *not* be trusted interfaces. Ethernet interfaces that are connected to an FCF should be configured as trusted interfaces and should not have FIP snooping enabled. Interfaces that are connected to a transit switch that is performing FIP snooping can be configured as trusted interfaces if the FCoE VLAN is not enabled for FIP snooping.

Optionally, you can specify an FC-MAP value for each FCoE VLAN. On a given FCoE VLAN, the switch learns only FCFs that have a matching FC-MAP value. The default FC-MAP value is 0EFC00h for all FC devices. (Enter hexadecimal values for FC-MAP preceded by the hexadecimal indicator “0x”—for example, 0x0EFC00.) If you change the FC-MAP value of an FCF, change the FC-MAP value for the FCoE VLAN it belongs to on the switch and on the servers you want to communicate with the FCF. An FCoE VLAN can have one and only one FC-MAP value.

There are differences in the way you configure FIP snooping and FCoE trusted interfaces on a switch that depend on whether the switch uses the original QFX/QFabric CLI (for example, a standalone QFX3500 or QFX3600 switch or a QFabric system Node device) or the Enhanced Layer 2 Software (ELS) CLI (for example, a standalone QFX5100 switch). This topic includes two configuration procedures, one for switches that run the original CLI, and one for switches that run the ELS CLI.

Original CLI Configuration

To enable VN2VF_Port FIP snooping:

- To enable VN2VF_Port FIP snooping on a single VLAN and specify the optional FC-MAP value:

  ```
  [edit ethernet-switching-options secure-access-port]
  user@switch# set vlan vlan-name examine-fip fc-map fc-map-value
  ```

  For example, to enable VN2VF_Port FIP snooping on a VLAN named **san1_vlan** and change the FC-MAP value to **0x0EFC03**:

  ```
  [edit ethernet-switching-options secure-access-port]
  user@switch# set vlan san1_vlan examine-fip fc-map 0x0EFC03
  ```

  NOTE: Changing the FC-MAP value causes all logins to drop and forces ENodes to log in again.

- To enable VN2VF_Port FIP snooping on all VLANs and use the default FC-MAP value:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set vlan all examine-fip
```

- To configure an interface as an FCoE trusted interface:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface interface-name fcoe-trusted
```

For example, to configure interface **xe-0/0/30** as an FCoE trusted interface:

```
[edit ethernet-switching-options secure-access-port]
user@switch# set interface xe-0/0/30 fcoe-trusted
```

ELS CLI Configuration

To enable VN2VF_Port FIP snooping:

- To enable VN2VF_Port FIP snooping on a VLAN and specify the optional FC-MAP value:

```
[edit]
user@switch# set vlans vlan-name forwarding-options fip-security fc-map fc-map-value
examine-vn2vf
```

For example, to enable VN2VF_Port FIP snooping on a VLAN named **san1_vlan** and change the FC-MAP value to **0x0EFC03**:

```
[edit]
user@switch# set vlans san1_vlan forwarding-options fip-security fc-map 0x0EFC03
examine-vn2vf
```

NOTE: Changing the FC-MAP value causes all logins to drop and forces ENodes to log in again.

- To configure an interface as an FCoE trusted interface:

```
[edit]
user@switch# set vlans vlan-name forwarding-options fip-security interface interface-name
fcoe-trusted
```

For example, to configure interface **xe-0/0/30** on VLAN named **san1_vlan** as an FCoE trusted interface:

```
[edit]
user@switch# set vlans san1_vlan forwarding-options fip-security interface xe-0/0/30
fcoe-trusted
```

Related Documentation

- *Example: Configuring an FCoE Transit Switch*
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Configuring VLAN Interfaces for FCoE Traffic on an FCoE Transit Switch on page 5066
- *Understanding FIP Snooping*
- Understanding VN_Port to VF_Port FIP Snooping on an FCoE Transit Switch on page 4858

Disabling VN2VF_Port FIP Snooping on an FCoE-FC Gateway Switch Interface

When the switch acts an FCoE-FC gateway, the FCoE-network-facing Ethernet interfaces in the FCoE VLAN are automatically enabled for VN_Port to VF_Port (VN2VF_Port) FIP snooping. You can disable VN2VF_Port FIP snooping on an individual Ethernet interface or you can disable VN2VF_Port FIP snooping globally for all Ethernet interfaces in a gateway Fibre Channel (FC) fabric.

Disable VN2VF_Port FIP snooping on an Ethernet interface by configuring it as an FCoE trusted interface. Disable VN2VF_Port FIP snooping on all Ethernet interfaces in an FC fabric by configuring the FC fabric as FCoE trusted.

Do not disable VN2VF_Port FIP snooping on an interface unless you are certain that the interface is connected to a trusted device. Do not disable VN2VF_Port FIP snooping on an FC fabric unless all of the FCoE-network-facing interfaces in the fabric are either connected to a transit switch that is performing VN2VF_Port FIP snooping on the FCoE devices as they log in to the FC network or all of the interfaces are connected to trusted devices.

VN2VF_Port FIP snooping installs firewall filters that block FIP and FCoE frames from sources that have not logged in to the switch and prevents unauthorized access to the network. Disabling VN2VF_Port FIP snooping disables these firewall filters and permits access to all FIP and FCoE frames transported on that interface.

- To disable VN2VF_Port FIP snooping on an FCoE-device-facing Ethernet interface in an FCoE VLAN, configure that interface as a trusted interface:

  ```
  [edit ethernet-switching-options secure-access-port]
  user@switch# set interface interface-name fcoe-trusted
  ```

  For example, to configure interface **xe-0/0/7** as a trusted FC interface:

  ```
  [edit ethernet-switching-options secure-access-port]
  user@switch# set interface xe-0/0/7 fcoe-trusted
  ```

- To disable VN2VF_Port FIP snooping on all FCoE-device-facing interfaces in a gateway FC fabric, configure that fabric as a trusted fabric:

  ```
  [edit]
  user@switch# set fc-fabrics fabric-name protocols fip fcoe-trusted
  ```

  For example, to configure an FC fabric named *santastic* as an FCoE trusted fabric:

  ```
  [edit]
  user@switch# set fc-fabrics santastic protocols fip fcoe-trusted
  ```

Related Documentation

- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- Understanding VN_Port to VF_Port FIP Snooping on an FCoE Transit Switch on page 4858
- Understanding Interfaces on an FCoE-FC Gateway on page 4829
- Understanding an FCoE-FC Gateway on page 4808

Enabling VN2VN_Port FIP Snooping and Configuring the Beacon Period on an FCoE Transit Switch

VN_Port to VN_Port (VN2VN_Port) FIP snooping on an FCoE transit switch provides security to help prevent unauthorized access and data transmission on a bridge that connects ENodes in the Ethernet network. VN2VN_Port FIP snooping provides security for virtual links by creating filters based on information gathered (snooped) about FCoE devices during FIP transactions.

VN2VN_Port FIP snooping is conceptually similar to VN2VF_Port FIP snooping between VN_Ports and VF_Ports, but VN2VN_Port FIP snooping does not require traffic between VN_Ports to traverse the Fibre Channel (FC) switch or FCoE forwarder (FCF). Instead, a VN_Port communicates transparently through the transit switch on a virtual link that emulates a direct connection to the VN_Port at the other end of the virtual link.

VN2VN_Port FIP snooping is disabled by default. You enable VN2VN_Port FIP snooping on a per-VLAN basis on VLANs that carry VN2VN_Port FCoE traffic. Ensure that the VLAN carries only FCoE traffic between VN_Ports, because enabling VN2VN_Port FIP snooping denies access for all other traffic, including VN2VF_Port FIP snooping traffic.

All ENodes that you want to communicate using VN2VN_Port FIP snooping must use an FCoE VLAN dedicated to VN2VN_Port traffic. You cannot mix VN2VN_Port FIP snooping traffic with VN2VF_Port FIP snooping traffic in the same FCoE VLAN.

NOTE: **An FCoE VLAN can support either VN2VF_Port FIP snooping or VN2VN_Port FIP snooping, but not both. Configure separate FCoE VLANs for VN2VF_Port FIP snooping traffic and for VN2VN_Port FIP snooping traffic. On FCoE VLANs that are configured as VN2VN_Port FIP snooping VLANs, VN2VF_Port traffic is dropped.**

The *beacon period* is conceptually similar to the FIP keepalive period (timer) for VN2VF_Port FIP snooping virtual link maintenance. The beacon period performs virtual link maintenance for VN2VN_Port FIP snooping. It is the time interval between messages that verify the connection is still valid and the device at the other end of the virtual link is still reachable. You set the beacon period value for each FCoE VLAN that you configure to do VN2VN_Port FIP snooping.

NOTE: **In addition to enabling VN2VN_Port FIP snooping and configuring the beacon period, you must also configure a dedicated FCoE VLAN for the VN2VN_Port traffic, and set the FCoE transit switch ports in the proper port mode and trusted or untrusted state (interfaces are untrusted by default). See the VN2VN_Port FIP snooping configuration example topics for complete configurations of several common network topologies.**

There are differences in the way you configure a native VLAN on an interface that depend on whether the switch uses the original QFX/QFabric CLI (for example, a standalone QFX3500 or QFX3600 switch or a QFabric system Node device) or the Enhanced Layer

2 Software (ELS) CLI (for example, a standalone QFX5100 switch). This topic includes two configuration procedures, one for switches that run the original CLI, and one for switches that run the ELS CLI.

Original CLI Configuration

To enable VN2VN_Port FIP snooping and set the beacon period on an FCoE VLAN that is dedicated to VN2VN_Port traffic:

- `[edit ethernet-switching-options secure-access-port]`
  `user@switch#` **set vlan *vlan-name* examine-fip examine-vn2vn beacon-period *milliseconds***

  For example, to enable VN2VN_Port FIP snooping on a VLAN named **vlan200** and set the beacon period to **90000** milliseconds:

  `[edit ethernet-switching-options secure-access-port]`
  `user@switch#` **set vlan vlan200 examine-fip examine-vn2vn beacon-period 90000**

ELS CLI Configuration

To enable VN2VN_Port FIP snooping and set the beacon period on an FCoE VLAN that is dedicated to VN2VN_Port traffic:

- `[edit]`
  `user@switch#` **set vlans *vlan-name* forwarding-options fip-security examine-vn2vn beacon-period *milliseconds***

  For example, to enable VN2VN_Port FIP snooping on a VLAN named **vlan200** and set the beacon period to **90000** milliseconds:

  `[edit]`
  `user@switch#` **set vlans vlan200 forwarding-options fip-security examine-vn2vn beacon-period 90000**

Related Documentation

- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 4977
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 4982
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 4990
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch on page 4865

Configuration Tasks (DCBX)

- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082

Configuring the DCBX Mode

You can configure the DCBX mode that an interface uses to communicate with the connected peer. QFX Systems support three DCBX modes:

- Autonegotiation—The interface negotiates with the connected peer to determine the DCBX mode. This is the default DCBX mode.
- IEEE DCBX—The interface uses IEEE DCBX type, length, and value (TLV) to exchange DCBX information with the connected peer. QFX3500 Node devices come up with IEEE DCBX enabled by default and then autonegotiate with the connected peer to determine the final DCBX mode.
- DCBX Version 1.01—The interface uses Converged Enhanced Ethernet (CEE) DCBX version 1.01 TLVs to exchange DCBX information with the connected peer. QFabric Node devices come up with DCBX version 1.01 enabled by default and then autonegotiate with the connected peer to determine the final DCBX mode.

NOTE: QFX Systems do not support pre-CEE (pre-DCB) versions of DCBX such as DCBX version 1.00. If a QFX Series interface receives an LLDP frame with pre-CEE DCBX TLVs, the system drops the frame.

Configure the DCBX mode by specifying the mode for one interface or for all interfaces.

- To configure the DCBX mode, specify the interface and the mode:

  ```
  [edit protocols dcbx]
  user@switch# set interface interface-name mode (auto-negotiate | ieee-dcbx | dcbx-version-1.01)
  ```

  For example, to configure DCBX version 1.01 on interface **xe-0/0/21**:

  ```
  user@switch# set protocols dcbx interface xe-0/0/21 mode dcbx-version-1.01
  ```

  To configure IEEE DCBX on all interfaces:

  ```
  user@switch# set protocols dcbx interface all mode ieee-dcbx
  ```

Related Documentation

- Configuring DCBX Autonegotiation on page 5076
- Disabling the ETS Recommendation TLV on page 5079
- Understanding DCBX on page 4905
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- show dcbx neighbors on page 5177

Configuring DCBX Autonegotiation

Data Center Bridging Capability Exchange protocol (DCBX) discovers the data center bridging (DCB) capabilities of peers by exchanging feature configuration information. DCBX also detects feature misconfiguration and mismatches, and can configure DCB on peers. DCBX is an extension of the Link Layer Discovery Protocol (LLDP), and LLDP must remain enabled on every interface for which you want to use DCBX. If you attempt to enable DCBX on an interface on which LLDP is disabled, the configuration commit operation fails.

NOTE: LLDP and DCBX are enabled by default on all interfaces.

The switch supports DCBX autonegotiation for:

- Priority-based flow control (PFC) configuration
- Layer 2 and Layer 4 applications such as Fibre Channel over Ethernet (FCoE) and Internet Small Computer System Interface (iSCSI)
- Enhanced transmission selection (ETS) advertisement

DCBX autonegotiation is configured on a per-interface basis for each supported feature or application. The PFC and application DCBX exchanges use autonegotiation by default. The default autonegotiation behavior is:

- DCBX is enabled on the interface if the connected peer device also supports DCBX.
- DCBX is disabled on the interface if the connected peer device does not support DCBX.

You can override the default behavior for each feature by turning off autonegotiation to force an interface to enable or disable the feature.

Autonegotiation of ETS means that when ETS is enabled on an interface (priority groups are configured), the interface advertises its ETS configuration to the peer device. In this case, priorities (forwarding classes) that are not part of a priority group (forwarding class set) receive no bandwidth and are advertised in an automatically generated default forwarding class. If ETS is not enabled on an interface (no priority groups are configured), all of the priorities are advertised in one automatically generated default priority group that receives 100 percent of the port bandwidth.

Disabling ETS autonegotiation prevents the interface from sending the Recommendation TLV or the Configuration TLV to the connected peer.

On interfaces that use IEEE DCBX mode to exchange DCBX parameters, you can disable autonegotiation of the enhanced transmission selection (ETS) Recommendation TLV to the peer if you want an asymmetric ETS configuration between the peers. DCBX still exchanges the ETS Configuration TLV if you disable the ETS Recommendation TLV.

Autonegotiation of PFC means that when PFC is enabled on an interface, if the peer device connected to the interface supports PFC and is provisioned compatibly with the switch, DCBX sets the PFC operational state to enabled. If the peer device connected to the interface does not support PFC or is not provisioned compatibly with the switch, DCBX sets the operational state to disabled.

In addition, if the peer advertises that it is “willing” to learn its PFC configuration from the switch, DCBX pushes the switch’s PFC configuration to the peer and does not check the peer’s administrative state. The switch does not learn PFC configuration from peers (the switch does not advertise its state as “willing”).

Disabling PFC autonegotiation prevents the interface from exchanging PFC configuration information with the peer. It forces the interface to enable PFC if PFC is configured on the interface or to disable PFC if PFC is not configured on the interface. If you disable PFC autonegotiation, the assumption is that the peer is also configured manually.

Autonegotiation of applications depends on whether or not you apply an application map to an interface. If you apply an application map to an interface, the interface autonegotiates DCBX for each application in the application map. PFC must be enabled on the FCoE priority (the FCoE IEEE 802.1p code point) for the interface to advertise the FCoE application. The interface only advertises applications that are included in the application map.

For example, if you apply an application map to an interface and the application map does not include the FCoE application, then that interface does not perform DCBX advertisement of FCoE.

If you do not apply an application map to an interface, DCBX does not advertise applications on that interface, with the exception of FCoE, which is handled differently than other applications.

NOTE: **If you do not apply an application map to an interface, the interface performs autonegotiation of FCoE if the interface carries traffic in the FCoE forwarding class and also has PFC enabled on the FCoE priority. On such interfaces, if DCBX detects that the peer device connected to the interface supports FCoE, the switch advertises its FCoE capability and IEEE 802.1p code point on that interface. If DCBX detects that the peer device connected to the interface does not support FCoE, DCBX marks that interface as “FCoE down” and disables FCoE on the interface.**

When DCBX marks an interface as “FCoE down,” the behavior of the switch depends on how you use it in the network:

- When the switch acts as an FCoE-FC gateway, it does not send or receive FCoE Initialization Protocol (FIP) packets.
- When the switch acts as an FCoE transit switch, the interface drops all of the FIP packets it receives. In addition, FIP packets received from an FCoE forwarder (FCF) are not forwarded to interfaces marked as “FCoE down.”

Disabling autonegotiation prevents the interface from exchanging application information with the peer. In this case, the assumption is that the peer is also configured manually.

To disable DCBX autonegotiation of PFC, applications (including FCoE), and ETS using the CLI:

1. Turn off autonegotiation for PFC.

   ```
   [edit]
   user@switch# set protocols dcbx interface interface-name priority-flow-control no-auto-negotiation
   ```

2. Turn off autonegotiation for applications.

   ```
   [edit]
   user@switch# set protocols dcbx interface interface-name applications no-auto-negotiation
   ```

3. Turn off autonegotiation for ETS.

   ```
   [edit]
   user@switch# set protocols dcbx interface interface-name enhanced-transmission-selection no-auto-negotiation
   ```

To disable autonegotiation of the ETS Recommendation TLV so that DCBX exchanges only the ETS Configuration TLV:

- ```
  [edit protocols dcbx interface interface-name]
  user@switch# set enhanced-transmission-selection no-recommendation-tlv
  ```

Related Documentation

- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Disabling the ETS Recommendation TLV on page 5079
- Understanding DCBX Application Protocol TLV Exchange on page 4915


  ```

## Disabling the ETS Recommendation TLV

The enhanced transmission selection (ETS) Recommendation TLV communicates the ETS settings that the switch wants the connected peer interface to use. If the peer interface is “willing,” the peer interface changes its configuration to match the configuration in the ETS Recommendation TLV. By default, the switch interfaces send the ETS Recommendation TLV to the peer. The settings communicated are the egress ETS settings defined by configuring hierarchical scheduling on the interface.

We recommend that you use the same ETS settings on the connected peer that you use on the switch interface and that you leave the ETS Recommendation TLV enabled. However, on interfaces that use IEEE DCBX as the DCBX mode, if you want an asymmetric configuration between the switch interface and the connected peer, you can disable the ETS Recommendation TLV.

NOTE: **Disabling the ETS Recommendation TLV on interfaces that use DCBX version 1.01 as the DCBX mode has no effect and does not change DCBX behavior.**

If you disable the ETS Recommendation TLV, the switch still sends the ETS Configuration TLV to the connected peer. The result is that the connected peer is informed about the switch DCBX ETS configuration, but even if the peer is “willing,” the peer does not change its configuration to match the switch configuration. This is asymmetric configuration—the two interfaces can have different parameter values for the ETS attribute.

To disable the ETS Recommendation TLV:

- `[edit protocols dcbx interface` *`interface-name`*`]`
  `user@switch#` **set enhanced-transmission-selection no-recommendation-tlv**

**Related Documentation**


- Configuring the DCBX Mode on page 5075
- Configuring DCBX Autonegotiation on page 5076
- Understanding DCBX on page 4905

- *Understanding Data Center Bridging Capability Exchange Protocol for EX Series Switches*

## Defining an Application for DCBX Application Protocol TLV Exchange

Define each application for which you want DCBX to exchange application protocol information. You can define Layer 2 and Layer 4 applications. After you define applications, you map them to IEEE 802.1p code points, and then apply the application map to the interfaces on which you want DCBX to exchange application protocol information with connected peers. (See *Related Documentation* for how to configure application maps and apply them to interfaces, and for an example of the entire procedure that also includes classifier configuration.)

NOTE: In Junos OS Release 12.1, the FCoE application was configured by default, so you did not need to configure it in an application map. In Junos OS Release 12.2, if you want DCBX to advertise the FCoE application on an interface and you apply an application map to that interface, you must explicitly configure FCoE in the application map. You also must enable priority-based flow control (PFC) on the FCoE code point on all interfaces that you want to advertise FCoE. If you apply an application map to an interface, the interface sends DCBX TLVs only for the applications configured in the application map.

Define Layer 2 applications by mapping an application name to an EtherType. Define Layer 4 applications by mapping an application name to a protocol (TCP or UDP) and a destination port.

- To define a Layer 2 application, specify the name of the application and its EtherType:

  `[edit applications]`
  `user@switch#` **set application *application-name* ether-type *ether-type***

  For example, to configure an application named **PTP** (for Precision Time Protocol) that uses the EtherType **0x88F7**:

  `user@switch#` **set applications application ptp ether-type 0x88F7**

- To define a Layer 4 application, specify the name of the application, its protocol (TCP or UDP), and its destination port:

  `[edit]`
  `user@switch#` **set applications application *application-name* protocol (tcp | udp) destination-port** *`port-value`*

  For example, to configure an application named **iscsi** (for Internet Small Computer System Interface) that uses the protocol **TCP** and the destination port **3260**:

  `user@switch#` **set applications application iscsi protocol tcp destination-port 3260**

**Related Documentation**


- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082
- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- **show dcbx neighbors on page 5177**

## Configuring an Application Map for DCBX Application Protocol TLV Exchange

After you define applications for which you want to exchange DCBX application protocol information, map the applications to IEEE 802.1p code points. The IEEE 802.1p code points identify incoming traffic and allow you to map that traffic to the desired application. You then apply the application map to the interfaces on which you want DCBX to exchange application protocol information with connected peers. (See *Related Documentation* for how to define applications and apply the application map to interfaces, and for an example of the entire procedure that also includes classifier configuration.)

NOTE: **In Junos OS Release 12.1, the FCoE application was configured by default, so you did not need to configure it in an application map. In Junos OS Release 12.2, if you want DCBX to advertise the FCoE application on an interface and you apply an application map to that interface, you must explicitly configure FCoE in the application map. You also must enable priority-based flow control (PFC) on the FCoE code point on all interfaces that you want to advertise FCoE. If you apply an application map to an interface, the interface sends DCBX TLVs only for the applications configured in the application map.**

Configure an application map by creating an application map name and mapping an application to one or more IEEE 802.1p code points.

- To define an application map, specify the name of the application map, the name of the application, and the IEEE 802.1p code points of the incoming traffic that you want to associate with the application in the application map:

  `[edit policy-options]`
  `user@switch#` **set application-maps *application-map-name* application *application-name* code-points [ *aliases* ] [ *bit-patterns* ]**

  For example, to configure an application map named **ptp-app-map** that includes an application named **PTP** (for Precision Time Protocol) and map the application to IEEE 802.1p code points **001** and **101**:

  `user@switch#` **set policy-options application-maps ptp-app-map application ptp code points [ 001 101 ]**

**Related Documentation**

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082
- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- **show dcbx neighbors on page 5177**

## Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange

After you define applications and map them to IEEE 802.1p code points in an application map, apply the application map to the interfaces on which you want DCBX to exchange the application protocol information with connected peers. (See *Related Documentation* for how to define applications and configure application maps to interfaces, and for an example of the entire procedure that also includes classifier configuration.)

NOTE: In Junos OS Release 12.1, the FCoE application was configured by default, so you did not need to configure it in an application map. In Junos OS Release 12.2, if you want DCBX to advertise the FCoE application on an interface and you apply an application map to that interface, you must explicitly configure FCoE in the application map. You also must enable priority-based flow control (PFC) on the FCoE code point on all interfaces that you want to advertise FCoE. If you apply an application map to an interface, the interface sends DCBX TLVs only for the applications configured in the application map.

- To apply an application map to a DCBX interface, specify the DCBX interface and the application map name:

  ```
  [edit protocols]
  user@switch# set dcbx interface interface-name application-map application-map-name
  ```

  For example, to apply an application map named **ptp-app-map** on interface **xe-0/0/11**:

  ```
  user@switch# set protocols dcbx interface xe-0/0/11 application-map ptp-app-map
  ```

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- **show dcbx neighbors on page 5177**

Configuration Statements

application (Application Maps)

Syntax

```
application application-name {
  code-points [ aliases ] [ bit-patterns ];
}
```

Hierarchy Level [edit policy-options application-maps *application-map-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Add an application to an application map and define the application’s code points.

Options *application-name*—Name of the application.

The remaining statement is explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

application (Applications)

Syntax

```
application application-name {
  destination-port port-value;
  protocol (tcp | udp);
  ether-type type;
}
```

Hierarchy Level [edit applications]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure properties to define an application.

Options *application-name*—Name of the application.

The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

application-map

Syntax application-map *application-map-name*;

Hierarchy Level [edit protocols dcbx interface *interface-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify an application map to apply to an interface.

Options *application-map-name*—Name of the application map.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show dcbx neighbors on page 5177
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

application-maps

Syntax

```
application-maps application-map-name {
  application application-name {
    code-points [ aliases ] [ bit-patterns ];
  }
}
```

Hierarchy Level

[edit policy-options]

Release Information

Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description

Define an application map by specifying the applications that belong to the application map.

Options

application-map-name—Name of the application map.

The remaining statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

applications (Applications)

Syntax

```
applications {
  application application-name {
    destination-port port-value;
    protocol (tcp | udp);
    ether-type type;
  }
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Define applications that DCBX advertises.

Options The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

applications (DCBX)

Syntax

```
applications {
  no-auto-negotiation;
}
```

Hierarchy Level [edit protocols dcbx interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 12.1 for the EX Series

Description Configure Data Center Bridging Capability Exchange protocol (DCBX) applications on an interface.

Options The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

-
- show dcbx neighbors on page 5177
- Understanding DCB Features and Requirements on page 4795

beacon-period

Syntax beacon-period *milliseconds*;

Hierarchy Level Original CLI

[edit ethernet-switching options secure-access-port vlan (all | *vlan-name*) examine-fip examine-vn2vn]

ELS CLI for Platforms that Support FCoE

[edit vlans *vlan-name* forwarding-options fip-security]

NOTE: **The beacon-period configuration statement is in a different hierarchy on the original CLI than on the Enhanced Layer 2 Software (ELS) CLI.**

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.

Description Set the interval between periodic beacons. Beacons perform virtual link maintenance for VN_Ports in a way that is similar to FIP keepalive advertisements.

The ENode sends periodic beacons every 90 seconds on behalf of the VN_Port. Each received beacon resets the session timer for the virtual link connection to the other VN_Port. If the FCF does not receive a beacon before the beacon timer expires, the VN_Port is considered as “down” and the virtual link is terminated. The beacon timer expires in 2.5 times the configured beacon timer value.

Options *milliseconds*—Time in milliseconds between beacons.

Range: 250 through 90000 milliseconds

Default: 8000 milliseconds

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 4977
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 4982
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 4990
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 5025
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 5030

- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 5036

code-points (Application Maps)

Syntax code-points [*aliases*] [*bit-patterns*];

Hierarchy Level [edit policy-options application-maps *application-map-name* application *application-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Define one or more code-point aliases or bit sets for an application.

Options ***aliases***—Name of the alias or aliases.

bit-patterns—Value of the code-point bits, in decimal form.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

dcbx

Syntax

```
dcbx {
  disable;
  interface (interface-name | all) {
    disable;
    application-map application-map-name;
    applications {
      no-auto-negotiation;
    }
    enhanced-transmission-selection {
      no-auto-negotiation;
      no-recommendation-tlv;
      recommendation-tlv {
        no-auto-negotiation;
      }
    }
    dcbx-version (auto-negotiate | ieee-dcbx | dcbx-version-1.01);
    priority-flow-control {
      no-auto-negotiation;
    }
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 11.3 for EX Series switches.
mode and **recommendation-tlv** statements introduced in Junos OS Release 12.2 for the QFX Series.

Description Configure DCBX properties.

Options The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show dcbx neighbors on page 5177**
- Understanding DCB Features and Requirements on page 4795
- Configuring DCBX Autonegotiation on page 5076
- *Understanding DCB Features and Requirements on EX Series Switches*
- *Disabling DCBX to Disable PFC Autonegotiation on EX Series Switches (CLI Procedure)*

dcbx-version

Syntax dcbx-version (auto-negotiate | ieee-dcbx | dcbx-version-1.01);

Hierarchy Level [edit protocols dcbx interface (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Set the DCBX version for the specified interface or interfaces.

QFX3500 switches come up in IEEE DCBX mode and then autonegotiate with the connected peer to set the DCBX version.

QFabric system Node devices come up using DCBX version 1.01, and then autonegotiate with the connected peer to set the DCBX mode.

Default The default DCBX mode is autonegotation.

Options **auto-negotiate**—Automatically negotiate the DCBX version with the connected peer.

ieee-dcbx—Force the interface to use IEEE DCBX mode, regardless of the peer configuration.

dcbx-version-1.01—Force the interface to use version 1.01 DCBX mode, regardless of the peer configuration.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show dcbx neighbors on page 5177**
- Configuring DCBX Autonegotiation on page 5076
- Understanding DCBX on page 4905

destination-port (Applications)

Syntax destination-port *port-value*;

Hierarchy Level [edit applications application *application-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Transmission Control Protocol (TCP) or User Datagram Protocol (UDP) destination port number, which combines with **protocol** to identify an application type. The Internet Assigned Numbers Authority (IANA) assigns port numbers. See the IANA *Service Name and Transport Protocol Port Number Registry* at http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xml for a list of assigned port numbers.

NOTE: To create an application for iSCSI, use the protocol **tcp** with the destination port number **3260**.

Options *port-value*—Identifier for the port.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

disable (DCBX)

Syntax disable

Hierarchy Level [edit protocols dcbx]

[edit protocols dcbx interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 11.3 for EX Series switches.

Description Disable Data Center Bridging Capability Exchange protocol (DCBX) on one or more 10-Gigabit Ethernet interfaces.

Default DCBX is enabled by default on all 10-Gigabit or higher Ethernet interfaces.

DCBX is enabled by default on all 10-Gigabit Ethernet interfaces on EX4500 CEE-enabled switches.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring DCBX Autonegotiation on page 5076
- *Disabling DCBX to Disable PFC Autonegotiation on EX Series Switches (CLI Procedure)*
- Understanding DCB Features and Requirements on page 4795
- *Understanding DCB Features and Requirements on EX Series Switches*

enhanced-transmission-selection

Syntax

```
enhanced-transmission-selection {
  no-auto-negotiation;
  no-recommendation-tlv;
  recommendation-tlv {
    no-auto-negotiation;
  }
}
```

Hierarchy Level [edit protocols dcbx interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Disable advertising the enhanced transmission selection (ETS) state of the interface to the peer. To disable ETS on the interface, do not enable ETS on the interface in the class-of-service (CoS) configuration.

Disabling ETS autonegotiation stops the QFX Series from advertising the ETS Configuration TLV and the ETS Recommendation TLV.

Disabling the ETS recommendation TLV stops the QFX Series from advertising the ETS Recommendation TLV, but the ETS Configuration TLV is still advertised.

Options **no-auto-negotiation**—Disable automatic negotiation of ETS (Configuration TLV and Recommendation TLV)

no-recommendation-tlv—Disable automatic negotiation of the ETS Recommendation TLV

recommendation-tlv—Enable automatic negotiation of ETS Recommendation TLV

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show dcbx neighbors on page 5177
- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Understanding DCB Features and Requirements on page 4795

ether-type

Syntax ether-type *ether-type*;

Hierarchy Level [edit applications application *application-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Two-octet field in an Ethernet frame that defines the protocol encapsulated in the frame payload. See http://standards.ieee.org/develop/regauth/ethertype/eth.txt for a list of Institute of Electrical and Electronics Engineers (IEEE) EtherTypes.

NOTE: To create a FIP application, use the EtherType 0x8914.

Options ***type***—Identifier for the EtherType.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- Understanding DCBX Application Protocol TLV Exchange on page 4915

examine-vn2vn

Syntax

```
examine-vn2vn {
  beacon-period milliseconds;
}
```

Hierarchy Level

Original CLI

[edit ethernet-switching options secure-access-port vlan (all | *vlan-name*) examine-fip]

ELS CLI for Platforms that Support FCoE

[edit vlans *vlan-name* forwarding-options fip-security]

NOTE: The examine-vn2vn configuration statement is in a different hierarchy on the original CLI than on the Enhanced Layer 2 Software (ELS) CLI.

Release Information

Statement introduced in Junos OS Release 12.2 for the QFX Series.
Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.

Description

Enable VN_Port to VN_Port (VN2VN) FIP snooping on a specified VLAN. The VLAN must be a dedicated FCoE VLAN that transports only FCoE traffic. A VLAN cannot support VN2VN FIP snooping and VN_Port to VF_Port FIP snooping (VN2VF) simultaneously. Configure separate VLANs for VN2VN FIP snooping and VN2VF FIP snooping.

When you enable VN2VN FIP snooping on a VLAN, the VN2VF session filters are removed and the all existing VN2VF sessions are terminated.

The remaining statement is explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 4977
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 4982
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 4990
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to the Same FCoE Transit Switch) on page 5025
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Directly Connected to Different FCoE Transit Switches) on page 5030
- Example: Configuring VN2VN_Port FIP Snooping (FCoE Hosts Indirectly Connected Through an Aggregation Layer FCoE Transit Switch) on page 5036

fc-map

Syntax fc-map *fc-map-value*;

Hierarchy Level Original CLI

[edit ethernet-switching options secure-access-port vlan (all | *vlan-name*) examine-fip]

ELS CLI for Platforms that Support FCoE

[edit vlans *vlan-name* forwarding-options fip-security]

NOTE: The fc-map configuration statement is in a different hierarchy on the original CLI than on the Enhanced Layer 2 Software (ELS) CLI.

QFX Series that Support FCoE-FC Gateway Configuration

[edit fc-fabrics *fc-fabric-name* protocols fip]

Release Information Statement introduced in Junos OS Release 10.4 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.

Description Set the FCoE mapped address prefix (FC-MAP) value for the FCoE VLAN to match the FC switch (or FCoE forwarder) FC-MAP value for the FC fabric. The FC-MAP value is a unique MAC address prefix an FC switch uses to identify FCoE traffic for a given FC fabric (traffic on a particular FCoE VLAN).

You can configure the FC-MAP value or use the default value. The default FC-MAP value is different for VN_Port to VF_Port (VN2VF_Port) FIP snooping (0x0EFC00) than for VN_Port to VN_Port (VN2VN_Port) FIP snooping.

The FC switch provides the FC-MAP value to FCoE nodes (ENodes) in the FIP discovery advertisement message. If the EX Series switch or the QFX Series FCoE VLAN FC-MAP value does not match the FC switch FC-MAP value, neither device discovers the FC switch on that VLAN, and the ENodes on that VLAN cannot access the FC switch. The FC switch accepts only FCoE traffic that uses the correct FC-MAP value as part of the VN_Port MAC address.

When the QFX Series acts as an FCoE-FC gateway, the FC-MAP value for the gateway and the FCoE devices must match the FC switch FC-MAP value in order to communicate with the FC switch.

NOTE: Changing the FC-MAP value causes all logins to drop and forces the ENodes to log in again.

Options ***fc-map-value***—FC-MAP value, hexadecimal value preceded by “0x”.

Range: 0x0EFC00 through 0x0EFCFF

Default: 0x0EFC00 for VN2VF_Port FIP snooping0x0EFD00 for VN2VN_Port FIP snooping

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **examine-fip on page 4613**
- **show fip snooping on page 5254**
- *Example: Configuring an FCoE Transit Switch*
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069

fcoe-trusted

Syntax fcoe-trusted;

Hierarchy Level Original CLI

[edit ethernet-switching-options secure-access-port interface *interface-name*]

ELS CLI for Platforms that Support FCoE

[edit vlans *vlan-name* forwarding-options fip-security interface *interface-name*]

NOTE: **The fcoe-trusted configuration statement is in a different hierarchy on the original CLI than on the Enhanced Layer 2 Software (ELS) CLI.**

QFX Series that Support FCoE-FC Gateway Configuration

[edit fc-fabrics *fc-fabric-name* protocols fip]

Release Information Statement introduced in Junos OS Release 10.4 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced for the FC fabric in Junos OS Release 11.3 for the QFX Series.
Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.

Description Configure the specified 10-Gigabit Ethernet interface to trust Fibre Channel over Ethernet (FCoE) traffic. If an interface is connected to another switch such as an FCoE forwarder (FCF) or a transit switch, you can configure the interface as trusted so that the interface forwards FCoE traffic from the switch to the FCoE devices without installing FIP snooping filters.

(QFX Series FCoE-FC gateway) Configure the specified local Fibre Channel fabric to trust FCoE traffic on all ports in the fabric. Changing the fabric ports from untrusted to trusted removes any existing FIP snooping filters from the ports. Changing the fabric ports from trusted to untrusted by removing the **fcoe-trusted** configuration from the fabric forces all of the FCoE sessions on those ports to log out so that when the ENodes and VN_Ports log in again, the switch can build the appropriate FIP snooping filters.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show fip snooping on page 5254**
- *Example: Configuring an FCoE Transit Switch*
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069

interface (DCBX)

Syntax

```
interface (interface-name | all) {
  disable;
  application-map application-map-name;
  applications {
    no-auto-negotiation;
  }
  enhanced-transmission-selection {
    no-auto-negotiation;
    no-recommendation-tlv;
    recommendation-tlv {
      no-auto-negotiation;
    }
  }
  dcbx-version (auto-negotiate | ieee-dcbx | dcbx-version-1.01);
  priority-flow-control {
    no-auto-negotiation;
  }
}
```

Hierarchy Level [edit protocols dcbx]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 11.3 for the EX Series switches.
Mode and **recommendation-tlv** statements introduced in Junos OS Release 12.2 for the QFX Series.

Description Configure DCBX properties on an interface.

Options *interface-name*—Name of the interface.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show dcbx neighbors on page 5177**
- Configuring DCBX Autonegotiation on page 5076
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCB Features and Requirements on page 4795
- *Understanding DCB Features and Requirements on EX Series Switches*
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

no-fcoe-trusted

Syntax no-fcoe-trusted;

Hierarchy Level Original CLI

[edit ethernet-switching-options secure-access-port interface *interface-name*]

ELS CLI for Platforms that Support FCoE

[edit vlans *vlan-name* forwarding-options fip-security interface *interface-name*]

NOTE: The **no-fcoe-trusted** configuration statement is in a different hierarchy on the original CLI than on the Enhanced Layer 2 Software (ELS) CLI.

Release Information Statement introduced in Junos OS Release 10.4 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.

Description Configure the specified 10-Gigabit Ethernet interface not to trust Fibre Channel over Ethernet (FCoE) traffic. If an interface is directly connected to an FCoE device, the interface should not be configured as an FCoE trusted interface. If an interface that you want to connect to an FCoE device has been configured as an FCoE trusted interface, use the **no-fcoe-trusted** statement to convert the interface to an untrusted interface. Untrusted interfaces can perform FIP snooping to provide access security for FCoE traffic.

However, if an interface is connected to another switch such as an FCoE forwarder (FCF) or a transit switch, you can configure the interface as trusted so that the interface forwards FCoE traffic from the switch to the FCoE devices without installing FIP snooping filters.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show fip snooping on page 5254
- *Example: Configuring an FCoE Transit Switch*
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069

policy-options

Syntax

```
policy-options
  application-maps application-map-name {
    application application-name {
      code-points [ aliases ] [ bit-patterns ];
    }
  }
  policy-statement policy-name {
    term term-name {
      from {
        family family-name;
        match-conditions;
        policy subroutine-policy-name;
        prefix-list prefix-list-name;
        prefix-list-filter prefix-list-name match-type <actions>;
        route-filter destination-prefix match-type <actions>;
        source-address-filter source-prefix match-type <actions>;
      }
      to {
        match-conditions;
        policy subroutine-policy-name;
      }
      then actions;
    }
  }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 12.1 for the EX Series.

Description Configure options such as application maps for DCBX application protocol exchange and policy statements.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

priority-flow-control

Syntax

```
priority-flow-control {
  no-auto-negotiation;
}
```

Hierarchy Level [edit protocols dcbx interface (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 11.3 for EX Series switches.

Description Disable autonegotiation of priority-based flow control (PFC) on one or more Ethernet interfaces. Autonegotiation enables PFC on an interface only if the switch and the peer device connected to the switch both support PFC and have the same PFC configuration. Disabling autonegotiation on an interface forces the interface to use the PFC state (enabled or disabled) that is configured on the switch by the configuration and assignment of the congestion notification profile.

Options **no-auto-negotiation**—Disable automatic negotiation of PFC.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show dcbx neighbors on page 5177**
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- *Configuring Priority-Based Flow Control for an EX Series Switch (CLI Procedure)*
- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- *Understanding Data Center Bridging Capability Exchange Protocol for EX Series Switches*
- *Understanding Priority-Based Flow Control*
- Understanding DCB Features and Requirements on page 4795

protocol (Applications)

Syntax protocol (tcp | udp);

Hierarchy Level [edit applications application *application-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Networking protocol type, which combines with **destination-port** to identify an application type.

NOTE: To create an application for iSCSI, use the protocol **tcp** with the destination port number **3260**.

Options **tcp**—Transmission Control Protocol

udp—User Datagram Protocol

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

recommendation-tlv

Syntax

```
recommendation-tlv {
  no-auto-negotiation;
}
```

Hierarchy Level [edit protocols dcbx interface *interface-name* enhanced-transmission-selection]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Disable or enable DCBX to send the ETS Recommendation TLV (also known as the Information TLV) on egress. This feature is valid only if the interface DCBX mode is IEEE DCBX. If the interface DCBX mode is DCBX version 1.01, this statement has no effect. (DCBX version 1.01 does not advertise separate TLVs for individual attributes.)

Default DCBX-enabled interfaces send the ETS recommendation TLV unless it is disabled.

Options **no-auto-negotiation**—Disable sending of the ETS recommendation TLV.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show dcbx neighbors on page 5177**
- Configuring DCBX Autonegotiation on page 5076

Configuration Statements (Original CLI Only)

auto-load-rebalance

Syntax auto-load-rebalance;

Hierarchy Level [edit fc-fabrics *fabric-name* proxy]

Release Information Command introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure the system to rebalance NP_Port link loads automatically on an FCoE-FC gateway proxy fabric if the link loads become unbalanced. Load rebalancing is a disruptive action that forces some or all sessions (depending on the configured load-balancing algorithm) to log out and then log in again. When sessions log in again, they are placed on NP_Port interfaces so that the link loads are balanced.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- Defining the Proxy Load-Balancing Algorithm on page 5056
- Example: Configuring Automated Fibre Channel Interface Load Rebalancing on page 4999
- Simulating On-Demand Fibre Channel Link Load Rebalancing (Dry Run Test) on page 5058
- Understanding Load Balancing in an FCoE-FC Gateway Proxy Fabric on page 4841
- Monitoring Fibre Channel Interface Load Balancing on page 5147

bb-sc-n

Syntax bb-sc-n *bb-sc-n*;

Hierarchy Level [edit interfaces *interface-name* fibrechannel-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the buffer-to-buffer credit state change number to prevent the permanent loss of Fibre Channel credits over time (buffer-to-buffer credit recovery).

Options *bb-sc-n*—Number of buffer-to-buffer state change credits.

Range: 0 through 15

Default: 0 (disabled)

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show fibre-channel interfaces on page 5234**
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Configuring a Fibre Channel Interface on page 5049
- Configuring a Physical Fibre Channel Interface on page 5048
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

description (Fibre Channel Fabrics)

Syntax description *description*

Hierarchy Level [edit fc-fabrics *fabric-name*]

Description Text string that describes the Fibre Channel fabric. The text string has no effect on the operation of the fabric.

Options *description*—Text that describes the fabric. Text can include letters, numbers, and hyphens (-) and can be up to 255 characters in length. If the text includes spaces, enclose the entire text string in quotation marks.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- **show fibre-channel fabric on page 5199**

examine-fip

Syntax

```
examine-fip {
  examine-vn2vn {
    beacon-period milliseconds;
  }
  fc-map fc-map-value;
}
```

Hierarchy Level [edit ethernet-switching-options secure-access-port vlan (all | *vlan-name*)]

Release Information Statement introduced in Junos OS Release 10.4 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement **examine-vn2vn** introduced in Junos OS Release 12.2 for the QFX Series.

Description

NOTE: This statement supports the original CLI. If your switch runs the Enhanced Layer 2 Software (ELS) CLI, see examine-vn2vf for VN_Port to VF_Port (VN2VF_Port) FIP snooping, and see examine-vn2vn for VN_Port to VN_Port (VN2VN_Port) FIP snooping. For ELS details, see “Getting Started with Enhanced Layer 2 Software” on page 58.

Enable FIP snooping on a specified VLAN. Ensure that the VLAN is a dedicated FCoE VLAN that transports only FCoE traffic.

(QFX Series only) Enable VN2VN_Port FIP snooping on the specified VLAN. The VLAN must be a dedicated FCoE VLAN that transports only VN2VN_Port traffic. One FCoE VLAN cannot support both VN2VF_Port FIP snooping and VN2VN_Port FIP snooping. Configure separate, dedicated FCoE VLANs for VN2VN_Port FIP snooping and VN2VN_Port FIP snooping.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *vlan*
- *Example: Configuring an FCoE Transit Switch*
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069

fabric-id

Syntax fabric-id *fc-fabric-id*;

Hierarchy Level [edit fc-fabrics *fc-fabric-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a unique identifier for the FC fabric.

NOTE: **Changing the ID of an FC fabric causes all logins to drop and forces the ENodes to log in again.**

Options *fc-fabric-id* —Unique identifier of the FC fabric.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- **show fibre-channel fabric on page 5199**
- Configuring an FCoE-FC Gateway Fibre Channel Fabric on page 5045
- Understanding an FCoE-FC Gateway on page 4808

fabric-type

Syntax fabric-type proxy;

Hierarchy Level [edit fc-fabrics *fc-fabric-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify that the FC fabric be an FCoE-FC gateway fabric.

Options **proxy**—Specify that the switch be an FCoE-FC gateway fabric.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- **show fibre-channel fabric on page 5199**
- Configuring an FCoE-FC Gateway Fibre Channel Fabric on page 5045
- Understanding an FCoE-FC Gateway on page 4808

fc2

Syntax

```
fc2 {
  traceoptions {
    file filename <replace> <size size> <files number> <no-stamp>;
    <world-readable | no-world-readable>;
    flag flag <flag-modifier>;
  }
}
```

Hierarchy Level [edit fc-fabrics *fc-fabric-name*]

Description Fibre Channel network layer (FC2) configuration.

Options The statements are explained separately.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

fc-fabrics

Syntax

```
fc-fabrics {
  fc-fabric-name {
    description
    fabric-id fc-fabric-id;
    fabric-type proxy;
    interface {
      interface-name {
        max-login-sessions max-login-sessions;
      }
      interface-name {
        max-login-sessions max-login-sessions;
      }
      <...>;
        max-login-sessions max-login-sessions;
      }
      vlan.interface-name;
    }
    fc2 {
      traceoptions {
        file filename <replace> <size size> <files number> <no-stamp>;
        <world-readable | no-world-readable>;
        flag flag <flag-modifier>;
      }
    }
    max-login-sessions max-login-sessions;
    protocols {
      fip {
        fcoe-trusted;
        fc-map fc-map-value;
        fka-adv-period milliseconds;
        interface {
          interface-name {
            fka-adv-period milliseconds;
            priority priority;
          }
        }
        max-sessions-per-enode max-sessions-per-enode;
        priority priority;
        traceoptions {
          file filename <replace> <size size> <files number> <no-stamp>;
          <world-readable | no-world-readable>;
          flag flag <flag-modifier> <disable>;
        }
      }
    }
    proxy {
      auto-load-rebalance
      load-balance-algorithm (simple | enode-based | flogi-based);
      no-fabric-wwn-verify;
      traceoptions {
        file filename <replace> <size size> <files number> <no-stamp>;
        <world-readable | no-world-readable>;
```

```
            flag flag <flag-modifier> <disable>;
          }
        }
      }
    }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure an FC fabric. You can configure a maximum of 12 FC fabrics, one per native FC port.

NOTE: **Changing the name of an FC fabric causes all logins to drop and forces the ENodes to log in again.**

Options *fc-fabric-name* —Unique name of the FC fabric.

The other statements are explained separately.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- show fibre-channel fabric on page 5199
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- Configuring a Physical Fibre Channel Interface on page 5048
- Configuring a Fibre Channel Interface on page 5049
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Assigning Interfaces to a Fibre Channel Fabric on page 5054
- Configuring an FCoE-FC Gateway Fibre Channel Fabric on page 5045
- Configuring FIP on an FCoE-FC Gateway on page 5059
- Configuring DCBX Autonegotiation on page 5076
- Overview of Fibre Channel on the QFX Series on page 4786
- Understanding FCoE-FC Gateway Functions on page 4812

fc-options

Syntax

```
fc-options
  max-login-sessions-per-node max-login-sessions-per-node;
  traceoptions {
    file filename <replace> <size size> <files number> <no-stamp>;
    <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set Fibre Channel options.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

family fcoe

Syntax

```
family fcoe {
  oxid (enable | disable);
}
```

Hierarchy Level [edit forwarding-options hash-key]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure whether or not to use the originator exchange identifier (OxID) field for hash control for FCoE traffic load balancing.

Options The statement is explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Enabling and Disabling CoS OxID Hash Control on page 5059
- Understanding OxID Hash Control for FCoE Traffic Load Balancing on page 4857

fibre-channel (Family Interfaces)

Syntax

```
fibre-channel {
  port-mode (f-port | np-port);
}
```

Hierarchy Level

[edit interfaces vlan unit *logical-unit-number* family],
[edit interfaces *interface-name* unit *logical-unit-number* family]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure the port mode for FCoE VLAN interfaces and native FC interfaces.

Options

The statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Configuring a Fibre Channel Interface on page 5049
- **show fibre-channel interfaces on page 5234**
- **show vlans on page 1722**
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

fibre-channel (Port)

Syntax

```
fibre-channel {
  port-range {
    port-range-low port-range-high;
  }
}
```

Hierarchy Level [edit chassis fpc *fpc-id* pic *pic-id*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify a range of ports to carry FC traffic when the switch is configured as an FCoE-FC gateway.

Options The statement is explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Configuring a Physical Fibre Channel Interface on page 5048
- show fibre-channel interfaces on page 5234
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

fibrechannel-options

Syntax

```
fibrechannel-options {
  bb-sc-n
  (loopback | no-loopback);
  speed (auto-negotiation | 2g | 4g | 8g);
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure FC interface properties such as speed and loopback mode.

Options The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show fibre-channel interfaces on page 5234
- Configuring a Fibre Channel Interface on page 5049

fip

Syntax

```
fip {
  fcoe-trusted;
  fc-map fc-map-value;
  fka-adv-period milliseconds;
  interface {
    interface-name {
      fka-adv-period milliseconds;
      priority priority;
    }
  }
  max-sessions-per-enode max-sessions-per-enode;
  priority priority;
  traceoptions {
    file filename <replace> <size size> <files number> <no-stamp>;
    <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
}
```

Hierarchy Level [edit fc-fabrics *fc-fabric-name* protocols]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure global or interface-specific FIP options. Individual interface settings override global settings.

Options The statements are explained separately.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- **show fibre-channel fip on page 5205**
- Configuring FIP on an FCoE-FC Gateway on page 5059
- Overview of FIP on page 4790

fka-adv-period

Syntax fka-adv-period *milliseconds*;

Hierarchy Level [edit fc-fabrics *fc-fabric-name* protocols fip],
[edit fc-fabrics *fc-fabric-name* protocols fip interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the global or interface-specific interval between periodic FIP keepalive advertisements. An interval set at the interface level overrides the global setting.

Options *milliseconds*—Time in milliseconds between FIP keepalive advertisements.

Range: 250 through 90000 milliseconds

Default: 8000 milliseconds

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- show fibre-channel fip on page 5205
- show fibre-channel fip interface on page 5220
- Overview of FIP on page 4790

interface (Fibre Channel Fabric)

Syntax

```
interface {
  interface-name {
    max-login-sessions max-login-sessions;
  }
  interface-name {
    max-login-sessions max-login-sessions;
  }
  <...> {
    max-login-sessions max-login-sessions;
  }
  vlan.interface-name;
}
```

Hierarchy Level [edit fc-fabrics *fc-fabric-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Associate one or more native Fibre Channel (FC) interfaces with an FC fabric and one VLAN interface for FCoE traffic. An FC interface can be associated with only one FC fabric.

Options ***interface-name***—Name of the native FC interface. You can assign one or more FC interfaces to an FC fabric.

vlan.*vlan-interface-name*—Name of the VLAN interface for FCoE traffic. You can assign one VLAN interface to an FC fabric.

The remaining statement is explained separately.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Configuring a Fibre Channel Interface on page 5049
- Configuring a Physical Fibre Channel Interface on page 5048
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

interface (FIP)

Syntax

```
interface {
  interface-name {
    fka-adv-period milliseconds;
    priority priority;
  }
}
```

Hierarchy Level [edit fc-fabrics *fc-fabric-name* protocols fip]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure FIP options on a per-interface basis. (Override global FIP configuration for a specified interface.)

Options *interface-name*—Name of the interface.

The statements are explained separately.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- **show fibre-channel fip on page 5205**
- Configuring FIP on an FCoE-FC Gateway on page 5059
- Overview of FIP on page 4790

load-balance-algorithm

Syntax load-balance-algorithm (simple | enode-based | flogi-based);

Hierarchy Level [edit fc-fabrics *fabric-name* proxy]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Set the load-balancing algorithm that the QFX Series uses to distribute FCoE sessions (FLOGI and FDISC sessions from the FCoE devices in the Ethernet network) among the NP_Port links to the FC switch.

NOTE: **Changing the load-balancing algorithm when FCoE sessions are running forces the FCoE sessions to log out, then log in again.**

Options **simple**—Load balancing is based on the weighted utilization (load) of the NP_Ports connected to an FC fabric. Each new FLOGI or FDISC is assigned to the least-loaded link. When a link load rebalance occurs, the system minimizes disruption by using an algorithm to log out only the sessions that need to be moved to other links to balance the link load. To further minimize disruption, the algorithm logs out the sessions with the fewest dependencies (for example, FDISC sessions are logged out before FLOGI sessions). When the sessions log in again, they are placed on NP_Port interfaces in a manner that balances the link loads. This is the default load-balancing algorithm.

enode-based—Load balancing is based on the ENode FLOGI. When an ENode logs in to the fabric, all subsequent FDISC sessions (VN_Port sessions) associated with that ENode are placed on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link. When a link load rebalance occurs, the system logs off all sessions. The sessions log in again and are placed on NP_Port interfaces in a balanced manner.

flogi-based—FLOGI-based load balancing is similar to ENode-based load balancing, but the behavior when the loads are rebalanced is different. Load balancing is based on the ENode FLOGI. When an ENode logs in to the fabric, all subsequent FDISC sessions associated with that ENode are placed on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link. When a link load rebalance occurs, the system minimizes disruption by using an algorithm to log out only the sessions that need to be moved to other links to balance the link load. When the logged out sessions log back in, they are placed on NP_Port interfaces in a manner that balances the link loads.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- Defining the Proxy Load-Balancing Algorithm on page 5056
- Example: Configuring Automated Fibre Channel Interface Load Rebalancing on page 4999

- Simulating On-Demand Fibre Channel Link Load Rebalancing (Dry Run Test) on page 5058
- Monitoring Fibre Channel Interface Load Balancing on page 5147
- Understanding Load Balancing in an FCoE-FC Gateway Proxy Fabric on page 4841

loopback (Fibre Channel Interface)

Syntax (loopback | no-loopback);

Hierarchy Level [edit **interfaces** *interface-name* **fibrechannel-options**]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Enable or disable loopback mode for FC interfaces.

Default By default, loopback mode is disabled on FC interfaces.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show fibre-channel interfaces on page 5234**
- Configuring a Fibre Channel Interface on page 5049

max-login-sessions

Syntax max-login-sessions *max-login-sessions*;

Hierarchy Level [edit fc-fabrics *fc-fabric-name*];
[edit fc-fabrics *fc-fabric-name* interface *interface-name*];

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Set the maximum number of FCoE initialization protocol (FIP) session logins permitted for an individual NP_Port interface in an FCoE-FC gateway fabric (FC fabric) or for the entire FCoE-FC gateway fabric. You can set a maximum FIP session limit for each NP_Port interface connected to an FC switch. You can also set a maximum FIP session limit for the entire FC fabric. The sum of the maximum login sessions permitted on the NP_Port interfaces in an FC fabric should not exceed the maximum login sessions configured for that FC fabric.

The maximum number of FIP sessions (the combined total of all VN2VF_Port and VN2VN_Port sessions on the system) is 2500 sessions.

Options *max-login-sessions*—Maximum number of FIP login sessions.

Range: 128 through 2500

Default: 2500

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- max-login-sessions-per-node on page 5125
- Setting the Maximum Number of FIP Login Sessions per FC Interface on page 5063
- Setting the Maximum Number of FIP Login Sessions per FC Fabric on page 5064
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

max-login-sessions-per-node

Syntax max-login-sessions-per-node *max-login-sessions-per-node*;

Hierarchy Level [edit fc-options]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Set the maximum number of FCoE initialization protocol (FIP) session logins permitted on a Node device. (This is the combined total of all VN2VF_Port and VN2VN_Port sessions on the Node device.)

On a QFX3500 switch, the **max-login-sessions-per-node** command sets the maximum FIP session login limit for all of the FC fabrics configured on the device. The combined number of FIP sessions on all FC fabrics on the device should not exceed this limit.

On a QFabric system, the **max-login-sessions-per-node** command globally sets the maximum FIP session login limit for each QFabric system Node device in the QFabric system. For example, if you set the Node limit to 2000 login sessions, then each QFabric Node device supports up to 2000 FIP login sessions. The total configured maximum number of login sessions of all of the FC fabrics on a Node device should not exceed the Node session limit.

NOTE: FIP login session limits configured at the FC fabric level or at the FC fabric interface level might limit a Node device to fewer total sessions than the configured Node limit.

Options *max-login-sessions-per-node*—Maximum number of FIP login sessions.

Range: 128 through 2500

Default: 2500

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- max-login-sessions on page 5124
- Setting the Maximum Number of FIP Login Sessions per Node Device on page 5065
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

max-sessions-per-enode

Syntax max-sessions-per-enode *max-sessions-per-enode*;

Hierarchy Level [edit fc-fabrics *fc-fabric-name* protocols fip]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Set the maximum number of FCoE login sessions (FLOGI plus FDISC) from a single ENode allowed on the gateway FC fabric (the fabric configured on the QFabric system). The maximum number of logins per ENode is 2000 sessions.

NOTE: A session is a FLOGI or FDISC login to the FC SAN fabric. Session does not refer to end-to-end storage sessions. There is no limit to the number of end-to-end storage sessions.

Options *max-sessions-per-enode*—Maximum number of FCoE sessions a single ENode can establish on the switch.

Range: 32 through 2000

Default: 32

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- fcoe-trusted on page 4596
- show fibre-channel fip on page 5205
- Configuring FIP on an FCoE-FC Gateway on page 5059
- Understanding FIP Parameters on an FCoE-FC Gateway on page 4825

no-fabric-wwn-verify

Syntax no-fabric-wwn-verfiy;

Hierarchy Level [edit fc-fabrics *fabric-name* proxy]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Disable the fabric worldwide name (WWN) verification check in the fabric login accept message (FLOGI-ACC) for implicit FLOGIs. If you enable this option, when a QFX Series NP_Port performs a FLOGI to the FC fabric, the QFX Series does not verify the fabric WWN in the FLOGI-ACC against the current fabric WWN.

NOTE: **Disabling or enabling the fabric WWN verification check logs out all FCoE sessions.**

Default Disabled. By default, all implicit FLOGIs from the QFX Series NP_Ports to the FC fabric are verified against the current fabric WWN.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- **show fibre-channel proxy fabric-state on page 5241**
- Understanding FCoE-FC Gateway Functions on page 4812

oxid

Syntax oxid (enable | disable)

Hierarchy Level [edit forwarding-options hash-key family fcoe]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Enable or disable whether the switch uses the originator exchange identifier (OxID) field for hash control for FCoE traffic load balancing.

Default OxID hash control is enabled by default.

Options **oxid (enable | disable)**—Enable or disable whether the switch uses the OxID hash control field for FCoE traffic load balancing.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Enabling and Disabling CoS OxID Hash Control on page 5059
- Understanding OxID Hash Control for FCoE Traffic Load Balancing on page 4857

port-mode (Fibre Channel Interfaces)

Syntax port-mode (f-port | np-port);

Hierarchy Level [edit interfaces vlan unit *unit* family fibre-channel],
[edit interfaces *interface-name* unit *logical-unit-number* family fibre-channel]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the FCoE VLAN interface port mode to F_Port to connect the switch to FCoE initiators, or configure the native FC interface port mode to proxy N_Port (NP_Port) to connect the switch to an FC switch fabric port (F_Port).

Options **f-port**—Configure an FCoE VLAN interface to connect to FCoE initiator Virtual N_Ports (VN_Ports).

np-port—Configure a native FC port to connect to an FC switch F_Port.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show fibre-channel interfaces on page 5234**
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Configuring a Fibre Channel Interface on page 5049
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

port-range

Syntax port-range *port-range-low port-range-high*;

Hierarchy Level [edit chassis fpc *fpc-id* pic *pic-id* fibre-channel]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a contiguous block of ports as FC ports. You can configure the FC-capable ports xe-0/0/0 through xe-0/0/5 as fc-0/0/0 through fc-0/0/5, and ports xe-0/0/42 through xe-0/0/47 as fc-0/0/42 through fc-0/0/47 to create blocks of native FC interfaces. You cannot individually configure a single port as a native FC interface. Within these port blocks, you cannot mix FC interfaces with Ethernet interfaces. All of the ports in a block must be either native FC interfaces or Ethernet interfaces.

You can configure:

- Six native FC interfaces by configuring either ports xe-0/0/0 through xe-0/0/5 as fc-0/0/0 through fc-0/0/5, or ports xe-0/0/42 through xe-0/0/47 as fc-0/0/42 through fc-0/0/47.
- Twelve native FC interfaces by configuring ports xe-0/0/0 through xe-0/0/5 as fc-0/0/0 through fc-0/0/5 and ports xe-0/0/42 through xe-0/0/47 as fc-0/0/42 through fc-0/0/47.
- No native FC interfaces by leaving ports xe-0/0/0 through xe-0/0/5 and ports xe-0/0/42 through xe-0/0/47 in their default state as Ethernet interfaces.

Options ***port-range-low***—Lowest-numbered port in the block of native FC interfaces, either **0** or **42**.

port-range-high—Highest-numbered port in the block of native FC interfaces. The value is **5** if the ***port-range-low*** value is **0**. The value is **47** if the ***port-range-low*** value is **42**.

NOTE: **Only a complete block of ports, xe-0/0/0 through xe-0/0/5, xe-0/0/42 through xe0/0/47, or both, can be configured as FC ports.**

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show fibre-channel interfaces on page 5234**
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Configuring a Physical Fibre Channel Interface on page 5048
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

priority (FIP)

Syntax priority *priority*;

Hierarchy Level [edit fc-fabrics *fc-fabric-name* protocols fip],
[edit fc-fabrics *fc-fabric-name* protocols fip interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Sets the global or interface-specific priority value associated with the switch FCF-MAC. CNAs use the priority value to determine the switch with which they will perform FIP FLOGI. The lower the value, the higher the priority. The switch advertises this value to the server ENodes on the FCoE network. A priority value set at the interface level overrides the global setting.

Options *priority* —Value that determines the FCF an ENode selects to perform FIP FLOGI. The lower the priority number, the higher the priority of the FCF.

Range: 0 through 255

Default: 128

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- show fibre-channel fip on page 5205
- show fibre-channel fip interface on page 5220
- Overview of FIP on page 4790
- Configuring FIP on an FCoE-FC Gateway on page 5059

protocols (FIP)

Syntax

```
protocols {
  fip {
    fcoe-trusted;
    fc-map fc-map-value;
    fka-adv-period milliseconds;
    interface {
      interface-name {
        fka-adv-period milliseconds;
        priority priority;
      }
    }
    max-sessions-per-enode max-sessions-per-enode;
    priority priority;
    traceoptions {
      file filename <replace> <size size> <files number> <no-stamp>;
      <world-readable | no-world-readable>;
      flag flag <flag-modifier> <disable>;
    }
  }
}
```

Hierarchy Level [edit fc-fabrics *fc-fabric-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure global or interface-specific FC protocol options. Individual interface settings override global settings.

Options The statements are explained separately.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- show fibre-channel fip on page 5205
- Configuring FIP on an FCoE-FC Gateway on page 5059
- Overview of FIP on page 4790

proxy (Fibre Channel)

Syntax

```
proxy {
  auto-load-rebalance
  load-balance-algorithm (simple | enode-based | flog-based);
  no-fabric-wwn-verify;
  traceoptions {
    file filename <replace> <size size> <files number> <no-stamp>
    <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
}
```

Hierarchy Level [edit fc-fabrics *fabric-name*]

Description Configure proxy fabric operations.

Options The statement is explained separately.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation
- Understanding FCoE-FC Gateway Functions on page 4812

speed (Fibre Channel Interfaces)

Syntax speed (auto-negotiation | 2g | 4g | 8g);

Hierarchy Level [edit interfaces *interface-name* fibrechannel-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure FC interface speed.

Options **auto-negotiation**—Automatically negotiate interface speed to match the speed of the attached link (2 Gbps, 4 Gbps, 8 Gbps).

2g—2 Gbps link speed

4g—4 Gbps link speed

8g—8 Gbps link speed

Default: auto-negotiation

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show fibre-channel interfaces on page 5234
- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Configuring a Fibre Channel Interface on page 5049
- Configuring a Physical Fibre Channel Interface on page 5048
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

traceoptions (FC-2 Fibre Channel)

Syntax

```
traceoptions {
  file filename <replace> <size size> <files number> <no-stamp>;
  <world-readable | no-world-readable>;
  flag flag <flag-modifier>;
}
```

Hierarchy Level [edit fc-fabrics *fabric-name* fc2]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set FC-2 protocol tracing options.

NOTE: **The traceoptions statement is not supported on the QFabric system.**

Default Traceoptions is disabled.

Options

file ***name***—Name of the file to receive the tracing operation output. Enclose the name in quotation marks. Traceoption output files are located in the **/var/log/** directory.

files ***number***—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**. The traceoption output continues in a second trace file named ***trace-file*.1**. When ***trace-file*.1** reaches its maximum size, output continues in a third file named ***trace-file*.2**, and so on. When the maximum number of trace files is reached, the oldest trace file is overwritten.

If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 1 trace file

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements:

- **all** —Trace all operations.
- **error**—Trace all error events
- **normal**—Trace all normal events.

Default: If you do not specify the **normal** option, only unusual or abnormal operations are traced.

- **parse**—Trace configuration parsing.
- **rx-frame**—(Optional) Trace received frames.
- **rx-frame-header**—(Optional) Trace received frame headers.

- **tx-frame**—(Optional) Trace transmitted frames.
- **tx-frame-header**—(Optional) Trace transmitted frame headers.

no-stamp—(Optional) Do not place timestamp information at the beginning of each line in the trace file.

Default: If you omit this option, timestamp information is placed at the beginning of each line of the tracing output.

no-world-readable—(Optional) Prevent any user from reading the log file.

replace—(Optional) Replace an existing trace file if there is one.

Default: If you do not include this option, tracing output is appended to an existing trace file.

size ***size***—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*** **.0**. Incoming tracefile data is logged in the now empty ***trace-file***. When ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size of 4 GB (the maximum is lower if 4 GB is not supported on your system)

Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

traceoptions (Fibre Channel)

Syntax

```
traceoptions {
  file filename <replace> <size size> <files number> <no-stamp>
  <world-readable | no-world-readable>;
  flag flag <flag-modifier>;
}
```

Hierarchy Level [edit fc-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set FC protocol tracing options.

NOTE: **The traceoptions statement is not supported on the QFabric system.**

Default Traceoptions is disabled.

Options **file** ***name***—Name of the file to receive the tracing operation output. Enclose the name in quotation marks. Traceoption output files are located in the **/var/log/** directory.

files ***number***—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**. The traceoption output continues in a second trace file named ***trace-file*.1**. When ***trace-file*.1** reaches its maximum size, output continues in a third file named ***trace-file*.2**, and so on. When the maximum number of trace files is reached, the oldest trace file is overwritten.

If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 1 trace file

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements:

- **all**—Trace all operations.
- **fabric**—Trace virtual fabric events.
- **fc2**—Trace the FC2 (network layer protocols) events.
- **fip**—Trace the Fibre Channel over Ethernet (FCoE) Initialization Protocol events.
- **flogi** —Trace the fabric login server events.
- **forwarding-database**—Trace the forwarding database and next-hop events.
- **interface**—Trace the interface events.

- **krt**—Trace the communication over the routing socket.
- **lib**—Trace library calls.
- **lif**—Trace Fibre Channel logical interface (fc-lif) events.
- **vswitch**—Trace virtual switch events.

The following are the global tracing options:

- **all**—All trace operations.
- **config-internal**—Trace configuration internals.
- **general**—Trace general events.
- **normal**—All normal events.

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **parse**—Trace configuration parsing.
- **state**—Trace state transitions.
- **task**—Trace protocol task processing.
- **timer**—Trace protocol task timer processing.

no-stamp—(Optional) Do not place timestamp information at the beginning of each line in the trace file.

Default: If you omit this option, timestamp information is placed at the beginning of each line of the tracing output.

no-world-readable—(Optional) Prevent any user from reading the log file.

replace—(Optional) Replace an existing trace file if there is one.

Default: If you do not include this option, tracing output is appended to an existing trace file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file* .0.** Incoming tracefile data is logged in the now empty ***trace-file***. When ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size of 4 GB (maximum is lower if 4 GB is not supported on your system)

Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

traceoptions (FIP Protocol Fibre Channel)

Syntax

```
traceoptions {
  file filename <replace> <size size> <files number> <no-stamp>
  <world-readable | no-world-readable>;
  flag flag <flag-modifier>
}
```

Hierarchy Level [edit fc-fabrics *fabric-name* protocols fip]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set proxy FC protocol tracing options.

NOTE: **The traceoptions statement is not supported on the QFabric system.**

Default Traceoptions is disabled.

Options

file ***name***—Name of the file to receive the tracing operation output. Enclose the name in quotation marks. Traceoption output files are located in the **/var/log/** directory.

files ***number*** —(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**. The traceoption output continues in a second trace file named ***trace-file*.1**. When ***trace-file*.1** reaches its maximum size, output continues in a third file named ***trace-file*.2**, and so on. When the maximum number of trace files is reached, the oldest trace file is overwritten.

If you specify a maximum number of files, you must also specify a maximum file size with the size option.

Range: 2 through 1000 files

Default: 1 trace file

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements:

- **all**—Trace all operations.
- **error**—Trace all error events
- **normal**—Trace all normal events.

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **packet**—Trace packet decoding operations
- **parse**—Trace configuration parsing.
- **state**—Trace state transitions.

no-stamp—(Optional) Do not place timestamp information at the beginning of each line in the trace file.

Default: If you omit this option, timestamp information is placed at the beginning of each line of the tracing output.

no-world-readable—(Optional) Prevent any user from reading the log file.

replace—(Optional) Replace an existing trace file if there is one.

Default: If you do not include this option, tracing output is appended to an existing trace file.

size ***size***—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*****.0.** Incoming tracefile data is logged in the now empty ***trace-file***. When ***trace-file*** again reaches its maximum size, ***trace-file*****.0** is renamed ***trace-file*****.1** and ***trace-file*** is renamed ***trace-file*****.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also specify a maximum number of trace files with the **files** option.

Syntax: ***x*****k** to specify KB, ***x*****m** to specify MB, or ***x*****g** to specify GB

Range: 10 KB through the maximum file size of 4 GB (maximum is lower if 4 GB is not supported on your system)

Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

traceoptions (Proxy Fibre Channel)

Syntax

```
traceoptions {
  file filename <replace> <size size> <files number> <no-stamp>
  <world-readable | no-world-readable>;
  flag flag <flag-modifier>
}
```

Hierarchy Level [edit fc-fabrics *fabric-name* proxy]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set proxy FC protocol tracing options.

NOTE: **The traceoptions statement is not supported on the QFabric system.**

Default Traceoptions is disabled.

Options **file** ***name***—Name of the file to receive the tracing operation output. Enclose the name in quotation marks. Traceoption output files are located in the **/var/log/** directory.

files ***number***—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**. The traceoption output continues in a second trace file named ***trace-file*.1**. When ***trace-file*.1** reaches its maximum size, output continues in a third file named ***trace-file*.2**, and so on. When the maximum number of trace files is reached, the oldest trace file is overwritten.

If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 1 trace file

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements:

- **all**—Trace all operations.
- **error**—Trace all error events.
- **interface**—Trace the interface events.
- **normal**—Trace all normal events.

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **packet**—Trace packet decoding operations
- **parse**—Trace configuration parsing.

- **state**—Trace state transitions.

no-stamp—(Optional) Do not place timestamp information at the beginning of each line in the trace file.

Default: If you omit this option, timestamp information is placed at the beginning of each line of the tracing output.

no-world-readable—(Optional) Prevent any user from reading the log file.

replace—(Optional) Replace an existing trace file if there is one.

Default: If you do not include this option, tracing output is appended to an existing trace file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**. Incoming tracefile data is logged in the now empty ***trace-file***. When ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size of 4 GB (maximum is lower if 4 GB is not supported on your system)

Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Configuration Statements (ELS CLI for Platforms that Support FCoE Only)

examine-vn2vf

Syntax examine-vn2vf

Hierarchy Level [edit vlans *vlan-name* forwarding-options fip-security]

Release Information Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.

Description

NOTE: This statement supports the Enhanced Layer 2 Software (ELS) CLI. If your switch runs the original (non-ELS) software, see examine-fip. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

Enable VN_Port to VF_Port (VN2VF_Port) FIP snooping on the specified VLAN. Ensure that the VLAN is a dedicated FCoE VLAN that transports only FCoE traffic.

If the switch also performs VN_Port to VN_Port (VN2VN_Port) FIP snooping, ensure that the VN2VN_Port traffic is on a different VLAN than the VN2VF_Port traffic. You cannot mix VN2VF_Port and VN2VN_Port traffic in the same VLAN, so you must use separate VLANs for VN2VF_Port and VN2VN_Port traffic.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- examine-vn2vn on page 5098
- Understanding VN_Port to VF_Port FIP Snooping on an FCoE Transit Switch on page 4858
- Understanding FCoE Transit Switch Functionality on page 4804
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069

interface (FIP Snooping)

Syntax
```
interface interface-name {
  (fcoe-trusted| no-fcoe-trusted);
}
```

Hierarchy Level [edit vlans *vlan-name* forwarding-options fip-security]

Release Information Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.

Description

NOTE: This statement supports the Enhanced Layer 2 Software (ELS) CLI. If your switch runs the original (non-ELS) software, see interface (Secure Access Port) for how to specify an interface to configure as FCoE trusted or FCoE untrusted. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

Specify an interface to set as FCoE trusted or as FCoE untrusted. Configure interfaces that connect to other switches as trusted interfaces. Configure interfaces that connect directly to FCoE devices as untrusted interfaces and enabled FIP snooping on the untrusted interfaces to prevent unauthorized access to the storage network.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- Understanding FCoE Transit Switch Functionality on page 4804

fip-security

Syntax

```
fip-security {
  examine-vn2vf;
  examine-vn2vn {
    beacon-period milliseconds;
  }
  fc-map fc-map-value;
  interface interface-name {
    (fcoe-trusted | no-fcoe-trusted;)
  }
}
```

Hierarchy Level [edit vlans *vlan-name* forwarding-options]

Release Information Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.

Description

NOTE: This statement supports the Enhanced Layer 2 Software (ELS) CLI. If your switch runs the original (non-ELS) software, see examine-fip. For ELS details, see "Getting Started with Enhanced Layer 2 Software" on page 58.

Configure FIP snooping and FCoE interface properties.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding VN_Port to VF_Port FIP Snooping on an FCoE Transit Switch on page 4858
- Understanding VN_Port to VN_Port FIP Snooping on an FCoE Transit Switch on page 4865
- Understanding FCoE Transit Switch Functionality on page 4804
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- Enabling VN2VN_Port FIP Snooping and Configuring the Beacon Period on an FCoE Transit Switch on page 5073

CHAPTER 60

Administration

Routine Monitoring

Monitoring Fibre Channel Interface Load Balancing

You can use operational mode commands to monitor load balancing when the switch is in FCoE-FC gateway mode:

Monitoring the Interface Load-Balancing State

Purpose Monitor the number of sessions, whether load balancing is enabled or disabled, and the load-balancing weight for each native Fibre Channel (FC) interface.

NOTE: A session is a FLOGI or FDISC login to the FC SAN fabric. Session does not refer to end-to-end storage sessions.

Action To monitor the load-balancing state of the native FC interfaces in the CLI, enter the following CLI command:

user@switch> **show fibre-channel proxy np-port**

For example:

```
user@switch> show fibre-channel proxy np-port
Fabric: sanfab1, Fabric-id: 10
NP-Port      State              Sessions       LB state   LB weight
fc-0/0/0.0   online             5              ON         4
fc-0/0/1.0   online             5              ON         4
fc-0/0/2.0   online             10             ON         8

Fabric: fc_fab2, Fabric-id: 200
```

```
NP-Port      State             Sessions      LB state    LB weight
fc-0/0/44.0 isolated           0             OFF         0

Fabric: fc_fabric_100, Fabric-id: 100
NP-Port      State             Sessions      LB state    LB weight
fc-0/0/46.0 online             1             ON          8
```

Meaning Table 392 on page 5148 summarizes key output fields for the FC interface load-balancing state.

Table 392: Summary of Key FC Interface Load-Balancing Output Fields

Field	Values
Fabric	Name of the fabric.
Fabric-id	Fabric ID number.
NP-Port	NP_Port interface connected to the FCoE forwarder (FCF) or the FC switch.
State	FCID state of the NP_Port interface: • **online**—The port is online and connected to the FC switch. FCoE devices can log in to the FC switch using this port. • **isolated**—The port is isolated and is not part of the load-balancing function. FCoE devices cannot log in to the FC switch using this port. • **offline**—The port is offline.
Sessions	Number of active sessions on the NP_Port interface.
LB state	Load-balancing state: • **On**—Load balancing is on • **Off**—Load balancing is off.
LB weight	Load-balancing weight, which reflects the port speed: • **2**—Port speed is 2 Gbps. • **4**—Port speed is 4 Gbps. • **8**—Port speed is 8 Gbps.

The gateway determines the least-loaded interface using the following weighted round-robin (WRR) algorithm:

(number-of-sessions * max-weight) / weight

where *max-weight* is an internal constant. If the load on the FC interfaces is equal, the session is assigned to the interface with the highest link speed (the greatest weight).

Monitoring the Fabric Load-Balancing Algorithm

Purpose Monitor the type of load-balancing algorithm (simple, ENode-based, or FLOGI-based) used on the native FC interfaces, whether or not automated load rebalancing is enabled, and the load rebalancing state of the fabric.

Action To monitor the load-balancing algorithm used on the native FC interfaces and the load rebalancing state in the CLI, enter the following CLI command:

user@switch> **show fibre-channel proxy fabric-state**

For example:

```
user@switch> show fibre-channel proxy fabric-state
Fabric: sanfab1, Fabric-id: 10
Proxy load balance algorithm: Simple, Fabric WWN verification: Yes
Auto load rebalance enabled  : No
Last rebalance start-time    : Never
Last rebalance end-time      : Never
Last rebalance trigger       : Link-up
Last rebalance trigger-time  : Mon Sep 10 21:42:30 2012 usec: 814602
Last rebalance trigger-result: Not-configured

Fabric: fc_fab2, Fabric-id: 200
Proxy load balance algorithm: ENode based, Fabric WWN verification: Yes
Auto load rebalance enabled  : No
Last rebalance start-time    : Never
Last rebalance end-time      : Never
Last rebalance trigger       : Link-up
Last rebalance trigger-time  : Mon Sep 17 17:23:35 2012 usec: 619684
Last rebalance trigger-result: Not-configured

Fabric: fc_fabric_100, Fabric-id: 100
Proxy load balance algorithm: FLOGI based, Fabric WWN verification: No
Auto load rebalance enabled  : Yes
Last rebalance start-time    : Never
Last rebalance end-time      : Never
Last rebalance trigger       : Config-CLI
Last rebalance trigger-time  : Fri Nov  2 08:56:16 2012 usec: 004487
Last rebalance trigger-result: Not-required
```

Meaning You can configure each local FC fabric on an FCoE-FC gateway to use one of three types of load-balancing algorithms, *simple*, *ENode-based*, or *FLOGI-based*. All of the native FC interfaces (NP_Ports) in a particular gateway FC fabric use the same load-balancing algorithm (the load-balancing algorithm is applied on a per-fabric basis).

Table 393 on page 5149 summarizes key output fields for the FC interface load-balancing algorithm and state.

Table 393: show fibre-channel proxy fabric-state Output Fields

Field Name	Field Description
Fabric	Name of the fabric.
Fabric-id	Fabric ID number.

Table 393: show fibre-channel proxy fabric-state Output Fields *(continued)*

Field Name	Field Description
Proxy load balance algorithm	Load-balancing algorithm used on the FCoE-FC gateway FC fabric: • Simple—Load balancing is based on the weighted utilization (load) of the NP_Ports connected to an FC fabric. Each new FLOGI or FDISC is assigned to the least-loaded link. On a link load rebalance, only the sessions that need to be moved to another link are logged out. When those sessions log in again, they are placed on active NP_Port interfaces in a balanced manner. • ENode-based—Load balancing is based on the ENode FLOGI. When an ENode logs in to the fabric, all subsequent FDISC sessions (VN_Port sessions) associated with that ENode are placed on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link. On a link load rebalance, all sessions are logged out. When the sessions log in again, they are placed on active NP_Port interfaces in a balanced manner. • FLOGI-based—Load balancing is based on the ENode FLOGI. When an ENode logs in to the fabric, all subsequent FDISC sessions (VN_Port sessions) associated with that ENode are placed on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link. On a link load rebalance, only the sessions that need to be moved to another link are logged out. When those sessions log in again, they are placed on active NP_Port interfaces in a balanced manner.
Fabric WWN verification	Fabric worldwide name (WWN) verification check state on the FCoE-FC gateway fabric: • Yes—Fabric WWN verification check is enabled. • No—Fabric WWN verification check is disabled.
Auto load rebalance enabled	Automated link load rebalancing configuration for the FCoE-FC gateway fabric: • No—Automated load balancing is disabled (default state). • Yes—Automated load balancing is enabled.
Last rebalance start-time	Time that the last link load rebalance began on the FCoE-FC gateway fabric: • Never—The link load has never been rebalanced. • Timestamp value—Time the last link load rebalancing started.
Last rebalance end-time	Time that the last link load rebalance ended on the FCoE-FC gateway fabric: • Never—The link load has never been rebalanced. • Timestamp value—Time the last link load rebalancing ended.

Table 393: show fibre-channel proxy fabric-state Output Fields *(continued)*

Field Name	Field Description
Last rebalance trigger	Event that triggered the last link load rebalance on the FCoE-FC gateway fabric: • None—The link load has never been rebalanced. • Config-CLI—Configure (enable) automated load balancing. • Request-CLI—Rebalance requested from the CLI using the **request fibre-channel proxy load-rebalance fabric *fabric-name*** operational command. • Preview-CLI—Rebalancing *dry run* requested from the CLI using the **request fibre-channel proxy load-rebalance dry-run fabric *fabric-name*** operational command. Indicates that the switch completed the dry run. A dry run simulates a link load rebalance and displays a list of sessions that might be affected if you request an actual rebalance. • Link-up—New FC link (NP_Port) up on the FCoE-FC gateway fabric, which causes a rebalance to distribute sessions to the new link. • Restore-complete—If the FC process on the switch restarts, the switch attempts to restore the session state that existed before the restart. When automated rebalance is enabled, restore-complete indicates that the sessions have been restored and rebalanced.
Last rebalance trigger-time	Time that the last link load rebalance was triggered on the FCoE-FC gateway fabric: • Never—Link load rebalancing has never been triggered. • Timestamp value—Time the last link load rebalancing was triggered.
Last rebalance trigger-result	Result of the last trigger event on the FCoE-FC gateway fabric: • Never—Link load rebalancing has never been triggered. • Not-configured—Automated rebalancing is not configured on the FCoE-FC gateway fabric. • Not-required—Last rebalance trigger did not require rebalancing the link load (the link load was already balanced across the active NP_Port links). • In-progress—Link load rebalancing is in progress and has not finished yet. • Restore-in-progress—The switch is recovering from an FC process restart and is in the process of restoring the sessions to the active NP_Port links. • Success—Link load rebalancing was successful. • Logged-out-all—All sessions have been logged out. • Preview-complete—The switch has finished simulating a dry run rebalancing request from the CLI (**request fibre-channel proxy load-rebalance dry-run fabric *fabric-name*** operational command) and reported the sessions that might be affected if you request an actual link load rebalance. • Fabric-deletion-in-progress—FCoE-FC gateway fabric is in the process of being deleted. NOTE: A trigger event does not necessarily result in a rebalance action. Link load rebalancing only occurs if the NP_Port interface session load is not balanced at the time of the trigger event.

Related Documentation

- show fibre-channel proxy fabric-state on page 5241

- **show fibre-channel proxy np-port on page 5248**
- Configuring a Fibre Channel Interface on page 5049
- Defining the Proxy Load-Balancing Algorithm on page 5056
- Example: Configuring Automated Fibre Channel Interface Load Rebalancing on page 4999
- Understanding Load Balancing in an FCoE-FC Gateway Proxy Fabric on page 4841
- Understanding FCoE-FC Gateway Functions on page 4812

Operational Commands

- clear fibre-channel fc2 statistics
- clear fibre-channel fip enode
- clear fibre-channel fip statistics
- clear fibre-channel fip vn-port
- clear fibre-channel flogi statistics
- clear fibre-channel proxy statistics
- clear fip snooping enode
- clear fip snooping statistics
- clear fip snooping vlan
- clear fip vlan-discovery statistics
- request fibre-channel proxy load-rebalance
- restart
- show dcbx
- show dcbx neighbors
- show fibre-channel fabric
- show fibre-channel fc2 sessions
- show fibre-channel fc2 statistics
- show fibre-channel fip
- show fibre-channel fip enode
- show fibre-channel fip fabric
- show fibre-channel fip fcf
- show fibre-channel fip interface
- show fibre-channel fip statistics
- show fibre-channel flogi fport
- show fibre-channel flogi nport
- show fibre-channel flogi statistics
- show fibre-channel interfaces
- show fibre-channel next-hops

- show fibre-channel routes
- show fibre-channel proxy fabric-state
- show fibre-channel proxy login-table
- show fibre-channel proxy np-port
- show fibre-channel proxy statistics
- show fip snooping
- show fip snooping enode
- show fip snooping fcf
- show fip snooping interface
- show fip snooping statistics
- show fip snooping vlan
- show fip vlan-discovery
- show route forwarding-table family fibre-channel

clear fibre-channel fc2 statistics

Syntax

clear fibre-channel fc2 statistics
<fabric *fabric-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Clear FC-2 (network layer) Fibre Channel statistics globally or on a specified Fibre Channel fabric.

Options

fabric *fabric-name*—(Optional) Clear FC-2 statistics only on the specified fabric.

Required Privilege Level

view

Related Documentation

- show fibre-channel fc2 statistics on page 5203
- show fibre-channel fc2 sessions on page 5201

List of Sample Output

clear fibre-channel fc2 statistics on page 5154

Sample Output

clear fibre-channel fc2 statistics

```
user@switch> clear fibre-channel fc2 statistics
```

clear fibre-channel fip enode

Syntax **clear fibre-channel fip enode** ***enode-mac***

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear Fibre Channel over Ethernet (FCoE) node (ENode) information for a specified ENode. This operation deletes the ENode state from the switch database and from the FIP snooping firewall filters, which causes the ENode to lose the connection to the Fibre Channel (FC) fabric and to log in to the fabric again. If you clear an ENode, all VN_Ports associated with that ENode are also cleared and lose their connection to the FC fabric and must log in to the fabric again.

Options *enode-mac*—MAC address of the ENode.

Required Privilege Level view

Related Documentation

- show fibre-channel fip enode on page 5210
- clear fibre-channel fip statistics on page 5156
- clear fibre-channel fip vn-port on page 5157

List of Sample Output clear fibre-channel fip enode on page 5155

Sample Output

clear fibre-channel fip enode

```
user@switch> clear fibre-channel fip enode 00:10:94:00:00:02
```

clear fibre-channel fip statistics

Syntax
clear fibre-channel fip statistics
<fabric *fabric-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear Fibre Channel over Ethernet (FCoE) initialization protocol (FIP) statistics.

Options **fabric *fabric-name***—(Optional) Clear FIP statistics only on the specified fabric.

Required Privilege Level view

Related Documentation
- show fibre-channel fip statistics on page 5223
- show fibre-channel fip on page 5205

List of Sample Output clear fibre-channel fip statistics on page 5156

Sample Output

clear fibre-channel fip statistics

```
user@switch> clear fibre-channel fip statistics
```

clear fibre-channel fip vn-port

Syntax **clear fibre-channel fip vn-port** ***vn-port--mac***

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear virtual N_Port (VN_Port) information for a specified VN_Port. This operation deletes the VN_Port state from the switch database and from the FIP snooping firewall filters, which causes the VN_Port to lose its connection to the Fibre Channel fabric and to log in to the fabric again. When you clear a VN_Port, other VN_Ports associated with the same Fibre Channel over Ethernet (FCoE) Node (ENode) are not affected and are not cleared.

Options ***vn-port-mac***—MAC address of the VN_Port.

Required Privilege Level view

Related Documentation

- show fibre-channel fip enode on page 5210
- clear fibre-channel fip enode on page 5155
- clear fibre-channel fip statistics on page 5156

List of Sample Output clear fibre-channel fip vn-port on page 5157

Sample Output

clear fibre-channel fip vn-port

```
user@switch> clear fibre-channel fip vn-port 00:10:94:00:00:08
```

clear fibre-channel flogi statistics

Syntax

clear fibre-channel flogi statistics
<**fabric** *fabric-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Clear fabric login (FLOGI) statistics globally or on a specified Fibre Channel fabric.

Options

fabric *fabric-name*—(Optional) Clear FLOGI statistics only on the specified fabric.

Required Privilege Level

view

Related Documentation

- show fibre-channel flogi statistics on page 5231
- show fibre-channel flogi fport on page 5227
- show fibre-channel flogi nport on page 5229

List of Sample Output

clear fibre-channel flogi statistics on page 5158

Sample Output

clear fibre-channel flogi statistics

```
user@switch> clear fibre-channel flogi statistics
```

clear fibre-channel proxy statistics

Syntax

clear fibre-channel proxy statistics
<fabric *fabric-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Clear Fibre Channel gateway statistics globally or on a specified Fibre Channel fabric.

Options

fabric *fabric-name*—(Optional) Clear proxy statistics only on the specified fabric.

Required Privilege Level

view

Related Documentation

- show fibre-channel proxy statistics on page 5251
- show fibre-channel proxy login-table on page 5245
- show fibre-channel proxy np-port on page 5248

List of Sample Output

clear fibre-channel proxy statistics on page 5159

Sample Output

clear fibre-channel proxy statistics

`user@switch>` **clear fibre-channel proxy statistics**

clear fip snooping enode

Syntax
clear fip snooping enode ***enode-mac***
<vlan *vlan-name*>

Release Information
Command introduced in Junos OS Release 10.4 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description
Clear FIP snooping information for the specified FCoE Node (ENode) or (optionally) only on a specified VLAN. This operation deletes the ENode state from the switch database and from the FIP snooping firewall filters, which causes the ENode to lose its connection to the FCoE forwarder (FCF) and to log in to the FCF again.

Options
enode-mac—MAC address of the ENode.

vlan ***vlan-name***—(Optional) Name of the VLAN.

Required Privilege Level
view

Related Documentation
- show fip snooping enode on page 5258

List of Sample Output
clear fip snooping enode enode-mac on page 5160

Sample Output

clear fip snooping enode enode-mac

```
user@switch> clear fip snooping enode 00:10:94:00:00:02
```

clear fip snooping statistics

Syntax

clear fip snooping statistics
<vlan *vlan-name*>

Release Information

Command introduced in Junos OS Release 10.4 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Clear FIP snooping statistics globally or on a specified VLAN.

Required Privilege Level

view

Related Documentation

- show fip snooping statistics on page 5268

List of Sample Output

clear fip snooping statistics on page 5161

Sample Output

clear fip snooping statistics

```
user@switch> clear fip snooping statistics
```

clear fip snooping vlan

Syntax **clear fip snooping vlan** ***vlan-name***

Release Information Command introduced in Junos OS Release 10.4 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear FIP snooping information for the specified VLAN. This operation deletes all ENode and FCF information for the VLAN from the switch database and causes the ENodes to lose their connections to the FCFs. After clearing a VLAN, the switch relearns all of the FCFs and ENodes on the VLAN, and the ENodes must log in to the FCF again.

Options ***vlan-name***—Name of the VLAN.

Required Privilege Level view

Related Documentation

- show fip snooping vlan on page 5271

List of Sample Output clear fip snooping vlan vlan-name on page 5162

Sample Output

clear fip snooping vlan vlan-name

```
user@switch> clear fip snooping vlan fcoevlan1
```


clear fip vlan-discovery statistics

Syntax **clear fip vlan-discovery statistics**

Release Information Command introduced in Junos OS Release 12.1 for the QFX Series.

Description Clear FIP VLAN discovery statistics.

Required Privilege Level view

Related Documentation

- show fip vlan-discovery on page 5275

List of Sample Output clear fip vlan-discovery statistics on page 5163

Sample Output

clear fip vlan-discovery statistics

```
user@switch> clear fip vlan-discovery statistics
```

request fibre-channel proxy load-rebalance

Syntax

request fibre-channel proxy load-rebalance
<dry-run>
fabric <*fabric-name*>
<brief | detail>

Release Information

Command introduced in Junos OS Release 12.3 for the QFX Series.

Description

Rebalance the link load on one or more FCoE-FC gateway proxy fabrics (local Fibre Channel fabrics on the gateway) on demand. Load rebalancing is a disruptive action that forces some or all sessions (depending on the configured load-balancing algorithm) to log out and then log in again. When sessions log in again, they are placed on NP_Port interfaces so that the link loads are balanced.

Link load rebalancing occurs 10 seconds after you run the rebalancing command, unless another rebalancing trigger occurs before the 10 seconds elapse. If another rebalancing event occurs before the 10-second timer elapses, the timer is extended. Rebalancing occurs a maximum of 30 seconds after you run the rebalancing command, regardless of whether more rebalancing events occur.

You can also perform a *dry run* to see a list of sessions that might be affected (logged out) if you request a load rebalance. A dry run does not rebalance the link loads; it only lists the sessions that might be affected if you rebalance.

Options

dry-run—(Optional) Simulates performing link load rebalancing and displays a list of sessions that might be affected if you rebalance the link loads.

fabric *fabric-name*—Name of the fabric on which you want to rebalance the link loads. If you do not specify a fabric name with the fabric keyword, all fabrics on the FCoE-FC gateway rebalance their link loads.

brief | detail—(Optional) Display the specified level of output.

Additional Information

Requesting link load rebalancing is a one-time, on-demand operation. You must explicitly request load rebalancing every time you want to rebalance the link loads. Alternatively, you can configure automated load rebalancing if you want the NP_Port links to be rebalanced automatically whenever a load-rebalancing trigger occurs.

Required Privilege Level

maintenance

Related Documentation

- Monitoring Fibre Channel Interface Load Balancing on page 5147
- Simulating On-Demand Fibre Channel Link Load Rebalancing (Dry Run Test) on page 5058
- Defining the Proxy Load-Balancing Algorithm on page 5056
- Example: Configuring Automated Fibre Channel Interface Load Rebalancing on page 4999
- Understanding Load Balancing in an FCoE-FC Gateway Proxy Fabric on page 4841

List of Sample Output request fibre-channel proxy load-rebalance dry-run fabric fc_fabric_100 on page 5165

Output Fields Table 394 on page 5165 lists the output fields for the **request fibre-channel proxy load-rebalance dry-run** command. Output fields are listed in the approximate order in which they appear.

Table 394: request fibre-channel proxy load-rebalance dry-run Output Fields

Field Name	Field Description
Fabric	Name of the fabric.
Fabric-id	Fabric ID number.
F-Port	FCoE VLAN interface (VF_Port interface to the FCoE network).
FCID	VN_Port Fibre Channel identifier provided by the Fibre Channel over Ethernet Forwarder (FCoE forwarder) or the Fibre Channel switch.
Port-WWN	Unique worldwide name (WWN) of the VN_Port.
NP-Port	Name of the native Fibre Channel interface.

Sample Output

request fibre-channel proxy load-rebalance dry-run fabric fc_fabric_100

```
user@host> request fibre-channel proxy load-rebalance dry-run fabric fc_fabric_100
Fabric: fc_fabric_100, Fabric-id: 100
F-Port                        FCID     Port-WWN                NP-Port
vlan.100                      0x8a013a 02:01:00:64:00:00:00:2a fc-0/0/1.0
vlan.100                      0x8a013c 02:01:00:64:00:00:00:2b fc-0/0/1.0
vlan.100                      0x8a0146 02:01:00:64:00:00:00:2e fc-0/0/1.0
vlan.100                      0x8a014c 02:01:00:64:00:00:00:2f fc-0/0/1.0
```

restart

Syntax

restart
<adaptive-services |ancpd-service | application-identification |audit-process | auto-configuration |captive-portal-content-delivery |ce-l2tp-service |chassis-control | class-of-service |clksyncd-service |database-replication|datapath-trace-service |dhcp-service | diameter-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging | ethernet-connectivity-fault-management |ethernet-link-fault-management |event-processing | firewall |general-authentication-service | gracefully | iccp-service |idp-policy | immediately |interface-control | ipsec-key-management | kernel-replication | l2-learning | l2cpd-service | l2tp-service | l2tp-universal-edge | lacp | license-service |link-management |local-policy-decision-function |mac-validation |mib-process | mobile-ip | mountd-service |mpls-traceroute |mspd | multicast-snooping |named-service | nfsd-service | packet-triggered-subscribers |peer-selection-service |pgcp-service | pgm | pic-services-logging | pki-service |ppp | ppp-service |pppoe | protected-system-domain-service | redundancy-interface-process | remote-operations | root-system-domain-service | routing <logical-system *logical-system-name*> | sampling | sbc-configuration-process | sdk-service |service-deployment | services | services pgcp gateway *gateway-name* | snmp |soft |static-subscribers |statistics-service| subscriber-management | subscriber-management-helper | tunnel-oamd |usb-control| vrrp |web-management>
<gracefully | immediately | soft>

Syntax (ACX Series Routers)

restart
<adaptive-services |audit-process | auto-configuration | autoinstallation |chassis-control | class-of-service |clksyncd-service |database-replication| dhcp-service | diameter-service | disk-monitoring | dynamic-flow-capture | ethernet-connectivity-fault-management |ethernet-link-fault-management |event-processing | firewall |general-authentication-service | gracefully | immediately |interface-control | ipsec-key-management | l2-learning | lacp |link-management |mib-process | mobile-ip | mountd-service |mpls-traceroute |mspd | named-service | nfsd-service | pgm | pki-service |ppp | pppoe | redundancy-interface-process | remote-operations | routing | sampling | sdk-service |secure-neighbor-discovery | service-deployment | services | snmp |soft |statistics-service| subscriber-management | subscriber-management-helper | tunnel-oamd | vrrp>

Syntax (EX Series Switches)

restart
<autoinstallation | chassis-control | class-of-service | database-replication | dhcp | dhcp-service | diameter-service | dot1x-protocol | ethernet-link-fault-management | ethernet-switching | event-processing | firewall | general-authentication-service | interface-control | kernel-replication | l2-learning | lacp | license-service | link-management | lldpd-service | mib-process | mountd-service | multicast-snooping | pgm | redundancy-interface-process | remote-operations | routing | secure-neighbor-discovery | service-deployment | sflow-service | snmp | vrrp | web-management>

Syntax (Routing Matrix)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging | event-processing | firewall | interface-control | ipsec-key-management | kernel-replication | l2-learning | l2tp-service | lacp | link-management | mib-process | pgm | pic-services-logging | ppp | pppoe | redundancy-interface-process | remote-operations | routing <logical-system *logical-system-name*> | sampling | service-deployment | snmp>
<all | all-lcc | lcc *number*>

<gracefully | immediately | soft>

Syntax (J Series Routing Platform)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | dhcp | dialer-services | dlsw | event-processing | firewall | interface-control | ipsec-key-management | isdn-signaling | l2-learning | l2tp-service | mib-process | network-access-service | pgm | ppp | pppoe | remote-operations | routing <logical-system *logical-system-name*> | sampling | service-deployment | snmp | usb-control | web-management>
<gracefully | immediately | soft>

Syntax (TX Matrix Routers)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | dhcp-service | diameter-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging | event-processing | firewall | interface-control | ipsec-key-management | kernel-replication | l2-learning | l2tp-service | lacp | link-management | mib-process |pgm | pic-services-logging | ppp | pppoe | redundancy-interface-process | remote-operations | routing <logical-system *logical-system-name*> | sampling | service-deployment | snmp| statistics-service>
<all-chassis | all-lcc | lcc *number* | scc>
<gracefully | immediately | soft>

Syntax (TX Matrix Plus Routers)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | dhcp-service | diameter-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging | event-processing | firewall | interface-control | ipsec-key-management | kernel-replication | l2-learning | l2tp-service | lacp | link-management | mib-process | pgm | pic-services-logging | ppp | pppoe | redundancy-interface-process | remote-operations | routing <logical-system *logical-system-name*> | sampling | service-deployment | snmp| statistics-service>
<all-chassis | all-lcc | all-sfc | lcc *number* | sfc *number*>
<gracefully | immediately | soft>

Syntax (MX Series Routers)

restart
<adaptive-services | ancpd-service |application-identification|audit-process | auto-configuration |captive-portal-content-delivery |ce-l2tp-service |chassis-control | class-of-service |clksyncd-service |database-replication| datapath-trace-service |dhcp-service | diameter-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging | ethernet-connectivity-fault-management |ethernet-link-fault-management |event-processing | firewall | general-authentication-service | gracefully |iccp-service |idp-policy |immediately |interface-control | ipsec-key-management | kernel-replication | l2-learning |l2cpd-service |l2tp-service | l2tp-universal-edge | lacp | license-service |link-management |local-policy-decision-function |mac-validation |mib-process | mobile-ip |mountd-service |mpls-traceroute |mspd | multicast-snooping |named-service | nfsd-service | packet-triggered-subscribers |peer-selection-service | pgcp-service | pgm | pic-services-logging | pki-service |ppp | ppp-service |pppoe | protected-system-domain-service | redundancy-interface-process | remote-operations |root-system-domain-service | routing |routing <logical-system *logical-system-name*> | sampling | sbc-configuration-process | sdk-service |service-deployment |services | services pgcp gateway *gateway-name* |snmp |soft |static-subscribers |statistics-service| subscriber-management | subscriber-management-helper | tunnel-oamd | usb-control| vrrp |web-management>
<all-members>
<gracefully | immediately | soft>
<local>
<member *member-id*>

Syntax (J Series Routers)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | dhcp | dhcp-service | dialer-services | diameter-service | dlsw | event-processing | firewall | interface-control | ipsec-key-management | isdn-signaling | l2ald | l2-learning | l2tp-service | mib-process | network-access-service | pgm | ppp | pppoe | remote-operations | routing <logical-system *logical-system-name*> | sampling | service-deployment | snmp | usb-control | web-management>
<gracefully | immediately | soft>

Syntax (QFX Series)

restart
<adaptive-services | audit-process | chassis-control | class-of-service | dialer-services | diameter-service | dlsw | ethernet-connectivity | event-processing | fibre-channel | firewall | general-authentication-service | igmp-host-services | interface-control | ipsec-key-management | isdn-signaling | l2ald | l2-learning | l2tp-service | mib-process | named-service | network-access-service | nstrace-process | pgm | ppp | pppoe | redundancy-interface-process | remote-operations |*logical-system-name*> | routing | sampling |secure-neighbor-discovery | service-deployment | snmp | usb-control | web-management>
<gracefully | immediately | soft>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 12.2 for ACX Series routers.
Options added:

- **dynamic-flow-capture** in Junos OS Release 7.4.
- **dlsw** in Junos OS Release 7.5.
- **event-processing** in Junos OS Release 7.5.
- **ppp** in Junos OS Release 7.5.
- **l2ald** in Junos OS Release 8.0.
- **link-management** in Release 8.0.
- **pgcp-service** in Junos OS Release 8.4.
- **sbc-configuration-process** in Junos OS Release 9.5.
- **services pgcp gateway** in Junos OS Release 9.6.
- **sfc** and **all-sfc** for the TX Matrix Router in Junos OS Release 9.6.

Description

Restart a Junos OS process.

CAUTION: Never restart a software process unless instructed to do so by a customer support engineer. A restart might cause the router or switch to drop calls and interrupt transmission, resulting in possible loss of data.

Options

none—Same as **gracefully**.

adaptive-services—(Optional) Restart the configuration management process that manages the configuration for stateful firewall, Network Address Translation (NAT), intrusion detection services (IDS), and IP Security (IPsec) services on the Adaptive Services PIC.

all-chassis—(TX Matrix and TX Matrix Plus routers only) (Optional) Restart the software process on all chassis.

all-lcc—(TX Matrix and TX Matrix Plus routers only) (Optional) For a TX Matrix router, restart the software process on all T640 routers connected to the TX Matrix router. For a TX Matrix Plus router, restart the software process on all T1600 routers connected to the TX Matrix Plus router.

all-members—(MX Series routers only) (Optional) Restart the software process for all members of the Virtual Chassis configuration.

all-sfc—(TX Matrix Plus routers only) (Optional) For a TX Matrix Plus router, restart the software processes for the TX Matrix Plus router (or switch-fabric chassis).

ancpd-service—(Optional) Restart the Access Node Control Protocol (ANCP) process, which works with a special Internet Group Management Protocol (IGMP) session to collect outgoing interface mapping events in a scalable manner.

application-identification—(Optional) Restart the process that identifies an application using intrusion detection and prevention (IDP) to allow or deny traffic based on applications running on standard or nonstandard ports.

audit-process—(Optional) Restart the RADIUS accounting process that gathers statistical data that can be used for general network monitoring, analyzing, and tracking usage patterns, for billing a user based on the amount of time or type of services accessed.

auto-configuration—(Optional) Restart the Interface Auto-Configuration process.

autoinstallation—(EX Series switches only) (Optional) Restart the autoinstallation process.

captive-portal-content-delivery—(Optional) Restart the HTTP redirect service by specifying the location to which a subscriber's initial Web browser session is redirected, enabling initial provisioning and service selection for the subscriber.

ce-l2tp-service—(M10, M10i, M7i, and MX Series routers only) (Optional) Restart the Universal Edge Layer 2 Tunneling Protocol (L2TP) process, which establishes L2TP tunnels and Point-to-Point Protocol (PPP) sessions through L2TP tunnels.

chassis-control—(Optional) Restart the chassis management process.

class-of-service—(Optional) Restart the class-of-service (CoS) process, which controls the router's or switch’s CoS configuration.

clksyncd-service—(Optional) Restart the external clock synchronization process, which uses synchronous Ethernet (SyncE).

database-replication—(EX Series switches and MX Series routers only) (Optional) Restart the database replication process.

datapath-trace-service—(Optional) Restart the packet path tracing process.

dhcp—(J Series routers and EX Series switches only) (Optional) Restart the software process for a Dynamic Host Configuration Protocol (DHCP) server. A DHCP server allocates network IP addresses and delivers configuration settings to client hosts without user intervention.

dhcp-service—(Optional) Restart the Dynamic Host Configuration Protocol process.

dialer-services—(J Series routers and EX Series switches only) (Optional) Restart the ISDN dial-out process.

diameter-service—(Optional) Restart the diameter process.

disk-monitoring—(Optional) Restart disk monitoring, which checks the health of the hard disk drive on the Routing Engine.

dlsw—(J Series routers and QFX Series only) (Optional) Restart the data link switching (DLSw) service.

dot1x-protocol—(EX Series switches only) (Optional) Restart the port-based network access control process.

dynamic-flow-capture—(Optional) Restart the dynamic flow capture (DFC) process, which controls DFC configurations on Monitoring Services III PICs.

ecc-error-logging—(Optional) Restart the error checking and correction (ECC) process, which logs ECC parity errors in memory on the Routing Engine.

ethernet-connectivity-fault-management—(Optional) Restart the process that provides IEEE 802.1ag Operation, Administration, and Management (OAM) connectivity fault management (CFM) database information for CFM maintenance association end points (MEPs) in a CFM session.

ethernet-link-fault-management—(EX Series switches and MX Series routers only) (Optional) Restart the process that provides the OAM link fault management (LFM) information for Ethernet interfaces.

ethernet-switching—(EX Series switches only) (Optional) Restart the Ethernet switching process.

event-processing—(Optional) Restart the event process (eventd).

fibre-channel—(QFX Series only) (Optional) Restart the Fibre Channel process.

firewall—(Optional) Restart the firewall management process, which manages the firewall configuration and enables accepting or rejecting packets that are transiting an interface on a router or switch.

general-authentication-service—(EX Series switches and MX Series routers only) (Optional) Restart the general authentication process.

gracefully—(Optional) Restart the software process.

iccp-service—(Optional) Restart the Inter-Chassis Communication Protocol (ICCP) process.

idp-policy—(Optional) Restart the intrusion detection and prevention (IDP) protocol process.

immediately—(Optional) Immediately restart the software process.

interface-control—(Optional) Restart the interface process, which controls the router's or switch's physical interface devices and logical interfaces.

ipsec-key-management—(Optional) Restart the IPsec key management process.

isdn-signaling—(J Series routers and QFX Series only) (Optional) Restart the ISDN signaling process, which initiates ISDN connections.

kernel-replication—(Optional) Restart the kernel replication process, which replicates the state of the backup Routing Engine when graceful Routing Engine switchover (GRES) is configured.

l2-learning—(Optional) Restart the Layer 2 address flooding and learning process.

l2cpd-service—(Optional) Restart the Layer 2 Control Protocol process, which enables features such as Layer 2 protocol tunneling and nonstop bridging.

l2tp-service— (M10, M10i, M7i, and MX Series routers only) (Optional) Restart the Layer 2 Tunneling Protocol (L2TP) process, which sets up client services for establishing Point-to-Point Protocol (PPP) tunnels across a network and negotiating Multilink PPP if it is implemented.

l2tp-universal-edge—(MX Series routers only) (Optional) Restart the L2TP process, which establishes L2TP tunnels and PPP sessions through L2TP tunnels.

lacp—(Optional) Restart the Link Aggregation Control Protocol (LACP) process. LACP provides a standardized means for exchanging information between partner systems on a link to allow their link aggregation control instances to reach agreement on the identity of the LAG to which the link belongs, and then to move the link to that LAG, and to enable the transmission and reception processes for the link to function in an orderly manner.

lcc *number*—(TX Matrix and TX Matrix Plus routers only) (Optional) For a TX Matrix router, restart the software process for a specific T640 router that is connected to the TX Matrix router. For a TX Matrix Plus router, restart the software process for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

license-service—(EX Series switches only) (Optional) Restart the feature license management process.

link-management— (TX Matrix and TX Matrix Plus routers and EX Series switches only) (Optional) Restart the Link Management Protocol (LMP) process, which establishes and maintains LMP control channels.

lldpd-service—(EX Series switches only) (Optional) Restart the Link Layer Discovery Protocol (LLDP) process.

local—(MX Series routers only) (Optional) Restart the software process for the local Virtual Chassis member.

local-policy-decision-function— (Optional) Restart the process for the Local Policy Decision Function, which regulates collection of statistics related to applications and application groups and tracking of information about dynamic subscribers and static interfaces.

mac-validation— (Optional) Restart the Media Access Control (MAC) validation process, which configures MAC address validation for subscriber interfaces created on demux interfaces in dynamic profiles on MX Series routers.

member *member-id*—(MX Series routers only) (Optional) Restart the software process for a specific member of the Virtual Chassis configuration. Replace ***member-id*** with a value of **0** or **1**.

mib-process—(Optional) Restart the Management Information Base (MIB) version II process, which provides the router's MIB II agent.

mobile-ip—(Optional) Restart the Mobile IP process, which configures Junos OS Mobile IP features.

mountd-service—(EX Series switches and MX Series routers only) (Optional) Restart the service for NFS mount requests.

mpls-traceroute—(Optional) Restart the MPLS Periodic Traceroute process.

mspd—(Optional) Restart the Multiservice process.

multicast-snooping—(EX Series switches and MX Series routers only) (Optional) Restart the multicast snooping process, which makes Layer 2 devices, such as VLAN switches, aware of Layer 3 information, such as the media access control (MAC) addresses of members of a multicast group.

named-service—(Optional) Restart the DNS Server process, which is used by a router or a switch to resolve hostnames into addresses.

network-access-service—(J Series routers and QFX Series only) (Optional) Restart the network access process, which provides the router's Challenge Handshake Authentication Protocol (CHAP) authentication service.

nfsd-service—(Optional) Restart the Remote NFS Server process, which provides remote file access for applications that need NFS-based transport.

packet-triggered-subscribers—(Optional) Restart the packet-triggered subscribers and policy control (PTSP) process, which allows the application of policies to dynamic subscribers that are controlled by a subscriber termination device.

peer-selection-service—(Optional) Restart the Peer Selection Service process.

pgcp-service—(Optional) Restart the pgcpd service process running on the Routing Engine. This option does not restart pgcpd processes running on mobile station PICs. To restart pgcpd processes running on mobile station PICs, use the **services pgcp gateway** option.

pgm—(Optional) Restart the process that implements the Pragmatic General Multicast (PGM) protocol for assisting in the reliable delivery of multicast packets.

pic-services-logging—(Optional) Restart the logging process for some PICs. With this process, also known as fsad (the file system access daemon), PICs send special logging information to the Routing Engine for archiving on the hard disk.

pki-service—(Optional) Restart the PKI Service process.

ppp—(Optional) Restart the Point-to-Point Protocol (PPP) process, which is the encapsulation protocol process for transporting IP traffic across point-to-point links.

ppp-service—(Optional) Restart the Universal Edge PPP process, which is the encapsulation protocol process for transporting IP traffic across Universal Edge routers.

pppoe—(Optional) Restart the Point-to-Point Protocol over Ethernet (PPPoE) process, which combines PPP that typically runs over broadband connections with the Ethernet link-layer protocol that allows users to connect to a network of hosts over a bridge or access concentrator.

protected-system-domain-service—(Optional) Restart the Protected System Domain (PSD) process.

redundancy-interface-process—(Optional) Restart the ASP redundancy process.

remote-operations—(Optional) Restart the remote operations process, which provides the ping and traceroute MIBs.

root-system-domain-service—(Optional) Restart the Root System Domain (RSD) service.

routing—(ACX Series routers, QFX Series, EX Series switches, and MX Series routers only) (Optional) Restart the routing protocol process.

routing <logical-system *logical-system-name*>—(Optional) Restart the routing protocol process, which controls the routing protocols that run on the router or switch and maintains the routing tables. Optionally, restart the routing protocol process for the specified logical system only.

sampling—(Optional) Restart the sampling process, which performs packet sampling based on particular input interfaces and various fields in the packet header.

sbc-configuration-process—(Optional) Restart the session border controller (SBC) process of the border signaling gateway (BSG).

scc—(TX Matrix routers only) (Optional) Restart the software process on the TX Matrix router (or switch-card chassis).

sdk-service—(Optional) Restart the SDK Service process, which runs on the Routing Engine and is responsible for communications between the SDK application and Junos OS. Although the SDK Service process is present on the router, it is turned off by default.

secure-neighbor-discovery—(QFX Series, EX Series switches, and MX Series routers only) (Optional) Restart the secure Neighbor Discovery Protocol (NDP) process, which provides support for protecting NDP messages.

sfc *number*—(TX Matrix Plus routers only) (Optional) Restart the software process on the TX Matrix Plus router (or switch-fabric chassis). Replace ***number*** with **0**.

service-deployment—(Optional) Restart the service deployment process, which enables Junos OS to work with the Session and Resource Control (SRC) software.

services—(Optional) Restart a service.

services pgcp gateway *gateway-name*—(Optional) Restart the pgcpd process for a specific border gateway function (BGF) running on an MS-PIC. This option does not restart the pgcpd process running on the Routing Engine. To restart the pgcpd process on the Routing Engine, use the **pgcp-service** option.

sflow-service—(EX Series switches only) (Optional) Restart the flow sampling (sFlow technology) process.

snmp—(Optional) Restart the SNMP process, which enables the monitoring of network devices from a central location and provides the router's or switch's SNMP master agent.

soft—(Optional) Reread and reactivate the configuration without completely restarting the software processes. For example, BGP peers stay up and the routing table stays constant. Omitting this option results in a graceful restart of the software process.

static-subscribers—(Optional) Restart the static subscribers process, which associates subscribers with statically configured interfaces and provides dynamic service activation and activation for these subscribers.

statistics-service—(Optional) Restart the process that manages the Packet Forwarding Engine statistics.

subscriber-management—(Optional) Restart the Subscriber Management process.

subscriber-management-helper—(Optional) Restart the Subscriber Management Helper process.

tunnel-oamd—(Optional) Restart the Tunnel OAM process, which enables the Operations, Administration, and Maintenance of Layer 2 tunneled networks. Layer 2 protocol tunneling (L2PT) allows service providers to send Layer 2 PDUs across the provider's cloud and deliver them to Juniper Networks EX Series Ethernet Switches that are not part of the local broadcast domain.

usb-control—(J Series routers and MX Series routers only) (Optional) Restart the USB control process.

vrrp—(ACX Series routers, EX Series switches, and MX Series routers only) (Optional) Restart the Virtual Router Redundancy Protocol (VRRP) process, which enables hosts on a LAN to make use of redundant routing platforms on that LAN without requiring more than the static configuration of a single default route on the hosts.

web-management—(J Series routers, QFX Series, EX Series switches, and MX Series routers only) (Optional) Restart the Web management process.

Required Privilege Level reset

Related Documentation

- Overview of Junos OS CLI Operational Mode Commands on page 73

List of Sample Output restart interfaces on page 5175

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

restart interfaces

```
user@host> restart interfaces
interfaces process terminated
interfaces process restarted
```


show dcbx

Syntax show dcbx

Release Information Command introduced in Junos OS Release 11.3 for the QFX Series.

Description List DCBX status (enabled or disabled) and the interfaces on which DCBX is enabled.

Required Privilege Level view

Related Documentation

- show dcbx neighbors on page 5177
- Configuring DCBX Autonegotiation on page 5076

Output Fields Table 395 on page 5176 lists the output fields for the **show dcbx** command. Output fields are listed in the approximate order in which they appear.

Table 395: show dcbx output fields

Field Name	Field Description
DCBX	Status of DCBX on the switch or for the specified interface: • Enabled—DCBX is enabled on the switch or on the specified interface • Disabled—DCBX is disabled on the switch or on the specified interface
Interface	Name of the interface

Sample Output

show dcbx

```
user@switch> show dcbx
DCBX                         : Enabled
Interface        DCBX
xe-0/0/9.0       enabled
xe-0/0/32.0      enabled
xe-0/0/36.0      enabled
```

show dcbx neighbors

Syntax

show dcbx neighbors
<interface ***interface-name*****>**
<terse>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 11.3 for EX Series switches.

Description

Display information about Data Center Bridging Capability Exchange protocol (DCBX) neighbor interfaces.

Options

none—Display information about all DCBX neighbor interfaces.

interface-name—(Optional) Display information for the specified interface.

terse—Display the specified level of output.

Required Privilege Level

view

Related Documentation

- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring an FCoE Transit Switch*
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCB Features and Requirements on page 4795
- *Understanding Data Center Bridging Capability Exchange Protocol for EX Series Switches*
- dcbx on page 5092

List of Sample Output

show dcbx neighbors interface (QFX Series, DCBX Version 1.01 Mode) on page 5190
show dcbx neighbors interface (QFX Series, IEEE DCBX Mode) on page 5192
show dcbx neighbors terse (QFX Series) on page 5194
show dcbx neighbors (EX4500 Switch: FCoE Interfaces on Both Local and Peer with PFC Configured Compatibly) on page 5194
show dcbx neighbors (EX4500 Switch: DCBX Interfaces on Local and Peer Are Configured Compatibly with iSCSI Application) on page 5195
show dcbx neighbors (EX4500 Switch: Includes ETS) on page 5196

Output Fields

Table 396 on page 5177 lists the output fields for the **show dcbx neighbors** command. Output fields are listed in the approximate order in which they appear.

Table 396: show dcbx neighbors Output Fields

Field Name	Field Description
Interface	Name of the interface.

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
Parent Interface		Name of the link aggregation group (LAG) interface to which the DCBX interface belongs.
Active-application-map		Name of the application map applied to the interface.
Protocol-Mode		(QFX Series) DCBX protocol mode the interface uses: • IEEE DCBX Version—The interface uses IEEE DCBX mode. • DCBX Version 1.01—The interface uses DCBX version 1.01. NOTE: On interfaces that use the IEEE DCBX mode, the **show dcbx neighbors interface** ***interface-name*** operational command does not include application, PFC, or ETS operational state in the output.
Protocol-State		(DCBX Version 1.01 only) DCBX protocol state synchronization status: • **in-sync**—The local interface received an acknowledge message from the peer to indicate that the peer received a state change message sent by the local interface. • **ack-pending**—The local interface has not yet received an acknowledge message from the peer to indicate that the peer received a state change message sent by the local interface.
Local-Advertisement		(DCBX Version 1.01 only) Status of advertisements that the local interface sends to the peer.
	Operational version	Version of the DCBX standard used.
	sequence-number	Number of state change messages sent to the peer. If the interface **Protocol-State** value is **in-sync**, this number should match the **acknowledge-id** number in the **Peer-Advertisement** section. If the interface **Protocol-State** value is **ack-pending**, this number does not match the **acknowledge-id** number in the **Peer-Advertisement** section.
	acknowledge-id	Number of acknowledge messages received from the peer. If the **Protocol-State** value is **in-sync**, this number should match the **sequence-number** value in the **Peer-Advertisement** section. If the **Protocol-State** value is **ack-pending**, this number does not match the **sequence-number** value in the **Peer-Advertisement** section.

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
Peer-Advertisement		(DCBX Version 1.01 only) Status of advertisements that the peer sends to the local interface.
	Operational version	Version of the DCBX standard used.
	sequence-number	Number of state change messages the peer sent to the local interface. If this number matches the **acknowledge-id** number in the **Local-Advertisement** field, this indicates that the local interface has acknowledged all of the peer's state change messages and is synchronized. If this number does not match the **acknowledge-id** number in the **Local-Advertisement** field, this indicates that the peer has not yet received an acknowledgment for a state change message from the local interface.
	acknowledge-id	Number of acknowledge messages the peer has received from the local interface. If this number matches the **sequence-number** value in the **Local-Advertisement** field, this indicates that the peer has acknowledged all of the local interface's state change messages and is in synchronization. If this number does not match the **sequence-number** value in the **Local-Advertisement** field, this indicates that the peer has not yet sent an acknowledgment for a state change message from the local interface.

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name			Field Description
Feature: PFC			Priority-based flow control (PFC) feature DCBX state information.
	Protocol-State		(DCBX Version 1.01 only) DCBX protocol state synchronization status: • **ack-pending**—The local interface has not yet received an acknowledge message from the peer to indicate that the peer received a PFC state change message sent by the local interface. • **in-sync**—The local interface received an acknowledge message from the peer to indicate that the peer received a PFC state change message sent by the local interface. • **not-applicable**—PFC autonegotiation is disabled.
	Operational State		(DCBX Version 1.01 only) Operational state of the feature: **enabled** or **disabled**.
	Local-Advertisement		Status of advertisements that the local interface sends to the peer.
		Enable	(DCBX Version 1.01 only) State that the local interface advertises to the peer: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
		Willing	Willingness of the local interface to learn the PFC configuration from the peer using DCBX: • **Yes**—The local interface is willing to learn the PFC configuration from the peer. • **No**—The local interface is not willing to learn the PFC configuration from the peer.
		Mac auth Bypass Capability	(IEEE DCBX only) (QFX Series) Media access controller (MAC) authentication bypass provides access to devices based on MAC address authentication. This is not supported, so the only value seen in the local advertisement field is **no**.
		Error	(DCBX Version 1.01 only) Configuration compatibility error status: • **No**—No error detected. Local and peer configuration are compatible. • **Yes**—Error detected. Local and peer configuration are not compatible.

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
	Operational State	PFC operational state on the interface: • Enabled—PFC is enabled on the interface • Disabled—PFC is disabled on the interface
	Maximum Traffic Classes capable to support PFC	Largest number of traffic classes the local interface supports for PFC: • **6** (EX Series switches) • **8** (QFX Series)
	Code Point	PFC code point, which is specified in the 3-bit class-of-service field in the VLAN header.
	Admin Mode	PFC administrative state for each code point on the local interface: • **Enabled**—PFC is enabled for the code point. • **Disabled**—PFC is disabled for the code point.
	Operational Mode	(QFX Series) PFC operational mode for each code point: • Enable—PFC is enabled on the code point. • Disable—PFC is disabled on the code point.
Peer-Advertisement		Status of advertisements that the peer sends to the local interface.
	Enable	(DCBX Version 1.01 only) State that the peer advertises to the local interface: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
	Willing	Willingness of the peer to learn the PFC configuration from the local interface using DCBX: • **Yes**—The peer is willing to learn the PFC configuration from the local interface. • **No**—The peer is not willing to learn the PFC configuration from the local interface.
	Error	(DCBX Version 1.01 only) Configuration compatibility error status: • **No**—No error detected. Local and peer configuration are compatible. • **Yes**—Error detected. Local and peer configuration are not compatible.

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
	Operational State	PFC operational state on the interface: • Enabled—PFC is enabled on the interface • Disabled—PFC is disabled on the interface
	Mac auth Bypass Capability	(IEEE DCBX only) (QFX Series) Media access controller (MAC) authentication bypass provides access to devices based on MAC address authentication. Although the QFX Series does not support this feature, the connected peer might support it. This field reports the peer state: • **Yes**—The connected peer supports MAC authentication bypass. • **No**—The connected peer does not support MAC authentication bypass.
	Maximum Traffic Classes capable to support PFC	Largest number of traffic classes the peer supports for PFC: • **6** (EX Series switches) • **8** (QFX Series)
	Code Point	PFC code point, which is specified in the 3-bit class-of-service field in the VLAN header.
	Admin Mode	PFC administrative state for each code point on the peer: • **Enabled**—PFC is enabled for the code point. • **Disabled**—PFC is disabled for the code point.

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name			Field Description
Feature: Application			State information for the DCBX application.
	Protocol-State		(DCBX Version 1.01 only) DCBX protocol state synchronization status: • **in-sync**—The local interface received an acknowledge message from the peer to indicate that the peer received an FCoE state change message sent by the local interface. • **ack-pending**—The local interface has not yet received an acknowledge message from the peer to indicate that the peer received an FCoE state change message sent by the local interface. • **not-applicable**—The local interface is set to **no-auto-negotiation** (autonegotiation is disabled). If the interface is associated with an FCoE forwarding class, the interface advertises FCoE capability even if the connected peer does not advertise FCoE capability.
	Local-Advertisement		Status of advertisements that the local interface sends to the peer. If the local interface is set to **no-auto-negotiation** (autonegotiation is disabled), the local advertisement portion of the output is not shown.
		Enable	(DCBX Version 1.01 only) State that the local interface advertises to the peer: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
		Willing	(DCBX Version 1.01 only) Willingness of the local interface to learn the FCoE interface state from the peer using DCBX: • **Yes**—The local interface is willing to learn the FCoE interface state from the peer. • **No**—The local interface is not willing to learn the FCoE interface state from the peer.
		Error	(DCBX Version 1.01 only) Configuration compatibility error status: • **No**—No error detected. The local and peer configuration are compatible. • **Yes**—Error detected. The local and peer configuration are not compatible.
		Appl-Name	Name of the application:

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name			Field Description
		Ethernet-Type	(DCBX Version 1.01 only) Ethernet type (EtherType) of the application. For example, **0x8906** indicates the EtherType for the FCoE application. Either the EtherType (for Layer 2 applications) or the Socket Number (for Layer 4 applications) of the application is displayed in the output.
		Socket-Number	Destination port socket number of the application, if applicable. Either the EtherType (for Layer 2 applications) or the Socket Number (for Layer 4 applications) of the application is displayed in the output.
		Priority-Field or **Priority-Map**	Priority assigned to the application. For EX Series switches, the priority of the FCoE application is determined by the PFC congestion notification profile that has been configured and associated with the FCoE interface. For other applications, the priority is based on the application map.
		Status	(DCBX Version 1.01 only) Local status when autonegotiation is enabled: • **Enabled**—The application feature is enabled on both the local interface and the peer interface. (The local configuration and the peer configuration match.) • **Disabled**—The local configuration and the peer configuration do not match. NOTE: If there is a configuration mismatch in one application between the switch and the peer, all the other applications including FCoE are disabled.
	Peer-Advertisement		Status of advertisements that the peer sends to the local interface.
		Enable	(DCBX Version 1.01 only) State that the peer advertises to the local interface: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
		Willing	(DCBX Version 1.01 only) Willingness of the peer to learn the FCoE interface state from the local interface using DCBX: • **Yes**—The peer is willing to learn the FCoE interface state from the local interface. • **No**—The peer is not willing to learn the FCoE interface state from the local interface.

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
	Error	(DCBX Version 1.01 only) Configuration compatibility error status: • **No**—No error detected. Local and peer configuration are compatible. • **Yes**—Error detected. Local and peer configuration are not compatible.
	Appl-Name	Name of the application: • **FCoE**—Fibre Channel over Ethernet
	Ethernet-Type	Ethernet type (EtherType) of the application. For example, **0x8906** indicates the EtherType for the FCoE application. Either the EtherType (for Layer 2 applications) or the Socket-Number (for Layer 4 applications) of the application is displayed in the output.
	Socket-Number	Destination port socket number of the application, if applicable. Either the EtherType (for Layer 2 applications) or the Socket Number (for Layer 4 applications) of the application is displayed in the output.
	Priority-Field or **Priority-Map**	Priority assigned to the application.
	Status	(DCBX Version 1.01 only) Peer interface status: • **Enabled**—The application feature is enabled on both the local interface and the peer interface. (The local configuration and the peer configuration match.) • **Disabled**—The local configuration and the peer configuration do not match.

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name			Field Description
Feature: ETS			Enhanced Transmission Selection (ETS) DCBX state information.
	Protocol-State		(DCBX Version 1.01 only) ETS protocol state synchronization status: • **in-sync**—The local interface received an acknowledge message from the peer to indicate that the peer received an ETS state change message sent by the local interface. • **ack-pending**—The local interface has not yet received an acknowledge message from the peer to indicate that the peer received an ETS state change message sent by the local interface.
	Operational State		(DCBX Version 1.01 only) Operational state of the feature, **enabled** or **disabled**.
	Local-Advertisement		Status of advertisements that the local interface sends to the peer.
		Enable	(DCBX Version 1.01 only) State that the local interface advertises to the peer: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
		TLV Type	(IEEE DCBX only) Type of ETS TLV: • Configuration—Advertises the Configuration TLV, which communicates the local ETS configuration to the peer but does not ask the peer to use the configuration. • Recommendation—Advertises the Recommendation TLV, which communicates the local ETS configuration to the peer, and if the peer is “willing,” configures the peer interface to match the local ETS configuration. • Recommendation-or-Configuration—Advertises both TLVs.
		Willing	Willingness of the local interface to learn the ETS state from the peer using DCBX (EX Series switches always advertise **No** for this field): • **Yes**—Local interface is willing to learn the ETS state from the peer. • **No**—Local interface is not willing to learn the ETS state from the peer.
		Credit Based Shaper	

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
		(IEEE DCBX only) Alternative method of flow control to buffer-to-buffer credit. The QFX Series does not support a credit-based shaper, so the value of this field is always **No**.
	Error	(DCBX Version 1.01 only) Configuration error status: • **No**—No error. This should always be the switch ETS error state. • **Yes**—Error detected.
	Maximum Traffic Classes capable to support PFC	(DCBX Version 1.01 only) Largest number of traffic classes the local interface supports for PFC.
	Maximum Traffic Classes supported	(IEEE DCBX only) Largest number of traffic classes the local interface supports for ETS. (EX Series switches support only one traffic class for ETS. However, a different value might be shown for this field.)
	Code Point	PFC code point, which is specified in the 3-bit class-of-service field in the VLAN header.
	Priority-Group	Class-of-service (CoS) priority group (forwarding class set) identification number.
	Percentage B/W	Configured minimum percentage of link bandwidth allocated to the priority group. Only explicitly configured values appear in this output column. If the link bandwidth is the default percentage, it is not shown. (EX Series switches allocate 100% of link bandwidth to the default priority group, group 7.)
	Transmission Selection Algorithm	(IEEE DCBX only) The transmission selection algorithm used by the interface. The QFX Series supports ETS but does not support using the credit-based shaper algorithm, so the only value shown in this field is **ETS**.
Peer-Advertisement		Status of advertisements that the peer sends to the local interface.
	Enable	

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
		(DCBX Version 1.01 only) State that the peer advertises to the local interface: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
	TLV Type	(IEEE DCBX only) Type of ETS TLV: • Configuration—Advertises the Configuration TLV, which communicates the local ETS configuration to the peer but does not ask the peer to use the configuration. • Recommendation—Advertises the Recommendation TLV, which communicates the local ETS configuration to the peer, and if the peer is “willing,” configures the peer interface to match the local ETS configuration. • Configuration/Recommendation—Advertises both TLVs.
	Willing	Willingness of the peer to learn the ETS state from the local interface using DCBX: • **Yes**—Peer is willing to learn the ETS state from the local interface. • **No**—Peer is not willing to learn the ETS state from the local interface.
	Credit Based Shaper	(IEEE DCBX only) Alternative method of flow control to buffer-to-buffer credit. The QFX Series does not support a credit-based shaper, so the value of this field is always **No**.
	Error	(DCBX Version 1.01 only) Configuration error status of the peer: • **No**—No error in peer ETS TLV. • **Yes**—Error in peer ETS TLV.
	Maximum Traffic Classes capable to support PFC	(DCBX Version 1.01 only) Largest number of traffic classes the local interface supports for PFC.
	Maximum Traffic Classes supported	(IEEE DCBX only) Largest number of traffic classes the local interface supports for ETS. (EX Series switches support only one traffic class for ETS. However, a different value might be shown for this field.)
	Code Point	

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
		PFC code point, which is specified in the 3-bit class-of-service field in the VLAN header.
	Priority-Group	CoS priority group (forwarding class set) identification number.
	Percentage B/W	Configured minimum percentage of link bandwidth allocated to the priority group. (EX Series switches allocate 100% of link bandwidth to the default priority group, group 7.)
	Transmission Selection Algorithm	(IEEE DCBX only) Transmission selection algorithm used by the interface. The QFX Series supports ETS but does not support using the credit-based shaper algorithm, so the only value shown in this field is **ETS**.
PFC		(QFX Series, **terse** option only) DCBX TLV advertisement state for PFC: • Disabled—PFC configuration matches the configuration on the connected peer and PFC is disabled • Enabled—PFC configuration matches the configuration on the connected peer and PFC is enabled • Not Advt—Interface does not advertise PFC to the connected peer
ETS		(**terse** option only) Local DCBX TLV advertisement state for ETS: • Advt—Interface advertises ETS TLVs • Disabled—ETS is disabled on the interface (interface does not advertise ETS)
ETS Rec		(**terse** option only) DCBX TLV peer advertisement state for ETS (state received from the connected DCBX peer): • Advt—Peer interface advertises ETS TLVs • Not Advt—Peer interface does not advertise ETS NOTE: When the DCBX mode is DCBX version 1.01, no peer information is displayed.

Table 396: show dcbx neighbors Output Fields *(continued)*

Field Name	Field Description
Version	(**terse** option only) The DCBX version used on the interface and whether the DCBX version was autonegotiated or explicitly configured: • **IEEE**—The interface uses IEEE DCBX. • **1.01**—The interface uses DCBX version 1.01. When the DCBX version used is the result of autonegotiation, the term **(Auto)** appears next to the version. For example, **IEEE (Auto)** indicates that the interface autonegotiated with the connected peer to use IEEE DCBX. Autonegotiation is enabled by default.

Sample Output

show dcbx neighbors interface (QFX Series, DCBX Version 1.01 Mode)

```
user@switch> show dcbx neighbors interface xe-0/0/0
Interface : xe-0/0/0.0 - Parent Interface: ae0.0
    Active-application-map: app-map-1
    Protocol-State: in-sync
    Protocol-Mode: DCBX Version 1.01

    Local-Advertisement:
        Operational version: 1
        sequence-number: 130, acknowledge-id: 102

    Peer-Advertisement:
        Operational version: 1
        sequence-number: 102, acknowledge-id: 130

    Feature: PFC, Protocol-State: in-sync

      Operational State: Enabled

      Local-Advertisement:
        Enable: Yes, Willing: No, Error: No
        Maximum Traffic Classes capable to support PFC: 8

        Code Point           Admin Mode   Operational Mode
          000                 Disabled     Disable
          001                 Disabled     Disable
          010                 Disabled     Disable
          011                 Enabled      Enable
          100                 Enabled      Enable
          101                 Disabled     Disable
          110                 Disabled     Disable
          111                 Disabled     Disable

      Peer-Advertisement:
        Enable: Yes, Willing: No, Error: No
        Maximum Traffic Classes capable to support PFC: 8

        Code Point           Admin Mode
          000                 Disabled
```



```
      001                 Disabled
      010                 Disabled
      011                 Enabled
      100                 Enabled
      101                 Disabled
      110                 Disabled
      111                 Disabled

Feature: Application, Protocol-State: in-sync

  Local-Advertisement:
    Enable: Yes, Willing: No, Error: No

    Appl-Name    Ethernet-Type    Socket-Number    Priority-Map    Status
      FCoE         0x8906                            00001110        Enabled

      iSCSI                           3260           10000000        Enabled


  Peer-Advertisement:
    Enable: Yes, Willing: Yes, Error: No

    Appl-Name    Ethernet-Type    Socket-Number    Priority-Map    Status

      FCoE         0x8906             N/A            00001110        Enabled


Feature: ETS, Protocol-State: in-sync

  Operational State: Enabled

  Local-Advertisement:
    Enable: Yes, Willing: No, Error: No
    Maximum Traffic Classes capable to support PFC: 8

    Code Point           Priority-Group
      000                  0
      001                  7
      010                  7
      011                  7
      100                  0
      101                  1
      110                  1
      111                  7

    Priority-Group       Percentage B/W
      0                    40%
      1                    5%

  Peer-Advertisement:
    Enable: Yes, Willing: No, Error: No
    Maximum Traffic Classes capable to support PFC: 8

    Code Point           Priority-Group
      000                  0
      001                  7
      010                  7
      011                  7
      100                  0
      101                  1
      110                  1
```



```
  111                  7

Priority-Group        Percentage B/W
  0                     40%
  1                     5%
```

show dcbx neighbors interface (QFX Series, IEEE DCBX Mode)

```
user@switch> show dcbx neighbors interface xe-0/0/0
Interface : xe-0/0/0.0 - Parent Interface: ae0.0
    Active-application-map: app-map-1
    Protocol-Mode: IEEE-DCBX Version

    Feature: PFC

      Local-Advertisement:
        Willing: No
        Mac auth Bypass Capability: No
        Operational State: Enabled

        Maximum Traffic Classes capable to support PFC: 8

        Code Point           Admin Mode
          000                 Disabled
          001                 Disabled
          010                 Disabled
          011                 Enabled
          100                 Enabled
          101                 Disabled
          110                 Disabled
          111                 Disabled

      Peer-Advertisement:
        Willing: No
        Mac auth Bypass Capability: No
        Operational State: Enabled

        Maximum Traffic Classes capable to support PFC: 8

        Code Point          Admin Mode
          000                 Disabled
          001                 Disabled
          010                 Disabled
          011                 Enabled
          100                 Enabled
          101                 Disabled
          110                 Disabled
          111                 Disabled

    Feature: Application

      Local-Advertisement:

        Appl-Name    Ethernet-Type    Socket-Number    Priority-field
          FCoE         0x8906                            00001110
          iSCSI                            3260          10000000

      Peer-Advertisement:
        Appl-Name    Ethernet-Type    Socket-Number    Priority-field
```



```
    FCoE        0x8906            N/A            00001110

Feature: ETS

  Local-Advertisement:
    TLV Type: Configuration/Recommendation
    Willing: No
    Credit Based Shaper: No
    Maximum Traffic Classes supported: 3

    Code Point          Priority-Group
      000                 0
      001                 7
      010                 7
      011                 7
      100                 0
      101                 1
      110                 1
      111                 7

    Priority-Group      Percentage B/W
      0                   40%
      1                   5%

    Priority-Group   Transmission Selection Algorithm
      0              Enhanced Transmission Selection
      1              Enhanced Transmission Selection

  Peer-Advertisement:
    TLV Type: Configuration
    Willing: No
    Credit Based Shaper: No

    Code Point          Priority-Group
      000                 0
      001                 7
      010                 7
      011                 7
      100                 0
      101                 1
      110                 1
      111                 7

    Priority-Group      Percentage B/W
      0                   40%
      1                   5%

    Priority-Group   Transmission Selection Algorithm
      0              Enhanced Transmission Selection
      1              Enhanced Transmission Selection

  Peer-Advertisement:

    TLV Type: Recommendation

    Code Point          Priority-Group
      000                 0
      001                 7
      010                 7
      011                 7
      100                 0
```

```
  101                   1
  110                   1
  111                   7

Priority-Group        Percentage B/W
  0                     40%
  1                     5%

Priority-Group    Transmission Selection Algorithm
  0               Enhanced Transmission Selection
  1               Enhanced Transmission Selection
```

show dcbx neighbors terse (QFX Series)

```
user@switch> show dcbx neighbors terse
Interface    Parent      PFC        ETS        ETS        Version
             Interface                                    Rec
xe-0/0/8.0   -           Enabled    Advt       Advt       IEEE (Auto)
xe-0/0/9.0   -           Disabled   Disabled              1.01
xe-0/0/11.0 ae0.0        Enabled    Advt       Advt       IEEE (Auto)
xe-0/0/12.0 ae0.0        Enabled    Advt       Advt       IEEE (Auto)
xe-0/0/32.0 -            Enabled    Advt       Not Advt   IEEE
xe-0/0/36.0 -            Not Advt   Advt       Advt       IEEE
```

show dcbx neighbors (EX4500 Switch: FCoE Interfaces on Both Local and Peer with PFC Configured Compatibly)

```
user@switch> show dcbx neighbors interface xe-0/0/14

   Interface : xe-0/0/14.0 - Parent Interface: ae0.0
    Protocol-State: in-sync

    Local-Advertisement:
        Operational version: 0
        sequence-number: 6, acknowledge-id: 6

    Peer-Advertisement:
        Operational version: 0
        sequence-number: 6, acknowledge-id: 6

    Feature: PFC, Protocol-State: in-sync

      Operational State: Enabled

      Local-Advertisement:
        Enable: Yes, Willing: No, Error: No
        Maximum Traffic Classes capable to support PFC: 6

         Code Point             Admin Mode
          000                  Disabled
          001                  Disabled
          010                  Disabled
          011                  Enabled
          100                  Disabled
          101                  Disabled
          110                  Disabled
          111                  Disabled
```



```
      Peer-Advertisement:
        Enable: Yes, Willing: No, Error: No
        Maximum Traffic Classes capable to support PFC: 6

        Code Point             Admin Mode
          000                 Disabled
          001                 Disabled
          010                 Disabled
          011                 Enabled
          100                 Disabled
          101                 Disabled
          110                 Disabled
          111                 Disabled


    Feature: Application, Protocol-State: in-sync

      Local-Advertisement:
        Enable: Yes, Willing: No, Error: No   <<< Error bit will not be set as
there is no miss configuration between local and peer.


        Appl-Name    Ethernet-Type    Socket-Number    Priority-Map    Status
        FCoE          0x8906                           00001000        Enabled


      Peer-Advertisement:
        Enable: Yes, Willing: No, Error: No

                 Appl-Name    Ethernet-Type    Socket-Number    Priority-Map
Status
                 FCoE          0x8906                           00001000
Enabled
```

show dcbx neighbors (EX4500 Switch: DCBX Interfaces on Local and Peer Are Configured Compatibly with iSCSI Application)

user@switch> **show dcbx neighbors interface xe-0/0/14**

```
  Interface : xe-0/0/14.0 - Parent Interface: ae0.0

    Protocol-State: in-sync

    Active-application-map: iscsi-map

     Local-Advertisement:
        Operational version: 0
        sequence-number: 9, acknowledge-id: 12


    Peer-Advertisement:
        Operational version: 0
        sequence-number: 12, acknowledge-id: 9


    Feature: PFC, Protocol-State: in-sync
      Operational State: Enabled
```

```
  Local-Advertisement:
   Enable: Yes, Willing: No, Error: No
   Maximum Traffic Classes capable to support PFC: 6


Code Point              Admin Mode
     000                 Disabled
     001                 Disabled
     010                 Disabled
     011                 Enabled
     100                 Disabled
     101                 Disabled
     110                 Disabled
     111                 Disabled

 Peer-Advertisement:
   Enable: Yes, Willing: No, Error: No
   Maximum Traffic Classes capable to support PFC: 6

Code Point              Admin Mode
     000                 Disabled
     001                 Disabled
     010                 Disabled
     011                 Enabled
     100                 Disabled
     101                 Disabled
     110                 Disabled
     111                 Disabled

Feature: Application, Protocol-State: in-sync
 Local-Advertisement:
   Enable: Yes, Willing: No, Error: No

       Appl-Name    Ethernet-Type    Socket-Number   Priority-Map    Status

        FCoE         0x8906                          00001000        Enabled

        iscsi                         3260           00100000        Enabled


 Peer-Advertisement:
   Enable: Yes, Willing: No, Error: No

       Appl-Name    Ethernet-Type    Socket-Number   Priority-Map    Status

        FCoE         0x8906                          00001000        Enabled

        iscsi                         3260           00100000        Enabled
```

show dcbx neighbors (EX4500 Switch: Includes ETS)

user@switch> **show dcbx neighbors interface xe-0/0/3**

```
Interface : xe-0/0/3.0
 Protocol-State: in-sync
 Active-application-map: map_iscsi

 Local-Advertisement:
     Operational version: 0
```



```
    sequence-number: 1, acknowledge-id: 5

Peer-Advertisement:
    Operational version: 0
    sequence-number: 5, acknowledge-id: 1

Feature: PFC, Protocol-State: in-sync

  Operational State: Enabled

  Local-Advertisement:
    Enable: Yes, Willing: No, Error: No
    Maximum Traffic Classes capable to support PFC: 6

    Code Point          Admin Mode
      000                 Enabled
      001                 Enabled
      010                 Disabled
      011                 Disabled
      100                 Disabled
      101                 Disabled
      110                 Disabled
      111                 Disabled

  Peer-Advertisement:
    Enable: Yes, Willing: Yes, Error: No
    Maximum Traffic Classes capable to support PFC: 8

    Code Point          Admin Mode
      000                 Enabled
      001                 Disabled
      010                 Disabled
      011                 Disabled
      100                 Enabled
      101                 Disabled
      110                 Disabled
      111                 Disabled

Feature: Application, Protocol-State: in-sync

  Local-Advertisement:
    Enable: Yes, Willing: No, Error: No

    Appl-Name    Ethernet-Type    Socket-Number    Priority-Map    Status
      FCoE         0x8906                            00000001        Enabled

      iscsi                         3260             00000010        Enabled


  Peer-Advertisement:
    Enable: Yes, Willing: Yes, Error: No

    Appl-Name    Ethernet-Type    Socket-Number    Priority-Map    Status
      FCoE         0x8906                            00001000        Enabled

      iscsi                         3260             00010000        Enabled


Feature: ETS, Protocol-State: in-sync

  Operational State: Enabled
```



```
Local-Advertisement:
  Enable: Yes, Willing: No, Error: No
  Maximum Traffic Classes supported : 3

  Code Point           Priority-Group
    000                  7
    001                  7
    010                  7
    011                  7
    100                  7
    101                  7
    110                  7
    111                  7

  Priority-Group       Percentage B/W
    7                    100%

Peer-Advertisement:
  Enable: Yes, Willing: Yes, Error: No
  Maximum Traffic Classes supported : 8

  Code Point           Priority-Group
    000                  0
    001                  1
    010                  0
    011                  0
    100                  2
    101                  0
    110                  0
    111                  0

  Priority-Group       Percentage B/W
    0                    30%
    1                    40%
    2                    30%
```


show fibre-channel fabric

Syntax
show fibre-channel fabric
<extensive | summary>
<*fabric-name*>
<sort-by (name | fabric-id)>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display Fibre Channel fabric information.

Options *fabric-name*—(Optional) Display output only for the specified fabric.

extensive | summary—(Optional) Display the specified level of output.

sort-by (name | fabric-id)—(Optional) Sort output by fabric name or fabric ID.

Required Privilege Level view

Related Documentation

- fc-fabrics on page 5113
- Configuring an FCoE-FC Gateway Fibre Channel Fabric on page 5045

List of Sample Output
show fibre-channel fabric on page 5200
show fibre-channel fabric extensive on page 5200

Output Fields Table 397 on page 5199 lists the output fields for the **show fibre-channel fabric** command. Output fields are listed in the approximate order in which they appear.

Table 397: show fibre-channel fabric Output Fields

Field Name	Field Description	Level of Output
Fabric	Name of the fabric.	All
Fabric-ID	Identification number of the fabric.	All
Type	Type of fabric. All fabrics are **PROXY** fabrics.	All
Interfaces	Native Fibre Channel interfaces and FCoE interfaces assigned to the fabric.	All
Created at	Date and time the fabric was created.	**extensive**
Internal Index	Fabric index internal to Junos OS.	**extensive**
Origin	Origin information internal to Junos OS.	**extensive**
Description	Text description of the fabric.	**extensive**

Table 397: show fibre-channel fabric Output Fields *(continued)*

Field Name	Field Description	Level of Output
Fabric WWN	Unique WWN of the fabric generated by the FCF.	**extensive**
Login sessions	Number of FIP login sessions currently running on the fabric.	**extensive**
Configured max login sessions	Configured maximum number of FIP login sessions permitted on the fabric.	**extensive**

Sample Output

show fibre-channel fabric

```
user@switch> show fibre-channel fabric
Fabric          Fabric-ID      Type     Interfaces

proxy2          200            PROXY
                                       fc-0/0/0.0
                                       fc-0/0/1.0
```

show fibre-channel fabric extensive

```
user@switch> show fibre-channel fabric extensive
Fabric: proxy2, Created at: Mon Apr 19 14:02:58 2010
Fabric-ID: 200, Internal index: 2, Origin: Static
Description: srv-fabric,  Type: PROXY,  Fabric WWN: 10:00:00:05:33:51:d7:cd
Login sessions: 200,  Configured max login sessions: 500
      fc-0/0/0.0, (untagged)
      fc-0/0/1.0, (untagged)
```

show fibre-channel fc2 sessions

Syntax

show fibre-channel fc2 sessions
<fabric *fabric-name*>
<brief | detail>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display Fibre Channel FC-2 information.

NOTE: A session is a FLOGI or FDISC login to the FC SAN fabric. Session does not refer to end-to-end storage sessions.

Options

fabric *fabric-name*—(Optional) Display output only for the specified fabric.

brief | detail—(Optional) Display the specified level of output.

Required Privilege Level view

Related Documentation

- show fibre-channel fc2 statistics on page 5203
- clear fibre-channel fc2 statistics on page 5154

List of Sample Output

show fibre-channel fc2 sessions on page 5202
show fibre-channel fc2 sessions detail on page 5202

Output Fields Table 398 on page 5201 lists the output fields for the **show fibre-channel fc2 sessions** command. Output fields are listed in the approximate order in which they appear.

Table 398: show fibre-channel fc2 sessions Output Fields

Field Name	Field Description	Level of Output
Fabric	Name of the fabric.	All
Fabric-id	Identification number of the fabric.	All
Interface Name	Name of the interface.	All
Local FCID	Address of the local end of the connection.	All
Far FCID	Address of the far (remote) end of the connection.	All
# Pending Exchanges	Number of pending exchanges for the session.	All
Flags	Flags internal to Junos OS.	**detail**

Table 398: show fibre-channel fc2 sessions Output Fields *(continued)*

Field Name	Field Description	Level of Output
Refcount	Reference count internal to Junos OS.	**detail**
Users	Information internal to Junos OS.	**detail**

Sample Output

show fibre-channel fc2 sessions

```
user@switch> show fibre-channel fc2 sessions
Fabric: fip-proxy, Fabric-id: 1
Interface      Local     Far         # Pending
Name           FCID      FCID        Exchanges
fc-0/0/0.0     *         0xfffffe    0
fc-0/0/1.0     *         0xfffffe    0
fc-0/0/2.0     *         0xfffffe    0
```

show fibre-channel fc2 sessions detail

```
user@switch> show fibre-channel fc2 sessions detail
Fabric: fip-proxy, Fabric-id: 1
Interface Name      fc-0/0/0.0
Local FCID:         *
Far FCID:           0xfffffe
Exchanges:          0
Flags:              SELF_LOCK USER_SYNCHED
Refcount:           2
Users:              1

Interface Name      fc-0/0/1.0
Local FCID:         *
Far FCID:           0xfffffe
Exchanges:          0
Flags:              SELF_LOCK USER_SYNCHED
Refcount:           2

Interface Name      fc-0/0/2.0
Local FCID:         *
Far FCID:           0xfffffe
Exchanges:          0
Flags:              SELF_LOCK USER_SYNCHED
Refcount:           2
Users:              1
```

show fibre-channel fc2 statistics

Syntax
show fibre-channel fc2 statistics
<**fabric** *fabric-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display Fibre Channel FC-2 statistics.

Options **fabric** ***fabric-name***—(Optional) Display output only for the specified fabric.

Required Privilege Level view

Related Documentation

- show fibre-channel fc2 sessions on page 5201
- clear fibre-channel fc2 statistics on page 5154

List of Sample Output show fibre-channel fc2 statistics on page 5204

Output Fields Table 399 on page 5203 lists the output fields for the **show fibre-channel fc2 statistics** command. Output fields are listed in the approximate order in which they appear.

Table 399: show fibre-channel fc2 statistics Output Fields

Field Name	Field Description
Global statistics	Statistics for all fabrics.
Frame buffers allocated	Number of frame buffers currently allocated to all fabrics.
Frame buffers freed	Number of frame buffers freed.
Frames dropped	Number of dropped frames.
Fabric statistics	Fabric-specific statistics.
Fabric	Name of the fabric.
Fabric-id	Identification number of the fabric.
Tx-FRJTs	Number of fabric frame rejects (F_RJTs).
Tx-PRJTs	Number of port frame rejects (P_RJTs).
Tx-LSRJTs	Number of link service rejections.
Tx-ABTS	Number of abort sequence frames sent.
Rx-Drops	Number of received frames dropped.

Table 399: show fibre-channel fc2 statistics Output Fields *(continued)*

Field Name	Field Description
Rx-ABTS	Number of abort sequence frames received.

Sample Output

show fibre-channel fc2 statistics

```
user@switch> show fibre-channel fc2 statistics
Global statistics:

Frame buffers allocated: 60
Frame buffers freed:     60
Frames dropped:          0

Fabric statistics:

Fabric : fip-proxy, Fabric-id: 1
Tx-FRJTs:     0
Tx-PRJTs:     0
Tx-LSRJTs:    0
Tx-ABTS:      0
Rx-Drops:     0
Rx-ABTS:      0
```

show fibre-channel fip

Syntax

show fibre-channel fip
<brief | detail>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Fibre Channel over Ethernet Initialization Protocol (FIP) information.

Options

brief | detail—(Optional) Display the specified level of output.

Required Privilege Level

view

Related Documentation

- Configuring FIP on an FCoE-FC Gateway on page 5059
- show fibre-channel fip enode on page 5210
- show fibre-channel fip fabric on page 5214
- show fibre-channel fip fcf on page 5217
- show fibre-channel fip interface on page 5220
- show fibre-channel fip statistics on page 5223
- clear fibre-channel fip statistics on page 5156

List of Sample Output

show fibre-channel fip on page 5207
show fibre-channel fip detail on page 5208

Output Fields

Table 400 on page 5205 lists the output fields for the **show fibre-channel fip** command. Output fields are listed in the approximate order in which they appear. A session is a FLOGI or FDISC login to the FC SAN fabric. Session does not refer to end-to-end storage sessions.

Table 400: show fibre-channel fip Output Fields

Field Name	Field Description	Level of Output
Configured max FIP sessions per Node Device	Configured maximum number of FIP sessions permitted on the Node device. For QFabric systems, this is the maximum number of FIP sessions permitted on each Node device in the fabric. For QFX3500 devices, this is the maximum number of FIP sessions permitted on the device.	**detail**
Node Device	Node device identifier.	**detail**
Total FIP sessions	Total number of FIP sessions on the FCoE-FC gateway switch.	**detail**

Table 400: show fibre-channel fip Output Fields *(continued)*

Field Name		Field Description	Level of Output
Total FCoE filters		Total number of FIP filters on the FCoE-FC gateway switch.	**detail**
Fabric Name		Name of the fabric and in parentheses the fabric ID.	All
FC-MAP		FCoE mapped address prefix of the FCoE forwarder for the fabric.	**detail**
FKA-ADV-PERIOD		Period of time in milliseconds between FIP keepalive advertisements configured for the FC fabric.	**detail**
MAX-SESSIONS-PER-ENODE		Maximum number of concurrent sessions (FLOGI and FDISC combined) that each ENode can instantiate.	**detail**
FCoE trusted		Whether ports on the FC fabric are trusted or untrusted: • **Yes**—Ports on the FC fabric are trusted; FIP snooping is turned off. • **No**—Ports on the FC fabric are not trusted; FIP snooping is turned on.	**detail**
Member		Information about an FCF that is a member of the fabric.	All
	• **FCF-MAC**	MAC address used in discovery advertisements.	All
	• **FKA-ADV-PERIOD**	Period of time in milliseconds between FIP keepalive advertisements configured for the FC interface.	**detail**
	• **FKA-ADV-D-BIT**	Disable FIP keepalive advertisement monitoring bit. The state is always **off**.	**detail**
	• **Type**	Type of interface: • **VF_Port Capable**—Interface can act as a VF_Port interface.	**detail**
	• **Priority**	Priority value associated with the switch FCF-MAC. Converged network adapters (CNAs) use the priority value to determine the switch with which they will perform FIP FLOGI. The lower the value, the higher the priority. Value range: 0 through 255.	**detail**
	• **State**	FIP state on the fabric: • **Enable**—FIP is enabled on the fabric. • **Disable**—FIP is disabled on the fabric.	**detail**

Table 400: show fibre-channel fip Output Fields *(continued)*

Field Name	Field Description	Level of Output
ENode	Information about a connected FCoE node (ENode).	All
• **ENode-MAC**	MAC address of the connected ENode.	All
• **Enode State**	Login state internal to Junos OS.	All
• **Configured ENode timer**	User-configured FIP keepalive advertisement interval in milliseconds.	**detail**
• **Running ENode timer**	Runtime interval in milliseconds of the last FIP keepalive advertisement received. This value changes every time an FKA_ADV is received.	**detail**
• **Active FIP Sessions**	Number of active FIP sessions on the ENode.	**detail**
• **VN-Port-MAC**	MAC address of a VN_Port on the ENode.	All
• **Session State**	Session state internal to Junos OS.	**detail**
• **Configured FKA-ADV**	User-configured FIP keepalive advertisement interval in milliseconds.	**detail**
• **Running FKA-ADV**	Runtime interval in milliseconds of the last FIP keepalive advertisement received. This value changes every time an FKA_ADV is received.	**detail**
• **Configured VN-Port Timer**	Configured state of the VN_Port keepalive timer in milliseconds. This value is always 90 and is not user-configurable.	**detail**
• **Running VN-Port Timer**	Running state of the VN_Port keepalive timer in milliseconds.	**detail**
• **FCID**	Fibre Channel ID of the VN_Port.	**detail**
• **WWN**	Unique worldwide name of the VN_Port.	**detail**

Sample Output

show fibre-channel fip

```
user@switch> show fibre-channel fip
Fabric Name : proxy2 (200)
  Member
  FCF-MAC : 00:30:48:b0:ee:d2 (Interface vlan.100)
    Enode
    Enode-MAC : 00:10:94:00:00:02       State : Logged-in
        Session
        VN-Port-MAC              : 0e:fc:00:03:00:02
        VN-Port-MAC              : 0e:fc:00:03:00:01
```



```
    Enode-MAC : 00:10:94:00:00:03       State : Logged-in
        Session
        VN-Port-MAC              : 0e:fc:00:03:00:04
        VN-Port-MAC              : 0e:fc:00:03:00:03
```

show fibre-channel fip detail

```
user@switch> show fibre-channel fip detail
Configured max FIP sessions per Node Device: 2500
Node Device: 0  Total FIP sessions: 4  Total FCoE filters: 4

Fabric Name : proxy2 (200)
  FC-MAP         : 0e:fc:00
  FKA-ADV-PERIOD : 90000        MAX-SESSIONS-PER-ENODE : 32
  FCoE trusted   : No

    Member
    FCF-MAC: 00:30:48:b0:ee:d2  (Interface vlan.100)
      FKA-ADV-PERIOD  : 90000    FKA-ADV-D-BIT-bit : Off
      Type : VF_Port Capable
      Priority : 86              State : Enable

        ENode
        Enode-MAC : 00:10:94:00:00:02   ENode State : Logged-in
         Configured ENode timer: 8000    Running ENode timer: 12226
         Active FIP Sessions : 2

          Session details
          VN-Port-MAC              : 0e:fc:00:03:00:02
          Session state            : Up
          Configured FKA-ADV       : 90000
          Running FKA-ADV          : 0
          Configured VN-Port Timer : 90000
          Running VN-Port Timer    : 213193
          FCID                     : 0x2c1a01
          WWN                      : 10:00:00:00:c9:a4:a3:cf

          VN-Port-MAC              : 0e:fc:00:03:00:01
          Session state            : Up
          Configured FKA-ADV       : 90000
          Running FKA-ADV          : 0
          Configured VN-Port Timer : 90000
          Running VN-Port Timer    : 213632
          FCID                     : 0x2c1a02
          WWN                      : 10:00:00:00:d9:b4:e3:df

        ENode
        Enode-MAC : 00:10:94:00:00:03   ENode State : Logged-in
         Configured ENode timer: 8000    Running ENode timer: 12254
         Active FIP Sessions : 2

          Session details
          VN-Port-MAC              : 0e:fc:00:03:00:04
          Session state            : Up
          Configured FKA-ADV       : 90000
          Running FKA-ADV          : 0
          Configured VN-Port Timer : 90000
          Running VN-Port Timer    : 213480
          FCID                     : 0x2c1a03
          WWN                      : 21:00:00:c0:dd:11:09:13
```

```
VN-Port-MAC               : 0e:fc:00:03:00:03
Session state             : Up
Configured FKA-ADV        : 90000
Running FKA-ADV           : 0
Configured VN-Port Timer : 90000
Running VN-Port Timer     : 214004
FCID                      : 0x2c1a04
WWN                       : 21:00:00:c0:df:12:08:14
```

show fibre-channel fip enode

Syntax

show fibre-channel fip enode ***enode-mac***
<brief | detail>
<vn-port-mac ***vn-port-mac*****>**

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) information for a specified ENode or a specified VN_Port on an ENode.

Options

brief | detail—(Optional) Display the specified level of output.

enode-mac—Display information for the ENode specified by the MAC address.

vn-port-mac ***vn-port-mac***—(Optional) Display information only for the specified VN_Port.

Required Privilege Level

view

Related Documentation

- Configuring FIP on an FCoE-FC Gateway on page 5059
- show fibre-channel fip on page 5205
- show fibre-channel fip fabric on page 5214
- show fibre-channel fip fcf on page 5217
- show fibre-channel fip interface on page 5220
- show fibre-channel fip statistics on page 5223
- clear fibre-channel fip enode on page 5155

List of Sample Output

show fibre-channel fip enode on page 5212
show fibre-channel fip enode detail on page 5213

Output Fields

Table 401 on page 5210 lists the output fields for the **show fibre-channel fip enode** command. Output fields are listed in the approximate order in which they appear. A session is a FLOGI or FDISC login to the FC SAN fabric. Session does not refer to end-to-end storage sessions.

Table 401: show fibre-channel fip enode Output Fields

Field Name	Field Description	Level of Output
Fabric Name	Name of the fabric and in parentheses the fabric ID.	All
FC-MAP	FCoE mapped address prefix of the FCoE forwarder for the fabric.	**detail**
FKA-ADV-PERIOD	Period of time in milliseconds between FIP keepalive advertisements configured for the FC fabric.	**detail**

Table 401: show fibre-channel fip enode Output Fields *(continued)*

Field Name		Field Description	Level of Output
MAX-SESSIONS-PER-ENODE		Maximum number of concurrent sessions (FLOGI and FDISC combined) that each ENode can instantiate.	**detail**
FCoE trusted		Whether ports on the FC fabric are trusted or untrusted: • **Yes**—Ports on the FC fabric are trusted; FIP snooping is turned off. • **No**—Ports on the FC fabric are not trusted; FIP snooping is turned on.	**detail**
Member		Information about an FCF that is a member of the fabric.	All
	• FCF-MAC	MAC address used in discovery advertisements.	All
	• FKA-ADV-PERIOD	Period of time in milliseconds between FIP keepalive advertisements configured for the FC interface.	**detail**
	• FKA-ADV-D-BIT	Disable FIP keepalive advertisement monitoring bit. The state is always **off**.	**detail**
	• Type	Type of interface: • **VF_Port Capable**—Interface can act as a VF_Port interface.	**detail**
	• Priority	Priority value associated with the switch FCF-MAC. Converged network adapters (CNAs) use the priority value to determine the switch with which they will perform FIP FLOGI. The lower the value, the higher the priority. Value range: 0 through 255.	**detail**
	• State	FIP state on the fabric: • **Enable**—FIP is enabled on the fabric. • **Disable**—FIP is disabled on the fabric.	**detail**

Table 401: show fibre-channel fip enode Output Fields *(continued)*

Field Name	Field Description	Level of Output
ENode	Information about a connected FCoE node (ENode).	All
• **ENode-MAC**	MAC address of the connected ENode.	All
• **ENode State**	Login state internal to Junos OS.	All
• **Configured ENode timer**	User-configured FIP keepalive advertisement interval in milliseconds.	**detail**
• **Running ENode timer**	Runtime interval in milliseconds of the last FIP keepalive advertisement received. This value changes every time an FKA_ADV is received.	**detail**
• **Active FIP Sessions**	Number of active FIP sessions on the ENode.	**detail**
• **VN-Port-MAC**	MAC address of a VN_Port on the ENode.	**detail**
• **Session State**	Session state internal to Junos OS.	**detail**
• **Configured FKA-ADV**	User-configured FIP keepalive advertisement interval in milliseconds.	**detail**
• **Running FKA-ADV**	Runtime interval in seconds of the last FIP keepalive advertisement received. This value changes every time an FKA_ADV is received.	**detail**
• **Configured VN-Port Timer**	Configured state of the VN_Port keepalive timer in seconds. This value is always 90 and is not user-configurable.	**detail**
• **Running VN-Port Timer**	Running state of the VN_Port keepalive timer in seconds.	**detail**
• **FCID**	Fibre Channel ID of the VN_Port.	**detail**
• **WWN**	Unique worldwide name of the VN_Port.	**detail**

Sample Output

show fibre-channel fip enode

```
user@switch> show fibre-channel fip enode 00:10:94:00:00:02
Fabric Name : proxy2 (200)
  Member
  FCF-MAC : 00:30:48:b0:ee:d2 (Interface vlan.100)
    Enode
    Enode-MAC : 00:10:94:00:00:02       State : Logged-in
        Session
        VN-Port-MAC              : 0e:fc:00:03:00:02
        VN-Port-MAC              : 0e:fc:00:03:00:01
```

show fibre-channel fip enode detail

```
user@switch> show fibre-channel fip enode 00:10:94:00:00:02 detail
Fabric Name : proxy2 (200)
  FC-MAP         : 0e:fc:00
  FKA-ADV-PERIOD : 90000       MAX-SESSIONS-PER-ENODE : 32
  FCoE trusted   : No

    Member
    FCF-MAC: 00:30:48:b0:ee:d2  (Interface vlan.100)
      FKA-ADV-PERIOD  : 90000    FKA-ADV-D-BIT-bit : Off
      Type : VF_Port Capable
      Priority : 86            State : Enable

        ENode
        Enode-MAC : 00:10:94:00:00:02   ENode State : Logged-in
         Configured ENode timer: 8000    Running ENode timer: 12226
         Active FIP Sessions : 2

          Session details
          VN-Port-MAC               : 0e:fc:00:03:00:02
          Session state             : Up
          Configured FKA-ADV        : 90000
          Running FKA-ADV           : 0
          Configured VN-Port Timer  : 90000
          Running VN-Port Timer     : 213193
          FCID                      : 0x2c1a01
          WWN                       : 10:00:00:00:c9:a4:a3:cf

          VN-Port-MAC               : 0e:fc:00:03:00:01
          Session state             : Up
          Configured FKA-ADV        : 90000
          Running FKA-ADV           : 0
          Configured VN-Port Timer  : 90000
          Running VN-Port Timer     : 213632
          FCID                      : 0x2c1a02
          WWN                       : 10:00:00:00:d9:b4:e3:df
```


show fibre-channel fip fabric

Syntax

show fibre-channel fip fabric ***fabric-name***
<brief | detail>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) information for a specified Fibre Channel fabric.

Options

brief | detail—(Optional) Display the specified level of output.

fabric-name—Display information for the specified fabric.

Required Privilege Level

view

Related Documentation

- Configuring FIP on an FCoE-FC Gateway on page 5059
- show fibre-channel fip on page 5205
- show fibre-channel fip enode on page 5210
- show fibre-channel fip fcf on page 5217
- show fibre-channel fip interface on page 5220
- show fibre-channel fip statistics on page 5223

List of Sample Output

show fibre-channel fip fabric proxy2 on page 5215
show fibre-channel fip fabric detail on page 5216

Output Fields

Table 402 on page 5214 lists the output fields for the **show fibre-channel fip fabric** command. Output fields are listed in the approximate order in which they appear.

Table 402: show fibre-channel fip fabric Output Fields

Field Name	Field Description	Level of Output
Fabric Name	Name of the fabric and in parentheses the fabric ID.	All
FC-MAP	FCoE mapped address prefix of the FCoE forwarder for the fabric.	**detail**
FKA-ADV-PERIOD	Period of time in milliseconds between FIP keepalive advertisements configured for the FC fabric.	**detail**

Table 402: show fibre-channel fip fabric Output Fields *(continued)*

Field Name	Field Description	Level of Output
Member	Information about an FCF that is a member of the fabric.	All
• **FCF-MAC**	MAC address used in discovery advertisements.	All
• **FKA-ADV-PERIOD**	Period of time in milliseconds between FIP keepalive advertisements configured for the FC interface.	**detail**
• **FKA-ADV-D-BIT**	Disable FIP keepalive advertisement monitoring bit. The state is always **off**.	**detail**
• **Type**	Type of interface: • **VF_Port Capable**—Interface can act as a VF_Port interface.	**detail**
ENode	Information about a connected FCoE node (ENode).	All
• **ENode-MAC**	MAC address of the connected ENode.	All
• **State**	Login state internal to Junos OS.	All
• **VN-Port-MAC**	MAC address of a VN_Port on the ENode.	**detail**
• **Session State**	Session state internal to Junos OS.	**detail**
• **Configured FKA-ADV**	User-configured FIP keepalive advertisement interval in milliseconds.	**detail**
• **Running FKA-ADV**	Runtime interval in seconds of the last FIP keepalive advertisement received. This value changes every time an FKA_ADV is received.	**detail**
• **Configured VN-Port Timer**	Configured state of the VN_Port keepalive timer in seconds. This value is always 90 and is not user-configurable.	**detail**
• **Running VN-Port Timer**	Running state of the VN_Port keepalive timer in seconds.	**detail**

Sample Output

show fibre-channel fip fabric proxy2

```
user@switch> show fibre-channel fip fabric proxy2
Fabric Name : proxy2 (200)
  Member
  FCF-MAC : 00:30:48:b0:ee:d2 (Interface vlan.100)
    Enode
```

```
    Enode-MAC : 00:10:94:00:00:02       State : Logged-in
    Enode-MAC : 00:10:94:00:00:03       State : Logged-in
```

show fibre-channel fip fabric detail

```
user@switch> show fibre-channel fip fabric proxy2 detail
Fabric Name : proxy2 (200)
  FC-MAP         : 0e:fc:00
  FKA-ADV-PERIOD : 90000

    Member
    FCF-MAC: 00:30:48:b0:ee:d2  (Interface vlan.100)
      FKA-ADV-PERIOD  : 90000     FKA-ADV-D-bit : Off
      Type : VF_Port Capable

        ENode
        Enode-MAC : 00:10:94:00:00:02   State : Logged-in

          Session details
          VN-Port-MAC              : 0e:fc:00:03:00:02
          Session state            : Up
          Configured FKA-ADV       : 90000
          Running FKA-ADV          : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0

          VN-Port-MAC              : 0e:fc:00:03:00:01
          Session state            : Up
          Configured FKA-ADV       : 90000
          Running FKA-ADV          : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0

        ENode
        Enode-MAC : 00:10:94:00:00:03   State : Logged-in

          Session details
          VN-Port-MAC              : 0e:fc:00:03:00:04
          Session state            : Up
          Configured FKA-ADV       : 90000
          Running FKA-ADV          : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0

          VN-Port-MAC              : 0e:fc:00:03:00:03
          Session state            : Up
          Configured FKA-ADV       : 90000
          Running FKA-ADV          : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0
```

show fibre-channel fip fcf

Syntax

show fibre-channel fip fcf *fcf-mac*
<brief | detail>
<fabric *fabric-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) information for a specified FCoE forwarder (FCF).

Options

brief | detail—(Optional) Display the specified level of output.

fabric ***fabric-name***—(Optional) Display FCF information only for the specified fabric.

fcf-mac—Display information for the FCF specified by the MAC address.

Required Privilege Level

view

Related Documentation

- Configuring FIP on an FCoE-FC Gateway on page 5059
- show fibre-channel fip on page 5205
- show fibre-channel fip enode on page 5210
- show fibre-channel fip fabric on page 5214
- show fibre-channel fip interface on page 5220
- show fibre-channel fip statistics on page 5223

List of Sample Output

show fibre-channel fip fcf on page 5218
show fibre-channel fip fcf detail on page 5219

Output Fields

Table 403 on page 5217 lists the output fields for the **show fibre-channel fip fcf** command. Output fields are listed in the approximate order in which they appear.

Table 403: show fibre-channel fip fcf Output Fields

Field Name	Field Description	Level of Output
Fabric Name	Name of the fabric and in parentheses the fabric ID.	All
FC-MAP	FCoE mapped address prefix of the FCoE forwarder for the fabric.	**detail**
FKA-ADV-PERIOD	Period of time in milliseconds between FIP keepalive advertisements configured for the FC fabric.	**detail**

Table 403: show fibre-channel fip fcf Output Fields *(continued)*

Field Name		Field Description	Level of Output
Member		Information about an FCF that is a member of the fabric.	All
	• **FCF-MAC**	MAC address used in discovery advertisements.	All
	• **FKA-ADV-PERIOD**	Period of time in milliseconds between FIP keepalive advertisements configured for the FC interface.	**detail**
	• **FKA-ADV-D-BIT**	Disable FIP keepalive advertisement monitoring bit. The state is always **off**.	**detail**
	• **Type**	Type of interface: • **VF_Port Capable**—Interface can act as a VF_Port interface.	**detail**
ENode		Information about a connected FCoE node (ENode).	All
	• **ENode-MAC**	MAC address of the connected ENode.	All
	• **State**	Login state internal to Junos OS.	All
	• **VN-Port-MAC**	MAC address of a VN_Port on the ENode.	**detail**
	• **Session State**	Session state internal to Junos OS.	**detail**
	• **Configured FKA-ADV**	User-configured FIP keepalive advertisement interval in milliseconds.	**detail**
	• **Running FKA-ADV**	Runtime interval in seconds of the last FIP keepalive advertisement received. This value changes every time an FKA_ADV is received.	**detail**
	• **Configured VN-Port Timer**	Configured state of the VN_Port keepalive timer in seconds. This value is always 90 and is not user-configurable.	**detail**
	• **Running VN-Port Timer**	Running state of the VN_Port keepalive timer in seconds.	**detail**

Sample Output

show fibre-channel fip fcf

```
user@switch> show fibre-channel fip fcf 00:30:48:b0:ee:d2
Fabric Name : proxy2 (200)
  Member
  FCF-MAC : 00:30:48:b0:ee:d2 (Interface vlan.100)
    Enode
```



```
Enode-MAC : 00:10:94:00:00:02       State : Logged-in
Enode-MAC : 00:10:94:00:00:03       State : Logged-in
```

show fibre-channel fip fcf detail

```
user@switch> show fibre-channel fip fcf 00:30:48:b0:ee:d2 detail
Fabric Name : proxy2 (200)
  FC-MAP         : 0e:fc:00
  FKA-ADV-PERIOD : 90000

    Member
    FCF-MAC: 00:30:48:b0:ee:d2  (Interface vlan.100)
      FKA-ADV-PERIOD  : 90000     FKA-ADV-D-bit : Off
      Type : VF_Port Capable

        ENode
        Enode-MAC : 00:10:94:00:00:02   State : Logged-in

          Session details
          VN-Port-MAC              : 0e:fc:00:03:00:02
          Session state            : Up
          Configured FKA-ADV       : 90000
          Running FKA-ADV          : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0

          VN-Port-MAC              : 0e:fc:00:03:00:01
          Session state            : Up
          Configured FKA-ADV       : 90000
          Running FKA-ADV          : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0

        ENode
        Enode-MAC : 00:10:94:00:00:03   State : Logged-in

          Session details
          VN-Port-MAC              : 0e:fc:00:03:00:04
          Session state            : Up
          Configured FKA-ADV       : 90000
          Running FKA-ADV          : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0

          VN-Port-MAC              : 0e:fc:00:03:00:03
          Session state            : Up
          Configured FKA-ADV       : 90000
          Running FKA-ADV          : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0
```

show fibre-channel fip interface

Syntax

show fibre-channel fip interface *interface-name*
<**brief | detail**>
<**enode** *enode-mac*>
<**fabric** *fabric-name*>
<**vn-port** *vn-port-mac*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) information for a specified interface.

Options

brief | detail—(Optional) Display the specified level of output.

enode-mac—MAC address of the ENode.

fabric *fabric-name*—(Optional) Display interface information only for the specified fabric.

interface-name—Display information for the specified interface.

vn-port-mac—MAC address of the VN_Port.

Required Privilege Level

view

Related Documentation

- Configuring FIP on an FCoE-FC Gateway on page 5059
- show fibre-channel fip on page 5205
- show fibre-channel fip enode on page 5210
- show fibre-channel fip fabric on page 5214
- show fibre-channel fip fcf on page 5217
- show fibre-channel fip statistics on page 5223
- clear fibre-channel fip vn-port on page 5157

List of Sample Output

show fibre-channel fip interface on page 5221
show fibre-channel fip interface detail on page 5222

Output Fields

Table 404 on page 5220 lists the output fields for the **show fibre-channel fip interface** command. Output fields are listed in the approximate order in which they appear.

Table 404: show fibre-channel fip interface Output Fields

Field Name	Field Description	Level of Output
Fabric Name	Name of the fabric and in parentheses the fabric ID.	All
FC-MAP	FCoE mapped address prefix of the FCoE forwarder for the fabric.	**detail**

Table 404: show fibre-channel fip interface Output Fields *(continued)*

Field Name		Field Description	Level of Output
FKA-ADV-PERIOD		Period of time in milliseconds between FIP keepalive advertisements configured for the FC fabric.	**detail**
Member		Information about an FCF that is a member of the fabric.	All
	• **FCF-MAC**	MAC address used in discovery advertisements.	All
	• **FKA-ADV-PERIOD**	Period of time in milliseconds between FIP keepalive advertisements configured for the FC interface.	**detail**
	• **FKA-ADV-D-BIT**	Disable FIP keepalive advertisement monitoring bit. The state is always **off**.	**detail**
	• **Type**	Type of interface: • **VF_Port Capable**—Interface can act as a VF_Port interface.	**detail**
ENode		Information about a connected FCoE node (ENode).	All
	• **ENode-MAC**	MAC address of the connected ENode.	All
	• **State**	Login state internal to Junos OS.	All
	• **VN-Port-MAC**	MAC address of a VN_Port on the ENode.	**detail**
	• **Session State**	Session state internal to Junos OS.	**detail**
	• **Configured FKA-ADV**	User-configured FIP keepalive advertisement interval in milliseconds.	**detail**
	• **Running FKA-ADV**	Runtime interval in seconds of the last FIP keepalive advertisement received. This value changes every time an FKA_ADV is received.	**detail**
	• **Configured VN-Port Timer**	Configured state of the VN_Port keepalive timer in seconds. This value is always 90 and is not user-configurable.	**detail**
	• **Running VN-Port Timer**	Running state of the VN_Port keepalive timer in seconds.	**detail**

Sample Output

show fibre-channel fip interface

```
user@switch> show fibre-channel fip interface vlan.100
Fabric Name : proxy2 (200)
  Member
```

```
FCF-MAC : 00:30:48:b0:ee:d2 (Interface vlan.100)
  Enode
  Enode-MAC : 00:10:94:00:00:02       State : Logged-in
  Enode-MAC : 00:10:94:00:00:03       State : Logged-in
```

show fibre-channel fip interface detail

```
user@switch> show fibre-channel fip interface vlan.100 detail
Fabric Name : proxy2 (200)
  FC-MAP         : 0e:fc:00
  FKA-ADV-PERIOD : 90000

    Member
    FCF-MAC: 00:30:48:b0:ee:d2  (Interface vlan.100)
      FKA-ADV-PERIOD  : 90000     FKA-ADV-D-bit : Off
      Type : VF_Port Capable

        ENode
        Enode-MAC : 00:10:94:00:00:02   State : Logged-in

          Session details
          VN-Port-MAC             : 0e:fc:00:03:00:02
          Session state           : Up
          Configured FKA-ADV      : 90000
          Running FKA-ADV         : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0

          VN-Port-MAC             : 0e:fc:00:03:00:01
          Session state           : Up
          Configured FKA-ADV      : 90000
          Running FKA-ADV         : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0

        ENode
        Enode-MAC : 00:10:94:00:00:03   State : Logged-in

          Session details
          VN-Port-MAC             : 0e:fc:00:03:00:04
          Session state           : Up
          Configured FKA-ADV      : 90000
          Running FKA-ADV         : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0

          VN-Port-MAC             : 0e:fc:00:03:00:03
          Session state           : Up
          Configured FKA-ADV      : 90000
          Running FKA-ADV         : 0
          Configured VN-Port Timer : 90
          Running VN-Port Timer    : 0
```


show fibre-channel fip statistics

Syntax

show fibre-channel fip statistics
<fabric *fabric-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Fibre Channel over Ethernet Initialization Protocol (FIP) statistics.

Options

fabric ***fabric-name***—(Optional) Display output only for the specified fabric.

Required Privilege Level

view

Related Documentation

- show fibre-channel fip on page 5205
- show fibre-channel fip enode on page 5210
- show fibre-channel fip fabric on page 5214
- show fibre-channel fip fcf on page 5217
- show fibre-channel fip interface on page 5220
- clear fibre-channel fip statistics on page 5156

List of Sample Output

show fibre-channel fip statistics on page 5225

Output Fields

Table 405 on page 5223 lists the output fields for the **show fibre-channel fip statistics** command. Output fields are listed in the approximate order in which they appear.

Table 405: show fibre-channel fip statistics Output Fields

Field Name	Field Description
Fabric name	Name of the fabric.
Interface name	Name of the FCoE VLAN interface.

Table 405: show fibre-channel fip statistics Output Fields *(continued)*

Field Name		Field Description
FIP Message Type		Type of FIP message for the displayed row of statistics..
	• **MDS**	Number of multicast discovery solicitations.
	• **UDS**	Number of unicast discovery solicitations.
	• **FLOGI**	Number of fabric login (FLOGI) messages.
	• **FDISC**	Number of fabric discovery (FDISC) messages.
	• **LOGO**	Number of fabric logout (LOGO) messages.
	• **ENODE KA**	Number of ENode keepalive messages.
	• **VN_Port KA**	Number of VN_Port keepalive messages.
	• **MDA**	Number of multicast discovery advertisements.
	• **UDA**	Number of unicast discovery advertisements.
	• **FLOGI ACC**	Number of fabric login requests accepted.
	• **FLOGI RJT**	Number of fabric login requests rejected.
	• **FDISC ACC**	Number of fabric discovery requests accepted.
	• **FDISC RJT**	Number of fabric discovery requests rejected.
	• **LOGO ACC**	Number of logout requests accepted.
	• **LOGO RJT**	Number of logout requests rejected.
	• **CVL**	Number of clear virtual links (CVL) messages.
	• **CVL ALL**	Number of CVL all messages.
Received		Number of messages received.
Sent		Number of messages sent.
Rx errors		Number of receive errors.

Table 405: show fibre-channel fip statistics Output Fields *(continued)*

Field Name		Field Description
Dropped		Number of dropped messages. NOTE: One cause of dropped messages is that the system limits the number of discovery solicitations (MDS and UDS) it accepts to a maximum of 100 outstanding requests at any given time. If the system has 100 discovery solicitations outstanding, the system does not respond to new discovery solicitations. Instead, the system drops new discovery solicitations and reports the number of dropped discovery solicitations in this field. When there are fewer than 100 outstanding discovery solicitations, the system responds to new requests as usual with a discovery advertisement.
General Statistics	**Number of frames recvd with invalid src-mac**	Number of frames received that have an invalid source media access control (MAC) address.
	Number of frames recvd with invalid version	Number of FIP frames received with an Invalid FIP version.
	Number of frames recvd with invalid opcode	Number of FIP validation descriptors with an invalid opcode received.
	Number of frames recvd with invalid subcode	Number of FIP validation descriptors with an invalid subcode received.
	Number of frames recvd on inactive FCF	Number of frames received on a logical interface if FIP is not active on that logical interface (for example, if a WWN is not allocated to that logical interface).

Sample Output

show fibre-channel fip statistics

```
user@switch> show fibre-channel fip statistics
Fabric name: proxy2

Interface name: vlan.100
FIP Message type      Received     Sent      Rx errors    Dropped
MDS                   22236        0         0            17089
UDS                   0            0         0            0
FLOGI                 1257         0         8            0
FDISC                 0            0         0            0
LOGO                  0            0         0            0
ENODE KA              455          0         6            0
VN_Port KA            22           0         0            0
MDA                   0            243       0            0
UDA                   0            5147      0            0
FLOGI ACC             0            376       0            0
FLOGI RJT             0            881       0            0
FDISC ACC             0            0         0            0
FDISC RJT             0            0         0            0
LOGO ACC              0            0         0            0
LOGO RJT              0            0         0            0
```

```
CVL                    0            374      0            0
CVL ALL                0            380      0            0


General Statistics:

Number of frame recvd with invalid src-mac:          0
Number of frame recvd with invalid version:          0
Number of frame recvd with invalid opcode:           0
Number of frame recvd with invalid subcode:          0
Number of frame recvd on inactive FCF:               0
```


show fibre-channel flogi fport

Syntax

show fibre-channel flogi fport
<fabric *fabric-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display Fibre Channel fabric login (FLOGI) F_Port information.

Options **fabric *fabric-name***—(Optional) Display output only for the specified fabric.

Required Privilege Level view

Related Documentation

- show fibre-channel flogi nport on page 5229
- show fibre-channel flogi statistics on page 5231

List of Sample Output show fibre-channel flogi fport on page 5227

Output Fields Table 406 on page 5227 lists the output fields for the **show fibre-channel flogi fport** command. Output fields are listed in the approximate order in which they appear.

Table 406: show fibre-channel flogi fport Output Fields

Field Name	Field Description
Fabric	Name of the fabric.
Interface	Name of the switch VF_Port interface.
Mac-Address	Media access control (MAC) address of the ENode.
State	Interface physical state: **up** or **down**.
Logins	Number of logins to the VF_Port.
NPIV	N_Port ID virtualization (NPIV) state: **Yes** or **No**.
FLOGI-Port-WWN	Unique worldwide name (WWN) of the VN_Port performing fabric login (FLOGI) to the switch VF_Port.

Sample Output

show fibre-channel flogi fport

```
user@switch> show fibre-channel flogi fport
Fabric: proxy2
Interface       Mac-Address         State  Logins   NPIV  FLOGI-Port-WWN
vlan.100       00:10:94:00:00:02   Up     2        Yes   20:00:10:94:00:01:00:01
vlan.100       00:10:94:00:00:03   Up     2        Yes   20:00:10:94:00:02:00:01
```

show fibre-channel flogi nport

Syntax

show fibre-channel flogi nport
<brief | detail>
<fabric *fabric-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Fibre Channel fabric login (FLOGI) VN_Port information.

Options

brief | detail—(Optional) Display the specified level of output.

fabric *fabric-name*—(Optional) Display output only for the specified fabric.

Required Privilege Level

view

Related Documentation

- show fibre-channel flogi fport on page 5227
- show fibre-channel flogi statistics on page 5231

List of Sample Output

show fibre-channel flogi nport on page 5230
show fibre-channel flogi nport detail on page 5230

Output Fields

Table 407 on page 5229 lists the output fields for the **show fibre-channel flogi nport** command. Output fields are listed in the approximate order in which they appear.

Table 407: show fibre-channel flogi nport Output Fields

Field Name	Field Description	Level of Output
Fabric	Name of the fabric.	All
Virtual-switch	Name of the fabric.	**detail**
Interface	Name of the VF_Port interface.	All
FCID	VN_Port Fibre Channel identifier provided by the Fibre Channel over Ethernet Forwarder (FCoE forwarder) or the Fibre Channel switch.	All
Port-WWN	Unique worldwide name (WWN) of the VN_Port.	All
Node-WWN	Unique WWN of the node hosting the VN_Port.	All
State or **Flogi-state**	Login state internal to Junos OS.	All
FLOGI-Port-WWN	Unique worldwide name (WWN) of the VN_Port performing fabric login (FLOGI) to the switch VF_Port.	**detail**

Sample Output

show fibre-channel flogi nport

```
user@switch> show fibre-channel flogi nport
Fabric: proxy2
Interface     FCID      Port-WWN                 Node-WWN                 State
vlan.100      0x030001  20:00:10:94:00:01:00:01  10:00:10:94:00:00:00:01 online
vlan.100      0x030002  20:00:10:94:00:01:00:05  10:00:10:94:00:00:00:01 online
vlan.100      0x030003  20:00:10:94:00:02:00:01  10:00:10:94:00:00:00:02 online
vlan.100      0x030004  20:00:10:94:00:02:00:05  10:00:10:94:00:00:00:02 online
```

show fibre-channel flogi nport detail

```
user@switch> show fibre-channel flogi nport detail
Fabric: proxy2
    Virtual-switch: proxy2

        Interface: vlan.100
        Flogi-state: online
        FCID: 0x030001
        Port-WWN: 20:00:10:94:00:01:00:01
        Node-WWN: 10:00:10:94:00:00:00:01
        FLOGI-Port-WWN: 20:00:10:94:00:01:00:01

        Interface: vlan.100
        Flogi-state: online
        FCID: 0x030002
        Port-WWN: 20:00:10:94:00:01:00:05
        Node-WWN: 10:00:10:94:00:00:00:01
        FLOGI-Port-WWN: 20:00:10:94:00:01:00:01

        Interface: vlan.100
        Flogi-state: online
        FCID: 0x030003
        Port-WWN: 20:00:10:94:00:02:00:01
        Node-WWN: 10:00:10:94:00:00:00:02
        FLOGI-Port-WWN: 20:00:10:94:00:02:00:01

        Interface: vlan.100
        Flogi-state: online
        FCID: 0x030004
        Port-WWN: 20:00:10:94:00:02:00:05
        Node-WWN: 10:00:10:94:00:00:00:02
        FLOGI-Port-WWN: 20:00:10:94:00:02:00:01
```


show fibre-channel flogi statistics

Syntax
show fibre-channel flogi statistics
<fabric *fabric-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display Fibre Channel fabric login (FLOGI) statistics.

Options **fabric** ***fabric-name***—(Optional) Display output only for the specified fabric.

Required Privilege Level view

Related Documentation

- show fibre-channel flogi fport on page 5227
- show fibre-channel flogi nport on page 5229
- clear fibre-channel flogi statistics on page 5158

List of Sample Output show fibre-channel flogi statistics on page 5232

Output Fields Table 408 on page 5231 lists the output fields for the **show fibre-channel flogi statistics** command. Output fields are listed in the approximate order in which they appear.

Table 408: show fibre-channel flogi statistics Output Fields

Field Name	Field Description
Fabric	Name of the fabric.
FLOGI-Server Message type	Type of message: • **FLOGI**—Fabric login (FLOGI) messages. • **FDISC**—Fabric discovery (FDISC) messages. • **FLOGO**—Fabric logout messages. • **FLOGO-LS-ACC**—Fabric logout link service accept messages. • **LS-Accept**—Link service accept messages. • **LS-Reject**—Link service reject messages. • **invalid**—Invalid messages.
Received	Number of messages received for a given message type.
Sent	Number of messages sent for a given message type.
Fabric	Name of the fabric.
Rx errors	Number of receive errors for a given type of message.

Table 408: show fibre-channel flogi statistics Output Fields *(continued)*

Field Name		Field Description
General Statistics	• Number of FC2 Header Parse Errors	Number of errors parsing the FC-2 header.
	• Number of FLOGI Parse Errors	Number of errors parsing fabric login requests.
	• Number of FDISC Parse Errors	Number of errors parsing fabric discovery requests.
	• Number of FLOGO Parse Errors	Number of errors parsing fabric logout requests.
	• Number of Logins Discarded as Domain-ID not available	Number of discarded logins due to unavailability of a domain ID.
	• Number of Logins Discarded as FCID not available	Number of discarded logins due to the unavailability of a Fibre Channel ID.
	• Number of FCID requests deferred	Number of deferred FCID requests.
	• Number of deferred FCID requests failed	Number of deferred FCID requests that failed.

Sample Output

show fibre-channel flogi statistics

```
user@switch> show fibre-channel flogi statistics
Fabric: proxy2

FLOGI-Server Message type    Received       Sent   Rx errors
FLOGI                        2              0      0
FDISC                        2              0      0
FLOGO                        0              0      0
FLOGO-LS-ACC                 0              0      0
LS-Accept                    0              4      0
LS-Reject                    0              0      0
invalid                      0              0      0

General Statistics:

Number of FC2 Header Parse Errors:                         0
Number of FLOGI Parse Errors:                              0
Number of FDISC Parse Errors:                              0
Number of FLOGO Parse Errors:                              0
Number of Logins Discarded as Domain-ID not available:     0
Number of Logins Discarded as FCID not available:          0
Number of FCID requests deferred:                          0
Number of deferred FCID requests failed:                   0
```

show fibre-channel interfaces

Syntax

<**brief | detail**>
<**fabric** *fabric-name*>
show fibre-channel interfaces *interface-name*

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display information about Fibre Channel (FC) interfaces.

Options

brief | detail—(Optional) Display the specified level of output.

fabric *fabric-name*—(Optional) Display output only for the specified fabric.

interface-name—Display output for the specified interface.

Required Privilege Level view

Related Documentation

- Example: Setting Up Fibre Channel and FCoE VLAN Interfaces in an FCoE-FC Gateway Fabric on page 4963
- Configuring a Physical Fibre Channel Interface on page 5048
- Configuring an FCoE VLAN Interface on an FCoE-FC Gateway on page 5051
- Configuring a Fibre Channel Interface on page 5049
- Assigning Interfaces to a Fibre Channel Fabric on page 5054

List of Sample Output

show fibre-channel interfaces on page 5235
show fibre-channel interfaces detail on page 5236

Output Fields Table 409 on page 5234 lists the output fields for the **show fibre-channel interfaces** command. Output fields are listed in the approximate order in which they appear.

Table 409: show fibre-channel interfaces Output Fields

Field Name	Field Description	Level of Output
Interface	Name of the FC interface.	All
Idx or **Index**	Interface index internal to Junos OS.	All
Type	Type of interface: • **FC**—Native FC interface • **FCOE**—Fibre Channel over Ethernet interface	All
Native Fabric-id	Identification number of the QFX Series fabric.	All
NPIV	N_Port ID virtualization (NPIV) state: **Yes** or **No**.	All

Table 409: show fibre-channel interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Config-Mode	User-configured port mode: • **F**—The port is configured as a VF_Port, an FCoE port connected to FCoE devices. • **NP**—The port is configured as a proxy N_Port (NP_Port), a native FC port connected to an FC switch.	All
Oper-Mode	Operational port mode: • **F**—The port is operating as a VF_Port, an FCoE port connected to FCoE devices. • **NP**—The port is operating as an NP_Port, a native FC port connected to an FC switch or an FCoE forwarder (FCF).	All
State	Interface state: **up** or **down**.	All
WWN	Unique worldwide name (WWN) of the port.	**detail**
FSM-State	Finite state machine state, internal to Junos OS.	**detail**
Class ID	Fibre Channel interface class ID, internal to Junos OS.	**detail**
BB_SC_N	Buffer-to-buffer state change number.	**detail**
Tx B2B credits	Number of buffer-to-buffer credits advertised by the neighbor switch that is connected to the FC interface.	**detail**
Fabric	Name of the fabric.	**detail**
Remote-MAC	Media access control (MAC) address of the remotely connected FCoE device VN_Port interface.	**detail**
Tagging	Not used. Value is shown as **untagged**.	**detail**
Mode	Logical interface (LIF) mode of operation.	**detail**
H/W token	Unique identifier for the FCoE VLAN interface, internal to Junos OS.	**detail**

Sample Output

show fibre-channel interfaces

```
user@switch> show fibre-channel interfaces
                                Native              Config  Oper
Interface        Idx   Type  Fabric-id     NPIV   Mode    Mode     State
fc-0/0/1.0       70    FC    200           YES    NP      NP       up
vlan.100         84    FCOE  200           YES    F       F        up
```


show fibre-channel interfaces detail

```
user@switch> show fibre-channel interfaces detail
Interface: fc-0/0/1.0, Index: 70, Type: FC, Native Fabric-id: 200
NPIV: YES, Config-Mode: NP, Oper-Mode: NP, State: up
WWN: 10:00:00:15:17:a9:98:64, FSM-State: up, Class ID: 1, BB_SC_N: 0
Tx B2B credits: 32
  Fabric                Remote-MAC         Tagging    Mode   Oper state
  proxy2                -                  untagged   NP     up

Interface: vlan.100, Index: 84, Type: FCOE, Native Fabric-id: 200
NPIV: YES, Config-Mode: F, Oper-Mode: F, State: up
WWN: 10:00:00:30:48:b0:ee:d2, FSM-State: up
H/W token: 13
  Fabric                Remote-MAC         Tagging    Mode   Oper state
  proxy2                00:10:94:00:00:02  untagged   VF     up
  proxy2                00:10:94:00:00:03  untagged   VF     up
```

show fibre-channel next-hops

Syntax show fibre-channel next-hops

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display Fibre Channel next-hop route information.

Required Privilege Level view

Related Documentation

- show fibre-channel routes on page 5239
- show route forwarding-table family fibre-channel on page 5277

List of Sample Output show fibre-channel next-hops on page 5237

Output Fields Table 410 on page 5237 lists the output fields for the **show fibre-channel next-hops** command. Output fields are listed in the approximate order in which they appear.

Table 410: show fibre-channel next-hops Output Fields

Field Name	Field Description
Type	Type of next hop internal to Junos OS.
State	State of the NP_Port interface: • **Active**—The interface is online. • **Deleted**—The interface is deleted.
Interface	Name of the interface.
Mac-Address	Media access control (MAC) address of the interface.
Index	Next-hop index identifier.
Ref-count	Reference count internal to Junos OS.
Flags	Flags internal to Junos OS.

Sample Output

show fibre-channel next-hops

```
user@switch> show fibre-channel next-hops
Type     State  Interface     Mac-Address        Index  Ref-count Flags
intf     Active fc-0/0/0.0                       0       1
ucast    Active vlan.100      00:15:17:a9:98:64  674     1        kernel, self
ucast    Active vlan.100      0e:fc:00:03:00:01  675     1        kernel, self
ucast    Active vlan.100      0e:fc:00:03:00:02  676     1        kernel, self
ucast    Active vlan.100      0e:fc:00:03:00:03  677     1        kernel, self
ucast    Active vlan.100      0e:fc:00:03:00:04  678     1        kernel, self
```


show fibre-channel routes

Syntax show fibre-channel routes
<fabric *fabric-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display Fibre Channel route information.

Options **fabric *fabric-name***—(Optional) Display output only for the specified fabric.

Required Privilege Level view

Related Documentation

- show fibre-channel next-hops on page 5237
- show route forwarding-table family fibre-channel on page 5277

List of Sample Output show fibre-channel routes on page 5239

Output Fields Table 411 on page 5239 lists the output fields for the **show fibre-channel routes** command. Output fields are listed in the approximate order in which they appear.

Table 411: show fibre-channel routes Output Fields

Field Name	Field Description
Fabric	Name of the fabric.
Route-prefix	Route destination.
State	State of the NP_Port interface: • **Active**—The interface is online. • **Deleted**—The interface is deleted.
Interface	Name of the interface.
Mac-Address	Media access control (MAC) address of the interface.
Index	Next-hop index identifier.
Flags	Flags internal to Junos OS.

Sample Output

show fibre-channel routes

```
user@switch> show fibre-channel routes
Fabric: proxy2
Route-prefix        State     Interface     Mac-Address          Index    Flags
0x030000/24         Active    fc-0/0/0.0    00:15:17:a9:98:64    674      kernel
```

```
0x030001/24        Active    vlan.100      0e:fc:00:03:00:01   675     kernel
0x030002/24        Active    vlan.100      0e:fc:00:03:00:02   676     kernel
0x030003/24        Active    vlan.100      0e:fc:00:03:00:03   677     kernel
0x030004/24        Active    vlan.100      0e:fc:00:03:00:04   678     kernel
```

show fibre-channel proxy fabric-state

Syntax

show fibre-channel proxy fabric-state
<fabric *fabric-name*>

Release Information

Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display Fibre Channel (FC) proxy fabric state information.

Options

fabric *fabric-name*—(Optional) Display output only for the specified fabric.

Required Privilege Level

view

Related Documentation

- Monitoring Fibre Channel Interface Load Balancing on page 5147
- **show fibre-channel proxy login-table on page 5245**
- **show fibre-channel proxy np-port on page 5248**
- **show fibre-channel proxy statistics on page 5251**

List of Sample Output

show fibre-channel proxy fabric-state on page 5243
show fibre-channel proxy fabric-state fabric on page 5243

Output Fields

Table 412 on page 5241 lists the output fields for the **show fibre-channel proxy fabric-state** command. Output fields are listed in the approximate order in which they appear.

Table 412: show fibre-channel proxy fabric-state Output Fields

Field Name	Field Description
Fabric	Name of the fabric.
Fabric-id	Fabric ID number.
Proxy load balance algorithm	Load-balancing algorithm used on the FCoE-FC gateway FC fabric: • Simple—Load balancing is based on the weighted utilization (load) of the NP_Ports connected to an FC fabric. Each new FLOGI or FDISC is assigned to the least-loaded link. On a link load rebalance, only the sessions that need to be moved to another link are logged out. When those sessions log in again, they are placed on active NP_Port interfaces in a balanced manner. • ENode-based—Load balancing is based on the ENode FLOGI. When an ENode logs in to the fabric, all subsequent FDISC sessions associated with that ENode are placed on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link. On a link load rebalance, all sessions are logged out. When the sessions log in again, they are placed on active NP_Port interfaces in a balanced manner. • FLOGI-based—Load balancing is based on the ENode FLOGI. When an ENode logs in to the fabric, all subsequent FDISC sessions associated with that ENode are placed on the same link as the ENode FLOGI session, regardless of the link load. New ENode FLOGIs are placed on the least-loaded link. On a link load rebalance, only the sessions that need to be moved to another link are logged out. When those sessions log in again, they are placed on active NP_Port interfaces in a balanced manner.

Table 412: show fibre-channel proxy fabric-state Output Fields *(continued)*

Field Name	Field Description
Fabric WWN verification	Fabric worldwide name (WWN) verification check state on the FCoE-FC gateway fabric: • Yes—Fabric WWN verification check is enabled. • No—Fabric WWN verification check is disabled.
Auto load rebalance enabled	Automated link load rebalancing configuration for the FCoE-FC gateway fabric: • No—Automated load balancing is disabled (default state). • Yes—Automated load balancing is enabled.
Last rebalance start-time	Time that the last link load rebalance began on the FCoE-FC gateway fabric: • Never—The link load has never been rebalanced. • Timestamp value—Time the last link load rebalancing started.
Last rebalance end-time	Time that the last link load rebalance ended on the FCoE-FC gateway fabric: • Never—The link load has never been rebalanced. • Timestamp value—Time the last link load rebalancing ended.
Last rebalance trigger	Event that triggered the last link load rebalance on the FCoE-FC gateway fabric: • None—The link load has never been rebalanced. • Config-CLI—Configure (enable) automated load balancing. • Request-CLI—Rebalance requested from the CLI using the **request fibre-channel proxy load-rebalance fabric *fabric-name*** operational command. • Preview-CLI—Rebalancing *dry run* requested from the CLI using the **request fibre-channel proxy load-rebalance dry-run fabric *fabric-name*** operational command. Indicates that the switch completed the dry run. A dry run simulates a link load rebalance and displays a list of sessions that might be affected if you request an actual rebalance. • Link-up—New FC link (NP_Port) up on the FCoE-FC gateway fabric, which causes a rebalance to distribute sessions to the new link. • Restore-complete—If the FC process on the switch restarts, the switch attempts to restore the session state that existed before the restart. When automated rebalance is enabled, restore-complete indicates that the sessions have been restored and rebalanced.
Last rebalance trigger-time	Time that the last link load rebalance was triggered on the FCoE-FC gateway fabric: • Never—Link load rebalancing has never been triggered. • Timestamp value—Time the last link load rebalancing was triggered.

Table 412: show fibre-channel proxy fabric-state Output Fields *(continued)*

Field Name	Field Description
Last rebalance trigger-result	Result of the last trigger event on the FCoE-FC gateway fabric: • Never—Link load rebalancing has never been triggered. • Not-configured—Automated rebalancing is not configured on the FCoE-FC gateway fabric. • Not-required—Last rebalance trigger did not require rebalancing the link load (the link load was already balanced across the active NP_Port links). • In-progress—Link load rebalancing is in progress and has not finished yet. • Restore-in-progress—The switch is recovering from an FC process restart and is in the process of restoring the sessions to the active NP_Port links. • Success—Link load rebalancing was successful. • Logged-out-all—All sessions have been logged out. • Preview-complete—The switch has finished simulating a dry run rebalancing request from the CLI (**request fibre-channel proxy load-rebalance dry-run fabric** ***fabric-name*** operational command) and reported the sessions that might be affected if you request an actual link load rebalance. • Fabric-deletion-in-progress—FCoE-FC gateway fabric is in the process of being deleted. NOTE: A trigger event does not necessarily result in a rebalance action. Link load rebalancing only occurs if the NP_Port interface session load is not balanced at the time of the trigger event.

Sample Output

show fibre-channel proxy fabric-state

```
user@switch> show fibre-channel proxy fabric-state
Fabric: san_fab1, Fabric-id: 10
Proxy load balance algorithm: Simple, Fabric WWN verification: Yes
Auto load rebalance enabled  : No
Last rebalance start-time    : Never
Last rebalance end-time      : Never
Last rebalance trigger       : Link-up
Last rebalance trigger-time  : Mon Sep 10 21:42:30 2012 usec: 814602
Last rebalance trigger-result: Not-configured

Fabric: san_fab2, Fabric-id: 20
Proxy load balance algorithm: ENode based, Fabric WWN verification: Yes
Auto load rebalance enabled  : No
Last rebalance start-time    : Never
Last rebalance end-time      : Never
Last rebalance trigger       : Link-up
Last rebalance trigger-time  : Mon Sep 17 17:23:35 2012 usec: 619684
Last rebalance trigger-result: Not-configured
```

show fibre-channel proxy fabric-state fabric

```
user@switch> show fibre-channel proxy fabric-state fabric fc_fabric_100
Fabric: fc_fabric_100, Fabric-id: 100
Proxy load balance algorithm: FLOGI based, Fabric WWN verification: No
Auto load rebalance enabled  : Yes
Last rebalance start-time    : Never
Last rebalance end-time      : Never
Last rebalance trigger       : Config-CLI
Last rebalance trigger-time  : Fri Nov  2 08:56:16 2012 usec: 004487
Last rebalance trigger-result: Not-required
```


show fibre-channel proxy login-table

Syntax

show fibre-channel proxy login-table
<brief | detail>
<fabric *fabric-name*>
<interface *interface-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display Fibre Channel (FC) proxy fabric login table information.

Options

brief | detail—(Optional) Display the specified level of output.

fabric *fabric-name*—(Optional) Display output only for the specified fabric.

interface *interface-name*—(Optional) Display output only for the specified interface.

Required Privilege Level view

Related Documentation

- Configuring an FCoE-FC Gateway Fibre Channel Fabric on page 5045
- **show fibre-channel proxy fabric-state on page 5241**
- **show fibre-channel proxy np-port on page 5248**
- **show fibre-channel proxy statistics on page 5251**

List of Sample Output

show fibre-channel proxy login-table on page 5246
show fibre-channel proxy login-table detail on page 5246

Output Fields Table 413 on page 5245 lists the output fields for the **show fibre-channel proxy login-table** command. Output fields are listed in the approximate order in which they appear.

Table 413: show fibre-channel proxy login-table Output Fields

Field Name	Field Description	Level of Output
Fabric	Name of the fabric.	All
Fabric-id	Fabric ID number.	All
F-Port	One of the following two values: • VF_Port interface connected to the Fibre Channel over Ethernet (FCoE) host, shown as the FCoE VLAN interface. • QFX Series FC port that is logged in to the FC switch, shown by a hyphen (-) to indicate that it is not the FCoE device VN_Port.	All
FCID	VN_Port Fibre Channel identifier provided by the Fibre Channel over Ethernet (FCoE) forwarder (FCF) or the Fibre Channel switch.	All

Table 413: show fibre-channel proxy login-table Output Fields *(continued)*

Field Name	Field Description	Level of Output
Port-WWN	Unique worldwide name (WWN) of the VN_Port.	All
Node-WWN	Unique WWN of the node hosting the VN_Ports.	**detail**
NP-Port	NP_Port interface connected to the FCoE forwarder (FCF) or the Fibre Channel switch.	All
Class	FLOGI service class.	**detail**
Fabric port WWN	Unique WWN of the fabric port (VF_Port).	**detail**
Fabric WWN	Unique WWN of the fabric generated by the FCF.	**detail**

Sample Output

show fibre-channel proxy login-table

```
user@switch> show fibre-channel proxy login-table
Fabric: proxy2, Fabric-id: 200
F-Port                 FCID     Port-WWN                NP-Port
-                      0x030000 10:00:00:15:17:a9:98:64 fc-0/0/0.0
vlan.100               0x030001 20:00:10:94:00:01:00:01 fc-0/0/0.0
vlan.100               0x030002 20:00:10:94:00:01:00:05 fc-0/0/0.0
vlan.100               0x030003 20:00:10:94:00:02:00:01 fc-0/0/0.0
vlan.100               0x030004 20:00:10:94:00:02:00:05 fc-0/0/0.0
```

show fibre-channel proxy login-table detail

```
user@switch> show fibre-channel proxy login-table detail
Fabric: proxy2, Fabric-id: 200

    FCID:               0x030000
    F-Port:             -
    NP-Port:            fc-0/0/0.0
    Port WWN:           10:00:00:15:17:a9:98:64
    Node WWN:           20:c8:11:22:33:44:55:66
    Class:              3
    Fabric port WWN:    10:00:00:15:17:a9:99:48
    Fabric WWN:         00:0a:df:ff:0b:11:22:34

    FCID:               0x030001
    F-Port:             vlan.100
    NP-Port:            fc-0/0/0.0
    Port WWN:           20:00:10:94:00:01:00:01
    Node WWN:           10:00:10:94:00:00:00:01
    Class:              3
    Fabric port WWN:    10:00:00:15:17:a9:99:48
    Fabric WWN:         00:0a:df:ff:0b:11:22:34

    FCID:               0x030002
    F-Port:             vlan.100
    NP-Port:            fc-0/0/0.0
    Port WWN:           20:00:10:94:00:01:00:05
```

```
Node WWN:         10:00:10:94:00:00:00:01
Class:            3
Fabric port WWN:  10:00:00:15:17:a9:99:48
Fabric WWN:       00:0a:df:ff:0b:11:22:34

FCID:             0x030003
F-Port:           vlan.100
NP-Port:          fc-0/0/0.0
Port WWN:         20:00:10:94:00:02:00:01
Node WWN:         10:00:10:94:00:00:00:02
Class:            3
Fabric port WWN:  10:00:00:15:17:a9:99:48
Fabric WWN:       00:0a:df:ff:0b:11:22:34

FCID:             0x030004
F-Port:           vlan.100
NP-Port:          fc-0/0/0.0
Port WWN:         20:00:10:94:00:02:00:05
Node WWN:         10:00:10:94:00:00:00:02
Class:            3
Fabric port WWN:  10:00:00:15:17:a9:99:48
Fabric WWN:       00:0a:df:ff:0b:11:22:34
```


show fibre-channel proxy np-port

Syntax

show fibre-channel proxy np-port
<brief | detail>
<fabric *fabric-name*>
<interface *interface-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Fibre Channel gateway fabric proxy Node Port (NP_Port) information.

Options

brief | detail—(Optional) Display the specified level of output.

fabric *fabric-name*—(Optional) Display output only for the specified fabric.

interface *interface-name*—(Optional) Display output only for the specified interface.

Required Privilege Level

view

Related Documentation

- Configuring an FCoE-FC Gateway Fibre Channel Fabric on page 5045
- Monitoring Fibre Channel Interface Load Balancing on page 5147
- show fibre-channel proxy fabric-state on page 5241
- show fibre-channel proxy login-table on page 5245
- show fibre-channel proxy statistics on page 5251

List of Sample Output

show fibre-channel proxy np-port on page 5249
show fibre-channel proxy np-port detail on page 5249

Output Fields

Table 414 on page 5248 lists the output fields for the **show fibre-channel proxy np-port** command. Output fields are listed in the approximate order in which they appear.

Table 414: show fibre-channel proxy np-port Output Fields

Field Name	Field Description	Level of Output
Fabric	Name of the fabric.	All
Fabric-id	Fabric ID number.	All
NP-Port	NP_Port interface connected to the FCoE forwarder (FCF) or the Fibre Channel switch.	All
State	FCID state of the NP_Port interface.	All
Sessions	Number of active sessions on the NP_Port interface. A session is a FLOGI or FDISC login to the FC SAN fabric. Session does not refer to end-to-end storage sessions.	All

Table 414: show fibre-channel proxy np-port Output Fields *(continued)*

Field Name	Field Description	Level of Output
Configured max login sessions	Configured maximum number of FIP login sessions permitted on the interface.	**detail**
Enodes	Number of ENodes with sessions on the NP_Port.	**detail**
LB state	Load-balancing state: • **On**—Load balancing is on • **Off**—Load balancing is off.	All
LB weight	Load balance weight, which reflects the port speed: • **2**—Port speed is 2 Gbps. • **4**—Port speed is 4 Gbps. • **8**—Port speed is 8 Gbps.	All
Ref-count	Reference count internal to Junos OS.	**detail**
Flags	Flags internal to Junos OS. NOTE: When an NP_Port interface reaches its configured maximum number of FIP sessions, the **Flags** field displays the flag **MAX-LOGINS-REACHED**.	**detail**

Sample Output

show fibre-channel proxy np-port

```
user@switch> show fibre-channel proxy np-port
Fabric: proxy1, Fabric-id: 10
NP-Port      State              Sessions      LB state   LB weight
fc-0/0/0.0   online             3             ON         4
fc-0/0/1.0   online             3             ON         4
fc-0/0/2.0   online             3             ON         4
root@junos1> show fibre-channel proxy np-port detail
```

show fibre-channel proxy np-port detail

```
user@switch> show fibre-channel proxy login-table detail
Fabric: proxy1, Fabric-id: 10

    NP-Port:                        fc-0/0/0.0
    State:                          online
    Sessions:                       3
    Configured max login sessions:  130
    Enodes                          1
    LB state:                       ON
    LB weight:                      4
    Ref-count:                      4
    Flags:                          UP LB
```



```
NP-Port:                        fc-0/0/1.0
State:                          online
Sessions:                       3
Configured max login sessions:  130
Enodes                          2
LB state:                       ON
LB weight:                      4
Ref-count:                      4
Flags:                          UP LB

NP-Port:                        fc-0/0/2.0
State:                          online
Sessions:                       130
Configured max login sessions:  130
Enodes                          17
LB state:                       OFF
LB weight:                      4
Ref-count:                      131
Flags:                          UP MAX-LOGINS-REACHED
```

show fibre-channel proxy statistics

Syntax

show fibre-channel proxy statistics
<fabric *fabric-name*>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Fibre Channel proxy fabric statistics.

Options

fabric ***fabric-name***—(Optional) Display output only for the specified fabric.

Required Privilege Level

view

Related Documentation

- Configuring an FCoE-FC Gateway Fibre Channel Fabric on page 5045
- **show fibre-channel proxy fabric-state on page 5241**
- **show fibre-channel proxy login-table on page 5245**
- **show fibre-channel proxy np-port on page 5248**
- **clear fibre-channel proxy statistics on page 5159**

List of Sample Output

show fibre-channel proxy statistics on page 5252

Output Fields

Table 415 on page 5251 lists the output fields for the **show fibre-channel proxy statistics** command. Output fields are listed in the approximate order in which they appear.

Table 415: show fibre-channel proxy statistics Output Fields

Field Name	Field Description
Fabric	Name of the fabric.
Fabric-id	Fabric ID number.

Table 415: show fibre-channel proxy statistics Output Fields *(continued)*

Field Name		Field Description
NP-Port Transmit Command Statistics		Transmitted command statistics for the NP_Port.
	• **Command**	Type of command issued on the NP_Port: • **FLOGI**—Fabric login commands issued. • **FDISC**—Fabric discovery commands issued. • **LOGO**—Logout commands issued. • **Others**—Other commands issued.
	• **Tx**	Number of times the command type was transmitted.
	• **Rx-ACC**	Number of times the NP_Port transmitted a receive accept message for the command type.
	• **Rx-RJT**	Number of times the NP_Port transmitted a receive reject message for the command type.
	• **Abort**	Number of times the NP_Port transmitted an abort message for the command type.
NP-Port Receive Command Statistics		Received command statistics for the NP_Port.
	• **Command**	The type of command received on the NP_Port: • **LOGO**—Logout commands issued. • **Others**—Other commands issued.
	• **Rx**	Number of times the command type was received.
	• **Tx-ACC**	Number of times the NP_Port received a transmit accept message for the command type.
	• **Tx-RJT**	Number of times the NP_Port received a transmit reject message for the command type.
	• **Abort**	Number of times the NP_Port received an abort message for the command type.

Sample Output

show fibre-channel proxy statistics

```
user@switch> show fibre-channel proxy statistics
Fabric: proxy1, Fabric-id: 10

NP-Port Transmit Command Statistics:
Command         Tx         Rx-ACC     Rx-RJT     Abort
FLOGI           3          3          0          0
FDISC           3          3          0          0
LOGO            0          0          0          0
```



```
Others          0         0         0         0

NP-Port Receive Command Statistics:
Command         Rx        Tx-ACC    Tx-RJT    Abort
LOGO            0         0         0         0
Others          0         0         0         0
```

show fip snooping

Syntax

show fip snooping
<brief | detail>

Release Information

Command introduced in Junos OS Release 10.4 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display FIP snooping information.

Options

none—Display FIP snooping information.

brief | detail—(Optional) Display the specified level of output.

Required Privilege Level

view

Related Documentation

- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- *Example: Configuring an FCoE Transit Switch*
- show fip snooping enode on page 5258
- show fip snooping fcf on page 5262
- show fip snooping interface on page 5265
- show fip snooping statistics on page 5268
- show fip snooping vlan on page 5271

List of Sample Output

show fip snooping on page 5256
show fip snooping brief (QFX Series) on page 5256
show fip snooping detail (QFX Series) on page 5256
show fip snooping detail on page 5257

Output Fields

Table 416 on page 5254 lists the output fields for the **show fip snooping** command. Output fields are listed in the approximate order in which they appear.

Table 416: show fip snooping Output Fields

Field Name	Field Description	Level of Output
VLAN	Name of the VLAN.	All
Mode	(QFX Series only) Snooping mode enabled on the FCoE VLAN: • VN2VF Snooping—The FCoE VLAN is configured for FIP snooping between an ENode VN_Port and a switch VF_Port. • VN2VN Snooping—The FCoE VLAN is configured for VN_Port to VN_Port FIP snooping between ENode VN_Ports.	All

Table 416: show fip snooping Output Fields *(continued)*

Field Name	Field Description	Level of Output
FC-MAP	FCoE mapped address prefix of the FCoE forwarder for the VLAN.	All
FCF or **FCF-MAC**	MAC address of the FCF.	All
Session Count or **Active Sessions**	Current number of virtual link sessions with VN_Ports.	All
VN_Port Count	(QFX Series only) Number of VN_Ports active on an ENode.	**brief**
Configured FKA-ADV	FIP keepalive interval in seconds configured on the FCF multiplied by three. For example, if the FKA_ADV period configured on the FCF is 86 seconds, the value of this field is 258. For the QFX Series only, the output of this field is always 0 (zero) if the VLAN is an FCoE-FC gateway VLAN. If the VLAN is a FIP snooping VLAN (a transit switch VLAN), then the output is accurate. This is because for an FCoE-FC gateway VLAN, FIP snooping is performed internally and the keepalive advertisements are not tracked by the switch's Ethernet module.	**detail**
Running FKA-ADV	Runtime interval in seconds of the last FIP keepalive advertisement the FCF received. This value changes every time the FCF receives an FKA_ADV. For the QFX Series only, the output of this field is always 0 (zero) if the VLAN is an FCoE-FC gateway VLAN. If the VLAN is a FIP snooping VLAN (a transit switch VLAN), then the output is accurate. This is because for an FCoE-FC gateway VLAN, FIP snooping is performed internally and the keepalive advertisements are not tracked by the switch's Ethernet module.	**detail**
Beacon Period	(QFX Series only) Beacon period interval in milliseconds.	**detail**
VN2VN Mode	(QFX Series only) Mode of VN2VN_Port snooping: • Multi-Point—Multiple ENodes are connected to the network and form multiple virtual links. Each virtual link is created between one pair of VN_Ports. This is analogous to the loop mode in traditional FC networks. • Point-to-Point—Two ENodes are connected to the network and form a single VN_Port to VN_Port virtual link. This is analogous to the point-to-point FC link between an FC initiator and an FC target.	**detail**
ENode-MAC	MAC address of the connected FCoE node (ENode).	All
Interface	Interface connected to the ENode.	**detail**
VN-Port MAC	MAC address of a VN_Port on the ENode.	All

Table 416: show fip snooping Output Fields *(continued)*

Field Name	Field Description	Level of Output
FKA-ADV	Runtime interval in seconds of the last FIP keepalive advertisement the ENode sent to the FCF on behalf of the VN_Port (VN_Port FKA_ADV). This value changes every time the ENode sends a VN_Port FKA_ADV to the FCF.	**detail**
Active VN_Ports	(QFX Series only) Number of VN_Ports active on an ENode.	**detail**
Vlink far-end VN-Port-MAC	(QFX Series only) Media access control (MAC) address of the VN_Port at the other end of the virtual link.	**detail**

Sample Output

show fip snooping

```
user@switch> show fip snooping
VLAN : fcoevlan1     FC-MAP : 0e:fc:00
  FCF : 00:10:94:00:00:01   Session Count : 2
    Enode-MAC : 00:10:94:00:00:02
      VN-Port-MAC : 0E:FC:00:00:00:05
      VN-Port-MAC : 0E:FC:00:00:00:01
```

show fip snooping brief (QFX Series)

```
user@switch> show fip snooping brief
VLAN: vlan100,    Mode: VN2VF Snooping
  FC-MAP: 0e:fc:00
  FCF: 30:10:94:01:00:00    Session Count: 2
    Enode-MAC: 10:10:94:01:00:01
      VN-Port-MAC: 0e:fc:00:01:0d:01
      VN-Port-MAC: 0e:fc:00:01:0e:01
VLAN: vlan101,    Mode: VN2VN Snooping
  FC-MAP: 0e:fc:00
    Enode-MAC: 10:10:94:01:00:02 VN_Port count: 1
      VN-Port-MAC: 0e:fc:00:01:0a:01  Session Count: 2
    Enode-MAC: 10:10:94:01:00:03 VN_Port count: 0
```

show fip snooping detail (QFX Series)

```
user@switch> show fip snooping detail
root@sw-pa02v> show fip snooping detail
VLAN: vlan100,  Mode: VN2VF Snooping
  FC-MAP: 0e:fc:00
  FCF Information
  FCF-MAC           : 30:10:94:01:00:00
  Active Sessions    : 2
  Configured FKA-ADV : 258
  Running FKA-ADV    : 188
    Enode Information
    Enode-MAC: 10:10:94:01:00:01,       Interface: xe-0/0/10
    Configured FKA-ADV : 258
    Running FKA-ADV    : 230
      Session Information
```



```
      VN-Port MAC: 0e:fc:00:01:0d:01,   FKA-ADV : 230
      VN-Port MAC: 0e:fc:00:01:0e:01,   FKA-ADV : 245

VLAN: vlan101,  Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
  Beacon_Period:  90000
  VN2VN Mode: Multi-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/10
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0a:01
         Active Sessions    : 2
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0b:01
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0c:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/11
      Active VN_Ports : 0
```

show fip snooping detail

```
user@switch> show fip snooping detail
VLAN : fcoevlan1    FC-MAP : 0e:fc:00
  FCF Information
  FCF-MAC           : 00:10:94:00:00:01
  Active Sessions    : 2
  Configured FKA-ADV : 258
  Running FKA-ADV    : 244
    Enode Information
    Enode-MAC : 00:10:94:00:00:02       Interface : xe-0/0/1
    Configured FKA-ADV : 258
    Running FKA-ADV    : 248
      Session Information
      VN-Port MAC : 0E:FC:00:00:00:05   FKA-ADV : 264
      VN-Port MAC : 0E:FC:00:00:00:01   FKA-ADV : 260
```

show fip snooping enode

Syntax

show fip snooping enode *enode-mac*
<brief | detail>
<vlan *vlan-name*>

Release Information

Command introduced in Junos OS Release 10.4 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display FIP snooping FCoE node (ENode) information.

Options

brief | detail—(Optional) Display the specified level of output.

enode-mac—Display information for the ENode specified by the MAC address.

vlan *vlan-name*—(Optional) Display FIP snooping information for the ENode on only the specified VLAN.

Required Privilege Level

view

Related Documentation

- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- *Example: Configuring an FCoE Transit Switch*
- show fip snooping on page 5254
- show fip snooping fcf on page 5262
- show fip snooping interface on page 5265
- show fip snooping statistics on page 5268
- show fip snooping vlan on page 5271

List of Sample Output

show fip snooping enode on page 5260
show fip snooping enode brief (QFX Series) on page 5260
show fip snooping enode detail (QFX Series) on page 5260
show fip snooping enode detail on page 5260

Output Fields

Table 417 on page 5258 lists the output fields for the **show fip snooping enode** command. Output fields are listed in the approximate order in which they appear.

Table 417: show fip snooping enode Output Fields

Field Name	Field Description	Level of Output
ENode and **ENode MAC**	MAC address of the ENode.	All
VLAN	Name of the VLAN.	All
Interface	Interface connected to the ENode.	All

Table 417: show fip snooping enode Output Fields *(continued)*

Field Name	Field Description	Level of Output
Mode	(QFX Series only) Snooping mode enabled on the FCoE VLAN: • VN2VF Snooping—The FCoE VLAN is configured for FIP snooping between an ENode VN_Port and a switch VF_Port. • VN2VN Snooping—The FCoE VLAN is configured for VN_Port to VN_Port FIP snooping between ENode VN_Ports.	All
VN_Port Count	(QFX Series only) Number of VN_Ports active on an ENode.	**brief**
Session Count	Current number of virtual link sessions with VN_Ports.	All
Configured FKA-ADV	FIP keepalive interval in seconds configured on the FCoE forwarder (FCF) multiplied by three. For example, if the FKA_ADV period configured on the FCF is 86 seconds, the value of this field is 258. This value remains constant. For the QFX Series only, the output of this field is always 0 (zero) if the VLAN is an FCoE-FC gateway VLAN. If the VLAN is a FIP snooping VLAN (a transit switch VLAN), then the output is accurate. This is because for an FCoE-FC gateway VLAN, FIP snooping is performed internally and the keepalive advertisements are not tracked by the switch's Ethernet module.	**detail**
Running FKA-ADV	Runtime interval in seconds of the last FIP keepalive advertisement the ENode sent to the FCF. This value changes every time the ENode sends an FKA_ADV to the FCF. For the QFX Series only, the output of this field is always 0 (zero) if the VLAN is an FCoE-FC gateway VLAN. If the VLAN is a FIP snooping VLAN (a transit switch VLAN), then the output is accurate. This is because for an FCoE-FC gateway VLAN, FIP snooping is performed internally and the keepalive advertisements are not tracked by the switch's Ethernet module.	**detail**
VN-Port or **VN-Port-MAC**	MAC address of a VN_Port on the ENode.	All
FKA-ADV	Runtime interval in seconds of the last FIP keepalive advertisement the ENode sent to the FCF on behalf of the VN_Port (VN_Port FKA_ADV). This value changes every time the ENode sends a VN_Port FKA_ADV to the FCF.	**detail**
FCF or **FCF-MAC**	MAC address of the FCF to which the VN_Port is connected.	All
Beacon Period	(QFX Series only) Beacon period interval in milliseconds.	**detail**

Table 417: show fip snooping enode Output Fields *(continued)*

Field Name	Field Description	Level of Output
VN2VN Mode	(QFX Series only) Mode of VN2VN_Port snooping: • Multi-Point—Multiple ENodes are connected to the network and form multiple virtual links. Each virtual link is created between one pair of VN_Ports. This is analogous to the loop mode in traditional FC networks. • Point-to-Point—Two ENodes are connected to the network and form a single VN_Port to VN_Port virtual link. This is analogous to the point-to-point FC link between an FC initiator and an FC target.	**detail**
Vlink far-end VN-Port-MAC	(QFX Series only) Media access control (MAC) address of the VN_Port at the other end of the virtual link.	**detail**

Sample Output

show fip snooping enode

```
user@switch> show fip snooping enode 00:10:94:00:00:02
Enode : 00:10:94:00:00:02   VLAN : vlan1   Interface : xe-0/0/1
        VN-Port-MAC           FCF-MAC
        0E:FC:00:00:00:05     00:10:94:00:00:01
        0E:FC:00:00:00:01     00:10:94:00:00:01
```

show fip snooping enode brief (QFX Series)

```
user@switch> show fip snooping enode 10:10:94:01:00:02 brief
Enode: 10:10:94:01:00:02 ,  VLAN: vlan101,  Interface: xe-0/0/10
  Mode: VN2VF Snooping      VN_Port Count: 1
        VN_Port Information
        VN_Port Mac: 0e:fc:00:01:0a:01     Session Count: 2
```

show fip snooping enode detail (QFX Series)

```
user@switch> show fip snooping enode 10:10:94:01:00:02 detail
Enode MAC: 10:10:94:01:00:02,   VLAN: vlan101,  Interface: xe-0/0/10
  Mode: VN2VF Snooping       VN_Port Count: 1
  Beacon_Period: 90000       VN2VN Mode: Multi-Point
        VN_Port Information
        VN_Port Mac: 0e:fc:00:01:0a:01     Session Count: 2
     Vlink far-end VN-Port-MAC: 0e:fc:00:01:0b:01
     Vlink far-end VN-Port-MAC: 0e:fc:00:01:0c:01
```

show fip snooping enode detail

```
user@switch> show fip snooping enode 00:10:94:00:00:02 detail
Enode MAC : 00:10:94:00:00:02   VLAN : vlan1    Interface : xe-0/0/1
Configured FKA-ADV : 258        Running FKA-ADV : 213
  Session Information
  VN-Port : 0E:FC:00:00:00:05   FKA-ADV : 229   FCF : 00:10:94:00:00:01
  VN-Port : 0E:FC:00:00:00:01   FKA-ADV : 225   FCF : 00:10:94:00:00:01
```


show fip snooping fcf

Syntax

show fip snooping fcf *fcf-mac*
<**brief | detail**>
<**vlan** *vlan-name*>

Release Information

Command introduced in Junos OS Release 10.4 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display FIP snooping FCoE forwarder (FCF) information.

Options

brief | detail—(Optional) Display the specified level of output.

fcf-mac—Display information for the FCF specified by the MAC address.

vlan-name—(Optional) Display FIP snooping information for the FCF on only the specified VLAN.

Required Privilege Level

view

Related Documentation

- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- *Example: Configuring an FCoE Transit Switch*
- show fip snooping on page 5254
- show fip snooping enode on page 5258
- show fip snooping interface on page 5265
- show fip snooping statistics on page 5268
- show fip snooping vlan on page 5271

List of Sample Output

show fip snooping fcf on page 5263
show fip snooping fcf detail on page 5263

Output Fields

Table 418 on page 5262 lists the output fields for the **show fip snooping fcf** command. Output fields are listed in the approximate order in which they appear.

Table 418: show fip snooping fcf Output Fields

Field Name	Field Description	Level of Output
FCF or **FCF-MAC**	MAC address of the FCoE forwarder.	All
VLAN	Name of the VLAN.	All
Session Count	Current number of virtual link sessions with VN_Ports.	None

Table 418: show fip snooping fcf Output Fields *(continued)*

Field Name	Field Description	Level of Output
Configured FKA-ADV	FIP keepalive interval in seconds configured on the FCF multiplied by three. For example, if the FKA_ADV period configured on the FCF is 86 seconds, the value of this field is 258.	**detail**
Running FKA-ADV	Runtime interval in seconds of the last FIP keepalive advertisement the FCF received. This value changes every time the FCF receives an FKA_ADV.	**detail**
ENode-MAC	MAC address of the connected ENode.	All
• **Interface**	Interface connected to the ENode.	**detail**
• **Configured FKA-ADV**	FIP keepalive interval in seconds configured on the FCF multiplied by three. For example, if the FKA_ADV period configured on the FCF is 86 seconds, the value of this field is 258. This value remains constant.	**detail**
• **Running FKA-ADV**	Runtime interval in seconds of the last FIP keepalive advertisement the ENode sent to the FCF. This value changes every time the ENode sends an FKA_ADV to the FCF.	**detail**
• **VN-Port MAC**	MAC address of a VN_Port on the ENode.	All
• **FKA-ADV**	Runtime interval in seconds of the last FIP keepalive advertisement the ENode sent to the FCF on behalf of the VN_Port (VN_Port FKA_ADV). This value changes every time the ENode sends a VN_Port FKA_ADV to the FCF.	**detail**

Sample Output

show fip snooping fcf

```
user@switch> show fip snooping fcf 00:10:94:00:00:01
FCF : 00:10:94:00:00:01   VLAN : vlan1   Session Count : 2
  Enode-MAC : 00:10:94:00:00:02
    VN-Port-MAC : 0E:FC:00:00:00:05
    VN-Port-MAC : 0E:FC:00:00:00:01
```

show fip snooping fcf detail

```
user@switch> show fip snooping fcf 00:10:94:00:00:01 detail
FCF-MAC : 00:10:94:00:00:01      VLAN : vlan1
Configured FKA-ADV : 258         Running FKA-ADV : 222
  Enode Information
  Enode-MAC : 00:10:94:00:00:02 Interface: xe-0/0/1
  Configured FKA-ADV : 258
  Running FKA-ADV    : 226
    Session Information
    VN-Port MAC : 0E:FC:00:00:00:05     FKA-ADV : 242
    VN-Port MAC : 0E:FC:00:00:00:01     FKA-ADV : 238
```


show fip snooping interface

Syntax

show fip snooping interface *interface-name*
<brief | detail>

Release Information

Command introduced in Junos OS Release 12.1 for the QFX Series.

Description

Display FIP snooping information for the specified interface.

Options

brief | detail—(Optional) Display the specified level of output.

interface-name—Display information for the specified interface.

Required Privilege Level

view

Related Documentation

- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- show fip snooping on page 5254
- show fip snooping enode on page 5258
- show fip snooping fcf on page 5262
- show fip snooping statistics on page 5268
- show fip snooping vlan on page 5271

List of Sample Output

show fip snooping interface on page 5267
show fip snooping interface detail on page 5267

Output Fields

Table 419 on page 5265 lists the output fields for the **show fip snooping interface *interface-name*** command. Output fields are listed in the approximate order in which they appear.

Table 419: show fip snooping interface Output Fields

Field Name	Field Description	Level of Output
VLAN	Name of the VLAN.	All
FC-MAP	FCoE mapped address prefix of the FCoE forwarder for the VLAN.	All
FCF or **FCF-MAC**	MAC address of the FCF.	All
Session Count or **Active Sessions**	Current number of virtual link sessions with VN_Ports.	All

Table 419: show fip snooping interface Output Fields *(continued)*

Field Name	Field Description	Level of Output
Configured FKA-ADV	FIP keepalive interval in seconds configured on the FCF multiplied by three. For example, if the FKA_ADV period configured on the FCF is 86 seconds, the value of this field is 258. For the QFX Series only, the output of this field is always 0 (zero) if the VLAN is an FCoE-FC gateway VLAN. If the VLAN is a FIP snooping VLAN (a transit switch VLAN), then the output is accurate. This is because for an FCoE-FC gateway VLAN, FIP snooping is performed internally and the keepalive advertisements are not tracked by the switch's Ethernet module.	**detail**
Running FKA-ADV	Runtime interval in seconds of the last FIP keepalive advertisement the FCF received. This value changes every time the FCF receives an FKA_ADV. For the QFX Series only, the output of this field is always 0 (zero) if the VLAN is an FCoE-FC gateway VLAN. If the VLAN is a FIP snooping VLAN (a transit switch VLAN), then the output is accurate. This is because for an FCoE-FC gateway VLAN, FIP snooping is performed internally and the keepalive advertisements are not tracked by the switch's Ethernet module.	**detail**
ENode-MAC	MAC address of the connected FCoE node (ENode).	All
Interface	Interface connected to the ENode.	**detail**
Configured FKA-ADV	FIP keepalive interval in seconds configured on the FCF multiplied by three. For example, if the FKA_ADV period configured on the FCF is 86 seconds, the value of this field is 258. This value remains constant. For the QFX Series only, the output of this field is always 0 (zero) if the VLAN is an FCoE-FC gateway VLAN. If the VLAN is a FIP snooping VLAN (a transit switch VLAN), then the output is accurate. This is because for an FCoE-FC gateway VLAN, FIP snooping is performed internally and the keepalive advertisements are not tracked by the switch's Ethernet module.	**detail**
Running FKA-ADV	Runtime interval in seconds of the last FIP keepalive advertisement the ENode sent to the FCF. This value changes every time the ENode sends an FKA_ADV to the FCF. For the QFX Series only, the output of this field is always 0 (zero) if the VLAN is an FCoE-FC gateway VLAN. If the VLAN is a FIP snooping VLAN (a transit switch VLAN), then the output is accurate. This is because for an FCoE-FC gateway VLAN, FIP snooping is performed internally and the keepalive advertisements are not tracked by the switch's Ethernet module.	**detail**
VN-Port MAC	MAC address of a VN_Port on the ENode.	All

Table 419: show fip snooping interface Output Fields *(continued)*

Field Name	Field Description	Level of Output
FKA-ADV	Runtime interval in seconds of the last FIP keepalive advertisement the ENode sent to the FCF on behalf of the VN_Port (VN_Port FKA_ADV). This value changes every time the ENode sends a VN_Port FKA_ADV to the FCF.	**detail**

Sample Output

show fip snooping interface

```
user@switch> show fip snooping interface xe-0/0/9.0
VLAN: vlan_100,    FC-MAP: 0e:fc:00
  FCF: 30:10:94:01:00:00    Session Count: 1
    Enode-MAC: 10:10:94:01:00:01
      VN-Port-MAC: 0e:fc:00:01:0a:01
```

show fip snooping interface detail

```
user@switch> show fip snooping interface xe-0/0/9.0 detail
VLAN: vlan_100, FC-MAP: 0e:fc:00
  FCF Information
  FCF-MAC            : 30:10:94:01:00:00
  Active Sessions    : 1
  Configured FKA-ADV : 368640000
  Running FKA-ADV    : 0
    Enode Information
    Enode-MAC: 10:10:94:01:00:01,       Interface: xe-0/0/9
    Configured FKA-ADV : 368640000
    Running FKA-ADV    : 0
      Session Information
      VN-Port MAC: 0e:fc:00:01:0a:01,   FKA-ADV : 0
```


show fip snooping statistics

Syntax

show fip snooping statistics
<vlan *vlan-name***>**

Release Information

Command introduced in Junos OS Release 10.4 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display FIP snooping statistics.

Options

vlan ***vlan-name***—(Optional) Display FIP snooping statistics for the specified VLAN.

Required Privilege Level

view

Related Documentation

- *Example: Configuring an FCoE Transit Switch*
- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- show fip snooping on page 5254
- show fip snooping enode on page 5258
- show fip snooping fcf on page 5262
- show fip snooping interface on page 5265
- show fip snooping vlan on page 5271

List of Sample Output

show fip snooping statistics (FIP Snooping) on page 5270
show fip snooping statistics (VN2VN_Port Snooping) on page 5270

Output Fields

Table 420 on page 5268 lists the output fields for the **show fip snooping statistics** command. Output fields are listed in the approximate order in which they appear.

Table 420: show fip snooping statistics Output Fields

Field Name	Field Description
VLAN	Name of the VLAN for which a set of statistics is displayed.
Mode	(QFX Series only) Snooping mode enabled on the FCoE VLAN: • VN2VF Snooping—The FCoE VLAN is configured for FIP snooping between an ENode VN_Port and a switch VF_Port. • VN2VN Snooping—The FCoE VLAN is configured for VN_Port to VN_Port FIP snooping between ENode VN_Ports.
Number of MDS	Number of multicast discovery solicitation messages sent on the VLAN.

Table 420: show fip snooping statistics Output Fields *(continued)*

Field Name	Field Description
Number of UDS	Number of unicast discovery solicitation messages sent on the VLAN.
Number of FLOGI	Number of fabric logins on the VLAN.
Number of FDISC	Number of fabric discovery logins on the VLAN.
Number of LOGO	Number of fabric logouts on the VLAN.
Number of ENode-keep-alive	Number of ENode keepalive messages sent on the VLAN.
Number of VNPort-keep-alive	Number of VN_Port keepalive messages sent on the VLAN.
Number of MDA	Number of multicast discovery advertisement messages sent on the VLAN.
Number of UDA	Number of unicast discovery advertisement messages sent on the VLAN.
Number of FLOGI_ACC	Number of fabric logins accepted on the VLAN.
Number of FLOGI_RJT	Number of fabric logins rejected on the VLAN.
Number of FDISC_ACC	Number of fabric discoveries accepted on the VLAN.
Number of FDISC_RJT	Number of fabric discoveries rejected on the VLAN.
Number of LOGO_ACC	Number of fabric logouts accepted on the VLAN.
Number of LOGO_RJT	Number of fabric logouts rejected on the VLAN.
Number of CVL	Number of clear virtual links (CVL) actions on the VLAN.
Number of VN_Port Probes Req	(QFX Series only) Number of multicast N_Port_ID probes sent to the ALL-VN2VN-ENode-MACs multicast address on the VLAN.
Number of VN_Port Claim Notif	(QFX Series only) Number of multicast N_Port_ID claim notifications sent on the VLAN.
Number of VN_Port Beacons	(QFX Series only) Number of multicast beacons sent on the VLAN.
Number of VN_Port Probes Reply	(QFX Series only) Number of replies to N_Port_ID probes sent on the VLAN. Replies are unicast to the ENode MAC address of the probe requester.

Table 420: show fip snooping statistics Output Fields *(continued)*

Field Name	Field Description
Number of VN_Port Claim Reply	(QFX Series only) Number of replies to N_Port_ID claim notifications sent on the VLAN. Replies are unicast to the ENode MAC address of the claim notifier.

Sample Output

show fip snooping statistics (FIP Snooping)

```
user@switch> show fip snooping statistics
VLAN: fcoevlan1      Mode: VN2VF Snooping

    Number of MDS:              2
    Number of UDS:              2
    Number of FLOGI:            2
    Number of FDISC:            2
    Number of LOGO:             0
    Number of Enode-keep-alive:  200
    Number of VNPort-keep-alive: 200

    Number of MDA:              25
    Number of UDA:              2
    Number of FLOGI_ACC:        2
    Number of FLOGI_RJT:        0
    Number of FDISC_ACC:        2
    Number of FDISC_RJT:        0
    Number of LOGO_ACC:         0
    Number of LOGO_RJT:         0
    Number of CVL:              0
```

show fip snooping statistics (VN2VN_Port Snooping)

```
user@switch> show fip snooping statistics
VLAN: vlan101   Mode: VN2VN Snooping

Number of VN_Port Probes Req:        3
Number of VN_Port Claim Notif:       3
Number of VN_Port Beacons:           0

Number of VN_Port Probes Reply:      3
Number of VN_Port Claim Reply:       3
Number of FLOGI:                     0
Number of FLOGI_ACC:                 0
Number of FLOGI_RJT:                 0
Number of FDISC:                     0
Number of FDISC_ACC:                 0
Number of FDISC_RJT:                 0
Number of LOGO:                      0
Number of LOGO_ACC:                  0
Number of LOGO_RJT:                  0
```


show fip snooping vlan

Syntax

show fip snooping vlan ***vlan-name***
<brief | detail>

Release Information

Command introduced in Junos OS Release 10.4 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display FIP snooping VLAN information.

Options

brief | detail—(Optional) Display the specified level of output.

vlan-name—Display information for the specified VLAN.

Required Privilege Level

view

Related Documentation

- Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch on page 5069
- *Example: Configuring an FCoE Transit Switch*
- show fip snooping on page 5254
- show fip snooping enode on page 5258
- show fip snooping fcf on page 5262
- show fip snooping interface on page 5265
- show fip snooping statistics on page 5268

List of Sample Output

show fip snooping vlan on page 5273
show fip snooping vlan (QFX Series, VN2VF_Port FIP Snooping) on page 5273
show fip snooping vlan (QFX Series, VN2VN_Port FIP Snooping) on page 5273
show fip snooping vlan detail (QFX Series, VN2VN_Port FIP Snooping) on page 5274
show fip snooping vlan detail on page 5274

Output Fields

Table 421 on page 5271 lists the output fields for the **show fip snooping vlan** command. Output fields are listed in the approximate order in which they appear.

Table 421: show fip snooping vlan Output Fields

Field Name	Field Description	Level of Output
VLAN	Name of the VLAN.	All

Table 421: show fip snooping vlan Output Fields *(continued)*

Field Name	Field Description	Level of Output
Mode	(QFX Series only) Snooping mode enabled on the FCoE VLAN: • VN2VF Snooping—The FCoE VLAN is configured for FIP snooping between an ENode VN_Port and a switch VF_Port. • VN2VN Snooping—The FCoE VLAN is configured for VN_Port to VN_Port FIP snooping between ENode VN_Ports.	All
VN_Port count	(QFX Series only) Number of VN_Ports active on an ENode when the mode is VN2VN_Port FIP snooping.	
FC-MAP	FCoE mapped address prefix of the FCoE forwarder for the VLAN.	All
Beacon_Period	(QFX Series only) Beacon period interval in milliseconds.	**detail**
VN2VN Mode	(QFX Series only) Mode of VN2VN_Port snooping: • Multi-Point—Multiple ENodes are connected to the network and form multiple virtual links. Each virtual link is created between one pair of VN_Ports. This is analogous to the loop mode in traditional FC networks. • Point-to-Point—Two ENodes are connected to the network and form a single VN_Port to VN_Port virtual link. This is analogous to the point-to-point FC link between an FC initiator and an FC target.	**detail**
FCF or **FCF-MAC**	MAC address of the FCF.	All
Session Count or **Active Sessions**	Current number of virtual link sessions with VN_Ports.	All
Configured FKA-ADV	FIP keepalive interval in seconds configured on the FCF multiplied by three. For example, if the FKA_ADV period configured on the FCF is 86 seconds, the value of this field is 258.	**detail**
Running FKA-ADV	Runtime interval in seconds of the last FIP keepalive advertisement the FCF received. This value changes every time the FCF receives an FKA_ADV.	**detail**

Table 421: show fip snooping vlan Output Fields *(continued)*

Field Name	Field Description	Level of Output
ENode-MAC	MAC address of the connected ENode.	All
• **Interface**	Interface connected to the ENode.	**detail**
• **Configured FKA-ADV**	FIP keepalive interval in seconds configured on the FCF multiplied by three. For example, if the FKA_ADV period configured on the FCF is 86 seconds, the value of this field is 258. This value remains constant.	**detail**
• **Running FKA-ADV**	Runtime interval in seconds of the last FIP keepalive advertisement the ENode sent to the FCF. This value changes every time the ENode sends an FKA_ADV to the FCF.	**detail**
• **VN-Port MAC**	MAC address of a VN_Port on the ENode.	All
• **FKA-ADV**	Runtime interval in seconds of the last FIP keepalive advertisement the ENode sent to the FCF on behalf of the VN_Port (VN_Port FKA_ADV). This value changes every time the ENode sends a VN_Port FKA_ADV to the FCF.	**detail**
• **Active VN_Ports**	(QFX Series only) Number of VN_Ports active on an ENode.	**detail**
• **Vlink far-end VN-Port-MAC**	(QFX Series only) Media access control (MAC) address of the VN_Port at the other end of the virtual link.	**detail**

Sample Output

show fip snooping vlan

```
user@switch> show fip snooping vlan fcoevlan1
VLAN : fcoevlan1     FC-MAP : 0e:fc:00
  FCF : 00:10:94:00:00:01   Session Count : 2
    Enode-MAC : 00:10:94:00:00:02
      VN-Port-MAC : 0E:FC:00:00:00:05
      VN-Port-MAC : 0E:FC:00:00:00:01
```

show fip snooping vlan (QFX Series, VN2VF_Port FIP Snooping)

```
user@switch> show fip snooping vlan fcoevlan1
VLAN : fcoevlan1     Mode: VN2VF Snooping
  FC-MAP : 0e:fc:00
  FCF : 00:10:94:00:00:01   Session Count : 2
    Enode-MAC : 00:10:94:00:00:02
      VN-Port-MAC : 0E:FC:00:00:00:05
      VN-Port-MAC : 0E:FC:00:00:00:01
```

show fip snooping vlan (QFX Series, VN2VN_Port FIP Snooping)

```
user@switch> show fip snooping vlan vlan101
```

```
VLAN: vlan101,    Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
    Enode-MAC: 10:10:94:01:00:02 VN_Port count: 1
      VN-Port-MAC: 0e:fd:00:00:0a:01  Session Count: 2
    Enode-MAC: 10:10:94:01:00:03 VN_Port count: 0
```

show fip snooping vlan detail (QFX Series, VN2VN_Port FIP Snooping)

```
user@switch> show fip snooping vlan vlan101 detail
VLAN: vlan101,  Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
  Beacon_Period:  90000
  VN2VN Mode: Multi-Point
    Enode Information
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/10
      Active VN_Ports : 1
      VN_Port Information
      VN-Port MAC: 0e:fd:00:00:0a:01
         Active Sessions    : 2
         Session Information
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0b:01
     Vlink far-end VN-Port-MAC: 0e:fd:00:00:0c:01
    Enode-MAC: 10:10:94:01:00:02,       Interface: xe-0/0/11
      Active VN_Ports : 0
```

show fip snooping vlan detail

```
user@switch> show fip snooping vlan fcoevlan1 detail
VLAN : fcoevlan1    FC-MAP : 0e:fc:00
  FCF Information
  FCF-MAC            : 00:10:94:00:00:01
  Active Sessions    : 2
  Configured FKA-ADV : 258
  Running FKA-ADV    : 235
    Enode Information
    Enode-MAC : 00:10:94:00:00:02       Interface : xe-0/0/1
    Configured FKA-ADV : 258
    Running FKA-ADV    : 239
      Session Information
      VN-Port MAC : 0E:FC:00:00:00:05   FKA-ADV : 255
      VN-Port MAC : 0E:FC:00:00:00:01   FKA-ADV : 251
```

show fip vlan-discovery

Syntax **show fip vlan-discovery (enodes | statistics)**

Release Information Command introduced in Junos OS Release 12.1 for the QFX Series.

Description Display FCoE VLAN information from the Fibre Channel switch or FCoE forwarder (FCF).

Options **enodes**—Display VLAN discovery information for each ENode.

statistics—Display VLAN discovery information statistics.

Required Privilege Level view

Related Documentation

- clear fip vlan-discovery statistics on page 5163
- Understanding FIP Functions on page 4817
- Understanding FIP Implementation on page 4821

List of Sample Output

show fip vlan-discovery enodes on page 5276
show fip vlan-discovery statistics (QFX3500) on page 5276
show fip vlan-discovery statistics (QFabric Systems) on page 5276

Output Fields Table 422 on page 5275 lists the output fields for the **show fip vlan-discovery** command. Output fields are listed in the approximate order in which they appear.

Table 422: show fip vlan-discovery Output Fields

Field Name	Field Description	Level of Output
Enode-MAC	Media access control (MAC) address of the ENode.	**enodes**
Interface	Name of the interface.	**enodes**
Unsolicited notification count	Number of unsolicited VLAN discovery notifications.	All
Solicited notification count	Number of solicited VLAN discovery notifications.	**statistics**
Node Group Name	Displays the name of the Node group on QFabric systems.	**statistics**
Request count	Number of VLAN discovery requests sent by the ENode. This number should match the **Solicited notification count** number.	**statistics**
VLAN tags	Tags of the FIP-enabled VLANs.	**enodes**

Sample Output

show fip vlan-discovery enodes

```
user@switch> show fip vlan-discovery enodes

Enode-MAC            Interface      Unsolicited     Vlan Tags
                                    Notification
                                    Count
00:10:94:00:00:02    xe-0/0/9.0        0            400
```

show fip vlan-discovery statistics (QFX3500)

```
user@switch> show fip vlan-discovery statistics
Request count: 0
Solicited notification count: 0
Unsolicited notification count: 1
```

show fip vlan-discovery statistics (QFabric Systems)

```
user@switch> show fip vlan-discovery statistics
NW-NG-0:
--------------------------------------------
Request count: 0
Solicited notification count: 0
Unsolicited notification count: 1

BBAK0399:
--------------------------------------------
Request count: 0
Solicited notification count: 0
Unsolicited notification count: 1

FCG001:
--------------------------------------------
Request count: 0
Solicited notification count: 0
Unsolicited notification count: 1
```

show route forwarding-table family fibre-channel

Syntax

show route forwarding-table family fibre-channel
<brief | detail | extensive>
<all>
<destination *destination-prefix*>
<interface-name *interface-name*>
<label *label*>
<matching *ip-prefix*>
<multicast>
<summary>
<table *routing-table-name*>
<vlan *vlan-name*>
<vpn *vpn-instance-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display Fibre Channel family forwarding table route information.

Options

brief | detail | extensive—(Optional) Display the specified level of output.

all—Display all routing forwarding tables.

destination *destination-prefix*—Destination prefix.

interface-name *interface-name*—Name of the interface.

label *label*—Display route entries for the specified label name.

matching *ip-prefix*—Display route entries for the specified IP prefix or length.

multicast—Display multicast routes.

summary—Display route count instead of details.

table *routing-table-name*—Name of the routing table.

vlan *vlan-name*—Name of the VLAN.

vpn *vpn-instance-name*—Name of the VPN instance.

Required Privilege Level view

Related Documentation

- show fibre-channel next-hops on page 5237
- show fibre-channel routes on page 5239

List of Sample Output show route forwarding-table family fibre-channel on page 5278

Output Fields Table 423 on page 5278 lists the output fields for the **show route forwarding-table family fibre-channel** command. Output fields are listed in the approximate order in which they appear.

Table 423: show route forwarding-table family fibre-channel Output Fields

Field Name	Field Description
Routing table	Name of the routing table.
Destination	Route destination.
Type	Type of route internal to Junos OS.
RtRef	Route reference count internal to Junos OS.
Next hop Type	Type of next hop internal to Junos OS.
Index	Next-hop index identifier.
NhRef	Number of routes that refer to the next hop.
Netif	Interface used to reach the next hop.

Sample Output

show route forwarding-table family fibre-channel

```
user@switch> show route forwarding-table family fibre-channel
Routing table: default.fibre-channel
Fibre Channel:
Destination       Type RtRef Next hop          Type Index NhRef Netif
default           perm     0                   dscd   126     1
0x30000/24        user     0                   ucst   674     2 fc-0/0/0.0
0x30001/24        user     0                   ucst   675     2 vlan.100
0x30002/24        user     0                   ucst   676     2 vlan.100
0x30003/24        user     0                   ucst   677     2 vlan.100
0x30004/24        user     0                   ucst   678     2 vlan.100
```

CHAPTER 61

Troubleshooting

Troubleshooting Procedures

Troubleshooting Dropped FCoE Traffic

Problem Fibre Channel over Ethernet (FCoE) traffic for which you want guaranteed delivery is dropped.

Cause There are several possible causes of dropped FCoE traffic (the list numbers of the possible causes correspond to the list numbers of the solutions in the *Solution* section.):

1. Priority-based flow control (PFC) is not enabled on the FCoE priority (IEEE 802.1p code point) in both the input and output stanzas of the congestion notification profile.
2. The FCoE traffic is not classified correctly at the ingress interface. FCoE traffic should either use the default **fcoe** forwarding class and classifier configuration (maps the **fcoe** forwarding class to IEEE 802.1p code point 011) or be mapped to a lossless forwarding class and to the code point enabled for PFC on the input and output interfaces.
3. The congestion notification profile that enables PFC on the FCoE priority is not attached to the interface.
4. The forwarding class set (priority group) used for guaranteed delivery traffic does not include the forwarding class used for FCoE traffic.
5. Insufficient bandwidth has been allocated for the FCoE queue or for the forwarding class set to which the FCoE queue belongs.
6. If you are using Junos OS Release 12.2, the **fcoe** forwarding class has been explicitly configured instead of using the default **fcoe** forwarding class configuration (forwarding-class-to-queue mapping).

NOTE: If you are using Junos OS Release 12.2, use the default forwarding-class-to-queue mapping for the lossless **fcoe** and **no-loss** forwarding classes. If you explicitly configure the lossless forwarding classes, the traffic mapped to those forwarding classes is treated as lossy (best effort) traffic and does *not* receive lossless treatment.

7. If you are using Junos OS Release 12.3 or later and you are not using the default **fcoe** forwarding class configuration, the forwarding class used for FCoE is not configured with the **no-loss** packet drop attribute. In Junos OS 12.3 or later, explicit forwarding classes configurations must include the **no-loss** packet drop attribute to be treated as lossless forwarding classes.

Solution The list numbers of the possible solutions correspond to the list numbers of the causes in the *Cause* section.

1. Check the congestion notification profile (CNP) to see if PFC is enabled on the FCoE priority (the correct IEEE 802.1p code point) on both input and output interfaces. Use the **show class-of-service congestion-notification** operational command to show the code points that are enabled for PFC in each CNP.

   If you are using the default configuration, FCoE traffic is mapped to code point 011 (priority 3). In this case, the input stanza of the CNP should show that PFC is enabled on code point 011, and the output stanza should show that priority 011 is mapped to flow control queue 3.

   If you explicitly configured a forwarding class for FCoE traffic, ensure that:

   - You specified the **no-loss** packet drop attribute in the forwarding class configuration
   - The code point mapped to the FCoE forwarding class in the ingress classifier is the code point enabled for PFC in the CNP input stanza
   - The code point and output queue used for FCoE traffic are mapped to each other in the CNP output stanza (if you are not using the default priority and queue, you must explicitly configure each output queue that you want to respond to PFC messages)

   For example, if you explicitly configure a forwarding class for FCoE traffic that is mapped to output queue 5 and to code point 101 (priority 5), the output of the **show class-of-service congestion-notification** looks like:

```
Name: fcoe_p5_cnp, Index: 12183
Type: Input
Cable Length: 100 m
  Priority     PFC          MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Disabled
  100          Disabled
  101          Enabled      2500
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  101
               5
```

2. Use the **show class-of-service classifier type ieee-802.1p** operational command to check if the classifier maps the forwarding class used for FCoE traffic to the correct IEEE 802.1p code point.
3. Ensure that the congestion notification profile and classifier are attached to the correct ingress interface. Use the operational command **show configuration class-of-service interfaces *interface-name***.
4. Check that the forwarding class set includes the forwarding class used for FCoE traffic. Use the operational command **show configuration class-of-service forwarding-class-sets** to show the configured priority groups and their forwarding classes.

5. Verify the amount of bandwidth allocated to the queue mapped to the FCoE forwarding class and to the forwarding class set to which the FCoE traffic queue belongs. Use the **show configuration class-of-service schedulers *scheduler-name*** operational command (specify the scheduler for FCoE traffic as the ***scheduler-name***) to see the minimum guaranteed bandwidth (**transmit-rate**) and maximum bandwidth (**shaping-rate**) for the queue.

   Use the **show configuration class-of-service traffic-control-profiles *traffic-control-profile*** operational command (specify the traffic control profile used for FCoE traffic as the ***traffic-control-profile***) to see the minimum guaranteed bandwidth (**guaranteed-rate**) and maximum bandwidth (**shaping-rate**) for the forwarding class set.

6. Delete the explicit FCoE forwarding-class-to-queue mapping so that the system uses the default FCoE forwarding-class-to-queue mapping. Include the **delete forwarding-classes class fcoe queue-num 3** statement at the **[edit class-of-service]** hierarchy level to remove the explicit configuration. The system then uses the default configuration for the FCoE forwarding class and preserves the lossless treatment of FCoE traffic.

7. Use the **show class-of-service forwarding-class** operational command to display the configured forwarding classes. The *No-Loss* column shows whether lossless transport is enabled or disabled for each forwarding class. If the forwarding class used for FCoE traffic is not enabled for lossless transport, include the **no-loss** packet drop attribute in the forwarding class configuration (**set class-of-service forwarding-classes class *fcoe-forwarding-class-name* queue-num *queue-number* no-loss**).

See “Example: Configuring CoS PFC for FCoE Traffic” on page 4921 for step-by-step instructions on how to configure PFC for FCoE traffic, including classifier, interface, congestion notification profile, PFC, and bandwidth scheduling configuration.

Related Documentation

- **show class-of-service congestion-notification on page 5825**
- **show class-of-service forwarding-class-set on page 5833**
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Overview of CoS Changes Introduced in Junos OS Release 12.2 on page 5304
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

Troubleshooting Fibre Channel Interface Deletion

Problem You deleted a Fibre Channel (FC) interface at the **[edit interfaces]** hierarchy level, but the commit check fails so the interface is not deleted.

Cause You must first delete the FC interface from the FC fabric on the QFX Series before you can delete the FC interface at the **[edit interfaces]** hierarchy level. You must perform both operations to delete a FC interface.

Solution First delete the interface from the FC fabric and then delete the interface from the QFX Series:

1. Delete the FC interface from the FC fabric to which it belongs:

   ```
   [edit]
   user@switch# delete fc-fabrics fabric-name interface interface-name
   ```

   For example, to delete the FC interface **fc-0/0/3.0** from an FC fabric named **sanfab1**:

   ```
   [edit]
   user@switch# delete fc-fabrics sanfab1 interface fc-0/0/3.0
   ```
2. Delete the FC interface at the **[edit interfaces]** hierarchy level:

   ```
   [edit]
   user@switch: delete interfaces interface-name
   ```

   For example, to delete the interface **fc-0/0/3.0** from the switch:

   ```
   [edit]
   user@switch: delete interfaces fc-0/0/3.0
   ```

Related Documentation

- fc-fabrics on page 5113
- interface on page 5120
- interfaces on page 2075
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

Troubleshooting Dropped FIP Traffic

Problem Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) traffic such as FIP VLAN discovery and notification frames is dropped on the QFX Series.

Cause The interface on which the FIP traffic is dropped does not have a native VLAN configured. FIP VLAN discovery and notification messages are exchanged as untagged packets on the native VLAN. (After the FCoE session with the Fibre Channel switch is established, FCoE traffic uses the FCoE VLAN.)

Solution Check to ensure that every 10-Gigabit Ethernet interface that connects to an FCoE device includes a native VLAN. Configure a native VLAN on all 10-Gigabit Ethernet interfaces that connect to FCoE devices.

NOTE: **Make sure that the native VLAN you are using on the QFX Series is the same native VLAN that the FCoE devices use for Ethernet traffic.**

The procedure for configuring a native VLAN on an interface is different on switches that use the original CLI than on switches that use the Enhanced Layer 2 Software (ELS) CLI. This topic provides the configuration procedure for each CLI.

Configuring a Native VLAN on Switches Using the Original CLI

To configure a native VLAN on an interface:

1. Set the interface port mode to **tagged-access** if you have not already done so:

   ```
   [edit]
   user@switch# set interfaces interface unit unit family ethernet-switching port-mode
   tagged-access
   ```

   For example, to set the port mode to **tagged-access** for interface **xe-0/0/6.0**:

   ```
   [edit]
   user@switch# set interfaces xe-0/0/6 unit 0 family ethernet-switching port-mode
   tagged-access
   ```

2. Configure the native VLAN if it does not already exist:

   ```
   [edit]
   user@switch# set vlans vlan-name vlan-id vlan-id
   ```

   For example, to name the native VLAN **native** and use the VLAN ID **1**:

   ```
   [edit]
   user@switch# set vlans native vlan-id 1
   ```

3. Configure the native VLAN on the interface:

   ```
   [edit]
   user@switch# set interfaces interface unit unit family ethernet-switching native-vlan-id
   vlan-id
   ```

   For example, to configure a native VLAN with the VLAN ID **1** on interface **xe-0/0/6.0**:

   ```
   [edit]
   user@switch# set interfaces xe-0/0/6 unit 0 family ethernet-switching native-vlan-id 1
   ```

Configuring a Native VLAN on Switches Using the ELS CLI

To configure a native VLAN on an interface:

1. Set the interface mode to **trunk** if you have not already done so:

   ```
   [edit]
   user@switch# set interfaces interface unit unit family ethernet-switching interface-mode
   trunk
   ```

   For example, to set the interface mode to **trunk** for interface **xe-0/0/6.0**:

   ```
   [edit]
   user@switch# set interfaces xe-0/0/6 unit 0 family ethernet-switching interface-mode trunk
   ```

2. Configure the native VLAN if it does not already exist:

   ```
   [edit]
   user@switch# set vlans vlan-name vlan-id vlan-id
   ```

   For example, to name the native VLAN **native** and use the VLAN ID **1**:

   ```
   [edit]
   user@switch# set vlans native vlan-id 1
   ```

3. Configure the native VLAN on the physical Ethernet interface:

```
[edit]
user@switch# set interfaces interface native-vlan-id vlan-id
```

For example, to configure a native VLAN with the VLAN ID **1** on interface **xe-0/0/6.0**:

```
[edit]
user@switch# set interfaces xe-0/0/6 native-vlan-id 1
```

4. Configure the Ethernet interface as a member of the native VLAN:

```
[edit]
user@switch# set interfaces interface unit unit family ethernet-switching vlan members
vlan-name
```

For example, to configure an Ethernet interface as a member of a native VLAN with the VLAN ID **1** on interface **xe-0/0/6.0**:

```
[edit]
user@switch# set interfaces xe-0/0/6 unit 0 family ethernet-switching vlan members native
```

Related Documentation

- interfaces on page 2075
- vlans on page 1639
- Understanding FIP Functions on page 4817
- Configuring VLAN Interfaces for FCoE Traffic on an FCoE Transit Switch on page 5066

PART 19

Traffic Management

CHAPTER 62

Overview

CoS Upgrade and Change Overview

Overview of CoS Upgrade Requirements (Junos OS Release 11.1 or 11.2 to a Later Release)

Before you upgrade to Junos OS Release 11.3, you must deactivate the CoS configuration if the CoS configuration includes any of the following features:

- **excess-rate** option
- **strict-high** or **high** priority queues
- Any of the Junos OS Release 11.1 or 11.2 default multidestination forwarding classes

CAUTION: If your CoS configuration contains any of the features listed above and you attempt to upgrade from Junos OS Release 11.1 or 11.2 to a later version without first editing the configuration, the Junos OS might not restart.

Junos OS Release 11.3 and later for QFX Series no longer supports the **excess-rate** statement, the **strict** priority option, or the default multidestination forwarding classes used in Junos OS Release 11.1 and 11.2. In addition, Junos OS Release 11.3 introduces new restrictions on how to configure and use **strict-high** priority queues.

This topic does not describe how to perform the software upgrade procedure. It describes how to deactivate your CoS configuration, edit your CoS configuration, and reactivate your CoS configuration at the appropriate times.

Use the following procedure to upgrade safely from Junos OS Release 11.1 or 11.2 to a later release:

1. Deactivate the CoS configuration *before* you upgrade the software:

   `user@switch#` **deactivate class-of-service**
2. Follow the upgrade procedure to Junos OS Release 11.3 or later software.
3. Make the following changes to the CoS configuration while the CoS configuration is still deactivated:
   - Remove the **excess-rate** statement from the CoS configuration if you have used it at the **[edit class-of-service schedulers]** or **[edit class-of-service traffic-control-profiles]** hierarchy level.
   - Remove the **strict-high** and **strict** priority queue configurations if you have used them at the **[edit class-of-service schedulers]** hierarchy level.
   - Remove the default multidestination forwarding classes (**mcast-be**, **mcast-af**, **mcast-ef**, and **mcast-nc**) if you have used them at the **[edit class-of-service schedulers]**, **[edit class-of-service rewrite-rules]**, **[edit class-of-service classifiers]**, **[edit class-of-service scheduler-maps]**, or **[edit class-of-service forwarding-class-sets]** hierarchy level. Alternatively, you can change the mapping of the multidestination traffic to use the new default multidestination forwarding class (**mcast**).
4. If desired, configure **strict-high** priority queues in accordance with the Junos OS Release 11.3 or later configuration rules, and map multidestination traffic to the default multidestination forwarding class (**mcast**).

5. Activate the CoS configuration:

   `user@switch#` **activate class-of-service**

6. Commit the CoS configuration:

   `user@switch#` **commit**

NOTE: If you configured the **transmit-rate** option for any queues under the **[edit class-of-service schedulers]** hierarchy level, if the rate is configured as an exact rate in Mbps, we recommend that you reconfigure the **transmit-rate** option as a percentage. This is because the scheduler converts exact rates to percentages, and when the exact rate is below 1 Gbps, some granularity may be lost in the conversion. You can avoid this potential issue by specifying the **transmit-rate** option as a percentage.

Related Documentation

- Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches on page 121
- Understanding CoS Classifiers on page 5334
- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Traffic Control Profiles on page 5381
- Overview of CoS Upgrade Requirements to Junos OS Release 12.2 on page 5291
- Overview of CoS Upgrade Requirements to Junos OS Release 12.3 (QFX3500 and QFX3600 Switches) or to Junos OS Release 13.1 (QFabric Systems) on page 5293
- Example: Configuring Unicast Classifiers on page 5495
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519

Overview of CoS Upgrade Requirements to Junos OS Release 12.2

Before you upgrade to Junos OS Release 12.2, you might need to edit the class-of-service (CoS) configuration, because the way the QFX Series handles lossless forwarding classes has changed in Junos OS Release 12.2.

By default, the **fcoe** and **no-loss** forwarding classes are mapped to output queue 3 and output queue 4, respectively. These are the only two forwarding classes (and the only two queues) that support lossless transport.

In Junos OS Release 12.1 and earlier, explicitly setting the lossless **fcoe** and **no-loss** forwarding classes resulted in the same CoS behavior as using the default configuration. However, in Junos OS Release 12.2, the behavior when you explicitly configure the lossless forwarding classes differs from the behavior when you use the default forwarding classes.

NOTE: The default behavior differs from the explicit configuration behavior even if the explicit configuration is exactly the same as the default configuration.

- If you use the default forwarding class configuration for the lossless queues (the configuration does not include explicit setting of the **fcoe** or the **no-loss** forwarding classes), then the **fcoe** and **no-loss** queues behave as lossless queues.

  If your CoS configuration does not explicitly configure the **fcoe** and **no-loss** forwarding classes, you can upgrade from Junos OS Release 12.1 to Junos OS Release 12.2, and the behavior of the two lossless queues remains the lossless.

- If your configuration includes statements that explicitly configure the **fcoe** or the **no-loss** forwarding class (using the **[set class-of-service forwarding-classes class *class-name* queue-num *queue-number*]** statement), after you upgrade to Junos OS Release 12.2, those queues do *not* receive lossless treatment and behave as lossy (**best-effort**) queues.

  If your CoS configuration explicitly configures the **fcoe** and **no-loss** forwarding classes, to retain the lossless behavior of those queues, you need to remove the explicit configuration for these two forwarding classes from the CoS configuration *before* you upgrade.

If you upgrade to Junos OS Release 12.2 and the **fcoe** and **no-loss** forwarding classes are explicitly configured, then those two queues continue to be used, but the traffic is treated as lossy traffic, not lossless traffic. To make the queues for these two forwarding classes lossless, you must delete the explicit forwarding class configuration.

CAUTION: **If you explicitly configured the fcoe or the no-loss forwarding class and you upgrade to Junos OS Release 12.2, the system does not return an upgrade error or a commit error, or a generate a syslog message, to notify you that these forwarding classes are no longer lossless. Traffic mapped to these forwarding classes is not treated as lossless traffic until you remove the explicit forwarding class configuration.**

Before you upgrade, delete the **fcoe** and **no-loss** forwarding classes from the explicit configuration to preserve the lossless behavior of traffic mapped to these forwarding classes.

- To delete the explicit **fcoe** forwarding class configuration:

  ```
  [edit]
  user@switch# delete class-of-service forwarding-class class fcoe queue-num 3
  user@switch# commit
  ```

- To delete the explicit **no-loss** forwarding class configuration:

  ```
  [edit]
  user@switch# delete class-of-service forwarding-class class no-loss queue-num 4
  user@switch# commit
  ```


NOTE: If you try to delete these forwarding classes and they have not been explicitly configured on the system, the system returns the message **warning: statement not found**. This simply means that there is no explicit configuration to delete and does not change the lossless behavior of the **fcoe** and **no-loss** forwarding classes.

After you delete the explicit configuration for the **fcoe** and **no-loss** forwarding classes, traffic mapped to those forwarding classes retains its lossless behavior after the upgrade to Junos OS Release 12.2.

Related Documentation

- Overview of CoS Upgrade Requirements (Junos OS Release 11.1 or 11.2 to a Later Release) on page 32
- Overview of CoS Upgrade Requirements to Junos OS Release 12.3 (QFX3500 and QFX3600 Switches) or to Junos OS Release 13.1 (QFabric Systems) on page 5293
- Overview of CoS Changes Introduced in Junos OS Release 11.3 on page 5296
- Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches on page 121
- Understanding CoS Forwarding Classes on page 5354
- Example: Configuring Forwarding Classes on page 5505

Overview of CoS Upgrade Requirements to Junos OS Release 12.3 (QFX3500 and QFX3600 Switches) or to Junos OS Release 13.1 (QFabric Systems)

Before you upgrade to Junos OS Release 12.3 (QFX3500 and QFX3600 switches) or to Junos OS Release 13.1 (QFabric systems), you might need to edit the class-of-service (CoS) configuration, because the way the QFX Series handles lossless forwarding classes has changed from earlier Junos OS releases. (Throughout this document, changes introduced on standalone switches in Junos OS Release 12.3 are introduced on QFabric systems in Junos OS Release 13.1 unless otherwise noted.)

Support for Six Lossless Forwarding Classes

By default, the *fcoe* and *no-loss* forwarding classes are mapped to output queue 3 and output queue 4, respectively, and to IEEE 802.1p priority 3 (code point 011) and priority 4 (code point 100), respectively. These are the only two forwarding classes (and the only two queues) that support lossless transport in the default configuration.

If you use the default CoS configuration, you do not need to edit the CoS configuration after upgrading to Junos OS Release 12.3 (QFX3500 and QFX3600 switches) or to Junos OS Release 13.1 (QFabric system) because the default CoS configuration is backward-compatible.

Junos OS Release 12.3 increases the support for lossless forwarding classes (priorities) from two forwarding classes to six forwarding classes. To support configuring lossless forwarding classes, Junos OS Release 12.3 introduces a new option to forwarding class configuration: the *no-loss* packet drop attribute.

NOTE: The new *no-loss* packet drop attribute and the previously existing *no-loss* default forwarding class have the same name, but they are not the same. You can use the no-loss packet drop attribute on any unicast forwarding class.

If you explicitly configure any lossless forwarding class (including explicitly configuring the default fcoe and no-loss forwarding classes), you *must* specify the no-loss packet drop attribute to obtain lossless behavior. If you do not explicitly configure the fcoe and no-loss forwarding classes, those forwarding classes remain lossless.

The addition of the no-loss packet drop attribute to forwarding class configuration means that when you upgrade from an earlier release to Junos OS Release 12.3, the new software might not preserve the lossless forwarding class configuration of the fcoe and no-loss forwarding classes.

If you used the default forwarding class configuration for the fcoe and no-loss forwarding classes, the CoS configuration is backward-compatible. You do not have to do anything to preserve the lossless behavior of traffic that uses those forwarding classes when you upgrade to Junos OS Release 12.3. (This is because the default configuration of these two forwarding classes includes the no-loss packet drop attribute.)

However, if you explicitly configured the fcoe or the no-loss forwarding class by including the **set forwarding-classes class *forwarding-class-name* queue-num *queue-number*** at the **[edit class-of-service]** hierarchy level, then those forwarding classes are no longer lossless, they are lossy. In Junos OS Release 12.3 and later, you must include the *no-loss* packet drop attribute in any explicit forwarding class configuration to configure a lossless forwarding class.

For example, before Junos OS Release 12.3, the following explicit configuration resulted in a lossless forwarding class:

`user@switch#` **set class-of-service forwarding-classes class fcoe queue-num 3**

However, in Junos OS Release 12.3, this configuration is lossy because it does not include the no-loss packet drop attribute. To preserve lossless behavior, after upgrading to Junos OS Release 12.3, you need to add the no-loss drop attribute:

`user@switch#` **set class-of-service forwarding-classes class fcoe queue-num 3 no-loss**

Alternatively, you can delete the explicit configuration before you upgrade to Junos OS Release 12.3 so that the system uses the default forwarding class, which is lossless:

`user@switch#` **delete class-of-service forwarding-classes class fcoe queue-num 3**

NOTE: The explicit configuration of other forwarding classes does not affect the lossless (or lossy) state of the fcoe and no-loss forwarding classes, because only the fcoe and no-loss forwarding classes are lossless forwarding classes before Junos OS Release 12.3. For example, if you explicitly configured the best-effort forwarding class but you used the default fcoe and no-loss forwarding classes in Junos OS Release 12.2, then when you upgrade to Junos OS Release 12.3, the fcoe and no-loss forwarding classes are still lossless (and the best-effort forwarding class retains its explicit configuration).

NOTE: To achieve lossless behavior for the traffic belonging to any forwarding class, you must also enable PFC on the IEEE 802.1p priority mapped to the forwarding class and ensure that DCBX exchanges the protocol TLVs for the application with the connected peer.

Scheduling on QFabric System Node Device Fabric (fte) Ports

Junos OS Release 13.1 introduces the ability to configure scheduling on the fabric (fte) ports of QFabric system Node devices. In earlier Junos OS releases, Node device fabric port scheduling was done by default, with no user configuration.

In Junos OS Release 13.1, the default fabric port scheduler configuration is similar to the default scheduler configuration on access interfaces. Similar to the access port default configuration, the default fabric port scheduler supports the five default forwarding classes (best-effort, fcoe, no-loss, network-control, and mcast). If you configure any new forwarding classes, you must configure scheduling on the fabric ports to allocate bandwidth to those forwarding classes, just as you must configure scheduling on the access ports for user-defined forwarding classes.

Strict-High Priority Scheduling on QFabric System Node Device Fabric (fte) Ports

If a fabric interface handles strict-high priority traffic, you must define a separate fc-set (priority group) for strict-high priority traffic. Strict-high priority traffic cannot be mixed with traffic of other priorities in an fc-set. For example, you might choose to create different fc-sets for best effort, lossless, strict-high priority, and multidestination traffic.

Related Documentation

- Overview of CoS Upgrade Requirements (Junos OS Release 11.1 or 11.2 to a Later Release) on page 32
- Overview of CoS Upgrade Requirements to Junos OS Release 12.2 on page 5291
- Upgrading Software on QFX3500, QFX3600, and QFX5100 Switches on page 121

Overview of CoS Changes Introduced in Junos OS Release 11.3

Junos OS Release 11.3 introduces many changes to class-of-service (CoS) functionality and to the CoS default values. This overview summarizes the changes, which other documents describe in detail.

NOTE: Some of the CoS changes are not backward compatible with Junos OS Releases 11.1 and 11.2. "Overview of CoS Upgrade Requirements (Junos OS Release 11.1 or 11.2 to a Later Release)" on page 32 describes how to upgrade to Junos OS Release 11.3 if you have configured CoS on your QFX3500 switch.

This topic describes the following changes in CoS default values and behavior:

CoS Default Value Changes

The default values of the following CoS components have changed in Junos OS Release 11.3:

Default Forwarding Classes

In Junos OS Releases 11.1 and 11.2, there were eight default forwarding classes, four unicast default forwarding classes and four default multidestination (multicast, broadcast, and destination lookup fail) forwarding classes. Table 424 on page 5296 shows the old default forwarding classes and default queue mapping:

Table 424: Junos OS Release 11.1 and 11.2 Default Forwarding Classes and Queue Mapping

Default Forwarding Class	Description	Default Queue Mapping
best-effort (be)	Unicast best-effort traffic	0
no-loss	Unicast guaranteed delivery for TCP no-loss traffic	2

Table 424: Junos OS Release 11.1 and 11.2 Default Forwarding Classes and Queue Mapping *(continued)*

Default Forwarding Class	Description	Default Queue Mapping
fcoe	Unicast guaranteed delivery for FCoE traffic	3
network-control	Unicast network control traffic	7
multicast-best-effort (mcast-be)	Multidestination best-effort traffic	8
multicast-expedited-forwarding (mcast-ef)	Multidestination low-loss, low-latency traffic	9
multicast-assured-forwarding (mcast-af)	Multidestination assured forwarding traffic	10
multicast-network-control (mcast-nc)	Multidestination network control traffic	11

Junos OS Release 11.3 changes the default forwarding classes and queue mapping in the following ways:

- Instead of eight default forwarding classes, there are five default forwarding classes.
- The same four unicast default forwarding classes remain valid, but the default queue mapping of the no-loss forwarding class has changed from queue 2 to queue 4.
- There is now only one default multidestination forwarding class instead of four default multidestination forwarding classes. All multidestination traffic is assigned by default to the default multidestination forwarding class.

NOTE: The rest of the forwarding class characteristics remain the same as before. For example, the QFX Series still supports 12 forwarding classes and 12 output queues. You can still configure a total of eight unicast forwarding classes and four multidestination forwarding classes. The unicast queues are still queues 0 through 7 and the multidestination queues are still queues 8 through 11. Unicast traffic must be mapped to unicast queues, and multidestination traffic must be mapped to multidestination queues. The queue to which a forwarding class is mapped determines whether the forwarding class is unicast or multidestination.

Table 425 on page 5297 shows the default forwarding classes and queue mapping in Junos OS 11.3 and later:

Table 425: Junos OS Release 11.3 Default Forwarding Classes and Queue Mapping

Default Forwarding Class	Description	Default Queue Mapping
best-effort (be)	Best-effort traffic class	0
fcoe	Guaranteed delivery for FCoE traffic	3

Table 425: Junos OS Release 11.3 Default Forwarding Classes and Queue Mapping *(continued)*

Default Forwarding Class	Description	Default Queue Mapping
no-loss	Guaranteed delivery for TCP no-loss traffic	4
network-control (nc)	Network control traffic	7
mcast	Multicast traffic	8

Default IEEE 802.1p Unicast Classifiers

In Junos OS Release 11.1 and 11.2, there were default unicast classifiers only for best-effort and network-control traffic, as shown in Table 426 on page 5298:

Table 426: Junos OS Release 11.1 and 11.2 Default IEEE 802.1 Unicast Classifiers

Code Point	Forwarding Class	Loss Priority
be (000)	best-effort	low
be1 (001)	best-effort	low
ef (010)	best-effort	low
ef1 (011)	best-effort	low
af11 (100)	best-effort	low
af12 (101)	best-effort	low
nc1 (110)	network-control	low
nc2 (111)	network-control	low

Junos OS Release 11.3 introduces new default classifiers for FCoE and no-loss traffic, replacing the best-effort classifiers mapped to IEEE 802.1p code points 011 and 100, respectively, as shown in Table 427 on page 5298:

Table 427: Junos OS Release 11.3 Default IEEE 802.1 Unicast Classifiers

Code Point	Forwarding Class	Loss Priority
be (000)	best-effort	low
be1 (001)	best-effort	low
ef (010)	best-effort	low
ef1 (011)	fcoe	low
af11 (100)	no-loss	low

Table 427: Junos OS Release 11.3 Default IEEE 802.1 Unicast Classifiers *(continued)*

Code Point	Forwarding Class	Loss Priority
af12 (101)	best-effort	low
nc1 (110)	network-control	low
nc2 (111)	network-control	low

Default IEEE 802.1p Multidestination Classifiers

In Junos OS Release 11.1 and 11.2, there were default multidestination classifiers for best-effort and network-control traffic, as shown in Table 428 on page 5299:

Table 428: Junos OS Release 11.1 and 11.2 Default IEEE 802.1 Multidestination Classifiers

Code Point	Forwarding Class	Loss Priority
be (000)	mcast-be	low
be1 (001)	mcast-be	low
ef (010)	mcast-be	low
ef1 (011)	mcast-be	low
af11 (100)	mcast-be	low
af12 (101)	mcast-be	low
nc1 (110)	mcast-nc	low
nc2 (111)	mcast-nc	low

Junos OS Release 11.3 replaces the best-effort and network-control multidestination classifiers and maps all IEEE 802.1p code points to the new default multidestination forwarding class, as shown in Table 429 on page 5299:

Table 429: Junos OS Release 11.3 Default IEEE 802.1 Multidestination Classifiers

Code Point	Forwarding Class	Loss Priority
be (000)	mcast	low
be1 (001)	mcast	low
ef (010)	mcast	low
ef1 (011)	mcast	low
af11 (100)	mcast	low

Table 429: Junos OS Release 11.3 Default IEEE 802.1 Multidestination Classifiers *(continued)*

Code Point	Forwarding Class	Loss Priority
af12 (101)	mcast	low
nc1 (110)	mcast	low
nc2 (111)	mcast	low

Default Scheduler

In Junos OS Release 11.1 and 11.2, there were four default schedulers:

- Unicast best effort
- Unicast network control
- Multidestination best effort
- Multidestination network control

Table 430 on page 5300 shows the default scheduler configuration in Junos OS Release 11.1 and 11.2:

Table 430: Junos OS Release 11.1 and 11.2 Default Schedulers

Default Scheduler and Queue Number	Guaranteed Rate (Minimum Bandwidth)	Shaping Rate (Maximum Bandwidth)	Excess Rate (Extra Bandwidth Sharing)	Priority
Best-effort scheduler (queue 0)	75%	None	25%	Low
Network-control scheduler (queue 7)	5%	None	25%	Low
Best-effort multidestination scheduler (queue 8)	15%	None	25%	Low
Network-control multidestination scheduler (queue 11)	5%	None	25%	Low

Junos OS Release 11.3 replaces the four old classifiers with five new classifiers:

- Unicast best effort
- FCoE
- No loss
- Unicast network control
- Multidestination

There are now four different default unicast classifiers to provide default CoS for lossless queues (FCoE and no-loss traffic). Because there is only one default multidestination forwarding class in Junos OS Release 11.3, there is only one default multidestination classifier for all multidestination traffic. Also, the excess rate default value is removed from the scheduler because the **excess-rate** statement is no longer supported, as described elsewhere in this document. Table 431 on page 5301 shows the default scheduler configuration in Junos OS Releases 11.3:

Table 431: Default Schedulers

Default Scheduler and Queue Number	Guaranteed Rate (Minimum Bandwidth)	Shaping Rate (Maximum Bandwidth)	Excess Bandwidth Sharing	Priority
Best-effort scheduler (queue 0)	5%	None	5%	Low
FCoE scheduler (queue 3)	35%	None	35%	Low
No-loss scheduler (queue 4)	35%	None	35%	Low
Network-control scheduler (queue 7)	5%	None	5%	Low
Multidestination scheduler (queue 8)	20%	None	20%	Low

NOTE: **The minimum guaranteed bandwidth rate also determines the amount of excess (extra) bandwidth that the queue can share. Extra bandwidth is allocated to queues in proportion to the minimum guaranteed bandwidth rate of each queue.**

Queue Priority Configuration Changes

In Junos OS Release 11.1 and 11.2, you could configure strict-high priority queues with a guaranteed minimum bandwidth and configure forwarding class sets (priority groups) with a mix of low priority and strict-high priority queues. In Junos OS Release 11.3 and later, these configurations are invalid, and several other changes have also been implemented:

- Priority configuration in Junos OS Release 11.1 and 11.2 provided three priority levels: **strict-high**, **high**, and **low**. In Junos OS Release 11.3, the **high** priority option has been removed. Only the **strict-high** and **low** priority options are valid in Release 11.3.
- Minimum guaranteed bandwidth (transmit rate) is not allowed on strict-high priority queues. Minimum guaranteed bandwidth (guaranteed rate) is not allowed on forwarding class sets that contain strict-high priority queues.

- You cannot configure a multidestination queue as a strict-high priority queue. You cannot configure a queue as a strict-high priority queue if it belongs to the multidestination forwarding class set.
- Only one forwarding class set can contain strict-high priority queues. If you want to configure a strict-high priority queue, you must also configure a separate forwarding class set for the strict-high priority queue. A forwarding class set cannot contain a mixture of low priority and strict-high priority queues.

The rest of the queue priority characteristics remain the same as before. For example, you can configure only one queue as a strict-high priority queue.

NOTE: **If you have configured strict-high or high priority queues in Junos OS Release 11.1 or 11.2, the changes in Release 11.3 are not backward compatible. Please read** "Overview of CoS Upgrade Requirements (Junos OS Release 11.1 or 11.2 to a Later Release)" on page 32 **before you upgrade to Release 11.3.**

Minimum Guaranteed Bandwidth (Transmit Rate and Guaranteed Rate) Changes

The following restrictions have been placed on minimum guaranteed bandwidth configuration in Junos OS Release 11.3:

- You cannot configure a guaranteed minimum bandwidth (transmit rate) for strict-high priority queues.
- Queues (forwarding classes) with a configured transmit rate cannot be included in a forwarding class set that has strict-high priority queues.
- You cannot configure a guaranteed minimum bandwidth (guaranteed rate) for forwarding class sets that include strict-high priority queues.
- For transmit rates below 1 Gbps, we recommend that you configure the transmit rate as a percentage instead of as a fixed rate. This is because the system converts fixed rates into percentages and may round small fixed rates to a lower percentage. For example, a fixed rate of 350 Mbps is rounded down to 3 percent instead of 3.5 percent.

Excess Rate Statement Disabled

The **excess-rate** statement has been disabled in Junos OS Release 11.3. Excess rate was used to specify the way extra bandwidth was shared among queues.

The **excess-rate** statement was used at the **[edit class-of-service schedulers]** hierarchy level for queue scheduling configuration and at the **[edit class-of-service traffic-control-profiles]** hierarchy level for forwarding class set scheduling configuration.

In Junos OS Release 11.3, extra bandwidth sharing among queues is proportional to the minimum guaranteed bandwidth (transmit rate) of the queue. Extra bandwidth sharing among forwarding class sets (priority groups) is proportional to the minimum guaranteed bandwidth (guaranteed rate) of the forwarding class set.

NOTE: If you have configured the excess-rate option in Junos OS Release 11.1 or 11.2, the changes in Release 11.3 are not backward compatible. Please read "Overview of CoS Upgrade Requirements (Junos OS Release 11.1 or 11.2 to a Later Release)" on page 32 before you upgrade to Release 11.3.

Queue Scheduling (Low and Strict-High Priority Queues)

In Junos OS Release 11.1 and 11.2, if you configured a guaranteed minimum bandwidth (transmit rate) for low-priority queues, the low-priority queues received their guaranteed minimum bandwidth from the same bandwidth pool as the strict-high priority queue, using round-robin scheduling. Until the minimum bandwidth requirements of all queues were met, the strict-high priority queue and low-priority queues that had a guaranteed minimum bandwidth were treated equally. After the minimum bandwidth requirements of all queues were met, the strict-high priority queue received as much of the leftover bandwidth as it needed. This meant that the only way to ensure that a strict-high priority queue received all of the bandwidth it needed was not to configure a guaranteed minimum bandwidth for other queues.

In Junos OS Release 11.3 and later, queue scheduling has changed so that queues receive bandwidth in the following sequence:

1. The strict-high priority queue receives all of the bandwidth it needs before any other queue is served. The strict-high priority queue can take the full port bandwidth if necessary and can starve other queues on the port.
2. The guaranteed minimum bandwidth (transmit rate) of low-priority queues is served until the minimum is met or the queues are empty.
3. All other low-priority queues and needs that exceed the minimum bandwidth are served.

Multidestination Traffic Changes

The changes to the default forwarding classes and classifiers affects multidestination traffic handling in Junos OS Release 11.3:

- The number of default multidestination forwarding classes has been reduced from four default multidestination forwarding classes in Junos OS Release 11.1 and 11.2 to one default multidestination in Release 11.3 (see Table 425 on page 5297).
- The default classifier configuration for multidestination traffic has changed so that there is now one default classifier for all multidestination traffic (see Table 429 on page 5299).
- By default, all IEEE 802.1p code points map to the default multidestination forwarding class.

- The default scheduler for multidestination traffic has changed so that there is now one default scheduler for all multidestination traffic (see Table 431 on page 5301).
- You cannot configure multidestination queues as strict-high priority queues and you cannot include strict-high priority queues in a forwarding class set that contains multidestination queues.

Related Documentation

- Overview of CoS Upgrade Requirements (Junos OS Release 11.1 or 11.2 to a Later Release) on page 32
- Overview of CoS Changes Introduced in Junos OS Release 12.2 on page 5304
- Understanding Default CoS Settings on page 5322
- Understanding Default CoS Scheduling and Classification on page 5360
- Understanding CoS Output Queue Schedulers on page 5371

Overview of CoS Changes Introduced in Junos OS Release 12.2

Junos OS Release 12.2 introduces some changes to class-of-service (CoS) functionality and to the CoS default values. This overview summarizes the changes, which other documents describe in detail.

This topic describes the following changes in CoS default values and behavior:

- Lossless Forwarding Classes (fcoe and no-loss) on page 5304
- Default MTU for Headroom Buffer Calculation for Lossless Forwarding Classes on page 5305
- CoS for Layer 3 Physical Interfaces on page 5305
- DSCP IPv6 Classifiers and Rewrite Rules on page 5305

Lossless Forwarding Classes (fcoe and no-loss)

The way the QFX Series handles lossless forwarding classes (the **fcoe** and **no-loss** forwarding classes) changes in Junos OS Release 12.2. In Junos OS Release 12.2 and in earlier releases, by default, the **fcoe** and **no-loss** forwarding classes are mapped to output queue 3 and output queue 4, respectively. These are the only two forwarding classes (and the only two queues) that support lossless transport.

In earlier releases, explicitly setting the lossless **fcoe** and **no-loss** forwarding classes resulted in the same CoS behavior as using the default configuration. However, in Junos OS Release 12.2, the behavior when you explicitly configure the lossless forwarding classes differs from the behavior when you use the default forwarding classes.

NOTE: **The default behavior differs from the explicit configuration behavior even if the explicit configuration is exactly the same as the default configuration.**

If you use the default forwarding class settings for the lossless queues (the configuration does not include explicit setting of the **fcoe** or the **no-loss** forwarding classes), then the **fcoe** and **no-loss** queues behave as lossless queues. When you upgrade to Junos OS Release 12.2, traffic assigned to the **fcoe** and **no-loss** queues continues to be treated as lossless traffic.

If your configuration explicitly sets the **fcoe** or the **no-loss** forwarding class (**set class-of-service forwarding-classes class *class-name* queue-num *queue-number***), after you upgrade to Junos OS Release 12.2, those queues do *not* receive lossless treatment and behave as lossy (**best-effort**) queues. To retain lossless treatment of the **fcoe** and **no-loss** queues, delete the explicit lossless forwarding class configuration before you upgrade to Junos OS Release 12.2.

CAUTION: If you explicitly configured the fcoe or the no-loss forwarding class, and you upgrade to Junos OS Release 12.2, the system does not return an upgrade error or a commit error, or a generate a syslog message, to notify you that these forwarding classes are no longer lossless. Traffic mapped to these forwarding classes is not treated as lossless traffic until you remove the explicit forwarding class configuration.

Default MTU for Headroom Buffer Calculation for Lossless Forwarding Classes

The default maximum transmission unit (MTU) the system uses for buffer headroom calculation is 2500 bytes for traffic classified into the **fcoe** forwarding class or the **no-loss** forwarding class.

In Junos OS Release 12.2, the default MTU used for buffer headroom calculation for the **fcoe** and **no-loss** forwarding classes remains 2500 bytes. However, if the buffer is filled, in Junos OS Release 12.2 you might experience commit failures.

CoS for Layer 3 Physical Interfaces

Before Junos OS Release 12.2, the QFX Series supported only Layer 2 CoS. Junos OS Release 12.2 introduces CoS support for Layer 3 traffic at the physical interface level.

If a physical Layer 3 interface has at least one logical interface configured on it, you can configure Layer 3 CoS for the physical interface. The CoS configured on the physical interface applies to all of the logical Layer 3 interfaces on that physical interface. The system does not support Layer 3 CoS configuration on individual Layer 3 logical interfaces.

DSCP IPv6 Classifiers and Rewrite Rules

Junos OS Release 12.2 introduces support for DSCP IPv6 classifiers and rewrite rules. The existing DSCP IP default classifier is now also the DSCP IPv6 default classifier.

You can configure and apply DSCP IPv6 classifiers and DSCP IPv6 rewrite rules to Layer 2 logical interfaces and to Layer 3 physical interfaces.

NOTE: DSCP IPv6 classifiers are not supported for multidestination (multicast, broadcast, and destination lookup fail) traffic.

Related Documentation

- Overview of CoS Upgrade Requirements to Junos OS Release 12.2 on page 5291
- Overview of CoS Changes Introduced in Junos OS Release 11.3 on page 5296
- Understanding Default CoS Settings on page 5322
- Understanding CoS Classifiers on page 5334
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

CoS Overview

Overview of Junos OS CoS for the QFX Series

When a network experiences congestion and delay, some packets must be dropped. Junos OS class of service (CoS) enables you to divide traffic into classes and set various levels of throughput and packet loss when congestion occurs. You have greater control over packet loss because you can configure rules tailored to your needs.

You can configure CoS features to provide multiple classes of service for different applications. CoS also allows you to rewrite the Differentiated Services code point (DSCP) or IEEE 802.1p code-point bits of packets leaving an interface, thus allowing you to tailor packets for the network requirements of the remote peers.

CoS provides multiple classes of service for different applications. You can configure multiple forwarding classes for transmitting packets, define which packets are placed into each output queue, schedule the transmission service level for each queue, and manage congestion using a random early detection (RED) algorithm.

In designing CoS applications, you must carefully consider your service needs, and you must thoroughly plan and design your CoS configuration to ensure consistency and interoperability across all platforms in a CoS domain.

Because QFX Series implements CoS in hardware rather than in software, you can experiment with and deploy CoS features without affecting packet forwarding and switching performance.

NOTE: CoS policies can be enabled or disabled on each switch interface. Also, each physical and logical interface on the switch can have associated custom CoS rules.

When you change or when you deactivate and then reactivate the class-of-service configuration, the system experiences packet drops because the system momentarily blocks traffic to change the mapping of incoming traffic to input queues.

This topic describes:

CoS Standards

The following RFCs define the standards for the QFX Series CoS capabilities:

- RFC 2474, *Definition of the Differentiated Services Field in the IPv4 and IPv6 Headers*
- RFC 2597, *Assured Forwarding PHB Group*

- RFC 2598, *An Expedited Forwarding PHB*
- RFC 2698, *A Two Rate Three Color Marker*

QFX Series also supports the following data center bridging (DCB) standards to provide the CoS (and other characteristics) Fibre Channel requires for transmitting storage traffic over an Ethernet network:

- IEEE 802.1Qbb, priority-based flow control (PFC)
- IEEE 802.1Qaz, enhanced transmission selection (ETS)
- IEEE 802.1AB (LLDP) extension called Data Center Bridging Capability Exchange Protocol (DCBX)

How Junos CoS Works

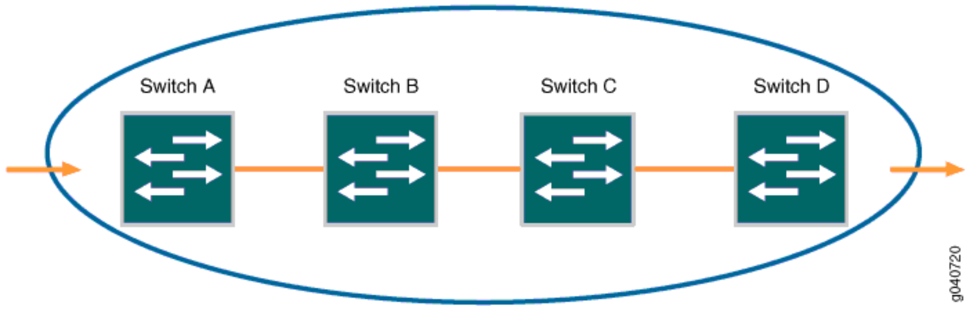
Junos CoS works by examining traffic entering at the edge of your network. The switch classifies traffic into defined service groups to provide the special treatment of traffic across the network. For example, you can send voice traffic across certain links and data traffic across other links. In addition, the data traffic streams can be serviced differently along the network path to ensure that higher-paying customers receive better service. As the traffic leaves the network at the far edge, you can reclassify the traffic to meet the policies of the targeted peer by rewriting the DSCP or IEEE 802.1 code-point bits.

To support CoS, you must configure each switch in the network. Generally, each switch examines the packets that enter it to determine their CoS settings. These settings dictate which packets are transmitted first to the next downstream switch. Switches at the edges of the network might be required to alter the CoS settings of the packets that enter the network to classify the packets into the appropriate service groups.

In Figure 189 on page 5309, Switch A is receiving traffic. As each packet enters, Switch A examines the packet's current CoS settings and classifies the traffic into one of the groupings defined on the switch. This definition allows Switch A to prioritize its resources for servicing the traffic streams it receives. Switch A might alter the CoS settings (forwarding class and loss priority) of the packets to better match the defined traffic groups.

When Switch B receives the packets, it examines the CoS settings, determines the appropriate traffic groups, and processes the packet according to those settings. It then transmits the packets to Switch C, which performs the same actions. Switch D also examines the packets and determines the appropriate groups. Because Switch D sits at the far end of the network, it can reclassify (rewrite) the CoS code-point bits of the packets before transmitting them.

Figure 189: Packet Flow Across the Network



Default CoS Behavior

If you do not configure CoS settings, the software performs some CoS functions to ensure that the system forwards traffic and protocol packets with minimum delay when the network is experiencing congestion. Some CoS settings, such as classifiers, are automatically applied to each logical interface that you configure. Other settings, such as rewrite rules, are applied only if you explicitly associate them with an interface.

Related Documentation

- Overview of Policers on page 4441
- Understanding Junos CoS Components on page 5315
- Understanding CoS Packet Flow on page 5319
- Understanding Default CoS Settings on page 5322
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474

Overview of Policers

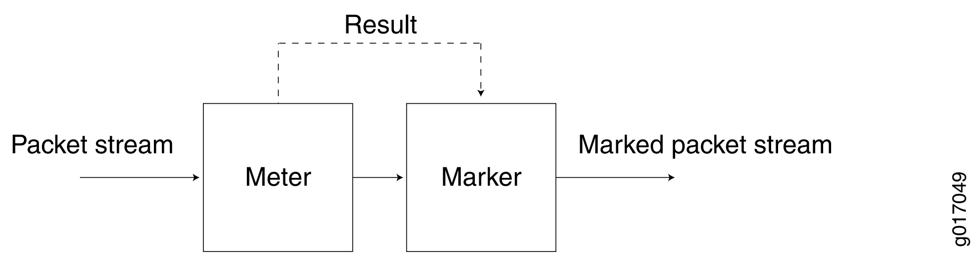
A switch polices traffic by limiting the input or output transmission rate of a class of traffic according to user-defined criteria. Policing (or rate-limiting) traffic allows you to control the maximum rate of traffic sent or received on an interface and to provide multiple priority levels or classes of service.

Policer Overview

You use policers to apply limits to traffic flow and set consequences for packets that exceed these limits—usually applying a higher loss priority—so that if packets encounter downstream congestion, they can be discarded first. Policers apply only to unicast packets.

Policers provide two functions: metering and marking. A policer meters (measures) each packet against traffic rates and burst sizes that you configure. It then passes the packet and the metering result to the marker, which assigns a packet loss priority that corresponds to the metering result. Figure 153 on page 4442 illustrates this process.

Figure 190: Flow of Tricolor Marking Policer Operation



After you name and configure a policer, you use it by specifying it as an action in one or more firewall filters.

Policer Types

A switch supports three types of policers:

- Single-rate two-color marker—A two-color policer (or "policer" when used without qualification) meters the traffic stream and classifies packets into two categories of packet loss priority (PLP) according to a configured bandwidth and burst-size limit. You can mark packets that exceed the bandwidth and burst-size limit with a specified PLP or simply discard them.

  You can specify this type of policer in an ingress or egress firewall.

  NOTE: **A two-color policer is most useful for metering traffic at the port (physical interface) level.**

- Single-rate three-color marker—This type of policer is defined in RFC 2697, *A Single Rate Three Color Marker*, as part of an assured forwarding (AF) per-hop-behavior (PHB) classification system for a Differentiated Services (DiffServ) environment. This type of policer meters traffic based on one rate—the configured committed information rate (CIR) as well as the committed burst size (CBS) and the excess burst size (EBS). The CIR specifies the average rate at which bits are admitted to the switch. The CBS specifies the usual burst size in bytes and the EBS specifies the maximum burst size in bytes. The EBS must be greater than or equal to the CBS, and neither can be 0.

  You can specify this type of policer in an ingress or egress firewall.

NOTE: A single-rate three-color marker (TCM) is most useful when a service is structured according to packet length and not peak arrival rate.

- Two-rate three-color marker—This type of policer is defined in RFC 2698, *A Two Rate Three Color Marker*, as part of an assured forwarding per-hop-behavior classification system for a Differentiated Services environment. This type of policer meters traffic based on two rates—the CIR and peak information rate (PIR) along with their associated burst sizes, the CBS and peak burst size (PBS). The PIR specifies the maximum rate at which bits are admitted to the network and must be greater than or equal to the CIR.

  You can specify this type of policer in an ingress or egress firewall.

NOTE: A two-rate three-color policer is most useful when a service is structured according to arrival rates and not necessarily packet length.

See Table 346 on page 4443 for information about how metering results are applied for each of these policer types.

Policer Actions

Policer actions are implicit or explicit and vary by policer type. *Implicit* means that Junos OS assigns the loss priority automatically. Table 346 on page 4443 describes the policer actions.

Table 432: Policer Actions

Policer	Marking	Implicit Action	Configurable Action
Single-rate two-color	Green (conforming)	Assign low loss priority	None
	Red (nonconforming)	None	Discard
Single-rate three-color	Green (conforming)	Assign low loss priority	None
	Yellow (above the CIR and CBS)	Assign medium-high loss priority	None
	Red (above the EBS)	Assign high loss priority	Discard

Table 432: Policer Actions *(continued)*

Policer	Marking	Implicit Action	Configurable Action
Two-rate three-color	Green (conforming)	Assign low loss priority	None
	Yellow (above the CIR and CBS)	Assign medium-high loss priority	None
	Red (above the PIR and PBS)	Assign high loss priority	Discard

NOTE: **If you specify a policer in an egress firewall filter, the only supported action is discard.**

Policer Colors

Single-rate and two-rate three-color policers can operate in two modes:

- Color-blind—In color-blind mode, the three-color policer assumes that all packets examined have not been previously marked or metered. In other words, the three-color policer is “blind” to any previous coloring a packet might have had.
- Color-aware—In color-aware mode, the three-color policer assumes that all packets examined have been previously marked or metered. In other words, the three-color policer is “aware” of the previous coloring a packet might have had. In color-aware mode, the three-color policer can increase the PLP of a packet but cannot decrease it. For example, if a color-aware three-color policer meters a packet with a medium PLP marking, it can raise the PLP level to high but cannot reduce the PLP level to low.

Filter-Specific Policers

You can configure policers to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. When you do this, rate limiting is applied in aggregate, so if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, the total bandwidth allowed by the filter is 1 Gbps. However, the behavior of a filter-specific policer is affected by how the firewall filter terms that reference the policer are stored in TCAM. If you create a filter-specific policer and reference it in multiple firewall filter terms, the policer allows more traffic than expected if the terms are stored in different TCAM slices. For example, if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms that are stored in three separate memory slices, the total bandwidth allowed by the filter is 3 Gbps, not 1 Gbps.

To prevent this unexpected behavior from occurring, use the information about TCAM slices presented in “Planning the Number of Firewall Filters to Create” on page 4435 to organize your configuration file so that all the firewall filter terms that reference a given filter-specific policer are stored in the same TCAM slice.

Suggested Naming Convention for Policers

We recommend that you use the naming convention ***policertypeTCM#-color type*** when configuring three-color policers and ***policer#*** when configuring two-color policers. TCM stands for three-color marker. Because policers can be numerous and must be applied correctly to work, a simple naming convention makes it easier to apply the policers properly. For example, the first single-rate, color-aware three-color policer configured would be named **srTCM1-ca**. The second two-rate, color-blind three-color configured would be named **trTCM2-cb**. The elements of this naming convention are explained below:

- sr (single-rate)
- tr (two-rate)
- TCM (tricolor marking)
- 1 or 2 (number of marker)
- ca (color-aware)
- cb (color-blind)

Policer Counters

Each policer that you configure includes an implicit counter that counts the number of packets that exceed the rate limits that are specified for the policer. If you use the same policer in multiple terms—either within the same filter or in different filters—the implicit counter counts all the packets that are policed in all of these terms. If you want to obtain separate packet counts for each term, use these options:

- Configure a unique policer for each term.
- Configure only one policer, but use a unique, explicit counter in each term.

Policer Algorithms

Policing uses the *token-bucket algorithm*, which enforces a limit on average bandwidth while allowing bursts up to a specified maximum value. It offers more flexibility than the *leaky bucket algorithm* in allowing a certain amount of bursty traffic before it starts discarding packets.

How Many Policers are Supported?

You can configure and commit the following numbers of policers on QFX3500 and QFX3600 devices when they are operating as standalone switches:

- Two-color policers used in ingress firewall filters: 767
- Three-color policers used in ingress firewall filters: 767
- Two-color policers used in egress firewall filters: 1022
- Three-color policers used in egress firewall filters: 512

Policers can Limit Egress Firewall Filters

The number of egress policers that you configure can affect the total number of allowed egress firewall filters. Every policer has two implicit counters that consume two entries in a 1024-entry TCAM that is used for counters, including counters that are configured as action modifiers in firewall filter terms. (Policers consume two entries because one is used for green packets and one is used for nongreen packets regardless of policer type.) If the TCAM becomes full, you cannot commit any more egress firewall filters that have terms with counters. For example, if you configure and commit 512 egress policers (two-color, three-color, or a combination of both policer types), all of the memory entries for counters are used up. If later in your configuration file you insert additional egress firewall filters with terms that also include counters, *none* of the terms in those filters are committed because there is no available memory space for the counters.

Here are some additional examples:

- Assume that you configure egress filters that include a total of 512 policers and no counters. Later in your configuration file you include another egress filter with 10 terms, 1 of which has a counter action modifier. None of the terms in this filter are committed because there is not enough TCAM space for the counter.
- Assume that you configure egress filters that include a total of 500 policers, so 1000 TCAM entries are occupied. Later in your configuration file you include the following two egress filters:
  - Filter A with 20 terms and 20 counters. All the terms in this filter are committed because there is enough TCAM space for all the counters.
  - Filter B comes after Filter A and has five terms and five counters. *None* of the terms in this filter are committed because there is not enough memory space for *all* the counters. (Five TCAM entries are required but only four are available.)

You can prevent this problem by ensuring that egress firewall filter terms with counter actions are placed earlier in your configuration file than terms that include policers. In this circumstance, Junos OS commits policers even if there is not enough TCAM space for the implicit counters. For example, assume the following:

- You have 1024 egress firewall filter terms with counter actions.
- Later in your configuration file you have an egress filter with 10 terms. None of the terms have counters but one has a policer action modifier.

You can successfully commit the filter with 10 terms even though there is not enough TCAM space for the implicit counters of the policer. The policer is committed without the counters.

Related Documentation

- Understanding Color-Blind Mode for Single-Rate Tricolor Marking on page 4447
- Understanding Color-Blind Mode for Two-Rate Tricolor Marking on page 4449
- Understanding Color-Aware Mode for Single-Rate Tricolor Marking on page 4447
- Understanding Color-Aware Mode for Two-Rate Tricolor Marking on page 4449

- Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 4538

Understanding Junos CoS Components

This topic describes the Junos operating system (OS) class-of-service (CoS) components for the QFX Series:

Code-Point Aliases

A code-point alias assigns a name to a pattern of code-point bits. You can use this name instead of the bit pattern when you configure other CoS components such as classifiers and rewrite rules.

Policers

Policers limit traffic of a certain class to a specified bandwidth and burst size. Packets exceeding the policer limits can be discarded, or can be assigned to a different forwarding class, a different loss priority, or both. You define policers with filters that you can associate with input interfaces.

Classifiers

Packet classification associates incoming packets with a particular CoS servicing level. In Junos OS, *classifiers* associate packets with a forwarding class and loss priority and assign packets to output queues based on the associated forwarding class. Junos OS supports two general types of classifiers:

- Behavior aggregate (BA) or CoS value traffic classifiers—Examine the CoS value in the packet header. The value in this single field determines the CoS settings applied to the packet. BA classifiers allow you to set the forwarding class and loss priority of a packet based on the Differentiated Services code point (DSCP) value or IEEE 802.1p value.
- Multifield traffic classifiers—Examine multiple fields in the packet, such as source and destination addresses and source and destination port numbers of the packet. With multifield classifiers, you set the forwarding class and loss priority of a packet based on firewall filter rules.

You can create unicast classifiers for unicast traffic and multidestination classifiers for multicast, broadcast, and destination lookup fail traffic. You cannot assign unicast traffic and multidestination traffic to the same classifier.

You can apply unicast classifiers to one or more interfaces. Multidestination classifiers apply to all of the switch interfaces and cannot be applied to individual interfaces.

Forwarding Classes

Forwarding classes group packets for transmission and CoS. You assign each packet to an output queue based on the packet's forwarding class. Forwarding classes affect the forwarding, scheduling, and rewrite marking policies applied to packets as they transit the switch.

The switch provides five default forwarding classes:

- fcoe—Fibre Channel over Ethernet traffic
- no-loss—Lossless traffic
- be—Best-effort traffic
- nc—Network control traffic
- mcast—Multicast traffic

The switch supports a total of 12 forwarding classes (8 unicast forwarding classes and 4 multicast forwarding classes), which provide flexibility in classifying traffic.

Forwarding Class Sets

You can group forwarding classes (output queues) into *forwarding class sets* in order to apply CoS to groups of traffic that require similar treatment. Forwarding class sets map traffic into priority groups to support enhanced transmission selection (ETS, described in IEEE 802.1Qaz).

You can configure up to three unicast forwarding class sets and one multicast forwarding class set. For example, you can configure different forwarding class sets to apply CoS to unicast groups of local area network (LAN) traffic, storage area network (SAN) traffic, and high-performance computing (HPC) traffic, and configure another group for multicast traffic.

Within each forwarding class set, you can configure special CoS treatment for the traffic mapped to each individual queue. This provides the ability to configure CoS in a two-tier hierarchical manner. At the forwarding class set tier, you configure CoS for groups of traffic using a *traffic control profile*. At the queue tier, you configure CoS for individual output queues within a forwarding class set using a *scheduler* that you map to a queue (forwarding class) using a *scheduler map*.

Flow Control (Ethernet PAUSE and Priority-Based Flow Control)

Ethernet PAUSE (described in IEEE 802.3X) is a link-level flow control mechanism. During periods of network congestion, Ethernet PAUSE stops all traffic on a full-duplex Ethernet link for a period of time specified in the PAUSE message.

Priority-based flow control (PFC, described in IEEE 802.1Qbb) is part of the IEEE data center bridging (DCB) specifications for creating a lossless Ethernet environment to transport loss-sensitive flows such as Fibre Channel over Ethernet (FCoE) traffic.

PFC is a link-level flow control mechanism similar to Ethernet PAUSE. However, Ethernet PAUSE stops all traffic on a link for a period of time. PFC decouples the pause function from the physical link and divides the traffic on the link into eight priorities (3-bit IEEE 802.1p code points). You can think of the eight priorities as eight "lanes" of traffic. You can apply pause selectively to the traffic on any priority without pausing the traffic on other priorities on the same link.

The granularity that PFC provides allows you to configure different levels of CoS for different types of traffic on the link. You can create lossless lanes for traffic such as FCoE, LAN backup, or management, while using standard frame-drop methods of congestion management for IP traffic on the same link.

NOTE: **If you transport FCoE traffic, you must enable PFC on the priority assigned to FCoE traffic (usually code point 011 on interfaces that carry FCoE traffic).**

Tail-Drop Profiles

A tail-drop profile (drop profile) defines parameters that enable the network to drop packets during periods of congestion. A drop profile defines the conditions under which packets of different loss priorities drop, by determining the probability of dropping a packet for each loss priority when output queues become congested. Drop profiles essentially set a value for a level of queue fullness—when the queue fills to the level of the queue fullness value, packets drop.

You can associate different drop profiles with different loss priorities to set the probability of dropping packets. You can apply a drop profile for each loss priority to a forwarding class (output queue) by applying a drop profile to a scheduler, and then mapping the scheduler to a forwarding class using a scheduler map. When the queue mapped to the forwarding class experiences congestion, the drop profile determines the level of packet drop for traffic of each loss priority in that queue.

Loss priority affects the scheduling of a packet without affecting the packet's relative ordering. Typically you mark packets exceeding a particular service level with a high loss priority.

Schedulers

Each switch interface has multiple queues assigned to store packets. The switch determines which queue to service based on a particular method of scheduling. This process often involves determining the sequence in which different types of packets should be transmitted.

You can define the priority (**priority**), minimum bandwidth (**transmit-rate**), maximum bandwidth (**shaping-rate**), and tail-drop profiles to be applied to a particular queue for packet transmission. Extra bandwidth is shared among queues in proportion to the minimum guaranteed bandwidth of each queue.

A scheduler map associates a specified forwarding class with a scheduler configuration. You can associate up to four user-defined scheduler maps with the interfaces.

Rewrite Rules

A *rewrite rule* sets the appropriate CoS bits in the outgoing packet. This allows the next downstream device to classify the packet into the appropriate service group. Rewriting (marking) outbound packets is useful when the switch is at the border of a network and must change the CoS values to meet the policies of the targeted peer.

NOTE: Ingress firewall filters can also rewrite forwarding class and loss priority values.

Related Documentation

- Understanding CoS Packet Flow on page 5319
- Understanding CoS Code-Point Aliases on page 5332
- Overview of Policers on page 4441
- Understanding CoS Classifiers on page 5334
- Understanding CoS Forwarding Classes on page 5354
- Understanding CoS Forwarding Class Sets (Priority Groups) on page 5359
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding CoS Tail-Drop Profiles on page 5409
- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Rewrite Rules on page 5414
- Understanding DCB Features and Requirements on page 4795

Understanding CoS Packet Flow

When a packet traverses a QFX Series Node device, the Node device provides the appropriate level of service to the packet using either default class of service (CoS) settings or CoS settings that you configure. On ingress ports, the Node device classifies packets into appropriate forwarding classes and assigns a loss priority to the packets. On egress ports, the Node device applies packet scheduling and (if you have configured them) rewrite rules to re-mark packets.

On the QFX Series, you can configure CoS on Layer 2 logical interfaces, and you can configure CoS on Layer 3 physical interfaces if you have defined at least one logical interface on the Layer 3 physical interface. You cannot configure CoS on Layer 2 physical interfaces and Layer 3 logical interfaces.

For Layer 2 traffic, either use the default CoS settings or configure CoS on each logical interface. You can apply different CoS settings to different Layer 2 logical interfaces.

For Layer 3 traffic, either use the default CoS settings or configure CoS on the physical interface (not on the logical unit). The QFX Series uses the CoS applied on the physical Layer 3 interface for all logical Layer 3 interfaces configured on the physical Layer 3 interface.

The QFX Series applies to CoS to packets as they flow through the system:

- An interface has one or more classifiers of different types applied to it (configure this at the **[edit class-of-service interfaces]** hierarchy level). The classifier types are based on the portion of the incoming packet that the classifier examines (IEEE 802.1p code point bits or DSCP code point bits).
- When a packet enters an ingress port, the classifier assigns the packet to a forwarding class and a loss priority based on the code point bits of the packet (configure this at the **[edit class-of-service classifiers]** hierarchy level).
- The QFX Series assigns each forwarding class to an output queue (configure this at the **[edit class-of-service forwarding-classes]** hierarchy level).
- Input (and output) policers meter traffic and can change the forwarding class and loss priority if a traffic flow exceeds its service level.
- A scheduler map is applied to each interface. When a packet exits an egress port, the scheduler map controls how it is treated (configure this at the **[edit class-of-service interfaces]** hierarchy level). A scheduler map assigns schedulers to forwarding classes (configure this at the **[edit class-of-service scheduler-maps]** hierarchy level).
- A scheduler defines how traffic is treated at the egress interface output queue (configure this at the **[edit class-of-service schedulers]** hierarchy level). You control the transmit rate, shaping rate, priority, and drop profile of each forwarding class by mapping schedulers to forwarding classes in scheduler maps, then applying scheduler maps to interfaces.

- A drop-profile defines how aggressively to drop packets that are mapped to a particular scheduler (configure this at the **[edit class-of-service drop-profiles]** hierarchy level).
- A rewrite rule takes effect as the packet leaves an interface that has a rewrite rule configured (configure this at the **[edit class-of-service rewrite-rules]** hierarchy level). The rewrite rule writes information to the packet (for example, a rewrite rule can re-mark the code point bits of outgoing traffic) according to the forwarding class and loss priority of the packet.

Figure 191 on page 5320 is a high-level flow diagram of how packets from various sources enter QFX Series interfaces, are classified at the ingress, and then scheduled (provided bandwidth) at the egress queues.

Figure 191: CoS Classifier, Queues, and Scheduler

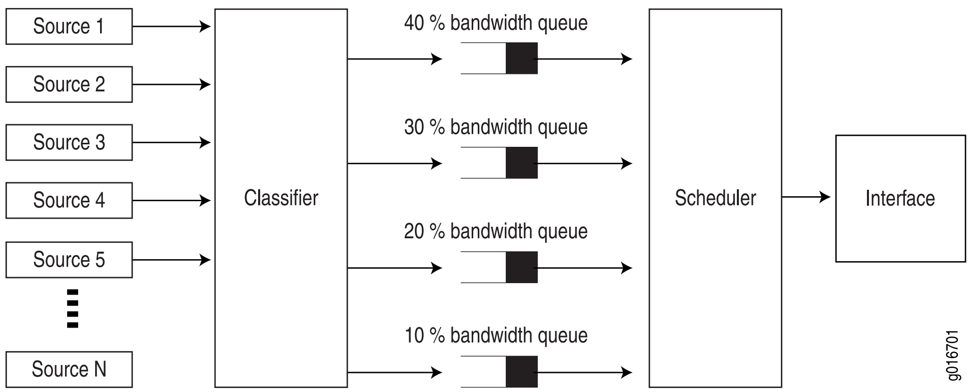
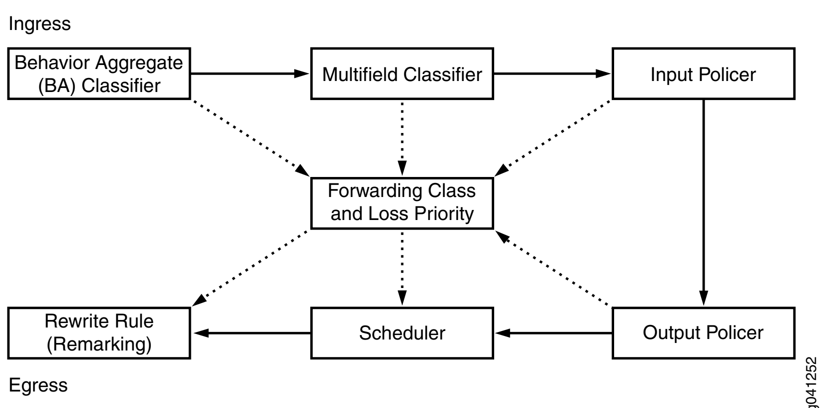


Figure 192 on page 5320 shows the packet flow through the CoS components that you can configure.

Figure 192: Packet Flow Through Configurable CoS Components



The middle box ("Forwarding Class and Loss Priority") represents two values that you can use on ingress and egress interfaces. The system uses these values for classifying traffic on ingress interfaces and for rewrite rule re-marking on egress interfaces. Each outer box represents a process component. The components in the top row apply to incoming packets. The components in the bottom row apply to outgoing packets.

The solid-line arrows show the direction of packet flow from ingress to egress. The dotted-line arrows show inputs and outputs or show settings and actions based on those settings.

For example, the BA classifier sets the forwarding class and loss priority of incoming packets, so the forwarding class and loss priority are outputs of the classifier and the arrow points away from the classifier. The scheduler receives the forwarding class and loss priority settings, and queues the outgoing packets based on those settings, so the arrow points toward the scheduler.

Related Documentation

- Understanding CoS Classifiers on page 5334
- Overview of Policers on page 4441
- Understanding CoS Forwarding Classes on page 5354
- Understanding Default CoS Scheduling and Classification on page 5360
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Priority Group Scheduling on page 5378
- Understanding CoS Tail-Drop Profiles on page 5409
- Understanding CoS Rewrite Rules on page 5414

CoS Inputs and Outputs Overview

Some CoS components map one set of values to another set of values. Each mapping contains one or more inputs and one or more outputs. When you configure a mapping, you set the outputs for a given set of inputs, as shown in Table 433 on page 5321.

Table 433: CoS Mappings—Inputs and Outputs

CoS Mappings	Inputs	Outputs	Comments
classifiers	code-points	forwarding-class, loss-priority	The map sets the forwarding class and packet loss priority (PLP) for a specific set of code points.
drop-profile-map	*loss-priority*, protocol	drop-profile	The map sets the drop profile for a specific PLP and protocol type.
rewrite-rules	loss-priority, forwarding-class	code-points	The map sets the code points for a specific forwarding class and PLP.
rewrite-value (Fibre Channel Interfaces)	forwarding-class	code-point	The map sets the code point for the forwarding class specified in the fixed classifier attached to the native Fibre Channel (NP_Port) interface.

Related Documentation

- Understanding CoS Packet Flow on page 5319
- Understanding CoS Classifiers on page 5334
- Example: Configuring Unicast Classifiers on page 5495

- Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers on page 5498
- Example: Configuring Forwarding Classes on page 5505
- Configuring CoS Drop Profile Maps on page 5677
- Defining CoS Rewrite Rules on page 5693

Understanding Default CoS Settings

If you do not configure CoS settings on the QFX Series, Junos OS performs some CoS functions to ensure that traffic and protocol packets are forwarded with minimum delay when the network experiences congestion. Some default mappings are automatically applied to each logical interface that you configure.

You can display default CoS settings by issuing the **show class-of-service** operational mode command.

This topic describes the default configurations for the following CoS components:

Default Forwarding Classes and Queue Mapping

Table 434 on page 5322 shows the default mapping of the default forwarding classes to queues and packet drop attribute.

Table 434: Default Forwarding Classes and Queue Mapping

Default Forwarding Class	Description	Default Queue Mapping	Packet Drop Attribute
best-effort (be)	Best-effort traffic class (priority 0, IEEE 802.1p code point 000)	0	drop
fcoe	Guaranteed delivery for FCoE traffic (priority 3, IEEE 802.1p code point 011)	3	no-loss
no-loss	Guaranteed delivery for TCP no-loss traffic (priority 4, IEEE 802.1p code point 100)	4	no-loss

Table 434: Default Forwarding Classes and Queue Mapping *(continued)*

Default Forwarding Class	Description	Default Queue Mapping	Packet Drop Attribute
network-control (nc)	Network control traffic (priority 7, IEEE 802.1p code point 111)	7	drop
mcast	Multidestination traffic	8	drop NOTE: You cannot configure multidestination forwarding classes as no-loss (lossless) traffic classes.

Default Forwarding Class Sets (Priority Groups)

If you do not explicitly configure forwarding class sets, the system automatically creates a default forwarding class set that contains all of the forwarding classes on the switch. The system assigns 100 percent of the port output bandwidth to the default forwarding class set.

Ingress traffic is classified based on the default classifier settings. The forwarding classes (queues) in the default forwarding class set receive bandwidth based on the default scheduler settings. Forwarding classes that are not part of the default scheduler receive no bandwidth.

The default forwarding class set is transparent. It does not appear in the configuration and is used for Data Center Bridging Capability Exchange (DCBX) protocol advertisement.

Default Code-Point Aliases

Table 435 on page 5323 shows the default mapping of code-point aliases to IEEE code points.

Table 435: Default IEEE 802.1 Code-Point Aliases

CoS Value Types	Mapping
be	000
be1	001
ef	010
ef1	011
af11	100
af12	101
nc1	110

Table 435: Default IEEE 802.1 Code-Point Aliases *(continued)*

CoS Value Types	Mapping
nc2	111

Table 436 on page 5324 shows the default mapping of code-point aliases to DSCP and DSCP IPv6 code points.

Table 436: Default DSCP and DCSP IPv6 Code-Point Aliases

CoS Value Types	Mapping
ef	101110
af11	001010
af12	001100
af13	001110
af21	010010
af22	010100
af23	010110
af31	011010
af32	011100
af33	011110
af41	100010
af42	100100
af43	100110
be	000000
cs1	001000
cs2	010000
cs3	011000
cs4	100000
cs5	101000

Table 436: Default DSCP and DCSP IPv6 Code-Point Aliases *(continued)*

CoS Value Types	Mapping
nc1	110000
nc2	111000

Default Classifiers

The QFX Series applies default unicast IEEE 802.1, unicast DSCP, and multidestination classifiers to each interface that does not have explicitly configured classifiers. If you explicitly configure one type of classifier but not other types of classifiers, the system uses only the configured classifier and does not use default classifiers for other types of traffic. There are two different default unicast IEEE 802.1 classifiers, a trusted classifier for ports that are in trunk mode or tagged-access mode, and an untrusted classifier for ports that are in access mode.

Table 437 on page 5325 shows the default mapping of IEEE 802.1 code-point values to unicast forwarding classes and loss priorities for ports in trunk mode or tagged-access mode.

Table 437: Default IEEE 802.1 Unicast Classifiers for Ports in Trunk Mode or Tagged Access Mode (Trusted Classifier)

Code Point	Forwarding Class	Loss Priority
be (000)	best-effort	low
be1 (001)	best-effort	low
ef (010)	best-effort	low
ef1 (011)	fcoe	low
af11 (100)	no-loss	low
af12 (101)	best-effort	low
nc1 (110)	network-control	low
nc2 (111)	network-control	low

Table 438 on page 5326 shows the default mapping of IEEE 802.1p code-point values to unicast forwarding classes and loss priorities for ports in access mode (all incoming traffic is mapped to best-effort forwarding classes).

Table 438: Default IEEE 802.1 Unicast Classifiers for Ports in Access Mode (Untrusted Classifier)

Code Point	Forwarding Class	Loss Priority
000	best-effort	low
001	best-effort	low
010	best-effort	low
011	best-effort	low
100	best-effort	low
101	best-effort	low
110	best-effort	low
111	best-effort	low

Table 439 on page 5326 shows the default mapping of IEEE 802.1 code-point values to multidestination (multicast, broadcast, and destination lookup fail traffic) forwarding classes and loss priorities.

Table 439: Default IEEE 802.1 Multidestination Classifiers

Code Point	Forwarding Class	Loss Priority
be (000)	mcast	low
be1 (001)	mcast	low
ef (010)	mcast	low
ef1 (011)	mcast	low
af11 (100)	mcast	low
af12 (101)	mcast	low
nc1 (110)	mcast	low
nc2 (111)	mcast	low

Table 440 on page 5327 shows the default mapping of DSCP code-point values to unicast forwarding classes and loss priorities for DSCP IP and DCSP IPv6.

Table 440: Default DSCP IP and IPv6 Unicast Classifiers

Code Point	Forwarding Class	Loss Priority
ef (101110)	best-effort	low
af11 (001010)	best-effort	low
af12 (001100)	best-effort	low
af13 (001110)	best-effort	low
af21 (010010)	best-effort	low
af22 (010100)	best-effort	low
af23 (010110)	best-effort	low
af31 (011010)	best-effort	low
af32 (011100)	best-effort	low
af33 (011110)	best-effort	low
af41 (100010)	best-effort	low
af42 (100100)	best-effort	low
af43 (100110)	best-effort	low
be (000000)	best-effort	low
cs1 (001000)	best-effort	low
cs2 (010000)	best-effort	low
cs3 (011000)	best-effort	low
cs4 (100000)	best-effort	low
cs5 (101000)	best-effort	low
nc1 (110000)	network-control	low
nc2 (111000)	network-control	low

NOTE: There are no default DSCP IP or IPv6 classifiers for multidestination traffic. DSCP IPv6 classifiers are not supported for multidestination traffic.

Default Rewrite Rules

There are no default rewrite rules. If you do not explicitly configure rewrite rules, the switch does not reclassify egress traffic.

Default Drop Profile

Table 441 on page 5328 shows the default drop profile configuration.

Table 441: Default Drop Profile

Fill Level	Drop Probability
100	100

Default Schedulers

Table 442 on page 5328 shows the default scheduler configuration.

Table 442: Default Schedulers

Default Scheduler and Queue Number	Guaranteed Rate (Minimum Bandwidth)	Shaping Rate (Maximum Bandwidth)	Excess Bandwidth Sharing	Priority	Buffer Size
Best-effort scheduler (queue 0)	5%	None	5%	low	5%
FCoE scheduler (queue 3)	35%	None	35%	low	35%
No-loss scheduler (queue 4)	35%	None	35%	low	35%
Network-control scheduler (queue 7)	5%	None	5%	low	5%
Multidestination scheduler (queue 8)	20%	None	20%	low	20%

NOTE: The minimum guaranteed bandwidth rate also determines the amount of excess (extra) bandwidth that the queue can share. Extra bandwidth is allocated to queues in proportion to the minimum guaranteed bandwidth rate of each queue.

Default Scheduler Maps

Table 443 on page 5328 shows the default mapping of forwarding classes to schedulers.

Table 443: Default Scheduler Maps

Forwarding Class	Scheduler
best-effort	Default BE scheduler

Table 443: Default Scheduler Maps *(continued)*

Forwarding Class	Scheduler
fcoe	Default FCoE scheduler
no-loss	No-loss scheduler
network-control	Default network-control scheduler
mcast-be	Default multidestination scheduler

Default Shared Buffer Configuration

Table Table 444 on page 5329 and Table 445 on page 5329 show the default shared buffer allocations:

Table 444: Default Ingress Shared Buffer Configuration

Total Shared Ingress Buffer	Lossless Buffer	Lossless-Headroom Buffer	Lossy Buffer
100%	9%	45%	46%

Table 445: Default Egress Shared Buffer Configuration

Total Shared Egress Buffer	Lossless Buffer	Lossy Buffer	Multicast Buffer
100%	50%	31%	19%

Related Documentation

- Overview of Junos OS CoS for the QFX Series on page 5307
- Understanding Junos CoS Components on page 5315
- Understanding Default CoS Scheduling and Classification on page 5360
- Understanding CoS Classifiers on page 5334
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344
- Understanding CoS Code-Point Aliases on page 5332
- Understanding CoS Forwarding Classes on page 5354
- Understanding CoS Rewrite Rules on page 5414
- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Tail-Drop Profiles on page 5409

Understanding Host Inbound Traffic Classification

The destination address of traffic that enters the switch can be an external device such as another switch, a router, or a server, or the destination can be the host (the switch

Routing Engine or CPU). When the destination is an external device, the DSCP and IEEE 802.1p code-point bits of incoming traffic are preserved as the traffic travels through the switch to the egress port. At the egress port, the code-point bits are either preserved when the packets are sent to the next hop or they are rewritten according to the rewrite rule attached to the egress interface.

When the destination of incoming traffic is the host, DSCP bits are preserved. However, IEEE 802.1p bits are not preserved. The IEEE 802.1p bits of traffic destined for the host are set to zero (0). This does not affect system behavior because the switch prioritizes traffic destined for the host based on the protocol type. For example, the switch gives a higher priority to BPDU traffic than to ping traffic.

Related Documentation

- Understanding Default CoS Scheduling and Classification on page 5360
- Understanding Host Routing Engine Outbound Traffic Queues and Defaults on page 5330

Understanding Host Routing Engine Outbound Traffic Queues and Defaults

The host Routing Engine and CPU generate outbound traffic that is transmitted using different protocols. You cannot configure a classifier to map different types of outbound traffic that the host generates to forwarding classes (queues). The traffic that the host generates is assigned to forwarding classes by default as shown in Table 446 on page 5331.

If you want to separate host outbound traffic from other traffic or if you want to assign that traffic to a particular queue, you can configure a single forwarding class for all traffic that the host generates. If you configure a forwarding class for outbound host traffic, that forwarding class is used globally for all traffic generated by the host. (That is, the host outbound traffic is mapped to the selected queue on all egress interfaces.) Configuring a forwarding class for host outbound traffic does not affect transit or incoming traffic.

Whether you use the default host outbound traffic forwarding class configuration or configure a forwarding class for all host outbound traffic, the configuration applies to all Layer 2 and Layer 3 protocols and to all application-level traffic such as FTP and ping operations.

If you configure a queue for host outbound traffic, the queue must be properly configured on all interfaces.

NOTE: **Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) packets generated by the CPU are always transmitted on the fcoe queue (queue 3), even if you configure a queue for host outbound traffic. This helps to ensure lossless behavior for FCoE traffic. QFabric systems classify FIP control packets into the same traffic class (fcoe) across the Interconnect device (fabric) and the egress Node device.**

By default, traffic generated by the host is sent to the best effort queue (queue 0) or to the network control queue (queue 7). Table 446 on page 5331 lists the default host traffic to output queue mapping.

Table 446: Routing Engine Protocol Default Queue Mapping

Routing Engine Protocol	Default Queue Mapping
Address Resolution Protocol (ARP) reply	Queue 0
ARP request	Queue 0
Border Gateway Protocol (BGP)	Queue 0
BGP TCP Retransmission	Queue 7
Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP)	Queue 3
File Transfer Protocol (FTP)	Queue 0
Internet Control Message Protocol (ICMP) reply	Queue 0
ICMP request	Queue 0
Internet Group Management Protocol (IGMP) query	Queue 7
IGMP report	Queue 0
Link Aggregation Control Protocol (LACP)	Queue 7
Open Shortest Path First (OSPF) hello	Queue 7
OSPF protocol data unit (PDU)	Queue 7
OSPF link state advertisements (LSAs)	Queue 7
Protocol Independent Multicast (PIM)	Queue 7
PIM hello	Queue 7
Simple Network Management Protocol (SNMP)	Queue 0
Secure Shell (SSH)	Queue 0
Telnet	Queue 0
Virtual Router Redundancy Protocol (VRRP)	Queue 7
VLAN Spanning Tree Protocol (VSTP)	Queue 7
xnm-clear-text	Queue 0
xnm-ssl	Queue 0

Related Documentation

- Understanding CoS Forwarding Classes on page 5354
- Changing the Host Outbound Traffic Default Queue Mapping on page 5683
- Example: Configuring Forwarding Classes on page 5505

Understanding CoS Code-Point Aliases

A code-point alias assigns a name to a pattern of code-point bits. You can use this name instead of the bit pattern when you configure other CoS components such as classifiers, drop-profile maps, and rewrite rules.

Behavior aggregate classifiers use class-of-service (CoS) values such as Differentiated Services code points (DSCPs) and IEEE 802.1 bits to associate incoming packets with a particular CoS servicing level. You can assign a meaningful name or alias to the CoS values and use that alias instead of bits when configuring CoS components. These aliases are not part of the specifications but are well known through usage. For example, the alias for DSCP 101110 is widely accepted as ef (expedited forwarding).

When you configure classes and define classifiers, you can refer to the markers by alias names. You can configure alias names for user-defined classifiers. If the value of an alias changes, it alters the behavior of any classifier that references it.

You can configure code-point aliases for the following type of CoS markers:

- dscp or dscp-ipv6—Handles incoming IP and IPv6 packets.
- ieee-802.1—Handles Layer 2 CoS.

This topic covers:

- Default Code-Point Aliases on page 5332

Default Code-Point Aliases

Table 447 on page 5332 shows the default mapping of code-point aliases to IEEE code points.

Table 447: Default IEEE 802.1 Code-Point Aliases

CoS Value Types	Mapping
be	000
be1	001
ef	010
ef1	011
af11	100
af12	101

Table 447: Default IEEE 802.1 Code-Point Aliases *(continued)*

CoS Value Types	Mapping
nc1	110
nc2	111

Table 448 on page 5333 shows the default mapping of code-point aliases to DSCP and DSCP IPv6 code points.

Table 448: Default DSCP and DSCP IPv6 Code-Point Aliases

CoS Value Types	Mapping
ef	101110
af11	001010
af12	001100
af13	001110
af21	010010
af22	010100
af23	010110
af31	011010
af32	011100
af33	011110
af41	100010
af42	100100
af43	100110
be	000000
cs1	001000
cs2	010000
cs3	011000
cs4	100000

Table 448: Default DSCP and DSCP IPv6 Code-Point Aliases *(continued)*

CoS Value Types	Mapping
cs5	101000
nc1	110000
nc2	111000

Related Documentation

- Understanding Junos CoS Components on page 5315
- Defining CoS Code-Point Aliases on page 5672

Understanding CoS Classifiers

Packet classification associates incoming packets with a particular class-of-service (CoS) servicing level. Classifiers associate packets with a forwarding class and a loss priority, and assign packets to output queues based on the associated forwarding class. There are three general types of classifiers:

- Behavior aggregate (BA) classifiers—DSCP and DSCP IPv6 classify IP and IPv6 traffic, EXP classifies MPLS traffic, and IEEE 802.1p classifiers classify all other traffic. (Although this topic covers EXP classifiers, for more details about EXP classifiers, see "Understanding CoS MPLS EXP Classifiers and Rewrite Rules" on page 3744.)
- Fixed classifiers—Fixed classifiers classify all ingress traffic on a physical interface into one forwarding class, regardless of the CoS bits in the packet header.
- Multifield (MF) classifiers—MF classifiers classify traffic based on more than one field in the packet header and take precedence over BA and fixed classifiers.

Interfaces and Output Queues

On Gigabit Ethernet interfaces, 10-Gigabit Ethernet interfaces, and link aggregation (LAG) interfaces, you can apply classifiers to Layer 2 logical interfaces and to Layer 3 physical interfaces if the Layer 3 physical interface has at least one defined logical interface. Classifiers applied to Layer 3 physical interfaces are used on all logical interfaces on that physical interface. "Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces" on page 5344 describes the interaction between classifiers and interfaces in greater detail.

You can configure both a BA classifier and an MF classifier on an interface. If you do this, the BA classification is performed first and then the MF classification is performed. If the two classification results conflict, the MF classification result overrides the BA classification result.

You cannot configure a fixed classifier and a BA classifier on the same interface.

You can configure both a DSCP or a DSCP IPv6 classifier and an IEEE 802.1p classifier on the same interface. IP traffic uses the DSCP or DSCP IPv6 classifier. All other traffic uses the IEEE classifier (except when you configure a global EXP classifier; in that case, MPLS traffic uses the EXP classifier). You can configure only one DSCP classifier on a physical interface (either one DSCP classifier or one DSCP IPv6 classifier, but not both).

Although you can configure as many EXP classifiers as you want, the switch uses only one MPLS EXP classifier as a global classifier on all interfaces. After you configure an MPLS EXP classifier, you can configure it as the global EXP classifier by including the EXP classifier in the **[edit class-of-service system-defaults classifiers exp]** hierarchy. All switch interfaces use the EXP classifier specified using this configuration statement to classify MPLS traffic.

You can create unicast BA classifiers for unicast traffic and multicast BA classifiers for multidestination traffic, which includes multicast, broadcast, and destination lookup fail (DLF) traffic. You cannot assign unicast traffic and multidestination traffic to the same BA classifier.

On each interface, the switch has separate output queues for unicast traffic and for multidestination traffic:

- The switch supports 12 output queues, with 8 queues dedicated to unicast traffic and 4 queues dedicated to multidestination traffic.
- Queues 0 through 7 are unicast traffic queues. You can apply only unicast BA classifiers to unicast queues. A unicast BA classifier should contain only forwarding classes that are mapped to unicast queues.
- Queues 8 through 11 are multidestination traffic queues. You can apply only multidestination BA classifiers to multidestination queues. A multidestination BA classifier should contain only forwarding classes that are mapped to multidestination queues.

You can apply unicast classifiers to one or more interfaces. Multidestination classifiers and EXP classifiers apply to all of the switch interfaces and cannot be applied to individual interfaces. Use the DSCP multidestination classifier for both IP and IPv6 multidestination traffic. The DSCP IPv6 classifier is not supported for multidestination traffic.

Behavior Aggregate Classifiers

The behavior aggregate classifier maps a class-of-service (CoS) value to a forwarding class and loss priority. The forwarding class determines the output queue. A scheduler uses the loss priority to control packet discard during periods of congestion by associating different drop profiles with different loss priorities.

The switch supports three types of BA classifiers:

- Differentiated Services Code Point (DSCP) for IP DiffServ (IP and IPv6)
- IEEE 802.1p CoS bits
- MPLS EXP

BA classifiers are based on fixed-length fields, which makes them computationally more efficient than MF classifiers. Therefore, core devices, which handle high traffic volumes, are normally configured to perform BA classification.

Unicast and multicast traffic cannot share the same classifier. You can map unicast traffic and multicast traffic to the same classifier CoS value, but the unicast traffic must belong to a unicast classifier and the multicast traffic must belong to a multidestination classifier.

Default Behavior Aggregate Classification

Juniper Networks Junos OS automatically assigns implicit default classifiers to all logical interfaces based on the type of interface. Table 449 on page 5336 lists different types of interfaces and the corresponding implicit default BA classifiers.

Table 449: Default BA Classification

Type of Interface	Default BA Classification
Layer 2 interface in trunk mode or in tagged-access mode	**ieee8021p-default**
Layer 3 interface	**dscp-default**
Layer 2 interface in access mode	**ieee8021p-untrusted**

NOTE: There are default BA classifiers for the **best-effort**, **fcoe**, **no-loss**, **network-control**, and **mcast** forwarding classes.

NOTE: There is no default MPLS EXP classifier. You must configure an EXP classifier and apply it globally to all interfaces by including it in the **[edit class-of-service system-defaults classifiers exp]** hierarchy.

If an EXP classifier is not configured, then if a fixed classifier is applied to the interface, the MPLS traffic uses the fixed classifier. If no EXP classifier and no fixed classifier is applied to the interface, MPLS traffic is treated as best-effort traffic. DSCP classifiers are not applied to MPLS traffic.

Because the EXP classifier is global, you cannot configure some ports to use a fixed IEEE 802.1p classifier for MPLS traffic on some interfaces and the global EXP classifier for MPLS traffic on other interfaces. When you configure a global EXP classifier, all MPLS traffic on all interfaces uses the EXP classifier, even interfaces that have a fixed classifier.

When you explicitly associate a unicast classifier with a logical interface, you override the default unicast classifier with the explicit unicast classifier.

NOTE: You can apply only one classifier of each type, DSCP and IEEE 802.1p, to a Layer 2 interface. If both types of classifiers are present, DSCP classifiers take precedence over IEEE 802.1p classifiers. (If you also configure a global EXP classifier, only MPLS traffic uses the EXP classifier, and other traffic uses the configured or default classifier for that traffic type.)

Importing a Classifier

You can use any existing classifier, including the default classifiers, as the basis for defining a new classifier. You accomplish this using the **import** statement.

The imported classifier is used as a template and is not modified. The modifications you make become part of a new classifier (and a new template) identified by the name of the new classifier. Whenever you commit a configuration that assigns a new class-name and loss-priority value to a code-point alias or set of bits, it replaces that entry in the new classifier template. As a result, you must explicitly specify every CoS value in every designation that requires modification.

Multidestination Classifiers

Multidestination classifiers are applied to all interfaces and cannot be applied to individual interfaces. You can configure both a DSCP multidestination classifier and an IEEE multidestination classifer. IP and IPv6 traffic use the DSCP classifier, and all other traffic uses the IEEE classifier.

DSCP IPv6 multidestination classifiers are not supported, so IPv6 traffic uses the DSCP multidestination classifier.

The default multidestination classifier is the IEEE 802.1p multidestination classifier.

PFC Priorities

The eight IEEE 802.1p code points correspond to the eight priorities that priority-based flow control (PFC) uses to differentiate traffic classes for lossless transport. When you map a forwarding class (which maps to an output queue) to an IEEE 802.1p CoS value, the IEEE 802.1p CoS value identifies the priority.

Although you can map a priority to any output queue (by mapping the priority to a forwarding class), we recommend that the priority and the unicast forwarding class match in a one-to-one correspondence in which priority 0 is assigned to queue 0, priority 1 is assigned to queue 1, and so on, as shown in Table 450 on page 5338. A one-to-one correspondence of queue and priority numbers makes it easier to configure and maintain the mapping of forwarding classes to priorities and queues.

Table 450: Default IEEE 802.1p Code Point to PFC Priority, Output Queue, and Forwarding Class Mapping

IEEE 802.1p Code Point	PFC Priority	Unicast Output Queue	Forwarding Class and Packet Drop Attribute
000	0	0	best-effort (drop)
001	1	1	best-effort (drop)
010	2	2	best-effort (drop)
011	3	3	fcoe (no-loss)
100	4	4	no-loss (no-loss)
101	5	5	best-effort (drop)
110	6	6	network-control (drop)
111	7	7	network-control (drop)

NOTE: By convention, deployments with converged server access typically use IEEE 802.1p priority 3 (011) for FCoE traffic. The default mapping of the fcoe forwarding class is to queue 3. Apply priority-based flow control (PFC) to the entire FCoE data path to configure the end-to-end lossless behavior that FCoE requires. We recommend that you use priority 3 for FCoE traffic unless your network architecture requires that you use a different priority.

Fixed Classifiers on Ethernet Interfaces

Fixed classifiers map all traffic on an interface to a forwarding class and a loss priority. (As opposed to BA classifiers, which map traffic into multiple different forwarding classes based on the CoS field value in the packet header.) The forwarding class determines the output queue. Incoming traffic of all IEEE 802.1p priorities is classified into the forwarding class specified in the fixed classifier. A scheduler uses the loss priority to control packet discard during periods of congestion by associating different drop profiles with different loss priorities.

You cannot configure a fixed classifier and a DSCP or IEEE 802.1p BA classifier on the same interface. If you configure a fixed classifier on an interface, you cannot configure a DSCP or an IEEE classifier on that interface. If you configure a DSCP classifier, an IEEE classifier, or both classifiers on an interface, you cannot configure a fixed classifier on that interface.

NOTE: Because EXP classifiers are global, you can configure both a global EXP classifier and also apply fixed classifiers on interfaces. When both the global EXP classifier and a fixed classifier are applied to an interface, MPLS traffic uses the EXP classifier and all other traffic uses the fixed classifier.

To switch from a fixed classifier to a BA classifier or to switch from a BA classifier to a fixed classifier, deactivate the existing classifier attachment on the interface, and then attach the new classifier to the interface.

NOTE: If you configure a fixed classifier that classifies all incoming traffic into the **fcoe** forwarding class (or any forwarding class designed to handle FCoE traffic), you must ensure that all traffic that enters the interface is FCoE traffic and is tagged with the FCoE IEEE 802.1p code point (priority).

Fixed Classifiers on Native Fibre Channel Interfaces (NP_Ports)

Applying a fixed classifier to a native Fibre Channel (FC) interface (NP_Port) is a special case. By default, native FC interfaces classify incoming traffic from the FC SAN into the **fcoe** forwarding class and map the traffic to IEEE 802.1p priority 3 (code point 011). When you apply a fixed classifier to an FC interface, you also configure a priority rewrite value for the interface. The FC interface uses the priority rewrite value as the IEEE 802.1p tag value for all incoming packets instead of the default value of 3.

For example, if you specify a priority rewrite value of 5 (code point 101) for an FC interface, the interface tags all incoming traffic from the FC SAN with priority 5 and classifies the traffic into the forwarding class specified in the fixed classifier.

NOTE: The forwarding class specified in the fixed classifier on FC interfaces must be a lossless forwarding class.

Multifield Classifiers

Multifield classifiers examine multiple fields in a packet such as source and destination addresses and source and destination port numbers of the packet. With MF classifiers, you set the forwarding class and loss priority of a packet based on firewall filter rules.

MF classification is normally performed at the network edge because of the general lack of DiffServ code point (DSCP) support in end-user applications. On a switch at the edge of a network, an MF classifier provides the filtering functionality that scans through a variety of packet fields to determine the forwarding class for a packet. Typically, a classifier performs matching operations on the selected fields against a configured value.

Packet Classification for Routed VLAN Interfaces (RVIs)

You cannot apply classifiers directly to routed VLAN interfaces (RVIs) because the members of RVIs are VLANs, not ports. However, you can apply classifiers to the VLAN port members of an RVI. You can also apply MF classifiers to RVIs.

Related Documentation

- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding CoS Packet Flow on page 5319
- Understanding Default CoS Settings on page 5322
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344
- Example: Configuring Unicast Classifiers on page 5495
- Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers on page 5498
- Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 5673
- Configuring a Global MPLS EXP Classifier on page 3782
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Defining CoS Multidestination (Multicast, Broadcast, DLF) BA Classifiers on page 5675

Understanding CoS MPLS EXP Classifiers and Rewrite Rules

You can use class of service (CoS) within MPLS networks to prioritize certain types of traffic during periods of congestion by applying packet classifiers and rewrite rules to the MPLS traffic. (For information about DSCP and IEEE 802.1p classifiers and general information about classifiers, see "Understanding CoS Classifiers" on page 5334. For information about DSCP and IEEE 802.1p rewrite rules, see "Understanding CoS Rewrite Rules" on page 5414.)

When a packet enters a customer-edge interface on the ingress provider edge (PE) switch, the switch associates the packet with a particular CoS servicing level before placing the packet onto the label-switched path (LSP). The switches within the LSP utilize the CoS value set at the ingress PE switch. The CoS value that was embedded in the classifier is translated and encoded in the MPLS header by means of the experimental (EXP) bits.

EXP classifiers map incoming MPLS packets to a forwarding class and a loss priority, and assign MPLS packets to output queues based on the forwarding class mapping. EXP classifiers are behavior aggregate (BA) classifiers.

EXP rewrite rules change (rewrite) the CoS value of the EXP bits in outgoing packets on the egress queues of the switch so that the new (rewritten) value matches the policies of a targeted peer. Policy matching allows the downstream routing platform or switch in a neighboring network to classify each packet into the appropriate service group.

NOTE: There is no default EXP classifier. There is no default EXP rewrite rule. If you want to classify incoming MPLS packets using the EXP bits, you must configure a global EXP classifier. If you want to rewrite the EXP bit value at the egress interface, you must configure EXP rewrite rules and apply them to logical interfaces.

This topic includes:

EXP Classifiers

Unlike DSCP and IEEE 802.1p BA classifiers, EXP classifiers are global to the switch and apply to all switch interfaces. When you configure and apply an EXP classifier, MPLS traffic on all interfaces uses the EXP classifier, even on interfaces that also have a fixed classifier. If an interface has both an EXP classifier and a fixed classifier, the EXP classifier is applied to MPLS traffic and the fixed classifier is applied to all other traffic.

Also unlike DSCP and IEEE 802.1p BA classifiers, there is no default EXP classifier. If you want to classify MPLS traffic based on the EXP bits, you must explicitly configure an EXP classifier and apply it the switch interfaces. Each EXP classifier has eight entries that correspond to the eight EXP CoS values (0 through 7, which correspond to bits 000 through 111).

You can configure as many EXP classifiers as you want. However, the switch uses only one MPLS EXP classifier as a global classifier on all interfaces. After you configure an MPLS EXP classifier, you can configure it as the global EXP classifier by including the EXP classifier in the **[edit class-of-service system-defaults classifiers exp]** hierarchy. All switch interfaces use the global EXP classifier to classify MPLS traffic.

Only one EXP classifier can be configured as the global EXP classifier at any time. If you want to change the global EXP classifier, delete the global EXP classifier configuration (use the **user@switch# delete class-of-service system-defaults classifiers exp** configuration statement), then configure the new global EXP classifier.

If an EXP classifier is not configured, then if a fixed classifier is applied to the interface, the MPLS traffic uses the fixed classifier. If no EXP classifier and no fixed classifier is applied to the interface, MPLS traffic is treated as best-effort traffic. DSCP classifiers are not applied to MPLS traffic.

Because the EXP classifier is global, you cannot configure some ports to use a fixed IEEE 802.1p classifier for MPLS traffic on some interfaces and the global EXP classifier for MPLS traffic on other interfaces. When you configure a global EXP classifier, all MPLS traffic on all interfaces uses the EXP classifier.

NOTE: The switch uses only the outermost label of incoming EXP packets for classification.

NOTE: MPLS packets with 802.1Q tags are not supported.

EXP Rewrite Rules

As MPLS packets enter or exit a network, edge switches might be required to alter the class-of-service (CoS) settings of the packets. EXP rewrite rules set the value of the EXP CoS bits within the header of the outgoing MPLS packet. Each rewrite rule reads the current forwarding class and loss priority associated with the packet, locates the chosen CoS value from a table, and writes that CoS value into the packet header, replacing the old CoS value. EXP rewrite rules apply only to MPLS traffic.

EXP rewrite rules apply only to logical interfaces. You cannot apply EXP rewrite rules to physical interfaces.

There are no default EXP rewrite rules. If you want to rewrite the EXP value in MPLS packets, you must configure EXP rewrite rules and apply them to logical interfaces. If no rewrite rules are applied, all MPLS labels that are pushed have a value of zero (0). The EXP value remains unchanged on MPLS labels that are swapped.

You can configure as many EXP rewrite rules as you want, but you can only apply 16 EXP rewrite rules at any time on the switch. On a given logical interface, all pushed MPLS labels have the same EXP rewrite rule applied to them. You can apply different EXP rewrite rules to different logical interfaces on the same physical interface.

You can apply an EXP rewrite rule to an interface that has a DSCP, DSCP IPv6, or IEEE 802.1p rewrite rule. Only MPLS traffic uses the EXP rewrite rule. MPLS traffic does not use DSCP or DSCP IPv6 rewrite rules.

If the switch is performing penultimate hop popping (PHP), EXP rewrite rules do not take effect. If both an EXP classifier and an EXP rewrite rule are configured on the switch, then the EXP value from the last popped label is copied into the inner label. If either an EXP classifier or an EXP rewrite rule (but not both) is configured on the switch, then the inner label EXP value is sent unchanged.

NOTE: **On each physical interface, either all forwarding classes that are being used on the interface must have rewrite rules configured or no forwarding classes that are being used on the interface can have rewrite rules configured. On any physical port, do not mix forwarding classes with rewrite rules and forwarding classes without rewrite rules.**

Schedulers

The schedulers for using CoS with MPLS are the same as for the other CoS configurations on the QFX Series. Default schedulers are provided only for the best-effort, fcoe, no-loss, and network-control forwarding classes. If you configure a custom forwarding class for MPLS traffic, you need to configure a scheduler to support that forwarding class and provide bandwidth to that forwarding class. See “Understanding CoS Output Queue Schedulers” on page 5371 and “Example: Configuring Queue Schedulers” on page 5511 for more information.

Related Documentation

- Understanding CoS Classifiers on page 5334
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344
- Configuring a Global MPLS EXP Classifier on page 3782
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Configuring CoS Bits for an MPLS Network on page 3781

Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces

At ingress interfaces, classifiers group incoming traffic into classes based on the IEEE 802.1p, DSCP, or MPLS EXP class of service (CoS) code point bits in the packet header. At egress interfaces, you can use rewrite rules to change (re-mark) the code point bits before the interface forwards the packets. At ingress interfaces, classifiers group incoming traffic into classes based on the IEEE 802.1p, DSCP, or MPLS EXP CoS code point bits in the packet header. At egress interfaces, rewrite rules can change (re-mark) the code point bits before the interface forwards the packets.

You can apply classifiers and rewrite rules to interfaces to control the level of CoS applied to each packet as it traverses the system and the network. This topic describes:

Supported Classifier and Rewrite Rule Types

Table 451 on page 5344 shows the types of classifiers and rewrite rules that the QFX Series supports:

Table 451: Supported Classifiers and Rewrite Rules

Classifier or Rewrite Rule Type	Description
Fixed classifier	Classifies all ingress traffic on a physical interface into one fixed forwarding class, regardless of the CoS bits in the packet header.
DSCP and DSCP IPv6 unicast classifiers	Classifies IP and IPv6 traffic into forwarding classes and assigns loss priorities to the traffic.
IEEE 802.1p unicast classifier	Classifies Ethernet traffic into forwarding classes and assigns loss priorities to the traffic.
MPLS EXP classifier	Classifies MPLS traffic into forwarding classes and assigns loss priorities to the traffic. The system uses one global EXP classifier on all switch interfaces.
DSCP multidestination classifier (also used for IPv6 multidestination traffic)	Classifies IP and IPv6 multicast, broadcast, and destination lookup fail (DLF) traffic into multidestination forwarding classes. Multidestination classifiers are applied to all interfaces and cannot be applied to individual interfaces.

Table 451: Supported Classifiers and Rewrite Rules *(continued)*

Classifier or Rewrite Rule Type	Description
IEEE 802.1p multidestination classifier	Classifies Ethernet multicast, broadcast, and destination lookup fail (DLF) traffic into multidestination forwarding classes. Multidestination classifiers are applied to all interfaces and cannot be applied to individual interfaces.
DSCP and DSCP IPv6 rewrite rules	Re-marks the DSCP code points of IP and IPv6 packets before forwarding the packets.
IEEE 802.1p rewrite rule	Re-marks the IEEE 802.1p code points of Ethernet packets before forwarding the packets.
MPLS EXP rewrite rule	Re-marks the EXP code points of MPLS packets before forwarding the packets.

NOTE: On native Fibre Channel (FC) interfaces (NP_Ports) only, you can specify a rewrite value to set the IEEE 802.1p code point of incoming FC traffic when the NP_Port encapsulates the FC packet in Ethernet before forwarding it to the FCoE network (see "Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway" on page 5446).

DSCP, IEEE 802.1p, and MPLS EXP classifiers are behavior aggregate (BA) classifiers. Unlike DSCP and IEEE 802.1p classifiers, EXP classifiers are global and apply to all interfaces. Also unlike DSCP and IEEE 802.1p classifiers, for MPLS traffic only, EXP classifiers overwrite fixed classifiers. (An interface that has a fixed classifier uses the EXP classifier for MPLS traffic, not the fixed classifier.)

Multidestination classifiers are global and apply to all interfaces; you cannot apply a multidestination classifier to individual interfaces.

Classifying packets into forwarding classes assigns packets to the output queues associated with the forwarding classes. Classifying traffic into a forwarding class associates the CoS scheduling for the forwarding class with that traffic.

NOTE: In addition to BA classifiers and fixed classifiers, which classify traffic based on the CoS field in the packet header, you can use firewall filters to configure multifield (MF) classifiers. MF classifiers classify traffic based on more than one field in the packet header and take precedence over BA and fixed classifiers.

Ethernet Interfaces Supported for Classifier and Rewrite Rule Configuration

To apply a classifier to incoming traffic or a rewrite rule to outgoing traffic, you need to apply the classifier or rewrite rule to one or more interfaces. When you apply a classifier or rewrite rule to an interface, the interface uses the classifier to group incoming traffic into forwarding classes and uses the rewrite rule to re-mark the CoS code point value of each packet before it leaves the system.

Not all interfaces types support all types of CoS configuration. This section describes:

Interface Types That Support Classifier and Rewrite Rule Configuration

You can apply classifiers to all Ethernet interfaces. For Layer 3 LAGs, configure BA or fixed classifiers on the LAG (ae) interface. The classifier configured on the LAG is valid on all of the LAG member interfaces.

You can apply fixed classifiers to native FC interfaces (NP_Ports). You cannot apply other types of classifiers or rewrite rules to native FC interfaces. You can rewrite the value of the IEEE 802.1p code point of incoming FC traffic when the interface encapsulates it in Ethernet before forwarding it to the FCoE network as described in "Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway" on page 5446.

Classifier and Rewrite Rule Physical and Logical Ethernet Interface Support

The QFX Series Ethernet ports can function as:

- Layer 2 physical interfaces (family ethernet-switching)
- Layer 2 logical interfaces (family ethernet-switching)
- Layer 3 physical interfaces (family inet/inet6)
- Layer 3 logical interfaces (family inet/inet6)

You can apply CoS classifiers and rewrite rules only to the following interfaces:

- Layer 2 logical interfaces
- Layer 3 physical interfaces if at least one logical Layer 3 interface is configured on the physical interface

NOTE: **The CoS you configure on a Layer 3 physical interface is applied to all of the Layer 3 logical interfaces on that physical interface. This means that each Layer 3 interface uses the same classifiers and rewrite rules for all of the Layer 3 traffic on that interface.**

You cannot apply classifiers or rewrite rules to Layer 2 physical interfaces or to Layer 3 logical interfaces. Table 452 on page 5347 shows on which interfaces you can configure and apply classifiers and rewrite rules.

Table 452: Ethernet Interface Support for Classifier and Rewrite Rule Configuration

CoS Classifiers and Rewrite Rules	Layer 2 Physical Interfaces	Layer 2 Logical Interfaces	Layer 3 Physical Interfaces (If at Least One Logical Layer 3 Interface Is Defined)	Layer 3 Logical Interfaces
Fixed classifier	No	Yes	Yes	No
DSCP classifier	No	Yes	Yes	No
DSCP IPv6 classifier	No	Yes	Yes	No
IEEE 802.1p classifier	No	Yes	Yes	No
EXP classifier	Global classifier, applies to all switch interfaces. Cannot be configured on individual interfaces.			
DSCP rewrite rule	No	Yes	Yes	No
DSCP IPv6 rewrite rule	No	Yes	Yes	No
IEEE 802.1p rewrite rule	No	Yes	Yes	No
EXP rewrite rule	No	Yes	Yes	No

NOTE: IEEE 802.1p mutidestination and DSCP multidestination classifiers are applied to all interfaces and cannot be applied to individual interfaces. No DSCP IPv6 multidestination classifier is supported. IPv6 multidestination traffic uses the DSCP multidestination classifier.

Routed VLAN Interfaces (RVIs) and Integrated Routing and Bridging (IRB) Interfaces

You cannot apply classifiers and rewrite rules directly to routed VLAN interfaces (RVIs) or integrated routing and bridging (IRB) interfaces because the members of RVIs and IRBs are VLANs, not ports. However, you can apply classifiers and rewrite rules to the VLAN port members of an RVI or an IRB. You can also apply MF classifiers to RVIs and IRBs.

Default Classifiers

If you do not explicitly configure classifiers on an Ethernet interface, the QFX Series applies default classifiers (see “Understanding Default CoS Settings” on page 5322) so that the traffic receives basic CoS treatment. The factors that determine the default classifier applied to the interface include the interface type (Layer 2 or Layer 3), the port mode (trunk, tagged-access, or access), and whether logical interfaces have been configured. The system applies a default classifier using the following rules:

- If the physical interface has at least one Layer 3 logical interface configured, it uses the default DSCP classifier.
- If the physical interface has a Layer 2 logical interface in trunk mode or tagged-access mode, it uses the default trusted classifier.
- If the physical interface has a Layer 2 logical interface in access mode, it uses the default untrusted classifier.
- If the physical interface has no logical interface configured, no default classifier is applied.
- The default multidestination classifier is the IEEE 802.1p multidestination classifier.
- There is no default MPLS EXP classifier. If you want to classify traffic using EXP bits, you must configure an EXP classifier and configure it as the global system default EXP classifier.

Default Rewrite Rules

No default rewrite rules are applied to interfaces. If you want to re-mark packets at the egress interface, you must explicitly configure a rewrite rule.

Classifier Precedence

You can apply multiple unicast classifiers (MF, fixed, IEEE 802.1p, DSCP, or EXP) to a physical or logical Ethernet interface to handle different types of traffic. (EXP classifiers are global and apply to all MPLS traffic on all interfaces.) When you apply more than one classifier to an interface, the system uses an order of precedence to determine which classifier to use on physical and logical interfaces:

- Unicast Classifier Precedence on Physical Ethernet Interfaces on page 5348
- Unicast Classifier Precedence on Logical Ethernet Interfaces on page 5349

Unicast Classifier Precedence on Physical Ethernet Interfaces

The precedence of unicast classifiers on physical interfaces, from the highest-priority classifier to the lowest-priority classifier, is:

- MF classifier on a logical interface (no classifier has a higher priority than MF classifiers)
- Fixed classifier on the physical interface
- DSCP or DSCP IPv6 classifier on the physical interface
- IEEE 802.1p classifier on the physical interface

NOTE: If an EXP classifier is configured, MPLS traffic uses the EXP classifier, even if an MF or fixed classifier is applied to the interface. If an EXP classifier is not configured, then if a fixed classifier is applied to the interface, the MPLS traffic uses the fixed classifier. If no EXP classifier and no fixed classifier is applied to the interface, MPLS traffic is treated as best-effort traffic. DSCP classifiers are not applied to MPLS traffic.

You can apply a DSCP classifier, an IEEE 802.1p classifier, and an EXP classifier on a physical interface. When all three classifiers are on an interface, IP traffic uses the DSCP classifier, MPLS traffic uses the EXP classifier, and all other traffic uses the IEEE classifier.

NOTE: You cannot apply a fixed classifier and a DSCP or IEEE classifier to the same interface. If a DSCP classifier, an IEEE classifier, or both are on an interface, you cannot apply a fixed classifier to that interface unless you first delete the DSCP and IEEE classifiers. If a fixed classifier is on an interface, you cannot apply a DSCP classifier or an IEEE classifier unless you first delete the fixed classifier.

Unicast Classifier Precedence on Logical Ethernet Interfaces

The precedence of unicast classifiers on logical interfaces, from the highest priority classifier to the lowest priority classifier, is:

- MF classifier on a logical interface (no classifier has a higher priority than MF classifiers)
- Fixed classifier on the logical interface
- DSCP or DSCP IPv6 classifier on the physical interface
- IEEE 802.1p classifier on the physical interface

NOTE: If an EXP classifier is configured, MPLS traffic uses the EXP classifier, even if a fixed classifier is applied to the interface. If an EXP classifier is not configured, then if a fixed classifier is applied to the interface, the MPLS traffic uses the fixed classifier. If no EXP classifier and no fixed classifier is applied to the interface, MPLS traffic is treated as best-effort traffic.

You can apply both a DSCP classifier and an IEEE 802.1p classifier on a logical interface. When both a DSCP and an IEEE classifier are on an interface, IP traffic uses the DSCP classifier, and all other traffic uses the IEEE classifier. If an MPLS EXP classifier is also applied to the interface, only MPLS traffic uses the EXP classifier.

Classifier Behavior and Limitations

Consider the following behaviors and constraints when you apply classifiers to physical and logical Ethernet interfaces:

- You can configure only one DSCP classifier (IP or IPv6) on a physical interface. You cannot configure both types of DSCP classifier on one physical interface. Both IP and IPv6 traffic use whichever DSCP classifier is configured on the interface.
- When you configure a DSCP or a DSCP IPv6 classifier on a physical interface and the physical interface has at least one logical Layer 3 interface, all packets (IP, IPv6, and non-IP) use that classifier.

- An interface with both a DSCP classifier (IP or IPv6) and an IEEE 802.1p classifier uses the DSCP classifier for IP and IPv6 packets, and uses the IEEE classifier for all other packets.
- Fixed classifiers and BA classifiers (DSCP and IEEE classifiers) are not permitted simultaneously on an interface. If you configure a fixed classifier on an interface, you cannot configure a DSCP or an IEEE classifier on that interface. If you configure a DSCP classifier, an IEEE classifier, or both classifiers on an interface, you cannot configure a fixed classifier on that interface.
- When you configure an IEEE 802.1p classifier on a physical interface and a DSCP classifier is not explicitly configured on that interface, the interface uses the IEEE classifier for all types of packets. No default DSCP classifier is applied to the interface. (In this case, if you want a DSCP classifier on the interface, you must explicitly configure it.)
- The system does not apply a default classifier to a physical interface until you create a logical interface on that physical interface. If you configure a Layer 3 logical interface, the system uses the default DSCP classifier. If you configure a Layer 2 logical interface, the system uses the default IEEE 802.1p trusted classifier if the port is in trunk mode or tagged-access mode, or the default IEEE 802.1p untrusted classifier if the port is in access mode.
- MF classifiers configured on logical interfaces take precedence over BA and fixed classifiers, with the exception of the global EXP classifier, which is always used for MPLS traffic. (Use firewall filters to configure MF classifiers.) When BA or fixed classifiers are present on an interface, you can still configure an MF classifier on that interface.
- There is no default EXP classifier for MPLS traffic.
- You can configure as many EXP classifiers as you want, but the switch uses only one MPLS EXP classifier as a global classifier on all interfaces. After you configure an MPLS EXP classifier, you can configure it as the global EXP classifier by including the EXP classifier in the **[edit class-of-service system-defaults classifiers exp]** hierarchy. All switch interfaces use the EXP classifier specified using this configuration statement to classify MPLS traffic, even on interfaces that have a fixed classifier. No other traffic uses the EXP classifier.

Rewrite Rule Precedence and Behavior

The following rules apply on both physical and logical Ethernet interfaces for rewrite rules:

- If you configure both one DSCP (or DSCP IPv6) rewrite rule and one IEEE 802.1p rewrite rule on an interface, both rewrite rules take effect. Traffic with IP and IPv6 headers use the DSCP rewrite rule, and traffic with a VLAN tag uses the IEEE rewrite rule.
- If you do not explicitly configure a rewrite rule, there is no default rewrite rule, so the system does not apply any rewrite rule to the interface.
- You can apply a DSCP rewrite rule or a DSCP IPv6 rewrite rule to an interface, but you cannot apply both a DSCP and a DSCP IPv6 rewrite rule to the same interface. Both IP and IPv6 packets use the same DSCP rewrite rule, regardless if the configured rewrite rule is DSCP or DSCP IPv6.

- MPLS EXP rewrite rules apply only to logical interfaces. You cannot apply to an EXP rewrite rule to a physical interface. You can configure as many EXP rewrite rules as you want, but you can only use 16 EXP rewrite rules at any time on the switch.
- A logical interface can use both DSCP (or DSCP IPv6) and EXP rewrite rules.
- DSCP and DSCP IPv6 rewrite rules are not applied to MPLS traffic.
- If the switch is performing penultimate hop popping (PHP), EXP rewrite rules do not take effect. If both an EXP classifier and an EXP rewrite rule are configured on the switch, then the EXP value from the last popped label is copied into the inner label. If either an EXP classifier or an EXP rewrite rule (but not both) is configured on the switch, then the inner label EXP value is sent unchanged.

Classifier and Rewrite Rule Configuration Interaction with Ethernet Interface Configuration

You can apply classifiers and rewrite rules only on Layer 2 logical interfaces and Layer 3 physical interfaces (if the Layer 3 physical interface has at least one defined logical interface). This section focuses on BA classifiers, but the interaction between BA classifiers and interfaces described in this section also applies to fixed classifiers and rewrite rules.

NOTE: Multidestination classifiers and EXP classifiers are global and apply to all switch interfaces. See "Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p)" on page 5673 for how to configure multidestination classifiers and see "Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p)" on page 5673 for how to configure EXP classifiers.

There are two components to applying classifiers or rewrite rules to interfaces:

1. Setting the interface family (inet, inet6, or ethernet-switching; ethernet-switching is the default interface family) in the **[edit interfaces]** configuration hierarchy.
2. Applying a classifier or rewrite rule to the interface in the **[edit class-of-service]** hierarchy.

These are separate operations that can be set and committed at different times. Because the type of classifier or rewrite rule you can apply to an interface depends on the interface family configuration, the system performs checks to ensure that the configuration is valid. The method the system uses to notify you of an invalid configuration depends on the **set** operation that causes the invalid configuration.

When applying the classifier or rewrite rule to the interface in the **[edit class-of-service]** hierarchy causes an invalid configuration, the system rejects the configuration and returns a commit check error.

When setting the interface family in the **[edit interfaces]** configuration hierarchy causes an invalid configuration, the system creates a syslog error message. When you receive the error message, you need to remove the classifier or rewrite rule configuration from the logical interface and apply it to the physical interface, or remove the classifier or rewrite rule configuration from the physical interface and apply it to the logical interface.

For classifiers, if you do not take action to correct the error, the system programs the default classifier for the interface family on the interface. (There are no default rewrite rules. If the commit check fails, no rewrite rule is applied to the interface.)

Two scenarios illustrate these situations:

- Scenario 1: Applying a Classifier to an Ethernet Interface Causes a Commit Check Error on page 5352
- Scenario 2: Configuring the Ethernet Interface Family Causes a Syslog Error on page 5352

NOTE: **Both of these scenarios also apply to fixed classifiers and rewrite rules.**

Scenario 1: Applying a Classifier to an Ethernet Interface Causes a Commit Check Error

In Scenario 1, we set the interface family, and then specify an invalid classifier.

1. Set and commit the interface as a Layer 3 (family **inet**) interface:

   ```
   [edit interfaces]
   user@switch# set xe-0/0/20 unit 0 family inet
   user@switch# commit
   ```

   This commit operation succeeds.

2. Set and commit a DSCP classifier on the logical interface (this example uses a DSCP classifier named **dscp1**):

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/20 unit 0 classifiers dscp dscp1
   user@switch# commit
   ```

   This configuration is not valid, because it attempts to apply a classifier to a Layer 3 logical interface. Because the failure is caused by the class-of-service configuration and not by the interface configuration, the system rejects the commit operation and issues a commit error, not a syslog message.

   Note that the commit operation succeeds if you apply the classifier to the physical Layer 3 interface as follows:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/20 classifiers dscp dscp1
   user@switch# commit
   ```

   Because the logical unit is not specified, the classifier is applied to the physical Layer 3 interface in a valid configuration, and the commit check succeeds.

Scenario 2: Configuring the Ethernet Interface Family Causes a Syslog Error

In Scenario 2, we set the classifier first, then set an invalid interface type.

1. Set and commit a DSCP classifier on a Layer 3 logical interface, assuming that the interface has no existing configuration:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/20 unit 0 classifiers dscp dscp1
   user@switch# commit
   ```


This commit succeeds. Because no explicit configuration existed on the interface, it is by default a Layer 2 (**family ethernet-switching**) interface. Layer 2 logical interfaces support BA classifiers, so applying the classifier is a valid configuration.

2. Set and commit the interface as a Layer 3 interface (family **inet**) interface:

```
[edit interfaces]
user@switch# set xe-0/0/20 unit 0 family inet
user@switch# commit
```

This configuration is not valid because it attempts to change an interface from Layer 2 (**family ethernet-switching**) to Layer 3 (**family inet**) when a classifier has already been applied to a logical interface. Layer 3 logical interfaces do not support classifiers. Because the failure is caused by the interface configuration and not by the class-of-service configuration, the system does not issue a commit error, but instead issues a syslog message.

When the system issues the syslog message, it programs the default classifier for the interface type on the interface. In this scenario, the interface has been configured as a Layer 3 interface, so the system applies the default DSCP profile to the physical Layer 3 interface.

In this scenario, to install a configured DSCP classifier, you remove the misconfigured classifier from the Layer 3 logical interface and apply it to the Layer 3 physical interface. For example:

```
[edit]
user@switch# delete class-of-service interfaces xe-0/0/20 unit 0 classifiers dscp dscp1
user@switch# commit
user@switch# set class-of-service interfaces xe-0/0/20 classifiers dscp dscp1
user@switch# commit
```

Related Documentation

- Understanding CoS Packet Flow on page 5319
- Understanding Default CoS Settings on page 5322
- Understanding CoS Classifiers on page 5334
- Understanding Default CoS Scheduling and Classification on page 5360
- Understanding CoS Rewrite Rules on page 5414
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5446
- Example: Configuring Unicast Classifiers on page 5495
- Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers on page 5498
- Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 5673
- Configuring a Global MPLS EXP Classifier on page 3782
- Defining CoS Rewrite Rules on page 5693
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Configuring CoS Fixed Classifier Rewrite Values for Native FC Interfaces (NP_Ports) on page 5698

Understanding CoS Forwarding Classes

Forwarding classes group traffic and assign the traffic to output queues. Each forwarding class is mapped to an output queue. Classification identifies the output queue for each incoming packet by mapping the packet code point bits to forwarding classes. The forwarding class to queue mapping defines the output queue used for the packet.

A classifier must associate each packet with one of the following five default forwarding classes or with a user-configured forwarding class in order to assign an output queue to the packet:

- fcoe—Guaranteed delivery for Fibre Channel over Ethernet (FCoE) traffic.
- no-loss—Guaranteed delivery for TCP lossless traffic.
- best-effort—Provides best-effort delivery without a service profile. Loss priority is typically not carried in a class-of-service (CoS) value.
- network-control—Supports protocol control and is typically high priority.
- mcast—Provides no service profile for multidestination (multicast, broadcast, and destination lookup fail) packets.

The switch supports up to 12 forwarding classes, thus enabling flexible, differentiated, packet classification. For example, you can configure multiple classes of best-effort traffic such as **best-effort**, **best-effort1**, and **best-effort2**.

The switch supports up to 12 output queues: 8 output queues for unicast traffic (queues 0 through 7) and 4 output queues for multidestination traffic (queues 8 through 11). Forwarding classes mapped to unicast queues are associated with unicast traffic, and forwarding classes mapped to multidestination queues are associated with multidestination traffic. You cannot map unicast and multidestination traffic to the same queue. You cannot map a strict-high priority queue to a multidestination forwarding class (queues 8 through 11 do not support strict-high priority configuration).

Default Forwarding Classes

Table 453 on page 5355 shows the four default forwarding classes defined for unicast traffic, and Table 454 on page 5356 shows the four default forwarding classes defined for multicast traffic.

If desired, you can rename the forwarding classes associated with the queues supported on your switch. Assigning a new class name to an output queue does not alter the default classification or scheduling that is applicable to that queue. CoS configurations can be quite complicated, so unless it is required by your scenario, we recommend that you not alter the default class names or queue number associations.

Table 453: Default Forwarding Classes for Unicast Packets

Forwarding Class Name	Default Queue Mapping	Comments
best-effort (be)	0	The software does not apply any special CoS handling to packets with 000000 in the DiffServ field. This is a backward compatibility feature. These packets are usually dropped under congested network conditions. By default, this is a lossy forwarding class with a packet drop attribute of **drop**.
fcoe	3	The software delivers assured bandwidth, low loss, low delay, and low delay variation (jitter) end to end for packets in this service class. The software accepts excess traffic in this class, but in contrast to the assured forwarding class, the out-of-profile expedited-forwarding class packets can be forwarded out of sequence or dropped. NOTE: By convention, deployments with converged server access typically use IEEE 802.1p priority 3 (011) for FCoE traffic. The default mapping of the **fcoe** forwarding class is to queue 3. Apply priority-based flow control (PFC) to the entire FCoE data path to configure the end-to-end lossless behavior that FCoE requires. We recommend that you use priority 3 for FCoE traffic unless your network architecture requires that you use a different priority. By default, this is a lossless forwarding class with a packet drop attribute of **no-loss**.
no-loss	4	The software offers a high level of assurance that the packets are delivered as long as the packet flow from the customer stays within a certain service profile that you define. The software accepts excess traffic, but it applies a tail-drop profile to determine if the excess packets are dropped and not forwarded. Up to two drop probabilities (low and high) are defined for this service class. By default, this is a lossless forwarding class with a packet drop attribute of **no-loss**.
network-control (nc)	7	The software delivers packets in this service class with a high priority. (These packets are not delay-sensitive.) Typically, these packets represent routing protocol hello or keepalive messages. Because loss of these packets jeopardizes proper network operation, packet delay is preferable to packet discard. By default, this is a lossy forwarding class with a packet drop attribute of **drop**.

Table 454: Default Forwarding Classes for Multicast Packets

Forwarding Class Name	Default Queue Mapping	Comments
mcast	8	The software does not apply any special CoS handling to the multidestination packets. These packets are usually dropped under congested network conditions. By default, this is a lossy forwarding class with a packet drop attribute of **drop**.

NOTE: Mirrored traffic is always sent to the queue that corresponds to the multidestination forwarding class. The switched copy of the mirrored traffic is forwarded with the priority determined by the behavior aggregate classification process.

Forwarding Class Configuration Rules

Take the following rules into account when you configure forwarding classes:

- Queue Assignment Rules on page 5356
- Scheduling Rules on page 5356
- Rewrite Rules on page 5357

Queue Assignment Rules

The following rules govern queue assignment:

- CoS configurations that specify more queues than the switch can support are not accepted. The commit operation fails with a detailed message that states the total number of queues available.
- All default CoS configurations are based on queue number. The name of the forwarding class that appears in the default configuration is the forwarding class currently associated with that queue.
- Only unicast forwarding classes can be mapped to unicast queues (0 through 7), and only multidestination forwarding classes can be mapped to multidestination queues (8 through 11).
- Strict-high priority queues cannot be mapped to multidestination forwarding classes. (Strict-high priority traffic cannot be mapped to queues 8 through 11).
- If you map more than one forwarding class to a queue, all of the forwarding classes mapped to the same queue must have the same packet drop attribute (all of the forwarding classes must be lossy, or all of the forwarding classes mapped to a queue must be lossless).

Scheduling Rules

When you define a forwarding class that is used on the switch (the behavior aggregate classifier has a forwarding class and you expect traffic for the forwarding class), you must also define a scheduling policy for the forwarding class. Defining a scheduling policy means:

- Mapping a scheduler to the forwarding class in a scheduler map
- Including the forwarding class in a forwarding class set
- Associating the scheduler map with a traffic control profile
- Attaching the traffic control profile to a forwarding class set and an interface

Rewrite Rules

On each physical interface, either all forwarding classes that are being used on the interface must have rewrite rules configured, or no forwarding classes that are being used on the interface can have rewrite rules configured. On any physical port, do not mix forwarding classes with rewrite rules and forwarding classes without rewrite rules.

Lossless Transport Support

The QFX Series supports up to six lossless forwarding classes. For lossless transport, you must enable PFC on the IEEE 802.1p code point of lossless forwarding classes. The following limitations apply to support lossless transport:

- The external cable length from the QFX3500 or QFabric system Node device to other devices cannot exceed 300 meters.
- The internal cable length from the QFabric system Node device to the QFabric system Interconnect device cannot exceed 150 meters.
- For FCoE traffic, the interface maximum transmission unit (MTU) must be at least 2180 bytes to accommodate the packet payload, headers, and checks.
- Changing any portion of a PFC configuration on a port blocks the entire port until the change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Changing the PFC configuration means any change to a congestion notification profile that is configured on a port (enabling or disabling PFC on a code point, changing the MRU or cable-length value, or specifying an output flow control queue). Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

NOTE: Junos OS Release 12.2 introduces changes to the way the QFX Series handles lossless forwarding classes (the **fcoe** and **no-loss** forwarding classes).

In Junos OS Release 12.1, both explicitly configuring the **fcoe** and **no-loss** forwarding classes, and using the default configuration for these forwarding classes, resulted in the same lossless behavior for traffic mapped to those forwarding classes.

However, in Junos OS Release 12.2, if you explicitly configure the **fcoe** or the **no-loss** forwarding class, that forwarding class is no longer treated as a lossless forwarding class. Traffic mapped to these forwarding classes is treated as lossy (**best-effort**) traffic. This is true even if the explicit configuration is exactly the same as the default configuration.

If your CoS configuration from Junos OS Release 12.1 or earlier includes the explicit configuration of the **fcoe** or the **no-loss** forwarding class, then when you upgrade to Junos OS Release 12.2, those forwarding classes are not lossless. To preserve the lossless treatment of these forwarding classes, delete the explicit **fcoe** and **no-loss** forwarding class configuration before you upgrade to Junos OS Release 12.2.

See "Overview of CoS Changes Introduced in Junos OS Release 12.2" on page 5304 for detailed information about this change and how to delete an existing lossless configuration.

In Junos OS Release 12.3, the default behavior of the **fcoe** and **no-loss** forwarding classes is the same as in Junos OS Release 12.2. However, in Junos OS Release 12.3, you can configure up to six lossless forwarding classes. All explicitly configured lossless forwarding classes must include the new **no-loss** packet drop attribute or the forwarding class is lossy.

Related Documentation

- Overview of CoS Changes Introduced in Junos OS Release 12.2 on page 5304
- Understanding Junos CoS Components on page 5315
- Understanding CoS Packet Flow on page 5319
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Example: Configuring Forwarding Classes on page 5505
- Defining CoS Forwarding Classes on page 5677

Understanding CoS Forwarding Class Sets (Priority Groups)

A forwarding class set is the Junos OS configuration construct that equates to a priority group in enhanced transmission selection (ETS, described in IEEE 802.1Qaz). The switch implements ETS using a two-tier hierarchical scheduler.

A priority group is a group of queues (priorities). Mapping a forwarding class to a queue defines the traffic for that queue, so a priority equates to a queue (forwarding class). The queues in a priority group share the port bandwidth allocated to that priority group. The traffic for queues in one priority group usually share similar traffic-handling requirements.

You can configure up to three unicast forwarding class sets and one multicast forwarding class set. Only unicast forwarding classes can belong to unicast forwarding class sets. Only multicast forwarding classes can belong to the multicast forwarding class set.

If you configure a strict-high priority queue, you must observe the following rules when configuring forwarding class sets:

- You must create a separate forwarding class set for the strict-high priority queue.
- Only one forwarding class set can contain strict-high priority queues.
- Strict-high priority queues cannot belong to the same forwarding class set as queues that are not strict-high priority.
- A strict-high priority queue cannot belong to a multidestination forwarding class set.
- You cannot configure a guaranteed minimum bandwidth (guaranteed rate) for a forwarding class set that includes a strict-high priority queue. (You also cannot configure a guaranteed minimum bandwidth for a strict-high queue.)

You must use hierarchical scheduling to define CoS for output queues. The two-tier hierarchical scheduler defines bandwidth resources for the priority group, and then allocates those resources among the priorities that belong to the priority group.

If you do not explicitly configure forwarding class sets, the system automatically creates a default forwarding class set that contains all of the forwarding classes on the switch. The system assigns 100 percent of the port output bandwidth to the default forwarding class set. Ingress traffic is classified based on the default classifier settings. The forwarding classes (queues) in the default forwarding class set receive bandwidth based on the default scheduler settings. Forwarding classes that are not part of the default scheduler receive no bandwidth. The default priority group is transparent. It does not appear in the configuration and is used for Data Center Bridging Capability Exchange Protocol (DCBX) advertisement.

When you explicitly configure forwarding class sets and map them to an interface, any forwarding class that you do not map to a forwarding class set receives no guaranteed bandwidth on that interface. Forwarding classes that belong to the default forwarding class set might receive bandwidth if the other forwarding class sets are not using all of the port bandwidth. However, the amount of bandwidth forwarding classes that are not in explicitly configured forwarding class sets receive is not guaranteed. The bandwidth for the default forwarding class depends on whether extra port bandwidth is available and therefore is not deterministic.

To guarantee bandwidth for forwarding classes in a predictable manner, be sure to map all forwarding classes that you expect to carry traffic on an interface to a forwarding class set and map the forwarding class set to the interface.

Related Documentation

- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Forwarding Class Sets on page 5508
- Defining CoS Forwarding Class Sets on page 5679

Understanding Default CoS Scheduling and Classification

If you do not configure hierarchical scheduling on an interface, the switch uses the default classifiers for ingress traffic and the default schedulers for egress traffic. Default scheduling and classification handle all traffic types (best-effort, FCoE, no-loss, network-control, and multidestination traffic).

Hierarchical scheduling groups egress queues (priorities, configured as forwarding classes) into priority groups (forwarding class sets). If you use only the default traffic scheduling and classification, the switch automatically creates a default priority group that contains all of the priorities (forwarding classes, which represent output queues) and assigns 100 percent of the port output bandwidth to that priority group. The forwarding classes (queues) in the default forwarding class set receive bandwidth based on the default classifier settings. The default priority group is transparent. It does not appear in the configuration and is used for Data Center Bridging Capability Exchange (DCBX) protocol advertisement.

NOTE: If you explicitly configure one or more priority groups on an interface, any forwarding class that is not assigned to a priority group on that interface receives *no bandwidth*. This means that if you configure hierarchical scheduling on an interface, every forwarding class (priority) that you want to forward traffic on that interface must belong to a forwarding class set (priority group).

The following sections describe:

- Default Classification on page 5360
- Default Scheduling on page 5363
- Default DCBX Advertisement on page 5364
- Default Scheduling and Classification Summary on page 5364

Default Classification

The default classifiers assign unicast and multicast best-effort and network-control ingress traffic to forwarding classes and loss priorities. The QFX Series applies default unicast IEEE 802.1, unicast DSCP, and multidestination classifiers to each interface that does not have explicitly configured classifiers. If you explicitly configure one type of classifier but not other types of classifiers, the system uses only the configured classifier and does not use default classifiers for other types of traffic. There are two different default unicast IEEE 802.1 classifiers, a trusted classifier for ports that are in trunk mode or tagged-access mode, and an untrusted classifier for ports that are in access mode.

Table 455 on page 5361 shows the default mapping of IEEE 802.1 code-point values to unicast forwarding classes and loss priorities for ports in trunk mode or tagged-access mode.

Table 455: Default IEEE 802.1 Unicast Classifiers for Ports in Trunk Mode or Tagged-Access Mode (Trusted Classifier)

Code Point	Forwarding Class	Loss Priority
be (000)	best-effort	low
be1 (001)	best-effort	low
ef (010)	best-effort	low
ef1 (011)	fcoe	low
af11 (100)	no-loss	low
af12 (101)	best-effort	low
nc1 (110)	network-control	low
nc2 (111)	network-control	low

Table 456 on page 5361 shows the default mapping of IEEE 802.1p code-point values to unicast forwarding classes and loss priorities for ports in access mode (all incoming traffic is mapped to best-effort forwarding classes).

Table 456: Default IEEE 802.1 Unicast Classifiers for Ports in Access Mode (Untrusted Classifier)

Code Point	Forwarding Class	Loss Priority
000	best-effort	low
001	best-effort	low
010	best-effort	low
011	best-effort	low
100	best-effort	low
101	best-effort	low

Table 456: Default IEEE 802.1 Unicast Classifiers for Ports in Access Mode (Untrusted Classifier) *(continued)*

Code Point	Forwarding Class	Loss Priority
110	best-effort	low
111	best-effort	low

Table 457 on page 5362 shows the default mapping of IEEE 802.1 code-point values to multidestination (multicast, broadcast, and destination lookup fail traffic) forwarding classes and loss priorities.

Table 457: Default IEEE 802.1 Multidestination Classifiers

Code Point	Forwarding Class	Loss Priority
be (000)	mcast	low
be1 (001)	mcast	low
ef (010)	mcast	low
ef1 (011)	mcast	low
af11 (100)	mcast	low
af12 (101)	mcast	low
nc1 (110)	mcast	low
nc2 (111)	mcast	low

Table 458 on page 5362 shows the default mapping of DSCP code-point values to unicast forwarding classes and loss priorities for DSCP IP and DCSP IPv6.

Table 458: Default DSCP IP and IPv6 Unicast Classifiers

Code Point	Forwarding Class	Loss Priority
ef (101110)	best-effort	low
af11 (001010)	best-effort	low
af12 (001100)	best-effort	low
af13 (001110)	best-effort	low
af21 (010010)	best-effort	low
af22 (010100)	best-effort	low

Table 458: Default DSCP IP and IPv6 Unicast Classifiers *(continued)*

Code Point	Forwarding Class	Loss Priority
af23 (010110)	best-effort	low
af31 (011010)	best-effort	low
af32 (011100)	best-effort	low
af33 (011110)	best-effort	low
af41 (100010)	best-effort	low
af42 (100100)	best-effort	low
af43 (100110)	best-effort	low
be (000000)	best-effort	low
cs1 (001000)	best-effort	low
cs2 (010000)	best-effort	low
cs3 (011000)	best-effort	low
cs4 (100000)	best-effort	low
cs5 (101000)	best-effort	low
nc1 (110000)	network-control	low
nc2 (111000)	network-control	low

NOTE: There are no default DSCP IP or IPv6 multidestination classifiers for multidestination traffic. DSCP IPv6 multidestination classifiers are not supported for multidestination traffic.

Default Scheduling

The default schedulers allocate egress bandwidth resources to unicast and multicast best-effort and network-control egress traffic as shown in Table 459 on page 5363:

Table 459: Default Scheduler Configuration

Default Scheduler and Queue Number	Guaranteed Rate (Minimum Bandwidth)	Shaping Rate (Maximum Bandwidth)	Excess Bandwidth Sharing	Priority	Buffer Size
Best-effort scheduler (queue 0)	5%	None	5%	low	5%

Table 459: Default Scheduler Configuration *(continued)*

Default Scheduler and Queue Number	Guaranteed Rate (Minimum Bandwidth)	Shaping Rate (Maximum Bandwidth)	Excess Bandwidth Sharing	Priority	Buffer Size
FCoE scheduler (queue 3)	35%	None	35%	low	35%
No-loss scheduler (queue 4)	35%	None	35%	low	35%
Network-control scheduler (queue 7)	5%	None	5%	low	5%
Multidestination scheduler (queue 8)	20%	None	20%	low	20%

NOTE: The minimum guaranteed bandwidth rate also determines the amount of excess (extra) bandwidth that the queue can share. Extra bandwidth is allocated to queues in proportion to the minimum guaranteed bandwidth rate of each queue.

Default DCBX Advertisement

When you configure hierarchical scheduling on an interface, DCBX advertises each priority group, the priorities in each priority group, and the bandwidth properties of each priority and priority group.

If you do not configure hierarchical scheduling on an interface, DCBX advertises the automatically created default priority group and its priorities. DCBX also advertises the default bandwidth allocation of the priority group, which is 100 percent of the port bandwidth.

Default Scheduling and Classification Summary

If you do not configure hierarchical scheduling on an interface:

- Default classifiers classify ingress traffic.
- Default schedulers schedule egress traffic.
- DCBX advertises a single default priority group with 100 percent of the port bandwidth allocated to that priority group. All priorities (forwarding classes) are assigned to the default priority group and receive bandwidth based on their default schedulers. The default priority group is generated automatically and is not user-configurable.

Related Documentation

- Understanding CoS Packet Flow on page 5319
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Understanding Default CoS Settings on page 5322
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

- Understanding DCB Features and Requirements on page 4795
- *Understanding Default CoS Scheduling on QFabric System Interconnect Devices (Junos OS Release 13.1 and Later Releases)*
- Example: Configuring Unicast Classifiers on page 5495
- Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers on page 5498
- Example: Configuring Queue Schedulers on page 5511

Understanding CoS Hierarchical Port Scheduling (ETS)

Scheduling defines the class-of-service (CoS) properties of output queues. These properties include the amount of interface bandwidth assigned to the queue, the queue priority, and the drop profiles associated with the queue.

Hierarchical port scheduling is a two-tier process that provides better port bandwidth utilization and greater flexibility to allocate resources to queues and to groups of queues. Hierarchical scheduling includes the Junos OS implementation of enhanced transmission selection (ETS, described in IEEE 802.1Qaz).

The two tiers used in hierarchical scheduling are priorities and priority groups, as shown in Table 460 on page 5366.

Table 460: Hierarchical Scheduling Tiers

Junos OS Configuration Construct	Equivalent ETS Construct	Description
Forwarding class	Priority	Think about priorities (forwarding classes) as output queues. You map forwarding classes to queues, so each forwarding class is in essence an output queue. When you use a classifier to map a forwarding class to an IEEE 802.1p code point, the code point identifies that traffic's priority for priority-based flow control (PFC). Thus the forwarding class, the queue mapped to the forwarding class, and the priority mapped to the forwarding class all identify the same traffic.
Forwarding class set	Priority group	Priority groups (forwarding class sets) are groups of priorities. Forwarding class membership in a forwarding class set defines the priority group to which each priority belongs. You can configure up to three unicast priority groups and one multicast forwarding class set.

NOTE: If you explicitly configure one or more priority groups on an interface, any priority that is not assigned to a priority group on that interface is assigned to an automatically generated default priority group and receives *no bandwidth*. This means that if you configure hierarchical scheduling on an interface, every forwarding class that you want to forward traffic on that interface must belong to a forwarding class set.

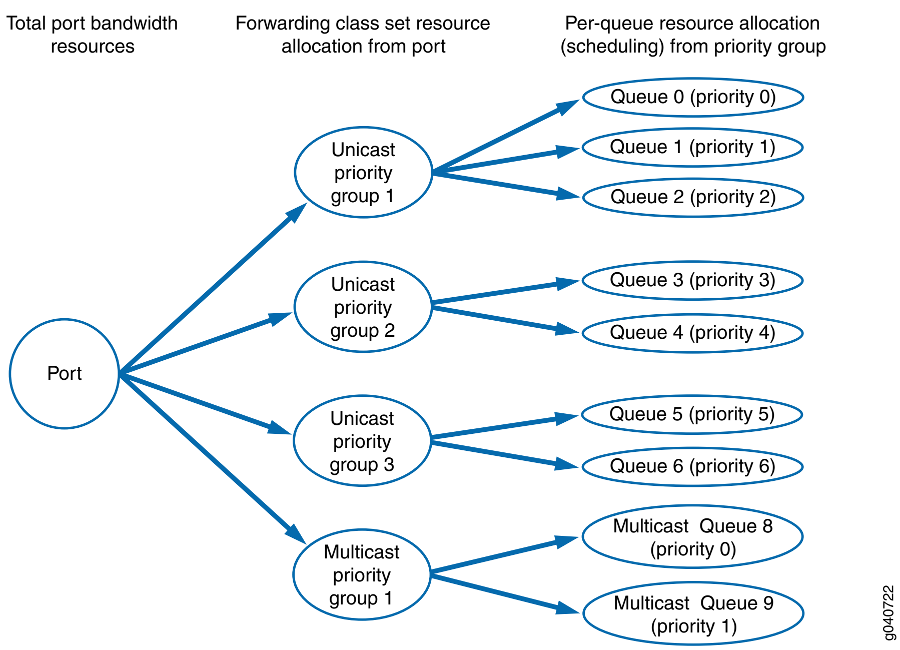
This topic describes:

Hierarchical Scheduling and ETS

Two-tier hierarchical scheduling enables you to manage bandwidth efficiently by enabling you to define the CoS properties for each priority group and for each priority. One tier of the hierarchical scheduler allocates port bandwidth to a priority group. The other tier of the hierarchical scheduler determines the portion of the priority group bandwidth that a queue can use.

The CoS properties you configure for a priority group define the port bandwidth resources available to the queues in that priority group. The CoS properties you configure for each queue specify the portion or percentage of the total bandwidth configured for the priority group that is available to the queue. Figure 193 on page 5367 shows the relationship of port resource allocation to priority groups and priority group resource allocation to queues (priorities).

Figure 193: Hierarchical Scheduling Tiers



If a queue is not using its allocated bandwidth, ETS shares the unused bandwidth among the other queues in the priority group. If link bandwidth is available or if a priority group on a link is not using its allocated bandwidth, ETS shares the unused bandwidth with other priority groups on the link. In this way ETS improves link bandwidth utilization and provides each queue with the maximum bandwidth. Priorities that consist of bursty traffic can share bandwidth during periods of low traffic transmission instead of consuming their entire bandwidth allocation when traffic loads are light.

NOTE: The available link bandwidth is the bandwidth remaining after servicing strict-high priority flows.

ETS Advertisement in DCBX

When you configure hierarchical scheduling on a port, Data Center Bridging Capability Exchange Protocol (DCBX) advertises:

- Each priority group
- The priorities in each priority group
- The bandwidth properties of each priority group and priority

When you configure hierarchical scheduling on a port, any priority that is not part of an explicitly configured priority group is assigned to the automatically generated default priority group and receives no bandwidth. The default priority group is transparent. It does not appear in the configuration.

Hierarchical Scheduling Process

Hierarchical scheduling consists of multiple configuration steps that create the priorities and the priority groups, schedule their resources, and assign them to interfaces. The steps below correspond to the six blocks in the packet flow diagram shown in Figure 194 on page 5369:

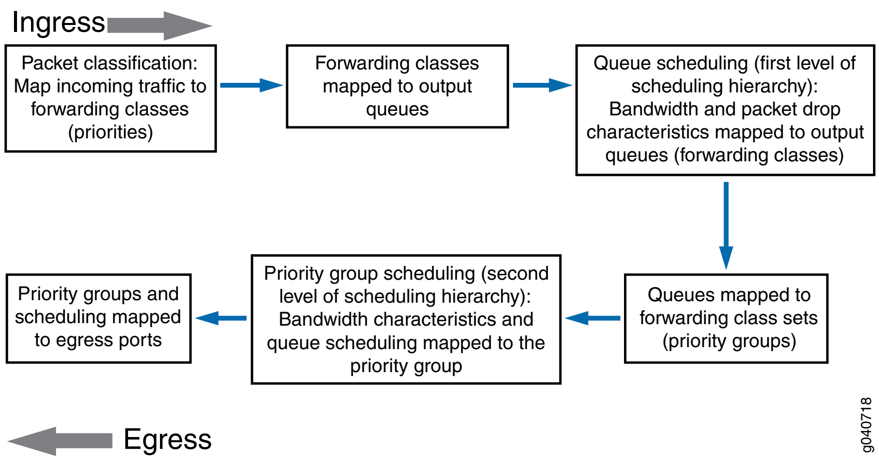
1. Packet classification:
   - Classify incoming traffic into priorities. This consists of either using the default classifiers or configuring classifiers to map IEEE 802.1p code points and loss priorities to the forwarding classes.
   - Apply the classifiers to ingress interfaces. This groups incoming traffic into forwarding classes (priorities) by mapping code points to forwarding classes and loss priorities on the specified interface.
2. Configure the output queues for the forwarding classes (priorities). This consists of either using the default forwarding classes and forwarding-class-to-queue mapping or creating your own forwarding classes and mapping them to queues.
3. Allocate resources to the forwarding classes:
   - Define resources for the priorities. This consists of configuring schedulers to set minimum guaranteed bandwidth, maximum bandwidth, drop profiles for Weighted Random Early Detection (WRED), and bandwidth priority to apply to a forwarding class. Extra bandwidth is shared among queues in proportion to the minimum guaranteed bandwidth of each queue.
   - Map resources to priorities. This consists of mapping forwarding classes to schedulers by using a scheduler map.
4. Configure priority groups. This consists of mapping forwarding classes (priorities) to forwarding class sets (priority groups) to define the priorities that belong to each priority group.
5. Define resources for the priority groups. This consists of configuring traffic control profiles to set minimum guaranteed bandwidth and maximum bandwidth for a priority group. Traffic control profiles also specify a scheduler map, which defines the resources

(schedulers) for the priorities in the priority group. Extra port bandwidth is shared among priority groups in proportion to the minimum guaranteed bandwidth of each priority group.

The traffic control profile bandwidth settings determine the port resources available to the priority group, and the schedulers specified in the scheduler map determine the amount of the priority group resources that each priority receives.

6. Apply the hierarchical scheduling to a port. This consists of attaching one or more priority groups to a port interface. For each priority group, you also attach a traffic control profile. Different priority groups on the same port can use different traffic control profiles.

Figure 194: Hierarchical Scheduling Packet Flow



Strict-High Priority Queues and Hierarchical Scheduling

If you configure a strict-high priority queue, you must observe the following rules:

- You must create a separate forwarding class set (priority group) for the strict-high priority queue.
- Only one forwarding class set can contain strict-high priority queues.
- Strict-high priority queues cannot belong to the same forwarding class set as queues that are not strict-high priority.
- A strict-high priority queue cannot belong to a multidestination forwarding class set.

NOTE: On a QFabric system, if a fabric (fte) interface handles strict-high priority traffic, you must define a separate fc-set (priority group) for strict-high priority traffic. Strict-high priority traffic cannot be mixed with traffic of other priorities in an fc-set. For example, you might choose to create different fc-sets for best effort, lossless, strict-high priority, and multidestination traffic.

Default Hierarchical Scheduling

If you do not explicitly configure hierarchical scheduling, the switch uses the default settings:

- The switch automatically creates a default forwarding class set that contains all of the forwarding classes on the switch. The switch assigns 100 percent of the port output bandwidth to the default forwarding class set. The default forwarding class set is transparent. It does not appear in the configuration and is used for Data Center Bridging Capability Exchange Protocol (DCBX) advertisement.
- Ingress traffic is classified based on the default classifier settings.
- The forwarding classes (queues) in the default forwarding class set receive bandwidth based on the default scheduler settings.

Related Documentation

- Understanding CoS Packet Flow on page 5319
- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Priority Group Scheduling on page 5378
- *Benefits of Configuring CoS Hierarchical Port Scheduling*
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding CoS Classifiers on page 5334
- Understanding Default CoS Scheduling and Classification on page 5360
- *Understanding CoS Scheduling on QFabric System Node Device Fabric (fte) Ports*
- *Understanding Default CoS Scheduling on QFabric System Interconnect Devices (Junos OS Release 13.1 and Later Releases)*
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Minimum Guaranteed Output Bandwidth on page 5521
- Example: Configuring Maximum Output Bandwidth on page 5526

Understanding CoS Output Queue Schedulers

Output queue scheduling defines the class-of-service (CoS) properties of output queues (priorities). Queue scheduling works with priority group scheduling to create a two-tier hierarchical scheduler. The hierarchical scheduler allocates bandwidth to a group of queues (priority group), and queue scheduling determines the portion of the priority group's bandwidth that a particular queue can use.

Scheduler maps associate queue schedulers with forwarding classes (output queues). You can associate each scheduler map with a traffic control profile, and then associate each traffic control profile with a forwarding class set (priority group) and a port interface. In conjunction with the priority group scheduling configured in the traffic control profile, queue scheduling configures the output queues, packet schedulers, and tail-drop processes that operate according to this mapping.

NOTE: When you configure bandwidth for a queue or a priority group, the switch considers only the data as the configured bandwidth. The switch does not account for the bandwidth consumed by the preamble and the interframe gap (IFG). Therefore, when you calculate and configure the bandwidth requirements for a queue or for a priority group, consider the preamble and the IFG as well as the data in the calculations.

Output Queue Scheduling Components

Table 461 on page 5371 provides a quick reference to the scheduler components you can configure to determine the bandwidth properties of output queues, and Table 462 on page 5372 provides a quick reference to some related scheduling configuration components.

Table 461: Output Queue Scheduler Components

Output Queue Scheduler Component	Description
Priority	Sets the scheduling priority applied to the queue.
Shaping rate	Sets the maximum bandwidth the queue can consume.

Table 461: Output Queue Scheduler Components *(continued)*

Output Queue Scheduler Component	Description
Transmit rate	Sets the minimum guaranteed bandwidth for the queue. Extra bandwidth is shared among queues in proportion to the minimum guaranteed bandwidth of each queue.
Drop profile	Sets the probability of dropping packets as the queue fills up.
Loss priority	Sets the traffic loss priority to which a drop profile applies.
Drop profile map	Maps a drop profile to a loss priority.
Buffer size	Sets the size of the queue buffer.

Table 462: Other Scheduling Components

Other Scheduling Components	Description
Scheduler map	Maps schedulers to queues (forwarding classes, also called priorities).
Forwarding class	Maps traffic to a queue (priority).
Traffic control profile	Sets scheduling for the forwarding class set (priority group) and associates a scheduler map with the forwarding class set to apply queue scheduling to the forwarding classes in the forwarding class set. Extra port bandwidth is shared among forwarding class sets in proportion to the minimum guaranteed bandwidth of each forwarding class set.
Forwarding class set	Name of a priority group. You map forwarding classes to priority groups. A forwarding class set consists of one or more forwarding classes.

Default Schedulers

Each forwarding class requires an associated scheduler. The default configuration uses only four forwarding classes, unicast best-effort (queue 0), unicast network-control (queue 3), multicast best-effort (queue 8), and multicast network control (queue 11). You can use the default schedulers or you can define new schedulers for these four forwarding classes. For any other forwarding class, you must explicitly configure a scheduler.

Table 463 on page 5372 shows the default schedulers.

Table 463: Default Schedulers

Default Scheduler and Queue Number	Guaranteed Rate (Minimum Bandwidth)	Shaping Rate (Maximum Bandwidth)	Excess Bandwidth Sharing	Priority	Buffer Size
Best-effort scheduler (queue 0)	5%	None	5%	Low	5%

Table 463: Default Schedulers *(continued)*

Default Scheduler and Queue Number	Guaranteed Rate (Minimum Bandwidth)	Shaping Rate (Maximum Bandwidth)	Excess Bandwidth Sharing	Priority	Buffer Size
FCoE scheduler (queue 3)	35%	None	35%	Low	35%
No-loss scheduler (queue 4)	35%	None	35%	Low	35%
Network-control scheduler (queue 7)	5%	None	5%	Low	5%
Multidestination scheduler (queue 8)	20%	None	20%	Low	20%

NOTE: **The minimum guaranteed bandwidth rate also determines the amount of excess (extra) bandwidth that the queue can share. Extra bandwidth is allocated to queues in proportion to the minimum guaranteed bandwidth rate of each queue.**

There are no resources assigned by default to queues 1, 2, 5, 6, 9, 10, and 11. You can define new unicast forwarding classes to assign to queues 1, 2, 5, and 6, and new multidestination forwarding classes to assign to queues 9, 10, and 11, which do not have default mappings to a forwarding class. You can assign resources to these queues manually using schedulers. In addition, you can change the default forwarding-class-to-queue mappings and the default schedulers.

By default, each queue can exceed the assigned bandwidth if additional bandwidth is available from other queues in the forwarding class set. When a forwarding class does not fully use the allocated minimum transmission bandwidth (transmit rate), other forwarding classes in the forwarding class set can use the remaining bandwidth if those forwarding classes receive more traffic than their allocated bandwidth.

Transmit Rate (Minimum Guaranteed Bandwidth)

The transmit rate determines the minimum guaranteed bandwidth for each forwarding class. It also determines how much excess (extra) bandwidth each low-priority queue can share; each queue shares extra bandwidth in proportion to its transmit rate. You specify the rate in bits per second as a fixed value such as 1 Mbps or as a percentage of the total forwarding class set minimum guaranteed bandwidth (the guaranteed rate set in the traffic control profile). Either the default scheduler or a scheduler you configure allocates a portion of the outgoing interface bandwidth to each forwarding class.

NOTE: For transmit rates below 1 Gbps, we recommend that you configure the transmit rate as a percentage instead of as a fixed rate. This is because the system converts fixed rates into percentages and may round small fixed rates to a lower percentage. For example, a fixed rate of 350 Mbps is rounded down to 3 percent instead of 3.5 percent.

You cannot configure a transmit rate for strict-high priority queues. Queues (forwarding classes) with a configured transmit rate cannot be included in a forwarding class set that has strict-high priority queues.

The allocated bandwidth can exceed the configured minimum rate if additional bandwidth is available from other queues in the forwarding class set. In case of congestion, the configured transmit rate is guaranteed for the queue. This property enables you to ensure that each queue receives the amount of bandwidth appropriate to its level of service.

NOTE: Configuring the minimum guaranteed bandwidth (transmit rate) for a forwarding class does not work unless you also configure the minimum guaranteed bandwidth (guaranteed rate) for the forwarding class set in the traffic control profile.

Additionally, the sum of the transmit rates of the queues in a forwarding class set should not exceed the guaranteed rate for the forwarding class set. (You cannot guarantee a minimum bandwidth for the queues that is greater than the minimum bandwidth guaranteed for the entire set of queues.)

Sharing Extra Bandwidth

Extra bandwidth is available to low-priority queues when the minimum guaranteed bandwidth of the queues does not use the full amount of forwarding class set bandwidth. This extra bandwidth is shared among the forwarding classes in the set based on the minimum guaranteed bandwidth of each queue.

For example, in a forwarding class set, Queue A has a transmit rate of 1 Gbps, Queue B has a transmit rate of 1 Gbps, and Queue C has a transmit rate of 2 Gbps. After servicing the minimum guaranteed bandwidth of these queues, the forwarding class set has an extra 2 Gbps of bandwidth available, and all three queues still have packets to forward. The queues receive the extra bandwidth in proportion to their transmit rates, so Queue A receives an extra 500 Mbps, Queue B receives an extra 500 Mbps, and Queue C receives an extra 1 Gbps.

Shaping Rate (Maximum Bandwidth)

The shaping rate determines the maximum bandwidth each forwarding class can consume. You specify the rate in bits per second as a fixed value such as 3 Mbps or as a percentage of the total forwarding class set maximum bandwidth (the shaping rate set in the traffic control profile).

The maximum bandwidth for a queue depends on the total bandwidth available to the forwarding class set to which the queue belongs and how much bandwidth the other queues in the forwarding class set consume.

NOTE: **In QFabric systems, if any queue that contains outgoing packets does not transmit packets for 12 consecutive seconds, the port automatically resets. A strict-high priority queue (or several queues with higher priorities than the starved queue) can consume all of the port bandwidth and prevent another queue from transmitting packets. To prevent a queue from being starved for bandwidth, you can configure a shaping rate on the queue or queues to prevent them from consuming all of the port bandwidth.**

Scheduling Priority

Scheduling priority determines the order in which an output interface transmits traffic from the queues, thus ensuring that queues containing important traffic receive better access to the outgoing interface. The priority setting in the scheduler determines the priority for the queue.

Two levels of scheduling priority are supported:

- Low—Low-priority queues transmit traffic based on the weighted round robin (WRR) algorithm. The scheduler first determines if an individual queue is within its defined bandwidth profile. The scheduler then regularly reevaluates whether each individual queue is within its defined bandwidth profile and compares the amount of data the queue transmits to the amount of bandwidth the scheduler allocates to the queue. When the transmitted amount is less than the allocated amount, the queue is considered to be in profile. A queue is out of profile when its transmitted amount is larger than its allocated amount. Out of profile queue data is transmitted only if bandwidth is available. Otherwise, it is buffered if buffer space is available. If no buffer space is available, the traffic may be dropped.
- Strict-high—You can configure only one queue as **strict-high** priority. The other 11 queues are **low** priority.

  The **strict-high** priority queue receives preferential treatment over the low-priority queues. The **strict-high** priority queue receives all of its configured bandwidth before low-priority queues are serviced. Low-priority queues do not transmit traffic until the strict-high priority queue is empty. Carefully consider how much bandwidth you want to allocate to the **strict-high** priority queue to avoid starving the low-priority queues.

  If you configure a strict-high priority queue, you must observe the following rules:

  - You must create a separate forwarding class set (priority group) for the strict-high priority queue.
  - Only one forwarding class set can contain strict-high priority queues.
  - Strict-high priority queues cannot belong to the same forwarding class set as queues that are not strict-high priority.

- A strict-high priority queue cannot belong to a multidestination forwarding class set.
- You cannot configure a minimum guaranteed bandwidth for a strict-high priority queue. (You cannot configure a transmit rate for a strict-high priority queue scheduler, and you cannot configure a guaranteed rate for a forwarding class set that has a strict-high priority queue.)

Junos OS performs priority queueing using the following steps:

1. Services the strict-high priority queue before any other queues are served
2. Services the minimum bandwidth (transmit rate) of low-priority queues until the minimum is met or the queues are empty
3. Services all other low-priority queues and needs that exceed the minimum bandwidth

Scheduler Drop-Profile Maps

Drop-profile maps associate drop profiles with a scheduler. A drop-profile map sets the drop profile for a specific packet loss priority (PLP) and protocol type:

- PLP—Low, medium-high, high. You configure the PLP during classifier configuration. When you use a scheduler map to associate a forwarding class with a scheduler, you can use a drop-profile map to map different drop profiles to the forwarding class for different PLPs.
- Protocol type—Drop profiles match all protocol types.

Buffer Size

Most of the total system buffer space is divided into two buffer pools, shared buffers and dedicated buffers. Shared buffers are a global pool that the ports share dynamically as needed. Dedicated buffers are a reserved portion of the buffer pool that is distributed evenly to all of the ports. Each port receives an equal allocation of dedicated buffer space. The dedicated buffer allocation to ports is not configurable because it is reserved for the ports.

The queue buffers are allocated from the dedicated buffer pool assigned to the port. By default, ports divide their allocation of dedicated buffers among the egress queues in the same proportion as the default scheduler sets the minimum guaranteed transmission rates (**transmit-rate**) for traffic. Only the queues included in the default scheduler receive dedicated buffers.

If you do not use the default configuration, you can explicitly configure the queue buffer size in either of two ways:

- As a percentage—The queue receives the specified percentage of dedicated port buffers when the queue is mapped to the scheduler and the scheduler is mapped to a port.
- As a remainder—After the port services the queues that have an explicit percentage buffer size configuration, the remaining port dedicated buffer space is divided equally among the other queues to which a scheduler is attached. (No default or explicit

scheduler means no dedicated buffer allocation for the queue.) If you configure a scheduler and you do not specify a buffer size as a percentage, *remainder* is the default setting.

NOTE: **The total of all of the explicitly configured buffer size percentages for all of the queues on a port cannot exceed 100 percent.**

For a complete discussion about queue buffer configuration in the context of ingress and egress port buffer configuration, see "Understanding CoS Buffer Configuration" on page 5391.

Scheduler Maps

A scheduler map associates a specified forwarding class with a scheduler configuration. After configuring a scheduler, you must include it in a scheduler map, associate the scheduler map with a traffic control profile, and then associate the traffic control profile with an interface and a forwarding class set.

You can associate up to four user-defined scheduler maps with traffic control profiles.

Related Documentation

- Understanding Junos CoS Components on page 5315
- Understanding CoS Priority Group Scheduling on page 5378
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Understanding CoS Buffer Configuration on page 5391
- Understanding CoS Scheduling Behavior and Configuration Considerations on page 5387
- *Understanding CoS Scheduling on QFabric System Node Device Fabric (fte) Ports*
- *Understanding Default CoS Scheduling on QFabric System Interconnect Devices (Junos OS Release 13.1 and Later Releases)*
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Minimum Guaranteed Output Bandwidth on page 5521
- Example: Configuring Maximum Output Bandwidth on page 5526
- Example: Configuring Queue Scheduling Priority on page 5516
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Tail-Drop Profiles on page 5501
- Example: Configuring Drop Profile Maps on page 5503

Understanding CoS Priority Group Scheduling

Priority group scheduling defines the class-of-service (CoS) properties of a group of output queues (priorities). Priority group scheduling works with output queue scheduling to create a two-tier hierarchical scheduler. The hierarchical scheduler allocates bandwidth to a group of queues (a priority group, called a forwarding class set in Junos OS configuration). Queue scheduling determines the portion of the priority group bandwidth that the particular queue can use.

You configure priority group scheduling in a traffic control profile and then associate the traffic control profile with a forwarding class set and an interface. You attach a scheduler map to the traffic control profile to specify the queue scheduling characteristics.

NOTE: When you configure bandwidth for a queue or a priority group, the switch considers only the data as the configured bandwidth. The switch does not account for the bandwidth consumed by the preamble and the interframe gap (IFG). Therefore, when you calculate and configure the bandwidth requirements for a queue or for a priority group, consider the preamble and the IFG as well as the data in the calculations.

Priority Group Scheduling Components

Table 464 on page 5378 provides a quick reference to the traffic control profile components you can configure to determine the bandwidth properties of priority groups, and Table 465 on page 5379 provides a quick reference to some related scheduling configuration components.

Table 464: Priority Group Scheduler Components

Traffic Control Profile Component	Description
Guaranteed rate	Sets the minimum guaranteed port bandwidth for the priority group. Extra port bandwidth is shared among priority groups in proportion to the guaranteed rate of each priority group on the port.
Shaping rate	Sets the maximum port bandwidth the priority group can consume.
Scheduler map	Maps schedulers to queues (forwarding classes, also called priorities). This determines the portion of the priority group bandwidth that a queue receives.

Table 465: Other Scheduling Components

Other Scheduling Components	Description
Forwarding class	Maps traffic to a queue (priority).
Forwarding class set	Name of a priority group. You map forwarding classes to priority groups. A forwarding class set consists of one or more forwarding classes.
Scheduler	Sets the bandwidth and scheduling priority of individual queues (forwarding classes).

Default Traffic Control Profile

There is no default traffic control profile.

Guaranteed Rate (Minimum Guaranteed Bandwidth)

The guaranteed rate determines the minimum guaranteed bandwidth for each priority group. It also determines how much excess (extra) port bandwidth the priority group can share; each priority group shares extra port bandwidth in proportion to its guaranteed rate. You specify the rate in bits per second as a fixed value such as 3 Mbps or as a percentage of the total port bandwidth.

The minimum transmission bandwidth can exceed the configured rate if additional bandwidth is available from other priority groups on the port. In case of congestion, the configured guaranteed rate is guaranteed for the priority group. This property enables you to ensure that each priority group receives the amount of bandwidth appropriate to its level of service.

NOTE: Configuring the minimum guaranteed bandwidth (transmit rate) for a forwarding class does not work unless you also configure the minimum guaranteed bandwidth (guaranteed rate) for the forwarding class set in the traffic control profile.

Additionally, the sum of the transmit rates of the queues in a forwarding class set should not exceed the guaranteed rate for the forwarding class set. (You cannot guarantee a minimum bandwidth for the queues that is greater than the minimum bandwidth guaranteed for the entire set of queues.)

You cannot configure a guaranteed rate for forwarding class sets that include strict-high priority queues.

Sharing Extra Bandwidth

Extra bandwidth is available to priority groups when the priority groups do not use the full amount of available port bandwidth. This extra port bandwidth is shared among the priority groups based on the minimum guaranteed bandwidth of each priority group.

For example, Port A has three priority groups: fc-set-1, fc-set-2, and fc-set-3. Fc-set-1 has a guaranteed rate of 2 Gbps, fc-set-2 has a guaranteed rate of 2 Gbps, and fc-set-3 has a guaranteed rate of 4 Gbps. After servicing the minimum guaranteed bandwidth of these priority groups, the port has an extra 2 Gbps of available bandwidth, and all three priority groups have still have packets to forward. The priority groups receive the extra bandwidth in proportion to their guaranteed rates, so fc-set-1 receives an extra 500 Mbps, fc-set-2 receives an extra 500 Mbps, and fc-set-3 receives an extra 1 Gbps.

Shaping Rate (Maximum Bandwidth)

The shaping rate determines the maximum bandwidth the priority group can consume. You specify the rate in bits per second as a fixed value such as 5 Mbps or as a percentage of the total port bandwidth.

The maximum bandwidth for a priority group depends on the total bandwidth available on the port and how much bandwidth the other priority groups on the port consume.

Scheduler Maps

A scheduler map maps schedulers to queues. When you associate a scheduler map with a traffic control profile, then associate the traffic control profile with an interface and a forwarding class set, the scheduling defined by the scheduler map determines the portion of the priority group resources that each individual queue can use.

You can associate up to four user-defined scheduler maps with traffic control profiles.

Related Documentation

- Understanding Junos CoS Components on page 5315
- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Understanding CoS Scheduling Behavior and Configuration Considerations on page 5387
- *Understanding CoS Scheduling on QFabric System Node Device Fabric (fte) Ports*
- *Understanding Default CoS Scheduling on QFabric System Interconnect Devices (Junos OS Release 13.1 and Later Releases)*
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Minimum Guaranteed Output Bandwidth on page 5521
- Example: Configuring Maximum Output Bandwidth on page 5526
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Tail-Drop Profiles on page 5501
- Example: Configuring Drop Profile Maps on page 5503

Understanding CoS Traffic Control Profiles

A traffic control profile defines the output bandwidth and scheduling characteristics of forwarding class sets (priority groups). The forwarding classes (queues) mapped to a forwarding class set share the bandwidth that you assign to the forwarding class set in the traffic control profile.

This two-tier hierarchical scheduling architecture provides flexibility in allocating resources among queues and:

- Assigns a portion of port bandwidth to a priority group. You define the port resources for the priority group in a traffic control profile.
- Allocates priority group bandwidth among the queues that belong to the priority group. A scheduler map attached to the traffic control profile defines the amount of the priority group's resources that each queue can use.

Attaching a priority group and traffic control profile to a port defines the hierarchical scheduling properties of the group and the queues that belong to the group.

The ability to create priority groups supports enhanced transmission selection (ETS, described in IEEE 802.1Qaz). When a priority group does not use its allocated port bandwidth, ETS shares the excess port bandwidth among other priority groups on the port in proportion to their guaranteed minimum bandwidth (guaranteed rate). This utilizes the port bandwidth better than scheduling schemes that require setting strict priorities that reserve bandwidth for all groups whether it is needed or not. ETS allows traffic groups that need extra bandwidth to use it if the bandwidth is available, while preserving the ability to specify the minimum guaranteed bandwidth for traffic groups.

Traffic control profiles define the following CoS properties for priority groups:

- Minimum guaranteed bandwidth—Also known as the committed information rate (CIR). This is the minimum amount of port bandwidth the priority group receives. Priorities in the priority group receive their minimum guaranteed bandwidth as a portion of the priority group's minimum guaranteed bandwidth. The **guaranteed-rate** statement defines the minimum guaranteed bandwidth.

  NOTE: **You cannot apply a traffic control profile with a minimum guaranteed bandwidth to a priority group that includes strict-high priority queues.**

- Shared excess (extra) bandwidth—When the priority groups on a port do not consume the full amount of bandwidth allocated to them or there is unallocated link bandwidth available, priority groups can contend for that extra bandwidth if they need it. Priorities in the priority group contend for extra bandwidth as a portion of the priority group's extra bandwidth. The amount of extra bandwidth for which a priority group can contend is proportional to the priority group's guaranteed minimum bandwidth (guaranteed rate).

- Maximum bandwidth—Also known as peak information rate (PIR). This is the maximum amount of port bandwidth the priority group receives. Priorities in the priority group receive their maximum bandwidth as a portion of the priority group's maximum bandwidth. The **shaping-rate** statement defines the maximum bandwidth.
- Queue scheduling—Each traffic control profile includes a scheduler map. The scheduler map maps priorities (forwarding classes) to schedulers to define the scheduling characteristics of the individual priorities in the priority group. The resources scheduled for each priority represent portions of the resources that the traffic control profile schedules for the entire priority group, not portions of the total link bandwidth. The **scheduler-maps** statement defines the mapping of forwarding classes to schedulers.

Related Documentation

- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Defining CoS Traffic Control Profiles (Priority Group Scheduling) on page 5684

Understanding CoS Priority Group and Queue Guaranteed Rates (Minimum Bandwidth)

You can set a guaranteed minimum bandwidth for individual forwarding classes (queues) and for groups of forwarding classes called forwarding class sets (priority groups). Setting a minimum guaranteed bandwidth ensures that priority groups and queues receive the bandwidth required to support the expected traffic.

This topic covers:

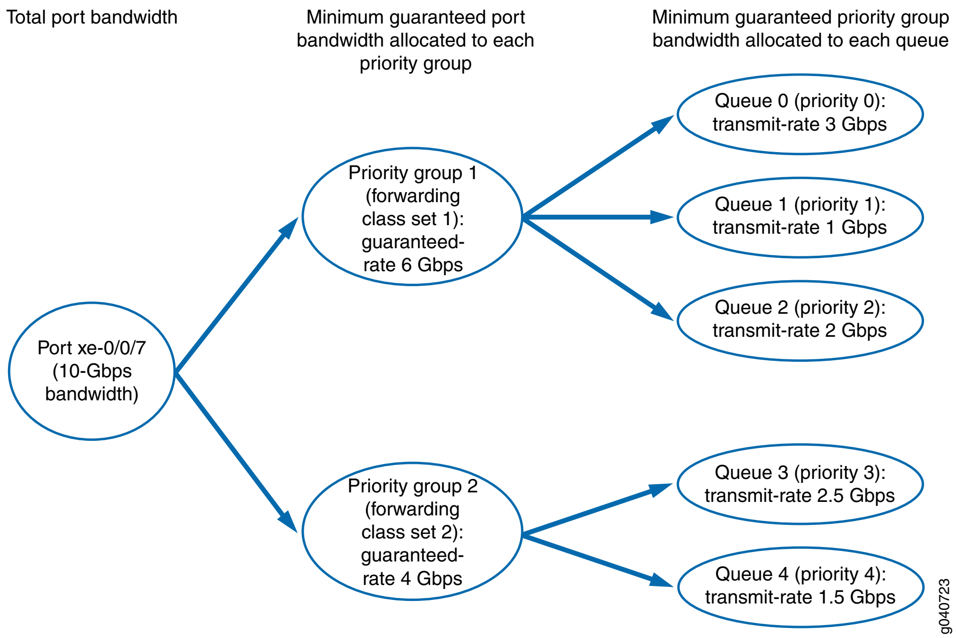
Guaranteeing Bandwidth Using Hierarchical Scheduling

The **guaranteed-rate** value for the priority group defines the minimum amount of bandwidth allocated to a forwarding class set on a port, whereas the **transmit-rate** value of the queue defines the minimum amount of bandwidth allocated to a particular queue in a priority group. The queue bandwidth is a portion of the priority group bandwidth.

NOTE: You cannot configure a minimum guaranteed bandwidth (transmit rate) for a forwarding class that is mapped to a strict-high priority queue, and you cannot configure a minimum guaranteed bandwidth (guaranteed rate) for a priority group that includes strict-high priority queues.

Figure 195 on page 5383 shows how the total port bandwidth is allocated to priority groups (forwarding class sets) based on the guaranteed rate of each priority group. It also shows how the guaranteed bandwidth of each priority group is allocated to the queues in the priority group based on the transmit rate of each queue.

Figure 195: Allocating Guaranteed Bandwidth Using Hierarchical Scheduling



The sum of the priority group guaranteed rates cannot exceed the total port bandwidth. If you configure guaranteed rates whose sum exceeds the port bandwidth, the system sends a syslog message to notify you that the configuration is not valid. However, the system does not perform a commit check. If you commit a configuration in which the sum of the guaranteed rates exceeds the port bandwidth, the hierarchical scheduler behaves unpredictably.

The sum of the queue transmit rates cannot exceed the total guaranteed rate of the priority group to which the queues belong. If you configure transmit rates whose sum exceeds the priority group guaranteed rate, the commit check fails and the system rejects the configuration.

NOTE: You must set both the priority group **guaranteed-rate** value and the queue **transmit-rate** value in order to configure the minimum bandwidth for individual queues. If you set the **transmit-rate** value but do not set the **guaranteed-rate** value, the configuration fails.

You can set the **guaranteed-rate** value for a priority group without setting the **transmit-rate** value for individual queues in the priority group. However, queues that do not have a configured **transmit-rate** value can become starved for bandwidth if other higher-priority queues need the priority group's bandwidth. To avoid starving a queue, it is a good practice to configure a **transmit-rate** value for most queues.

If you configure the guaranteed rate of a priority group as a percentage, configure all of the transmit rates associated with that priority group as percentages. In this case, if any of the transmit rates are configured as absolute values instead of percentages, the configuration is not valid and the system sends a syslog message.

Priority Group Guaranteed Rate (Minimum Bandwidth)

Setting a priority group **guaranteed-rate** enables you to reserve a portion of the port bandwidth for the forwarding classes (queues) in that forwarding class set. The minimum bandwidth (**guaranteed-rate**) that you configure for a priority group sets the minimum bandwidth available to all of the forwarding classes in the forwarding class set.

The combined **guaranteed-rate** value of all of the forwarding class sets associated with an interface cannot exceed the amount of bandwidth available on that interface.

You configure the priority group **guaranteed-rate** in the traffic control profile. You cannot apply a traffic control profile that has a guaranteed rate to a priority group that includes strict-high priority queues.

Queue Transmit Rate (Minimum Bandwidth)

Setting a queue **transmit-rate** enables you to reserve a portion of the priority group bandwidth for the individual queue. For example, a queue that handles Fibre Channel over Ethernet (FCoE) traffic might require a minimum rate of 4 Gbps to ensure the class of service that storage area network (SAN) traffic requires.

The priority group **guaranteed-rate** sets the aggregate minimum amount of bandwidth available to the queues that belong to the priority group. The cumulative total minimum bandwidth the queues consume cannot exceed the minimum bandwidth allocated to the priority group to which they belong. (The combined transmit rates of the queues in a priority group cannot exceed the priority group's guaranteed rate.)

You must configure the **guaranteed-rate** value of the priority group in order to set a **transmit-rate** value for individual queues that belong to the priority group. The reason is that if there is no guaranteed bandwidth for a priority group, there is no way to guarantee bandwidth for queues in that priority group.

You configure the queue **transmit-rate** in the scheduler configuration. You cannot configure a transmit rate for strict-high priority queues.

Related Documentation

- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Traffic Control Profiles on page 5381
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Defining CoS Queue Schedulers on page 5679
- Defining CoS Traffic Control Profiles (Priority Group Scheduling) on page 5684

Understanding CoS Priority Group Shaping and Queue Shaping (Maximum Bandwidth)

If the amount of traffic on an interface exceeds the maximum bandwidth of the interface, it leads to congestion. You can use priority group (forwarding class set) shaping and queue shaping to manage the excess traffic and avoid congestion.

The maximum bandwidth sets the most bandwidth a priority group or a queue can use after all of the priority group and queue minimum bandwidth requirements are met, even if more bandwidth is available.

This topic covers:

- Priority Group Shaping on page 5385
- Queue Shaping on page 5385
- Shaping Maximum Bandwidth Using Hierarchical Scheduling on page 5386

Priority Group Shaping

Priority group shaping enables you to shape the aggregate traffic of a forwarding class set on a port to a maximum rate that is less than the line or port rate. The maximum bandwidth (**shaping-rate**) that you configure for a priority group sets the maximum bandwidth available to all of the forwarding classes (queues) in the forwarding class set.

If a port has more than one priority group and the combined **shaping-rate** value of the priority groups is greater than the amount of port bandwidth available, the bandwidth is shared proportionally among the priority groups.

You configure the priority group **shaping-rate** in the traffic control profile.

Queue Shaping

Queue shaping throttles the rate at which queues transmit packets. For example, using queue shaping, you can rate-limit a strict-high priority queue so that the strict-priority queue does not lock out (or starve) low-priority queues. Similarly, for any queue, you can configure queue shaping (**shaping-rate**) to set the maximum bandwidth for a particular queue.

The **shaping-rate** value of the priority group sets the aggregate maximum amount of bandwidth available to the queues that belong to the priority group. The cumulative total bandwidth the queues consume cannot exceed the maximum bandwidth of the priority group to which they belong on a port.

If a priority group has more than queue and the combined **shaping-rate** value of the queues is greater than the amount of bandwidth available to the priority group, the bandwidth is shared proportionally among the queues.

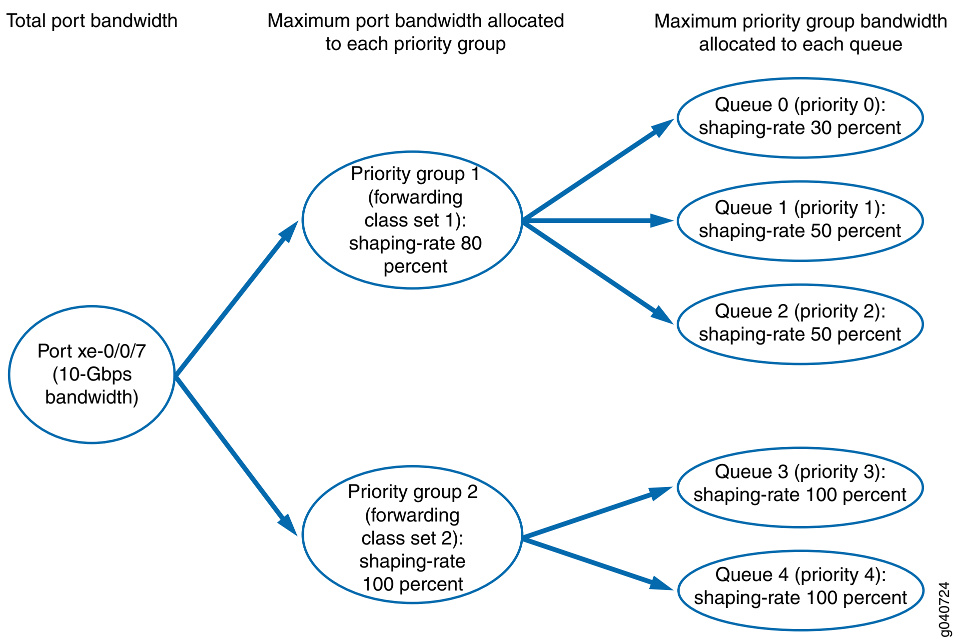
You configure the queue **shaping-rate** in the scheduler configuration.

Shaping Maximum Bandwidth Using Hierarchical Scheduling

Priority group shaping defines the maximum bandwidth allocated to a forwarding class set on a port, whereas queue shaping defines a limit on maximum bandwidth usage per queue. The queue bandwidth is a portion of the priority group bandwidth.

Figure 196 on page 5386 shows how the port bandwidth is allocated to priority groups (forwarding class sets) based on the shaping rate of each priority group, and how the bandwidth of each priority group is allocated to the queues in the priority group based on the shaping rate of each queue.

Figure 196: Setting Maximum Bandwidth Using Hierarchical Scheduling



Related Documentation

- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Traffic Control Profiles on page 5381
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519

- Defining CoS Queue Schedulers on page 5679
- Defining CoS Traffic Control Profiles (Priority Group Scheduling) on page 5684

Understanding CoS Scheduling Behavior and Configuration Considerations

Many factors affect scheduling configuration and bandwidth requirements, including:

- When you configure bandwidth for a queue or a priority group, the switch considers only the data as the configured bandwidth. The switch does not account for the bandwidth consumed by the preamble and the interframe gap (IFG). Therefore, when you calculate and configure the bandwidth requirements for a queue or for a priority group, consider the preamble and the IFG as well as the data in the calculations.
- When you define a forwarding class that will be used on the switch (the behavior aggregate classifier has a forwarding class and you expect traffic for the forwarding class), you must also define a scheduling policy for the forwarding class. Defining a scheduling policy means:
  - Mapping a scheduler to the forwarding class in a scheduler map
  - Including the forwarding class in a forwarding class set
  - Associating the scheduler map with a traffic control profile
  - Attaching the traffic control profile to a forwarding class set and an interface
- On each physical interface, either all forwarding classes that are being used on the interface must have rewrite rules configured, or no forwarding classes that are being used on the interface can have rewrite rules configured. On any physical port, do not mix forwarding classes with rewrite rules and forwarding classes without rewrite rules.
- For packets that carry both an inner VLAN tag and an outer VLAN tag, the rewrite rule rewrites only the outer VLAN tag.
- Configuring the minimum guaranteed bandwidth (**transmit-rate**) for a queue (forwarding class) does not work unless you also configure the minimum guaranteed bandwidth (**guaranteed-rate**) for the priority group (forwarding class set) in the traffic control profile.

  Additionally, the sum of the transmit rates of the queues in a forwarding class set should not exceed the guaranteed rate for the forwarding class set. (You cannot guarantee a minimum bandwidth for the queues that is greater than the minimum bandwidth guaranteed for the entire set of queues.) If you configure transmit rates whose sum exceeds the guaranteed rate of the forwarding class set, the commit check fails and the system rejects the configuration.
- The sum of the priority group guaranteed rates cannot exceed the total port bandwidth. If you configure guaranteed rates whose sum exceeds the port bandwidth, the system sends a syslog message to notify you that the configuration is not valid. However, the system does not perform a commit check. If you commit a configuration in which the sum of the guaranteed rates exceeds the port bandwidth, the hierarchical scheduler behaves unpredictably.

- If you configure the **guaranteed-rate** of a priority group as a percentage, configure all of the transmit rates associated with that priority group as percentages. In this case, if any of the transmit rates are configured as absolute values instead of percentages, the configuration is not valid and the system sends a syslog message.
- There are several factors to consider if you want to configure strict-high priority queues:
  - You cannot configure a minimum guaranteed bandwidth (**transmit-rate**) for a strict-high priority queue. You cannot configure a minimum guaranteed bandwidth (**guaranteed-rate**) for a forwarding class set that includes a strict-high priority queue.
  - You must create a separate forwarding class set for the strict-high priority queue.
  - Only one forwarding class set can contain strict-high priority queues.
  - Strict-high priority queues cannot belong to the same forwarding class set as queues that are not strict-high priority.
  - A strict-high priority queue cannot belong to a multidestination forwarding class set.
- In QFabric systems, if any queue that contains outgoing packets does not transmit packets for 12 consecutive seconds, the port automatically resets. Failure of a queue to transmit packets for 12 consecutive seconds may be due to:
  - A strict-high priority queue consuming all of the port bandwidth
  - Several queues consuming all of the port bandwidth
  - Any queue or port receiving continuous priority-based flow control (PFC) or 802.3x Ethernet PAUSE messages (received PFC and PAUSE messages prevent a queue or a port, respectively, from transmitting packets because of network congestion)
  - Other conditions that prevent a queue from obtaining port bandwidth for 12 consecutive seconds

  If the cause is a strict-high priority queue consuming all of the port bandwidth, you can use rate shaping to configure a maximum rate for the strict-high priority queue and prevent it from using all of the port bandwidth. To configure rate shaping, include the **shaping-rate (*rate* | percent *percentage*)** statement at the **[edit class-of-service schedulers *scheduler-name*]** hierarchy level and apply the shaping rate to the strict-high priority scheduler.

  If several queues consume all of the port bandwidth, you can use a scheduler to rate shape those queues and prevent them from using all of the port bandwidth.
- For transmit rates below 1 Gbps, we recommend that you configure the transmit rate as a percentage instead of as a fixed rate. This is because the system converts fixed rates into percentages and may round small fixed rates to a lower percentage. For example, a fixed rate of 350 Mbps is rounded down to 3 percent instead of 3.5 percent.
- When you set the maximum bandwidth for a queue or for a priority group (**shaping-rate**) at 100 Kbps or lower, the traffic shaping behavior is accurate only within +/– 20 percent of the configured **shaping-rate**.
- Ingress port congestion can occur during periods of egress port congestion if an ingress port forwards traffic to more than one egress port, and at least one of those egress ports experiences congestion. If this occurs, the congested egress port can cause the

ingress port to exceed its fair allocation of ingress buffer resources. When the ingress port exceeds its buffer resource allocation, frames are dropped at the ingress. Ingress port frame drop affects not only the congested egress ports, but also all of the egress ports to which the congested ingress port forwards traffic.

If a congested ingress port drops traffic that is destined for one or more uncongested egress ports, configure a weighted random early detection (WRED) drop profile and apply it to the egress queue that is causing the congestion. The drop profile prevents the congested egress queue from affecting egress queues on other ports by dropping frames at the egress instead of causing congestion at the ingress port.

NOTE: **Do not configure drop profiles for the fcoe and no-loss forwarding classes. FCoE and other lossless traffic queues require lossless behavior. Use priority-based flow control (PFC) to prevent frame drop on lossless priorities.**

- On an ingress port, do not configure classifiers that map the same IEEE 802.1p code point to both a multidestination traffic flow and a lossless unicast traffic flow (such as the default lossless **fcoe** or **no-loss** forwarding classes). Any code point used for multidestination traffic on a port should not be used to classify unicast traffic into a lossless forwarding class on the same port.

  If a multidestination traffic flow and a lossless unicast traffic flow use the same code point on a port, the multidestination traffic is treated the same way as the lossless traffic. For example, if priority-based flow control (PFC) is applied to the lossless traffic, the multidestination traffic of the same code point is also paused. During periods of congestion, treating multidestination traffic the same as lossless unicast traffic can create ingress port congestion for the multidestination traffic and affect the multidestination traffic on all of the egress ports the multidestination traffic uses.

  For example, the following configuration can cause ingress port congestion for the multidestination flow:

  1. For unicast traffic, IEEE 802.1p code point 011 is classified into the **fcoe** forwarding class:

     `user@switch#` **set class-of-service classifiers ieee-802.1 ucast_cl forwarding-class fcoe loss-priority low code-points 011**

  2. For multidestination traffic, IEEE 802.1p code point **011** is classified into the **mcast** forwarding class:

     `user@switch#` **set class-of-service classifiers ieee-802.1 mcast-cl forwarding-class mcast loss-priority low code-points 011**

  3. The unicast classifier that maps traffic with code point **011** to the **fcoe** forwarding class is mapped to interface **xe-0/0/1**:

     `user@switch#` **set class-of-service interfaces xe-0/0/1 unit 0 classifiers ieee-802.1 ucast_cl**

  4. The multidestination classifier that maps traffic with code point **011** to the **mcast** forwarding class is mapped to all interfaces (multidestination traffic maps to all interfaces and cannot be mapped to individual interfaces):

     `user@switch#` **set class-of-service multi-destination classifiers ieee-802.1 mcast-cl**

Because the same code point (**011**) maps unicast traffic to a lossless traffic flow and also maps multidestination traffic to a multidestination traffic flow, the multidestination traffic flow might experience ingress port congestion during periods of congestion.

To avoid ingress port congestion, do not map the code point used by the multidestination traffic to lossless unicast traffic. For example:

1. Instead of classifying code point **011** into the **fcoe** forwarding class, classify code point **011** into the **best-effort** forwarding class:

   `user@switch#` **set class-of-service classifiers ieee-802.1 ucast_cl forwarding-class best-effort loss-priority low code-points 011**

2. `user@switch#` **set class-of-service classifiers ieee-802.1 mcast-cl forwarding-class mcast loss-priority low code-points 011**
3. `user@switch#` **set class-of-service interfaces xe-0/0/1 unit 0 classifiers ieee-802.1 ucast_cl**
4. `user@switch#` **set class-of-service multi-destination classifiers ieee-802.1 mcast-cl**

   Because the code point **011** does not map unicast traffic to a lossless traffic flow, the multidestination traffic flow does not experience ingress port congestion during periods of congestion.

The best practice is to classify unicast traffic with IEEE 802.1p code points that are also used for multidestination traffic into best-effort forwarding classes.

Related Documentation

- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Priority Group Scheduling on page 5378
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- *Benefits of Configuring CoS Hierarchical Port Scheduling*
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474

Understanding CoS Buffer Configuration

Each QFX3500 and QFX3600 switch has 9 MB of Packet Forwarding Engine (PFE) wide common packet buffer memory that is used to store packets on interface queues. Each QFX5100 switch has 12 MB of PFE wide common packet buffer memory. The buffer memory has separate ingress and egress accounting to make accept, drop, or pause decisions. Because the switch has a single pool of memory with separate ingress and egress accounting, the full amount of buffer memory is available from both the ingress and the egress perspective. Packets are accounted for as they enter and leave the switch, but there is no concept of a packet arriving at an ingress buffer and then being moved to an egress buffer.

The buffers are divided into two pools from both an ingress and an egress perspective:

1. *Shared buffers* are a global memory pool that the switch allocates dynamically to ports as needed, so the buffers are shared among the switch ports.
2. *Dedicated buffers* are a memory pool divided equally among the switch ports. Each port receives a minimum guaranteed amount of buffer space, dedicated to each port, not shared among ports.

NOTE: **Lossless traffic is traffic on which you enable priority-based flow control (PFC) to ensure lossless transport. Lossless traffic does not refer to best-effort traffic on a link enabled for Ethernet PAUSE (IEEE 802.3x).**

The switch reserves nonconfigurable buffer space to ensure that ports and queues receive a minimum memory allocation. You can configure how the system uses the rest of the buffer space to optimize the allocation for your mix of network traffic. You can configure the percentage of available buffer space used as shared buffer space versus dedicated buffer space. You can also configure how shared buffer space is allocated to different types of traffic. You can optimize the buffer settings for the traffic on your network.

The default buffer configuration is designed for networks that have a balance of best-effort and lossless traffic.

The default class-of-service configuration provides two lossless forwarding classes (**fcoe** and **no-loss**), a best-effort unicast forwarding class, a network control traffic forwarding class, and one multidestination (multicast, broadcast, and destination lookup fail) forwarding class. Each default forwarding class maps to a different default output queue. The default configuration allocates the buffers in a manner that supports a moderate amount of lossless traffic while still providing the ability to absorb bursts in best-effort traffic transmission.

Changing the buffer settings changes the abilities of the buffers to absorb traffic bursts and handle lossless traffic. For example, networks with mostly best-effort traffic require allocating most of the shared buffer space to best-effort buffers. This provides deep, flexible buffers that can absorb traffic bursts with minimal packet loss, at the expense of buffer availability for lossless traffic.

Conversely, networks with mostly lossless traffic require allocating most of the shared buffer space to lossless headroom buffers. This prevents packet loss on lossless flows at the expense of absorbing bursty best-effort traffic efficiently.

CAUTION: **Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.**

This topic describes the buffer architecture and settings:

Buffer Pools

From both an ingress and an egress perspective, the PFE buffer is split into two main pools, a shared buffer pool and a dedicated buffer pool that ensures a minimum allocation to each port. You can configure the amount of buffer space allocated to each of the two pools. A portion of the buffer space is reserved so that there is always a minimum amount of shared and dedicated buffer space available to each port.

- Shared buffer pool—A global memory space that all of the ports on the switch share dynamically as they need buffers. The shared buffer pool is further partitioned into buffers for best-effort unicast, best-effort multidestination (broadcast, multicast, and destination lookup fail), and PFC (lossless) traffic types. You can allocate global shared memory space to buffer partitions to better support different mixes of network traffic. The larger the shared buffer pool, the better the switch can absorb traffic bursts because more shared memory is available for the traffic.
- Dedicated buffer pool—A reserved global memory space allocated equally to each port. The switch reserves a minimum dedicated buffer pool that is not user-configurable. You can divide the dedicated buffer allocation for a port among the port queues on a per-port, per-queue basis. (For example, this enables you to dedicate more buffer space to queues that transport lossless traffic.)

  A larger dedicated buffer pool means a larger amount of dedicated buffer space for each port, so congestion on one port is less likely to affect traffic on another port because the traffic does not need to use as much shared buffer space. However, the larger the dedicated buffer pool, the less bursty traffic the switch can handle because there is less dynamic shared buffer memory.

You can configure the way the available unreserved portion of the buffer space is allocated to the global shared buffer pool and to the dedicated shared buffer pool by configuring the ingress and egress shared buffer percentages.

By default, 100 percent of the available unreserved buffer space is allocated to the shared buffer pool. If you change the percentage of space allocated to the shared buffer, the available buffer space that is not allocated to the shared buffer is allocated to the dedicated buffer. For example, if you configure the ingress shared buffer pool as 80 percent, the remaining 20 percent of the available buffer space is allocated to the dedicated buffer pool and divided equally across the ports.

NOTE: When 100 percent of the available (user-configurable) buffers are allocated to the shared buffer pool, the switch still reserves a minimum dedicated buffer pool.

You can separately configure ingress and egress shared buffer pool allocations. You can also partition the ingress and egress shared buffer pool to allocate percentages of the shared buffer pool to specific types of traffic. If you do not use the default configuration or one of the recommended configurations, pay particular attention to the ingress configuration of the lossless and lossless headroom buffers (these buffers handle PFC pause during periods of congestion) and to the egress configuration of the best-effort buffers to handle incast congestion (multiple synchronized sources sending data to the same receiver in parallel).

In addition to the shared buffer pool and the dedicated buffer pool, there is also a small ingress global headroom buffer pool that is reserved and is not configurable.

When contention for buffer space occurs, the switch uses an internal algorithm to ensure that the buffer pools are distributed fairly among competing flows. When traffic for a given flow exceeds the amount of dedicated port buffer reserved for that flow, the flow begins to consume memory from the dynamic shared buffer pool. Competing flows compete for shared buffer memory with other flows that also have exhausted their dedicated buffers. When there is no congestion, there are no competing flows.

Buffer Handling of Lossless Flows (PFC) Versus Ethernet PAUSE

When we discuss lossless buffers in the following sections, we mean buffers that handle traffic on which you enable PFC to ensure lossless transport. The lossless buffers are not used for best-effort traffic on a link on which you enable Ethernet PAUSE (IEEE 802.3x). The lossless ingress and egress shared buffers, and the ingress lossless headroom shared buffer, are used only for traffic on which you enable PFC.

NOTE: To support lossless flows, you must configure the appropriate data center bridging capabilities (PFC, DCBX, or ETS) and scheduling properties.

Shared Buffer Pool and Partitions

The shared buffer pool is a global memory space that all of the ports on the switch share dynamically as they need buffers. The switch uses the shared buffer pool to absorb traffic bursts after the dedicated buffer pool for a port is exhausted.

You can divide both the ingress shared buffer pool and the egress shared buffer pool into three partitions to allocate percentages of each buffer pool to different types of traffic. When you partition the ingress or egress shared buffer pool:

- If you explicitly configure one ingress shared buffer partition, you must explicitly configure all three ingress shared buffer partitions. (You either explicitly configure all three ingress partitions or you use the default setting for all three ingress partitions.)

  If you explicitly configure one egress shared buffer partition, you must explicitly configure all three egress shared buffer partitions. (You either explicitly configure all three egress partitions or you use the default setting for all three egress partitions.)

  The switch returns a commit error if you do not explicitly configure all three partitions when configuring the ingress or egress shared buffer partitions.
- The combined percentages of the three ingress shared buffer partitions must total exactly 100 percent.

  The combined percentages of the three egress shared buffer partitions must total exactly 100 percent.

  When you explicitly configure ingress or egress shared buffer partitions, the switch returns a commit error if the total percentage of the three partitions does not equal 100 percent.
- If you explicitly partition one set of shared buffers, you do not have to explicitly partition the other set of shared buffers. For example, you can explicitly configure the ingress shared buffer partitions and use the default egress shared buffer partitions. However, if you change the buffer partitions for the ingress buffer pool to match the expected types of traffic flows, you would probably also want to change the buffer partitions for the egress buffer pool to match those traffic flows.

You can configure the percentage of available unreserved buffer space allocated to the shared buffer pool. Space that you do not allocate to the shared buffer pool is added to the dedicated buffer pool and divided equally among the ports. The default configuration allocates 100 percent of the unreserved ingress and egress buffer space to the shared buffers.

Configuring the ingress and egress shared buffer pool partitions enables you to allocate more buffers to the types of traffic your network predominantly carries, and fewer buffers to other traffic.

Ingress Shared Buffer Pool Partitions

You can configure three ingress buffer pool partitions:

- Lossless buffers—Shared buffer pool for all lossless ingress traffic. The recommended minimum value for lossless buffers is 5 percent.

- Lossless headroom buffers—Shared buffer pool for packets received while a pause is asserted. If PFC is enabled on priorities on a port, when the port sends a pause message to the connected peer, the port uses the headroom buffers to store the packets that arrive between the time the port sends the pause message and the time the last packet arrives after the peer pauses traffic. The minimum value for lossless headroom buffers is 0 (zero) percent. (Lossless headroom buffers are the only buffers for which the recommended value can be less than 5 percent.)
- Lossy buffers—Shared buffer pool for all best-effort ingress traffic (best-effort unicast, multidestination, and strict-high priority traffic). The recommended minimum value for best-effort buffers is 5 percent.

The combined percentage values of the ingress lossless, lossless headroom, and best-effort buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. If you explicitly configure an ingress shared buffer partition, you must explicitly configure all three ingress buffer partitions, even if the lossless headroom buffer partition has a value of 0 (zero) percent.

Egress Shared Buffer Pool Partitions

You can configure three egress buffer pool partitions:

- Lossless buffers—Shared buffer pool for all lossless egress queues. The recommended minimum value for lossless buffers is 5 percent.
- Lossy buffers—Shared buffer pool for all best-effort egress queues (best-effort unicast, and strict-high priority queues). The recommended minimum value for best-effort buffers is 5 percent.
- Multicast buffers—Shared buffer pool for all multidestination (multicast, broadcast, and destination lookup fail) egress queues. The recommended minimum value for multicast buffers is 5 percent.

The combined percentage values of the egress lossless, lossy, and multicast buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. All egress buffer partitions must be explicitly configured and should have a value of at least 5 percent. If you explicitly configure an egress shared buffer partition, you must explicitly configure all three egress buffer partitions, and each partition should have a value of at least 5 percent.

Dedicated Port Buffer Pool and Buffer Allocation to Queues

The global dedicated buffer pool is memory that is allocated equally to each port, so each port receives a guaranteed minimum amount of buffer space. Dedicated buffers are not shared among ports. Each port receives an equal proportion of the dedicated buffer pool.

The amount of dedicated buffer space is not user-configurable and depends on the percentage of available nonreserved buffers allocated to the shared buffers. (The dedicated buffer space is equal to the minimum reserved port buffers plus the remainder of the available nonreserved buffers that are not allocated to the shared buffer pool.)

When traffic enters and exits the switch, the switch ports use their dedicated buffers to store packets. If the dedicated buffers are not sufficient to handle the traffic, the switch uses shared buffers. The only way to increase the dedicated buffer pool is to decrease the shared buffer pool from its default value of 100 percent of available unreserved buffers.

NOTE: **If 100 percent of the available unreserved buffers are allocated to the shared buffer pool, the switch still reserves a minimum dedicated buffer pool.**

The larger the shared buffer pool, the better the burst absorption across the ports. The larger the dedicated buffer pool, the larger the amount of dedicated buffer space for each port. The greater the dedicated buffer space, the less likely that congestion on one port can affect traffic on another port, because the traffic does not need to use as much shared buffer space.

Allocating Dedicated Port Buffers to Queues

You can divide the dedicated buffer allocation for an egress port among the port queues by including the **buffer-size** statement in the scheduler configuration. This enables you to control the egress port dedicated buffer allocation on a per-port, per-queue basis. (For example, this enables you to dedicate more buffer space to queues that transport lossless traffic, or to stop the port from reserving buffers for queues that do not carry traffic.) Egress dedicated port buffer allocation is a hierarchical structure that allocates a global dedicated buffer pool evenly among ports, and then divides the allocation for each port among the port queues.

By default, ports divide their allocation of dedicated buffers among their egress queues in the same proportion as the default scheduler sets the minimum guaranteed transmission rates (the **transmit-rate** option) for traffic. Only the queues included in the default scheduler receive bandwidth and dedicated buffers, in the proportions shown in Table 466 on page 5396:

Table 466: Default Dedicated Buffer Allocation to Egress Queues (Based on Default Scheduler)

Forwarding Class	Queue	Minimum Guaranteed Bandwidth (transmit-rate)	Proportion of Reserved Dedicated Port Buffers
best-effort	0	5%	5%
fcoe	3	35%	35%
no-loss	4	35%	35%
network-control	7	5%	5%
mcast	8	20%	20%

In the default configuration, no egress queues other than the ones shown in Table 466 on page 5396 receive an allocation of dedicated port buffers.

NOTE: The switch uses hierarchical scheduling to control port and queue bandwidth allocation, as described in "Understanding CoS Hierarchical Port Scheduling (ETS)" on page 5366 and shown in "Example: Configuring CoS Hierarchical Port Scheduling (ETS)" on page 5474. For egress queue buffer size configuration, when you attach a traffic control profile (includes the queue scheduler information) to a port, the dedicated egress buffers on the port are divided among the queues as configured in the scheduler.

If you do not want to use the default allocation of dedicated port buffers to queues, use the **buffer-size** option in the scheduler that is attached to the port to configure the queue allocation. You can configure the dedicated buffer allocation to queues in two ways:

- As a percentage—The queue receives the specified percentage of dedicated port buffers when the queue is mapped to the scheduler and the scheduler is attached to a port.
- As a remainder—After the port services the queues that have an explicit percentage buffer size configuration, the remaining dedicated port buffer space is divided equally among the other queues to which a scheduler is attached. (No default or explicit scheduler for a queue means no dedicated buffer allocation for that queue.) If you configure a scheduler and you do not specify a buffer size as a percentage, *remainder* is the default setting.

NOTE: The total of all of the explicitly configured buffer size percentages for all of the queues on a port cannot exceed 100 percent.

Configuring Dedicated Port Buffer Allocation to Queues

In a port configuration that includes multiple forwarding class sets, with multiple forwarding classes mapped to multiple schedulers, the allocation of port dedicated buffers to queues depends on the mix of queues with buffer sizes configured as explicit percentages and queues configured with (or defaulted to) the **remainder** option.

The best way to demonstrate how using the percentage and remainder options affects dedicated port buffer allocation to queues is by showing an example of queue buffer allocation, and then showing how the queue buffer allocation changes when you add another forwarding class (queue) to the port.

Table 467 on page 5398 shows an initial configuration that includes four forwarding class sets, the five default forwarding classes (mapped to the five default queues for those forwarding classes), the **buffer-size** option configuration, and the resulting buffer allocation for each queue. Table 468 on page 5398 shows the same configuration after we add another forwarding class (best-effort-2, mapped to queue 1) to the best-effort forwarding class set. Comparing the buffer allocations in each table shows you how adding another queue affects buffer allocation when you use remainders and explicit percentages to configure the buffer allocation for different queues.

Table 467: Egress Queue Dedicated Buffer Allocation (Example 1)

Forwarding Class Set (Priority Group)	Forwarding Class	Queue	Scheduler Buffer Size Configuration	Buffer Allocation per Queue (Percentage)
fc-set-be	best-effort	0	10%	10%
fc-set-lossless	fcoe	3	20%	20%
	no-loss	4	40%	40%
fc-set-strict-high	network-control	7	remainder	15%
fc-set-mcast	mcast	8	remainder	15%

In this first example, 70 percent of the egress port dedicated buffer pool is explicitly allocated to the best-effort, fcoe, and no-loss queues. The remaining 30 percent of the port dedicated buffer pool is split between the two queues that use the **remainder** option (network-control and mcast), so each queue receives 15 percent of the dedicated buffer pool.

Now we add another forwarding class (queue) to the best-effort priority group (fc-set-be) and configure it with a buffer size of *remainder* instead of configuring a specific percentage. Because a third queue now shares the remaining dedicated buffers, the queues that share the remainder receive fewer dedicated buffers, as shown in Table 468 on page 5398. The queues with explicitly configured percentages receive the configured percentage of dedicated buffers.

Table 468: Egress Queue Dedicated Buffer Allocation with Another Remainder Queue (Example 2)

Priority Group (fc-set)	Forwarding Class	Queue	Scheduler Buffer Size Configuration	Buffer Allocation per Queue (Percentage)
fc-set-be	best-effort	0	10%	10%
	best-effort-2	1	remainder	10%
fc-set-lossless	fcoe	3	20%	20%
	no-loss	4	40%	40%
fc-set-strict-high	network-control	7	remainder	10%
fc-set-mcast	mcast	8	remainder	10%

The two tables show how the port divides the dedicated buffer space that remains after servicing the queues that have an explicitly configured percentage of dedicated buffer space.

Trade-off Between Shared Buffer Space and Dedicated Buffer Space

The trade-off between shared buffer space and dedicated buffer space is:

- Shared buffers provide better absorption of traffic bursts because there is a larger pool of dynamic buffers that ports can use as needed to handle the bursts. However, all flows that exhaust their dedicated buffer space compete for the shared buffer pool. A larger shared buffer pool means a smaller dedicated buffer pool, and therefore more competition for the shared buffer pool because more flows exhaust their dedicated buffer allocation. Too much shared buffer space results in no single flow receiving very much shared buffer space, to maintain fairness when many flows contend for that space.
- Dedicated buffers provide guaranteed buffer space to each port. The larger the dedicated buffer pool, the less likely that congestion on one port affects traffic on another port, because the traffic does not need to use as much shared buffer space. However, less shared buffer space means less ability to dynamically absorb traffic bursts.

For optimal burst absorption, the switch needs enough dedicated buffer space to avoid persistent competition for the shared buffer space. When fewer flows compete for the shared buffers, the flows that need shared buffer space to absorb bursts receive more of the shared buffer because fewer flows exhaust their dedicated buffer space.

The default configuration and all of the recommended configurations allocate 100 percent of the user-configurable memory space to the global shared buffer pool because the amount of space reserved for dedicated buffers provides enough space to avoid persistent competition for dynamic shared buffers. This results in fewer flows competing for the shared buffers, so the competing flows receive more of the buffer space.

Order of Buffer Consumption

The total buffer pool is divided into ingress and egress shared buffer pools and dedicated buffer pools. When traffic flows through the switch, the buffer space is used in a particular order that depends on the type of traffic.

On ingress, the order of buffer consumption is:

- Best-effort unicast traffic:
  1. Dedicated buffers
  2. Shared buffers
  3. Global headroom buffers (very small)
- Lossless unicast traffic:
  1. Dedicated buffers
  2. Shared buffers

3. Lossless headroom buffers
4. Global headroom buffers (very small)

- Multidestination traffic:
  1. Dedicated buffers
  2. Shared buffers
  3. Global headroom buffers (very small)

On egress, the order of buffer consumption is the same for unicast best-effort, lossless unicast, and multidestination traffic:

- Dedicated buffers
- Shared buffers

In all cases on all ports, the switch uses the dedicated buffer pool first and the shared buffer pool only after the dedicated buffer pool for the port or queue is exhausted. This reserves the maximum amount of dynamic shared buffer space to absorb traffic bursts.

Default Buffer Pool Values

You can view the default or configured ingress and egress buffer pool values in KB units using the **show class-of-service shared-buffer** operational command. You can view the configured shared buffer pool values in percent units using the **show configuration class-of-service shared-buffer** operational command.

This section provides the default total buffer, shared buffer, and dedicated buffer values for QFX Series switches.

Total Buffer Pool Size

The total buffer pool is common memory that has separate ingress and egress accounting, so the full buffer pool is available from both the ingress and egress perspective. The total buffer pool consists of the dedicated buffer space and the shared buffer space. The size of the total buffer pool is not user-configurable, but the allocation of buffer space to the dedicated and shared buffer pools is user-configurable.

On QFX3500 and QFX3600 switches, the combined total size of the ingress and egress buffer pools is approximately 9 MB (exactly 9360 KB).

On QFX5100 switches, the combined total size of the ingress and egress buffer pools is approximately 12 MB (exactly 12480 KB).

Shared Buffer Pool Default Values

The QFX5100 switch has a larger shared buffer pool (12 MB) than QFX3500 and QFX3600 switches (9 MB). However, the allocation of shared buffer space to the individual ingress and egress buffer pools is the same on a percentage basis, even though the absolute values are different. For example, the default ingress lossless buffer is 9 percent of the total shared ingress buffer space on QFX5100, QFX3500, and QFX3600 switches, even though the default absolute value of the ingress lossless buffer is 861.05KB on QFX5100 switches and 648.18KB on QFX3500 and QFX3600 switches.

This section describes the default values in percent and in KB for the shared ingress and shared egress buffers.

- Shared Ingress Buffer Default Values on page 5401
- Shared Egress Buffer Default Values on page 5401

Shared Ingress Buffer Default Values

The QFX5100 switch has a larger shared ingress buffer than the QFX3500 and QFX3600 switches. Table 469 on page 5401 shows the default ingress shared buffer allocation values in KB units for QFX5100 switches.

Table 469: QFX5100 Switch Default Shared Ingress Buffer Values (KB)

Total Shared Ingress Buffer	Lossless Buffer	Lossless-Headroom Buffer	Lossy Buffer
9567.19 KB	861.05 KB	4305.23 KB	4400.91 KB

Table 470 on page 5401 shows the default ingress shared buffer allocation values in KB units for QFX3500 and QFX3600 switches.

Table 470: QFX3500 and QFX3600 Switch Default Shared Ingress Buffer Values (KB)

Total Shared Ingress Buffer	Lossless Buffer	Lossless-Headroom Buffer	Lossy Buffer
7202 KB	648.18 KB	3240.9 KB	3312.92 KB

Table 471 on page 5401 shows the default ingress shared buffer allocation values as percentages for QFX5100, QFX3500, and QFX3600 switches. (If you change the default shared buffer allocation, you configure the change as a percentage.)

Table 471: Default Shared Ingress Buffer Values (Percentage)

Total Shared Ingress Buffer	Lossless Buffer	Lossless-Headroom Buffer	Lossy Buffer
100%	9%	45%	46%

Shared Egress Buffer Default Values

The QFX5100 switch has a larger shared egress buffer than the QFX3500 and QFX3600 switches. Table 472 on page 5402 shows the default egress shared buffer allocation values in KB units for QFX5100 switches.

Table 472: QFX5100 Switch Default Shared Egress Buffer Values (KB)

Total Shared Egress Buffer	Lossless Buffer	Lossy Buffer	Multicast Buffer
8736 KB	4368 KB	2708.16 KB	1659.84 KB

Table 473 on page 5402 shows the default egress shared buffer allocation values in KB units.

Table 473: QFX3500 and QFX3600 Switch Default Shared Egress Buffer Values (KB)

Total Shared Egress Buffer	Lossless Buffer	Lossy Buffer	Multicast Buffer
6656 KB	3328 KB	2063.36 KB	1264.64 KB

Table 474 on page 5402 shows the default egress shared buffer allocation values as percentages.

Table 474: Default Shared Egress Buffer Values (Percentage)

Total Shared Egress Buffer	Lossless Buffer	Lossy Buffer	Multicast Buffer
100%	50%	31%	19%

Dedicated Buffer Pool Default Values

The system reserves ingress and egress dedicated buffer pools that are divided equally among the switch ports. By default, the system allocates 100 percent of the available unreserved buffer space to the shared buffer pool. If you reduce the percentage of available unreserved buffer space allocated to the shared buffer pool, the remaining unreserved buffer space is added to the dedicated buffer pool allocation. You configure the amount of dedicated buffer pool space by reducing (or increasing) the percentage of buffer space allocated to the shared buffer pool. You do not directly configure the dedicated buffer pool allocation.

The default dedicated buffer pool values for QFX3500 and QFX3600 switches in KB units are:

- Ingress dedicated buffer—2158 KB
- Egress dedicated buffer—2704.0 KB

The default dedicated buffer pool values for QFX5100 switches in KB units are:

- Ingress dedicated buffer—2912.81 KB
- Egress dedicated buffer—3744 KB

Shared Buffer Configuration Recommendations for Different Network Traffic Scenarios

The way you configure the shared buffer pool depends on the mix of traffic on your network. This section provides shared buffer configuration recommendations for five basic network traffic scenarios:

- Balanced traffic—The network carries a balanced mix of unicast best-effort, lossless, and multicast traffic. (This is the default configuration.)
- Best-effort unicast traffic—The network carries mostly unicast best-effort traffic.
- Best-effort traffic with Ethernet PAUSE (IEEE 802.3X) enabled—The network carries mostly best-effort traffic with Ethernet PAUSE enabled on the links.
- Best-effort multicast traffic—The network carries mostly multicast best-effort traffic.
- Lossless traffic—The network carries mostly lossless traffic (traffic on which PFC is enabled).

NOTE: Lossless traffic is defined as traffic on which you enable PFC to ensure lossless transport. Lossless traffic does not refer to best-effort traffic on a link on which you enable Ethernet PAUSE. Start with the recommended profiles for each network traffic scenario, and adjust them if necessary for your network traffic conditions.

CAUTION: Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete. This includes changing the default configuration to one of the recommended configurations.

Because you configure buffer allocations in percentages, the recommended allocations for each network traffic scenario are valid for all QFX Series switches. Use one of the following recommended shared buffer configurations for your network traffic conditions. Start with a recommended configuration, then make small adjustments to the buffer allocations to fine-tune the buffers if necessary as described in "Optimizing Buffer Configuration" on page 5406.

Balanced Traffic (Default Configuration)

The default shared buffer configuration is optimized for networks that carry a balanced mix of best-effort unicast, lossless, and multidestination (multicast, broadcast, and destination lookup fail) traffic. The default class-of-service (CoS) configuration is also optimized for networks that carry a balanced mix of traffic.

We recommend that you use the default shared buffer configuration for networks that carry a balanced mix of traffic, especially if you are using the default CoS settings. Table 475 on page 5404 shows the default ingress shared buffer allocations:

Table 475: Default Ingress Shared Buffer Configuration

Total Shared Ingress Buffer	Lossless Buffer	Lossless-Headroom Buffer	Lossy Buffer
100%	9%	45%	46%

Table 476 on page 5404 shows the default egress shared buffer allocations:

Table 476: Default Egress Shared Buffer Configuration

Total Shared Egress Buffer	Lossless Buffer	Lossy Buffer	Multicast Buffer
100%	50%	31%	19%

Best-Effort Unicast Traffic

If your network carries mostly best-effort (lossy) unicast traffic, then the default shared buffer configuration allocates too much buffer space to support lossless transport. Instead of wasting those buffers, we recommend that you use the following ingress shared buffer settings (see Table 477 on page 5404) and egress shared buffer settings (see Table 478 on page 5404):

Table 477: Recommended Ingress Shared Buffer Configuration for Networks with Mostly Best-Effort Unicast Traffic

Total Shared Ingress Buffer	Lossless Buffer	Lossless-Headroom Buffer	Lossy Buffer
100%	5%	0%	95%

Table 478: Recommended Egress Shared Buffer Configuration for Networks with Mostly Best-Effort Unicast Traffic

Total Shared Egress Buffer	Lossless Buffer	Lossy Buffer	Multicast Buffer
100%	5%	75%	20%

See "Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic" on page 5530 for an example that shows you how to configure the recommended buffer settings shown in Table 477 on page 5404 and Table 478 on page 5404.

Ethernet PAUSE Traffic

If your network carries mostly best-effort (lossy) traffic *and* enables Ethernet PAUSE on links, then the default shared buffer configuration allocates too much buffer space to the shared ingress buffer (Ethernet PAUSE traffic uses the dedicated buffers instead of shared buffers) and not enough space to the lossless-headroom buffers. We recommend that you use the following ingress shared buffer settings (see Table 479 on page 5405) and egress shared buffer settings (see Table 480 on page 5405):

Table 479: Recommended Ingress Shared Buffer Configuration for Networks with Mostly Best-Effort Traffic and Ethernet PAUSE Enabled

Total Shared Ingress Buffer	Lossless Buffer	Lossless-Headroom Buffer	Lossy Buffer
70%	5%	80%	15%

Table 480: Recommended Egress Shared Buffer Configuration for Networks with Mostly Best-Effort Traffic and Ethernet PAUSE Enabled

Total Shared Egress Buffer	Lossless Buffer	Lossy Buffer	Multicast Buffer
100%	5%	75%	20%

See "Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Traffic on Links with Ethernet PAUSE Enabled" on page 5535 for an example that shows you how to configure the recommended buffer settings shown in Table 477 on page 5404 and Table 478 on page 5404.

Best-Effort Multicast (Multidestination) Traffic

If your network carries mostly best-effort (lossy) multicast traffic, then the default shared buffer configuration allocates too much buffer space to support lossless transport. Instead of wasting those buffers, we recommend that you use the following ingress shared buffer settings (see Table 481 on page 5405) and egress shared buffer settings (see Table 482 on page 5406):

Table 481: Recommended Ingress Shared Buffer Configuration for Networks with Mostly Best -Effort Multicast Traffic

Total Shared Ingress Buffer	Lossless Buffer	Lossless-Headroom Buffer	Lossy Buffer
100%	5%	0%	95%

Table 482: Recommended Egress Shared Buffer Configuration for Networks with Mostly Best-Effort Multicast Traffic

Total Shared Egress Buffer	Lossless Buffer	Lossy Buffer	Multicast Buffer
100%	5%	20%	75%

See "Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic" on page 5541 for an example that shows you how to configure the recommended buffer settings shown in Table 481 on page 5405 and Table 482 on page 5406.

Lossless Traffic

If your network carries mostly lossless traffic, then the default shared buffer configuration allocates too much buffer space to support best-effort traffic. Instead of wasting those buffers, we recommend that you use the following ingress shared buffer settings (see Table 483 on page 5406) and egress shared buffer settings (see Table 484 on page 5406):

Table 483: Recommended Ingress Shared Buffer Configuration for Networks with Mostly Lossless Traffic

Total Shared Ingress Buffer	Lossless Buffer	Lossless-Headroom Buffer	Lossy Buffer
100%	15%	80%	5%

Table 484: Recommended Egress Shared Buffer Configuration for Networks with Mostly Lossless Traffic

Total Shared Egress Buffer	Lossless Buffer	Lossy Buffer	Multicast Buffer
100%	90%	5%	5%

See "Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic" on page 5547 for an example that shows you how to configure the recommended buffer settings shown in Table 483 on page 5406 and Table 484 on page 5406.

Optimizing Buffer Configuration

Starting from the default configuration or from a recommended buffer configuration, you can further optimize the buffer allocation to best support the mix of traffic on your network. Adjust the settings gradually to fine-tune the shared buffer allocation. Use caution when adjusting the shared buffer configuration, not just when you fine-tune the ingress and egress buffer partitions, but also when you fine-tune the total ingress and egress shared buffer percentage. (Remember that if you allocate less than 100 percent of the available buffers to the shared buffers, the remaining buffers are added to the dedicated buffers). Tuning the buffers incorrectly can cause problems such as ingress port congestion.

CAUTION: Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.

The relationship between the sizes of the ingress buffer pool and the egress buffer pool affects when and where packets are dropped. The buffer pool sizes include the shared buffers and the dedicated buffers. In general, if there are more ingress buffers than egress buffers, the switch can experience ingress port congestion because egress queues fill before ingress queues can empty.

Use the show class-of-service shared-buffer operational command to see the sizes in kilobytes (KB) of the dedicated and shared buffers and of the shared buffer partitions.

For best-effort traffic (unicast and multidestination), the combined ingress lossy shared buffer partition and ingress dedicated buffers must be *less than* the combined egress lossy and multicast shared buffer partitions plus the egress dedicated buffers. This prevents ingress port congestion by ensuring that egress best-effort buffers are deeper than ingress best-effort buffers, and ensures that if packets are dropped, they are dropped at the egress queues. (Packets dropping at the ingress prevents the egress schedulers from working properly.)

For lossless traffic (traffic on which you enable PFC), the combined ingress lossless shared buffer partition and a reasonable portion of the ingress headroom buffer partition, plus the dedicated buffers, must be *less than* the total egress lossless shared buffer partition and dedicated buffers. (A reasonable portion of the ingress headroom buffer is approximately 20 to 25 percent of the buffer space, but this varies depending on how much buffer headroom is required to support the lossless traffic.) When these conditions are met, if there is ingress port congestion, the ingress port congestion triggers PFC on the ingress port to prevent packet loss. If the total lossless ingress buffers exceed the total lossless egress buffers, packets could be dropped at the egress instead of PFC being applied at the ingress to prevent packet loss.

NOTE: If you commit a buffer configuration for which the switch does not have sufficient resources, the switch might log an error instead of returning a commit error. After you commit a buffer configuration, check the syslog messages to ensure that the new buffer configuration did not fail to commit.

If the buffer configuration commits but you receive a syslog message that indicates the configuration cannot be implemented, you can:

- Reconfigure the buffers or reconfigure other parameters (for example, the PFC configuration, which affects the need for lossless headroom buffers and lossless buffers—the more priorities you pause, the more lossless and lossless headroom buffer space you need), then attempt the commit operation again.
- Roll back the switch to the last successful configuration.

If you receive a syslog message that says the buffer configuration cannot be implemented, you must take corrective action. If you do not fix the configuration or roll back to a previous successful configuration, the system behavior is unpredictable.

General Buffer Configuration Rules and Considerations

Keep the following rules and considerations in mind when you configure the buffers:

- Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.
- If you configure the ingress or egress shared buffer percentages as less than 100 percent, the remaining percentage of buffer space is added to the dedicated buffer pool.
- The sum of all of the ingress shared buffer partitions must equal 100 percent. Each partition must be configured with a value of at least 5 percent except the lossless headroom buffer, which can have a value of 0 percent.
- The sum of all of the egress shared buffer partitions must equal 100 percent. Each partition must be configured with a value of at least 5 percent.
- Lossless and lossless headroom shared buffers serve traffic on which you enable PFC, and do not serve traffic subject to Ethernet PAUSE.
- The switch uses the dedicated buffer pool first and the shared buffer pool only after the dedicated buffer pool for a port or queue is exhausted.
- Too little dedicated buffer space results in too much competition for shared buffer space.
- Too much dedicated buffer space results in poorer burst absorption because there is less available shared buffer space.
- Always check the syslog messages after you commit a new buffer configuration.
- The optimal buffer configuration for your network depends on the types of traffic on the network. If your network carries less traffic of a certain type (for example, lossless

traffic), then you can reduce the size of the buffers allocated to that type of traffic (for example, you can reduce the sizes of the lossless and lossless headroom buffers).

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Traffic on Links with Ethernet PAUSE Enabled on page 5535
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Example: Configuring Queue Schedulers on page 5511
- Configuring Global Ingress and Egress Shared Buffers on page 5690

Understanding CoS Tail-Drop Profiles

When the number of packets queued is greater than the ability of the switch to empty an output queue, the queue requires a method for determining which packets to drop to relieve the congestion. Weighted random early detection (WRED) drop profiles define the drop probability of packets as the output queue fills. During periods of congestion, as the output queue fills, the switch drops incoming packets as determined by a drop profile until the output queue becomes less congested.

Depending on the drop probabilities, a drop profile can drop many packets long before the buffer becomes full, or it can drop only a few packets even if the buffer is almost full.

You configure drop profiles in the drop profile section of the class-of-service (CoS) configuration hierarchy. You apply drop profiles using a drop profile map in each scheduler configuration. For each scheduler, you can configure separate drop profiles for each combination of loss priority (low, medium-high, and high) and protocol.

Drop profiles define the meaning of each of the loss priorities by setting the values for when to drop packets and the probability that packets will drop.

You can configure a maximum of 32 drop profiles.

NOTE: You cannot apply drop profiles to multidestination (multicast) queues.

Do not apply drop profiles to lossless flows such as FCoE traffic, because the corresponding queues require lossless behavior. Use priority-based flow control (PFC) to prevent packet drop.

- Drop Profile Parameters on page 5410
- Default Drop Profile on page 5411
- Packet Drop Method on page 5411

Drop Profile Parameters

Drop profiles specify two values:

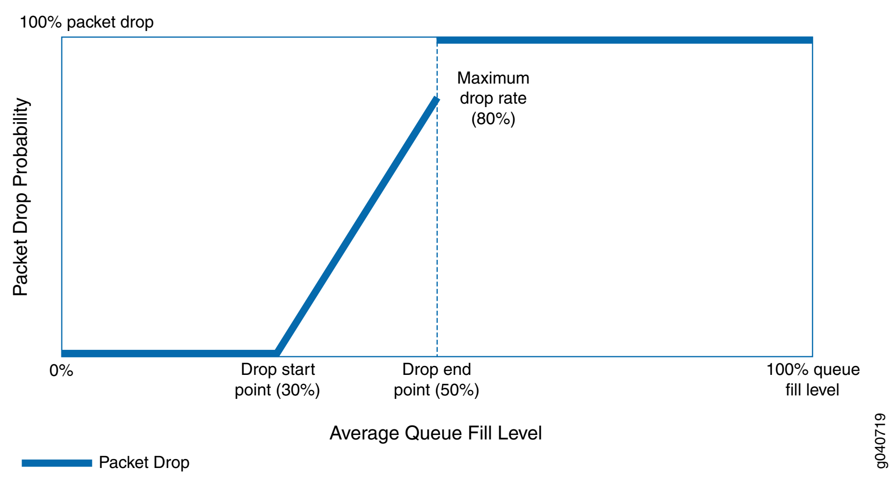
- Fill level—The queue fullness value, which represents a percentage of the memory used to store packets in relation to the total amount of memory allocated to the queue.
- Drop probability—The percentage value that corresponds to the likelihood that an individual packet is dropped.

You set two queue fill levels and two drop probabilities in each drop profile. The two fill levels and the two drop probabilities create two pairs of values. The first fill level and the first drop probability create one value pair and the second fill level and the second drop probability create the second value pair.

The first fill level value specifies the percentage of queue fullness at which packets begin to drop, known as the drop start point. Until the queue reaches this level of fullness, no packets are dropped. The second fill level value specifies the percentage of queue fullness at which all packets are dropped, known as the drop end point.

The first drop probability value is always **0** (zero). This pairs with the drop start point and specifies that until the queue fullness level reaches the first fill level, no packets drop. When the queue fullness exceeds the drop start point, packets begin to drop until the queue exceeds the second fill level, when all packets drop. The second drop probability value, known as the maximum drop rate, specifies the likelihood of dropping packets when the queue fullness reaches the drop end point. As the queue fills from the drop start point to the drop end point, packets drop in a smooth, linear pattern (called an interpolated graph) as shown in Figure 197 on page 5410. After the drop end point, all packets drop.

Figure 197: Tail-Drop Profile Packet Drop



The thick line in Figure 197 on page 5410 shows the packet drop characteristics for a sample tail-drop profile. At the drop start point, the queue reaches a fill level of 30 percent. At the drop end point, the queue fill level reaches 50 percent, and the maximum drop rate is 80 percent.

No packets drop until the queue fill level reaches the drop start point of 30 percent. When the queue reaches the 30 percent fill level, packets begin to drop. As the queue fills, the percentage of packets dropped increases in a linear fashion. When the queue fills to the drop end point of 50 percent, the rate of packet drop has increased to the maximum drop rate of 80 percent. When the queue fill level exceeds the drop end point of 50 percent, all of the packets drop until the queue fill level drops below 50 percent.

Default Drop Profile

If you do not configure default profiles and apply them to queue schedulers, the switch uses the default drop profile for lossy traffic classes. In the default drop profile, when the fill level is 0 percent, the drop probability is 0 percent. When the fill level is 100 percent, the drop probability is 100 percent. As soon as packets arrive on a queue, the default profile might begin to drop packets.

Packet Drop Method

When a packet reaches the head of the queue, the switch generates a random number between 0 and 100. The switch plots the random number against the drop profile using the current fullness of the queue. When the random number falls above the graph line, the packet is transmitted. When the number falls below the graph line, the packet is dropped.

To create the linear drop pattern from the drop start point to the drop end point, the drop probabilities are derived using a linear approximation with eight sections, or steps, from the minimum queue fill level to the maximum queue fill level. The fill levels are divided into the eight sections equally, starting at the minimum fill level and ending at the maximum fill level. As the queue fills, the percentage of dropped packets increases. The percentage of packets dropped is based on the maximum drop rate.

For example, the default drop profile (which specifies a maximum drop rate of 100 percent) has the following drop probabilities at each section, or step, in the eight-section linear drop pattern:

- First section—The minimum drop probability is 6.25 percent of the maximum drop rate. The maximum drop probability is 12.5 percent of the maximum drop rate.
- Second section—The minimum drop probability is 18.75 percent of the maximum drop rate. The maximum drop probability is 25 percent of the maximum drop rate.
- Third section—The minimum drop probability is 30.25 percent of the maximum drop rate. The maximum drop probability is 37.5 percent of the maximum drop rate.
- Fourth section—The minimum drop probability is 43.75 percent of the maximum drop rate. The maximum drop probability is 50 percent of the maximum drop rate.
- Fifth section—The minimum drop probability is 56.25 percent of the maximum drop rate. The maximum drop probability is 62 percent of the maximum drop rate.
- Sixth section—The minimum drop probability is 68.75 percent of the maximum drop rate. The maximum drop probability is 75.5 percent of the maximum drop rate.

- Seventh section—The minimum drop probability is 81.25 percent of the maximum drop rate. The maximum drop probability is 87.5 percent of the maximum drop rate.
- Eighth section—The minimum drop probability is 92.75 percent of the maximum drop rate. The maximum drop probability is 100 percent of the maximum drop rate.

Packets drop even when there is no congestion, because packet drops begin at the drop start point regardless of whether congestion exists on the port. The default drop profile example represents the worst-case scenario, because the drop start point fill level is 0 percent, so packet drop begins when the queue starts to receive packets.

You can specify when packets begin to drop by configuring a drop start point at a fill level greater than 0 percent. For example, if you configure a drop profile that has a drop start point of 30 percent, packets do not drop until the queue is 30 percent full.

The smaller the gap between the minimum drop rate (which is always 0) and the maximum drop rate, the smaller the gap between the minimum drop probability and the maximum drop probability at each section (step) of the linear drop pattern. The default drop profile, which has the maximum gap between the minimum drop rate (0 percent) and the maximum drop rate (100 percent), has the highest gap between the minimum drop probability and the maximum drop probability at each step. Configuring a lower maximum drop rate for a drop profile reduces the gap between the minimum drop probability and the maximum drop probability.

Drop Profile Maps

Drop profile maps are part of scheduler configuration. A drop profile map maps a drop profile to a loss priority and a protocol. Specifying the drop profile map in a scheduler associates the drop profile with the queues (forwarding classes) that you map to the scheduler in a scheduler map.

You configure loss priority for a queue in the classifier section of the CoS configuration hierarchy, and the loss priority is applied to the queue at the ingress interface.

Each scheduler can have multiple drop profile maps, one for each combination of loss priority and protocol.

Congestion Prevention

Configuring drop profiles on output queues prevents them from impacting other queues on the egress ports. If you do not configure drop profiles and map them to output queues, output queues without drop profiles can impact output queues on other egress ports, even if those queues are not experiencing congestion.

For example, if an ingress port forwards traffic to more than one egress port, and at least one of the egress ports experiences congestion, that can cause ingress port congestion. Ingress port congestion (ingress buffer exceeds its resource allocation) can cause frames to drop at the ingress port instead of at the egress port. Ingress port frame drop affects all of the egress ports to which the congested ingress port forwards traffic, not just the congested egress port.

NOTE: Do not configure drop profiles for the **fcoe** and **no-loss** forwarding classes. FCoE and other lossless traffic queues require lossless behavior. Use priority-based flow control (PFC) to prevent frame drop on lossless priorities.

Related Documentation

- Understanding Junos CoS Components on page 5315
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Tail-Drop Profiles on page 5501
- Example: Configuring Drop Profile Maps on page 5503
- Example: Configuring Unicast Classifiers on page 5495
- Configuring CoS Tail-Drop Profiles on page 5676
- Configuring CoS Drop Profile Maps on page 5677
- Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 5673

Understanding CoS Rewrite Rules

As packets enter or exit a network, edge switches might be required to alter the class-of-service (CoS) settings of the packets. Rewrite rules set the value of the CoS bits within the header of the outgoing packet. Each rewrite rule reads the current forwarding class and loss priority associated with the packet, locates the chosen CoS value from a table, and writes this CoS value into the packet header, replacing the old CoS value. Rewrite rules must be assigned to an interface for rewrites to be activated.

You can apply (bind) one DSCP or DSCP IPv6 rewrite rule and one IEEE 802.1p rewrite rule to each interface as described in "Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces" on page 5344. You can also bind EXP rewrite rules to logical interfaces to rewrite the CoS bits of MPLS traffic.

You cannot apply both a DSCP and a DSCP IPv6 rewrite rule to the same interface. Each interface supports only one DSCP rewrite rule. Both IP and IPv6 packets use the same DSCP rewrite rule, regardless if the configured rewrite rule is DSCP or DSCP IPv6. You can apply an EXP rewrite rule on an interface that has DSCP or IEEE rewrite rules. Only MPLS traffic uses the EXP rewrite rule.

NOTE: There are no default rewrite rules.

You can look at behavior aggregate (BA) classifiers and rewrite rules as two sides of the same coin. A BA classifier reads the CoS bits of incoming packets and classifies the packets into forwarding classes, then the system applies the CoS configured for the forwarding class to those packets. Rewrite rules change (rewrite) the CoS bits just before the packets leave the system so that the next switch or router can apply the appropriate level of CoS to the packets. When you apply a rewrite rule to an interface, the rewrite rule is the last CoS action performed on the packet before it is forwarded.

Rewrite rules alter CoS values in outgoing packets on the outbound interfaces of an edge switch to accommodate the policies of a targeted peer. This allows the downstream switch in a neighboring network to classify each packet into the appropriate service group.

NOTE: On each physical interface, either all forwarding classes that are being used on the interface must have rewrite rules configured or no forwarding classes that are being used on the interface can have rewrite rules configured. On any physical port, do not mix forwarding classes with rewrite rules and forwarding classes without rewrite rules.

QFX Series does not have default rewrite rules. If you want to apply a rewrite rule to outgoing packets, you must explicitly configure the rewrite rule.

NOTE: Rewrite rules are applied *before* the egress filter is matched to traffic. Because the code point rewrite occurs before the egress filter is matched to traffic, the egress filter match is based on the rewrite value, not on the original code point value in the packet.

For packets that carry both an inner VLAN tag and an outer VLAN tag, the rewrite rule rewrites only the outer VLAN tag.

MPLS EXP rewrite rules apply only to logical interfaces. You cannot apply to an EXP rewrite rule to a physical interface. You can configure as many EXP rewrite rules as you want, but you can only use 16 EXP rewrite rules at any time on the switch. On a given logical interface, all pushed MPLS labels have the same EXP rewrite rule applied to them. You can apply different EXP rewrite rules to different logical interfaces on the same physical interface.

NOTE: If the switch is performing penultimate hop popping (PHP), EXP rewrite rules do not take effect. If both an EXP classifier and an EXP rewrite rule are configured on the switch, then the EXP value from the last popped label is copied into the inner label. If either an EXP classifier or an EXP rewrite rule (but not both) is configured on the switch, then the inner label EXP value is sent unchanged.

Related Documentation

- Understanding Junos CoS Components on page 5315
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Defining CoS Rewrite Rules on page 5693
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Configuring a Global MPLS EXP Classifier on page 3782

Understanding CoS Flow Control (Ethernet PAUSE and PFC)

Flow control supports lossless transmission by regulating traffic flows to avoid dropping frames during periods of congestion. Flow control stops and resumes the transmission of network traffic between two connected peer nodes on a full-duplex Ethernet physical link. Controlling the flow by pausing and restarting it prevents buffers on the nodes from overflowing and dropping frames. You configure flow control on a per-interface basis.

The QFX Series supports two methods of flow control:

- IEEE 802.3X Ethernet PAUSE
- IEEE 802.1Qbb priority-based flow control (PFC)

Ethernet PAUSE and PFC are link-level flow control mechanisms.

Ethernet PAUSE pauses transmission of all traffic on a physical Ethernet link.

PFC decouples the pause function from the physical Ethernet link and enables you to divide traffic on one link into eight priorities. You can think of the eight priorities as eight “lanes” of traffic that are mapped to forwarding classes and output queues. Each priority is mapped to a 3-bit IEEE 802.1p CoS code point flag in the VLAN header. You can enable PFC on one or more priorities (IEEE 802.1p code points) on a link. When PFC-enabled traffic is paused on a link, traffic that is not PFC-enabled continues to flow (or is dropped if congestion is severe enough).

Use Ethernet PAUSE when you want to prevent packet loss on all of the traffic on a link. Use PFC to prevent traffic loss only on specified types of traffic (for example, Fibre Channel over Ethernet traffic).

NOTE: **Depending on the amount of traffic on a link or assigned to a priority, pausing traffic can cause ingress port congestion and spread congestion through the network.**

Attempting to configure both Ethernet PAUSE and PFC on a link causes a commit error. Ethernet PAUSE and PFC are mutually exclusive configurations on an interface.

By default, all forms of flow control are disabled. You must explicitly enable flow control on interfaces to pause traffic.

- Ethernet PAUSE on page 5416
- PFC on page 5420
- Lossless Transport Support Summary on page 5424

Ethernet PAUSE

Ethernet PAUSE is a congestion relief feature that works by providing link-level flow control for all traffic on a full-duplex Ethernet link. Ethernet PAUSE works in both directions on the link. In one direction, an interface generates and sends Ethernet PAUSE messages to stop the connected peer from sending more traffic. In the other direction, the interface responds to Ethernet PAUSE messages it receives from the connected peer to stop sending traffic. Ethernet PAUSE also works on aggregated Ethernet interfaces. For example, if the connected peer interfaces are called Node A and Node B:

- When the receive buffers on interface Node A reach a certain level of fullness, the interface generates and sends an Ethernet PAUSE message to the connected peer (interface Node B) to tell the peer to stop sending frames. The Node B buffers store frames until the time period specified in the Ethernet PAUSE frame elapses; then Node B resumes sending frames to Node A.
- When interface Node A receives an Ethernet PAUSE message from interface Node B, interface Node A stops transmitting frames until the time period specified in the Ethernet PAUSE frame elapses; then Node A resumes transmission. (The Node A transmit buffers store frames until Node A resumes sending frames to Node B.)

  In this scenario, if Node B sends an Ethernet PAUSE frame with a time value of 0 to Node A, the 0 time value indicates to Node A that it can resume transmission. This happens when the Node B buffer empties to below a certain threshold and the buffer can once again accept traffic.

Symmetric flow control means an interface has the same Ethernet PAUSE configuration in both directions. The Ethernet PAUSE generation and Ethernet PAUSE response functions are both configured as enabled, or they are both disabled. You configure symmetric flow control by including the **flow-control** statement at the **[edit interfaces *interface-name* ether-options]** hierarchy level.

Asymmetric flow control allows you to configure the Ethernet PAUSE functionality in each direction independently on an interface. The configuration for generating Ethernet PAUSE messages and for responding to Ethernet PAUSE messages does not have to be the same. It can be enabled in both directions, disabled in both directions, or enabled in one direction and disabled in the other direction. You configure asymmetric flow control by including the **configured-flow-control** statement at the **[edit interfaces *interface-name* ether-options]** hierarchy level.

On any particular interface, symmetric and asymmetric flow control are mutually exclusive. Asymmetric flow control overrides and disables symmetric flow control. (If PFC is configured on an interface, the PFC configuration overrides Ethernet PAUSE flow control.) The QFX Series supports both symmetric and asymmetric flow control.

- Symmetric Flow Control on page 5417
- Asymmetric Flow Control on page 5418

Symmetric Flow Control

Symmetric flow control configures both the receive and transmit buffers in the same state. The interface can both send Ethernet PAUSE messages and respond to them (flow control is enabled), or the interface cannot send Ethernet PAUSE messages or respond to them (flow control is disabled).

When you enable symmetric flow control on an interface, the Ethernet PAUSE behavior depends on the configuration of the connected peer. With symmetric flow control enabled, the interface can perform any Ethernet PAUSE functions that the connected peer can perform. (When symmetric flow control is disabled, the interface does not send or respond to Ethernet PAUSE messages.)

Asymmetric Flow Control

Asymmetric flow control enables you to specify independently whether or not the interface receive buffer generates and sends Ethernet PAUSE messages to stop the connected peer from transmitting traffic, and whether or not the interface transmit buffer responds to Ethernet PAUSE messages it receives from the connected peer and stops transmitting traffic. The receive buffer configuration determines if the interface transmits Ethernet PAUSE messages, and the transmit buffer configuration determines if the interface receives and responds to Ethernet PAUSE messages:

- Receive buffers on—Enable Ethernet PAUSE transmission (generate and send Ethernet PAUSE frames)
- Transmit buffers on—Enable Ethernet PAUSE reception (respond to received Ethernet PAUSE frames)

You must explicitly set the flow control for both the receive buffer and the transmit buffer (**on** or **off**) to configure asymmetric Ethernet PAUSE. Table 373 on page 4887 describes the configured flow control state when you set the receive (Rx) and transmit (Tx) buffers on an interface:

Table 485: Asymmetric Ethernet PAUSE Flow Control Configuration

Receive (Rx) Buffer	Transmit (Tx) Buffer	Configured Flow Control State
On	Off	Interface generates and sends Ethernet PAUSE messages. Interface does not respond to Ethernet PAUSE messages (interface continues to transmit even if peer requests that the interface stop sending traffic).
Off	On	Interface responds to Ethernet PAUSE messages received from the connected peer, but does not generate or send Ethernet PAUSE messages. (The interface does not request that the connected peer stop sending traffic.)
On	On	Same functionality as symmetric Ethernet PAUSE. Interface generates and sends Ethernet PAUSE messages and responds to received Ethernet PAUSE messages.
Off	Off	Ethernet PAUSE flow control is disabled.

The configured flow control is the Ethernet PAUSE state configured on the interface.

On 1-Gigabit Ethernet interfaces, the QFX Series supports autonegotiation of Ethernet PAUSE with the connected peer. (The QFX Series does not support autonegotiation on 10-Gigabit Ethernet interfaces.) Autonegotiation enables the interface to exchange state advertisements with the connected peer so that the two devices can agree on the Ethernet PAUSE configuration. Each interface advertises its flow control state to the connected peer using a combination of the Ethernet PAUSE and ASM_DIR bits, as described in Table 374 on page 4888:

Table 486: Flow Control State Advertised to the Connected Peer (Autonegotiation)

Rx Buffer State	Tx Buffer State	PAUSE Bit	ASM_DIR Bit	Description
Off	Off	0	0	The interface advertises no Ethernet PAUSE capability. This is equivalent to disabling flow control on an interface.
On	On	1	0	The interface advertises symmetric flow control (both the transmission of Ethernet PAUSE messages and the ability to receive and respond to Ethernet PAUSE messages).
On	Off	0	1	The interface advertises asymmetric flow control (the transmission of Ethernet PAUSE messages, but not the ability to receive and respond to Ethernet PAUSE messages).
Off	On	1	1	The interface advertises both symmetric and asymmetric flow control. Although the interface does not generate and send Ethernet PAUSE requests to the peer, the interface supports both symmetric and asymmetric Ethernet PAUSE configuration on the peer because the peer is not affected if the peer does not receive Ethernet PAUSE requests. (If the interface responds to the peer's Ethernet PAUSE requests, that is sufficient to support either symmetric or asymmetric flow control on the peer.)

The flow control configuration on each switch interface interacts with the flow control configuration of the connected peer. Each peer advertises its state to the other peer. The interaction of the flow control configuration of the peers determines the flow control behavior (resolution) between them, as shown in Table 375 on page 4889. The first four columns show the Ethernet PAUSE configuration on the local QFX Series and on the connected peer (also known as the link partner). The last two columns show the Ethernet PAUSE resolution that results from the local and peer configurations on each interface. This illustrates how the Ethernet PAUSE configuration of each interface affects the Ethernet PAUSE behavior on the other interface.

NOTE: In the Resolution columns of the table, disabling Ethernet PAUSE transmit means that the interface receive buffers do not generate and send Ethernet PAUSE messages to the peer. Disabling Ethernet PAUSE receive means that the interface transmit buffers do not respond to Ethernet PAUSE messages received from the peer.

Table 487: Asymmetric Ethernet PAUSE Behavior on Local and Peer Interfaces

Local Interface (QFX Series)		Peer Interface			
PAUSE Bit	ASM_DIR Bit	PAUSE Bit	ASM_DIR Bit	Local Resolution	Peer Resolution
0	0	Don't care	Don't care	Disable Ethernet PAUSE transmit and receive	Disable Ethernet PAUSE transmit and receive
0	1	0	Don't care	Disable Ethernet PAUSE transmit and receive	Disable Ethernet PAUSE transmit and receive
0	1	1	0	Disable Ethernet PAUSE transmit and receive	Disable Ethernet PAUSE transmit and receive
0	1	1	1	Enable Ethernet PAUSE transmit and disable Ethernet PAUSE receive	Disable Ethernet PAUSE transmit and enable Ethernet PAUSE receive
1	0	0	Don't care	Disable Ethernet PAUSE transmit and receive	Disable Ethernet PAUSE transmit and receive
1	0	1	Don't care	Enable Ethernet PAUSE transmit and receive	Enable Ethernet PAUSE transmit and receive
1	1	0	0	Disable Ethernet PAUSE transmit and receive	Disable Ethernet PAUSE transmit and receive
1	1	0	1	Enable Ethernet PAUSE receive and disable Ethernet PAUSE transmit	Enable Ethernet PAUSE transmit and disable Ethernet PAUSE receive
1	1	Don't care	Don't care	Enable Ethernet PAUSE transmit and receive	Enable Ethernet PAUSE transmit and receive

NOTE: For your convenience, Table 375 on page 4889 replicates Table 28B-3 of Section 2 of the IEEE 802.X specification.

PFC

PFC is a lossless transport and congestion relief feature that works by providing granular link-level flow control for each IEEE 802.1p code point (priority) on a full-duplex Ethernet link. When the receive buffer on a switch interface fills to a threshold, the switch transmits a pause frame to the sender (the connected peer) to temporarily stop the sender from transmitting more frames. The buffer threshold must be low enough so that the sender has time to stop transmitting frames and the receiver can accept the frames already on the wire before the buffer overflows. The switch automatically sets queue buffer thresholds to prevent frame loss.

When congestion forces one priority on a link to pause, all of the other priorities on the link continue to send frames. Only frames of the paused priority are not transmitted. When the receive buffer empties below another threshold, the switch sends a message that starts the flow again.

You configure PFC using a congestion notification profile (CNP). A CNP has two parts:

- Input—Specify the code point (or code points) on which to enable PFC, and optionally specify the maximum receive unit (MRU) and the cable length between the interface and the connected peer interface.
- Output—Specify the output queue or output queues that respond to pause messages from the connected peer.

You apply a PFC configuration by configuring a CNP on one or more interfaces. Each interface that uses a particular CNP is enabled to pause traffic with the priorities (code points) specified in that CNP. You can configure one CNP on an interface, and you can configure different CNPs on different interfaces. When you configure a CNP on an interface, ingress traffic that is mapped to a priority that the CNP enables for PFC is paused whenever the queue buffer fills to the pause threshold. (The pause threshold is not user-configurable.)

Configure PFC for a priority end to end along the entire data path to create a lossless lane of traffic on the network. You can selectively pause the traffic in any queue without pausing the traffic for other queues on the same link. You can create lossless lanes for traffic such as Fibre Channel over Ethernet (FCoE), LAN backup, or management, while using standard frame-drop congestion management for IP traffic on the same link.

Potential consequences of link-level flow control are:

- Ingress port congestion (configuring too many lossless flows can cause ingress port congestion)
- A paused priority that causes upstream devices to pause the same priority, thus spreading congestion back through the network

By definition, PFC supports symmetric pause only (as opposed to Ethernet PAUSE, which supports symmetric and asymmetric pause). With symmetric pause, a device can:

- Transmit pause frames to pause incoming traffic. (You configure this using the input stanza of a congestion notification profile.)
- Receive pause frames and stop sending traffic to a device whose buffer is too full to accept more frames. (You configure this using the output stanza of a congestion notification profile.)

Receiving a PFC frame from a connected peer pauses traffic on egress queues based on the IEEE 802.1p priorities that the PFC pause frame identifies. The priorities are 0 through 7. By default, the priorities map to queue numbers 0 through 7, respectively, and to specific forwarding classes, as shown in Table 376 on page 4891:

Table 488: Default PFC Priority to Queue and Forwarding Class Mapping

IEEE 802.1p Priority (Code Point)	Queue	Forwarding Class
0 (000)	0	best-effort
1 (001)	1	best-effort
2 (010)	2	best-effort
3 (011)	3	fcoe
4 (100)	4	no-loss
5 (101)	5	best-effort
6 (110)	6	network-control
7 (111)	7	network-control

For example, a received PFC pause frame that pauses priority 3 pauses output queue 3. If you do not want to use the default configuration, you can configure customized mapping of priorities to queues and forwarding classes.

NOTE: By convention, deployments with converged server access typically use IEEE 802.1p priority 3 for FCoE traffic. The default forwarding class configuration sets the **fcoe** forwarding class as a lossless forwarding class that is mapped to queue 3. The default classifier maps incoming priority 3 traffic to the **fcoe** forwarding class. *However, you must apply PFC to the entire FCoE data path to configure the end-to-end lossless behavior that FCoE traffic requires.*

If your network uses priority 3 for FCoE traffic, we recommend that you use the default configuration. If your network uses a priority other than 3 for FCoE traffic, you can configure lossless FCoE transport on any IEEE 80.21p priority as described in “Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows” on page 5427 and “Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway” on page 5446.

You enable PFC on a priority by:

1. Specifying the IEEE 802.1p code point to pause in the input stanza of a CNP
2. Applying the CNP to the ingress interfaces on which you want to pause the traffic

CAUTION: Any change to the PFC configuration on a port temporarily blocks the entire port (not just the priorities affected by the PFC change) so that the port can implement the change, then unblocks the port. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

A change to the PFC configuration means any change to a CNP, including changing the input portion of the CNP (enabling or disabling PFC on a priority, or changing the MRU or cable-length values) or changing the output portion the CNP that enables or disables output flow control on a queue. A PFC configuration change only affects ports that use the changed CNP.

The following actions change the PFC configuration:

- Deleting or disabling a PFC configuration (input or output) in a CNP that is in use on one or more interfaces. For example:
  1. An existing CNP with an input stanza that enables PFC on priorities 3, 5, and 6 is configured on interfaces xe-0/0/20 and xe-0/0/21.
  2. We disable the PFC configuration for priority 6 in the input CNP, and then commit the configuration.
  3. The PFC configuration change causes all traffic on interfaces xe-0/0/20 and xe-0/0/21 to stop until the PFC change has been implemented. When the PFC change has been implemented, traffic resumes.
- Configuring a CNP on an interface. (This changes the PFC state by enabling PFC on one or more priorities.)
- Deleting a CNP from an interface. (This changes the PFC state by disabling PFC on one or more priorities.)

When you associate the CNP with an interface, the interface uses PFC to send pause requests when the output queue buffer for the lossless traffic fills to the pause threshold.

Although unicast traffic and multidestination (multicast, broadcast, and destination lookup fail) traffic must use different classifiers, you can map a unicast queue (queue 0 through 7) and a multidestination queue (queue 8, 9, 10, or 11) to the same PFC priority so that both unicast and multicast traffic use that priority. Do not map multidestination traffic to lossless priorities. Starting with Junos OS Release 12.3, you can map one priority to multiple output queues.

NOTE: You can attach a maximum of one CNP to an interface, but you can create an unlimited number of CNPs that explicitly configure only the input stanza and use the default output stanza.

The output stanza of the CNP maps to a profile that interfaces use to respond to pause messages received from the connected peer. On standalone QFX3500 switches and QFX3600 switches, you can create two CNPs with an explicitly configured output stanza.

When a QFX3500 switch or a QFX3600 switch is a Node device in a QFabric system, you can create one CNP with an explicitly configured output stanza. (One fewer profile is available on QFabric systems because the system needs a default profile for fabric interfaces, which are not used as fabric interfaces when the switches are not part of a QFabric system. "Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows" on page 5427 describes configuring output flow control.

Lossless Transport Support Summary

The QFX Series supports up to six lossless forwarding classes. For lossless transport, you must enable PFC on the IEEE 802.1p priorities (code points) mapped to lossless forwarding classes.

CAUTION: Any change to the PFC configuration on a port temporarily blocks the entire port (not just the priorities affected by the PFC change) so that the port can implement the change, then unblocks the port. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

The following limitation applies to support lossless transport on QFabric systems only:

- The internal fiber cable length from the QFabric system Node device to the QFabric system Interconnect device cannot exceed 150 meters.

The default CoS configuration provides two lossless forwarding classes, *fcoe* and *no-loss*. If you explicitly configure lossless forwarding classes, you must include the **no-loss** packet drop attribute to enable lossless behavior, or the traffic is not lossless. For both default and explicit lossless forwarding class configuration, you must configure CNP input stanzas to enable PFC on the priority of the lossless traffic and apply the CNPs to ingress interfaces.

NOTE: Junos OS Release 12.2 introduced changes to the way the QFX Series handles lossless forwarding classes (including the default **fcoe** and **no-loss** forwarding classes).

In Junos OS Release 12.1, either explicitly configuring the **fcoe** and **no-loss** forwarding classes or using the default configuration for these forwarding classes resulted in the same lossless behavior for traffic mapped to those forwarding classes.

However, in Junos OS Release 12.2, if you explicitly configure the **fcoe** or the **no-loss** forwarding class, that forwarding class is no longer treated as a lossless forwarding class. Traffic mapped to these forwarding classes is treated as lossy (best-effort) traffic. This is true even if the explicit configuration is exactly the same as the default configuration.

If your CoS configuration from Junos OS Release 12.1 or earlier includes the explicit configuration of the **fcoe** or the **no-loss** forwarding class, then when you upgrade to Junos OS Release 12.2, those forwarding classes are not lossless. To preserve the lossless treatment of these forwarding classes, delete the the explicit **fcoe** and **no-loss** forwarding class configuration before you upgrade to Junos OS Release 12.2.

See "Overview of CoS Changes Introduced in Junos OS Release 12.2" on page 5304 for detailed information about this change and how to delete an existing lossless configuration.

In Junos OS Release 12.3, the default behavior of the **fcoe** and **no-loss** forwarding classes is the same as in Junos OS Release 12.2. However, in Junos OS Release 12.3, you can configure up to six lossless forwarding classes. All explicitly configured lossless forwarding classes must include the new **no-loss** packet drop attribute or the forwarding class is lossy.

"Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows" on page 5427 provides detailed information about the explicit configuration of lossless priorities and about the default configuration of lossless priorities, including the input and output stanzas of the CNP.

NOTE: PFC and Ethernet PAUSE are used only on Ethernet interfaces. Fabric (fte) ports on QFabric systems (Node device fabric ports and Interconnect device fabric ports) use link-layer flow control (LLFC) to ensure the appropriate treatment of lossless traffic.

Related Documentation

- Overview of CoS Changes Introduced in Junos OS Release 12.2 on page 5304
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427
- Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5446

QFX Series Standalone Switches, QFabric Systems Only

Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows

Junos OS Release 12.3 increased support for lossless priorities from two lossless forwarding classes to up to six lossless forwarding classes on QFX3500 and QFX3600 switches. Each forwarding class is mapped to an IEEE 802.1p code point (priority).

NOTE: Junos OS Release 13.1 introduced support for up to six lossless forwarding classes on QFabric systems. Throughout this document, features introduced on standalone switches in Junos OS Release 12.3 are introduced on QFabric systems in Junos OS Release 13.1 unless otherwise noted.

Junos OS Release 13.2 is the first QFX5100 switch release. The QFX5100 also supports up to six lossless forwarding classes. However, because the QFX5100 switch has no native Fibre Channel (FC) interfaces, the QFX5100 switch does not support native FC traffic and does not support configuration as an FCoE-FC gateway. Throughout this document, features that pertain to native FC traffic and to FCoE-FC gateway configuration do not apply to QFX5100 switches.

Earlier Junos OS software releases supported two lossless forwarding classes, the default *fcoe* and *no-loss* forwarding classes, which are mapped by default to IEEE 802.1p priorities 3 (code point 011) and 4 (code point 100), respectively. Junos OS Release 12.3 also introduced a new output stanza in the congestion notification profile (CNP) to configure priority-based flow control (PFC) on output queues.

The default configuration is the same as the default configuration in Junos OS Release 12.2 and is backward-compatible. If you need only two (or fewer) lossless forwarding classes, use the default configuration. If you need more than two lossless forwarding classes, you can use the two default forwarding classes and configure additional lossless forwarding classes. If you do not want to use the default lossless forwarding classes, you can change them or use only the lossless forwarding classes that you explicitly configure.

- Lossless Transport Features Introduced in Junos OS Release 12.3 on page 5427
- Default Lossless Priority Configuration on page 5428
- Configuring Lossless Priorities on page 5431
- Backward Compatibility with Junos OS Releases Earlier Than Release 12.3 on page 5443
- Configuration Rules and Recommendations on page 5444

Lossless Transport Features Introduced in Junos OS Release 12.3

Support for lossless transport introduced in Junos OS Release 12.3 includes:

- Configuring up to six lossless forwarding classes.
- Configuring PFC pause on output queues to program the output queues that can respond to PFC pause messages received from the connected peer. The priorities you pause on output queues must match the priorities on which you enable PFC on the corresponding ingress interfaces. For example, if you program output queues to pause

priorities 3 (011) and 5 (101), then you must also enable pause on priorities 3 and 5 on the corresponding ingress interfaces. Configuring flow control on the output queues and enabling PFC on the corresponding input queues allows you to pause up to six priorities (forwarding classes).

- Controlling the headroom buffer on Ethernet interfaces by configuring the maximum receive unit (MRU) size for the traffic mapped to an IEEE 802.1p priority (configured per priority) and the length of the attached cable (configured per interface). The MRU size can range up to full jumbo packet size (9216 bytes).
- Remapping (rewriting) IEEE 802.1p priorities on native Fibre Channel (FC) interfaces when the system is acting as an FCoE-FC gateway. If the Ethernet (FCoE) network uses a different IEEE 802.1p priority than priority 3 (011) for FCoE traffic, then you can use priority remapping to classify FCoE traffic into a lossless forwarding class mapped to that different priority (see "Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway" on page 5446).

Lossless transport still requires configuring previously existing features, including enabling PFC on the lossless priorities on ingress interfaces, and configuring classifiers to classify incoming traffic into lossless forwarding classes based on the IEEE 802.1p priority tag of the packet.

NOTE: If you expect a large amount of lossless traffic on your network and configure multiple lossless traffic classes, ensure that you reserve enough scheduling resources (bandwidth) and lossless headroom buffer space to support the lossless flows. ("Understanding CoS Buffer Configuration" on page 5391 describes how to configure buffers and provides a recommended buffer configuration for networks with larger amounts of lossless traffic.)

Default Lossless Priority Configuration

If you do not explicitly configure forwarding classes, the system uses the default forwarding class configuration, which provides two default lossless forwarding classes (*fcoe* and *no-loss*). (If you change the forwarding class configuration on a QFX Series switch or on a QFabric Node device, the changes apply to all traffic on that device because forwarding classes are global to a particular device.)

If you do not explicitly configure classifiers, and you do not explicitly configure flow control to pause output queues (configured in the output stanza of the CNP), the default classifier and the default output queue pause configuration are applied to all Ethernet interfaces on QFX Series switches and Node devices. You can override the default classifier and the default output queue pause configuration on a per-interface basis by applying an explicit configuration to an Ethernet interface. The default configuration is used on all Ethernet interfaces that do not have an explicit configuration.

NOTE: If you do not configure flow control on output queues, the default configuration uses a one-to-one mapping of IEEE 802.1p code points (priorities) to output queues by number. For example, priority 0 (code point 000) is mapped to queue 0, priority 1 (code point 001) is mapped to queue 1, and so on. If you do not use the default configuration, you must explicitly configure flow control on each output queue that you want to enable for PFC pause in the output stanza of the CNP.

In the default configuration, only queue 3 and queue 4 are enabled to respond to pause messages from the connected peer. For queue 3 to respond to pause messages, priority 3 (code point 011) must be enabled for PFC in the input stanza of the CNP. For queue 4 to respond to pause messages, priority 4 (code point 100) must be enabled for PFC in the input stanza of the CNP.

The default configuration is the same as the default configuration in software releases earlier than Junos OS Release 12.3, and provides the same lossless behavior:

- There are two default lossless forwarding classes (the no-loss packet drop attribute is applied automatically):
  fcoe—Mapped to output queue 3
  no-loss—Mapped to output queue 4
- The default classifier maps the fcoe forwarding class to IEEE 802.1p priority 3 (011) and the no-loss forwarding class to IEEE 802.1p priority 4 (100)
- Priority-based flow control (PFC) is enabled on Ethernet interface output queues 3 and 4 when those queues carry lossless traffic (traffic that is mapped to the fcoe and no-loss forwarding classes, respectively). In Junos OS software releases earlier than Release 12.3, output queue flow control was not user-configurable.

  On native FC interfaces (NP_Ports), default flow control is enabled on output queue 3 (IEEE 802.1p priority 3) for FCoE/FC traffic.
- PFC must be enabled explicitly on the lossless IEEE 802.1p priorities (code points) on ingress Ethernet interfaces; no default PFC configuration is applied at ingress interfaces. If you do not enable PFC on lossless priorities, those priorities might experience packet loss during periods of congestion. For example, if you want lossless FCoE traffic and you are using the default fcoe forwarding class, you use a CNP to enable PFC on priority 3 (code point 011), and apply that CNP to all ingress interfaces that carry FCoE traffic.
- On Ethernet ports, PFC buffer calculations use the following default values to determine the headroom buffer size:
  Cable length—100 meters (approximately 328 feet)
  MRU for priority 3 traffic—2500 bytes
  MRU for priority 4 traffic—9216 bytes
  Maximum transmission unit (MTU)—1522 (or the configured MTU value for the interface)

NOTE: If you configure flow control on a priority that is not one of the default flow control priorities, the default MRU value is 2500 bytes. For example, if you configure flow control on priority 5 and you do not configure an MRU value, the default MRU value is 2500 bytes.

- DCBX is enabled on all interfaces in autonegotiation mode, and automatically exchanges FCoE application protocol type, length, and values (TLVs) on interfaces that carry FCoE traffic. However, if you explicitly configure DCBX protocol TLV exchange for any application, then you must explicitly configure protocol TLV exchange for every application for which you want DCBX to exchange TLVs, including FCoE.

The default CoS configuration is backward-compatible with the *default* CoS configuration of software releases before Junos OS Release 12.3. If you explicitly configure lossless transport, ensure that the input and output queues corresponding to the lossless forwarding classes are explicitly configured for PFC pause.

NOTE: If you *explicitly* configured the lossless fcoe or no-loss forwarding classes before upgrading from a release earlier than Junos OS Release 12.3, those forwarding classes are *not* lossless after the upgrade to Junos OS Release 12.3 or later. To regain lossless behavior, you can delete the explicit configuration and use the default lossless forwarding classes, or you can use the no-loss packet drop attribute introduced in Junos OS Release 12.3 to configure the forwarding classes for lossless behavior.

Table 489 on page 5430 summarizes the default unicast forwarding classes and their mapping to output queues, IEEE 802.1p priorities, and drop attributes.

Table 489: Mapping of Default Unicast Forwarding Class to Queue, IEEE 802.1p Priority, and Drop Attribute

Forwarding Class Name	Output Queue	Priority	Drop Attribute
best-effort	0	0	drop
fcoe	3	3	no-loss
no-loss	4	4	no-loss
network-control	7	7	drop

There is one default multidestination forwarding class named *mcast* for multicast, broadcast, and destination lookup fail (DLF) traffic that is mapped to output queue 8 with a drop attribute of drop. (Incoming multidestination traffic on all IEEE 802.1p priorities is mapped to the mcast forwarding class by default.)

Configuring Lossless Priorities

Configuring more than two lossless priorities (forwarding classes), or changing the default mapping of lossless forwarding classes to priorities and paused output queues, requires explicit configuration. Configuring lossless priorities includes:

- Configuring forwarding classes with the no-loss packet drop attribute
- Using a CNP to configure PFC on ingress interfaces and flow control (PFC) on egress interfaces
- Configuring a classifier to map IEEE 802.1p priorities (code points) to the correct forwarding classes (the forwarding classes for which you want lossless transport)

In addition, on Ethernet interfaces, DCBX must exchange the appropriate application protocol TLVs for the lossless traffic, and when the switch acts as an FCoE-FC gateway, you need to remap the FCoE priority on native FC interfaces if your network uses a priority other than 3 (IEEE code point 011) for FCoE traffic. This section describes:

Configuring Lossless Forwarding Classes (Packet Drop Attribute)

Junos OS Release 12.3 introduced the *no-loss* parameter for forwarding class configuration. (Although it uses the same name, this is not the no-loss default forwarding class. It is a packet drop attribute you can specify to configure any unicast forwarding class as a lossless forwarding class.)

You can configure up to six forwarding classes (depending on system architecture and the availability of system resources) as lossless forwarding classes by including the **no-loss** drop attribute at the **[edit class-of-service forwarding-classes class *forwarding-class-name* queue-num *queue-number*]** hierarchy level.

If you use the default fcoe or no-loss forwarding classes, they include the no-loss drop attribute by default. If you explicitly configure the fcoe or no-loss forwarding classes and you want to retain their lossless behavior, you *must* include the no-loss drop attribute in the configuration.

NOTE: All forwarding classes mapped to the same output queue must have the same packet drop attribute. (All forwarding classes mapped to the same output queue must be either lossy or lossless. You cannot map both a lossy and a lossless forwarding class to the same queue.)

To avoid fate sharing (different flows receiving the same CoS treatment), use a one-to-one mapping of lossless forwarding classes to IEEE 802.1p code points (priorities) and queues. (Each forwarding class should be mapped to a different queue and classified into a different priority.) The classifier attached to the interface determines the forwarding class to priority mapping.

The fcoe and no-loss forwarding classes are special cases, because in the default configuration, they are configured for lossless behavior (providing that you also enable PFC on the priorities mapped to the fcoe and no-loss forwarding classes in the CNP input stanza).

Table 490 on page 5432 summarizes the possible configurations of the fcoe and no-loss forwarding classes in Junos OS Release 12.3 and later, and the result of those configurations in terms of lossless traffic behavior. It is assumed that PFC, DCBX, and classifiers are properly configured.

Table 490: FCoE and No-Loss Forwarding Class Configuration in Junos OS Release 12.3

Explicit (User-Configured) or Default Forwarding Class Configuration	Packet Drop Attribute	Result and Notes
Default	Default	The fcoe and no-loss forwarding classes are lossless. NOTE: Even if you explicitly configure other forwarding classes (lossy or lossless forwarding classes), the fcoe and no-loss forwarding classes remain lossless because they are not explicitly configured.
Explicit	Not specified in the explicit forwarding class configuration	The fcoe and no-loss forwarding classes are lossy because they do not include the no-loss drop attribute.
Explicit	No-loss	The fcoe and no-loss forwarding classes are lossless.
Explicit, configured in Junos OS Release 12.2 or earlier	Not specified (packet drop attribute was not available before Junos OS Release 12.3)	The fcoe and no-loss forwarding classes are lossy in Junos OS Release 12.3 and later because they do not include the no-loss drop attribute. NOTE: To retain lossless behavior, before you upgrade to Junos OS Release 12.3, delete the explicit configuration so that the system uses the default configuration. Alternatively, you can reconfigure the forwarding classes with the no-loss packet drop attribute after upgrading to Junos OS Release 12.3 or later.

For all other forwarding classes, you must explicitly configure lossless transport by specifying the no-loss packet drop attribute, because the default configuration for all other forwarding classes is lossy.

Congestion Notification Profiles (PFC Configuration)

Use CNPs to configure lossless PFC characteristics on input and output interfaces.

The input stanza of a CNP enables PFC on specified IEEE 802.1p priorities (code points) and fine-tunes headroom buffer settings by configuring the maximum receive unit (MRU) value and cable length on ingress interfaces.

The output stanza of a CNP enables PFC (flow control) on output queues for specified IEEE 802.1p priorities so that the queues can respond to PFC pause messages from the connected peer on the priority of your choice. (By default, output queues 3 and 4 respond to received PFC messages when those queues carry lossless traffic in the fcoe and no-loss forwarding classes, respectively.)

To achieve lossless transport, the priority paused at the ingress interfaces must match the priority paused at the egress interfaces for a given traffic flow. For example, if you configure ingress interfaces to pause traffic tagged with IEEE 802.1p priority 5 (code point 101) and priority 5 traffic is mapped to output queue 5, then you must also configure the corresponding output interfaces to pause priority 5 on queue 5. In addition, the forwarding class mapped to queue 5 must be configured as a lossless forwarding class (using the no-loss drop attribute).

CAUTION: Any change to the PFC configuration on a port temporarily blocks the entire port (not just the priorities affected by the PFC change) so that the port can implement the change, then unblocks the port. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

A change to the PFC configuration means any change to a CNP, including changing the input portion of the CNP (enabling or disabling PFC on a priority, or changing the MRU or cable-length values) or changing the output portion the CNP that enables or disables output flow control on a queue. A PFC configuration change only affects ports that use the changed CNP.

The following actions change the PFC configuration:

- Deleting or disabling a PFC configuration (input or output) in a CNP that is in use on one or more interfaces. For example:
  1. An existing CNP with an input stanza that enables PFC on priorities 3, 5, and 6 is configured on interfaces xe-0/0/20 and xe-0/0/21.
  2. We disable the PFC configuration for priority 6 in the input CNP, and then commit the configuration.

3. The PFC configuration change causes all traffic on interfaces xe-0/0/20 and xe-0/0/21 to stop until the PFC change has been implemented. When the PFC change has been implemented, traffic resumes.

- Configuring a CNP on an interface. (This changes the PFC state by enabling PFC on one or more priorities.)
- Deleting a CNP from an interface. (This changes the PFC state by disabling PFC on one or more priorities.)

Configuring Input Interface Flow Control (PFC and Headroom Buffer Calculation)

On Ethernet interfaces, the input stanza of the CNP enables PFC on specified priorities so that the ingress interface can send a pause message to the connected peer during periods of congestion. Input CNPs also fine-tune the headroom buffers used for PFC support by allowing you to configure the MRU value and cable length (if you do not want to use the default configuration).

Headroom buffers support lossless transport by storing the traffic that arrives at an interface after the interface sends a PFC flow control message to pause incoming traffic. Until the connected peer receives the flow control message and pauses traffic, the interface continues to receive traffic and must buffer it (and the traffic that is still on the wire after the peer pauses) to prevent packet loss.

The system uses the MRU and the length of the attached physical cable to calculate buffer headroom allocation. The default configuration values are:

- MRU for priority 3 traffic—2500 bytes
- MRU for priority 4 traffic—9216 bytes
- Cable length—100 meters (approximately 328 feet)

NOTE: If you configure flow control on a priority that is not one of the default flow control priorities, the default MRU value is 2500 bytes. For example, if you configure flow control on priority 5 and you do not explicitly configure an MRU value, the default MRU value is 2500 bytes.

You can fine-tune the MRU and the cable length to adjust the size of the headroom buffer on an interface. The QFX Series has a shared global buffer pool and dynamically allocates headroom buffer space to lossless queues as needed.

A lower MRU or a shorter cable length reduces the amount of headroom buffer required on an interface and leaves more headroom buffer space for other interfaces. A higher MRU or a longer cable length increases the amount of headroom buffer space required on an interface and leaves less headroom buffer space for other interfaces.

In many cases, you can better utilize the headroom buffers by reducing the MRU value (for example, an MRU of 2180 is sufficient for most FCoE networks) and by reducing the cable length value if the physical cable is less than 100 meters long.

NOTE: When you configure the headroom buffers by changing the MRU or the cable length, and commit the configuration, the system performs a commit check and rejects the configuration if sufficient headroom buffer space is not available.

However, the system does not perform a commit check but instead returns a syslog error if:

- The buffers are configured on a LAG interface.
- The default classifier is used on the interface (instead of a user-configured classifier).
- The interface has not been created yet.

Configuring Output Interface Flow Control (PFC)

On Ethernet interfaces, you can use the output stanza of the CNP to configure flow control on unicast output queues and enable PFC pause response on specified IEEE 802.1p priorities. By default, output queues 3 and 4 are enabled for PFC pause on priorities 3 (IEEE 802.1p code point 011) and 4 (IEEE 802.1p code point 100). The default PFC pause response supports the default lossless forwarding class configuration, which maps the fcoe forwarding class to queue 3 and priority 3, and maps the no-loss forwarding class to queue 4 and priority 4.

Configuring PFC on output queues enables you to pause any priority on any unicast output queue on any Ethernet interface. Output flow control enables you to use more than two output queues to support lossless traffic flows (you can configure up to six lossless forwarding classes and map them to different output queues that are enabled for PFC pause). Output queue flow control also enables you to support multiple lossless forwarding classes (each mapped to a different priority and output queue) for one class of traffic.

NOTE: Output flow control only works when PFC is enabled in the CNP input stanza on the corresponding priorities on the interface.

For example, if the converged Ethernet network uses two different priorities for FCoE traffic (for example, priority 3 and priority 5), then you can classify those priorities into different lossless forwarding classes that are mapped to different output queues by:

1. Configuring two lossless forwarding classes for FCoE traffic, with each forwarding class mapped to a different output queue. For example, you could use the default fcoe forwarding class, which is mapped to queue 3, and you could configure a second lossless forwarding class called fcoe1 and map it to queue 5. The fcoe forwarding class is for priority 3 FCoE traffic (code point 011), and the fcoe1 forwarding class is for priority 5 (code point 101) FCoE traffic.
2. Configuring a classifier that maps each forwarding class to the desired IEEE 802.1p code point (priority). If FCoE traffic on both priorities uses one interface, the classifier

must classify both forwarding classes to the correct priorities. If FCoE traffic of different priorities uses different interfaces, the classifier configuration on each interface must map the correct priority to the corresponding lossless forwarding class.

3. Applying the classifier to the interfaces that carry FCoE traffic. The classifier determines the mapping of forwarding classes to priorities on each interface.

To configure lossless transport for these forwarding classes, you also need to:

- Enable PFC on the two priorities (3 and 5 in this example) at the ingress interfaces in the CNP input stanza.
- Configure PFC on the output queues and priorities for the forwarding classes in the CNP output stanza so that the interface can respond to pause messages received from the connected peer.

  NOTE: When you configure the CNP on an interface, all ingress and egress traffic is blocked until the configuration is implemented, then the interface is unblocked and traffic resumes. During the time the interface is blocked, all queues on the interface experience packet loss.

- Configure DCBX to exchange application protocol TLVs on both FCoE priorities.

NOTE: If you do not configure flow control to pause output queues, the default configuration uses a one-to-one mapping of IEEE 802.1p code points (priorities) to output queues by number. For example, priority 0 (code point 000) is mapped to queue 0, priority 1 (code point 001) is mapped to queue 1, and so on. By default, only queues 3 and 4 are enabled to respond to pause messages from the connected peer, and you must explicitly enable PFC on the corresponding priorities in the CNP input stanza to achieve lossless behavior.

If you do not use the default configuration, you must explicitly configure flow control on each output queue that you want to enable for PFC pause. For example, if you explicitly configure flow control on output queue 5, the default configuration is no longer valid, and only output queue 5 is enabled for PFC pause. Output queues 3 and 4 are no longer enabled for PFC pause, so traffic using those queues no longer responds to PFC pause messages even if the corresponding forwarding class is configured with the no-loss drop attribute. To retain the pause configuration on output queues 3 and 4 and configure flow control on queue 5, you need to explicitly configure flow control on queues 3, 4, and 5.

You cannot configure flow control to pause a multidestination output queue. You can configure flow control to pause only unicast output queues.

Output Interface Flow Control Profiles

Configuring the CNP output stanza creates an output flow control profile that tells egress ports the queues on which the Ethernet interface should respond to PFC pause messages. Although you can create an unlimited number of CNPs that contain input stanzas only, the number of CNPs that you can configure with output stanzas is limited:

- For QFX3500 and QFX3600 standalone switches that are not part of a QFabric system, you can configure up to two output interface flow control profiles. (You can configure up to two CNPs with output stanzas.)
- For QFabric systems, you can configure one output interface flow control profile per Node device. (You can configure one CNP with an output stanza per Node device.)

There are a total of four output flow control profiles.

The system has a default output flow control profile that is applied to all Ethernet interfaces when the CNP attached to the interface has only an input stanza and does not include an output stanza. The default profile responds to PFC pause messages received on queue 3 (for priority 3, for the default fcoe forwarding class) and on queue 4 (for priority 4, for the default no-loss forwarding class), and is effective only if PFC is configured on those priorities in the CNP input stanza.

Additionally, the system has two internal output flow control profiles that it applies automatically to fabric (FTE) ports and to native FC interfaces (NP_Ports). When the QFX3500 switch or the QFX3600 switch is not part of a QFabric system, the profile normally used for FTE ports is available for user configuration and provides a second user-configurable profile. (That is why standalone QFX3500 and QFX3600 switches have two user-configurable output flow control profiles, but QFX3500 and QFX3600 switches that are part of a QFabric have only one user-configurable output flow control profile.)

Because one output CNP can configure PFC pause response on multiple output queues (priorities), one user-configurable output CNP is usually flexible enough to specify the desired PFC response on all programmed interfaces.

NOTE: **Each port can use one output flow control profile. You cannot apply more than one profile to one port.**

Output flow control profiles can be expressed in table format. For example, Table 491 on page 5437 shows the default output flow control profile that pauses priorities 3 and 4 on queues 3 and 4 (remember that PFC must also be enabled on code points 3 and 4 in the CNP input stanza in order for PFC to work):

Table 491: Default Output Flow Control Profile

IEEE 802.1p Priority Specified in Received PFC Frame	Paused Output Queue
0 (000)	—

Table 491: Default Output Flow Control Profile *(continued)*

IEEE 802.1p Priority Specified in Received PFC Frame	Paused Output Queue
1 (001)	—
2 (010)	—
3 (011)	3
4 (100)	4
5 (101)	—
6 (110)	—
7 (111)	—

Table 492 on page 5438 is an example of a user-configured output flow control profile. Using the example from the preceding section, the CNP output stanza configures flow control on output queue 5, and also explicitly configures output flow control on queues 3 and 4 for the fcoe and no-loss forwarding classes. (If you explicitly configure an output CNP, you must explicitly configure every output queue that you want to respond to PFC messages, because the user-configured profile overrides the default profile. If this example did not include queues 3 and 4, those queues would no longer respond to received PFC messages.)

Table 492: User-Configred Output Flow Control Profile

IEEE 802.1p Priority Specified in Received PFC Frame	Paused Output Queue
0 (000)	—
1 (001)	—
2 (010)	—
3 (011)	3
4 (100)	4
5 (101)	5
6 (110)	—
7 (111)	—

Remember that you must also enable PFC on code points 3, 4, and 5 in the CNP input stanza for this configuration to work. When you configure the CNP on an interface, all ingress and egress traffic is blocked until the configuration is implemented, then the interface is unblocked and traffic resumes. During the time the interface is blocked, all queues on the interface experience packet loss.

Configuring PFC Across Layer 3 Interfaces on QFX5100 Switches

Enabling PFC on traffic flows is based on the IEEE 802.1p code point (priority) in the priority code point (PCP) field of the Ethernet frame header (sometimes known as the CoS bits). To enable PFC on traffic that crosses Layer 3 interfaces, the traffic must be classified by its IEEE 802.1p code point, not by its DSCP (or DSCP IPv6) code point.

See "Understanding PFC Functionality Across Layer 3 Interfaces" on page 5465 for a conceptual overview of how to enable PFC on traffic across Layer 3 interfaces. See "Example: Configuring PFC Across Layer 3 Interfaces" on page 5651 for an example of how to configure PFC on traffic that traverses Layer 3 interfaces.

Configuring DCBX (Application Protocol TLV Exchange)

For applications that require lossless transport, DCBX exchanges application protocol TLVs with the connected peer interface. By default, DCBX advertises FCoE application protocol TLVs on all interfaces that are enabled for DCBX, and by default, DCBX is enabled on all interfaces. DCBX advertises no other applications by default.

For each application (for example, iSCSI) that you want to configure for lossless transport, you must enable the interfaces which carry that application traffic to exchange DCBX protocol TLVs with the connected peer. The TLV exchange allows the peer interfaces to negotiate a compatible configuration to support the application.

If you configure DCBX to advertise any application, the default DCBX advertisement is overridden, and DCBX advertises only the configured applications. If you want an interface to advertise only the FCoE application, you do not have to configure DCBX application protocol TLV exchange; instead, you can use the default configuration.

If you want DCBX to advertise other applications, you must explicitly configure an application map and apply it to the interfaces on which you want to exchange protocol TLVs for those applications. If you want to exchange FCoE application protocol TLVs in addition to other application protocol TLVs, you must also explicitly configure the FCoE application in the application map. "Understanding DCBX Application Protocol TLV Exchange" on page 4915 describes how application mapping works.

NOTE: Lossless transport also requires that you enable PFC on the correct priority (IEEE 802.1p code point) on the ingress interfaces using an input CNP. If the priority you pause at the ingress interfaces is not mapped to queue 3 or queue 4 (the two output queues that are enabled for PFC pause flow control by default), then you must also enable the output queues that correspond to paused input priorities to pause using the output stanza of the CNP.

Fate Sharing Among Traffic Classes

You can configure different lossless (or lossy) traffic flows to share fate—that is, to receive the same CoS treatment.

Fate sharing is not desirable for I/O convergence. Instead of independent control of the fate of each type of flow, different types of flows receive the same treatment. Fate sharing is particularly undesirable for lossless flows. If one lossless flow experiences congestion and must be paused, that affects flows that share fate with the congested flow even if the other flows are not experiencing congestion, and also can cause ingress port congestion. If your network requires that all 802.1p priorities be lossless, you can achieve that by allowing some fate sharing among the eight priorities by spreading them across up to six lossless forwarding classes.

If the number of lossless priorities is less than or equal to the number of configured lossless forwarding classes, then you can avoid fate sharing by configuring a one-to-one mapping of forwarding classes to IEEE 802.1p code points (priorities) and output queues. (Each forwarding class should be mapped to a different output queue and classified to a different priority.)

If you want to configure different traffic flows to share fate, the QFX Series supports two fate-sharing configurations: mapping one forwarding class to more than one IEEE 802.1p code point (priority), and mapping two forwarding classes to the same output queue:

1. If you map one lossless forwarding class to more than one priority, the traffic tagged with each of the priorities uses the same CoS properties associated (the CoS properties associated with the forwarding class). For example, configuring a forwarding class called fc1, mapping it to queue 1, and mapping it to code points 101 and 110 using a classifier named classify1 results in the traffic tagged with priorities 101 and 110 sharing fate:

   ```
   user@switch# set class-of-service forwarding-classes class fc1 queue-num 1 no-loss
   user@switch# set class-of-service classifiers ieee-802.1 classify1 forwarding class fc1 loss-priority low code-points 101
   user@switch# set class-of-service classifiers ieee-802.1 classify1 forwarding class fc1 loss-priority low code-points 110
   ```

   In this case, if the traffic mapped to either priority experiences congestion, both priorities are paused because they are mapped to the same forwarding class and are therefore treated similarly.

2. If you map multiple lossless forwarding classes to the same output queue, the traffic mapped to the forwarding classes uses the same output queue. This increases the amount of traffic the queue needs to buffer and forward, and can create congestion that affects all of the traffic flows that are mapped to the queue. For example, configuring two forwarding classes called fc1 and fc2, mapping both forwarding classes to queue 1, and mapping the forwarding classes to code points 101 and 110 (respectively) using a classifier named classify1 results in the traffic tagged with priorities 101 and 110 sharing fate on the same output queue:

   ```
   user@switch# set class-of-service forwarding-classes class fc1 queue-num 1 no-loss
   user@switch# set class-of-service forwarding-classes class fc2 queue-num 1 no-loss
   user@switch# set class-of-service classifiers ieee-802.1 classify1 forwarding class fc1 loss-priority low code-points 101
   user@switch# set class-of-service classifiers ieee-802.1 classify1 forwarding class fc2 loss-priority low code-points 110
   ```

   in this case, even though the two forwarding classes use different IEEE 802.1p priorities, if one forwarding class experiences congestion, it affects the other forwarding class.

The reason is that if the output queue is paused because of congestion on either forwarding class, all traffic that uses that queue is paused. Since both forwarding classes are mapped to the queue, the traffic mapped to both forwarding classes is paused.

NOTE: If you map more than one forwarding class to a queue, all of the forwarding classes mapped to the same queue must have the same packet drop attribute (all of the forwarding classes must be lossy, or all of the forwarding classes mapped to a queue must be lossless).

Transit Switch Configuration Versus FCoE-FC Gateway Configuration

On a transit switch (all Ethernet ports, no native FC ports) that forwards FCoE traffic (or other traffic that requires lossless transport across the Ethernet network), the configuration of classifiers, lossless forwarding classes, DCBX, and PFC on ingress and egress interfaces to support lossless transport is as described in this document.

When the QFX Series acts as an FCoE-FC gateway, the system uses native FC interfaces (NP_Ports) to connect to the FC switch (or FCoE forwarder) at the FC network edge. You cannot apply CNPs or DCBX to native FC interfaces, only to Ethernet interfaces.

On an FCoE-FC gateway, the Ethernet interface configuration of classifiers, DCBX, and PFC is the same as the Ethernet interface configuration on a transit switch. The configuration of lossless forwarding classes is also the same.

However, supporting lossless transport on native FC interfaces requires that you rewrite the IEEE 802.1p priority value *if* your network uses any priority other than 3 (IEEE code point 011) for FCoE traffic. If your network uses priority 3 for FCoE traffic, you can and should use the default configuration on native FC interfaces.

By default, native FC interfaces tag packets with priority 3 when they encapsulate the incoming FC packets in Ethernet. If your FCoE network uses a different priority than 3 for FCoE traffic, you need to rewrite the priority value to the value that your network uses on the FC interface, classify the FCoE traffic to the correct priority on the Ethernet interfaces, and enable PFC on the correct priority on the Ethernet interfaces, as described in "Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway" on page 5446.

Configuration Results and Commit Checks

Different configurations of forwarding classes and their drop attributes, classifiers, CNPs (PFC flow control), and Ethernet PAUSE (IEEE 802.3X flow control) result in different system behaviors.

Table 493 on page 5442 describes the results of the possible lossless transport configurations in each case. The assumption in the *Result* column is that the system's buffer headroom calculation resulted in a successful configuration.

However, if the system calculates that there is insufficient buffer space to support the configuration, a commit check prevents you from committing the configuration on an individual Ethernet interface. For LAG interfaces, the system does not issue a commit check error but instead issues a syslog message.

NOTE: After you configure lossless transport for a LAG interface, be sure to check the syslog messages to confirm that the commit was successful.

Table 493: Results of Lossless Priority Configuration

Classifier Configuration	Congestion Notification Profile Configuration	Ethernet PAUSE (IEEE 802.3X) Configuration	Result
None (default classifier)	None	None	System default configuration. No flows are lossless. To achieve lossless behavior for the default fcoe and no-loss forwarding classes, you must configure a CNP to enable PFC on their IEEE 802.1p code points (011 and 100 respectively).
Classifier with no lossless forwarding classes	None	None	No lossless traffic flows are configured; all traffic is best effort.
Classifier with at least one lossless forwarding class	None	None	Because no CNP is attached to interfaces, PFC is not enabled on the code point of the lossless traffic and no headroom buffer is allocated to the lossless queue, so packets can drop during periods of congestion. This configuration does not achieve lossless behavior.
None (default classifier)	PFC enabled on the fcoe and no-loss forwarding class code points (priorities)	None	The default classifier classifies traffic into two lossless forwarding classes, fcoe and no-loss. The CNP enables PFC on the priorities mapped to both lossless forwarding classes, resulting in lossless behavior for traffic mapped to the fcoe and no-loss forwarding classes.
None (default classifier)	None	Flow control enabled	The system calculates buffer headroom for the physical link based on the interface MTU and the default cable length. The system does not calculate buffer headroom for individual output queues. Because Ethernet PAUSE is enabled on the link instead of PFC being enabled on the lossless priorities, the entire link is paused during periods of congestion. This configuration results in lossless behavior for all of the forwarding classes on the link, but because all traffic is paused, this can cause greater overall network congestion.

Table 493: Results of Lossless Priority Configuration *(continued)*

Classifier Configuration	Congestion Notification Profile Configuration	Ethernet PAUSE (IEEE 802.3X) Configuration	Result
Classifier with at least one lossless forwarding class	PFC enabled on the lossless forwarding class code points (priorities)	None	Headroom buffer allocated only to priorities that are mapped to the lossless forwarding classes and on which PFC is enabled. This configuration achieves lossless behavior for the lossless forwarding classes.
Classifier with no lossless forwarding classes	None	Flow control enabled	The system calculates buffer headroom for the physical link based on the interface MTU and the default cable length, and it pauses all traffic on the link during periods of congestion.
Classifier with at least one lossless forwarding class	None	Flow control enabled	The system calculates buffer headroom for the physical link based on the interface MTU and the default cable length, and it pauses all traffic on the link during periods of congestion.
Classifier with at least one lossless forwarding class	PFC enabled on the lossless forwarding class code points (priorities)	Flow control enabled on a *different* interface than the interface with the CNP	The system checks the available buffer space for both the PFC-enabled priorities and for the other link. If sufficient buffer space is available, the lossless forwarding classes configured with PFC on one interface and also all of the traffic on the link with Ethernet PAUSE enabled achieve lossless behavior.

NOTE: If you attempt to configure both PFC and Ethernet PAUSE on a link, the system returns a commit error. PFC and Ethernet PAUSE are mutually exclusive configurations on an interface.

Backward Compatibility with Junos OS Releases Earlier Than Release 12.3

The addition of the no-loss packet drop attribute to forwarding class configuration means that when you upgrade from an earlier release to Junos OS Release 12.3, the new software might not preserve the lossless forwarding class configuration of the fcoe and no-loss forwarding classes.

If you used the default forwarding class configuration for the fcoe and no-loss forwarding classes, the CoS configuration is backward-compatible. You do not have to do anything to preserve the lossless behavior of traffic that uses those forwarding classes when you upgrade to Junos OS Release 12.3. (This is because the default configuration of these two forwarding classes includes the no-loss packet drop attribute.)

However, if you explicitly configured the fcoe or the no-loss forwarding class by including the **set forwarding-classes class *forwarding-class-name* queue-num *queue-number*** statement at the **[edit class-of-service]** hierarchy level, then those forwarding classes are no longer lossless, they are lossy. (They are lossy because explicit configuration in releases earlier than Junos OS Release 12.3 did not use the no-loss packet drop attribute.) In Junos OS Release 12.3 and later, you must include the no-loss packet drop attribute in explicit forwarding class configurations to configure a lossless forwarding class.

For example, before Junos OS Release 12.3, the following explicit configuration resulted in a lossless forwarding class:

`user@switch#` **set class-of-service forwarding-classes class fcoe queue-num 3**

However, in Junos OS Release 12.3, this configuration is lossy because it does not include the no-loss packet drop attribute. To preserve lossless behavior, after upgrading to Junos OS Release 12.3, you need to add the no-loss drop attribute:

`user@switch#` **set class-of-service forwarding-classes class fcoe queue-num 3 no-loss**

Alternatively, you can delete the explicit configuration before you upgrade to Junos OS Release 12.3 so that the system uses the default forwarding class, which is lossless:

`user@switch#` **delete class-of-service forwarding-classes class fcoe queue-num 3**

NOTE: The explicit configuration of other forwarding classes does not affect the lossless (or lossy) state of the fcoe and no-loss forwarding classes, because only the fcoe and no-loss forwarding classes were lossless forwarding classes before Junos OS Release 12.3. For example, if you explicitly configured the best-effort forwarding class but you used the default fcoe and no-loss forwarding classes in Junos OS Release 12.2, then when you upgrade to Junos OS Release 12.3, the fcoe and no-loss forwarding classes are still lossless (and the best-effort forwarding classes retains its explicit configuration).

NOTE: To achieve lossless behavior for the traffic belonging to any forwarding class, you must also use a CNP to enable PFC on the IEEE 802.1p priority mapped to the forwarding class and apply the CNP to the relevant interfaces, and ensure that DCBX exchanges the protocol TLVs for the application with the connected peer.

Configuration Rules and Recommendations

Keep in mind the following configuration rules and recommendations when you configure lossless traffic flows:

- You can configure a maximum of six lossless forwarding classes (forwarding classes with the no-loss packet drop attribute).
- All forwarding classes that you map to the same queue must have the same packet drop attribute (all of the forwarding classes must be lossy, or all of the forwarding classes must be lossless).
- You cannot configure flow control to pause a multidestination output queue. You can configure PFC flow control only to pause unicast output queues.
- Forwarding classes mapped to multidestination queues (queues 8 through 11) cannot have the no-loss packet drop attribute. (Multidestination forwarding classes cannot be configured as lossless forwarding classes.)
- Do not configure weighted random early detection (WRED) on lossless forwarding classes. (Do not associate a drop profile with a forwarding class that has the no-loss packet drop attribute.)

Related Documentation

- Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5446
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding CoS Buffer Configuration on page 5391
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- *Understanding CoS Scheduling on QFabric System Node Device Fabric (fte) Ports*
- *Understanding Default CoS Scheduling on QFabric System Interconnect Devices (Junos OS Release 13.1 and Later Releases)*
- Understanding PFC Functionality Across Layer 3 Interfaces on page 5465
- Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch) on page 5584
- Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface on page 5593
- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI) on page 5615
- Example: Configuring IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5631
- Example: Configuring PFC Across Layer 3 Interfaces on page 5651
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685

Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway

When the QFX Series acts as an FCoE-FC gateway, it connects an Ethernet network that carries Fibre Channel over Ethernet (FCoE) traffic to a Fibre Channel (FC) network. Ethernet interfaces connect to the FCoE network. Native FC interfaces (NP_Ports) connect to the FC network.

FCoE traffic typically uses IEEE 802.1p priority 3 (code point 011). The QFX Series default configuration maps priority 3 traffic to the FCoE forwarding class. If your FCoE network uses priority 3 for FCoE traffic, you do not need to remap priorities, because the default configuration maps priority 3 to the FCoE forwarding class. (But you do need to enable PFC on IEEE 802.1p code point 3 on the Ethernet interfaces to achieve lossless behavior.)

However, if the FCoE network uses a different IEEE 802.1p priority than priority 3 for FCoE traffic, then you can use priority remapping to classify FCoE traffic into a lossless forwarding class mapped to that priority (and classified to that priority on the FCoE Ethernet interfaces in the ingress classifier). You specify the lossless forwarding class used for the FCoE traffic by configuring a fixed classifier and applying it to the native FC (NP_Port) interface. All traffic received from the FC SAN on that NP_Port interface is classified into the forwarding class specified in the fixed classifier.

When native FC interfaces on the FCoE-FC gateway encapsulate incoming FC traffic in Ethernet to create FCoE frames, by default they assign IEEE 802.1p code point 011 to the FCoE traffic, forward the traffic internally to the gateway Ethernet interfaces, and then forward the traffic to the FCoE network. Setting a rewrite value for the IEEE 802.1p code point configures the gateway native FC interface to assign the rewrite value priority to the FCoE frames when the native FC interface forwards the FCoE frames to the gateway Ethernet interface. Instead of a priority of 3, the FCoE frames use the priority specified in the rewrite value.

You can configure one rewrite value for each local FCoE-FC gateway fabric. All of the native FC interfaces in a particular fabric must use the same rewrite value. Native FC interfaces that belong to different FCoE-FC gateway fabrics can use different rewrite values.

Priority Remapping Configuration

Native FC interfaces on an FCoE-FC gateway receive native FC traffic from the FC SAN and encapsulate it in Ethernet to create FCoE frames. Priority remapping enables you to map the encapsulated FC traffic (the FCoE traffic) to any IEEE 802.1p priority. (This is similar to the rewrite rules you can configure to remap forwarding classes to code points on Ethernet egress interfaces, but the rewrite takes place at the ingress FC interface so that the QFX Series uses the correct priority for FCoE traffic on the converged Ethernet network.)

To support lossless traffic flows, you must configure the remapped priority correctly on the native FC interfaces and also on the Ethernet interfaces that connect to the FCoE network. Achieving lossless behavior for FCoE traffic when you remap the FCoE priority requires configuring:

- A lossless forwarding class for FCoE traffic (or using the default *fcoe* forwarding class)
- A behavior aggregate (BA) classifier on the FCoE Ethernet interfaces to map the FCoE forwarding class to the IEEE 802.1p code points (priority) used for FCoE traffic on the FCoE network (the ingress classifier priority for the forwarding class must be the same as the rewrite value priority)
- A fixed classifier on the FCoE-FC gateway FC interface that maps all traffic from the FC network into the lossless FCoE forwarding class (the forwarding class must be lossless)
- A priority rewrite value that remaps the IEEE 802.1p code point on the FCoE-FC gateway FC interface to the priority used for FCoE traffic on the FCoE network
- An input congestion notification profile (CNP) to enable priority-based flow control (PFC) on the FCoE code point (the code point used as the rewrite value) at the Ethernet ingress interfaces

The ingress and egress configurations must match to achieve lossless behavior. The priority and the forwarding class specified in the BA classifier and in the CNP on the Ethernet ingress interfaces must match the fixed classifier and rewrite value on the FC interfaces. You must specify the same lossless FCoE forwarding class in each configuration and use the same IEEE 802.1p code point (priority) so that the FCoE traffic is properly classified into flows and so that those flows receive lossless treatment.

For example, if you configure a lossless forwarding class named *my_fcoe_fc* and your Ethernet network uses IEEE 802.1p priority 5 (code point 101) for FCoE traffic, then:

- The forwarding class configuration, the BA classifier, and the fixed classifier all specify *my_fcoe_fc* as the forwarding class
- The BA classifier, the input CNP, and the rewrite value all specify the IEEE 802.1p code point 101

Configuration Rules

The following configuration rules apply when you remap priorities on an FCoE-FC gateway:

- Each native FC interface (NP_Port) supports one IEEE 802.1p priority value. The interface rewrites the IEEE 802.1p code point of all incoming traffic on the interface to the rewrite value. (The FC interface uses either the default value of 3 or the rewrite value for all incoming traffic.)
- Ports in the same FCoE-FC gateway local fc-fabric must use the same rewrite value. For example, if ports fc-0/0/0 and fc-0/0/1 are in the same local FCoE-FC gateway fabric, they must use the same rewrite value. If you attempt to commit a configuration that uses different IEEE 802.1p priority rewrite values, the system returns a commit error.

- Ports in different FCoE-FC gateway local fc-fabrics can use different rewrite values. An example scenario is:
  - Interfaces fc-0/0/0 and fc-0/0/1 are in FCoE-FC gateway fc-fabric *my_fc_fab1*.
  - Interfaces fc-0/0/4 and fc-0/0/5 are in FCoE-FC gateway fc-fabric *my_fc_fab2*.

  In this scenario, interfaces fc-0/0/0 and fc-0/0/1 must use the same rewrite value because they belong to the same local FC fabric on the gateway. Interfaces fc-0/0/4 and fc-0/0/5 also must use the same rewrite value because they belong to the same local FC fabric. However, the rewrite value you use for interfaces fc-0/0/0 and fc-0/0/1 can be different than the rewrite value you use for interfaces fc-0/0/4 and fc-0/0/5 because the interfaces belong to different local FC fabrics.
- You can apply the rewrite value only to native FC interfaces; you cannot apply the rewrite value configuration to Ethernet interfaces.
- The forwarding class specified in the fixed classifier on the native FC interface must be a lossless forwarding class. You cannot apply a fixed classifier to a native FC interface unless the associated forwarding class is lossless. (The forwarding class must be one of the two default lossless forwarding classes, or you must explicitly configure the forwarding class with the *no-loss* drop attribute.)
- The lossless forwarding class and IEEE 802.1p priority configuration must match on the FCoE-FC gateway native FC interfaces and Ethernet interfaces:
  - The same IEEE 802.1p priority (code point) must be enabled for PFC on the Ethernet ingress interfaces, classified to the lossless forwarding class used in the native FC interface fixed classifier, and set as the rewrite value on the native FC interfaces.
  - The same lossless forwarding class must be used in the fixed classifier on the native FC interfaces and in the classifier configuration on the Ethernet interfaces.

Fate Sharing

To ensure that congestion on one interface does not affect the fate of traffic on a native FC interface on which you remap priorities, avoid fate sharing (different traffic flows receiving the same CoS treatment) configurations.

You can avoid fate sharing by ensuring that the remapping priority (code point) on the native FC interface is classified only to the forwarding class used in the fixed classifier on all other interfaces. For example, if you configure a fixed classifier on an FC interface that classifies all of the traffic into lossless forwarding class myfcoe1 and remaps the priority to priority 5 (IEEE 802.1p code point 101), then in all other classifier configurations on all other interfaces, priority 5 should always be classified to forwarding class myfcoe1. If you classify priority 6 on another interface to forwarding class myfcoe1, then congestion on priority 6 traffic affects priority 5 traffic unfairly.

Related Documentation

- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427
- Example: Configuring IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5631

- Configuring CoS Fixed Classifier Rewrite Values for Native FC Interfaces (NP_Ports) on page 5698

Understanding DCB Features and Requirements

Data center bridging (DCB) is a set of enhancements to the IEEE 802.1 bridge specifications. DCB modifies and extends Ethernet behavior to support I/O convergence in the data center. I/O convergence includes but is not limited to the transport of Ethernet LAN traffic and Fibre Channel (FC) storage area network (SAN) traffic on the same physical Ethernet network infrastructure.

A converged architecture saves cost by reducing the number of networks and switches required to support both types of traffic, reducing the number of interfaces required, reducing cable complexity, and reducing administration activities.

The Juniper Networks QFX Series supports the DCB features required to transport converged Ethernet and FC traffic while providing the class-of-service (CoS) and other characteristics FC requires for transmitting storage traffic. To accommodate FC traffic, DCB specifications provide:

- A flow control mechanism called priority-based flow control (PFC, described in IEEE 802.1Qbb) to help provide lossless transport.
- A discovery and exchange protocol for conveying configuration and capabilities among neighbors to ensure consistent configuration across the network, called Data Center Bridging Capability Exchange protocol (DCBX), which is an extension of Link Layer Data Protocol (LLDP, described in IEEE 802.1AB).
- A bandwidth management mechanism called enhanced transmission selection (ETS, described in IEEE 802.1Qaz).
- A congestion management mechanism called quantized congestion notification (QCN, described in IEEE 802.1Qau).

The switch supports the PFC, DCBX, and ETS standards but does not support QCN. The switch also provides the high-bandwidth interfaces (10-Gbps minimum) required to support DCB and converged traffic.

This topic describes the DCB standards and requirements the switch supports:

Lossless Transport

FC traffic requires lossless transport (defined as no frames dropped because of congestion). Standard Ethernet does not support lossless transport, but the DCB extensions to Ethernet along with proper buffer management enable an Ethernet network to provide the level of class of service (CoS) necessary to transport FC frames encapsulated in Ethernet over an Ethernet network.

This section describes these factors in creating lossless transport over Ethernet:

PFC

PFC is a link-level flow control mechanism similar to Ethernet PAUSE (described in IEEE 802.3x). Ethernet PAUSE stops all traffic on a link for a period of time. PFC enables you to divide traffic on a link into eight priorities and stop the traffic of a selected priority without stopping the traffic assigned to other priorities on the link.

Pausing the traffic of a selected priority enables you to provide lossless transport for traffic assigned that priority and at the same time use standard lossy Ethernet transport for the rest of the link traffic.

Buffer Management

Buffer management is critical to the proper functioning of PFC, because if buffers are allowed to overflow, frames are dropped and transport is not lossless.

For each lossless flow priority, the switch requires sufficient buffer space to:

- Store frames sent during the time it takes to send the PFC pause frame across the cable between devices.
- Store the frames that are already on the wire when the sender receives the PFC pause frame.

The propagation delay due to cable length and speed, as well as processing speed, determines the amount of buffer space needed to prevent frame loss due to congestion.

The switch automatically sets the threshold for sending PFC pause frames to accommodate delay from cables as long as 150 meters (492 feet) and to accommodate large frames that might be on the wire when the switch sends the pause frame. This ensures that the switch sends pause frames early enough to allow the sender to stop transmitting before the receive buffers on the switch overflow.

Physical Interfaces

The switch supports 10-Gbps, full-duplex interfaces. The switch enables DCB capability only on 10-Gbps (or faster) Ethernet interfaces.

ETS

PFC divides traffic into up to eight separate streams (priorities, configured on the switch as forwarding classes) on a physical link. ETS enables you to manage the link bandwidth by:

- Grouping the priorities into priority groups (configured on the switch as forwarding class sets).
- Specifying the bandwidth available to each of the priority groups as a percentage of the total available link bandwidth.

- Allocating the bandwidth to the individual priorities in the priority group.

The available link bandwidth is the bandwidth remaining after servicing strict priority flows.

Managing link bandwidth with ETS provides several advantages:

- There is uniform management of all types of traffic on the link, both congestion-managed traffic and standard Ethernet traffic.
- When a priority group does not use all of its allocated bandwidth, other priority groups on the link can use that bandwidth as needed.

  When a priority in a priority group does not use all of its allocated bandwidth, other priorities in the group can use that bandwidth.

  The result is better bandwidth utilization, because priorities that consist of bursty traffic can share bandwidth during periods of low traffic transmission instead of consuming their entire bandwidth allocation when traffic loads are light.
- You can assign traffic types with different service needs to different priorities so that each traffic type receives appropriate treatment.
- Strict priority traffic retains its allocated bandwidth.

DCBX

DCB devices use DCBX to exchange configuration information with directly connected peers (switches and endpoints such as servers). DCBX is an extension of LLDP. If you disable LLDP on an interface, that interface cannot run DCBX. If you attempt to enable DCBX on an interface on which LLDP is disabled, the configuration commit fails.

DCBX can:

- Discover the DCB capabilities of peers.
- Detect DCB feature misconfiguration or mismatches between peers.
- Configure DCB features on peers.

You can configure DCBX operation for PFC, ETS, and for Layer 2 and Layer 4 applications such as FCoE and iSCSI. DCBX is enabled or disabled on a per-interface basis.

Related Documentation

- Overview of Fibre Channel on the QFX Series on page 4786
- Understanding FCoE on page 4799
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding DCBX on page 4905
- Understanding Fibre Channel Terminology on page 4895
- Example: Configuring CoS PFC for FCoE Traffic on page 4921

Understanding DCBX

Data Center Bridging Capability Exchange protocol (DCBX) is an extension of Link Layer Data Protocol (LLDP). If you disable LLDP on an interface, that interface cannot run DCBX. If you attempt to enable DCBX on an interface on which LLDP is disabled, the configuration commit operation fails. Data center bridging (DCB) devices use DCBX to exchange configuration information with directly connected peers.

This topic describes:

DCBX Basics

DCBX can:

- Discover the DCB capabilities of peers.
- Detect DCB feature misconfiguration or mismatches between peers.
- Configure DCB features on peers.

You can configure DCBX operation for priority-based flow control (PFC), Layer 2 and Layer 4 applications such as FCoE and iSCSI, and ETS. DCBX is enabled or disabled on a per-interface basis.

By default, for PFC and ETS, DCBX automatically negotiates administrative state and configuration with each interface's connected peer. To enable DCBX negotiation for applications, you must configure the applications, map them to IEEE 802.1p code points in an application map, and apply the application map to interfaces.

The FCoE application only needs to be included in an application map when you want an interface to exchange type, length, and values (TLVs) for other applications in addition to FCoE. If FCoE is the only application you want an interface to advertise, then you do not need to use an application map. For ETS, DCBX pushes the switch configuration to peers if they are set to learn the configuration from the switch (unless you disable sending the ETS recommendation TLV on interfaces in IEEE DCBX mode).

You can override the default behavior for PFC, for ETS, or for all applications mapped to an interface by turning off autonegotiation to force an interface to enable or disable that feature. You can also disable DCBX autonegotiation for applications on an interface by excluding those applications from the application map you apply to that interface or by deleting the application map from the interface.

The default autonegotiation behavior for applications that are mapped to an interface is:

- DCBX is enabled on the interface if the connected peer device also supports DCBX.
- DCBX is disabled on the interface if the connected peer device does not support DCBX.

During negotiation of capabilities, the switch can push the PFC configuration to an attached peer if the peer is configured as “willing” to learn the PFC configuration from other peers. The Juniper Networks switch does not support self autoprovisioning and does not change its configuration during autonegotiation to match the peer configuration. (The Juniper switch is not “willing” to learn the PFC configuration from peers.)

NOTE: When a port with DCBX enabled begins to exchange type, length, and value (TLV) entries, optional LLDP TLVs on that port are not advertised to neighbors, so that the switch can interoperate with a wider variety of converged network adapters (CNAs) and Layer 2 switches that support DCBX.

DCBX Modes and Support

This section describes DCBX support on the QFX Series:

DCBX Modes (Versions)

The QFX Series supports the two most common DCBX modes:

- IEEE DCBX—The newest DCBX version. Different TLVs have different subtypes (for example, the subtype for the ETS configuration TLV is 9); the IEEE DCBX Organizationally Unique Identifier (OUI) is 0x0080c2.
- DCBX version 1.01—The Converged Enhanced Ethernet (CEE) version of DCBX. It has a subtype of 2 and an OUI of 0x001b21.

IEEE DCBX and DCBX version 1.01 differ mainly in frame format. DCBX version 1.01 uses one TLV that includes all DCBX attribute information, which is sent as sub-TLVs. IEEE DCBX uses a unique TLV for each DCB attribute.

NOTE: The QFX Series does not support pre-CEE (pre-DCB) DCBX versions. Unsupported older versions of DCBX have a subtype of 1 and an OUI of 0x001b21. The QFX Series drops LLDP frames that contain pre-CEE DCBX TLVs.

Table 378 on page 4907 summarizes the differences between IEEE DCBX and DCBX version 1.01, including show command output:

Table 494: Summary of Differences Between IEEE DCBX and DCBX Version 1.01

Characteristic	IEEE DCBX	DCBX Version 1.01
OUI	0x0080c2	0x001b21
Frame Format	Sends a separate, unique TLV for each DCBX attribute. For example, IEEE DCBX uses separate TLVs for ETS, PFC, and each application. Configuration and Recommendation information is sent in different TLVs	Sends one TLV that includes all DCBX attribute information organized in sub-TLVs. The “willing” bit determines whether or not an interface can change its configuration to match the connected peer.
Symmetric/asymmetric configuration with peer	Asymmetric or symmetric	Symmetric only
Differences in the **show dcbx interface *interface-name*** operational command	• Synchronization information is not shown because symmetric configuration is not required. • Operational state information is not shown because the operational states do not have to be symmetric. • TLV type is shown because unique TLVs are sent for each DCBX attribute. • ETS peer Configuration TLV and Recommendation TLV information is shown separately because they are different TLVs.	• Synchronization information is shown because symmetric configuration is required. • Operational state information is shown because the operational states do have to be symmetric. • TLV type is not shown because one TLV is used for all attribute information. • Recommendation TLV is not sent (DCBX Version 1.01 uses the “willing” bit to determine whether or not an interface uses the peer interface configuration).

For more information about how each DCBX mode exchanges TLVs, see the following specifications:

- For DCBX version 1.01—http://www.ieee802.org/1/files/public/docs2008/az-wadekar-dcbx-capability-exchange-discovery-protocol-1108-v1.01.pdf
- For IEEE DCBX—http://www.ieee802.org/1/files/private/az-drafts/d2/802-1az-d2-4.pdf

NOTE: As of Junos OS Release 12.2, this document is located in a private area of the IEEE website, and access requires a password from the IEEE organization. If you are not an IEEE member, you might not be able to access this document until it moves to the public area of the IEEE website.

You can configure interfaces to use the following DCBX modes:

- IEEE DCBX—The interface uses IEEE DCBX regardless of the configuration on the connected peer.

- DCBX version 1.01—The interface uses DCBX version 1.01 regardless of the configuration on the connected peer.
- Autonegotiation—The interface automatically negotiates with the connected peer to determine the DCBX version the peers use. Autonegotiation is the default DCBX mode.

If you configure a DCBX mode on an interface, the interface ignores DCBX protocol data units (PDUs) it receives from the connected peer if the PDUs do not match the DCBX version configured on the interface. For example, if you configure an interface to use IEEE DCBX and the connected peer sends DCBX version 1.01 LLDP PDUs, the interface ignores the version 1.01 PDUs. If you configure an interface to use DCBX version 1.01 and the peer sends IEEE DCBX LLDP PDUs, the interface ignores the IEEE DCBX PDUs.

NOTE: On interfaces that use the IEEE DCBX mode, the **show dcbx neighbors interface *interface-name*** operational command does not include application, PFC, or ETS operational state in the output.

Autonegotiation

Autonegotiation is the default DCBX mode. Each interface automatically negotiates with its connected peer to determine the DCBX version that both interfaces use to exchange DCBX information.

When an interface connects to its peer interface, the interface advertises IEEE DCBX TLVs to the peer. If the interface receives one IEEE DCBX PDU from the peer, the interface sets the DCBX mode as IEEE DCBX. If the interface receives three DCBX version 1.01 TLVs from the peer, the interface sets DCBX version 1.01 as the DCBX mode.

Autonegotiation works slightly differently on QFX3500 switches and QFabric systems:

- QFX3500 switch—When an interface connects to its peer interface, the interface advertises IEEE DCBX TLVs to the peer. If the interface receives an IEEE DCBX TLV from the peer, the interface sets IEEE DCBX as the DCBX mode. If the interface receives three consecutive DCBX version 1.01 TLVs from the peer, the interface sets DCBX version 1.01 as the DCBX mode.
- QFabric system—When an interface connects to its peer interface, the interface advertises DCBX version 1.01 TLVs to the peer. If the interface receives an IEEE DCBX TLVs from the peer, the interface sets IEEE DCBX as the DCBX mode. If the interface receives three consecutive DCBX version 1.01 TLVs from the peer, the interface retains DCBX version 1.01 as the DCBX mode.

NOTE: If the link flaps or the LLDP process restarts, the interface starts the autonegotiation process again. The interface does not use the last received DCBX communication mode.

CNA Support for DCBX Modes

Different CNA vendors support different versions and capabilities of DCBX. The DCBX configuration you use on QFX Series interfaces depends on the DCBX features that the CNAs in your network support.

Interface Support for DCBX

You can configure DCBX on 10-Gigabit Ethernet interfaces and on link aggregation group (LAG) interfaces whose member interfaces are all 10-Gigabit Ethernet interfaces.

DCBX Attribute Types

DCBX has three attribute types:

- Informational—These attributes are exchanged using LLDP, but do not affect DCBX state or operation; they only communicate information to the peer. For example, application priority TLVs are informational TLVs.
- Asymmetric—The values for these types of attributes do not have to be the same on the connected peer interfaces. Peers exchange asymmetric attributes when the attribute values can differ on each peer interface. The peer interface configurations might match or they might differ. For example, ETS Configuration and Recommendation TLVs are asymmetric TLVs.
- Symmetric—The intention is that the values for these types of attributes should be the same on both of the connected peer interfaces. Peer interfaces exchange symmetric attributes to ensure symmetric DCBX configuration for those attributes. For example, PFC Configuration TLVs are symmetric TLVs.

The following sections describe asymmetric and symmetric DCBX attributes:

- Asymmetric Attributes on page 5456
- Symmetric Attributes on page 5457

Asymmetric Attributes

DCBX passes asymmetric attributes between connected peer interfaces to communicate parameter information about those attributes (features). The resulting configuration for an attribute might be different on each peer, so the parameters configured on one interface might not match the parameters on the connected peer interface.

There are two types of asymmetric attribute TLVs:

- Configuration TLV—Configuration TLVs communicate the current operational state and the state of the “willing” bit. The “willing” bit communicates whether or not the interface is willing to accept and use the configuration from the peer interface. If an interface is “willing,” the interface uses the configuration it receives from the peer interface. (The peer interface configuration can override the configuration on the “willing” interface.) If an interface is “not willing”, the configuration on the interface cannot be overridden by the peer interface configuration.
- Recommendation TLV—Recommendation TLVs communicate the parameters the interface recommends that the connected peer interface should use. When an interface

sends a Recommendation TLV, if the connected peer is “willing,” the connected peer changes its configuration to match the parameters in the Recommendation TLV.

Symmetric Attributes

DCBX passes symmetric attributes between connected peer interfaces to communicate parameter information about those attributes (features), with the objective that both interfaces should use the same configuration. The intent is that the parameters configured on one interface should match the parameters on the connected peer interface.

There is one type of symmetric attribute TLV, the Configuration TLV. As with asymmetric attributes, symmetric attribute Configuration TLVs communicate the current operational state and the state of the “willing” bit. “Willing” interfaces use the peer interface parameter values for the attribute. (The attribute configuration of the peer overrides the configuration on the “willing” interface.)

DCBX Application Protocol TLV Exchange

DCBX advertises the switch’s capabilities for Layer 2 applications such as FCoE and Layer 4 applications such as iSCSI:

Application Protocol TLV Exchange

For all applications, DCBX advertises the application’s state and IEEE 802.1p code points on the interfaces to which the application is mapped. If an application is not mapped to an interface, that interface does not advertise the application’s TLVs. There is an exception for FCoE application protocol TLV exchange when FCoE is the only application you want DCBX to advertise on an interface.

FCoE Application Protocol TLV Exchange

Protocol TLV exchange for the FCoE application depends on whether FCoE is the only application you want the interface to advertise or whether you want the interface to exchange other application TLVs in addition to FCoE TLVs.

If FCoE is the only application you want DCBX to advertise on an interface, DCBX exchanges FCoE application protocol TLVs by default if the interface:

- Carries FCoE traffic (traffic mapped by CoS configuration to the FCoE forwarding class)
- Has a congestion notification profile with PFC enabled on the FCoE priority (IEEE 802.1p code point)
- Does *not* have an application map

NOTE: If no CoS configuration for FCoE is mapped to an interface, that interface does not exchange FCoE application protocol TLVs.

If you want DCBX to advertise FCoE and other applications on an interface, you must specify all of the applications, including FCoE, in an application map, and apply the application map to the desired interfaces.

NOTE: **If an application map is applied to an interface, the FCoE application must be explicitly configured in the application map, or the interface does not exchange FCoE TLVs.**

When DCBX advertises the FCoE application, it advertises the FCoE state and IEEE 802.1p code points. If a peer device connected to a switch interface does not support FCoE, DCBX uses autonegotiation to mark the interface as "FCoE down," and FCoE is disabled on that interface.

Disabling Application Protocol TLV Exchange

To disable DCBX application protocol exchange for all applications on an interface, issue the **set protocols dcbx interface** ***interface-name*** **applications no-auto-negotiation** command.

You can also disable DCBX application protocol exchange for applications on an interface by deleting the application map from the interface, or by deleting a particular application from the application map. However, when you delete an application from an application map, the application protocol is no longer exchanged on any interface which uses that application map.

DCBX and PFC

After you enable PFC on a switch interface, DCBX uses autonegotiation to control the operational state of the PFC functionality.

If the peer device connected to the interface supports PFC and is provisioned compatibly with the switch, DCBX sets the PFC operational state to enabled. If the peer device connected to the interface does not support PFC or is not provisioned compatibly with the switch, DCBX sets the operational state to disabled. (PFC must be symmetrical.)

If the peer advertises that it is "willing" to learn its PFC configuration from the switch, DCBX pushes the switch's PFC configuration to the peer and does not check the peer's administrative state.

You can manually override DCBX control of the PFC operational state on a per-interface basis by disabling autonegotiation. If you disable autonegotiation on an interface on which you have configured PFC, then PFC is enabled on that interface regardless of the peer configuration. To disable PFC on an interface, do not configure PFC on that interface.

DCBX and ETS

This section describes:

Default DCBX ETS Advertisement

If you do not configure ETS on an interface, the switch automatically creates a default priority group that contains all of the priorities (forwarding classes, which represent output queues) and assigns 100 percent of the port output bandwidth to that priority group. The default priority group is transparent. It does not appear in the configuration and is used for DCBX advertisement. DCBX advertises the default priority group, its priorities, and the assigned bandwidth.

If you configure ETS on an interface, DCBX advertises:

- Each priority group on the interface
- The priorities in each priority group
- The bandwidth properties of each priority group and priority

Any priority on that interface that is not part of an explicitly configured priority group (forwarding class set) is assigned to the automatically generated default priority group and receives no bandwidth. If you configure ETS on an interface, every forwarding class (priority) on that interface for which you want to forward traffic must belong to a forwarding class set (priority group).

ETS Advertisement and Peer Configuration

DCBX does not control the switch's ETS (hierarchical scheduling) operational state. If the connected peer is configured as "willing," DCBX pushes the switch's ETS configuration to the switch's peers if the ETS Recommendation TLV is enabled (it is enabled by default). If the peer does not support ETS or is not consistently provisioned with the switch, DCBX does not change the ETS operational state on the switch. The ETS operational state remains enabled or disabled based only on the switch hierarchical scheduling configuration and is enabled by default.

When ETS is configured, DCBX advertises the priority groups, the priorities in the priority groups, and the bandwidth configuration for the priority groups and priorities. Any priority (essentially a forwarding class or queue) that is not part of a priority group has no scheduling properties and receives no bandwidth.

You can manually override whether DCBX advertises the ETS state to the peer on a per-interface basis by disabling autonegotiation. This does not affect the ETS state on the switch or on the peer , but it does prevent the switch from sending the Recommendation TLV or the Configuration TLV to the connected peer. To disable ETS on an interface, do not configure priority groups (forwarding class sets) on the interface.

ETS Recommendation TLV

The ETS Recommendation TLV communicates the ETS settings that the switch wants the connected peer interface to use. If the peer interface is "willing," it changes its configuration to match the configuration in the ETS Recommendation TLV. By default, the switch interfaces send the ETS Recommendation TLV to the peer. The settings communicated are the egress ETS settings defined by configuring hierarchical scheduling on the interface.

We recommend that you use the same ETS settings on the connected peer that you use on the switch interface and that you leave the ETS Recommendation TLV enabled. However, on interfaces that use IEEE DCBX as the DCBX mode, if you want an asymmetric configuration between the switch interface and the connected peer, you can disable the ETS Recommendation TLV by including the **no-recommendation-tlv** statement at the **[edit protocols dcbx interface *interface-name* enhanced-transmission-selection]** hierarchy level.

NOTE: You can disable the ETS Recommendation TLV only when the DCBX mode on the interface is IEEE DCBX. Disabling the ETS Recommendation TLV has no effect if the DCBX mode on the interface is DCBX version 1.01. (IEEE DCBX uses separate application attribute TLVs, but DCBX version 1.01 sends all application attributes in the same TLV and uses sub-TLVs to separate the information.)

If you disable the ETS Recommendation TLV, the switch still sends the ETS Configuration TLV to the connected peer. The result is that the connected peer is informed about the switch DCBX ETS configuration, but even if the peer is “willing,” the peer does not change its configuration to match the switch configuration. This is asymmetric configuration—the two interfaces can have different parameter values for the ETS attribute.

For example, if you want a CNA connected to a switch interface to have different bandwidth allocations than the switch ETS configuration, you can disable the ETS Recommendation TLV and configure the CNA for the desired bandwidth. The switch interface and the CNA exchange configuration parameters, but the CNA does not change its configuration to match the switch interface configuration.

Related Documentation

- Understanding DCBX Application Protocol TLV Exchange on page 4915
- Understanding DCB Features and Requirements on page 4795
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Understanding FCoE on page 4799
- Configuring the DCBX Mode on page 5075
- Configuring DCBX Autonegotiation on page 5076
- Disabling the ETS Recommendation TLV on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929

Understanding DCBX Application Protocol TLV Exchange

Data Center Bridging Capability Exchange protocol (DCBX) discovers the data center bridging (DCB) capabilities of connected peers. DCBX also advertises the capabilities of applications on interfaces by exchanging application protocol information through application type, length, and value (TLV) elements. DCBX is an extension of Link Layer Discovery Protocol (LLDP). LLDP must remain enabled on every interface on which you want to use DCBX.

NOTE: LLDP and DCBX are enabled by default on all interfaces.

Setting up application protocol exchange consists of:

- Defining applications
- Mapping the applications to IEEE 802.1p code points in an *application map*
- Configuring classifiers to prioritize incoming traffic and map the incoming traffic to the application by the traffic code points
- Applying the application maps and classifiers to interfaces

You need to explicitly define the applications that you want an interface to advertise. The FCoE application is a special case (see "Applications" on page 4915) and only needs to be defined on an interface if you want DCBX to exchange application protocol TLVs for other applications in addition to FCoE on that interface.

You also need to explicitly map all defined applications that you want an interface to advertise to IEEE 802.1p code points in an application map. The FCoE application is a special case (see "Application Maps" on page 4916) and only requires inclusion in an application map when you want an interface to use DCBX for other applications in addition to FCoE, as described later in this topic.

This topic describes:

Applications

Before an interface can exchange application protocol information, you need to define the applications that you want to advertise, except FCoE if FCoE is the only application that you want the interface to advertise.

NOTE: If FCoE is the only application that you want DCBX to advertise on an interface, DCBX exchanges FCoE application protocol TLVs by default if the interface:

- Carries FCoE traffic (traffic mapped by CoS configuration to the FCoE forwarding class and applied to the interface)
- Has a congestion notification profile with PFC enabled on the FCoE priority (IEEE 802.1p code point)
- Does *not* have an application map

If you apply an application map to an interface, then all applications that you want DCBX to advertise must be defined and configured in the application map, including the FCoE application.

If no CoS configuration for FCoE is mapped to an interface, that interface does not exchange FCoE application protocol TLVs.

You can define:

- Layer 2 applications by EtherType
- Layer 4 applications by a combination of protocol (TCP or UDP) and destination port number

The EtherType is a two-octet field in the Ethernet frame that denotes the protocol encapsulated in the frame. For a list of common EtherTypes, see http://standards.ieee.org/develop/regauth/ethertype/eth.txt on the IEEE standards organization website. For a list of port numbers and protocols, see the *Service Name and Transport Protocol Port Number Registry* at http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xml on the Internet Assigned Numbers Authority (IANA) website.

You must explicitly define each application that you want to advertise, except FCoE. The FCoE application is defined by default (EtherType 0x8906).

Application Maps

An application map maps defined applications to one or more IEEE 802.1p code points. Each application map contains one or more applications. DCBX includes the configured application code points in the protocol TLVs exchanged with the connected peer.

To exchange protocol TLVs for an application, you must include the application in an application map. The FCoE application is a special case:

- If you want DCBX to exchange application protocol TLVs for more than one application on a particular interface, you must configure the applications, define an application map to map the applications to code points, and apply the application map to the interface. In this case, you must also define the FCoE application and add it to the application map.

This is the same process and treatment required for all other applications. In addition, for DCBX to exchange FCoE application TLVs, you must enable priority-based flow control (PFC) on the FCoE priority (the FCoE IEEE 802.1p code point) on the interface.

- If FCoE is the only application that you want DCBX to advertise on an interface, then you do not need to configure an application map and apply it to the interface. By default, when an interface has no application map, and the interface carries traffic mapped to the FCoE forwarding class, and PFC is enabled on the FCoE priority, the interface advertises FCoE TLVs (autonegotiation mode). DCBX exchanges FCoE application protocol TLVs by default until you apply an application map to the interface, remove the FCoE traffic from the interface (you can do this by removing the or editing the classifier for FCoE traffic), or disable PFC on the FCoE priority.

  If you apply an application map to an interface that did not have an application map and was exchanging FCoE application TLVs, and you do not include the FCoE application in the application map, the interface stops exchanging FCoE TLVs. Every interface that has an application map must have FCoE included in the application map (and PFC enabled on the FCoE priority) in order for DCBX to exchange FCoE TLVs.

Mapping an application to code points does two things:

- Maps incoming traffic with the same code points to that application
- Allows you to configure classifiers that map incoming application traffic, by code point, to a forwarding class and a loss priority, in order to apply class of service (CoS) to application traffic and prioritize application traffic

You apply an application map to an interface to enable DCBX application protocol exchange on that interface for each application specified in the application map. All of the applications that you want an interface to advertise must be configured in the application map that you apply to the interface, with the previously noted exception for the FCoE application when FCoE is the only application for which you want DCBX to exchange protocol TLVs on an interface.

Classifying and Prioritizing Application Traffic

When traffic arrives at an interface, the interface classifies the incoming traffic based on its code points. Classifiers map code points to loss priorities and forwarding classes. The loss priority prioritizes the traffic. The forwarding class determines the traffic output queue and CoS service level.

When you map an application to an IEEE 802.1p code point in an application map and apply the application map to an interface, incoming traffic on the interface that matches the application code points is mapped to the appropriate application. The application receives the loss priority and the CoS associated with the forwarding class for those code points, and is placed in the output queue associated with the forwarding class.

You can use the default classifier or you can configure a classifier to map the application code points defined in the application map to forwarding classes and loss priorities.

Enabling Interfaces to Exchange Application Protocol Information

Each interface with the **fcoe** forwarding class and PFC enabled on the FCoE code point is enabled for FCoE application protocol exchange by default until you apply an application map to the interface. If you apply an application map to an interface and you want that interface to exchange FCoE application protocol TLVs, you must include the FCoE application in the application map. (In all cases, to achieve lossless transport, you must also enable PFC on the FCoE code point or code points.)

Except when FCoE is the only protocol you want DCBX to advertise on an interface, interfaces on which you want to exchange application protocol TLVs must include the following two items:

- The application map that contains the application(s)
- A classifier

NOTE: You must also enable PFC on the code point of any traffic for which you want to achieve lossless transport.

Disabling DCBX Application Protocol Exchange

To disable DCBX application protocol exchange for all applications on an interface, issue the **set protocols dcbx interface *interface-name* applications no-auto-negotiation** command.

You can also disable DCBX application protocol exchange for applications on an interface by deleting the application map from the interface, or by deleting a particular application from the application map. However, when you delete an application from an application map, the application protocol is no longer exchanged on any interface which uses that application map.

On interfaces that use IEEE DCBX mode to exchange DCBX parameters, you can disable sending the enhanced transmission selection (ETS) Recommendation TLV to the peer if you want an asymmetric ETS configuration between the peers.

Related Documentation

- Understanding DCBX on page 4905
- Understanding CoS Classifiers on page 5334
- Configuring DCBX Autonegotiation on page 5076
- Disabling the ETS Recommendation TLV on page 5079
- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929

- Example: Configuring Unicast Classifiers on page 5495

QFX5100 Switches Only

- Understanding PFC Functionality Across Layer 3 Interfaces on page 5465

Understanding PFC Functionality Across Layer 3 Interfaces

Priority-based flow control (PFC) allows you to select traffic flows within a link and pause them, so that the output queues associated with the flows do not overflow and drop packets. (PFC is more granular than Ethernet PAUSE, which pauses all traffic on a physical link.) PFC helps you configure lossless transport for traffic flows across a data center bridging network.

However, you might want to create a traffic flow that losslessly traverses the Layer 2 data center bridging network *and* also losslessly traverses a Layer 3 network that connects Ethernet hosts in different Layer 2 networks. On a QFX5100 switch running the Enhanced Layer 2 Software (ELS) CLI, in addition to configuring PFC on Layer 2 (bridging) interfaces, you can configure PFC on traffic that traverses Layer 3 interfaces. This enables you to preserve the lossless characteristics that PFC provides on traffic, even when the traffic crosses Layer 3 interfaces that connect two Layer 2 networks.

PFC works the same way across Layer 3 interfaces as it works across Layer 2 interfaces. When an output queue buffer reaches a certain fill level threshold, the switch sends a PFC pause message to the connected peer to pause transmission of the traffic on which PFC is enabled. Pausing the incoming traffic prevents the queue buffer from overflowing and dropping packets, just as on Layer 2 interfaces. When the queue buffer fill level decreases below a certain threshold, the interface sends a message to the connected peer to restart traffic transmission.

Although PFC is a data center bridging technology, PFC also works on Layer 3 interfaces because PFC operates at the queue level. When you use an IEEE 802.1p classifier to classify incoming traffic (map incoming traffic to a forwarding class and a loss priority based on the IEEE 802.1p code point in the Ethernet frame header) and you enable PFC on the appropriate priority (IEEE 802.1p code point), PFC works on Layer 2 and Layer 3 interfaces.

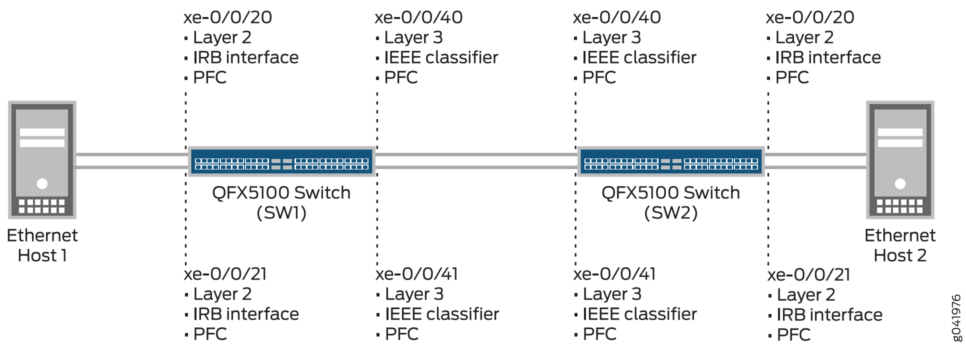
NOTE: Lossless traffic on Layer 3 interfaces *must* use an IEEE 802.1p classifier to classify incoming traffic, because PFC does not use DSCP or DSCP IPv6 code points to identify traffic for flow control. PFC cannot pause traffic flows unless the incoming traffic is classified by an IEEE 802.1p classifier. Do not apply a DSCP (or a DSCP IPv6) classifier to Layer 3 traffic on which you want to enable PFC.

Because PFC functionality relies on the mapping (classifying) of traffic to IEEE 802.1p code points and on enabling PFC on the correct code point(s) at each interface, you must ensure that incoming traffic has the correct 3-bit IEEE 802.1p code point (priority) in the priority code point (PCP) field of the Ethernet frame header (sometimes known as the CoS bits).

NOTE: **Layer 3 interfaces do not support FCoE traffic. FCoE traffic must use Layer 2 interfaces and cannot use Layer 3 interfaces. Therefore, you cannot enable PFC on FCoE traffic across Layer 3 interfaces.**

Figure Figure 198 on page 5466 shows a topology in which two Ethernet hosts in Layer 2 networks communicate across a Layer 3 network, with PFC enabled on all of the Layer 2 and Layer 3 switch interfaces.

Figure 198: Enabling PFC Across Layer 3 Interface Hops



The Ethernet host-facing interfaces (xe-0/0/20 and xe-0/0/21 on both switches) and the Layer 3 network-facing interfaces (interfaces xe-0/0/40 and xe-0/0/41 on both switches) require different interface configurations to enable PFC on the Layer 3 interfaces. In addition, the class of service (CoS) for each interface must be configured correctly, including enabling PFC on the traffic that you want to treat as lossless traffic:

Ethernet-host facing interfaces (xe-0/0/20 and xe-0/0/21) require the following configuration:

- Set interfaces as family ethernet-switching
- Set the interface mode as trunk mode
- Create VLANs to carry the traffic
- Create IRB interfaces to place the Layer 2 VLAN traffic on Layer 3 for transport between IP networks
- Create an IEEE 802.1p classifier to classify incoming traffic into the correct forwarding class, based on the IEEE 802.1p code point
- Create a congestion notification profile (CNP) to configure PFC on the IEEE 802.1p code point of the traffic that you want treat as lossless traffic
- Apply the classifier and the CNP to the Layer 2 interfaces
- Configure CoS: lossless forwarding classes, hierarchical port scheduling (also known as enhanced transmission selection) and apply it to the Layer 2 interfaces

Layer 3 IP network-facing interfaces (xe-0/0/40 and xe-0/0/41) require the following configuration:

- Set interfaces as family inet
- Set VLAN tagging on the interfaces
- Create VLANs to carry the traffic
- Create an IEEE 802.1p classifier to classify incoming traffic into the correct forwarding class, based on the IEEE 802.1p code point (do not use a DSCP or DSCP IPv6 classifier)
- Create a congestion notification profile (CNP) to configure PFC on the IEEE 802.1p code point of the traffic that you want treat as lossless traffic on the Layer 3 interfaces
- Apply the IEEE 802.1p classifier and the CNP to the Layer 3 interfaces
- Configure CoS: lossless forwarding classes, hierarchical port scheduling (enhanced transmission selection) and apply it to the Layer 3 interfaces

NOTE: Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

When you configure the Layer 2 and Layer 3 interfaces correctly, the switch enables PFC on the traffic between Ethernet Host 1 and Ethernet Host 2 across the entire path between the two hosts. If any output queue in the path on which PFC is enabled experiences congestion, PFC pauses the traffic and prevents packet loss for the flow.

Related Documentation

- Example: Configuring PFC Across Layer 3 Interfaces on page 5651
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Understanding CoS Classifiers on page 5334
- Understanding CoS Forwarding Classes on page 5354
- Understanding Routed VLAN Interfaces on page 1409 (Topic also applies to IRB interfaces.)

QFX3500 and QFX3600 Virtual Chassis Only

- CoS on QFX Series Virtual Chassis Switch Ports on page 5468

CoS on QFX Series Virtual Chassis Switch Ports

QFX Series Virtual Chassis devices have access ports to connect to external peer devices, just as other QFX Series devices have access ports. QFX Series Virtual Chassis devices also have Virtual Chassis ports (VCPs) to interconnect members of the Virtual Chassis, in a similar way that QFabric system Node devices have fabric (fte) ports to connect to the QFabric system Interconnect device. VCPs are not used for external access.

Class of service (CoS) on Virtual Chassis access ports is the same as CoS on other QFX Series device access ports, except for shared buffer settings. However, CoS on VCPs differs in several ways from CoS on QFabric system Node device fabric ports.

This topic describes CoS support on Virtual Chassis access interfaces and on VCPs:

Access Interface CoS Support

CoS on Virtual Chassis access interfaces is the same as CoS on QFX Series device access interfaces, except for shared buffer settings. The documentation for QFX Series CoS on access interfaces applies to Virtual Chassis access interfaces, except some of the shared buffer documentation.

Similarities in CoS Support on Virtual Chassis Access Interfaces and Other QFX Series Access Interfaces

Virtual Chassis access interfaces support the following CoS features in the same way as other QFX Series device access interfaces:

- Forwarding classes—The default forwarding classes, queue mapping, and packet drop attributes (Table 495 on page 5469) are the same as on other QFX Series access interfaces:

Table 495: Default Forwarding Class Configuration

Default Forwarding Class	Default Queue Mapping	Default Packet Drop Attribute
best-effort (be)	0	drop
fcoe	3	no-loss
no-loss	4	no-loss
network-control (nc)	7	drop
mcast	8	drop

- Packet classification—Classifier default settings and configuration are the same as on other QFX Series access interfaces. Support for behavior aggregate, multifield, multidestination, and fixed classifiers is the same as on other QFX Series access interfaces.
- Enhanced transmission selection (ETS)—This data center bridging (DCB) feature that supports hierarchical scheduling has the same defaults and user configuration as on other QFX Series access interfaces, including forwarding class set (priority group) and traffic control profile configuration.
- Priority-based flow control (PFC)—This DCB feature that supports lossless transport has the same defaults and user configuration as on other QFX Series access interfaces, including support for six lossless priorities (forwarding classes).
- Ethernet PAUSE—This feature has the same defaults and configuration as on other QFX Series access interfaces.
- Queue scheduling—This feature has the same defaults, configuration, and scheduler-to-forwarding-class mapping as on other QFX Series access interfaces. Queue scheduling is a subset of hierarchical scheduling.
- Priority group (forwarding class set) scheduling—This feature has the same defaults and configuration as on other QFX Series access interfaces. Priority group scheduling is a subset of hierarchical scheduling.
- Tail-drop profiles—This feature has the same defaults and configuration as on other QFX Series access interfaces.

- Code-point aliases—This feature has the same defaults and configuration as on other QFX Series access interfaces.
- Rewrite rules—As on other QFX Series access interfaces, there are no default rewrite rules applied to egress traffic.
- Host outbound traffic—This feature has the same defaults and configuration as on other QFX Series access interfaces.

Differences in CoS Support on Virtual Chassis Access Interfaces and Other QFX Series Access Interfaces

The default shared buffer settings and the way in which you configure shared buffers are the same on Virtual Chassis access interfaces as on other QFX Series device access interfaces. The difference is that on Virtual Chassis access interfaces, the shared buffer configuration is global and applies to all access ports on all members of the Virtual Chassis. (On other QFX Series device access interfaces, you can configure different buffer settings on different standalone systems or on different QFabric system Node devices.)

You cannot configure different shared buffer settings for different Virtual Chassis members. All members of a Virtual Chassis use the same shared buffer configuration.

VCP Interface CoS Support

CoS on the VCP interfaces that connect the Virtual Chassis members is similar to CoS on the fabric interfaces of QFabric system Node devices, but there are several important differences:

- Similarities in CoS Support on VCP Interfaces and QFabric System Node Device Fabric Interfaces on page 5470
- Differences in CoS Support on VCP Interfaces and QFabric System Node Device Fabric Interfaces on page 5471

Similarities in CoS Support on VCP Interfaces and QFabric System Node Device Fabric Interfaces

VCP interfaces support full hierarchical scheduling (ETS). ETS includes the following CoS features. VCP interfaces support no other CoS features.

- Creating forwarding class sets (priority groups) and mapping forwarding classes to forwarding class sets.
- Scheduling individual output queues. The scheduler defaults and configuration are the same as the scheduler on access interfaces.
- Scheduling priority groups (forwarding class sets) using a traffic control profile. The defaults and configuration are the same as on access interfaces.

NOTE: You cannot attach classifiers, congestion notification profiles, or rewrite rules to VCP interfaces. Also, you cannot configure buffer settings on VCP interfaces. Similar to fabric interfaces on QFabric system Node devices, you can only attach forwarding class sets and traffic control profiles to VCP interfaces.

The behavior of lossless traffic across 40-Gigabit VCP interfaces is the same as the behavior of lossless traffic across QFabric system Node device fabric ports. The system automatically enables flow control for lossless forwarding classes (priorities). The system dynamically calculates buffer headroom that is allocated from the global lossless-headroom buffer for the lossless forwarding classes on each 40-Gigabit VCP interface. If there is not enough global lossless-headroom buffer space to support the number of lossless flows on a 40-Gigabit VCP interface, the system generates a syslog message.

NOTE: **After you configure lossless transport on a Virtual Chassis, check the syslog messages to ensure that there is sufficient buffer space to support the configuration.**

NOTE: **If you break out a 40-Gigabit VCP interface into 10-Gigabit VCP interfaces, lossless transport is not supported on the 10-Gigabit VCP interfaces. Lossless transport is supported only on 40-Gigabit VCP interfaces. (10-Gigabit access interfaces support lossless transport.)**

Differences in CoS Support on VCP Interfaces and QFabric System Node Device Fabric Interfaces

Although most of the CoS behavior on VCP interfaces is similar to CoS behavior on the fabric ports of QFabric system Node devices, there are some important differences:

- Hierarchical scheduling (queue and priority group scheduling)—On QFabric system Node device fabric interfaces, you can apply a different hierarchical scheduler (traffic control profile) to different priority groups (forwarding class sets) on different interfaces. However, on VCP interfaces, the schedulers that you apply to priority groups are global to all VCP interfaces. One hierarchical scheduler controls scheduling for a priority group on all VCP interfaces.

  You attach a scheduler to VCP interfaces using the global identifier (vcp-*) for VCP interfaces. For example, if you want to apply a traffic control profile (traffic control profiles contain both queue and priority group scheduling configuration) named *vcp-hpc-tcp* to a forwarding class set named *vcp-hpc-fcset*, you include the following statement in the configuration:

  ```
  [edit]
  user@switch# set class-of-service interfaces vcp-* forwarding-class-set vcp-hpc-fcset
  output-traffic-control-profile vcp-hpc-tcp
  ```

  The system applies the hierarchical scheduler *vcp-hpc-tcp* to the traffic mapped to the priority group *vcp-hpc-fcset* on all VCP interfaces.

- You cannot attach classifiers, congestion notification profiles, or rewrite rules to VCP interfaces. Also, you cannot configure buffer settings on VCP interfaces. Similar to QFabric system Node device fabric interfaces, you can only attach forwarding class sets and traffic control profiles to VCP interfaces.

- Lossless transport is supported only on 40-Gigabit VCP interfaces. If you break out a 40-Gigabit VCP interface into 10-Gigabit VCP interfaces, lossless transport is not supported on the 10-Gigabit VCP interfaces.

CPU-Generated Host Outbound Traffic

CPU-generated host outbound traffic is forwarded on the network-control forwarding class, which is mapped to queue 7. If you use the default scheduler, the network-control queue receives a guaranteed minimum bandwidth (transmit rate) of 5 percent of port bandwidth. The guaranteed minimum bandwidth is more than sufficient to ensure lossless transport of host outbound traffic.

However, if you configure and apply a scheduler instead of using the default scheduler, you must ensure that the network-control forwarding class (or whatever forwarding class you configure for host outbound traffic) receives sufficient guaranteed bandwidth to prevent packet loss.

TIP: If you configure a scheduler instead of using the default scheduler, we recommend that you configure the network-control queue (or the queue you configure for host outbound traffic if it is not the network-control queue) as a strict-high priority queue. Strict-high priority queues receive the bandwidth required to transmit their entire queues before other queues are served.

As with all strict-high priority traffic, if you configure the network-control queue (or any other queue) as a strict-high priority queue, you must also create a separate forwarding class set (priority group) that contains only strict-high priority traffic, and apply the strict-high priority forwarding class set and its traffic control profile (hierarchical scheduler) to the VCP interfaces.

Related Documentation

- Understanding Default CoS Settings on page 5322
- Understanding CoS Classifiers on page 5334
- Understanding CoS Forwarding Classes on page 5354
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Understanding CoS Buffer Configuration on page 5391
- Understanding CoS Tail-Drop Profiles on page 5409
- Understanding CoS Rewrite Rules on page 5414
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding Host Routing Engine Outbound Traffic Queues and Defaults on page 5330

- *Understanding CoS Scheduling on QFabric System Node Device Fabric (fte) Ports*
- *Understanding Default CoS Scheduling on QFabric System Interconnect Devices (Junos OS Release 13.1 and Later Releases)*

CHAPTER 63

Configuration

Configuration Examples

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547

Example: Configuring CoS Hierarchical Port Scheduling (ETS)

Hierarchical port scheduling defines the class-of-service (CoS) properties of output queues, which are mapped to forwarding classes (forwarding classes are mapped to IEEE 802.1p priorities, so mapping queues to forwarding classes also maps queues to priorities). Hierarchical port scheduling enables you to group priorities that require similar CoS resources into priority groups. You define the port bandwidth resources for a priority group, and you define the amount of the priority group's resources that each priority in the group can use.

Hierarchical port scheduling is the Junos OS implementation of enhanced transmission selection (ETS, described in IEEE 802.1Qaz). One major benefit of hierarchical port scheduling is greater port bandwidth utilization. If a priority group on a port does not use all of its allocated bandwidth, other priority groups on that port can use that bandwidth. Also, if a priority within a priority group does not use its allocated bandwidth, other priorities within that priority group can use that bandwidth.

Configuring hierarchical scheduling is a multistep procedure that includes:

- Mapping forwarding classes to queues
- Defining forwarding class sets (priority groups)
- Defining behavior aggregate classifiers
- Configuring priority-based flow control (PFC) for lossless priorities (queues)
- Applying classifiers and PFC configuration to ingress interfaces
- Defining drop profiles
- Defining schedulers
- Mapping forwarding classes to schedulers
- Defining traffic control profiles
- Assigning priority groups and traffic control profiles to egress ports

This example describes how to configure hierarchical scheduling:

- Requirements on page 5475
- Overview on page 5475
- Configuration on page 5478
- Verification on page 5486

Requirements

This example uses the following hardware and software components:

- One Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

Keep the following considerations in mind when you plan the port bandwidth allocation for priority groups and for individual priorities:

- How much traffic and what types of traffic you expect to traverse the system.
- How you want to divide different types of traffic into priorities (forwarding classes, also called queues) to apply different CoS treatment to the traffic. Dividing traffic into priorities includes:
  - Mapping the code points of ingress traffic to forwarding classes using behavior aggregate (BA) classifiers. This classifies incoming traffic into the appropriate forwarding class.
  - Mapping forwarding classes to output queues. This defines the output queue for each type of traffic.
  - Attaching the BA classifier to the desired ingress interfaces so that incoming traffic maps to the desired forwarding classes and queues.
- How you want to organize priorities into priority groups (forwarding class sets).

  Traffic that requires similar treatment usually belongs in the same priority group. To do this, place forwarding classes that require similar bandwidth, loss, and other characteristics in the same forwarding class set. For example, you can map all types of best-effort traffic forwarding classes into one forwarding class set.
- How much of the port bandwidth you want to allocate to each priority group and to each of the priorities in each priority group. The following considerations apply to bandwidth allocation:
  - Estimate how much traffic you expect in each forwarding class (output queue) and how much traffic you expect in each forwarding class set (the aggregate amount of traffic in the forwarding classes that belong to the forwarding class set).
  - The combined minimum guaranteed bandwidth of the priorities (forwarding classes) in a priority group should not exceed the minimum guaranteed bandwidth of the priority group. The transmit rate scheduler parameter defines the minimum guaranteed bandwidth for forwarding classes. Scheduler maps associate schedulers with forwarding classes.
  - The combined minimum guaranteed bandwidth of the priority groups (forwarding class sets) on a port should not exceed the port's total bandwidth. Traffic control profiles define the minimum bandwidth for a forwarding class set. Associating a scheduler map with a traffic control profile sets the scheduling for the individual forwarding classes in the forwarding class set.

This example creates hierarchical port scheduling by defining priority groups for best effort, guaranteed delivery, and high-performance computing (HPC) traffic. Each priority group includes priorities that need to receive similar CoS treatment. Each priority group and each priority within each priority group receive the CoS resources needed to service their flows. Lossless priorities use PFC to prevent packet loss when the network experiences congestion.

Topology

Table 496 on page 5476 shows the configuration components for this example.

Table 496: Components of the Hierarchical Port Scheduling (ETS) Configuration Topology

Property	Settings
Hardware	QFX3500 switch
Mapping of forwarding classes (priorities) to queues	**best-effort** to queue **0** **be** to queue **1** **fcoe** (Fibre Channel over Ethernet) to queue **3** **no-loss** to queue **4** **hpc** (high-performance computing) to queue **5** **network-control** to queue **7** NOTE: If you are using Junos OS Release 12.2 or later, use the default forwarding-class-to-queue mapping for the lossless **fcoe** and **no-loss** forwarding classes. If you explicitly configure the default lossless forwarding classes, the traffic mapped to those forwarding classes is treated as lossy (**best-effort**) traffic and does *not* receive lossless treatment. In Junos OS Release 12.3 and later, you can include the *no-loss* packet drop attribute in the explicit forwarding class configuration to configure a lossless forwarding class.
Forwarding class sets (priority groups)	**best-effort-pg**: contains forwarding classes **best-effort**, **be**, and **network control** **guar-delivery-pg**: contains forwarding classes **fcoe** and **no-loss** **hpc-pg**: contains forwarding class **hpc**
Behavior aggregate classifier (maps forwarding classes and loss priorities to incoming packets by IEEE 802.1 code point)	Name—**hsclassifier1** Code point mapping: • **000** to forwarding class **best-effort** and loss priority **low** • **001** to forwarding class **be** and loss priority **high** • **011** to forwarding class **fcoe** and loss priority **low** • **100** to forwarding class **no-loss** and loss priority **low** • **101** to forwarding class **hpc** and loss priority **low** • **110** to forwarding class **network-control** and loss priority **low**

Table 496: Components of the Hierarchical Port Scheduling (ETS) Configuration Topology *(continued)*

Property	Settings
PFC	Congestion notification profile name—**gd-cnp** PFC enabled on code points: **011** (**fcoe** priority), **010** (**no-loss** priority)
Drop profiles NOTE: The **fcoe** and **no-loss** priorities (queues) do not use drop profiles because they are lossless traffic classes.	**dp-be-low**: drop start point **25**, drop end point **50**, maximum drop rate **80** **dp-be-high**: drop start point **10**, drop end point **40**, maximum drop rate **100** **dp-hpc**: drop start point **75**, drop end point **90**, maximum drop rate **75** **dp-nc**: drop start point **80**, drop end point **100**, maximum drop rate **100**
Queue schedulers	**be-sched**: minimum bandwidth **3g**, maximum bandwidth **100%**, priority **low**, drop profiles **dp-be-low** and **dp-be-high** **fcoe-sched**: minimum bandwidth **2.5g**, maximum bandwidth **100%**, priority **low** **hpc-sched**: minimum bandwidth **2g**, maximum bandwidth **100%**, priority **low**, drop profile **dp-hpc** **nc-sched**: minimum bandwidth **500m**, maximum bandwidth **100%**, priority **low**, drop profile **dp-nc** **nl-sched**: minimum bandwidth **2g**, maximum bandwidth **100%**, priority **low**
Forwarding class-to-scheduler mapping	Scheduler map **be-map**: Forwarding class **best-effort**, scheduler **be-sched** Forwarding class **be**, scheduler **be-sched** Forwarding class **network-control**, scheduler **nc-sched** Scheduler map **gd-map**: Forwarding class **fcoe**, scheduler **fcoe-sched** Forwarding class **no-loss**, scheduler **nl-sched** Scheduler map **hpc-map**: Forwarding class **hpc**, scheduler **hpc-sched**
Traffic control profiles	**be-tcp**: scheduler map **be-map**, minimum bandwidth **3.5g**, maximum bandwidth **100%** **gd-tcp**: scheduler map **gd-map**, minimum bandwidth **4.5g**, maximum bandwidth **100%** **hpc-tcp**: scheduler map **hpc-map**, minimum bandwidth **2g**, maximum bandwidth **100%**
Interfaces	This example configures hierarchical port scheduling on interfaces **xe-0/0/20** and **xe-0/0/21**. Because traffic is bidirectional, you apply the ingress and egress configuration components to both interfaces: • Classifier Name—**hsclassifier1** • Forwarding class sets—**best-effort-pg**, **guar-deliver-pg**, **hpc-pg** • Congestion notification profile—**gd-cnp**

Figure 199 on page 5478 shows a block diagram of the configuration components and the configuration flow of the CLI statements used in the example. You can perform the configuration steps in a different sequence if you want.

Figure 199: Hierarchical Port Scheduling Components Block Diagram

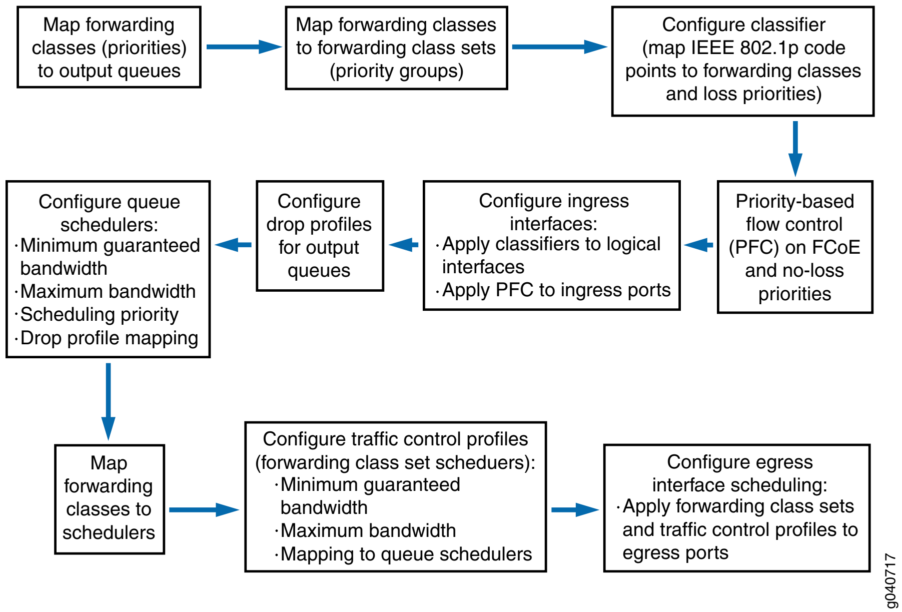
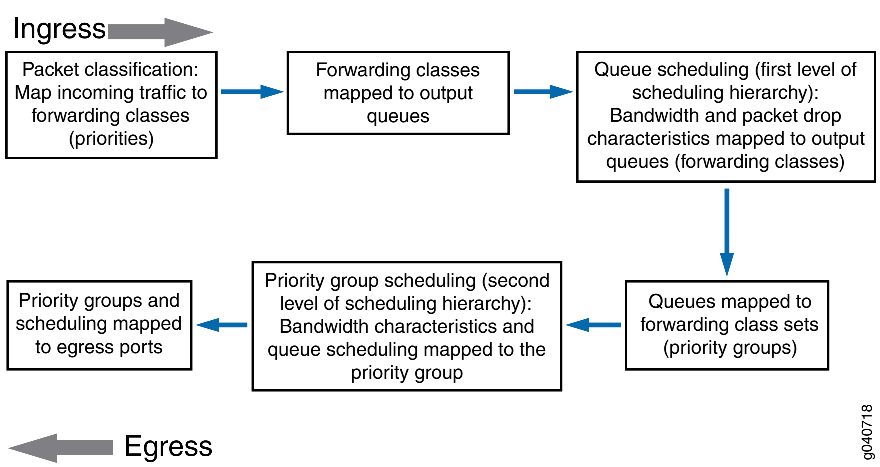


Figure 200 on page 5478 shows a block diagram of the hierarchical scheduling packet flow from ingress to egress.

Figure 200: Hierarchical Port Scheduling Packet Flow Block Diagram



Configuration

CLI Quick Configuration

To quickly configure hierarchical port scheduling, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level:

```
[edit class-of-service]
set forwarding-classes class best-effort queue-num 0
set forwarding-classes class be2 queue-num 1
set forwarding-classes class hpc queue-num 5
set forwarding-classes class network-control queue-num 7
set forwarding-class-sets best-effort-pg class best-effort
set forwarding-class-sets best-effort-pg class be2
set forwarding-class-sets best-effort-pg class network-control
set forwarding-class-sets guar-delivery-pg class fcoe
set forwarding-class-sets guar-delivery-pg class no-loss
set forwarding-class-sets hpc-pg class hpc
set classifiers ieee-802.1 hsclassifier1 forwarding-class best-effort loss-priority low code-points 000
set classifiers ieee-802.1 hsclassifier1 forwarding-class be2 loss-priority high code-points 001
set classifiers ieee-802.1 hsclassifier1 forwarding-class fcoe loss-priority low code-points 011
set classifiers ieee-802.1 hsclassifier1 forwarding-class no-loss loss-priority low code-points 100
set classifiers ieee-802.1 hsclassifier1 forwarding-class hpc loss-priority low code-points 101
set classifiers ieee-802.1 hsclassifier1 forwarding-class network-control loss-priority low code-points 110
set congestion-notification-profile gd-cnp input ieee-802.1 code-point 011 pfc
set congestion-notification-profile gd-cnp input ieee-802.1 code-point 100 pfc
set interfaces xe-0/0/20 unit 0 classifiers ieee-802.1 hsclassifier1
set interfaces xe-0/0/21 unit 0 classifiers ieee-802.1 hsclassifier1
set interfaces xe-0/0/20 congestion-notification-profile gd-cnp
set interfaces xe-0/0/21 congestion-notification-profile gd-cnp
set drop-profiles dp-be-low interpolate fill-level 25 fill-level 50 drop-probability 0 drop-probability 80
set drop-profiles dp-be-high interpolate fill-level 10 fill-level 40 drop-probability 0 drop-probability 100
set drop-profiles dp-nc interpolate fill-level 80 fill-level 100 drop-probability 0 drop-probability 100
set drop-profiles dp-hpc interpolate fill-level 75 fill-level 90 drop-probability 0 drop-probability 75
set schedulers be-sched priority low transmit-rate 3g
set schedulers be-sched shaping-rate percent 100
set schedulers be-sched drop-profile-map loss-priority low protocol any drop-profile dp-be-low
set schedulers be-sched drop-profile-map loss-priority high protocol any drop-profile dp-be-high
set schedulers fcoe-sched priority low transmit-rate 2500m
set schedulers fcoe-sched shaping-rate percent 100
set schedulers hpc-sched priority low transmit-rate 2g
set schedulers hpc-sched shaping-rate percent 100
set schedulers hpc-sched drop-profile-map loss-priority low protocol any drop-profile dp-hpc
set schedulers nc-sched priority low transmit-rate 500m
set schedulers nc-sched shaping-rate percent 100
set schedulers nc-sched drop-profile-map loss-priority low protocol any drop-profile dp-nc
set schedulers nl-sched priority low transmit-rate 2g
set schedulers nl-sched shaping-rate percent 100
set scheduler-maps be-map forwarding-class best-effort scheduler be-sched
set scheduler-maps be-map forwarding-class be2 scheduler be-sched
set scheduler-maps be-map forwarding-class network-control scheduler nc-sched
set scheduler-maps gd-map forwarding-class fcoe scheduler fcoe-sched
set scheduler-maps gd-map forwarding-class no-loss scheduler nl-sched
set scheduler-maps hpc-map forwarding-class hpc scheduler hpc-sched
set traffic-control-profiles be-tcp scheduler-map be-map guaranteed-rate 3500m
set traffic-control-profiles be-tcp shaping-rate percent 100
set traffic-control-profiles gd-tcp scheduler-map gd-map guaranteed-rate 4500m
set traffic-control-profiles gd-tcp shaping-rate percent 100
```

set traffic-control-profiles hpc-tcp scheduler-map hpc-map guaranteed-rate 2g
set traffic-control-profiles hpc-tcp shaping-rate percent 100
set interfaces xe-0/0/20 forwarding-class-set best-effort-pg output-traffic-control-profile be-tcp
set interfaces xe-0/0/20 forwarding-class-set guar-delivery-pg output-traffic-control-profile gd-tcp
set interfaces xe-0/0/20 forwarding-class-set hpc-pg output-traffic-control-profile hpc-tcp
set interfaces xe-0/0/21 forwarding-class-set best-effort-pg output-traffic-control-profile be-tcp
set interfaces xe-0/0/21 forwarding-class-set guar-delivery-pg output-traffic-control-profile gd-tcp
set interfaces xe-0/0/21 forwarding-class-set hpc-pg output-traffic-control-profile hpc-tcp

Step-by-Step Procedure

To perform a step-by-step configuration of the forwarding classes (priorities), forwarding class sets (priority groups), classifiers, queue schedulers, PFC, traffic control profiles, and interfaces to set up hierarchical port scheduling (ETS):

1. Configure the forwarding classes (priorities) and map them to unicast output queues (do not explicitly map the **fcoe** and **no-loss** forwarding classes to output queues; use the default configuration):

```
[edit class-of-service]
user@switch# set forwarding-classes class best-effort queue-num 0
user@switch# set forwarding-classes class be2 queue-num 1
user@switch# set forwarding-classes class hpc queue-num 5
user@switch# set forwarding-classes class network-control queue-num 7
```

2. Configure forwarding class sets (priority groups) to group forwarding classes (priorities) that require similar CoS treatment:

```
[edit class-of-service]
user@switch# set forwarding-class-sets best-effort-pg class best-effort
user@switch# set forwarding-class-sets best-effort-pg class be2
user@switch# set forwarding-class-sets best-effort-pg class network-control
user@switch# set forwarding-class-sets guar-delivery-pg class fcoe
user@switch# set forwarding-class-sets guar-delivery-pg class no-loss
user@switch# set forwarding-class-sets hpc-pg class hpc
```

3. Configure a classifier to set the loss priority and IEEE 802.1 code points assigned to each forwarding class at the ingress:

```
[edit class-of-service]
user@switch# set classifiers ieee-802.1 hsclassifier1 forwarding-class best-effort
loss-priority low code-points 000
user@switch# set classifiers ieee-802.1 hsclassifier1 forwarding-class be2 loss-priority
high code-points 001
user@switch# set classifiers ieee-802.1 hsclassifier1 forwarding-class fcoe loss-priority
low code-points 011
user@switch# set classifiers ieee-802.1 hsclassifier1 forwarding-class no-loss loss-priority
low code-points 100
user@switch# set classifiers ieee-802.1 hsclassifier1 forwarding-class hpc loss-priority low
code-points 101
user@switch# set classifiers ieee-802.1 hsclassifier1 forwarding-class network-control
loss-priority low code-points 110
```

4. Configure a congestion notification profile to enable PFC on the FCoE and no-loss queue IEEE 802.1 code points:

```
[edit class-of-service]
user@switch# set congestion-notification-profile gd-cnp input ieee-802.1 code-point 011
pfc
user@switch# set congestion-notification-profile gd-cnp input ieee-802.1 code-point 100
pfc
```


5. Assign the classifier to the interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/20 unit 0 classifiers ieee-802.1 hsclassifier1
   user@switch# set interfaces xe-0/0/21 unit 0 classifiers ieee-802.1 hsclassifier1
   ```

6. Apply the PFC configuration to the interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/20 congestion-notification-profile gd-cnp
   user@switch# set interfaces xe-0/0/21 congestion-notification-profile gd-cnp
   ```

7. Configure the drop profile for the best-effort low loss-priority queue:

   ```
   [edit class-of-service]
   user@switch# set drop-profiles dp-be-low interpolate fill-level 25 fill-level 50
   drop-probability 0 drop-probability 80
   ```

8. Configure the drop profile for the best-effort high loss-priority queue:

   ```
   [edit class-of-service]
   user@switch# set drop-profiles dp-be-high interpolate fill-level 10 fill-level 40
   drop-probability 0 drop-probability 100
   ```

9. Configure the drop profile for the network-control queue:

   ```
   [edit class-of-service]
   user@switch# set drop-profiles dp-nc interpolate fill-level 80 fill-level 100 drop-probability
   0 drop-probability 100
   ```

10. Configure the drop profile for the high-performance computing queue:

    ```
    [edit class-of-service]
    user@switch# set drop-profiles dp-hpc interpolate fill-level 75 fill-level 90 drop-probability
    0 drop-probability 75
    ```

11. Define the minimum guaranteed bandwidth, priority, maximum bandwidth, and drop profiles for the best-effort queue:

    ```
    [edit class-of-service]
    user@switch# set schedulers be-sched priority low transmit-rate 3g
    user@switch# set schedulers be-sched shaping-rate percent 100
    user@switch# set schedulers be-sched drop-profile-map loss-priority low protocol any
    drop-profile dp-be-low
    user@switch# set schedulers be-sched drop-profile-map loss-priority high protocol any
    drop-profile dp-be-high
    ```

12. Define the minimum guaranteed bandwidth, priority, and maximum bandwidth for the FCoE queue:

    ```
    [edit class-of-service]
    user@switch# set schedulers fcoe-sched priority low transmit-rate 2500m
    user@switch# set schedulers fcoe-sched shaping-rate percent 100
    ```

13. Define the minimum guaranteed bandwidth, priority, maximum bandwidth, and drop profile for the high-performance computing queue:

    ```
    [edit class-of-service]
    user@switch# set schedulers hpc-sched priority low transmit-rate 2g
    user@switch# set schedulers hpc-sched shaping-rate percent 100
    user@switch# set schedulers hpc-sched drop-profile-map loss-priority low protocol any
    drop-profile dp-hpc
    ```

14. Define the minimum guaranteed bandwidth, priority, maximum bandwidth, and drop profile for the network-control queue:

    ```
    [edit class-of-service]
    user@switch# set schedulers nc-sched priority low transmit-rate 500m
    user@switch# set schedulers nc-sched shaping-rate percent 100
    user@switch# set schedulers nc-sched drop-profile-map loss-priority low protocol any drop-profile dp-nc
    ```

15. Define the minimum guaranteed bandwidth, priority, and maximum bandwidth for the no-loss queue:

    ```
    [edit class-of-service]
    user@switch# set schedulers nl-sched priority low transmit-rate 2g
    user@switch# set schedulers nl-sched shaping-rate percent 100
    ```

16. Map the schedulers to the appropriate forwarding classes (queues):

    ```
    [edit class-of-service]
    user@switch# set scheduler-maps be-map forwarding-class best-effort scheduler be-sched
    user@switch# set scheduler-maps be-map forwarding-class be2 scheduler be-sched
    user@switch# set scheduler-maps be-map forwarding-class network-control scheduler nc-sched
    user@switch# set scheduler-maps gd-map forwarding-class fcoe scheduler fcoe-sched
    user@switch# set scheduler-maps gd-map forwarding-class no-loss scheduler nl-sched
    user@switch# set scheduler-maps hpc-map forwarding-class hpc scheduler hpc-sched
    ```

17. Define the traffic control profile for the best-effort priority group (queue scheduler to mapping, minimum guaranteed bandwidth, and maximum bandwidth):

    ```
    [edit class-of-service]
    user@switch# set traffic-control-profiles be-tcp scheduler-map be-map guaranteed-rate 3500m
    user@switch# set traffic-control-profiles be-tcp shaping-rate percent 100
    ```

18. Define the traffic control profile for the guaranteed delivery priority group (queue to scheduler mapping, minimum guaranteed bandwidth, and maximum bandwidth):

    ```
    [edit class-of-service]
    user@switch# set traffic-control-profiles gd-tcp scheduler-map gd-map guaranteed-rate 4500m
    user@switch# set traffic-control-profiles gd-tcp shaping-rate percent 100
    ```

19. Define the traffic control profile for the high-performance computing priority group (queue to scheduler mapping, minimum guaranteed bandwidth, and maximum bandwidth):

    ```
    [edit class-of-service]
    user@switch# set traffic-control-profiles hpc-tcp scheduler-map hpc-map guaranteed-rate 2g
    user@switch# set traffic-control-profiles hpc-tcp shaping-rate percent 100
    ```

20. Apply the three priority groups (forwarding class sets) and the appropriate traffic control profiles to the egress ports:

    ```
    [edit class-of-service]
    user@switch# set interfaces xe-0/0/20 forwarding-class-set best-effort-pg output-traffic-control-profile be-tcp
    user@switch# set interfaces xe-0/0/20 forwarding-class-set guar-delivery-pg output-traffic-control-profile gd-tcp
    user@switch# set interfaces xe-0/0/20 forwarding-class-set hpc-pg output-traffic-control-profile hpc-tcp
    ```



```
user@switch# set interfaces xe-0/0/21 forwarding-class-set best-effort-pg
output-traffic-control-profile be-tcp
user@switch# set interfaces xe-0/0/21 forwarding-class-set guar-delivery-pg
output-traffic-control-profile gd-tcp
user@switch# set interfaces xe-0/0/21 forwarding-class-set hpc-pg
output-traffic-control-profile hpc-tcp
```

Results

Display the results of the configuration (the system shows only the explicitly configured parameters; it does not show default parameters such as the **fcoe** and **no-loss** lossless forwarding classes):

```
user@switch> show configuration class-of-service
classifiers {
  ieee-802.1 hsclassifier1 {
    forwarding-class best-effort {
      loss-priority low code-points 000;
    }
    forwarding-class be2 {
      loss-priority high code-points 001;
    }
    forwarding-class fcoe {
      loss-priority low code-points 011;
    }
    forwarding-class no-loss {
      loss-priority low code-points 100;
    }
    forwarding-class hpc {
      loss-priority low code-points 101;
    }
    forwarding-class network-control {
      loss-priority low code-points 110;
    }
  }
  drop-profiles {
    dp-be-low {
      interpolate {
        fill-level [ 25 50 ];
        drop-probability [ 0 80 ];
      }
    }
    dp-be-high {
      interpolate {
        fill-level [ 10 40 ];
        drop-probability [ 0 100 ];
      }
    }
    dp-hpc {
      interpolate {
        fill-level [ 75 90 ];
        drop-probability [ 0 75 ];
      }
    }
    dp-nc {
      interpolate {
```

```
            fill-level [ 80 100 ];
            drop-probability [ 0 100 ];
        }
    }
}
forwarding-classes {
    class best-effort queue-num 0;
    class be2 queue-num 1;
    class hpc queue-num 5;
    class network-control queue-num 7;
}
traffic-control-profiles {
    be-tcp {
        scheduler-map be-map;
        shaping-rate percent 100;
        guaranteed-rate 3500000000;
    }
    gd-tcp {
        scheduler-map gd-map;
        shaping-rate percent 100;
        guaranteed-rate 4500000000;
    }
    hpc-tcp {
        scheduler-map hpc-map;
        shaping-rate percent 100;
        guaranteed-rate 2g;
    }
}
forwarding-class-sets {
    guar-delivery-pg {
        class fcoe;
        class no-loss;
    }
    best-effort-pg {
        class best-effort;
        class be2;
        class network-control;
    }
    hpc-pg {
        class hpc;
    }
}
congestion-notification-profile {
    gd-cnp {
        input {
            ieee-802.1 {
                code-point 011 {
                    pfc;
                }
                code-point 100 {
                    pfc;
                }
            }
        }
    }
}
```

```
interfaces {
  xe-0/0/20 {
    forwarding-class-set {
      best-effort-pg {
        output-traffic-control-profile be-tcp;
      }
      guar-delivery-pg {
        output-traffic-control-profile gd-tcp;
      }
      hpc-pg {
        output-traffic-control-profile hpc-tcp;
      }
    }
    congestion-notification-profile gd-cnp;
    unit 0 {
      classifiers {
        ieee-802.1 hsclassifier1;
      }
    }
  }
  xe-0/0/21 {
    forwarding-class-set {
      best-effort-pg {
        output-traffic-control-profile be-tcp;
      }
      guar-delivery-pg {
        output-traffic-control-profile gd-tcp;
      }
      hpc-pg {
        output-traffic-control-profile hpc-tcp;
      }
    }
    congestion-notification-profile gd-cnp;
    unit 0 {
      classifiers {
        ieee-802.1 hsclassifier1;
      }
    }
  }
}
scheduler-maps {
  be-map {
    forwarding-class best-effort scheduler be-sched;
    forwarding-class network-control scheduler nc-sched;
    forwarding-class be2 scheduler be-sched;
  }
  gd-map {
    forwarding-class fcoe scheduler fcoe-sched;
    forwarding-class no-loss scheduler nl-sched;
  }
  hpc-map {
    forwarding-class hpc scheduler hpc-sched;
  }
}
schedulers {
  be-sched {
```



```
            transmit-rate 3g;
            shaping-rate percent 100;
            priority low;
            drop-profile-map loss-priority low protocol any drop-profile dp-be-low;
            drop-profile-map loss-priority high protocol any drop-profile dp-be-high;
        }
        fcoe-sched {
            transmit-rate 2500000000;
            shaping-rate percent 100;
            priority low;
        }
        hpc-sched {
            transmit-rate 2g;
            shaping-rate percent 100;
            priority low;
            drop-profile-map loss-priority low protocol any drop-profile dp-hpc;
        }
        nc-sched {
            transmit-rate 500m;
            shaping-rate percent 100;
            priority low;
            drop-profile-map loss-priority low protocol any drop-profile dp-nc;
        }
        nl-sched {
            transmit-rate 2g;
            shaping-rate percent 100;
            priority low;
        }
    }
```

TIP: To quickly configure the interfaces, issue the **load merge terminal** command, and then copy the hierarchy and paste it into the switch terminal window.

Verification

To verify that the hierarchical port scheduling components have been created and are operating properly, perform these tasks:

- Verifying That the Forwarding Classes (Priorities) Have Been Created on page 5487
- Verifying That the Forwarding Class Sets (Priority Groups) Have Been Created on page 5487
- Verifying That the Classifier Has Been Created on page 5488
- Verifying That Priority-Based Flow Control Has Been Enabled on page 5488
- Verifying That the Output Queue Schedulers Have Been Created on page 5489
- Verifying That the Drop Profiles Have Been Created on page 5492

- Verifying That the Priority Group Output Schedulers (Traffic Control Profiles) Have Been Created on page 5493
- Verifying the Interface Configuration on page 5494

Verifying That the Forwarding Classes (Priorities) Have Been Created

Purpose Verify that the forwarding classes have been created and mapped to the correct queues. (The system shows only the explicitly configured forwarding classes. It does not show default forwarding classes such as **fcoe** and **no-loss**.)

Action List the forwarding classes using the operational mode command **show class-of-service forwarding-class**:

```
user@switch> show class-of-service forwarding-class
Forwarding class                       ID      Queue  Policing priority  No-Loss

  best-effort                          0        0         normal        Disabled

  be2                                  1        3         normal        Disabled

  hpc                                  2        4         normal        Disabled

  network-control                      3        7         normal        Disabled

  mcast                                8        8         normal        Disabled
```

Meaning The **show class-of-service forwarding-class** command lists all of the configured forwarding classes, the internal identification number of each forwarding class, the queues that are mapped to the forwarding classes, the policing priority, and whether the forwarding class is lossless (no-loss packet drop attribute enabled) or lossy forwarding class (no-loss packet drop attribute disabled). The command output shows that:

- Forwarding class **best-effort** maps to queue **0** and is lossy
- Forwarding class **be2** maps to queue **1** and is lossy
- Forwarding class **hpc** maps to queue **5** and is lossy
- Forwarding class **network-control** maps to queue **7** and is lossy

In addition, the command lists the default multicast (multidestination) forwarding class and the default queue to which it is mapped.

Verifying That the Forwarding Class Sets (Priority Groups) Have Been Created

Purpose Verify that the priority groups have been created and that the correct priorities (forwarding classes) belong to the appropriate priority group.

Action List the forwarding class sets using the operational mode command **show class-of-service forwarding-class-set**:

```
user@switch> show class-of-service forwarding-class-set
Forwarding class set: best-effort-pg, Type: normal-type, Forwarding class set
index: 19907
  Forwarding class                       Index
  best-effort                              0
```

```
  be2                                     1
  network-control                         5

Forwarding class set: guar-delivery-pg, Type: normal-type, Forwarding class set
index: 43700
  Forwarding class                      Index
  fcoe                                    2
  no-loss                                 3

Forwarding class set: hpc-pg, Type: normal-type, Forwarding class set index: 60758

  Forwarding class                      Index
  hpc                                     4
```

Meaning The **show class-of-service forwarding-class-set** command lists all of the configured forwarding class sets (priority groups), the forwarding classes (priorities) that belong to each priority group, and the internal index number of each priority group. The command output shows that:

- The forwarding class set **best-effort-pg** includes the forwarding classes **best-effort**, **be2**, and **network-control**.
- The forwarding class set **guar-delivery-pg** includes the forwarding classes **fcoe** and **no-loss**.
- The forwarding class set **hpc-pg** includes the forwarding class **hpc**.

Verifying That the Classifier Has Been Created

Purpose Verify that the classifier maps forwarding classes to the correct IEEE 802.1p code points and packet loss priorities.

Action List the classifier configured for hierarchical port scheduling using the operational mode command **show class-of-service classifier name hsclassifier1**:

```
user@switch> show class-of-service classifier name hsclassifier1
Classifier: hsclassifier1, Code point type: ieee-802.1, Index: 43607
  Code point         Forwarding class                   Loss priority
  000                best-effort                        low
  001                be2                                high
  011                fcoe                               low
  100                no-loss                            low
  101                hpc                                low
  110                network-control                    low
```

Meaning The **show class-of-service classifier name hsclassifier1** command lists all of the IEEE 802.1p code points and the loss priorities mapped to all of the forwarding classes in the classifier. The command output shows that the forwarding classes **best-effort**, **be2**, **no-loss**, **fcoe**, **hpc**, and **network-control** have been created and mapped to IEEE 802.1p code points and loss priorities.

Verifying That Priority-Based Flow Control Has Been Enabled

Purpose Verify that PFC is enabled on the correct priorities for lossless transport.

Action List the congestion notification profiles using the operational mode command **show class-of-service congestion-notification**:

```
user@switch> show class-of-service congestion-notification
Type: Input, Name: gd-cnp, Index: 51687
Cable Length: 100 m
  Priority      PFC          MRU
  000           Disabled
  001           Disabled
  010           Disabled
  011           Enabled      2500
  100           Enabled      2500
  101           Disabled
  110           Disabled
  111           Disabled
Type: Output
  Priority      Flow-Control-Queues
  000
                0
  001
                1
  010
                2
  011
                3
  100
                4
  101
                5
  110
                6
  111
                7
```

Meaning The **show class-of-service congestion-notification** command lists all of the congestion notification profiles and the IEEE 802.1p code points with PFC enabled. The command output shows that PFC is enabled for code points **011** (**fcoe** priority and queue) and **100** (**no-loss** priority and queue) for the **gd-cnp** congestion notification profile.

The command also shows the default cable length (100 meters), the default maximum receive unit (2500 bytes), and the default mapping of priorities to output queues because this example does not include configuring these options.

Verifying That the Output Queue Schedulers Have Been Created

Purpose Verify that the output queue schedulers have been created with the correct bandwidth parameters and priorities, mapped to the correct queues, and mapped to the correct drop profiles.

Action List the scheduler maps using the operational mode command **show class-of-service scheduler-map**:

```
user@switch> show class-of-service scheduler-map
Scheduler map: be-map, Index: 64023

  Scheduler: be-sched, Forwarding class: best-effort, Index: 13005
    Transmit rate: 3000000000 bps, Rate Limit: none, Buffer size: remainder,
```

```
    Buffer Limit: none, Priority: low
    Excess Priority: unspecified
    Shaping rate: 100 percent,
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any         55387    dp-be-low
      Medium high     any             1    <default-drop-profile>
      High            any          4369    dp-be-high

  Scheduler: be-sched, Forwarding class: be2, Index: 13005
    Transmit rate: 3000000000 bps, Rate Limit: none, Buffer size: remainder,
    Buffer Limit: none, Priority: low
    Excess Priority: unspecified
    Shaping rate: 100 percent,
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any         55387    dp-be-low
      Medium high     any             1    <default-drop-profile>
      High            any          4369    dp-be-high

  Scheduler: nc-sched, Forwarding class: network-control, Index: 45740
    Transmit rate: 500000000 bps, Rate Limit: none, Buffer size: remainder,
    Buffer Limit: none, Priority: low
    Excess Priority: unspecified
    Shaping rate: 100 percent,
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any         44207    dp-nc
      Medium high     any             1    <default-drop-profile>
      High            any             1    <default-drop-profile>

Scheduler map: gd-map, Index: 61447

  Scheduler: fcoe-sched, Forwarding class: fcoe, Index: 37289
    Transmit rate: 2500000000 bps, Rate Limit: none, Buffer size: remainder,
    Buffer Limit: none, Priority: low
    Excess Priority: unspecified
    Shaping rate: 100 percent,
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any         44207    <default-drop-profile>
      Medium high     any             1    <default-drop-profile>
      High            any             1    <default-drop-profile>

  Scheduler: nl-sched, Forwarding class: no-loss, Index: 29359
    Transmit rate: 2000000000 bps, Rate Limit: none, Buffer size: remainder,
    Buffer Limit: none, Priority: low
    Excess Priority: unspecified
    Shaping rate: 100 percent,
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any         44207    <default-drop-profile>
      Medium high     any             1    <default-drop-profile>
      High            any             1    <default-drop-profile>

Scheduler map: hpc-map, Index: 56941
```

```
Scheduler: hpc-sched, Forwarding class: hpc, Index: 55900
  Transmit rate: 2000000000 bps, Rate Limit: none, Buffer size: remainder,
  Buffer Limit: none, Priority: low
  Excess Priority: unspecified
  Shaping rate: 100 percent,
  drop-profile-map-set-type: mark
  Drop profiles:
    Loss priority   Protocol    Index    Name
    Low             any         57716    dp-hpc
    Medium high     any             1    <default-drop-profile>
    High            any             1    <default-drop-profile>
```

Meaning The **show class-of-service scheduler-map** command lists all of the configured scheduler maps. For each scheduler map, the command output includes:

- The name of the scheduler map (**scheduler-map** field)
- The name of the scheduler (**scheduler** field)
- The forwarding classes mapped to the scheduler (**forwarding-class** field)
- The minimum guaranteed queue bandwidth (**transmit-rate** field)
- The scheduling priority (**priority** field)
- The maximum bandwidth in the priority group the queue can consume (**shaping-rate** field)
- The drop profile loss priority (**loss priority** field) for each drop profile name (**name** field)

The command output shows that:

- The scheduler map **be-map** has been created and has these properties:
  - There are two schedulers, **be-sched** and **nc-sched**.
  - The scheduler **be-sched** has two forwarding classes, **best-effort** and **be2**.
  - Scheduler **be-sched** forwarding classes **best-effort** and **be2** share a minimum guaranteed bandwidth of **3000000000 bps**, can consume a maximum of **100 percent** of the priority group bandwidth, and use the drop profile **dp-be-low** for low loss-priority traffic, the default drop profile for medium-high loss-priority traffic, and the drop profile **dp-be-high** for high loss-priority traffic.
  - The scheduler **nc-sched** has one forwarding class, **network-control**.
  - The **network-control** forwarding class has a minimum guaranteed bandwidth of **500000000 bps**, can consume a maximum of **100 percent** of the priority group bandwidth, and uses the drop profile **dp-nc** for low loss-priority traffic and the default drop profile for medium-high and high loss priority traffic.
- The scheduler map **gd-map** has been created and has these properties:
  - There are two schedulers, **fcoe-sched** and **nl-sched**.
  - The scheduler **fcoe-sched** has one forwarding class, **fcoe**.

- The **fcoe** forwarding class has a minimum guaranteed bandwidth of **2500000000 bps**, and can consume a maximum of **100 percent** of the priority group bandwidth.
- The scheduler **nl-sched** has one forwarding class, **no-loss**.
- The **no-loss** forwarding class has a minimum guaranteed bandwidth of **2000000000 bps**, and can consume a maximum of **100 percent** of the priority group bandwidth.

- The scheduler map **hpc-map** has been created and has these properties:
  - There is one scheduler, **hpc-sched**.
  - The scheduler **hpc-sched** has one forwarding class, **hpc**.
  - The **hpc** forwarding class has a minimum guaranteed bandwidth of **2000000000 bps**, can consume a maximum of **100 percent** of the priority group bandwidth, and uses the drop profile **dp-hpc** for low loss-priority traffic and the default drop profile for medium-high and high loss-priority traffic.

Verifying That the Drop Profiles Have Been Created

Purpose Verify that the drop profiles **dp-be-high**, **dp-be-low**, **dp-hpc**, and **dp-nc** have been created with the correct fill levels and drop probabilities.

Action List the drop profiles using the operational mode command **show configuration class-of-service drop-profiles**:

```
user@switch> show configuration class-of-service drop-profiles
dp-be-low {
    interpolate {
        fill-level [ 25 50 ];
        drop-probability [ 0 80 ];
    }
}
dp-be-high {
    interpolate {
        fill-level [ 10 40 ];
        drop-probability [ 0 100 ];
    }
}
dp-hpc {
    interpolate {
        fill-level [ 75 90 ];
        drop-probability [ 0 75 ];
    }
}
dp-nc {
    interpolate {
        fill-level [ 80 100 ];
        drop-probability [ 0 100 ];
    }
```

Meaning The **show configuration class-of-service drop-profiles** command lists the drop profiles and their properties. The command output shows that there are four drop profiles configured, **dp-be-high**, **dp-be-low**, **dp-hpc**, and **dp-nc**. The output also shows that:

- For **dp-be-low**, the drop start point (the first fill level) is when the queue is 25 percent filled, the drop end point (the second fill level) occurs when the queue is 50 percent filled, and the drop probability at the drop end point is 80 percent.
- For **dp-be-high**, the drop start point (the first fill level) is when the queue is 10 percent filled, the drop end point (the second fill level) occurs when the queue is 40 percent filled, and the drop probability at the drop end point is 100 percent.
- For **dp-hpc**, the drop start point (the first fill level) is when the queue is 75 percent filled, the drop end point (the second fill level) occurs when the queue is 90 percent filled, and the drop probability at the drop end point is 75 percent.
- For **dp-nc**, the drop start point (the first fill level) is when the queue is 80 percent filled, the drop end point (the second fill level) occurs when the queue is 100 percent filled, and the drop probability at the drop end point is 100 percent.

Verifying That the Priority Group Output Schedulers (Traffic Control Profiles) Have Been Created

Purpose Verify that the traffic control profiles **be-tcp**, **gd-tcp**, and **hpc-tcp** have been created with the correct bandwidth parameters and scheduler mapping.

Action List the traffic control profiles using the operational mode command **show class-of-service traffic-control-profile**:

```
user@switch> show class-of-service traffic-control-profile
Traffic control profile: be-tcp, Index: 40535
  Shaping rate: 100 percent
  Scheduler map: be-map
  Guaranteed rate: 3500000000

Traffic control profile: gd-tcp, Index: 37959
  Shaping rate: 100 percent
  Scheduler map: gd-map
  Guaranteed rate: 4500000000

Traffic control profile: hpc-tcp, Index: 47661
  Shaping rate: 100 percent
  Scheduler map: hpc-map
  Guaranteed rate: 2000000000
```

Meaning The **show class-of-service traffic-control-profile** command lists all of the configured traffic control profiles. For each traffic control profile, the command output includes:

- The name of the traffic control profile (**traffic-control-profile**)
- The maximum port bandwidth the priority group can consume (**shaping-rate**)
- The scheduler map associated with the traffic control profile (**scheduler-map**)
- The minimum guaranteed priority group port bandwidth (**guaranteed-rate**)

The command output shows that:

- The traffic control profile **be-tcp** can consume a maximum of **100 percent** of the port bandwidth, is associated with the scheduler map **be-map**, and has a minimum guaranteed bandwidth of **3500000000 bps**.
- The traffic control profile **gd-tcp** can consume a maximum of **100 percent** of the port bandwidth, is associated with the scheduler map **gd-map**, and has a minimum guaranteed bandwidth of **4500000000 bps**.
- The traffic control profile **hpc-tcp** can consume a maximum of **100 percent** of the port bandwidth, is associated with the scheduler map **hpc-map**, and has a minimum guaranteed bandwidth of **2000000000 bps**.

Verifying the Interface Configuration

Purpose Verify that the classifier, the congestion notification profile, and the forwarding class sets are configured on interfaces **xe-0/0/20** and **xe-0/0/21**.

Action List the interfaces using the operational mode commands **show configuration class-of-service interfaces xe-0/0/20** and **show configuration class-of-service interfaces xe-0/0/21**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/20
forwarding-class-set {
    best-effort-gp {
        output-traffic-control-profile be-tcp;
    }
    guar-delivery-pg {
        output-traffic-control-profile gd-tcp;
    }
    hpc-pg {
        output-traffic-control-profile hpc-tcp;
    }
}
congestion-notification-profile gd_cnp;
unit 0 {
    classifiers {
        ieee-802.1 hsclassifier1;
    }
}
```

```
user@switch> show configuration class-of-service interfaces xe-0/0/21
forwarding-class-set {
    best-effort-gp {
        output-traffic-control-profile be-tcp;
    }
    guar-delivery-pg {
        output-traffic-control-profile gd-tcp;
    }
    hpc-pg {
        output-traffic-control-profile hpc-tcp;
    }
}
congestion-notification-profile gd_cnp;
unit 0 {
    classifiers {
        ieee-802.1 hsclassifier1;
    }
}
```


Meaning

The **show configuration class-of-service interfaces** ***interface-name*** command shows that each interface includes the forwarding class sets **best-effort-pg**, **guar-delivery-pg**, and **hpc-pg**, congestion notification profile **gd-cnp**, and the IEEE 802.1p classifier **hsclassifier1**.

Related Documentation

- Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 5673
- *Benefits of Configuring CoS Hierarchical Port Scheduling*
- Assigning CoS Components to Interfaces on page 5696
- Example: Configuring Tail-Drop Profiles on page 5501
- Example: Configuring Drop Profile Maps on page 5503
- Example: Configuring Forwarding Classes on page 5505
- Example: Configuring Forwarding Class Sets on page 5508
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Queue Scheduling Priority on page 5516
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Minimum Guaranteed Output Bandwidth on page 5521
- Example: Configuring Maximum Output Bandwidth on page 5526
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Overview of CoS Changes Introduced in Junos OS Release 12.2 on page 5304
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- Understanding CoS Scheduling Behavior and Configuration Considerations on page 5387
- *Understanding CoS Scheduling on QFabric System Node Device Fabric (fte) Ports*
- *Understanding Default CoS Scheduling on QFabric System Interconnect Devices (Junos OS Release 13.1 and Later Releases)*

Example: Configuring Unicast Classifiers

Packet classification associates incoming packets with a particular CoS servicing level. Classifiers associate packets with a forwarding class and loss priority and assign packets to output queues based on the associated forwarding class. You apply classifiers to ingress interfaces.

Requirements

This example uses the following hardware and software components:

- A Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

Junos OS supports three general types of classifiers:

- Behavior aggregate or CoS value traffic classifiers—Examine the CoS value in the packet header. The value in this single field determines the CoS settings applied to the packet. BA classifiers allow you to set the forwarding class and loss priority of a packet based on the Differentiated Services code point (DSCP or DSCP IPv6) value, IEEE 802.1p value, or MPLS EXP value.
- Fixed classifiers. Fixed classifiers classify all ingress traffic on a physical interface into one forwarding class, regardless of the CoS bits in the packet header.
- Multifield traffic classifiers—Examine multiple fields in the packet, such as source and destination addresses and source and destination port numbers of the packet. With multifield classifiers, you set the forwarding class and loss priority of a packet based on firewall filter rules.

NOTE: **You must assign unicast traffic and multidestination (multicast, broadcast, and destination lookup fail) traffic to different classifiers. One classifier cannot include both unicast and multidestination forwarding classes. A unicast classifier can include only forwarding classes for unicast traffic.**

This example describes how to configure a BA classifier called **ba-ucast-classifier** as the default IEEE 802.1 map and apply it to ingress interface **xe-0/0/10**. The BA classifier assigns loss priorities, as shown in Table 497 on page 5496, to incoming packets in the four forwarding classes.

You can use the same procedure to set multifield classifiers (except that you use firewall filter rules).

Table 497: ba-ucast-classifier Loss Priority Assignments

Unicast Forwarding Class	For CoS Traffic Type	ba-ucast-classifier Loss Priority to IEEE 802.1p Code Point Mapping	Packet Drop Attribute
be	Best-effort traffic	Low loss priority code point: **000**	drop
fcoe	Guaranteed delivery for Fibre Channel over Ethernet (FCoE) traffic	Low loss priority code point: **011**	no-loss

Table 497: ba-ucast-classifier Loss Priority Assignments *(continued)*

Unicast Forwarding Class	For CoS Traffic Type	ba-ucast-classifier Loss Priority to IEEE 802.1p Code Point Mapping	Packet Drop Attribute
no-loss	Guaranteed delivery for TCP traffic	Low loss priority code point: **100**	no-loss
nc	Network-control traffic	Low loss priority code point: **110**	drop

Configuring Unicast Classifiers

To configure a unicast IEEE 802.1 BA classifier named **ba-ucast-classifier** as the default IEEE 802.1 map:

1. Associate code point **000** with forwarding class **be** and loss priority **low**:

   ```
   [edit class-of-service classifiers]
   user@switch# set ieee-802.1 ba-ucast-classifier import default forwarding-class be loss-priority low code-points 000
   ```
2. Associate code point **011** with forwarding class **fcoe** and loss priority **low**:

   ```
   [edit class-of-service classifiers]
   user@switch# set ieee-802.1 ba-ucast-classifier forwarding-class fcoe loss-priority low code-points 011
   ```
3. Associate code point **100** with forwarding class **no-loss** and loss priority **low**:

   ```
   [edit class-of-service classifiers]
   user@switch# set ieee-802.1 ba-ucast-classifier forwarding-class no-loss loss-priority low code-points 100
   ```
4. Associate code point **110** with forwarding class **nc** and loss priority **low**:

   ```
   [edit class-of-service classifiers]
   user@switch# set ieee-802.1 ba-ucast-classifier forwarding-class nc loss-priority low code-points 110
   ```
5. Apply the unicast classifier to ingress interface **xe-0/0/10**:

   ```
   [edit class-of-service interfaces]
   user@switch# set xe-0/0/10 unit 0 classifiers ieee-802.1 ba-ucast-classifier
   ```

Verification

To verify the unicast classifier configuration, perform these tasks:

- Verifying the Unicast Classifier Configuration on page 5497
- Verifying the Ingress Interface Configuration on page 5498

Verifying the Unicast Classifier Configuration

Purpose Verify that you configured the unicast classifier with the correct forwarding classes, loss priorities, and code points.

Action List the classifier configuration using the operational mode command **show configuration class-of-service classifiers ieee-802.1 ba-ucast-classifier**:

```
user@switch> show configuration class-of-service classifiers ieee-802.1 ba-ucast-classifier
```



```
    forwarding-class be {
        loss-priority low code-points 000;
    }
    forwarding-class fcoe {
        loss-priority low code-points 011;
    }
    forwarding-class no-loss {
        loss-priority low code-points 100;
    }
    forwarding-class nc
        loss-priority low code-points 110;
    }
```

Verifying the Ingress Interface Configuration

Purpose Verify that the unicast classifier **ba-ucast-classifier** is attached to ingress interface **xe-0/0/10**.

Action List the ingress interface using the operational mode command **show configuration class-of-service interfaces xe-0/0/10**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/10
congestion-notification-profile fcoe-cnp;
unit 0 {
    classifiers {
        ieee-802.1 ba-ucast-classifier;
    }
}
```

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers on page 5498
- Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 5673
- Configuring a Global MPLS EXP Classifier on page 3782
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Monitoring CoS Classifiers on page 5809
- Understanding CoS Classifiers on page 5334
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers

Packet classification associates incoming packets with a particular CoS servicing level. Classifiers associate packets with a forwarding class and loss priority and assign packets to output queues based on the associated forwarding class.

- Requirements on page 5499
- Overview on page 5499
- Configuring Multidestination Classifiers on page 5500
- Verification on page 5500

Requirements

This example uses the following hardware and software components:

- A Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

Junos OS supports three general types of classifiers:

- Behavior aggregate or CoS value traffic classifiers—Examine the CoS value in the packet header. The value in this single field determines the CoS settings applied to the packet. BA classifiers allow you to set the forwarding class and loss priority of a packet based on the Differentiated Services code point (DSCP) value or IEEE 802.1p value.

  NOTE: **DSCP IPv6 multidestination classifiers are not supported. IPv6 multidestination traffic uses the DSCP multidestination classifier.**

- Fixed classifiers. Fixed classifiers classify all ingress traffic on a physical interface into one forwarding class, regardless of the CoS bits in the packet header.
- Multifield traffic classifiers—Examine multiple fields in the packet such as source and destination addresses and source and destination port numbers of the packet. With multifield classifiers, you set the forwarding class and loss priority of a packet based on firewall filter rules.

Multidestination classifiers apply to all of the switch interfaces and handle multicast, broadcast, and destination lookup fail (DLF) traffic. You cannot apply a multidestination classifier to a single interface or to a range of interfaces.

NOTE: **You must assign unicast traffic and multicast traffic to different classifiers. One classifier cannot include both unicast and multicast forwarding classes. A multidestination classifier can include only forwarding classes for multicast traffic.**

The following example describes how to configure a BA classifier called **ba-mcast-classifier**, which is applied to all of the switch interfaces. The BA classifier assigns loss priorities, as shown in Table 498 on page 5500, to incoming packets in the multidestination forwarding class.

You can use the same procedure to set multifield classifiers (except that you use firewall filter rules).

Table 498: BA-mcast-classifier Loss Priority Assignments

Multicast Forwarding Class	For CoS Traffic Type	ba-mcast-classifier Assignment
mcast	Best-effort multicast traffic	Low loss priority code point: **000**

Configuring Multidestination Classifiers

To configure a multicast IEEE 802.1 BA classifier named **ba-mcast-classifier**:

1. Associate code point **000** with forwarding class **mcast** and loss priority **low**:

   ```
   [edit class-of-service classifiers]
   user@switch# set ieee-802.1 ba-mcast-classifier forwarding-class mcast-be loss-priority
   low code-points 000
   ```
2. Configure the classifier as a multidestination classifier:

   ```
   [edit class-of-service]
   user@switch# set multi-destination classifiers ieee-802.1 ba-mcast-classifier
   ```

Verification

To verify the multidestination classifier configuration, perform these tasks:

- Verifying the IEEE 802.1 Multidestination Classifier on page 5500
- Verifying the Multidestination Classifier Configuration on page 5500

Verifying the IEEE 802.1 Multidestination Classifier

Purpose Verify that the classifier **ba-mcast-classifier** is configured as the IEEE 802.1 multidestination classifier:

Action Verify the results of the classifier configuration using the operational mode command **show configuration class-of-service multi-destination classifiers ieee-802.1**:

```
user@switch> show configuration class-of-service multi-destination classifiers ieee-802.1
ba-mcast-classifier;
```

Verifying the Multidestination Classifier Configuration

Purpose Verify that you configured the multidestination classifier with the correct forwarding classes, loss priorities, and code points.

Action List the classifier configuration using the operational mode command **show configuration class-of-service classifiers ieee-802.1 ba-mcast-classifier**:

```
user@switch> show configuration class-of-service classifiers ieee-802.1 ba-mcast-classifier
    forwarding-class mcast {
        loss-priority low code-points 000;
    }
```

Related Documentation

- Example: Configuring Unicast Classifiers on page 5495
- Defining CoS Multidestination (Multicast, Broadcast, DLF) BA Classifiers on page 5675
- Monitoring CoS Classifiers on page 5809

Example: Configuring Tail-Drop Profiles

You can configure an interpolated weighted random early detection (WRED) tail-drop profile to control packet drop characteristics for different traffic loss priorities.

NOTE: You cannot enable WRED on multidestination (multicast) queues. You can enable WRED only on unicast queues.

Also, do not enable WRED on lossless traffic flows. Use priority-based flow control (PFC) to prevent packet loss on lossless forwarding classes.

Requirements

This example uses the following hardware and software components:

- A Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

You associate a tail-drop profile with a loss priority in a scheduler. When you attach the scheduler to a forwarding class (queue), you apply the interpolated drop profile to traffic of the specified loss priority in that queue. *Interpolated* means that the switch creates a smooth drop curve from a drop start point to a drop end point, with a maximum drop rate that is reached at the drop end point:

- Drop start point—Percentage of average queue fill level when the WRED algorithm starts to drop packets. Before the drop start point, no packets are scheduled to drop.
- Drop end point—Average queue fill level at which all subsequently arriving packets are dropped. When the queue fill levels falls below the drop end point, packets begin to be forwarded again. (At the drop end point, the packet drop probability becomes 100 percent.)
- Maximum drop rate—Drop probability when the average queue fill level reaches the drop end point.

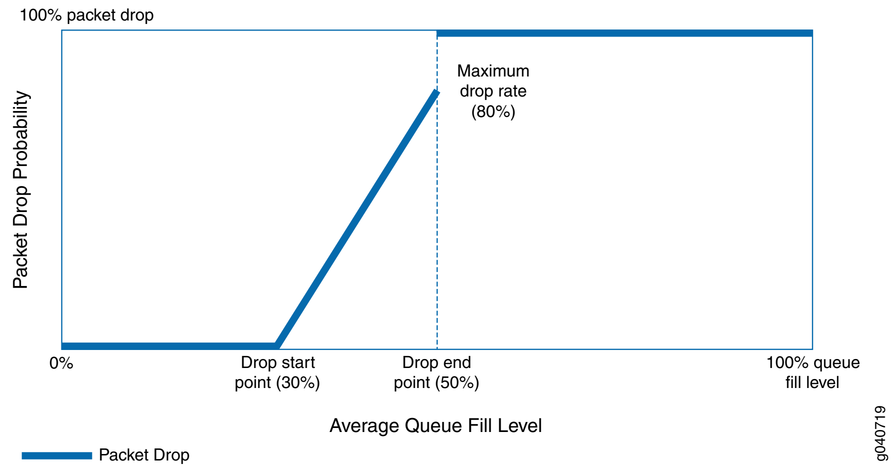
You set the drop start point and the drop end point by specifying two queue fill level percentage values. The first value is the drop start point and the second value is the drop end point.

You set the maximum drop rate by specifying two drop probability percentage values. The first value is always zero (0), which is the minimum drop rate, the probability of dropping a packet at the drop start point. The second value is the maximum drop rate at the drop end point.

The drop rate is zero until the queue fill level reaches the drop start point. As the queue continues to fill, packets drop in smooth linear curve until the queue reaches the drop end point, when packets drop at the maximum drop rate. If the queue fills beyond the drop end point, all packets that match the drop profile are dropped.

Figure 201 on page 5502 shows the graph for a drop profile with a drop start point of 30 percent, a drop end point of 50 percent, and a maximum drop rate of 80 percent.

Figure 201: Tail-Drop Profile Packet Drop Example



The graph shows that when the queue fill level is less than 30 percent, the packet drop rate is zero. When the queue fill level reaches 30 percent, packets begin to drop. As the queue fills, a higher percentage of packets drop. When the queue fill level reaches 50 percent, the packet drop rate has climbed to 80 percent. When the queue fill level exceeds 50 percent, all packets drop.

This example describes how to configure the drop profile shown in Figure 201 on page 5502. The drop profile will have:

- The name **be-dp1**
- 30 percent for the drop start point (first **fill-level** setting)
- 50 percent for the drop end point (second **fill-level** setting)
- 0 percent for the minimum drop rate (first **drop-probability** setting)
- 80 percent for the maximum drop rate (second **drop-probability** setting)

You apply a drop profile by configuring a drop profile map that maps the drop profile to a packet loss priority and associates the drop profile and packet loss priority with a scheduler. When you associate the scheduler with a forwarding class (queue), the switch applies the drop profile to the packets in the forwarding class that have a matching packet loss priority.

Configuring a Drop Profile

1. Set the drop start point at **30** percent, the drop end point at **50** percent, the minimum drop rate at **0** percent, and the maximum drop rate at **80** percent for the drop profile **be-dp1**:

```
[edit class-of-service]
user@switch# set drop-profile be-dp1 interpolate fill-level 30 fill-level 50 drop-probability
0 drop-probability 80
```

Verification

Verifying the Drop Profile Configuration

Purpose Verify that you configured the drop profile **be-dp1** with the correct drop start and end points and with the correct drop rates.

Action Verify the results of the drop profile configuration using the operational mode command **show configuration class-of-service drop-profiles be-dp1**:

```
user@switch> show configuration class-of-service drop-profiles be-dp1
interpolate {
    fill-level [ 30 50 ];
    drop-probability [ 0 80 ];
}
```

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Drop Profile Maps on page 5503
- Configuring CoS Tail-Drop Profiles on page 5676
- Understanding CoS Tail-Drop Profiles on page 5409

Example: Configuring Drop Profile Maps

A drop-profile map associates a tail-drop profile for traffic of a specified loss priority with a scheduler. When you use a scheduler map to map a scheduler to a forwarding class, the drop profile map associated with the scheduler applies the specified tail-drop profile to traffic in the forwarding class that matches the specified loss priority.

Requirements

This example uses the following hardware and software components:

- A Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

Drop profile maps enable you to configure different drop profiles for traffic of different loss priorities within the same scheduler. You can associate different drop profiles with low-priority, medium-high priority, and high-priority traffic within a single scheduler, and then map that scheduler to a forwarding class. This applies the appropriate drop profile to traffic of each loss priority in a forwarding class. Drop profile maps apply to all traffic protocols.

The following example describes how to configure a drop profile map for a scheduler named **mylan** that includes:

- A drop profile called **lp-profile** for low-priority traffic
- A drop profile called **mh-profile** for medium-high priority traffic
- A drop profile called **h-profile** for high-priority traffic

You apply the drop profiles in the drop profile map to a forwarding class by associating the scheduler **mylan** with a forwarding class in a scheduler map.

Configuring a Drop Profile Map

1. Configure the drop profile for low-priority traffic:

```
[edit class-of-service]
user@switch# set schedulers mylan drop-profile-map loss-priority low protocol any drop-profile lp-profile
```

2. Configure the drop profile for medium-high priority traffic:

```
[edit class-of-service]
user@switch# set schedulers mylan drop-profile-map loss-priority medium-high protocol any drop-profile mh-profile
```

3. Configure the drop profile for high-priority traffic:

```
[edit class-of-service]
user@switch# set schedulers mylan drop-profile-map loss-priority high protocol any drop-profile h-profile
```

Verification

Verifying the Drop Profile Map Configuration

Purpose Verify that you configured the drop profile map for the scheduler **mylan** with the correct loss priorities and drop profiles.

Action Verify the results of the drop profile map configuration using the operational mode command **show configuration class-of-service schedulers mylan**:

```
user@switch> show configuration class-of-service schedulers mylan
transmit-rate 3g;
shaping-rate percent 100;
priority low;
drop-profile-map loss-priority low protocol any drop-profile lp-profile;
drop-profile-map loss-priority medium-high protocol any drop-profile mh-profile;
drop-profile-map loss-priority high protocol any drop-profile h-profile;
```


NOTE: This example does not include configuring scheduler bandwidth and priority. This information (transmit rate, shaping rate, and priority) is shown for completeness.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Tail-Drop Profiles on page 5501
- Configuring CoS Drop Profile Maps on page 5677
- Understanding CoS Tail-Drop Profiles on page 5409

Example: Configuring Forwarding Classes

Forwarding classes allow you to group packets for transmission. You assign packets to unicast or multidestination (multicast, broadcast, and destination lookup fail) output queues based on forwarding classes.

Requirements

This example uses the following hardware and software components:

- One Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

The switch supports a total of 12 forwarding classes. In order to forward traffic, you must map (assign) the forwarding classes to unicast or multidestination output queues. The switch has 12 queues. Queues 0 through 7 are for unicast traffic, and queues 8 through 11 are for multidestination traffic. The switch supports up to two lossless forwarding classes.

By default, four categories of unicast forwarding classes and one multidestination forwarding class are defined. You can define the remaining seven forwarding classes and configure them as unicast or multidestination by mapping them to unicast or multidestination queues. The type of queue, unicast or multidestination, determines the type of forwarding class.

The four default unicast forwarding classes are:

- **be**—Best-effort traffic
- **fcoe**—Guaranteed delivery for Fibre Channel over Ethernet traffic
- **no-loss**—Guaranteed delivery for TCP no-loss traffic
- **nc**—Network control traffic

The default multidestination forwarding class is:

- **mcast**—Multidestination traffic

Map forwarding classes to queues using the **class** statement, which enables you to configure up to 12 forwarding classes. You can map more than one forwarding class to a single queue, but all forwarding classes mapped to a particular queue must be of the same type, either unicast or multicast. You cannot mix unicast and multicast forwarding classes on the same queue. The statement format is:

```
[edit class-of-service forwarding-classes]
user@switch# class class-name queue-num queue-number;
```

NOTE: If you are using Junos OS Release 12.2, use the default forwarding-class-to-queue mapping for the lossless **fcoe** and **no-loss** forwarding classes. If you explicitly configure the lossless forwarding classes, the traffic mapped to those forwarding classes is treated as lossy (**best-effort**) traffic and does *not* receive lossless treatment.

In Junos OS Release 12.3 and later, you can include the *no-loss* packet drop attribute in explicit forwarding class configurations to configure a lossless forwarding class.

NOTE: Junos OS Release 11.3R1 and earlier supported an alternate method of mapping forwarding classes to queues that allowed you to map only one forwarding class to a queue using the statement:

```
[edit class-of-service forwarding-classes]
user@switch# queue queue-number class-name
```

The **queue** statement has been deprecated and is no longer valid in Junos OS Release 11.3R2 and later. If you have a configuration that uses the **queue** statement to map forwarding classes to queues, edit the configuration to replace the **queue** statement with the **class** statement.

NOTE: The QFX Series uses hierarchical scheduling to control output queue forwarding. When you define a forwarding class that will carry traffic on the switch (the behavior aggregate classifier has a forwarding class and you expect traffic for the forwarding class), you must also define a scheduling policy for the forwarding class. Defining a scheduling policy means:

- Mapping a scheduler to the forwarding class in a scheduler map
- Including the forwarding class in a forwarding class set
- Associating the scheduler map with a traffic control profile
- Attaching the traffic control profile to a forwarding class set and an interface

Table 499 on page 5507 shows the configuration forwarding-class-to-queue mapping for this example:

Table 499: Forwarding-Class-to-Queue Example Configuration

Forwarding Class	Queue
best-effort	0
nc	7
mcast	8

Configuring Forwarding Classes

To configure CoS forwarding classes, map the forwarding classes to queues:

1. Map the **best-effort** forwarding class to queue **0**:

   ```
   [edit class-of-service forwarding-classes]
   user@switch# set class best-effort queue-num 0
   ```

2. Map the **nc** forwarding class to queue **7**:

   ```
   [edit class-of-service forwarding-classes]
   user@switch# set class nc queue-num 7
   ```

3. Map the **mcast-be** forwarding class to queue **8**:

   ```
   [edit class-of-service forwarding-classes]
   user@switch# set class mcast-be queue-num 8
   ```

Verification

Verifying the Forwarding-Class-to-Queue Mapping

Purpose Verify the forwarding-class-to-queue mapping. (The system shows only the explicitly configured forwarding classes; it does not show default forwarding classes such as **fcoe** and **no-loss**.)

Action Verify the results of the forwarding class configuration using the operational mode command **show configuration class-of-service forwarding-classes**:

```
user@switch> show configuration class-of-service forwarding-classes
class best-effort queue-num 0;
class network-control queue-num 7;
class mcast queue-num 8;
```

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Defining CoS Forwarding Classes on page 5677
- Monitoring CoS Forwarding Classes on page 5810
- Overview of CoS Changes Introduced in Junos OS Release 11.3 on page 5296
- Overview of CoS Changes Introduced in Junos OS Release 12.2 on page 5304
- Understanding CoS Forwarding Classes on page 5354

Example: Configuring Forwarding Class Sets

A forwarding class set (fc-set) is a priority group for enhanced transmission selection (ETS) traffic control. Each fc-set consists of one or more forwarding classes (output queues).

ETS enables you to configure link resources (bandwidth and bandwidth sharing characteristics) for a priority group, and then allocate the priority group's resources among the forwarding classes that belong to the priority group. This is called two-tier, or hierarchical, scheduling. Traffic control profiles control the scheduling for the priority group, and schedulers control the scheduling for individual forwarding classes.

Requirements

This example uses the following hardware and software components:

- A Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

You can configure up to three unicast fc-sets and one multicast fc-set. A common way to configure unicast priority groups is to configure separate fc-sets for local area network (LAN) traffic, storage area network (SAN) traffic, and high-performance computing (HPC) traffic, and then assign the appropriate forwarding classes to each fc-set.

NOTE: **If you configure strict-high priority queues, you must create an fc-set that is dedicated only to strict-high priority traffic. Only one fc-set can contain strict-high priority queues. Queues that are not strict-high priority cannot belong to the same fc-set as strict-high priority queues. The multidestination fc-set cannot contain strict-high priority queues.**

To apply ETS, you map one or more fc-sets to a physical egress port. You can map up to three forwarding class sets to each port. When you map an fc-set to a port, the port uses hierarchical scheduling to allocate port resources to the priority group (fc-set) and to allocate the priority group resources to the queues (forwarding classes) that belong to the priority group.

This example describes how to:

- Configure three fc-sets called **lan-pg**, **san-pg**, and **hpc-pg**.
- Assign forwarding classes to each of the fc-sets.
- Apply the fc-sets and their output traffic control profiles to an egress interface.

This example does not describe how to configure the forwarding classes assigned to the fc-sets or how to configure traffic control profiles. Table 500 on page 5509 shows the configuration components for this example:

Table 500: Components of the Forwarding Class Sets Configuration Example

Component	Settings
Hardware	QFX3500 switch
LAN traffic priority group	Forwarding class set: **lan-pg** Forwarding classes: **best-effort-1**, **best-effort-2**
SAN traffic priority group	Forwarding class set: **san-pg** Forwarding classes: **fcoe**, **fcoe-2**
HPC traffic priority group	Forwarding class set: **hpc-pg** Forwarding classes: **nc**, **high-perf**
Egress interface	**xe-0/0/7**

Configuring Forwarding Class Sets

1. Define the **lan-pg** priority group (fc-set) and assign to it the forwarding classes **best-effort-1** and **best-effort-2**:

```
[edit class-of-service]
user@switch# set forwarding-class-sets lan-pg class best-effort-1
user@switch# set forwarding-class-sets lan-pg class best-effort-2
```

2. Define the **san-pg** priority group and assign to it the forwarding classes **fcoe** and **fcoe-2**:

```
[edit class-of-service]
```

```
user@switch# set forwarding-class-sets san-pg class fcoe
user@switch# set forwarding-class-sets san-pg class fcoe-2
```

3. Define the **hpc-pg** priority group and assign to it the forwarding classes **nc** and **high-perf**:

```
[edit class-of-service]
user@switch# set forwarding-class-sets hpc-pg class nc
user@switch# set forwarding-class-sets hpc-pg class high-perf
```

4. Map the three forwarding class sets to an interface (the output traffic control profiles associated with the forwarding class sets determine the class of service scheduling for the priority groups):

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/7 forwarding-class-set lan-pg
output-traffic-control-profile lan-tcp
user@switch# set interfaces xe-0/0/7 forwarding-class-set san-pg
output-traffic-control-profile san-tcp
user@switch# set interfaces xe-0/0/7 forwarding-class-set hpc-pg
output-traffic-control-profile hpc-tcp
```

Verification

To verify the priority group configuration, perform these tasks:

- Verifying Forwarding Class Set Membership on page 5510
- Verifying the Egress Interface Configuration on page 5510

Verifying Forwarding Class Set Membership

Purpose Verify that you configured the **lan-pg**, **san-pg**, and **hpc-pg** priority groups with the correct forwarding classes.

Action List the forwarding class set member configuration using the operational mode command **show configuration class-of-service forwarding-class-sets**:

```
user@switch> show configuration class-of-service forwarding-class-sets
lan-pg {
    class best-effort-1;
    class best-effort-2;
}
san-pg {
    class fcoe;
    class fcoe-2;
}
hpc-pg {
    class high-perf;
    class nc;
}
```

Verifying the Egress Interface Configuration

Purpose Verify that egress interface **xe-0/0/7** is associated with the **lan-pg**, **san-pg**, and **hpc-pg** priority groups and with the correct output traffic control profiles.

Action Display the egress interface using the operational mode command **show configuration class-of-service interfaces xe-0/0/7**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/7
forwarding-class-set {
    lan-pg {
        output-traffic-control-profile lan-tcp;
    }
    san-pg {
        output-traffic-control-profile san-tcp;
    }
    hpc-pg {
        output-traffic-control-profile hpc-tcp;
    }
}
```

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Defining CoS Forwarding Class Sets on page 5679
- Understanding CoS Forwarding Class Sets (Priority Groups) on page 5359

Example: Configuring Queue Schedulers

Schedulers define the CoS properties of output queues. These properties include the amount of interface bandwidth assigned to the queue, the priority of the queue, and the tail-drop profiles associated with the queue.

Requirements

This example uses the following hardware and software components:

- Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

Scheduler parameters define the following characteristics for the queues mapped to the scheduler:

- **transmit-rate**—Minimum bandwidth, also known as the committed information rate (CIR). Each queue mapped to the scheduler receives a minimum of either the configured amount of absolute bandwidth or the configured percentage of bandwidth. The transmit rate also determines the amount of excess (extra) priority group bandwidth that the queue can share. Extra priority group bandwidth is allocated among the queues in the priority group in proportion to the transmit rate of each queue. You cannot configure a transmit rate for strict-high priority queues. Queues (forwarding classes) with a configured transmit rate cannot be included in a forwarding class set that has strict-high priority queues.

  NOTE: The **transmit-rate** setting works only if you also configure the **guaranteed-rate** in the traffic control profile that is attached to the forwarding class set to which the queue belongs. If you do not configure the **guaranteed-rate**, the **transmit-rate** does not work. The sum of all queue transmit rates in a forwarding class set should not exceed the traffic control profile guaranteed rate. If you configure transmit rates whose sum exceeds the forwarding class set guaranteed rate, the commit check fails, and the system rejects the configuration.

  NOTE: Include the preamble bytes and interframe gap bytes as well as the data bytes in your bandwidth calculations.

- **shaping-rate**—Maximum bandwidth, also known as the peak information rate (PIR). Each queue receives a maximum of the configured amount of absolute bandwidth or the configured percentage of bandwidth, even if more bandwidth is available.

  NOTE: Include the preamble bytes and interframe gap bytes as well as the data bytes in your bandwidth calculations.

- **priority**—One of two bandwidth priorities that queues associated with a scheduler can receive:
  - **low**—The scheduler has low priority.
  - **strict-high**—The scheduler has strict-high priority. You can configure only one queue as a strict-high priority queue. Strict-high priority allocates the scheduled bandwidth to the queue before any other queue receives bandwidth. Other queues receive the bandwidth that remains after the strict-high queue has been serviced.
- **drop-profile-map**—Mapping of a drop profile to a loss priority and protocol to apply WRED to the scheduler.
- **buffer-size**—Size of the queue buffer as a percentage of the dedicated buffer space on the port, or as a proportional share of the dedicated buffer space on the port that remains after the explicitly configured queues are served.

NOTE: Ingress port congestion can occur during periods of egress port congestion if an ingress port forwards traffic to more than one egress port, and at least one of those egress ports experiences congestion. If this occurs, the congested egress port can cause the ingress port to exceed its fair allocation of ingress buffer resources. When the ingress port exceeds its buffer resource allocation, frames are dropped at the ingress. Ingress port frame drop affects not only the congested egress ports, but also all of the egress ports to which the congested ingress port forwards traffic.

If a congested ingress port drops traffic that is destined for one or more uncongested egress ports, configure a weighted random early detection (WRED) drop profile and apply it to the egress queue that is causing the congestion. The drop profile prevents the congested egress queue from affecting egress queues on other ports by dropping frames at the egress instead of causing congestion at the ingress port.

NOTE: Do not configure drop profiles for the fcoe and no-loss forwarding classes. FCoE and other lossless traffic queues require lossless behavior. Use priority-based flow control (PFC) to prevent frame drop on lossless priorities.

Scheduler maps associate schedulers with forwarding classes (queues). After defining schedulers and mapping them to queues in a scheduler map, to configure hardware queue scheduling (port scheduling) you:

1. Associate a scheduler map with a traffic control profile (a traffic control profile schedules resources for a group of forwarding classes, called a *forwarding class set* or *priority group*).
2. Attach a forwarding class and a traffic control profile to an interface.

You can associate up to four user-defined scheduler maps with forwarding class sets.

This process configures the hardware queues, packet schedulers, and WRED characteristics that operate according to the scheduler mapping. The traffic control profile uses the scheduler CoS properties to determine the resources that should be allocated to the individual output queues from the total resources available to the priority group.

Table 501 on page 5513 shows the configuration components for this example.

Table 501: Components of the Queue Scheduler Configuration Example

Component	Settings
Hardware	QFX3500 switch

Table 501: Components of the Queue Scheduler Configuration Example *(continued)*

Component	Settings
Scheduler	Name: **be-sched** Transmit rate: **20%** Shaping rate: **40%** Buffer size: **20%** Priority: **low** Drop profile: **be-dp**
Scheduler map	Name: **be-map** Forwarding class to associate with the **be-sched** scheduler: **best-effort**
Traffic control profile	Name: **be-tcp** NOTE: This topic does not describe how to define a traffic control profile.
Forwarding class set	Name: **lan-pg**

Configuring a CoS Scheduler

To configure a CoS scheduler using the CLI:

1. Create a scheduler (**be-sched**) with a minimum guaranteed bandwidth of 2 Gbps, a maximum bandwidth of 4 Gbps, low priority, and map it to the drop profile **be-dp**:

   ```
   [edit class-of-service schedulers]
   user@switch# set be-sched transmit-rate percent 20
   user@switch# set be-sched shaping-rate percent 40
   user@switch# set be-sched buffer-size percent 20
   user@switch# set be-sched priority low
   user@switch# set be-sched drop-profile-map loss-priority low protocol any drop-profile
   be-dp
   ```

2. Configure a scheduler map (**be-map**) that associates the scheduler (**be-sched**) with the forwarding class (**best-effort**):

   ```
   [edit class-of-service scheduler-maps]
   user@switch# set be-map forwarding-class best-effort scheduler be-sched
   ```

3. Associate the scheduler map **be-map** with a traffic control profile (**be-tcp**):

   ```
   [edit class-of-service traffic-control-profiles]
   user@switch# set be-tcp scheduler-map be-map
   ```

4. Associate the traffic control profile **be-tcp** with a forwarding class set (**lan-pg**) and a 10-Gigabit Ethernet interface (**xe-0/0/7**):

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/7 forwarding-class-set lan-pg
   output-traffic-control-profile be-tcp
   ```

5. Alternatively, you can assign the scheduler map (**be-map**) to all the 10-Gigabit Ethernet interfaces using wildcards (**xe-***):

   ```
   [edit class-of-service interfaces]
   user@switch# set xe-* forwarding-class-set lan-pg output-traffic-control-profile be-tcp
   ```


Verification

To verify that the queue scheduler has been created and is mapped to the correct interfaces, perform these tasks:

- Verifying the Scheduler Configuration on page 5515
- Verifying the Scheduler Map Configuration on page 5515
- Verifying That the Scheduler Is Associated with the Interface on page 5516

Verifying the Scheduler Configuration

Purpose Verify that the queue scheduler **be-sched** has been created with a minimum guaranteed bandwidth of 2 Gbps, a maximum bandwidth of 4 Gbps, the priority set to **low**, and the drop profile **be-dp**.

Action Display the scheduler using the operational mode command **show configuration class-of-service schedulers be-sched**:

```
user@switch> show configuration class-of-service schedulers be-sched
transmit-rate percent 20;
shaping-rate percent 40;
buffer-size percent 20
priority low;
drop-profile-map loss-priority low protocol any drop-profile be-dp;
```

Verifying the Scheduler Map Configuration

Purpose Verify that the scheduler map **be-map** has been created and associates the forwarding class **best-effort** with the scheduler **be-sched**, and also that the scheduler map is attached to the traffic control profile **be-tcp**.

Action Display the scheduler map using the operational mode command **show configuration class-of-service scheduler-maps be-map**:

```
user@switch> show configuration class-of-service scheduler-maps be-map
forwarding-class best-effort scheduler be-sched;
```

Display the traffic control profile to verify that the scheduler map **be-map** is attached using the operational mode command **show configuration class-of-service traffic-control-profiles be-tcp scheduler-map**:

```
user@switch> show configuration class-of-service traffic-control-profiles be-tcp scheduler-map
scheduler-map be-map;
```

NOTE: This topic does not describe how to configure a traffic control profile or its allocation of port bandwidth. Using a traffic control profile to configure the port resource allocation to the priority group is necessary to implement hierarchical scheduling.

Verifying That the Scheduler Is Associated with the Interface

Purpose Verify that the forwarding class set (**lan-pg**) and the traffic control profile (**be-tcp**) that are associated with the queue scheduler are attached to the interface **xe-0/0/7**.

Action List the interface using the operational mode command **show configuration class-of-service interfaces xe-0/0/7**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/7
forwarding-class-set {
    lan-pg {
        output-traffic-control-profile be-tcp;
    }
}
```

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Minimum Guaranteed Output Bandwidth on page 5521
- Example: Configuring Maximum Output Bandwidth on page 5526
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Tail-Drop Profiles on page 5501
- Defining CoS Queue Schedulers on page 5679
- Monitoring CoS Scheduler Maps on page 5813
- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366
- *Understanding CoS Scheduling on QFabric System Node Device Fabric (fte) Ports*
- *Understanding Default CoS Scheduling on QFabric System Interconnect Devices (Junos OS Release 13.1 and Later Releases)*
- Understanding CoS Buffer Configuration on page 5391

Example: Configuring Queue Scheduling Priority

You can configure the bandwidth scheduling priority of individual queues by specifying the priority in a scheduler, and then using a scheduler map to associate the scheduler with a queue.

Requirements

This example uses the following hardware and software components:

- A Juniper Networks QFX3500 Switch

- Junos OS Release 11.1 or later for the QFX Series

Overview

Queues can have one of two bandwidth priorities:

- **strict-high**—You can configure only one queue as a strict-high or high-priority queue. Strict-high priority allocates the scheduled bandwidth to the queue before any other queue receives bandwidth. Other queues receive the bandwidth that remains after the strict-high queue has been serviced.

  NOTE: If you configure **strict-high** priority queues, you must create an fc-set that is dedicated only to **strict-high** priority traffic. Only one fc-set can contain strict-high priority queues. Queues that are not strict-high priority cannot belong to the same fc-set as strict-high priority queues. The multidestination fc-set cannot contain strict-high priority queues.

- **low**—Low priority. Traffic with this priority is serviced after any queue that has a **strict-high** priority.

Table 502 on page 5517 shows the configuration components for this example.

This example describes how to set the queue priority for two forwarding classes (queues) named **fcoe** and **no-loss**. Both queues have a priority of **low**. The scheduler for the **fcoe** queue is named **fcoe-sched** and the scheduler for the **no-loss** queue is named **nl-sched**. One scheduler map, **schedmap1**, associates the schedulers to the queues.

Table 502: Components of the Queue Scheduler Priority Configuration Example

Component	Settings
Hardware	QFX3500 switch
Schedulers	**fcoe-sched** for FCoE traffic **nl-sched** for no-loss traffic
Priority	**low** for FCoE traffic **low** for no-loss traffic
Scheduler map	**schedmap1**: FCoE mapping: scheduler **fcoe-sched** to forwarding class **fcoe** No-loss mapping: scheduler **nl-sched** to forwarding class **no-loss**

Configuring Queue Scheduling Priority

To configure queue priority using the CLI:

1. Create the FCoE scheduler with **low** priority:

```
[edit class-of-service]
user@switch# set schedulers fcoe-sched priority low
```

2. Create the no-loss scheduler with **low** priority:

```
[edit class-of-service]
user@switch# set schedulers nl-sched priority low
```

3. Associate the schedulers with the desired queues in the scheduler map:

```
[edit class-of-service]
user@switch# set scheduler-maps schedmap1 forwarding-class fcoe scheduler fcoe-sched
user@switch# set scheduler-maps schedmap1 forwarding-class no-loss scheduler nl-sched
```

Verification

To verify that you configured the queue scheduling priority for bandwidth and mapped the schedulers to the correct forwarding classes, perform these tasks:

- Verifying the Queue Scheduling Priority on page 5518
- Verifying the Scheduler-to-Forwarding-Class Mapping on page 5518

Verifying the Queue Scheduling Priority

Purpose Verify that you configured the queue schedulers **fcoe-sched** and **nl-sched** with **low** queue scheduling priority.

Action Display the **fcoe-sched** scheduler priority configuration using the operational mode command **show configuration class-of-service schedulers fcoe-sched priority**:

```
user@switch> show configuration class-of-service schedulers fcoe-sched priority
priority low;
```

Display the **nl-sched** scheduler priority configuration using the operational mode command **show configuration class-of-service schedulers nl-sched priority**:

```
user@switch> show configuration class-of-service schedulers nl-sched priority
priority low;
```

Verifying the Scheduler-to-Forwarding-Class Mapping

Purpose Verify that you configured the scheduler map **schedmap1** to map scheduler **fcoe-sched** to forwarding class **fcoe** and schedule **nl-sched** to forwarding class **no-loss**.

Action Display the scheduler map **schedmap1** using the operational mode command **show configuration class-of-service scheduler-maps schedmap1**:

```
user@switch> show configuration class-of-service scheduler-maps schedmap1
forwarding-class fcoe scheduler fcoe-sched;
forwarding-class no-loss scheduler nl-sched;
```

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Defining CoS Queue Scheduling Priority on page 5682
- Monitoring CoS Scheduler Maps on page 5813

Example: Configuring Traffic Control Profiles (Priority Group Scheduling)

A traffic control profile defines the output bandwidth and scheduling characteristics of forwarding class sets (priority groups). The forwarding classes (queues) mapped to a forwarding class set share the bandwidth resources that you configure in the traffic control profile. A scheduler map associates forwarding classes with schedulers to define how the individual queues in a forwarding class set share the bandwidth allocated to that forwarding class set.

Requirements

This example uses the following hardware and software components:

- A Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

The parameters you configure in a traffic control profile define the following characteristics for the priority group:

- **guaranteed-rate**—Minimum bandwidth, also known as the committed information rate (CIR). Each priority group receives a minimum of either the configured amount of absolute bandwidth or the configured percentage of bandwidth. The guaranteed rate also determines the amount of excess (extra) port bandwidth that the priority group can share. Extra port bandwidth is allocated among the priority groups on a port in proportion to the guaranteed rate of each priority group.

  NOTE: In order for the transmit-rate option (minimum bandwidth for a queue that you set using scheduler configuration) to work properly, you must configure the **guaranteed-rate** for the priority group. If a priority group does not have a guaranteed minimum bandwidth, the queues (forwarding classes) that belong to the priority group cannot have a guaranteed minimum bandwidth.

  NOTE: Include the preamble bytes and interframe gap bytes as well as the data bytes in your bandwidth calculations.

- **shaping-rate**—Maximum bandwidth, also known as the peak information rate (PIR). Each priority group receives a maximum of the configured amount of absolute bandwidth or the configured percentage of bandwidth, even if more bandwidth is available.

NOTE: Include the preamble bytes and interframe gap bytes as well as the data bytes in your bandwidth calculations.

- **scheduler-map**—Bandwidth and scheduling characteristics for the queues, defined by mapping forwarding classes to schedulers. (The queue scheduling characteristics represent amounts or percentages of the priority group bandwidth, not the amounts or percentages of total link bandwidth.)

NOTE: Because a port can have more than one priority group, when you assign resources to a priority group, keep in mind that the total port bandwidth must serve all of the queues associated with that port.

For example, if you map three priority groups to a 10-Gigabit Ethernet port, the queues associated with all three of the priority groups share the 10-Gbps bandwidth as defined by the traffic control profiles. Therefore, the total combined **guaranteed-rate** value of the three priority groups should not exceed 10 Gbps. If you configure guaranteed rates whose sum exceeds the port bandwidth, the system sends a syslog message to notify you that the configuration is not valid. However, the system does not perform a commit check. If you commit a configuration in which the sum of the guaranteed rates exceeds the port bandwidth, the hierarchical scheduler behaves unpredictably.

The sum of the queue (forwarding class) transmit rates cannot exceed the total **guaranteed-rate** of the priority group to which the queues belong. If you configure transmit rates whose sum exceeds the priority group guaranteed rate, the commit check fails and the system rejects the configuration.

If you configure the **guaranteed-rate** of a priority group as a percentage, configure all of the transmit rates associated with that priority group as percentages. In this case, if any of the transmit rates are configured as absolute values instead of percentages, the configuration is not valid and the system sends a syslog message.

Configuring a Traffic Control Profile

This example describes how to configure a traffic control profile named **san-tcp** with a scheduler map named **san-map1**and allocate to it a minimum bandwidth of 4 Gbps and a maximum bandwidth of 8 Gbps:

1. Create the traffic control profile and set the **guaranteed-rate** (minimum guaranteed bandwidth) to **4g**:

   ```
   [edit class-of-service]
   ```

```
user@switch# set traffic-control-profiles san-tcp guaranteed-rate 4g
```

2. Set the **shaping-rate** (maximum guaranteed bandwidth) to **8g**:

```
[edit class-of-service]
user@switch# set traffic-control-profiles san-tcp shaping-rate 8g
```

3. Associate the scheduler map **san-map1** with the traffic control profile:

```
[edit class-of-service]
user@switch# set traffic-control-profiles san-tcp scheduler-map san-map1
```

Verification

Verifying the Traffic Control Profile Configuration

Purpose Verify that the traffic control profile **san-tcp** has been created with a minimum guaranteed bandwidth of 4 Gbps, a maximum bandwidth of 8 Gbps, and the scheduler map **san-map1**.

Action List the traffic control profile using the operational mode command **show configuration class-of-service traffic-control-profiles san-tcp**:

```
user@switch> show configuration class-of-service traffic-control-profiles san-tcp
scheduler-map san-map1;
shaping-rate percent 8g;
guaranteed-rate 4g;
```

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Minimum Guaranteed Output Bandwidth on page 5521
- Example: Configuring Maximum Output Bandwidth on page 5526
- Example: Configuring Queue Schedulers on page 5511
- Defining CoS Traffic Control Profiles (Priority Group Scheduling) on page 5684
- Understanding CoS Traffic Control Profiles on page 5381
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366

Example: Configuring Minimum Guaranteed Output Bandwidth

Scheduling the minimum guaranteed output bandwidth for a queue (forwarding class) requires configuring both tiers of the two-tier hierarchical scheduler. One tier is scheduling the resources for the individual queue. The other tier is scheduling the resources for the priority group (forwarding class set) to which the queue belongs.

Requirements

This example uses the following hardware and software components:

- A Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

The priority group minimum guaranteed bandwidth defines the minimum total amount of bandwidth available for all of the queues in the priority group to meet their minimum bandwidth requirements.

The **transmit-rate** setting in the scheduler configuration determines the minimum guaranteed bandwidth for an individual queue. The transmit rate also determines the amount of excess (extra) priority group bandwidth that the queue can share. Extra priority group bandwidth is allocated among the queues in the priority group in proportion to the transmit rate of each queue.

The **guaranteed-rate** setting in the traffic control profile configuration determines the minimum guaranteed bandwidth for a priority group. The guaranteed rate also determines the amount of excess (extra) port bandwidth that the priority group can share. Extra port bandwidth is allocated among the priority groups on a port in proportion to the guaranteed rate of each priority group.

NOTE: You must configure both the **transmit-rate** value for the queue and the **guaranteed-rate** value for the priority group in order to set a valid minimum bandwidth guarantee for a queue. (If the priority group does not have a guaranteed minimum bandwidth, there is no guaranteed bandwidth pool from which the queue can take its guaranteed minimum bandwidth.)

The sum of the queue transmit rates in a priority group should not exceed the guaranteed rate for the priority group. (You cannot guarantee a minimum bandwidth for the queues that is greater than the minimum bandwidth guaranteed for the entire set of queues.)

NOTE: When you configure bandwidth for a queue or a priority group, the switch considers only the data as the configured bandwidth. The switch does not account for the bandwidth consumed by the preamble and the interframe gap (IFG). Therefore, when you calculate and configure the bandwidth requirements for a queue or for a priority group, consider the preamble and the IFG as well as the data in the calculations.

NOTE: You cannot configure minimum guaranteed bandwidth on strict-high priority queues or on a priority group that contains strict-high priority queues.

This example describes how to:

- Configure a transmit rate (minimum guaranteed queue bandwidth) of 2 Gbps for queues in a scheduler named **be-sched**.
- Configure a guaranteed rate (minimum guaranteed priority group bandwidth) of 4 Gbps for a priority group in a traffic control profile named **be-tcp**.
- Assign the scheduler to a queue named **best-effort** by using a scheduler map named **be-map**.
- Associate the scheduler map **be-map** with the traffic control profile **be-tcp**.
- Assign the queue **best-effort** to a priority group named **be-pg**.
- Assign the priority group and the minimum guaranteed bandwidth scheduling to the egress interface **xe-0/0/7**.

Table 503 on page 5523 shows the configuration components for this example:

Table 503: Components of the Minimum Guaranteed Output Bandwidth Configuration Example

Component	Settings
Hardware	QFX3500 switch
Minimum guaranteed queue bandwidth	Transmit rate: **2g**
Minimum guaranteed priority group bandwidth	Guaranteed rate: **4g**
Scheduler	**be-sched**
Scheduler map	**be-map**
Traffic control profile	**be-tcp**
Forwarding class set (priority group)	**be-pg**
Queue (forwarding class)	**best-effort**
Egress interface	**xe-0/0/7**

Configuring Guaranteed Minimum Bandwidth

To configure the minimum guaranteed bandwidth hierarchical scheduling for a queue and a priority group:

1. Configure the minimum guaranteed queue bandwidth of 2 Gbps for scheduler **be-sched**:

   ```
   [edit class-of-service schedulers]
   user@switch# set be-sched transmit-rate 2g
   ```

2. Configure the minimum guaranteed priority group bandwidth of 4 Gbps for traffic control profile **be-tcp**:

```
[edit class-of-service traffic-control-profiles]
user@switch# set be-tcp guaranteed-rate 4g
```

3. Associate the scheduler **be-sched** with the **best-effort** queue in the scheduler map **be-map**:

```
[edit class-of-service scheduler-maps]
user@switch# set be-map forwarding-class best-effort scheduler be-sched
```

4. Associate the scheduler map with the traffic control profile:

```
[edit class-of-service traffic-control-profiles]
user@switch# set be-tcp scheduler-map be-map
```

5. Assign the **best-effort** queue to the priority group **be-pg**:

```
[edit class-of-service forwarding-class-sets]
user@switch# set be-pg class best-effort
```

6. Apply the configuration to interface **xe-0/0/7**:

```
[edit class-of-service interfaces]
user@switch# set xe-0/0/7 forwarding-class-set be-pg output-traffic-control-profile be-tcp
```

Verification

To verify the minimum guaranteed output bandwidth configuration, perform these tasks:

- Verifying the Minimum Guaranteed Queue Bandwidth on page 5524
- Verifying the Priority Group Minimum Guaranteed Bandwidth and Scheduler Map Association on page 5524
- Verifying the Scheduler Map Configuration on page 5525
- Verifying Queue (Forwarding Class) Membership in the Priority Group on page 5525
- Verifying the Egress Interface Configuration on page 5525

Verifying the Minimum Guaranteed Queue Bandwidth

Purpose Verify that you configured the minimum guaranteed queue bandwidth as **2g** in the scheduler **be-sched**.

Action Display the minimum guaranteed bandwidth in the **be-sched** scheduler configuration using the operational mode command **show configuration class-of-service schedulers be-sched transmit-rate**:

```
user@switch> show configuration class-of-service schedulers be-sched transmit-rate
2g;
```

Verifying the Priority Group Minimum Guaranteed Bandwidth and Scheduler Map Association

Purpose Verify that the minimum guaranteed priority group bandwidth is **4g** and the attached scheduler map is **be-map** in the traffic control profile **be-tcp**.

Action Display the minimum guaranteed bandwidth in the **be-tcp** traffic control profile configuration using the operational mode command **show configuration class-of-service traffic-control-profiles be-tcp guaranteed-rate**:

```
user@switch> show configuration class-of-service traffic-control-profiles be-tcp guaranteed-rate
4g;
```

Display the scheduler map in the **be-tcp** traffic control profile configuration using the operational mode command **show configuration class-of-service traffic-control-profiles be-tcp scheduler-map**:

```
user@switch> show configuration class-of-service traffic-control-profiles be-tcp scheduler-map
scheduler-map be-map;
```

Verifying the Scheduler Map Configuration

Purpose Verify that the scheduler map **be-map** maps the forwarding class **best-effort** to the scheduler **be-sched**.

Action Display the **be-map** scheduler map configuration using the operational mode command **show configuration class-of-service schedulers maps be-map**:

```
user@switch> show configuration class-of-service scheduler-maps be-map
forwarding-class best-effort scheduler be-sched;
```

Verifying Queue (Forwarding Class) Membership in the Priority Group

Purpose Verify that the forwarding class set **be-pg** includes the forwarding class **best-effort**.

Action Display the **be-pg** forwarding class set configuration using the operational mode command **show configuration class-of-service forwarding-class-sets be-pg**:

```
user@switch> show configuration class-of-service forwarding-class-sets be-pg
class best-effort;
```

Verifying the Egress Interface Configuration

Purpose Verify that the forwarding class set **be-pg** and the traffic control profile **be-tcp** are attached to egress interface **xe-0/0/7**.

Action Display the egress interface using the operational mode command **show configuration class-of-service interfaces xe-0/0/7**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/7
forwarding-class-set {
    be-pg {
        output-traffic-control-profile be-tcp;
    }
}
```

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519

- Example: Configuring Queue Scheduling Priority on page 5516
- Example: Configuring Forwarding Class Sets on page 5508
- Understanding CoS Traffic Control Profiles on page 5381
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366

Example: Configuring Maximum Output Bandwidth

Scheduling the maximum output bandwidth for a queue (forwarding class) requires configuring both tiers of the hierarchical scheduler. One tier is scheduling the resources for the individual queue. The other tier is scheduling the resources for the priority group (forwarding class set) to which the queue belongs.

Requirements

This example uses the following hardware and software components:

- A Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

The priority group maximum bandwidth defines the maximum total amount of bandwidth available for all of the queues in the priority group.

The **shaping-rate** setting in the scheduler configuration determines the maximum bandwidth for an individual queue.

The **shaping-rate** setting in the traffic control profile configuration determines the maximum bandwidth for a priority group.

NOTE: When you configure bandwidth for a queue or a priority group, the switch considers only the data as the configured bandwidth. The switch does not account for the bandwidth consumed by the preamble and the interframe gap (IFG). Therefore, when you calculate and configure the bandwidth requirements for a queue or for a priority group, consider the preamble and the IFG as well as the data in the calculations.

NOTE: When you set the maximum bandwidth (**shaping-rate**) for a queue or for a priority group at 100 Kbps or less, the traffic shaping behavior is accurate only within +/– 20 percent of the configured **shaping-rate** value.

This example describes how to:

- Configure a maximum rate of 4 Gbps for queues in a scheduler named **be-sched**.
- Configure a maximum rate of 6 Gbps for a priority group in a traffic control profile named **be-tcp**.
- Assign the scheduler to a queue named **best-effort** by using a scheduler map named **be-map**.
- Associate the scheduler map **be-map** with the traffic control profile **be-tcp**.
- Assign the queue **best-effort** to a priority group named **be-pg**.
- Assign the priority group and the bandwidth scheduling to the interface **xe-0/0/7**.

Table 504 on page 5527 shows the configuration components for this example:

Table 504: Components of the Maximum Output Bandwidth Configuration Example

Component	Settings
Hardware	QFX3500 switch
Maximum queue bandwidth	Shaping rate: **4g**
Maximum priority group bandwidth	Shaping rate: **6g**
Scheduler	**be-sched**
Scheduler map	**be-map**
Traffic control profile	**be-tcp**
Forwarding class set (priority group)	**be-pg**
Queue (forwarding class)	**best-effort**
Egress interface	**xe-0/0/7**

Configuring Maximum Bandwidth

To configure the maximum bandwidth hierarchical scheduling for a queue and a priority group:

1. Configure the maximum queue bandwidth of 4 Gbps for scheduler **be-sched**:

   ```
   [edit class-of-service schedulers]
   user@switch# set be-sched shaping-rate 4g
   ```

2. Configure the maximum priority group bandwidth of 6 Gbps for traffic control profile **be-tcp**:

   ```
   [edit class-of-service traffic-control-profiles]
   user@switch# set be-tcp shaping-rate 6g
   ```

3. Associate the scheduler **be-sched** with the **best-effort** queue in the scheduler map **be-map**:

```
[edit class-of-service scheduler-maps]
user@switch# set be-map forwarding-class best-effort scheduler be-sched
```

4. Associate the scheduler map with the traffic control profile:

```
[edit class-of-service traffic-control-profiles]
user@switch# set be-tcp scheduler-map be-map
```

5. Assign the **best-effort** queue to the priority group **be-pg**:

```
[edit class-of-service forwarding-class-sets]
user@switch# set be-pg class best-effort
```

6. Apply the configuration to interface **xe-0/0/7**:

```
[edit class-of-service interfaces]
user@switch# set xe-0/0/7 forwarding-class-set be-pg output-traffic-control-profile be-tcp
```

Verification

To verify the maximum output bandwidth configuration, perform these tasks:

- Verifying the Maximum Queue Bandwidth on page 5528
- Verifying the Priority Group Maximum Bandwidth and Scheduler Map Association on page 5528
- Verifying the Scheduler Map Configuration on page 5529
- Verifying Queue (Forwarding Class) Membership in the Priority Group on page 5529
- Verifying the Egress Interface Configuration on page 5529

Verifying the Maximum Queue Bandwidth

Purpose Verify that you configured the maximum queue bandwidth as **4g** in the scheduler **be-sched**.

Action List the maximum bandwidth in the **be-sched** scheduler configuration using the operational mode command **show configuration class-of-service schedulers be-sched shaping-rate**:

```
user@switch> show configuration class-of-service schedulers be-sched shaping-rate
4g;
```

Verifying the Priority Group Maximum Bandwidth and Scheduler Map Association

Purpose Verify that the maximum priority group bandwidth is **6g** and the attached scheduler map is **be-map** in the traffic control profile **be-tcp**.

Action List the maximum bandwidth in the **be-tcp** traffic control profile configuration using the operational mode command **show configuration class-of-service traffic-control-profiles be-tcp shaping-rate**:

```
user@switch> show configuration class-of-service traffic-control-profiles be-tcp shaping-rate
4g;
```


List the scheduler map in the **be-tcp** traffic control profile configuration using the operational mode command **show configuration class-of-service traffic-control-profiles be-tcp scheduler-map**:

```
user@switch> show configuration class-of-service traffic-control-profiles be-tcp scheduler-map
scheduler-map be-map;
```

Verifying the Scheduler Map Configuration

Purpose Verify that the scheduler map **be-map** maps the forwarding class **best-effort** to the scheduler **be-sched**.

Action List the **be-map** scheduler map configuration using the operational mode command **show configuration class-of-service schedulers maps be-map**:

```
user@switch> show configuration class-of-service scheduler-maps be-map
forwarding-class best-effort scheduler be-sched;
```

Verifying Queue (Forwarding Class) Membership in the Priority Group

Purpose Verify that the forwarding class set **be-pg** includes the forwarding class **best-effort**.

Action List the **be-pg** forwarding class set configuration using the operational mode command **show configuration class-of-service forwarding-class-sets be-pg**:

```
user@switch> show configuration class-of-service forwarding-class-sets be-pg
class best-effort;
```

Verifying the Egress Interface Configuration

Purpose Verify that the forwarding class set **be-pg** and the traffic control profile **be-tcp** are attached to egress interface **xe-0/0/7**.

Action List the egress interface using the operational mode command **show configuration class-of-service interfaces xe-0/0/7**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/7
forwarding-class-set {
    be-pg {
        output-traffic-control-profile be-tcp;
    }
}
```

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Forwarding Class Sets on page 5508
- Understanding CoS Traffic Control Profiles on page 5381
- Understanding CoS Hierarchical Port Scheduling (ETS) on page 5366

Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic

Although the switch reserves some buffer space to ensure a minimum memory allocation for ports and queues, you can configure how the system uses the rest of the buffer space to optimize the buffer allocation for your particular mix of network traffic.

This example shows you the recommended configuration of the global shared buffer pool to support a network that carries mostly best-effort (lossy) unicast traffic. The global shared buffer pool is memory space that all of the ports on the switch share dynamically as they need buffers. You can allocate global shared memory space to different types of buffers to better support different mixes of network traffic.

CAUTION: **Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.**

Use the default shared buffer settings (for a network with a balanced mix of lossless, best effort, and multicast traffic) or one of the recommended shared buffer configurations for your mix of network traffic (mostly best-effort unicast traffic, mostly best-effort traffic on links enabled for Ethernet PAUSE, mostly multicast traffic, or mostly lossless traffic). Either the default configuration or one of the recommended configurations provides a buffer allocation that satisfies the needs of most networks.

After starting from the recommended configuration, you can fine-tune the shared buffer settings, but do so with caution to prevent traffic loss due to buffer misconfiguration.

Requirements

This example uses the following hardware and software components:

- Juniper Networks QFX3500 Switch
- Junos OS Release 12.3 or later for the QFX Series

Overview

You can configure the percentage of available (user-configurable) buffer space allocated to the global shared buffers. Any space that you do not allocate to the global shared buffer pool is added to the dedicated buffer pool. The default configuration allocates 100 percent of the available buffer space to the global shared buffers.

You can partition the ingress and egress shared buffer pools to allocate more buffers to the types of traffic your network predominantly carries, and fewer buffers to other traffic.

From the buffer space allocated to the ingress shared buffer pool, you can allocate space to:

- Lossless buffers—Percentage of shared buffer pool for all lossless ingress traffic. The minimum value for the lossless buffers is 5 percent.
- Lossless headroom buffers—Percentage of shared buffer pool for packets received while a pause is asserted. If Ethernet PAUSE is configured on a port or if priority-based flow control (PFC) is configured on priorities on a port, when the port sends a pause message to the connected peer, the port uses the headroom buffers to store the packets that arrive between the time the port sends the pause message and the time the last packet arrives after the peer pauses traffic. The minimum value for the lossless headroom buffers is 0 (zero) percent. (Lossless headroom buffers are the only buffers that can have a minimum value of less than 5 percent.)
- Lossy buffers—Percentage of shared buffer pool for all best-effort ingress traffic (best-effort unicast, multidestination, and strict-high priority traffic). The minimum value for the lossy buffers is 5 percent.

The combined percentage values of the ingress lossless, lossless headroom, and lossy buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. All ingress buffer partitions must be explicitly configured, even when the lossless headroom buffer partition has a value of 0 (zero) percent.

From the buffer space allocated to the egress shared buffer pool, you can allocate space to:

- Lossless buffers—Percentage of shared buffer pool for all lossless egress queues. The minimum value for the lossless buffers is 5 percent.
- Lossy buffers—Percentage of shared buffer pool for all best-effort egress queues (best-effort unicast, and strict-high priority queues). The minimum value for the lossy buffers is 5 percent.
- Multicast buffers—Percentage of shared buffer pool for all multidestination (multicast, broadcast, and destination lookup fail) egress queues. The minimum value for the multicast buffers is 5 percent.

The combined percentage values of the egress lossless, lossy, and multicast buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. All egress buffer partitions must be explicitly configured and must have a value of at least 5 percent.

To configure the shared buffers to support a network that carries mostly best-effort unicast traffic, more buffer space needs to be allocated to lossy buffers, and less buffer space should be allocated to lossless buffers. This example shows you how to configure the global shared buffer pool allocation that we recommend to support a network that carries mostly unicast traffic.

Topology

Table 505 on page 5532 shows the configuration components for this example.

Table 505: Components of the Recommended Shared Buffer Configuration for Best-Effort Unicast Network Topologies

Component	Settings
Hardware	QFX3500 switch
Ingress shared buffer	Percentage of available ingress buffer space allocated to the ingress shared buffer: 100% Percentage of ingress buffer space allocated to lossless traffic (lossless buffer partition): 5% Percentage of ingress buffer space allocated to lossless headroom traffic (lossless-headroom buffer partition): 0% Percentage of ingress buffer space allocated to best-effort traffic (lossy buffer partition): 95%
Egress shared buffer	Percentage of available egress buffer space allocated to the egress shared buffer: 100% Percentage of egress buffer space allocated to lossless queues (lossless buffer partition): 5% Percentage of egress buffer space allocated to best-effort queues (lossy buffer partition): 75% Percentage of egress buffer space allocated to multicast traffic (multicast buffer partition): 20%

Configuration

CLI Quick Configuration

To quickly configure the recommended shared buffer settings for networks that carry mostly best-effort unicast traffic, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level:

```
[edit class-of-service shared-buffer]
set ingress percent 100
set ingress buffer-partition lossless percent 5
set ingress buffer-partition lossless-headroom percent 0
set ingress buffer-partition lossy percent 95
set egress percent 100
set egress buffer-partition lossless percent 5
set egress buffer-partition lossy percent 75
set egress buffer-partition multicast percent 20
```

Configuring the Global Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic

Step-by-Step Procedure

To configure the global ingress and egress shared buffer allocations and partitions for a network that carries mostly best-effort unicast traffic:

1. Configure the percentage of available (nonreserved) buffers used for the ingress global shared buffer pool:

   ```
   [edit class-of-service shared-buffer]
   user@switch# set ingress percent 100
   ```

2. Configure the global ingress buffer partitions for lossless, lossless-headroom, and lossy traffic:

   ```
   [edit class-of-service shared-buffer]
   user@switch# set ingress buffer-partition lossless percent 5
   user@switch# set ingress buffer-partition lossless-headroom percent 0
   ```

```
user@switch# set ingress buffer-partition lossy percent 95
```

3. Configure the percentage of available (nonreserved) buffers used for the egress global shared buffer pool:

```
[edit class-of-service shared-buffer]
user@switch# set egress percent 100
```

4. Configure the global egress buffer partitions for lossless, lossy, and multicast queues:

```
[edit class-of-service shared-buffer]
user@switch# set egress buffer-partition lossless percent 5
user@switch# set egress buffer-partition lossy percent 75
user@switch# set egress buffer-partition multicast percent 20
```

Results

Display the results of the configuration:

```
root@dcbg-tp-pa-02> show configuration class-of-service shared-buffer
ingress {
    percent 100;
    buffer-partition lossless {
        percent 5;
    }
    buffer-partition lossy {
        percent 95;
    }
    buffer-partition lossless-headroom {
        percent 0;
    }
}
egress {
    percent 100;
    buffer-partition lossless {
        percent 5;
    }
    buffer-partition lossy {
        percent 75;
    }
    buffer-partition multicast {
        percent 20;
    }
}
```

Verification

Verify that the shared buffer configuration has been created properly.

Verifying the Shared Buffer Configuration

Purpose Verify that the ingress and egress global shared buffer pools are correctly configured and partitioned among the shared buffer types.

Action List the global shared buffer configuration using the operational mode command **show class-of-service shared-buffer**:

```
user@switch> show class-of-service shared-buffer
root@dcbg-tp-pa-02> show class-of-service shared-buffer
Ingress:
  Total Buffer     :  9360.00 KB
```

```
  Dedicated Buffer :  2158.00 KB
  Shared Buffer    :  7202.00 KB
    Lossless         :  360.10 KB
    Lossless Headroom :  0.00 KB
    Lossy            :  6841.90 KB

  Lossless Headroom Utilization:
  Node Device        Total         Used                 Free
  0                  0.00 KB       0.00 KB              0.00 KB

Egress:
  Total Buffer     :  9360.00 KB
  Dedicated Buffer :  2704.00 KB
  Shared Buffer    :  6656.00 KB
    Lossless         :  332.80 KB
    Multicast        :  1331.20 KB
    Lossy            :  4992.00 KB
```

Meaning The **show class-of-service shared-buffer** operational command shows all of the ingress and egress global shared buffer settings, including the buffer partitioning.

For the ingress shared buffers, the command output shows:

- The total switch buffer pool is 9360 KB (9 MB).
- The dedicated buffer pool is 2158 KB. This is the size of the global ingress dedicated buffer pool when you configure the ingress shared buffer pool as 100 percent of the available (user-configurable) buffer space. This is the minimum size of the reserved, ingress dedicated ingress buffer pool (not user-configurable). If you configure the shared buffer as less than 100 percent of the available buffer pool, the remaining buffer space is added to the dedicated buffer pool.
- With the ingress shared buffer pool configured as 100 percent of the available buffers, the total size of the ingress shared buffer pool is 7202 KB.
- The ingress shared buffer pool is partitioned to allocate:
  - 360.10 KB to lossless traffic
  - No space to lossless headroom traffic
  - 6841.90 KB to lossy unicast traffic
- The Lossless Headroom Utilization field shows how much of the buffer space reserved for paused traffic is used. Because the lossless headroom buffer partition is set to 0 (zero) percent, the total amount of lossless headroom buffer space is 0 KB; therefore the amount of used and free lossless headroom buffer space is also 0 KB.

For the egress shared buffers, the command output shows:

- The total switch buffer pool is 9360 KB (9 MB).
- The dedicated buffer pool is 2704 KB. This is the size of the global egress dedicated buffer pool when you configure the egress shared buffer pool as 100 percent of the available (user-configurable) buffer space. This is the minimum size of the reserved, egress dedicated buffer pool (not user-configurable). If you configure the shared buffer

as less than 100 percent of the available buffer pool, the remaining buffer space is added to the dedicated buffer pool.

- With the egress shared buffer pool configured as 100 percent of the available buffers, the total size of the egress shared buffer pool is 6656 KB. This is less than the ingress shared buffer pool because the switch reserves more egress dedicated buffer space than ingress dedicated buffer space. (More dedicated buffer space means less shared buffer space, and more shared buffer space means less dedicated buffer space.)
- The egress shared buffer pool is partitioned to allocate:
  - 332.80 KB to lossless traffic
  - 1331.20 KB to multicast traffic
  - 4992 KB to lossy unicast traffic

NOTE: The output values are valid for QFX3500 and QFX3600 switches. QFX5100 switches have larger buffers (12MB instead of 9MB), so the total buffer size and the sizes of each buffer partition are larger on QFX5100 switches.

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Traffic on Links with Ethernet PAUSE Enabled on page 5535
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Configuring Global Ingress and Egress Shared Buffers on page 5690
- Understanding CoS Buffer Configuration on page 5391

Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Traffic on Links with Ethernet PAUSE Enabled

Although the switch reserves some buffer space to ensure a minimum memory allocation for ports and queues, you can configure how the system uses the rest of the buffer space to optimize the buffer allocation for your particular mix of network traffic.

This example shows you the recommended configuration of the global shared buffer pool to support a network that carries mostly best-effort (lossy) traffic on links with Ethernet PAUSE (IEEE 802.3X) enabled. The global shared buffer pool is memory space that all of the ports on the switch share dynamically as they need buffers. You can allocate global shared memory space to different types of buffers to better support different mixes of network traffic.

CAUTION: **Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.**

Use the default shared buffer settings (for a network with a balanced mix of lossless, best effort, and multicast traffic) or one of the recommended shared buffer configurations for your mix of network traffic (mostly best-effort unicast traffic, mostly best-effort traffic on links enabled for Ethernet PAUSE, mostly multicast traffic, or mostly lossless traffic). Either the default configuration or one of the recommended configurations provides a buffer allocation that satisfies the needs of most networks.

After starting from the recommended configuration, you can fine-tune the shared buffer settings, but do so with caution to prevent traffic loss due to buffer misconfiguration.

Requirements

This example uses the following hardware and software components:

- Juniper Networks QFX3500 Switch
- Junos OS Release 12.3 or later for the QFX Series

Overview

You can configure the percentage of available (user-configurable) buffer space allocated to the global shared buffers. Any space that you do not allocate to the global shared buffer pool is added to the dedicated buffer pool. The default configuration allocates 100 percent of the available buffer space to the global shared buffers.

You can partition the ingress and egress shared buffer pools to allocate more buffers to the types of traffic your network predominantly carries, and fewer buffers to other traffic. From the buffer space allocated to the ingress shared buffer pool, you can allocate space to:

- Lossless buffers—Percentage of shared buffer pool for all lossless ingress traffic. The minimum value for the lossless buffers is 5 percent.
- Lossless headroom buffers—Percentage of shared buffer pool for packets received while a pause is asserted. If Ethernet PAUSE is configured on a port or if priority-based flow control (PFC) is configured on priorities on a port, when the port sends a pause message to the connected peer, the port uses the headroom buffers to store the packets that arrive between the time the port sends the pause message and the time the last packet arrives after the peer pauses traffic. The minimum value for the lossless headroom buffers is 0 (zero) percent. (Lossless headroom buffers are the only buffers that can have a minimum value of less than 5 percent.)

- Lossy buffers—Percentage of shared buffer pool for all best-effort ingress traffic (best-effort unicast, multidestination, and strict-high priority traffic). The minimum value for the lossy buffers is 5 percent.

The combined percentage values of the ingress lossless, lossless headroom, and lossy buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. All ingress buffer partitions must be explicitly configured, even when the lossless headroom buffer partition has a value of 0 (zero) percent.

From the buffer space allocated to the egress shared buffer pool, you can allocate space to:

- Lossless buffers—Percentage of shared buffer pool for all lossless egress queues. The minimum value for the lossless buffers is 5 percent.
- Lossy buffers—Percentage of shared buffer pool for all best-effort egress queues (best-effort unicast and strict-high priority queues). The minimum value for the lossy buffers is 5 percent.
- Multicast buffers—Percentage of shared buffer pool for all multidestination (multicast, broadcast, and destination lookup fail) egress queues. The minimum value for the multicast buffers is 5 percent.

The combined percentage values of the egress lossless, lossy, and multicast buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. All egress buffer partitions must be explicitly configured and must have a value of at least 5 percent.

To configure the shared buffers to support a network that carries mostly best-effort traffic on links enabled for Ethernet PAUSE, more buffer space needs to be allocated to ingress dedicated port buffers, and less buffer space should be allocated to ingress shared buffers. Also, more buffer space needs to be allocated to lossless-headroom buffers, and less space to ingress lossy buffers. This example shows you how to configure the global shared buffer pool allocation that we recommend to support a network that carries mostly best-effort traffic on links enabled for Ethernet PAUSE.

Topology

Table 506 on page 5537 shows the configuration components for this example.

Table 506: Components of the Recommended Shared Buffer Configuration for Best-Effort Network Topologies with Links Enabled for Ethernet PAUSE

Component	Settings
Hardware	QFX3500 switch

Table 506: Components of the Recommended Shared Buffer Configuration for Best-Effort Network Topologies with Links Enabled for Ethernet PAUSE *(continued)*

Component	Settings
Ingress shared buffer	Percentage of available ingress buffer space allocated to the ingress shared buffer: 70% Percentage of ingress buffer space allocated to lossless traffic (lossless buffer partition): 5% Percentage of ingress buffer space allocated to lossless headroom traffic (lossless-headroom buffer partition): 80% Percentage of ingress buffer space allocated to best-effort traffic (lossy buffer partition): 15%
Egress shared buffer	Percentage of available egress buffer space allocated to the egress shared buffer: 100% Percentage of egress buffer space allocated to lossless queues (lossless buffer partition): 5% Percentage of egress buffer space allocated to best-effort queues (lossy buffer partition): 75% Percentage of egress buffer space allocated to multicast traffic (multicast buffer partition): 20%

Configuration

CLI Quick Configuration

To quickly configure the recommended shared buffer settings for networks that carry mostly best-effort unicast traffic, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level:

```
[edit class-of-service shared-buffer]
set ingress percent 70
set ingress buffer-partition lossless percent 5
set ingress buffer-partition lossless-headroom percent 80
set ingress buffer-partition lossy percent 15
set egress percent 100
set egress buffer-partition lossless percent 5
set egress buffer-partition lossy percent 75
set egress buffer-partition multicast percent 20
```

Configuring the Global Shared Buffer Pool for Networks with Mostly Best-Effort Traffic on Links Enabled for Ethernet PAUSE

Step-by-Step Procedure

To configure the global ingress and egress shared buffer allocations and partitions:

1. Configure the percentage of available (nonreserved) buffers used for the ingress global shared buffer pool:

   ```
   [edit class-of-service shared-buffer]
   user@switch# set ingress percent 70
   ```

2. Configure the global ingress buffer partitions for lossless, lossless-headroom, and lossy traffic:

   ```
   [edit class-of-service shared-buffer]
   user@switch# set ingress buffer-partition lossless percent 5
   user@switch# set ingress buffer-partition lossless-headroom percent 80
   user@switch# set ingress buffer-partition lossy percent 15
   ```

3. Configure the percentage of available (nonreserved) buffers used for the egress global shared buffer pool:

```
[edit class-of-service shared-buffer]
user@switch# set egress percent 100
```

4. Configure the global egress buffer partitions for lossless, lossy, and multicast queues:

```
[edit class-of-service shared-buffer]
user@switch# set egress buffer-partition lossless percent 5
user@switch# set egress buffer-partition lossy percent 75
user@switch# set egress buffer-partition multicast percent 20
```

Results

Display the results of the configuration:

```
root@dcbg-tp-pa-02> show configuration class-of-service shared-buffer
ingress {
    percent 70;
    buffer-partition lossless {
        percent 5;
    }
    buffer-partition lossy {
        percent 15;
    }
    buffer-partition lossless-headroom {
        percent 80;
    }
}
egress {
    percent 100;
    buffer-partition lossless {
        percent 5;
    }
    buffer-partition lossy {
        percent 75;
    }
    buffer-partition multicast {
        percent 20;
    }
}
```

Verification

Verify that the shared buffer configuration has been created properly.

Verifying the Shared Buffer Configuration

Purpose Verify that the ingress and egress global shared buffer pools are correctly configured and partitioned among the shared buffer types.

Action List the global shared buffer configuration using the operational mode command **show class-of-service shared-buffer**:

```
user@switch> show class-of-service shared-buffer
root@dcbg-tp-pa-02> show class-of-service shared-buffer
Ingress:
  Total Buffer     :  9360.00 KB
  Dedicated Buffer :  4318.60 KB
```

```
  Shared Buffer    :  5041.40 KB
    Lossless          :  252.07 KB
    Lossless Headroom :  4033.12 KB
    Lossy             :  756.21 KB

Egress:
  Total Buffer     :  9360.00 KB
  Dedicated Buffer :  2704.00 KB
  Shared Buffer    :  6656.00 KB
    Lossless          :  332.80 KB
    Multicast         :  1331.20 KB
    Lossy             :  4992.00 KB
```

Meaning The **show class-of-service shared-buffer** operational command shows all of the ingress and egress global shared buffer settings, including the buffer partitioning.

For the ingress shared buffers, the command output shows:

- The total switch buffer pool is 9360 KB (9 MB).
- The dedicated buffer pool is 4318.6 KB. This is the size of the global ingress dedicated buffer pool when you configure the ingress shared buffer pool as 70 percent of the available (user-configurable) buffer space.
- With the ingress shared buffer pool configured as 70 percent of the available buffers, the total size of the ingress shared buffer pool is 5041.4 KB.
- The ingress shared buffer pool is partitioned to allocate:
  - 252.07 KB to lossless traffic
  - 4033.12 KB to lossless headroom traffic
  - 756.21 KB to lossy unicast traffic

For the egress shared buffers, the command output shows:

- The total switch buffer pool is 9360 KB (9 MB).
- The dedicated buffer pool is 2704 KB. This is the size of the global egress dedicated buffer pool when you configure the egress shared buffer pool as 100 percent of the available (user-configurable) buffer space. This is the minimum size of the reserved, egress dedicated buffer pool (not user-configurable). If you configure the shared buffer as less than 100 percent of the available buffer pool, the remaining buffer space is added to the dedicated buffer pool.
- With the egress shared buffer pool configured as 100 percent of the available buffers, the total size of the egress shared buffer pool is 6656 KB. This is less than the ingress shared buffer pool because the switch reserves more egress dedicated buffer space than ingress dedicated buffer space. (More dedicated buffer space means less shared buffer space, and more shared buffer space means less dedicated buffer space.)
- The egress shared buffer pool is partitioned to allocate:
  - 332.80 KB to lossless traffic
  - 1331.20 KB to multicast traffic

- 4992 KB to lossy unicast traffic

NOTE: The output values are valid for QFX3500 and QFX3600 switches. QFX5100 switches have larger buffers (12MB instead of 9MB), so the total buffer size and the sizes of each buffer partition are larger on QFX5100 switches.

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Configuring Global Ingress and Egress Shared Buffers on page 5690
- Understanding CoS Buffer Configuration on page 5391

Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic

Although the switch reserves some buffer space to ensure a minimum memory allocation for ports and queues, you can configure how the system uses the rest of the buffer space to optimize the buffer allocation for your particular mix of network traffic.

This example shows you the recommended configuration of the global shared buffer pool to support a network that carries mostly multicast traffic. The global shared buffer pool is memory space that all of the ports on the switch share dynamically as they need buffers. You can allocate global shared memory space to different types of buffers to better support different mixes of network traffic.

CAUTION: Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.

Use the default shared buffer settings (for a network with a balanced mix of lossless, best effort, and multicast traffic) or one of the recommended shared buffer configurations for your mix of network traffic (mostly best-effort unicast traffic, mostly best-effort traffic on links enabled for Ethernet PAUSE, mostly multicast traffic, or mostly lossless traffic). Either the default configuration or one of the recommended configurations provides a buffer allocation that satisfies the needs of most networks.

After starting from the recommended configuration, you can fine-tune the shared buffer settings, but do so with caution to prevent traffic loss due to buffer misconfiguration.

Requirements

This example uses the following hardware and software components:

- Juniper Networks QFX3500 Switch
- Junos OS Release 12.3 or later for the QFX Series

Overview

You can configure the percentage of available (user-configurable) buffer space allocated to the global shared buffers. Any space that you do not allocate to the global shared buffer pool is added to the dedicated buffer pool. The default configuration allocates 100 percent of the available buffer space to the global shared buffers.

You can partition the ingress and egress shared buffer pools to allocate more buffers to the types of traffic your network predominantly carries, and fewer buffers to other traffic. From the buffer space allocated to the ingress shared buffer pool, you can allocate space to:

- Lossless buffers—Percentage of shared buffer pool for all lossless ingress traffic. The minimum value for the lossless buffers is 5 percent.
- Lossless headroom buffers—Percentage of shared buffer pool for packets received while a pause is asserted. If Ethernet PAUSE is configured on a port or if priority-based flow control (PFC) is configured on priorities on a port, when the port sends a pause message to the connected peer, the port uses the headroom buffers to store the packets that arrive between the time the port sends the pause message and the time the last packet arrives after the peer pauses traffic. The minimum value for the lossless headroom buffers is 0 (zero) percent. (Lossless headroom buffers are the only buffers that can have a minimum value of less than 5 percent.)
- Lossy buffers—Percentage of shared buffer pool for all best-effort ingress traffic (best-effort unicast, multidestination, and strict-high priority traffic). The minimum value for the lossy buffers is 5 percent.

The combined percentage values of the ingress lossless, lossless headroom, and lossy buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. All ingress buffer partitions must be explicitly configured, even when the lossless headroom buffer partition has a value of 0 (zero) percent.

From the buffer space allocated to the egress shared buffer pool, you can allocate space to:

- Lossless buffers—Percentage of shared buffer pool for all lossless egress queues. The minimum value for the lossless buffers is 5 percent.
- Lossy buffers—Percentage of shared buffer pool for all best-effort egress queues (best-effort unicast, and strict-high priority queues). The minimum value for the lossy buffers is 5 percent.
- Multicast buffers—Percentage of shared buffer pool for all multidestination (multicast, broadcast, and destination lookup fail) egress queues. The minimum value for the multicast buffers is 5 percent.

The combined percentage values of the egress lossless, lossy, and multicast buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. All egress buffer partitions must be explicitly configured and must have a value of at least 5 percent.

To configure the shared buffers to support a network that carries mostly multicast traffic, more buffer space needs to be allocated to lossy buffers, less buffer space should be allocated to lossless buffers, and more space needs to be allocated to egress multicast buffers. This example shows you how to configure the global shared buffer pool allocation that we recommend to support a network that carries mostly multicast traffic.

Topology

Table 507 on page 5543 shows the configuration components for this example.

Table 507: Components of the Recommended Shared Buffer Configuration for Multicast Network Topologies

Component	Settings
Hardware	QFX3500 switch
Ingress shared buffer	Percentage of available ingress buffer space allocated to the ingress shared buffer: 100% Percentage of ingress buffer space allocated to lossless traffic (lossless buffer partition): 5% Percentage of ingress buffer space allocated to lossless headroom traffic (lossless-headroom buffer partition): 0% Percentage of ingress buffer space allocated to best-effort traffic (lossy buffer partition): 95%
Egress shared buffer	Percentage of available egress buffer space allocated to the egress shared buffer: 100% Percentage of egress buffer space allocated to lossless queues (lossless buffer partition): 5% Percentage of egress buffer space allocated to best-effort queues (lossy buffer partition): 20% Percentage of egress buffer space allocated to multicast traffic (multicast buffer partition): 75%

Configuration

CLI Quick Configuration

To quickly configure the recommended shared buffer settings for networks that carry mostly multicast traffic, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level:

```
[edit class-of-service shared-buffer]
set ingress percent 100
set ingress buffer-partition lossless percent 5
set ingress buffer-partition lossless-headroom percent 0
set ingress buffer-partition lossy percent 95
set egress percent 100
set egress buffer-partition lossless percent 5
set egress buffer-partition lossy percent 20
set egress buffer-partition multicast percent 75
```

Configuring the Global Shared Buffer Pool for Networks with Mostly Multicast Traffic

Step-by-Step Procedure

To configure the global ingress and egress shared buffer allocations and partitions for a network that carries mostly multicast traffic:

1. Configure the percentage of available (nonreserved) buffers used for the ingress global shared buffer pool:

   ```
   [edit class-of-service shared-buffer]
   user@switch# set ingress percent 100
   ```

2. Configure the global ingress buffer partitions for lossless, lossless-headroom, and lossy traffic:

   ```
   [edit class-of-service shared-buffer]
   user@switch# set ingress buffer-partition lossless percent 5
   user@switch# set ingress buffer-partition lossless-headroom percent 0
   user@switch# set ingress buffer-partition lossy percent 95
   ```

3. Configure the percentage of available (nonreserved) buffers used for the egress global shared buffer pool:

   ```
   [edit class-of-service shared-buffer]
   user@switch# set egress percent 100
   ```

4. Configure the global egress buffer partitions for lossless, lossy, and multicast queues:

   ```
   [edit class-of-service shared-buffer]
   user@switch# set egress buffer-partition lossless percent 5
   user@switch# set egress buffer-partition lossy percent 20
   user@switch# set egress buffer-partition multicast percent 75
   ```

Results

Display the results of the configuration:

```
root@dcbg-tp-pa-02> show configuration class-of-service shared-buffer
ingress {
    percent 100;
    buffer-partition lossless {
        percent 5;
    }
    buffer-partition lossy {
        percent 95;
    }
    buffer-partition lossless-headroom {
        percent 0;
    }
}
```



```
egress {
    percent 100;
    buffer-partition lossless {
        percent 5;
    }
    buffer-partition lossy {
        percent 20;
    }
    buffer-partition multicast {
        percent 75;
    }
}
```

Verification

Verify that the shared buffer configuration has been created properly.

Verifying the Shared Buffer Configuration

Purpose Verify that the ingress and egress global shared buffer pools are correctly configured and partitioned among the shared buffer types.

Action List the global shared buffer configuration using the operational mode command **show class-of-service shared-buffer**:

```
user@switch> show class-of-service shared-buffer
root@dcbg-tp-pa-02> show class-of-service shared-buffer
Ingress:
  Total Buffer     :  9360.00 KB
  Dedicated Buffer :  2158.00 KB
  Shared Buffer    :  7202.00 KB
    Lossless          :  360.10 KB
    Lossless Headroom :  0.00 KB
    Lossy             :  6841.90 KB

  Lossless Headroom Utilization:
  Node Device         Total          Used                 Free
  0                   0.00 KB        0.00 KB              0.00 KB

Egress:
  Total Buffer     :  9360.00 KB
  Dedicated Buffer :  2704.00 KB
  Shared Buffer    :  6656.00 KB
    Lossless          :  332.80 KB
    Multicast         :  4992.00 KB
    Lossy             :  1331.20 KB
```

Meaning The **show class-of-service shared-buffer** operational command shows all of the ingress and egress global shared buffer settings, including the buffer partitioning.

For the ingress shared buffers, the command output shows:

- The total switch buffer pool is 9360 KB (9 MB).
- The dedicated buffer pool is 2158 KB. This is the size of the global ingress dedicated buffer pool when you configure the ingress shared buffer pool as 100 percent of the available (user-configurable) buffer space. This is the minimum size of the reserved, ingress dedicated ingress buffer pool (not user-configurable). If you configure the

shared buffer as less than 100 percent of the available buffer pool, the remaining buffer space is added to the dedicated buffer pool.

- With the ingress shared buffer pool configured as 100 percent of the available buffers, the total size of the ingress shared buffer pool is 7202 KB.
- The ingress shared buffer pool is partitioned to allocate:
  - 360.10 KB to lossless traffic
  - No space to lossless headroom traffic
  - 6841.90 KB to lossy unicast traffic
- The Lossless Headroom Utilization field shows how much of the buffer space reserved for paused traffic is used. Because the lossless headroom buffer partition is set to 0 (zero) percent, the total amount of lossless headroom buffer space is 0 KB; therefore the amount of used and free lossless headroom buffer space is also 0 KB.

For the egress shared buffers, the command output shows:

- The total switch buffer pool is 9360 KB (9 MB).
- The dedicated buffer pool is 2704 KB. This is the size of the global egress dedicated buffer pool when you configure the egress shared buffer pool as 100 percent of the available (user-configurable) buffer space. This is the minimum size of the reserved, egress dedicated buffer pool (not user-configurable). If you configure the shared buffer as less than 100 percent of the available buffer pool, the remaining buffer space is added to the dedicated buffer pool.
- With the egress shared buffer pool configured as 100 percent of the available buffers, the total size of the egress shared buffer pool is 6656 KB. This is less than the ingress shared buffer pool because the switch reserves more egress dedicated buffer space than ingress dedicated buffer space. (More dedicated buffer space means less shared buffer space, and more shared buffer space means less dedicated buffer space.)
- The egress shared buffer pool is partitioned to allocate:
  - 332.80 KB to lossless traffic
  - 4992 KB to multicast traffic
  - 1331.20 KB to lossy unicast traffic

NOTE: The output values are valid for QFX3500 and QFX3600 switches. QFX5100 switches have larger buffers (12MB instead of 9MB), so the total buffer size and the sizes of each buffer partition are larger on QFX5100 switches.

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Traffic on Links with Ethernet PAUSE Enabled on page 5535
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Configuring Global Ingress and Egress Shared Buffers on page 5690
- Understanding CoS Buffer Configuration on page 5391

Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic

Although the switch reserves some buffer space to ensure a minimum memory allocation for ports and queues, you can configure how the system uses the rest of the buffer space to optimize the buffer allocation for your particular mix of network traffic.

This example shows you the recommended configuration of the global shared buffer pool to support a network that carries mostly lossless traffic. The global shared buffer pool is memory space that all of the ports on the switch share dynamically as they need buffers. You can allocate global shared memory space to different types of buffers to better support different mixes of network traffic.

CAUTION: **Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.**

Use the default shared buffer settings (for a network with a balanced mix of lossless, best effort, and multicast traffic) or one of the recommended shared buffer configurations for your mix of network traffic (mostly best-effort unicast traffic, mostly best-effort traffic on links enabled for Ethernet PAUSE, mostly multicast traffic, or mostly lossless traffic). Either the default configuration or one of the recommended configurations provides a buffer allocation that satisfies the needs of most networks.

NOTE: **When we discuss lossless buffers, we mean buffers that handle traffic on which you enable priority-based flow control (PFC) to ensure lossless transport. The lossless buffers are not used for best-effort traffic on a link on which you enable Ethernet PAUSE (IEEE 802.3x).**

After starting from the recommended configuration, you can fine-tune the shared buffer settings, but do so with caution to prevent traffic loss due to buffer misconfiguration.

- Requirements on page 5548
- Overview on page 5548
- Configuration on page 5549
- Verification on page 5551

Requirements

This example uses the following hardware and software components:

- Juniper Networks QFX3500 Switch
- Junos OS Release 12.3 or later for the QFX Series

Overview

You can configure the percentage of available (user-configurable) buffer space allocated to the global shared buffers. Any space that you do not allocate to the global shared buffer pool is added to the dedicated buffer pool. The default configuration allocates 100 percent of the available buffer space to the global shared buffers.

You can partition the ingress and egress shared buffer pools to allocate more buffers to the types of traffic your network predominantly carries, and fewer buffers to other traffic. From the buffer space allocated to the ingress shared buffer pool, you can allocate space to:

- Lossless buffers—Percentage of shared buffer pool for all lossless ingress traffic. The minimum value for the lossless buffers is 5 percent.
- Lossless headroom buffers—Percentage of shared buffer pool for packets received while a pause is asserted. If Ethernet PAUSE is configured on a port or if priority-based flow control (PFC) is configured on priorities on a port, when the port sends a pause message to the connected peer, the port uses the headroom buffers to store the packets that arrive between the time the port sends the pause message and the time the last packet arrives after the peer pauses traffic. The minimum value for the lossless headroom buffers is 0 (zero) percent. (Lossless headroom buffers are the only buffers that can have a minimum value of less than 5 percent.)
- Lossy buffers—Percentage of shared buffer pool for all best-effort ingress traffic (best-effort unicast, multidestination, and strict-high priority traffic). The minimum value for the lossy buffers is 5 percent.

The combined percentage values of the ingress lossless, lossless headroom, and lossy buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. All ingress buffer partitions must be explicitly configured, even when the lossless headroom buffer partition has a value of 0 (zero) percent.

From the buffer space allocated to the egress shared buffer pool, you can allocate space to:

- Lossless buffers—Percentage of shared buffer pool for all lossless egress queues. The minimum value for the lossless buffers is 5 percent.
- Lossy buffers—Percentage of shared buffer pool for all best-effort egress queues (best-effort unicast, and strict-high priority queues). The minimum value for the lossy buffers is 5 percent.

- Multicast buffers—Percentage of shared buffer pool for all multidestination (multicast, broadcast, and destination lookup fail) egress queues. The minimum value for the multicast buffers is 5 percent.

The combined percentage values of the egress lossless, lossy, and multicast buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. All egress buffer partitions must be explicitly configured and must have a value of at least 5 percent.

To configure the shared buffers to support a network that carries mostly lossless traffic, more buffer space needs to be allocated to lossless buffers, and less buffer space should be allocated to lossy buffers. This example shows you how to configure the global shared buffer pool allocation that we recommend to support a network that carries mostly lossless traffic.

Topology

Table 508 on page 5549 shows the configuration components for this example.

Table 508: Components of the Recommended Shared Buffer Configuration for Lossless Network Topologies

Component	Settings
Hardware	QFX3500 switch
Ingress shared buffer	Percentage of available ingress buffer space allocated to the ingress shared buffer: 100% Percentage of ingress buffer space allocated to lossless traffic (lossless buffer partition): 15% Percentage of ingress buffer space allocated to lossless headroom traffic (lossless headroom buffer partition): 80% Percentage of ingress buffer space allocated to best-effort traffic (lossy buffer partition): 5%
Egress shared buffer	Percentage of available egress buffer space allocated to the egress shared buffer: 100% Percentage of egress buffer space allocated to lossless queues (lossless buffer partition): 90% Percentage of egress buffer space allocated to best-effort queues (lossy buffer partition): 5% Percentage of egress buffer space allocated to multicast traffic (multicast buffer partition): 5%

Configuration

CLI Quick Configuration

To quickly configure the recommended shared buffer settings for networks that carry mostly lossless traffic, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level:

```
[edit class-of-service shared-buffer]
set ingress percent 100
set ingress buffer-partition lossless percent 15
set ingress buffer-partition lossless-headroom percent 80
set ingress buffer-partition lossy percent 5
set egress percent 100
```

set egress buffer-partition lossless percent 90
set egress buffer-partition lossy percent 5
set egress buffer-partition multicast percent 5

Configuring the Global Shared Buffer Pool for Networks with Mostly Lossless Traffic

Step-by-Step Procedure

To configure the global ingress and egress shared buffer allocations and partitions for a network that carries mostly lossless traffic:

1. Configure the percentage of available (nonreserved) buffers used for the ingress global shared buffer pool:

```
[edit class-of-service shared-buffer]
user@switch# set ingress percent 100
```

2. Configure the global ingress buffer partitions for lossless, lossless-headroom, and lossy traffic:

```
[edit class-of-service shared-buffer]
user@switch# set ingress buffer-partition lossless percent 15
user@switch# set ingress buffer-partition lossless-headroom percent 80
user@switch# set ingress buffer-partition lossy percent 5
```

3. Configure the percentage of available (nonreserved) buffers used for the egress global shared buffer pool:

```
[edit class-of-service shared-buffer]
user@switch# set egress percent 100
```

4. Configure the global egress buffer partitions for lossless, lossy, and multicast queues:

```
[edit class-of-service shared-buffer]
user@switch# set egress buffer-partition lossless percent 90
user@switch# set egress buffer-partition lossy percent 5
user@switch# set egress buffer-partition multicast percent 5
```

Results

Display the results of the configuration:

```
rroot@dcbg-tp-pa-02> show configuration class-of-service shared-buffer
ingress {
    percent 100;
    buffer-partition lossless {
        percent 15;
    }
    buffer-partition lossy {
        percent 5;
    }
    buffer-partition lossless-headroom {
        percent 80;
    }
}
egress {
    percent 100;
    buffer-partition lossless {
        percent 90;
    }
    buffer-partition lossy {
        percent 5;
    }
    buffer-partition multicast {
```

```
            percent 5;
        }
    }
```

Verification

Verify that the shared buffer configuration has been created properly.

Verifying the Shared Buffer Configuration

Purpose Verify that the ingress and egress global shared buffer pools are correctly configured and partitioned among the shared buffer types.

Action List the global shared buffer configuration using the operational mode command **show class-of-service shared-buffer**:

```
user@switch> show class-of-service shared-buffer
root@dcbg-tp-pa-02> show class-of-service shared-buffer
Ingress:
  Total Buffer     :  9360.00 KB
  Dedicated Buffer :  2158.00 KB
  Shared Buffer    :  7202.00 KB
    Lossless          :  1080.30 KB
    Lossless Headroom :  5761.60 KB
    Lossy             :  360.10 KB

  Lossless Headroom Utilization:
  Node Device         Total          Used                  Free
  0                   5761.60 KB     0.00 KB               5761.60 KB

Egress:
  Total Buffer     :  9360.00 KB
  Dedicated Buffer :  2704.00 KB
  Shared Buffer    :  6656.00 KB
    Lossless          :  5990.40 KB
    Multicast         :  332.80 KB
    Lossy             :  332.80 KB
```

Meaning The **show class-of-service shared-buffer** operational command shows all of the ingress and egress global shared buffer settings, including the buffer partitioning.

For the ingress shared buffers, the command output shows:

- The total switch buffer pool is 9360 KB (9 MB).
- The dedicated buffer pool is 2158 KB. This is the size of the global ingress dedicated buffer pool when you configure the ingress shared buffer pool as 100 percent of the available (user-configurable) buffer space. This is the minimum size of the reserved, ingress dedicated ingress buffer pool (not user-configurable). If you configure the shared buffer as less than 100 percent of the available buffer pool, the remaining buffer space is added to the dedicated buffer pool.
- With the ingress shared buffer pool configured as 100 percent of the available buffers, the total size of the ingress shared buffer pool is 7202 KB.
- The ingress shared buffer pool is partitioned to allocate:
  - 1080 KB to lossless traffic

  - 5761.60 KB to lossless headroom traffic
  - 360.10 KB to lossy unicast traffic

- The Lossless Headroom Utilization field shows how much of the buffer space reserved for paused traffic is used. Of the total available lossless headroom buffer space of 5761.60 KB, currently no buffer space is being used, so all 5761.60 KB of buffer space is free.

For the egress shared buffers, the command output shows:

- The total switch buffer pool is 9360 KB (9 MB).
- The dedicated buffer pool is 2704 KB. This is the size of the global egress dedicated buffer pool when you configure the egress shared buffer pool as 100 percent of the available (user-configurable) buffer space. This is the minimum size of the reserved, egress dedicated buffer pool (not user-configurable). If you configure the shared buffer as less than 100 percent of the available buffer pool, the remaining buffer space is added to the dedicated buffer pool.
- With the egress shared buffer pool configured as 100 percent of the available buffers, the total size of the egress shared buffer pool is 6656 KB. This is less than the ingress shared buffer pool because the switch reserves more egress dedicated buffer space than ingress dedicated buffer space. (More dedicated buffer space means less shared buffer space, and more shared buffer space means less dedicated buffer space.)
- The egress shared buffer pool is partitioned to allocate:
  - 5990.40 KB to lossless traffic
  - 332.80 KB to multicast traffic
  - 332.80 KB to lossy unicast traffic

NOTE: The output values are valid for QFX3500 and QFX3600 switches. QFX5100 switches have larger buffers (12MB instead of 9MB), so the total buffer size and the sizes of each buffer partition are larger on QFX5100 switches.

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Traffic on Links with Ethernet PAUSE Enabled on page 5535
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Configuring Global Ingress and Egress Shared Buffers on page 5690
- Understanding CoS Buffer Configuration on page 5391

Configuration Examples (QFX Series Standalone Switches, QFabric Systems Only)

Example: Configuring CoS PFC for FCoE Traffic

Priority-based flow control (PFC, described in IEEE 802.1Qbb) is a link-level flow control mechanism that you apply at ingress interfaces. PFC enables you to divide traffic on one physical link into eight priorities. You can think of the eight priorities as eight “lanes” of traffic that correspond to queues (forwarding classes). Each priority is mapped to a 3-bit IEEE 802.1p CoS flag in the VLAN header.

You can selectively apply PFC to the traffic in any queue without pausing the traffic in other queues on the same link. You must apply PFC to FCoE traffic to ensure lossless transport.

To configure PFC on FCoE traffic, use the default FCoE forwarding-class-to-queue mapping and:

- Configure a classifier that associates the FCoE forwarding class with FCoE traffic.
- Configure a congestion notification profile to apply PFC to the FCoE traffic.
- Apply the classifier and the PFC configuration to ingress interfaces.
- Configure the bandwidth scheduling for the FCoE forwarding class output queue.
- Create a forwarding class set (priority group) that includes the FCoE forwarding class; this is required to configure enhanced transmission selection (ETS) and support data center bridging (DCB).
- Configure the bandwidth scheduling for the FCoE priority group.
- Apply the scheduling to the egress interfaces.

NOTE: If you are using Junos OS Release 12.2 or later, use the default forwarding classes for the lossless **fcoe** forwarding class. If you explicitly configure default lossless forwarding classes, the traffic mapped to those forwarding classes is treated as lossy (**best-effort**) traffic and does *not* receive lossless treatment.

In Junos OS Release 12.3 and later, you can include the *no-loss* packet drop attribute in explicit forwarding class configurations to configure a lossless forwarding class.

This example describes how to configure PFC for FCoE traffic:

Requirements

This example uses the following hardware and software components:

- A Juniper Networks QFX3500 Switch
- Junos OS Release 11.1 or later for the QFX Series

Overview

FCoE traffic requires PFC to ensure lossless packet transport. This example shows you how to:

- Assign FCoE traffic to the FCoE priority at the ingress.
- Create and apply CoS for the FCoE traffic using ETS (hierarchical port scheduling).
- Apply PFC to the FCoE traffic.
- Apply the configuration to ingress and egress interfaces.

NOTE: Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

Each interface in this example is configured as both an ingress interface and an egress interface, so the classifier, congestion notification profile, and port scheduling are applied to all of the interfaces.

Topology

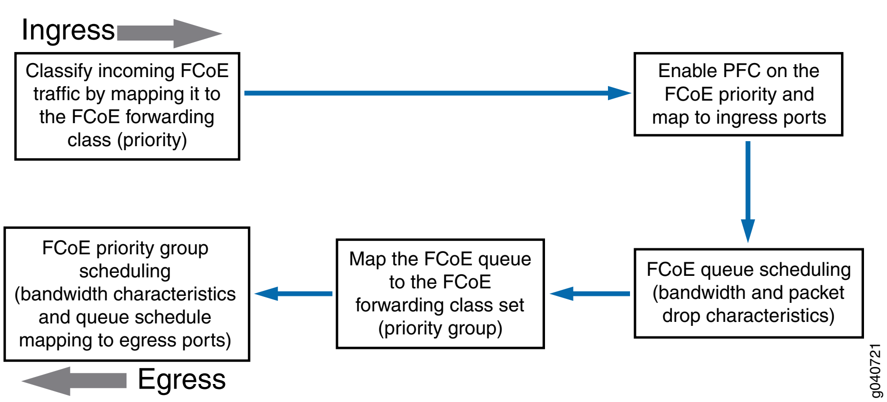
Table 379 on page 4923 shows the configuration components for this example.

Table 509: Components of the PFC for FCoE Traffic Configuration Topology

Component	Settings
Hardware	QFX3500 switch
Behavior aggregate classifier (maps the FCoE forwarding class to incoming packets by IEEE 802.1 code point)	Code point **011** to forwarding class **fcoe** and loss priority **low** Ingress interfaces: **xe-0/0/31**, **xe-0/0/32**, **xe-0/0/33**, **xe-0/0/34**
PFC congestion notification profile	**fcoe-cnp**: Code point **011** Ingress interfaces: **xe-0/0/31**, **xe-0/0/32**, **xe-0/0/33**, **xe-0/0/34**
FCoE queue scheduler	**fcoe-sched**: Minimum bandwidth **3g** Maximum bandwidth **100%** Priority **low**
Forwarding class-to-scheduler mapping	Scheduler map **fcoe-map**: Forwarding class **fcoe** Scheduler **fcoe-sched**
Forwarding class set (FCoE priority group)	**fcoe-pg**: Forwarding class **fcoe** Egress interfaces: **xe-0/0/31**, **xe-0/0/32**, **xe-0/0/33**, **xe-0/0/34**
Traffic control profile	**fcoe-tcp**: Scheduler map **fcoe-map** Minimum bandwidth **3g** Maximum bandwidth **100%**

Figure 179 on page 4924 shows a block diagram of the configuration components and the configuration flow of the CLI statements used in the example.

Figure 202: PFC for FCoE Traffic Configuration Components Block Diagram



Configuration

CLI Quick Configuration

To quickly configure PFC for FCoE traffic, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level:

```
[edit class-of-service]
set classifiers ieee-802.1 fcoe-classifier forwarding-class fcoe loss-priority low code-points 011
set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
set interfaces xe-0/0/31 unit 0 classifiers ieee-802.1 fcoe-classifier
set interfaces xe-0/0/32 unit 0 classifiers ieee-802.1 fcoe-classifier
set interfaces xe-0/0/33 unit 0 classifiers ieee-802.1 fcoe-classifier
set interfaces xe-0/0/34 unit 0 classifiers ieee-802.1 fcoe-classifier
set interfaces xe-0/0/31 congestion-notification-profile fcoe-cnp
set interfaces xe-0/0/32 congestion-notification-profile fcoe-cnp
set interfaces xe-0/0/33 congestion-notification-profile fcoe-cnp
set interfaces xe-0/0/34 congestion-notification-profile fcoe-cnp
set schedulers fcoe-sched priority low transmit-rate 3g
set schedulers fcoe-sched shaping-rate percent 100
set scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
set forwarding-class-sets fcoe-pg class fcoe
set traffic-control-profiles fcoe-tcp scheduler-map fcoe-map guaranteed-rate 3g
set traffic-control-profiles fcoe-tcp shaping-rate percent 100
set interfaces xe-0/0/31 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp
set interfaces xe-0/0/32 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp
set interfaces xe-0/0/33 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp
set interfaces xe-0/0/34 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp
```

Step-by-Step Procedure

To configure the FCoE forwarding class (priority), ingress classifier, output queue scheduling, forwarding class set (priority group) and its output port scheduling, PFC application, and interfaces to set up PFC for FCoE traffic:

1. Configure a classifier to set the loss priority and IEEE 802.1 code point assigned to the FCoE forwarding class at the ingress:

   ```
   [edit class-of-service]
   user@switch# set classifiers ieee-802.1 fcoe-classifier forwarding-class fcoe loss-priority low code-points 011
   ```

2. Configure PFC on the FCoE queue by applying FCoE to the IEEE 802.1 code point **011**:

   ```
   [edit class-of-service]
   user@switch# set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
   ```

3. Apply the PFC configuration to the ingress interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/31 congestion-notification-profile fcoe-cnp
   user@switch# set interfaces xe-0/0/32 congestion-notification-profile fcoe-cnp
   user@switch# set interfaces xe-0/0/33 congestion-notification-profile fcoe-cnp
   user@switch# set interfaces xe-0/0/34 congestion-notification-profile fcoe-cnp
   ```

4. Assign the classifier to the ingress interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/31 unit 0 classifiers ieee-802.1 fcoe-classifier
   user@switch# set interfaces xe-0/0/32 unit 0 classifiers ieee-802.1 fcoe-classifier
   ```



```
user@switch# set interfaces xe-0/0/33 unit 0 classifiers ieee-802.1 fcoe-classifier
user@switch# set interfaces xe-0/0/34 unit 0 classifiers ieee-802.1 fcoe-classifier
```

5. Configure output scheduling for the FCoE queue:

```
[edit class-of-service]
user@switch# set schedulers fcoe-sched priority low transmit-rate 3g
user@switch# set schedulers fcoe-sched shaping-rate percent 100
```

6. Map the FCoE forwarding class to the FCoE scheduler:

```
[edit class-of-service]
user@switch# set scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
```

7. Configure the forwarding class set for the FCoE traffic:

```
[edit class-of-service]
user@switch# set forwarding-class-sets fcoe-pg class fcoe
```

8. Define the traffic control profile for the FCoE forwarding class set:

```
[edit class-of-service]
user@switch# set traffic-control-profiles fcoe-tcp scheduler-map fcoe-map
guaranteed-rate 3g
user@switch# set traffic-control-profiles fcoe-tcp shaping-rate percent 100
```

9. Apply the FCoE forwarding class set and traffic control profile to the egress ports:

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/31 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
user@switch# set interfaces xe-0/0/32 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
user@switch# set interfaces xe-0/0/33 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
user@switch# set interfaces xe-0/0/34 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
```

Results

Display the results of the configuration (the system shows only the explicitly configured parameters; it does not show default parameters such as the **fcoe** lossless forwarding class):

```
user@switch> show configuration class-of-service
classifiers {
  ieee-802.1 fcoe-classifier {
    forwarding-class fcoe {
      loss-priority low code-points 011;
    }
  }
  traffic-control-profiles {
    fcoe-tcp {
      scheduler-map fcoe-map;
      shaping-rate percent 100;
      guaranteed-rate 3000000000;
    }
  }
  forwarding-class-sets {
    fcoe-pg {
```

```
      class fcoe;
    }
  }
  congestion-notification-profile {
    fcoe-cnp {
      input {
        ieee-802.1 {
          code-point 011 {
            pfc;
          }
        }
      }
    }
  }
  interfaces {
    xe-0/0/31 {
      congestion-notification-profile fcoe-cnp;
      forwarding-class-set {
        fcoe-pg {
          output-traffic-control-profile fcoe-tcp;
        }
      }
      unit 0 {
        classifiers {
          ieee-802.1 fcoe-classifier;
        }
      }
    }
    xe-0/0/32 {
      congestion-notification-profile fcoe-cnp;
      forwarding-class-set {
        fcoe-pg {
          output-traffic-control-profile fcoe-tcp;
        }
      }
      unit 0 {
        classifiers {
          ieee-802.1 fcoe-classifier;
        }
      }
    }
    xe-0/0/33 {
      congestion-notification-profile fcoe-cnp;
      forwarding-class-set {
        fcoe-pg {
          output-traffic-control-profile fcoe-tcp;
        }
      }
      unit 0 {
        classifiers {
          ieee-802.1 fcoe-classifier;
        }
      }
    }
    xe-0/0/34 {
      congestion-notification-profile fcoe-cnp;
```

```
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        unit 0 {
            classifiers {
                ieee-802.1 fcoe-classifier;
            }
        }
    }
}
scheduler-maps {
    fcoe-map {
        forwarding-class fcoe scheduler fcoe-sched;
    }
}
schedulers {
    fcoe-sched {
        transmit-rate 3000000000;
        shaping-rate percent 100;
        priority low;
    }
}
```

TIP: To quickly configure the interfaces, issue the **load merge terminal** command and then copy the hierarchy and paste it into the switch terminal window.

Verification

To verify that the PFC configuration for FCoE traffic components has been created and is operating properly, perform these tasks:

- Verifying That Priority-Based Flow Control Has Been Enabled on page 5559
- Verifying the Ingress Interface PFC Configuration on page 5560

Verifying That Priority-Based Flow Control Has Been Enabled

Purpose Verify that PFC is enabled on the FCoE queue to enable lossless transport.

Action List the congestion notification profiles using the operational mode command **show class-of-service congestion-notification**:

```
user@switch> show class-of-service congestion-notification
Type: Input, Name: fcoe-cnp, Index: 51697
Cable Length: 100 m
  Priority      PFC          MRU
  000           Disabled
  001           Disabled
  010           Disabled
  011           Enabled      2500
  100           Disabled
```

```
  101         Disabled
  110         Disabled
  111         Disabled
Type: Output
  Priority    Flow-Control-Queues
  000
              0
  001
              1
  010
              2
  011
              3
  100
              4
  101
              5
  110
              6
  111
              7
```

Meaning The **show class-of-service congestion-notification** operational command lists all of the congestion notification profiles and which IEEE 802.1p code points have PFC enabled. The command output shows that PFC is enabled on code point **011** for the **fcoe-cnp** congestion notification profile.

The command also shows the default cable length (100 meters), the default maximum receive unit (2500 bytes), and the default mapping of priorities to output queues because this example does not include configuring these options.

Verifying the Ingress Interface PFC Configuration

Purpose Verify that the classifier **fcoe-classifier** and the congestion notification profile **fcoe-cnp** are configured on ingress interfaces **xe-0/0/31**, **xe-0/0/32**, **xe-0/0/33**, and **xe-0/0/34**.

Action List the ingress interfaces using the operational mode command **show configuration class-of-service interfaces**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/31
congestion-notification-profile fcoe-cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe-classifier;
    }
}

user@switch> show configuration class-of-service interfaces xe-0/0/32
congestion-notification-profile fcoe-cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe-classifier;
    }
}

user@switch> show configuration class-of-service interfaces xe-0/0/33
```



```
congestion-notification-profile fcoe-cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe-classifier;
    }
}

user@switch> show configuration class-of-service interfaces xe-0/0/34
congestion-notification-profile fcoe-cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe-classifier;
    }
}
```

Meaning The **show configuration class-of-service interfaces** commands list the congestion notification profile that is mapped to the interface (**fcoe-cnp**) and the IEEE 802.1p classifier associated with the interface (**fcoe-classifier**).

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Overview of CoS Changes Introduced in Junos OS Release 12.2 on page 5304
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

Example: Configuring CoS for FCoE Transit Switch Traffic Across an MC-LAG

Multichassis link aggregation groups (MC-LAGs) provide redundancy and load balancing between two QFX Series switches, multihoming support for client devices such as servers, and a loop-free Layer 2 network without running Spanning Tree Protocol (STP).

NOTE: **This example uses Junos OS without support for the Enhanced Layer 2 Software (ELS) configuration style. If your switch runs software that supports ELS, see** “Example: Configuring CoS for FCoE Transit Switch Traffic Across an MC-LAG” on page 5002.

You can use an MC-LAG to provide a redundant aggregation layer for Fiber Channel over Ethernet (FCoE) traffic in an *inverted-U* topology. To support lossless transport of FCoE traffic across an MC-LAG, you must configure the appropriate class of service (CoS) on both of the QFX Series switches with MC-LAG port members. The CoS configuration must be the same on both of the MC-LAG switches because an MC-LAG does not carry forwarding class and IEEE 802.1p priority information.

NOTE: This example describes how to configure CoS to provide lossless transport for FCoE traffic across an MC-LAG that connects two QFX Series switches. It also describes how to configure CoS on the FCoE transit switches that connect FCoE hosts to the QFX Series switches that form the MC-LAG.

This example does *not* describe how to configure the MC-LAG itself. For a detailed example of MC-LAG configuration, see "Example: Configuring Multichassis Link Aggregation" on page 1904. However, this example includes a subset of MC-LAG configuration that only shows how to configure interface membership in the MC-LAG.

Ports that are part of an FCoE-FC gateway configuration (a virtual FCoE-FC gateway fabric) do not support MC-LAGs. Ports that are members of an MC-LAG act as FCoE passthrough transit switch ports.

QFX Series switches support MC-LAGs. QFabric system Node devices do not support MC-LAGs, and QFX3500 and QFX3600 Virtual Chassis switches do not support FCoE.

This topic describes:

Requirements

This example uses the following hardware and software components:

- Two Juniper Networks QFX3500 Switches that form an MC-LAG for FCoE traffic.
- Two Juniper Networks QFX3500 Switches that provide FCoE server access in transit switch mode and that connect to the MC-LAG switches. These switches can be standalone QFX3500 switches or they can be Node devices in a QFabric system.
- FCoE servers (or other FCoE hosts) connected to the transit switches.
- Junos OS Release 12.2 or later for the QFX Series.

Overview

FCoE traffic requires lossless transport. This example shows you how to:

- Configure CoS for FCoE traffic on the two QFX3500 switches that form the MC-LAG, including priority-based flow control (PFC) and enhanced transmission selection (ETS; hierarchical scheduling of resources for the FCoE forwarding class priority and for the forwarding class set priority group).

> NOTE: Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

- Configure CoS for FCoE on the two FCoE transit switches that connect FCoE hosts to the MC-LAG switches and enable FIP snooping on the FCoE VLAN at the FCoE transit switch access ports.
- Disable IGMP snooping on the FCoE VLAN.
- Configure the appropriate port mode, MTU, and FCoE trusted or untrusted state for each interface to support lossless FCoE transport.

Topology

QFX3500 switches that act as transit switches support MC-LAGs for FCoE traffic in an inverted-U network topology, as shown in Figure 180 on page 4942.

Figure 203: Supported Topology for an MC-LAG on an FCoE Transit Switch

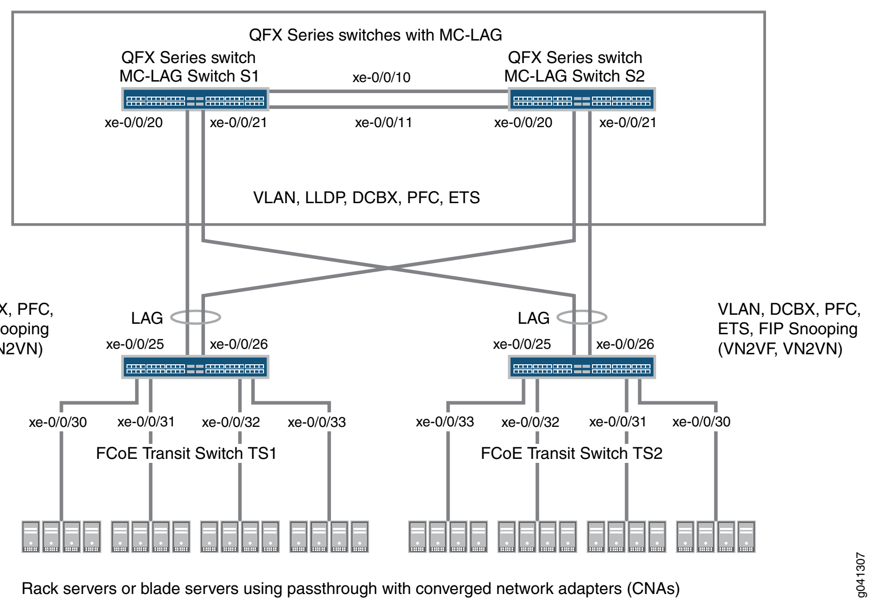


Table 383 on page 4943 shows the configuration components for this example.

Table 510: Components of the CoS for FCoE Traffic Across an MC-LAG Configuration Topology

Component	Settings
Hardware	Four QFX3500 switches (two to form the MC-LAG as passthrough transit switches and two transit switches for FCoE access).
Forwarding class (all switches)	Default **fcoe** forwarding class.
Classifier (forwarding class mapping of incoming traffic to IEEE priority)	Default IEEE 802.1p trusted classifier on all FCoE interfaces.
LAGs and MC-LAG	S1—Ports xe-0/0/10 and x-0/0/11 are members of LAG **ae0**, which connects Switch S1 to Switch S2. Ports xe-0/0/20 and xe-0/0/21 are members of MC-LAG **ae1**. All ports are configured in **trunk** port mode, as **fcoe-trusted**, and with an MTU of **2180**. S2—Ports xe-0/0/10 and x-0/0/11 are members of LAG **ae0**, which connects Switch S2 to Switch S1. Ports xe-0/0/20 and xe-0/0/21 are members of MC-LAG **ae1**. All ports are configured in **trunk** port mode, as **fcoe-trusted**, and with an MTU of **2180**. NOTE: Ports xe-0/0/20 and xe-0/0/21 on Switches S1 and S2 are the members of the MC-LAG. TS1—Ports xe-0/0/25 and x-0/0/26 are members of LAG **ae1**, configured in **trunk** port mode, as **fcoe-trusted**, and with an MTU of **2180**. Ports xe-0/0/30, xe-0/0/31, xe-0/0/32, and xe-0/0/33 are configured in **tagged-access** port mode, with an MTU of **2180**. TS2—Ports xe-0/0/25 and x-0/0/26 are members of LAG **ae1**, configured in **trunk** port mode, as **fcoe-trusted**, and with an MTU of **2180**. Ports xe-0/0/30, xe-0/0/31, xe-0/0/32, and xe-0/0/33 are configured in **tagged-access** port mode, with an MTU of **2180**.
FCoE queue scheduler (all switches)	**fcoe-sched**: Minimum bandwidth **3g** Maximum bandwidth **100%** Priority **low**
Forwarding class-to-scheduler mapping (all switches)	Scheduler map **fcoe-map**: Forwarding class **fcoe** Scheduler **fcoe-sched**

Table 510: Components of the CoS for FCoE Traffic Across an MC-LAG Configuration Topology *(continued)*

Component	Settings
Forwarding class set (FCoE priority group, all switches)	**fcoe-pg**: Forwarding class **fcoe** Egress interfaces: • S1—LAG **ae0** and MC-LAG **ae1** • S2—LAG **ae0** and MC-LAG **ae1** • TS1—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33** • TS2—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33**
Traffic control profile (all switches)	**fcoe-tcp**: Scheduler map **fcoe-map** Minimum bandwidth **3g** Maximum bandwidth **100%**
PFC congestion notification profile (all switches)	**fcoe-cnp**: Code point **011** Ingress interfaces: • S1—LAG **ae0** and MC-LAG **ae1** • S2—LAG **ae0** and MC-LAG **ae1** • TS1—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33** • TS2—LAG **ae1**, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33**
FCoE VLAN name and tag ID	Name—**fcoe_vlan** ID—**100** Include the FCoE VLAN on the interfaces that carry FCoE traffic on all four switches. Disable IGMP snooping on the interfaces that belong to the FCoE VLAN on all four switches.
FIP snooping	Enable FIP snooping on Transit Switches TS1 and TS2 on the FCoE VLAN. Configure the LAG interfaces that connect to the MC-LAG switches as FCoE trusted interfaces so that they do not perform FIP snooping. This example enables VN2VN_Port FIP snooping on the FCoE transit switch interfaces connected to the FCoE servers. The example is equally valid with VN2VF_Port FIP snooping enabled on the transit switch access ports. The method of FIP snooping you enable depends on your network configuration.

NOTE: This example uses the default IEEE 802.1p trusted BA classifier, which is automatically applied to trunk mode and tagged access mode ports if you do not apply an explicitly configured classifier.

To configure CoS for FCoE traffic across an MC-LAG:

- Use the default FCoE forwarding class and forwarding-class-to-queue mapping (do not explicitly configure the FCoE forwarding class or output queue). The default FCoE forwarding class is **fcoe**, and the default output queue is queue **3**.

  NOTE: In Junos OS Release 12.2, traffic mapped to explicitly configured forwarding classes, even lossless forwarding classes such as **fcoe**, is treated as lossy (**best-effort**) traffic and does *not* receive lossless treatment. To receive lossless treatment in Release 12.2, traffic must use one of the default lossless forwarding classes (**fcoe** or **no-loss**).

  In Junos OS Release 12.3 and later, you can include the *no-loss* packet drop attribute in the explicit forwarding class configuration to configure a lossless forwarding class.

- Use the default trusted BA classifier, which maps incoming packets to forwarding classes by the IEEE 802.1p code point (CoS priority) of the packet. The trusted classifier is the default classifier for interfaces in trunk and tagged-access port modes. The default trusted classifier maps incoming packets with the IEEE 802.1p code point 3 (**011**) to the FCoE forwarding class. If you choose to configure the BA classifier instead of using the default classifier, you must ensure that FCoE traffic is classified into forwarding classes in exactly the same way on both MC-LAG switches. Using the default classifier ensures consistent classifier configuration on the MC-LAG ports.
- Configure a congestion notification profile that enables PFC on the FCoE code point (code point **011** in this example). The congestion notification profile configuration must be the same on both MC-LAG switches.
- Apply the congestion notification profile to the interfaces.
- Configure enhanced transmission selection (ETS, also known as hierarchical scheduling) on the interfaces to provide the bandwidth required for lossless FCoE transport. Configuring ETS includes configuring bandwidth scheduling for the FCoE forwarding class, a forwarding class set (priority group) that includes the FCoE forwarding class, and a traffic control profile to assign bandwidth to the forwarding class set that includes FCoE traffic.
- Apply the ETS scheduling to the interfaces.
- Configure the port mode, MTU, and FCoE trusted or untrusted state for each interface to support lossless FCoE transport.

In addition, this example describes how to enable FIP snooping on the Transit Switch TS1 and TS2 ports that are connected to the FCoE servers and how to disable IGMP snooping on the FCoE VLAN. To provide secure access, FIP snooping must be enabled on the FCoE access ports.

This example focuses on the CoS configuration to support lossless FCoE transport across an MC-LAG. This example does not describe how to configure the properties of MC-LAGs and LAGs, although it does show you how to configure the port characteristics required to support lossless transport and how to assign interfaces to the MC-LAG and to the LAGs.

Before you configure CoS, configure:

- The MC-LAGs that connect Switches S1 and S2 to Switches TS1 and TS2. ("Example: Configuring Multichassis Link Aggregation" on page 1904 describes how to configure MC-LAGs.)
- The LAGs that connect the Transit Switches TS1 and TS2 to MC-LAG Switches S1 and S2. ("Configuring Link Aggregation" on page 2019 describes how to configure LAGs.)
- The LAG that connects Switch S1 to Switch S2.

Configuration

To configure CoS for lossless FCoE transport across an MC-LAG, perform these tasks:

CLI Quick Configuration

To quickly configure CoS for lossless FCoE transport across an MC-LAG, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI for MC-LAG Switch S1 and MC-LAG Switch S2 at the **[edit]** hierarchy level. The configurations on Switches S1 and S2 are identical because the CoS configuration must be identical, and because this example uses the same ports on both switches.

Switch S1 and Switch S2

```
set class-of-service schedulers fcoe-sched priority low transmit-rate 3g
set class-of-service schedulers fcoe-sched shaping-rate percent 100
set class-of-service scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
set class-of-service forwarding-class-sets fcoe-pg class fcoe
set class-of-service traffic-control-profiles fcoe-tcp scheduler-map fcoe-map guaranteed-rate
3g
set class-of-service traffic-control-profiles fcoe-tcp shaping-rate percent 100
set class-of-service interfaces ae0 forwarding-class-set fcoe-pg output-traffic-control-profile
fcoe-tcp
set class-of-service interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile
fcoe-tcp
set class-of-service congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
set class-of-service interfaces ae0 congestion-notification-profile fcoe-cnp
set class-of-service interfaces ae1 congestion-notification-profile fcoe-cnp
set vlans fcoe_vlan vlan-id 100
set protocols igmp-snooping vlan fcoe_vlan disable
set interfaces xe-0/0/10 ether-options 802.3ad ae0
```

```
set interfaces xe-0/0/11 ether-options 802.3ad ae0
set interfaces xe-0/0/20 ether-options 802.3ad ae1
set interfaces xe-0/0/21 ether-options 802.3ad ae1
set interfaces ae0 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan
set interfaces ae0 mtu 2180
set interfaces ae1 mtu 2180
set ethernet-switching-options secure-access-port interface ae0 fcoe-trusted
set ethernet-switching-options secure-access-port interface ae1 fcoe-trusted
```

To quickly configure CoS for lossless FCoE transport across an MC-LAG, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI for Transit Switch TS1 and Transit Switch TS2 at the **[edit]** hierarchy level. The configurations on Switches TS1 and TS2 are identical because the CoS configuration must be identical, and because this example uses the same ports on both switches.

Switch TS1 and Switch TS2

```
set class-of-service schedulers fcoe-sched priority low transmit-rate 3g
set class-of-service schedulers fcoe-sched shaping-rate percent 100
set class-of-service scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
set class-of-service forwarding-class-sets fcoe-pg class fcoe
set class-of-service traffic-control-profiles fcoe-tcp scheduler-map fcoe-map guaranteed-rate
3g
set class-of-service traffic-control-profiles fcoe-tcp shaping-rate percent 100
set class-of-service interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile
fcoe-tcp
set class-of-service interfaces xe-0/0/30 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service interfaces xe-0/0/31 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service interfaces xe-0/0/32 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service interfaces xe-0/0/33 forwarding-class-set fcoe-pg
output-traffic-control-profile fcoe-tcp
set class-of-service congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
set class-of-service interfaces ae1 congestion-notification-profile fcoe-cnp
set class-of-service interfaces xe-0/0/30 congestion-notification-profile fcoe-cnp
set class-of-service interfaces xe-0/0/31 congestion-notification-profile fcoe-cnp
set class-of-service interfaces xe-0/0/32 congestion-notification-profile fcoe-cnp
set class-of-service interfaces xe-0/0/33 congestion-notification-profile fcoe-cnp
set vlans fcoe_vlan vlan-id 100
set protocols igmp-snooping vlan fcoe_vlan disable
set interfaces xe-0/0/25 ether-options 802.3ad ae1
set interfaces xe-0/0/26 ether-options 802.3ad ae1
set interfaces ae1 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan
set interfaces xe-0/0/30 unit 0 family ethernet-switching port-mode tagged-access vlan members
fcoe_vlan
set interfaces xe-0/0/31 unit 0 family ethernet-switching port-mode tagged-access vlan members
fcoe_vlan
set interfaces xe-0/0/32 unit 0 family ethernet-switching port-mode tagged-access vlan members
fcoe_vlan
set interfaces xe-0/0/33 unit 0 family ethernet-switching port-mode tagged-access vlan members
fcoe_vlan
set interfaces ae1 mtu 2180
set interfaces xe-0/0/30 mtu 2180
set interfaces xe-0/0/31 mtu 2180
```

set interfaces xe-0/0/32 mtu 2180
set interfaces xe-0/0/33 mtu 2180
set ethernet-switching-options secure-access-port interface ae1 fcoe-trusted
set ethernet-switching-options secure-access-port vlan fcoe_vlan examine-fip examine-vn2v2 beacon-period 90000

Configuring MC-LAG Switches S1 and S2

Step-by-Step Procedure

To configure CoS resource scheduling (ETS), PFC, the FCoE VLAN, and the LAG and MC-LAG interface membership and characteristics to support lossless FCoE transport across an MC-LAG (this example uses the default **fcoe** forwarding class and the default classifier to map incoming FCoE traffic to the FCoE IEEE 802.1p code point **011**, so you do not configure them):

1. Configure output scheduling for the FCoE queue:

   ```
   [edit class-of-service]
   user@switch# set schedulers fcoe-sched priority low transmit-rate 3g
   user@switch# set schedulers fcoe-sched shaping-rate percent 100
   ```

2. Map the FCoE forwarding class to the FCoE scheduler (**fcoe-sched**):

   ```
   [edit class-of-service]
   user@switch# set scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched
   ```

3. Configure the forwarding class set (**fcoe-pg**) for the FCoE traffic:

   ```
   [edit class-of-service]
   user@switch# set forwarding-class-sets fcoe-pg class fcoe
   ```

4. Define the traffic control profile (**fcoe-tcp**) to use on the FCoE forwarding class set:

   ```
   [edit class-of-service]
   user@switch# set traffic-control-profiles fcoe-tcp scheduler-map fcoe-map
   guaranteed-rate 3g
   user@switch# set traffic-control-profiles fcoe-tcp shaping-rate percent 100
   ```

5. Apply the FCoE forwarding class set and traffic control profile to the LAG and MC-LAG interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces ae0 forwarding-class-set fcoe-pg output-traffic-control-profile
   fcoe-tcp
   user@switch# set interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile
   fcoe-tcp
   ```

6. Enable PFC on the FCoE priority by creating a congestion notification profile (**fcoe-cnp**) that applies FCoE to the IEEE 802.1 code point **011**:

   ```
   [edit class-of-service]
   user@switch# set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point
   011 pfc
   ```

7. Apply the PFC configuration to the LAG and MC-LAG interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces ae0 congestion-notification-profile fcoe-cnp
   user@switch# set interfaces ae1 congestion-notification-profile fcoe-cnp
   ```

8. Configure the VLAN for FCoE traffic (**fcoe_vlan**):

   ```
   [edit vlans]
   user@switch# set fcoe_vlan vlan-id 100
   ```

9. Disable IGMP snooping on the FCoE VLAN:

```
[edit protocols]
user@switch# set igmp-snooping vlan fcoe_vlan disable
```

10. Add the member interfaces to the LAG between the two MC-LAG switches:

```
[edit interfaces]
user@switch# set xe-0/0/10 ether-options 802.3ad ae0
user@switch# set xe-0/0/11 ether-options 802.3ad ae0
```

11. Add the member interfaces to the MC-LAG:

```
[edit interfaces]
user@switch# set xe-0/0/20 ether-options 802.3ad ae1
user@switch# set xe-0/0/21 ether-options 802.3ad ae1
```

12. Configure the port mode as **trunk** and membership in the FCoE VLAN (**fcoe_vlan**)for the LAG (**ae0**) and for the MC-LAG (**ae1**):

```
[edit interfaces]
user@switch# set interfaces ae0 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan
user@switch# set interfaces ae1 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan
```

13. Set the MTU to **2180** for the LAG and MC-LAG interfaces. 2180 bytes is the minimum size required to handle FCoE packets because of the payload and header sizes; you can configure the MTU to a higher number of bytes if desired, but not less than 2180 bytes:

```
[edit interfaces]
user@switch# set ae0 mtu 2180
user@switch# set ae1 mtu 2180
```

14. Set the LAG and MC-LAG interfaces as FCoE trusted ports. Ports that connect to other switches should be trusted and should not perform FIP snooping:

```
[edit]
user@switch# set ethernet-switching-options secure-access-port interface ae0 fcoe-trusted
user@switch# set ethernet-switching-options secure-access-port interface ae1 fcoe-trusted
```

Configuring FCoE Transit Switches TS1 and TS2

Step-by-Step Procedure

The CoS configuration on FCoE Transit Switches TS1 and TS2 is similar to the CoS configuration on MC-LAG Switches S1 and S2. However, the port configurations differ, and you must enable FIP snooping on the Switch TS1 and Switch TS2 FCoE access ports.

To configure resource scheduling (ETS), PFC, the FCoE VLAN, and the LAG interface membership and characteristics to support lossless FCoE transport across the MC-LAG (this example uses the default **fcoe** forwarding class and the default classifier to map incoming FCoE traffic to the FCoE IEEE 802.1p code point **011**, so you do not configure them):

1. Configure output scheduling for the FCoE queue:

```
[edit class-of-service]
user@switch# set schedulers fcoe-sched priority low transmit-rate 3g
user@switch# set schedulers fcoe-sched shaping-rate percent 100
```

2. Map the FCoE forwarding class to the FCoE scheduler (**fcoe-sched**):

[edit class-of-service]
user@switch# **set scheduler-maps fcoe-map forwarding-class fcoe scheduler fcoe-sched**

3. Configure the forwarding class set (**fcoe-pg**) for the FCoE traffic:

   [edit class-of-service]
   user@switch# **set forwarding-class-sets fcoe-pg class fcoe**

4. Define the traffic control profile (**fcoe-tcp**) to use on the FCoE forwarding class set:

   [edit class-of-service]
   user@switch# **set traffic-control-profiles fcoe-tcp scheduler-map fcoe-map guaranteed-rate 3g**
   user@switch# **set traffic-control-profiles fcoe-tcp shaping-rate percent 100**

5. Apply the FCoE forwarding class set and traffic control profile to the LAG interface and to the FCoE access interfaces:

   [edit class-of-service]
   user@switch# **set interfaces ae1 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp**
   user@switch# **set class-of-service interfaces xe-0/0/30 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp**
   user@switch# **set class-of-service interfaces xe-0/0/31 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp**
   user@switch# **set class-of-service interfaces xe-0/0/32 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp**
   user@switch# **set class-of-service interfaces xe-0/0/33 forwarding-class-set fcoe-pg output-traffic-control-profile fcoe-tcp**

6. Enable PFC on the FCoE priority by creating a congestion notification profile (**fcoe-cnp**) that applies FCoE to the IEEE 802.1 code point **011**:

   [edit class-of-service]
   user@switch# **set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc**

7. Apply the PFC configuration to the LAG interface and to the FCoE access interfaces:

   [edit class-of-service]
   user@switch# **set interfaces ae1 congestion-notification-profile fcoe-cnp**
   user@switch# **set class-of-service interfaces xe-0/0/30 congestion-notification-profile fcoe-cnp**
   user@switch# **set class-of-service interfaces xe-0/0/31 congestion-notification-profile fcoe-cnp**
   user@switch# **set class-of-service interfaces xe-0/0/32 congestion-notification-profile fcoe-cnp**
   user@switch# **set class-of-service interfaces xe-0/0/33 congestion-notification-profile fcoe-cnp**

8. Configure the VLAN for FCoE traffic (**fcoe_vlan**):

   [edit vlans]
   user@switch# **set fcoe_vlan vlan-id 100**

9. Disable IGMP snooping on the FCoE VLAN:

   [edit protocols]
   user@switch# **set igmp-snooping vlan fcoe_vlan disable**

10. Add the member interfaces to the LAG:

    [edit interfaces]
    user@switch# **set xe-0/0/25 ether-options 802.3ad ae1**

```
user@switch# set xe-0/0/26 ether-options 802.3ad ae1
```

11. On the LAG (**ae1**), configure the port mode as **trunk** and membership in the FCoE VLAN (**fcoe_vlan**):

```
[edit interfaces]
user@switch# set interfaces ae1 unit 0 family ethernet-switching port-mode trunk vlan members fcoe_vlan
```

12. On the FCoE access interfaces (**xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, **xe-0/0/33**), configure the port mode as **tagged-access** and membership in the FCoE VLAN (**fcoe_vlan**):

```
[edit interfaces]
user@switch# set interfaces xe-0/0/30 unit 0 family ethernet-switching port-mode tagged-access vlan members fcoe_vlan
user@switch# set interfaces xe-0/0/31 unit 0 family ethernet-switching port-mode tagged-access vlan members fcoe_vlan
user@switch# set interfaces xe-0/0/32 unit 0 family ethernet-switching port-mode tagged-access vlan members fcoe_vlan
user@switch# set interfaces xe-0/0/33 unit 0 family ethernet-switching port-mode tagged-access vlan members fcoe_vlan
```

13. Set the MTU to **2180** for the LAG and FCoE access interfaces. 2180 bytes is the minimum size required to handle FCoE packets because of the payload and header sizes; you can configure the MTU to a higher number of bytes if desired, but not less than 2180 bytes:

```
[edit interfaces]
user@switch# set ae1 mtu 2180
user@switch# set xe-0/0/30 mtu 2180
user@switch# set xe-0/0/31 mtu 2180
user@switch# set xe-0/0/32 mtu 2180
user@switch# set xe-0/0/33 mtu 2180
```

14. Set the LAG interface as an FCoE trusted port. Ports that connect to other switches should be trusted and should not perform FIP snooping:

```
[edit]
user@switch# set ethernet-switching-options secure-access-port interface ae1 fcoe-trusted
```

NOTE: Access ports xe-0/0/30, xe-0/0/31, xe-0/0/32, and xe-0/0/33 are not configured as FCoE trusted ports. The access ports remain in the default state as untrusted ports because they connect directly to FCoE devices and must perform FIP snooping to ensure network security.

15. Enable FIP snooping on the FCoE VLAN to prevent unauthorized FCoE network access (this example uses VN2VN_Port FIP snooping; the example is equally valid if you use VN2VF_Port FIP snooping):

```
[edit]
user@switch# set ethernet-switching-options secure-access-port vlan fcoe_vlan examine-fip examine-vn2vn beacon-period 90000
```

Results

Display the results of the CoS configuration on MC-LAG Switch S1 and on MC-LAG Switch S2 (the results on both switches are the same):

```
user@switch> show configuration class-of-service
traffic-control-profiles {
  fcoe-tcp {
    scheduler-map fcoe-map;
    shaping-rate percent 100;
    guaranteed-rate 3000000000;
  }
}
forwarding-class-sets {
  fcoe-pg {
    class fcoe;
  }
}
congestion-notification-profile {
  fcoe-cnp {
    input {
      ieee-802.1 {
        code-point 011 {
          pfc;
        }
      }
    }
  }
}
interfaces {
  ae0 {
    forwarding-class-set {
      fcoe-pg {
        output-traffic-control-profile fcoe-tcp;
      }
    }
    congestion-notification-profile fcoe-cnp;
  }
  ae1 {
    forwarding-class-set {
      fcoe-pg {
        output-traffic-control-profile fcoe-tcp;
      }
    }
    congestion-notification-profile fcoe-cnp;
  }
}
scheduler-maps {
  fcoe-map {
    forwarding-class fcoe scheduler fcoe-sched;
  }
}
schedulers {
  fcoe-sched {
    transmit-rate 3000000000;
```

```
      shaping-rate percent 100;
      priority low;
    }
}
```

NOTE: The forwarding class and classifier configurations are not shown because the show command does not display default portions of the configuration.

For MC-LAG verification commands, see "Example: Configuring Multichassis Link Aggregation" on page 1904.

Display the results of the CoS configuration on FCoE Transit Switch TS1 and on FCoE Transit Switch TS2 (the results on both transit switches are the same):

```
user@switch> show configuration class-of-service
traffic-control-profiles {
  fcoe-tcp {
    scheduler-map fcoe-map;
    shaping-rate percent 100;
    guaranteed-rate 3000000000;
  }
}
forwarding-class-sets {
  fcoe-pg {
    class fcoe;
  }
}
congestion-notification-profile {
  fcoe-cnp {
    input {
      ieee-802.1 {
        code-point 011 {
          pfc;
        }
      }
    }
  }
}
interfaces {
  xe-0/0/30 {
    forwarding-class-set {
      fcoe-pg {
        output-traffic-control-profile fcoe-tcp;
      }
    }
    congestion-notification-profile fcoe-cnp;
  }
  xe-0/0/31 {
    forwarding-class-set {
      fcoe-pg {
        output-traffic-control-profile fcoe-tcp;
      }
```



```
        }
        congestion-notification-profile fcoe-cnp;
    }
    xe-0/0/32 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
    xe-0/0/33 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
    ae1 {
        forwarding-class-set {
            fcoe-pg {
                output-traffic-control-profile fcoe-tcp;
            }
        }
        congestion-notification-profile fcoe-cnp;
    }
}
scheduler-maps {
    fcoe-map {
        forwarding-class fcoe scheduler fcoe-sched;
    }
}
schedulers {
    fcoe-sched {
        transmit-rate 3000000000;
        shaping-rate percent 100;
        priority low;
    }
}
```

NOTE: The forwarding class and classifier configurations are not shown because the **show** command does not display default portions of the configuration.

Verification

To verify that the CoS components and FIP snooping have been configured and are operating properly, perform these tasks. Because this example uses the default **fcoe** forwarding class and the default IEEE 802.1p trusted classifier, the verification of those configurations is not shown:

Verifying That the Output Queue Schedulers Have Been Created

Purpose Verify that the output queue scheduler for FCoE traffic has the correct bandwidth parameters and priorities, and is mapped to the correct forwarding class (output queue). Queue scheduler verification is the same on each of the four switches.

Action List the scheduler map using the operational mode command **show class-of-service scheduler-map fcoe-map**:

```
user@switch> show class-of-service scheduler-map fcoe-map
Scheduler map: fcoe-map, Index: 9023

  Scheduler: fcoe-sched, Forwarding class: fcoe, Index: 37289
    Transmit rate: 3000000000 bps, Rate Limit: none, Buffer size: remainder,
    Buffer Limit: none, Priority: low
    Excess Priority: unspecified
    Shaping rate: 100 percent,
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    <default-drop-profile>
      Medium high     any             1    <default-drop-profile>
      High            any             1    <default-drop-profile>
```

Meaning The **show class-of-service scheduler-map fcoe-map** command lists the properties of the scheduler map **fcoe-map**. The command output includes:

- The name of the scheduler map (**fcoe-map**)
- The name of the scheduler (**fcoe-sched**)
- The forwarding classes mapped to the scheduler (**fcoe**)
- The minimum guaranteed queue bandwidth (transmit rate **3000000000 bps**)
- The scheduling priority (**low**)

- The maximum bandwidth in the priority group the queue can consume (shaping rate **100 percent**)
- The drop profile loss priority for each drop profile name. This example does not include drop profiles because you do not apply drop profiles to FCoE traffic.

Verifying That the Priority Group Output Scheduler (Traffic Control Profile) Has Been Created

Purpose Verify that the traffic control profile **fcoe-tcp** has been created with the correct bandwidth parameters and scheduler mapping. Priority group scheduler verification is the same on each of the four switches.

Action List the FCoE traffic control profile properties using the operational mode command **show class-of-service traffic-control-profile fcoe-tcp**:

```
user@switch> show class-of-service traffic-control-profile fcoe-tcp
Traffic control profile: fcoe-tcp, Index: 18303
  Shaping rate: 100 percent
  Scheduler map: fcoe-map
  Guaranteed rate: 3000000000
```

Meaning The **show class-of-service traffic-control-profile fcoe-tcp** command lists all of the configured traffic control profiles. For each traffic control profile, the command output includes:

- The name of the traffic control profile (**fcoe-tcp**)
- The maximum port bandwidth the priority group can consume (shaping rate **100 percent**)
- The scheduler map associated with the traffic control profile (**fcoe-map**)
- The minimum guaranteed priority group port bandwidth (guaranteed rate **3000000000** in bps)

Verifying That the Forwarding Class Set (Priority Group) Has Been Created

Purpose Verify that the FCoE priority group has been created and that the **fcoe** priority (forwarding class) belongs to the FCoE priority group. Forwarding class set verification is the same on each of the four switches.

Action List the forwarding class sets using the operational mode command **show class-of-service forwarding-class-set fcoe-pg**:

```
user@switch> show class-of-service forwarding-class-set fcoe-pg
Forwarding class set: fcoe-pg, Type: normal-type, Forwarding class set index:
31420
  Forwarding class                       Index
  fcoe                                     1
```

Meaning The **show class-of-service forwarding-class-set fcoe-pg** command lists all of the forwarding classes (priorities) that belong to the **fcoe-pg** priority group, and the internal index number of the priority group. The command output shows that the forwarding class set **fcoe-pg** includes the forwarding class **fcoe**.

Verifying That Priority-Based Flow Control Has Been Enabled

Purpose Verify that PFC is enabled on the FCoE code point. PFC verification is the same on each of the four switches.

Action List the FCoE congestion notification profile using the operational mode command **show class-of-service congestion-notification fcoe-cnp**:

```
user@switch> show class-of-service congestion-notification fcoe-cnp
Type: Input, Name: fcoe-cnp, Index: 6879
Cable Length: 100 m
  Priority     PFC          MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Enabled      2500
  100          Disabled
  101          Disabled
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  000
               0
  001
               1
  010
               2
  011
               3
  100
               4
  101
               5
  110
               6
  111
               7
```

Meaning The **show class-of-service congestion-notification fcoe-cnp** command lists all of the IEEE 802.1p code points in the congestion notification profile that have PFC enabled. The command output shows that PFC is enabled on code point **011** (**fcoe** queue) for the **fcoe-cnp** congestion notification profile.

The command also shows the default cable length (100 meters), the default maximum receive unit (2500 bytes), and the default mapping of priorities to output queues because this example does not include configuring these options.

Verifying That the Interface Class of Service Configuration Has Been Created

Purpose Verify that the CoS properties of the interfaces are correct. The verification output on MC-LAG Switches S1 and S2 differs from the output on FCoE Transit Switches TS1 and TS2.

Action List the interface CoS configuration on MC-LAG Switches S1 and S2 using the operational mode command **show configuration class-of-service interfaces**:

```
user@switch> show configuration class-of-service interfaces
ae0 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}

ae1 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
```

List the interface CoS configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show configuration class-of-service interfaces**:

```
user@switch> show configuration class-of-service interfaces
xe-0/0/30 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
xe-0/0/31 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
xe-0/0/32 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
xe-0/0/33 {
    forwarding-class-set {
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
ae1 {
    forwarding-class-set {
```

```
        fcoe-pg {
            output-traffic-control-profile fcoe-tcp;
        }
    }
    congestion-notification-profile fcoe-cnp;
}
```

Meaning The **show configuration class-of-service interfaces** command lists the class of service configuration for all interfaces. For each interface, the command output includes:

- The name of the interface (for example, **ae0** or **xe-0/0/30**)
- The name of the forwarding class set associated with the interface (**fcoe-pg**)
- The name of the traffic control profile associated with the interface (output traffic control profile, **fcoe-tcp**)
- The name of the congestion notification profile associated with the interface (**fcoe-cnp**)

NOTE: Interfaces that are members of a LAG are not shown individually. The LAG or MC-LAG CoS configuration is applied to all interfaces that are members of the LAG or MC-LAG. For example, the interface CoS configuration output on MC-LAG Switches S1 and S2 shows the LAG CoS configuration but does not show the CoS configuration of the member interfaces separately. The interface CoS configuration output on FCoE Transit Switches TS1 and TS2 shows the LAG CoS configuration but also shows the configuration for interfaces xe-0/0/30, xe-0/0/31, xe-0/0/32, and xe-0/0/33, which are not members of a LAG.

Verifying That the Interfaces Are Correctly Configured

Purpose Verify that the LAG membership, MTU, VLAN membership, and port mode of the interfaces are correct. The verification output on MC-LAG Switches S1 and S2 differs from the output on FCoE Transit Switches T1 and T2.

Action List the interface configuration on MC-LAG Switches S1 and S2 using the operational mode command **show configuration interfaces**:

```
user@switch> show configuration interfaces
xe-0/0/10 {
    ether-options {
        802.3ad ae0;
    }
}
xe-0/0/11 {
    ether-options {
        802.3ad ae0;
    }
}
xe-0/0/20 {
    ether-options {
        802.3ad ae1;
```

```
    }
}
xe-0/0/21 {
    ether-options {
        802.3ad ae1;
    }
}
ae0 {
    mtu 2180;
    unit 0 {
        family ethernet-switching {
            port-mode trunk;
            vlan {
                members fcoe_vlan;
            }
        }
    }
}
ae1 {
    mtu 2180;
    unit 0 {
        family ethernet-switching {
            port-mode trunk;
            vlan {
                members fcoe_vlan;
            }
        }
    }
}
```

List the interface configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show configuration interfaces**:

```
user@switch> show configuration interfaces
xe-0/0/25 {
    ether-options {
        802.3ad ae1;
    }
}
xe-0/0/26 {
    ether-options {
        802.3ad ae1;
    }
}
xe-0/0/30 {
    mtu 2180;
    unit 0 {
        family ethernet-switching {
            port-mode tagged-access;
            vlan {
                members fcoe_vlan;
            }
        }
    }
}
xe-0/0/31 {
    mtu 2180;
    unit 0 {
        family ethernet-switching {
            port-mode tagged-access;
```

```
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }
    xe-0/0/32 {
        mtu 2180;
        unit 0 {
            family ethernet-switching {
                port-mode tagged-access;
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }
    xe-0/0/33 {
        mtu 2180;
        unit 0 {
            family ethernet-switching {
                port-mode tagged-access;
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }

    ae1 {
        mtu 2180;
        unit 0 {
            family ethernet-switching {
                port-mode trunk;
                vlan {
                    members fcoe_vlan;
                }
            }
        }
    }
```

Meaning The **show configuration interfaces** command lists the configuration of each interface by interface name.

For each interface that is a member of a LAG, the command lists only the name of the LAG to which the interface belongs.

For each LAG interface and for each interface that is not a member of a LAG, the command output includes:

- The MTU (**2180**)
- The unit number of the interface (**0**)
- The port mode (**trunk** mode for interfaces that connect two switches, **tagged-access** mode for interfaces that connect to FCoE hosts)
- The name of the VLAN in which the interface is a member (**fcoe_vlan**)

Verifying That FIP Snooping Is Enabled on the FCoE VLAN on FCoE Transit Switches TS1 and TS2 Access Interfaces

Purpose Verify that FIP snooping is enabled on the FCoE VLAN access interfaces. FIP snooping is enabled only on the FCoE access interfaces, so it is enabled only on FCoE Transit Switches TS1 and TS2. FIP snooping is not enabled on MC-LAG Switches S1 and S2 because FIP snooping is done at the Transit Switch TS1 and TS2 FCoE access ports.

Action List the port security configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show configuration ethernet-switching-options secure-access-port**:

```
user@switch> show configuration ethernet-switching-options secure-access-port
interface ae1.0 {
    fcoe-trusted;
}
vlan fcoe_vlan {
    examine-fip {
        examine-vn2vn {
            beacon-period 90000;
        }
    }
}
```

Meaning The **show configuration ethernet-switching-options secure-access-port** command lists port security information, including whether a port is trusted. The command output shows that:

- LAG port **ae1.0**, which connects the FCoE transit switch to the MC-LAG switches, is configured as an FCoE trusted interface. FIP snooping is not performed on the member interfaces of the LAG (**xe-0/0/25** and **xe-0/0/26**).
- FIP snooping is enabled (**examine-fip**) on the FCoE VLAN (**fcoe_vlan**), the type of FIP snooping is VN2VN_Port FIP snooping (**examine-vn2vn**) and the beacon period is set to 90000 milliseconds. On Transit Switches TS1 and TS2, all interface members of the FCoE VLAN perform FIP snooping unless the interface is configured as FCoE trusted. On Transit Switches TS1 and TS2, interfaces **xe-0/0/30**, **xe-0/0/31**, **xe-0/0/32**, and **xe-0/0/33** perform FIP snooping because they are not configured as FCoE trusted. The interface members of LAG **ae1** (**xe-0/0/25** and **xe-0/0/26**) do not perform FIP snooping because the LAG is configured as FCoE trusted.

Verifying That the FIP Snooping Mode Is Correct on FCoE Transit Switches TS1 and TS2

Purpose Verify that the FIP snooping mode is correct on the FCoE VLAN. FIP snooping is enabled only on the FCoE access interfaces, so it is enabled only on FCoE Transit Switches TS1 and TS2. FIP snooping is not enabled on MC-LAG Switches S1 and S2 because FIP snooping is done at the Transit Switch TS1 and TS2 FCoE access ports.

Action List the FIP snooping configuration on FCoE Transit Switches TS1 and TS2 using the operational mode command **show fip snooping brief**:

```
user@switch> show fip snooping brief
```

```
VLAN: fcoe_vlan,    Mode: VN2VN Snooping
  FC-MAP: 0e:fd:00
...
```

NOTE: The output has been truncated to show only the relevant information.

Meaning The **show fip snooping brief** command lists FIP snooping information, including the FIP snooping VLAN and the FIP snooping mode. The command output shows that:

- The VLAN on which FIP snooping is enabled is **fcoe_vlan**
- The FIP snooping mode is VN2VN_Port FIP snooping (**VN2VN Snooping**)

Verifying That IGMP Snooping Is Disabled on the FCoE VLAN

Purpose Verify that IGMP snooping is disabled on the FCoE VLAN on all four switches.

Action List the IGMP snooping protocol information on each of the four switches using the **show configuration protocols igmp-snooping** command:

```
user@switch> show configuration protocols igmp-snooping
vlan fcoe_vlan {
    disable;
}
```

Meaning The **show configuration protocols igmp-snooping** command lists the IGMP snooping configuration for the VLANs configured on the switch. The command output shows that IGMP snooping is disabled on the FCoE VLAN (**fcoe_vlan**).

Related Documentation

- Example: Configuring Multichassis Link Aggregation on page 1904
- Configuring Link Aggregation on page 2019
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Understanding Multichassis Link Aggregation on page 1853
- Understanding MC-LAGs on an FCoE Transit Switch on page 4881

Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch)

The default system configuration supports FCoE traffic on priority 3 (IEEE 802.1p code point 011). If the FCoE traffic on your converged Ethernet network uses priority 3, the only user configuration required for lossless transport is to enable PFC on code point 011 on the FCoE ingress interfaces.

However, if your network uses a different priority than 3 for FCoE traffic, you need to configure lossless FCoE transport on that priority. This example shows you how to configure lossless FCoE transport on a converged Ethernet network that uses priority 5 (IEEE 802.1p code point 101) for FCoE traffic instead of using priority 3.

Requirements

This example uses the following hardware and software components:

- One Juniper Networks QFX3500 Switch in transit switch (FIP snooping) mode
- Junos OS Release 12.3 or later for the QFX Series

Overview

Although FCoE traffic typically uses IEEE 802.1p priority 3 on converged Ethernet networks, some networks use a different priority for FCoE traffic. Regardless of the priority used, FCoE traffic must receive lossless treatment. Supporting lossless behavior for FCoE traffic when your network does not use priority 3 requires configuring:

- A lossless forwarding class for FCoE traffic.
- A behavior aggregate (BA) classifier to map the FCoE forwarding class to the appropriate IEEE 802.1p priority.
- A congestion notification profile (CNP) to enable PFC on the FCoE code point at the interface ingress and to configure flow control on the interface egress. Flow control on the interface egress enables the interface to respond to PFC messages received from the connected peer and pause the correct IEEE 802.1p priority on the correct output queue.

  NOTE: **Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.**

- A DCBX application and an application map to support DCBX application TLV exchange for the lossless FCoE traffic on the configured FCoE priority. By default, DCBX is enabled on all Ethernet interfaces, but only on priority 3 (IEEE 802.1p code point 011). To support DCBX application TLV exchange when you are not using the default configuration, you must configure all of the applications and map them to interfaces and priorities.

The priorities specified in the BA classifiers, CNP, and DCBX application map must match, or the configuration does not work. You must specify the same lossless FCoE forwarding class in each configuration and use the same IEEE 802.1p code point (priority) so that the FCoE traffic is properly classified into flows and so that those flows receive lossless treatment.

Topology

This example shows how to configure one lossless FCoE traffic class, map it to a priority other than priority 3, and configure flow control to ensure lossless behavior on the interfaces. This example uses two Ethernet interfaces, xe-0/0/25 and xe-0/0/26. The interfaces connect to a converged Ethernet network that uses IEEE 802.1p priority 5 (code point 101) for FCoE traffic.

The configuration on the two interfaces is the same. Both interfaces use the same explicitly configured lossless FCoE forwarding class and the same ingress classifier. Both interfaces enable PFC on priority 5 and enable flow control on the same output queue (which is mapped to the lossless FCoE forwarding class).

Table 511 on page 5586 shows the configuration components for this example.

Table 511: Components of the Configuration Topology for FCoE Traffic That Does Not Use Priority 3

Component	Settings
Hardware	QFX3500 switch
Forwarding class	Name—**fcoe1** Queue mapping—queue **5** Packet drop attribute—**no-loss** NOTE: A lossless forwarding class can be mapped to any output queue. However, because the **fcoe1** forwarding class uses priority 5 in this example, matching that traffic to a forwarding class that uses queue 5 creates a configuration that is logical and easy to map because the priority and the queue are identified by the same number.
BA classifier	Name—**fcoe_p5** FCoE priority mapping—Forwarding class **fcoe1** mapped to code point **101** (IEEE 802.1p priority 5) and a packet loss priority of **low**.

Table 511: Components of the Configuration Topology for FCoE Traffic That Does Not Use Priority 3 *(continued)*

Component	Settings
PFC configuration (CNPs)	CNP name—**fcoe_p5_cnp** Input CNP code point—**101** MRU—**2240** bytes Cable length—**100** meters Output CNP code point—**101** Output CNP flow control queue—**5** NOTE: When you apply a CNP with an explicit output queue flow control configuration to an interface, the explicit CNP overwrites the default output CNP. The output queues that are enabled for pause in the default configuration (queues 3 and 4) are not enabled for pause unless they are included in the explicitly configured output CNP.
DCBX application mapping	Application name—**fcoe_p5_app** Application EtherType—**0x8906** Application map name—**fcoe_p5_app_map** Application map code points—**101** NOTE: LLDP and DCBX must be enabled on the interface. By default, LLDP and DCBX are enabled on all Ethernet interfaces.

NOTE: This example does not include scheduling (bandwidth allocation) configuration or the FIP snooping configuration. This examples focuses only on the lossless FCoE priority configuration.

Configuration

CLI Quick Configuration

To quickly configure a lossless FCoE forwarding class that uses a different priority than IEEE 802.1p priority 3 for FCoE traffic on an FCoE transit switch, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set class-of-service forwarding-classes class fcoe1 queue-num 5 no-loss
set class-of-service classifiers ieee-802.1 fcoe_p5 forwarding-class fcoe1 loss-priority low
code-points 101
set class-of-service interfaces xe-0/0/25 unit 0 classifiers ieee-802.1 fcoe_p5
set class-of-service interfaces xe-0/0/26 unit 0 classifiers ieee-802.1 fcoe_p5
set class-of-service congestion-notification-profile fcoe_p5_cnp input ieee-802.1 code-point 101
pfc mru 2240
set class-of-service congestion-notification-profile fcoe_p5_cnp input cable-length 100
```


set class-of-service congestion-notification-profile fcoe_p5_cnp output ieee-802.1 code-point 101 pfc flow-control-queue 5
set class-of-service interfaces xe-0/0/25 congestion-notification-profile fcoe_p5_cnp
set class-of-service interfaces xe-0/0/26 congestion-notification-profile fcoe_p5_cnp
set applications application fcoe_p5_app ether-type 0x8906
set policy-options application-maps fcoe_p5_app_map application fcoe_p5_app code-points 101
set protocols dcbx interface xe-0/0/25 application-map fcoe_p5_app_map
set protocols dcbx interface xe-0/0/26 application-map fcoe_p5_app_map

Configuring A Lossless FCoE Forwarding Class On IEEE 802.1p Priority 5

Step-by-Step Procedure

To configure a lossless forwarding class for FCoE traffic on IEEE 802.1p priority 5 (code point 101), classify FCoE traffic into the lossless forwarding class, configure a congestion notification profile to enable PFC on the FCoE priority and output queue, and configure DCBX application protocol TLV exchange for traffic on the FCoE priority:

1. Configure the lossless forwarding class (named **fcoe1** and mapped to output queue **5**) for FCoE traffic on IEEE 802.1p priority 5:

   ```
   [edit class-of-service]
   user@switch# set forwarding-classes class fcoe1 queue-num 5 no-loss
   ```

2. Configure the ingress classifier (**fcoe_p5**). The classifier maps the FCoE priority (code point **101**) to the lossless FCoE forwarding class **fcoe1**:

   ```
   [edit class-of-service classifiers]
   user@switch# set ieee-802.1 fcoe_p5 forwarding-class fcoe1 loss-priority low code-points
   101
   ```

3. Apply the classifier to interfaces **xe-0/0/25** and **xe-0/026**:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/25 unit 0 classifiers ieee-802.1 fcoe_p5
   user@switch# set interfaces xe-0/0/26 unit 0 classifiers ieee-802.1 fcoe_p5
   ```

4. Configure the CNP. The input stanza enables PFC on the FCoE priority (IEEE 802.1p code point 101), sets the MRU value (2240 bytes), and sets the cable length value (100 meters). The output stanza configures flow control on output queue 5 on the FCoE priority:

   ```
   [edit class-of-service]
   user@switch# set congestion-notification-profile fcoe_p5_cnp input ieee-802.1 code-point
   101 pfc mru 2240
   user@switch# set congestion-notification-profile fcoe_p5_cnp input cable-length 100
   user@switch# set congestion-notification-profile fcoe_p5_cnp output ieee-802.1 code-point
   101 pfc flow-control-queue 5
   ```

5. Apply the CNP to the interfaces:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/25 congestion-notification-profile fcoe_p5_cnp
   user@switch# set interfaces xe-0/0/26 congestion-notification-profile fcoe_p5_cnp
   ```

6. Configure the DCBX application for FCoE to map to the Ethernet interfaces, so that DCBX can exchange application protocol TLVs on the IEEE 802.1p priority 5 instead of on the default priority 3:

   ```
   [edit]
   user@switch# set applications application fcoe_p5_app ether-type 0x8906
   ```


7. Configure a DCBX application map to map the FCoE application to the correct IEEE 802.1p FCoE priority:

```
[edit]
user@switch# set policy-options application-maps fcoe_p5_app_map application
fcoe_p5_app code-points 101
```

8. Apply the application map to the Ethernet interfaces so that DCBX exchanges FCoE application TLVs on the correct code point:

```
[edit]
user@switch# set protocols dcbx interface xe-0/0/25 application-map fcoe_p5_app_map
user@switch# set protocols dcbx interface xe-0/0/26 application-map fcoe_p5_app_map
```

Verification

To verify the configuration and proper operation of the lossless forwarding class and IEEE 802.1p priority, perform these tasks:

- Verifying the Forwarding Class Configuration on page 5589
- Verifying the Behavior Aggregate Classifier Configuration on page 5590
- Verifying the PFC Flow Control Configuration (CNP) on page 5590
- Verifying the Interface Configuration on page 5591
- Verifying the DCBX Application Configuration on page 5591
- Verifying the DCBX Application Map Configuration on page 5591
- Verifying the DCBX Application Protocol Exchange Interface Configuration on page 5592

Verifying the Forwarding Class Configuration

Purpose Verify that the lossless forwarding class **fcoe1** has been created.

Action Show the forwarding class configuration by using the operational command **show class-of-service forwarding class**:

```
user@switch# show class-of-service forwarding-class
Forwarding class                        ID       Queue   Policing priority  No-Loss

  best-effort                          0          0          normal         Disabled

  fcoe                                 1          3          normal         Enabled

  no-loss                              2          4          normal         Enabled

  network-control                      3          7          normal         Disabled

  fcoe1                                4          5          normal         Enabled

  mcast                                8          8          normal         Disabled
```

Meaning The **show class-of-service forwarding-class** command shows all of the forwarding classes. The command output shows that the **fcoe1** forwarding class is configured on output queue **5** with the no-loss packet drop attribute enabled.

Because we did not explicitly configure the default forwarding classes, they remain in their default state, including the lossless configuration of the **fcoe** and **no-loss** default forwarding classes.

Verifying the Behavior Aggregate Classifier Configuration

Purpose Verify that the classifier maps the forwarding classes to the correct IEEE 802.1p code points (priorities) and packet loss priorities.

Action List the classifier configured to support lossless FCoE transport using the operational mode command **show class-of-service classifier**:

```
user@switch> show class-of-service classifier
Classifier: fcoe_p5, Code point type: ieee-802.1, Index: 63065
  Code point         Forwarding class                    Loss priority
  101                fcoe1                               low
```

Meaning The **show class-of-service classifier** command shows the IEEE 802.1p code points and the loss priorities that are mapped to the forwarding classes in each classifier.

Classifier **fcoe_p5** maps code point **101** (priority 5) to explicitly configured lossless forwarding class **fcoe1** and a packet loss priority of **low**, and all other priorities to the **best-effort** forwarding class with a packet loss priority of **high**.

Verifying the PFC Flow Control Configuration (CNP)

Purpose Verify that PFC is enabled on the correct input priority and that flow control is configured on the correct output queue in the CNP.

Action Display the congestion notification profile using the operational mode command **show class-of-service congestion-notification**:

```
user@switch> show class-of-service congestion-notification
Name: fcoe_p5_cnp, Index: 12137
Type: Input
Cable Length: 100 m
  Priority     PFC          MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Disabled
  100          Disabled
  101          Enabled      2240
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  101
               5
```

Meaning The **show class-of-service congestion-notification** command shows the input and output stanzas of the configured CNPs.

The **fcoe_p5_cnp** CNP input stanza shows that PFC is enabled on code point **101** (priority 5), the MRU is **2240** bytes, and the cable length is **100** meters. The CNP output stanza shows that output flow control is configured on queue **5** for code point **101** (priority 5).

Verifying the Interface Configuration

Purpose Verify that the correct classifier and congestion notification profile are configured on the interfaces.

Action List the ingress interfaces using the operational mode commands **show configuration class-of-service interfaces xe-0/0/25** and **show configuration class-of-service interfaces xe-0/0/26**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/25
congestion-notification-profile fcoe_p5_cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe_p5;
    }
}

user@switch> show configuration class-of-service interfaces xe-0/0/26
congestion-notification-profile fcoe_p5_cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe_p5;
    }
}
```

Meaning Both the **show configuration class-of-service interfaces xe-0/0/25** command and the **show configuration class-of-service interfaces xe-0/0/26** command show that the congestion notification profile **fcoe_p5_cnp** is configured on each interface, and that the IEEE 802.1p classifier associated with each interface is **fcoe_p5**.

Verifying the DCBX Application Configuration

Purpose Verify that the DCBX application for FCoE is configured.

Action List the DCBX applications by using the configuration mode command **show applications**:

```
user@switch# show applications
application fcoe_p5_app {
    ether-type 0x8906;
```

Meaning The **show applications** configuration mode command shows all of the configured applications. The output shows that the application **fcoe_p5_app** is configured with an EtherType of **0x8906**.

Verifying the DCBX Application Map Configuration

Purpose Verify that the application map is configured.

Action List the application maps by using the configuration mode command **show policy-options application-maps**:

```
user@switch# show policy-options application-maps
fcoe_p5_app_map {
    application fcoe_p5_app code-points 101;
}
```

Meaning The **show policy-options application-maps** configuration mode command lists all of the configured application maps and the applications that belong to each application map. The output shows that application map **fcoe_p5_app_map** consists of the application named **fcoe_p5_app**, which is mapped to IEEE 802.1p code point **101**.

Verifying the DCBX Application Protocol Exchange Interface Configuration

Purpose Verify that the application map is applied to the correct interfaces.

Action List the application maps on each interface using the configuration mode command **show protocols dcbx**:

```
user@switch# show protocols dcbx
interface xe-0/0/25.0 {
    application-map fcoe_p5_app_map;
}
interface xe-0/0/26.0 {
    application-map fcoe_p5_app_map;
}
```

Meaning The **show protocols dcbx** configuration mode command lists the application map association with interfaces. The output shows that interfaces **xe-0/0/25.0** and **xe-0/0/26.0** use application map **fcoe_p5_app_map**.

Related Documentation

- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface on page 5593
- Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI) on page 5615
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- Example: Configuring Unicast Classifiers on page 5495
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface

The default system configuration supports FCoE traffic on priority 3 (IEEE 802.1p code point 011). If the FCoE traffic on your converged Ethernet network uses priority 3, the only user configuration required for lossless transport is to enable PFC on code point 011 on the FCoE ingress interfaces.

However, if your converged Ethernet network uses more than one priority for FCoE traffic, you need to configure lossless transport for each FCoE priority. This example shows you how to configure lossless FCoE transport on a converged Ethernet network that uses both priority 3 (IEEE 802.1p code point 011) and priority 5 (IEEE 802.1p code point 101) for FCoE traffic.

Requirements

This example uses the following hardware and software components:

- One Juniper Networks QFX3500 Switch in transit switch (FIP snooping) mode
- Junos OS Release 12.3 or later for the QFX Series

Overview

Some network topologies support FCoE traffic on more than one IEEE 802.1p priority. For example, a converged Ethernet network might include two separate FCoE networks that use different priorities to identify traffic. Interfaces that carry traffic for both FCoE networks need to support lossless FCoE transport on both priorities.

Supporting lossless behavior for two FCoE traffic classes requires configuring:

- At least one lossless forwarding class for FCoE traffic (this example uses the default **fcoe** forwarding class as one of the lossless FCoE forwarding classes, so we need to explicitly configure only one FCoE forwarding class).
- A behavior aggregate (BA) classifier to map the FCoE forwarding classes to the appropriate IEEE 802.1p code points (priorities).
- A congestion notification profile (CNP) to enable PFC on the FCoE code points at the interface ingress and to configure PFC flow control on the interface egress so that the interface can respond to PFC messages received from the connected peer.

NOTE: Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

- DCBX applications and an application map to support DCBX application TLV exchange for the lossless FCoE traffic on the configured FCoE priorities. By default, DCBX is enabled on all Ethernet interfaces, but only on priority 3 (IEEE 802.1p code point 011). To support DCBX application TLV exchange when you are not using the default configuration, you must configure all of the applications and map them to interfaces and priorities.

The priorities specified in the BA classifier, CNP, and DCBX application map must match, or the configuration does not work. You must specify the same lossless FCoE forwarding class in each configuration and use the same IEEE 802.1p code point (priority) so that the FCoE traffic is properly classified into flows and so that those flows receive lossless treatment.

Topology

This example shows how to configure two lossless FCoE traffic classes on an interface, map them to two different priorities, and configure flow control to ensure lossless behavior. This example uses two Ethernet interfaces, xe-0/0/20 and xe-0/0/21, that are connected to the converged Ethernet network. Both interfaces transport FCoE traffic on priorities 3 (011) and 5 (101), and must support lossless transport of that traffic.

Table 512 on page 5594 shows the configuration components for this example.

Table 512: Components of the Two Lossless FCoE Priorities on an Interface Configuration Topology

Component	Settings
Hardware	QFX3500 switch
Forwarding classes	Name—**fcoe1** Queue mapping—queue **5** Packet drop attribute—**no-loss** NOTE: A lossless forwarding class can be mapped to any output queue. However, because the **fcoe1** forwarding class uses priority 5 in this example, matching that traffic to a forwarding class that uses queue 5 creates a configuration that is logical and easy to map because the priority and the queue are identified by the same number. Name—**fcoe** This is the default lossless FCoE forwarding class, so no configuration required. The **fcoe** forwarding class is mapped to priority 3 (IEEE 802.1p code point 011) and to output queue 3 with a packet drop attribute of **no-loss**.

Table 512: Components of the Two Lossless FCoE Priorities on an Interface Configuration Topology *(continued)*

Component	Settings
BA classifier	Name—**fcoe_classifier** FCoE priority mapping for forwarding class **fcoe**—mapped to code point **011** (IEEE 802.1p priority 3) and a packet loss priority of **low**. FCoE priority mapping for forwarding class **fcoe1**—mapped to code point **101** (IEEE 802.1p priority 5) and a packet loss priority of **low**.
PFC configuration (CNP)	CNP name—**fcoe_cnp** Input CNP code points—**011** and **101** MRU—2240 bytes Cable length—100 meters Output CNP code points—**011** and **101** Output CNP flow control queues—**3** and **5** NOTE: When you apply a CNP with an explicit output queue flow control configuration to an interface, the explicit CNP overwrites the default output CNP. The output queues that are enabled for PFC pause in the default configuration (queues 3 and 4) are not enabled for PFC pause unless they are included in the explicitly configured output CNP. In this example, because the explicit output CNP overwrites the default output CNP, we must explicitly configure flow control on queue 3.
DCBX application mapping	Application name—**fcoe_app** Application EtherType—**0x8906** Application map name—**fcoe_app_map** Application map code points—**011** and **101** NOTE: LLDP and DCBX must be enabled on the interface. By default, LLDP and DCBX are enabled on all Ethernet interfaces.
Interfaces	Interfaces **xe-0/0/20** and **xe-0/0/21** use the same configuration: • Classifier—**fcoe_classifier** • CNP—**fcoe_cnp** • DCBX application map—**fcoe_app_map**

NOTE: This example does not include scheduling (bandwidth allocation) configuration or the FIP snooping configuration. This examples focuses only on the lossless FCoE priority configuration.

Configuration

CLI Quick Configuration

To quickly configure two lossless FCoE forwarding classes that use different priorities on an FCoE transit switch interface, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set class-of-service forwarding-classes class fcoe1 queue-num 5 no-loss
set class-of-service classifiers ieee-802.1 fcoe_classifier forwarding-class fcoe loss-priority low
code-points 011
set class-of-service classifiers ieee-802.1 fcoe_classifier forwarding-class fcoe1 loss-priority low
code-points 101set class-of-service interfaces xe-0/0/20 unit 0 classifiers ieee-802.1 fcoe_classifier
set class-of-service interfaces xe-0/0/21 unit 0 classifiers ieee-802.1 fcoe_classifier
set class-of-service congestion-notification-profile fcoe_cnp input ieee-802.1 code-point 011 pfc
mru 2240
set class-of-service congestion-notification-profile fcoe_cnp input ieee-802.1 code-point 101 pfc
mru 2240
set class-of-service congestion-notification-profile fcoe_cnp input cable-length 100
set class-of-service congestion-notification-profile fcoe_cnp output ieee-802.1 code-point 011
pfc flow-control-queue 3
set class-of-service congestion-notification-profile fcoe_cnp output ieee-802.1 code-point 101
pfc flow-control-queue 5
set class-of-service interfaces xe-0/0/20 congestion-notification-profile fcoe_cnp
set class-of-service interfaces xe-0/0/21 congestion-notification-profile fcoe_cnp
set applications application fcoe_app ether-type 0x8906
set policy-options application-maps fcoe_app_map application fcoe_app code-points [011 101]
set protocols dcbx interface xe-0/0/20 application-map fcoe_app_map
set protocols dcbx interface xe-0/0/21 application-map fcoe_app_map
```

Step-by-Step Procedure

To configure two lossless forwarding classes for FCoE traffic on the same interface, classify FCoE traffic into the forwarding classes, configure CNPs to enable PFC on the FCoE priorities and output queues, and configure DCBX application protocol TLV exchange for traffic on both FCoE priorities:

1. Configure lossless forwarding class **fcoe1** and map it to output queue **5** for FCoE traffic that uses IEEE 802.1p priority 5:

```
[edit class-of-service]
user@switch# set forwarding-classes class fcoe1 queue-num 5 no-loss
```

NOTE: This examples uses the default **fcoe** forwarding class as the other lossless FCoE forwarding class.

2. Configure the ingress classifier. The classifier maps the FCoE priorities (IEEE 802.1p code points **011** and **101**) to lossless FCoE forwarding classes **fcoe** and **fcoe1**, respectively:

```
[edit class-of-service classifiers]
user@switch# set ieee-802.1 fcoe_classifier forwarding-class fcoe loss-priority low
code-points 011
user@switch# set ieee-802.1 fcoe_classifier forwarding-class fcoe1 loss-priority low
code-points 101
```

3. Apply the classifier to the interfaces:

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/20 unit 0 classifiers ieee-802.1 fcoe_classifier
user@switch# set interfaces xe-0/0/21 unit 0 classifiers ieee-802.1 fcoe_classifier
```

4. Configure the CNP. The input stanza enables PFC on the FCoE priorities (IEEE 802.1p code points 011 and 101), sets the MRU value (2240 bytes), and sets the cable length value (100 meters). The output stanza configures flow control on output queues 3 and 5 on the FCoE priorities:

```
[edit class-of-service]
user@switch# set congestion-notification-profile fcoe_cnp input ieee-802.1 code-point 011 pfc mru 2240
user@switch# set congestion-notification-profile fcoe_cnp input ieee-802.1 code-point 101 pfc mru 2240
user@switch# set congestion-notification-profile fcoe_cnp input cable-length 100
user@switch# set congestion-notification-profile fcoe_cnp output ieee-802.1 code-point 011 pfc flow-control-queue 3
user@switch# set congestion-notification-profile fcoe_cnp output ieee-802.1 code-point 101 pfc flow-control-queue 5
```

5. Apply the CNP to the interfaces:

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/20 congestion-notification-profile fcoe_cnp
user@switch# set interfaces xe-0/0/21 congestion-notification-profile fcoe_cnp
```

6. Configure a DCBX application for FCoE to map to the Ethernet interfaces, so that DCBX can exchange application protocol TLVs on both of the IEEE 802.1p priorities used for FCoE transport:

```
[edit]
user@switch# set applications application fcoe_app ether-type 0x8906
```

7. Configure a DCBX application map to map the FCoE application to the correct IEEE 802.1p FCoE priorities:

```
[edit]
user@switch# set policy-options application-maps fcoe_app_map application fcoe_app code-points [011 101]
```

8. Apply the application map to the interfaces so that DCBX exchanges FCoE application TLVs on the correct code points:

```
[edit]
user@switch# set protocols dcbx interface xe-0/0/20 application-map fcoe_app_map
user@switch# set protocols dcbx interface xe-0/0/21 application-map fcoe_app_map
```

Verification

To verify the configuration and proper operation of the lossless forwarding classes and IEEE 802.1p priorities, perform these tasks:

- Verifying the Forwarding Class Configuration on page 5598
- Verifying the Behavior Aggregate Classifier Configuration on page 5598
- Verifying the PFC Flow Control Configuration (CNP) on page 5599
- Verifying the Interface Configuration on page 5599
- Verifying the DCBX Application Configuration on page 5600

- Verifying the DCBX Application Map Configuration on page 5600
- Verifying the DCBX Application Protocol Exchange Interface Configuration on page 5600

Verifying the Forwarding Class Configuration

Purpose Verify that the lossless forwarding class **fcoe1** has been created.

Action Show the forwarding class configuration by using the operational command **show class-of-service forwarding class**:

```
user@switch# show class-of-service forwarding-class
Forwarding class                          ID       Queue  Policing priority  No-Loss

  best-effort                            0          0         normal         Disabled

  fcoe                                    1          3         normal         Enabled

  no-loss                                 2          4         normal         Enabled

  network-control                        3          7         normal         Disabled

  fcoe1                                   4          5         normal         Enabled

  mcast                                  8          8         normal         Disabled
```

Meaning The **show class-of-service forwarding-class** command shows all of the forwarding classes. The command output shows that the **fcoe1** forwarding class is configured on output queue **5** with the no-loss packet drop attribute enabled.

Because we did not explicitly configure the default forwarding classes, they remain in their default state, including the lossless configuration of the **fcoe** and **no-loss** default forwarding classes.

Verifying the Behavior Aggregate Classifier Configuration

Purpose Verify that the three classifiers map the forwarding classes to the correct IEEE 802.1p code points (priorities) and packet loss priorities.

Action List the classifiers using the operational mode command **show class-of-service classifier**:

```
user@switch> show class-of-service classifier
Classifier: fcoe_classifier, Code point type: ieee-802.1, Index: 10964
  Code point          Forwarding class                    Loss priority
  011                 fcoe                                low
  101                 fcoe1                               low
```

Meaning The **show class-of-service classifier** command shows the IEEE 802.1p code points and the loss priorities that are mapped to the forwarding classes in each classifier.

Classifier **fcoe_classifier** maps code point **011** to default lossless forwarding class **fcoe** and a packet loss priority of **low**, and maps code point **101** to explicitly configured lossless forwarding class **fcoe1** and a packet loss priority of **low**.

Verifying the PFC Flow Control Configuration (CNP)

Purpose Verify that PFC is enabled on the correct input priorities and that flow control is configured on the correct output queues and priorities.

Action List the CNPs using the operational mode command **show class-of-service congestion-notification**:

```
user@switch> show class-of-service congestion-notification
Name: fcoe_cnp, Index: 46504
Type: Input
Cable Length: 100 m
  Priority     PFC          MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Enabled      2240
  100          Disabled
  101          Enabled      2240
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  011
               3
  101
               5
```

Meaning The **show class-of-service congestion-notification** command shows the input and output stanzas of the CNP.

The CNP **fcoe_cnp** input stanza shows that PFC is enabled on code points **011** and **101**, the MRU is **2240** bytes on both priorities, and the interface cable length is **100** meters. The CNP output stanza shows that output flow control is configured on queues **3** and **5** for code points **011** and **101**, respectively.

Verifying the Interface Configuration

Purpose Verify that the classifier and congestion notification profile are configured on the interfaces. Both interfaces should show the same configuration.

Action List the ingress interfaces using the operational mode commands **show configuration class-of-service interfaces xe-0/0/20** and **show configuration class-of-service interfaces xe-0/0/21**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/20
ccongestion-notification-profile fcoe_cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe_classifier;
    }
}

user@switch> show configuration class-of-service interfaces xe-0/0/21
congestion-notification-profile fcoe_cnp;
unit 0 {
```

```
    classifiers {
        ieee-802.1 fcoe_classifier;
    }
}
```

Meaning The **show configuration class-of-service interfaces xe-0/0/20** command shows that the congestion notification profile **fcoe_cnp** is configured on the interface, and that the IEEE 802.1p classifier associated with the interface is **fcoe_classifier**.

The **show configuration class-of-service interfaces xe-0/0/21** command shows that the congestion notification profile **fcoe_cnp** is configured on the interface, and that the IEEE 802.1p classifier associated with the interface is **fcoe_classifier**.

Verifying the DCBX Application Configuration

Purpose Verify that the DCBX application for FCoE is configured.

Action List the DCBX applications by using the configuration mode command **show applications**:

```
user@switch# show applications
application fcoe_app {
    ether-type 0x8906;
```

Meaning The **show applications** configuration mode command shows all of the configured applications. The output shows that the application **fcoe_app** is configured with an EtherType of **0x8906**.

Verifying the DCBX Application Map Configuration

Purpose Verify that the application map is configured.

Action List the application maps by using the configuration mode command **show policy-options application-maps**:

```
user@switch# show policy-options application-maps
fcoe_app_map {
    application fcoe_app code-points [011 101];
}
```

Meaning The **show policy-options application-maps** configuration mode command lists all of the configured application maps and the applications that belong to each application map. The output shows that application map **fcoe_app_map** consists of the application named **fcoe_app**, which is mapped to IEEE 802.1p code points **011** and **101** (priorities 3 and 5, respectively).

Verifying the DCBX Application Protocol Exchange Interface Configuration

Purpose Verify that the application map is applied to the interfaces.

Action List the application maps on each interface using the configuration mode command **show protocols dcbx**:

```
user@switch# show protocols dcbx
```

```
interface xe-0/0/20.0 {
    application-map fcoe_app_map;
}
interface xe-0/0/21.0 {
    application-map fcoe_app_map;
}
```

Meaning The **show protocols dcbx** configuration mode command lists the application map association with interfaces. The output shows that interfaces **xe-0/0/20.0** and **xe-0/0/21.0** use application map **fcoe_app_map**.

Related Documentation

- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch) on page 5584
- Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI) on page 5615
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- Example: Configuring Unicast Classifiers on page 5495
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces

Although the default configuration provides two lossless forwarding classes mapped to two different IEEE 802.1p priorities (code points), you can explicitly configure up to six lossless forwarding classes and map them to different priorities. You can support up to six different types of lossless traffic, and you can support the same type of traffic if it uses different priorities in different parts of your converged network.

This example shows you how to configure two lossless forwarding classes for FCoE traffic and map them to two different priorities on an FCoE transit switch.

- Requirements on page 5601
- Overview on page 5602
- Configuration on page 5606
- Verification on page 5609

Requirements

This example uses the following hardware and software components:

- One Juniper Networks QFX3500 Switch in transit switch (FIP snooping) mode
- Junos OS Release 12.3 or later for the QFX Series

Overview

Some network topologies support FCoE traffic on more than one IEEE 802.1p priority. For example, when the QFX3500 switch acts as a transit switch, it could be connected to two QFX3500 switches in FCoE-FC gateway mode. Each of the gateway switches could connect a set of FCoE clients to a different SAN, and each set of FCoE clients could use a different priority for FCoE traffic to avoid fate sharing and maintain separation of the two FCoE networks. In this case, you need to configure two forwarding classes for FCoE traffic, each mapped to a different output queue and a different priority.

Supporting lossless behavior for two FCoE traffic classes requires configuring:

- At least one lossless forwarding class for FCoE traffic (this example uses the default **fcoe** forwarding class as one of the two lossless FCoE forwarding classes, so we need to explicitly configure only one FCoE forwarding class)
- Behavior aggregate (BA) classifiers to map the FCoE forwarding classes to the appropriate IEEE 802.1p code points (priorities) on each interface
- Congestion notification profiles (CNPs) for each interface to enable PFC on the FCoE code points at the interface ingress and to configure PFC flow control on the interface egress so that the interface can respond to PFC messages received from the connected peer

  NOTE: Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

- DCBX applications and an application map to support DCBX application TLV exchange for the lossless FCoE traffic on the configured FCoE priorities. By default, DCBX is enabled on all Ethernet interfaces, but only on priority 3 (IEEE 802.1p code point 011). To support DCBX application TLV exchange when you are not using the default configuration, you must configure all of the applications and map them to interfaces and priorities.

The priorities specified in the BA classifiers, CNPs, and DCBX application map must match, or the configuration does not work. You must specify the same lossless FCoE forwarding class in each configuration and use the same IEEE 802.1p code point (priority) so that the FCoE traffic is properly classified into flows and so that those flows receive lossless treatment.

Topology

This example shows how to configure two lossless FCoE traffic classes, map them to two different priorities, and configure flow control to ensure lossless behavior for those priorities on the interfaces. This example uses three Ethernet interfaces, xe-0/0/20, xe-0/0/21, and xe-0/0/22:

- Interface xe-0/0/20 connects to an FCoE-FC gateway that connects to Fibre Channel (FC) SAN 1. FCoE traffic to and from FC SAN 1 uses the default **fcoe** forwarding class and the default mapping to priority 3 (IEEE 802.1p code point 011) and output queue 3.
- Interface xe-0/0/21 connects to another FCoE-FC gateway that connects to Fibre Channel (FC) SAN 2. FCoE traffic to and from FC SAN-2 uses an explicitly configured FCoE forwarding class that is mapped to priority 5 (code point 101) and output queue 5.
- Interface xe-0/0/22 connects to FCoE devices on the converged Ethernet network and handles traffic destined for FC SAN 1 and FC SAN 2. Interface xe-0/0/22 must properly handle lossless FCoE traffic of both priorities (both FCoE forwarding classes), including pausing the traffic on ingress or egress as required.

Figure 204 on page 5603 shows the topology for this example, and Table 513 on page 5603 shows the configuration components for this example.

Figure 204: Topology of the Two Lossless FCoE Priorities Example

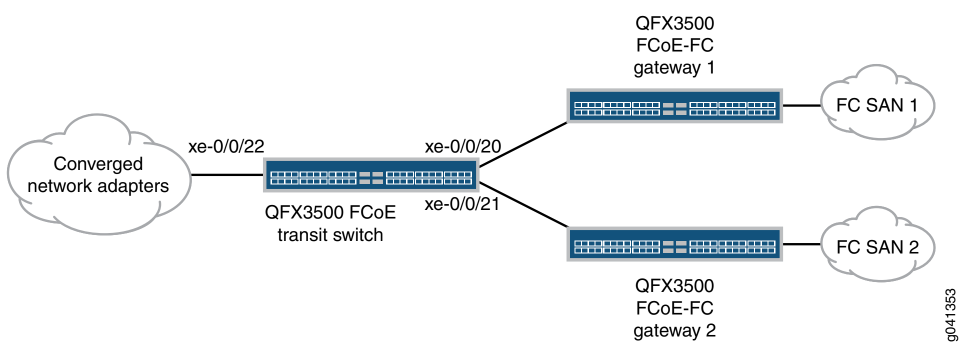


Table 513: Components of the Two Lossless FCoE Priorities Configuration Topology

Component	Settings
Hardware	QFX3500 switch
Forwarding classes	Name—**fcoe1** Queue mapping—queue **5** Packet drop attribute—**no-loss** NOTE: A lossless forwarding class can be mapped to any output queue. However, because the **fcoe1** forwarding class uses priority 5 in this example, matching that traffic to a forwarding class that uses queue 5 creates a configuration that is logical and easy to map because the priority and the queue are identified by the same number. Name—**fcoe** This is the default lossless FCoE forwarding class, so no configuration required. The **fcoe** forwarding class is mapped to priority 3 (IEEE 802.1p code point 011) and to output queue 3 with a packet drop attribute of **no-loss**

Table 513: Components of the Two Lossless FCoE Priorities Configuration Topology *(continued)*

Component	Settings
BA classifiers	Each interface requires a different classifier because each interface handles a different subset of FCoE traffic. • Interface xe-0/0/20 classifier: Name—**fcoe_p3** FCoE priority mapping—Forwarding class **fcoe** mapped to code point **011** (IEEE 802.1p priority 3) and a packet loss priority of **low**. • Interface xe-0/0/21 classifier: Name—**fcoe_p5** FCoE priority mapping—Forwarding class **fcoe1** mapped to code point **101** (IEEE 802.1p priority 5) and a packet loss priority of **low**. • Interface xe-0/0/22 classifier: Name—**fcoe_p3_p5** FCoE priority mapping—Forwarding class **fcoe1** mapped to code point **101** and a packet loss priority of **low**, and forwarding class **fcoe** mapped to code point **011** and a packet loss priority of **low**.

Table 513: Components of the Two Lossless FCoE Priorities Configuration Topology *(continued)*

Component	Settings
PFC configuration (CNPs)	Each interface requires a different CNP because each interface handles a different subset of FCoE traffic and must pause that traffic on different priorities. • Interface xe-0/0/20 CNP: CNP name—**fcoe_p3_cnp** Input CNP code point—**011** MRU—2240 bytes Cable length—100 meters NOTE: Because interface xe-0/0/20 uses the default FCoE configuration, output queue 3 is paused by default and you do not need to configure the output stanza of the CNP. • Interface xe-0/0/21 CNP: CNP name—**fcoe_p5_cnp** Input CNP code point—**101** MRU—**2240** bytes Cable length—**150** meters Output CNP code point—**101** Output CNP flow control queue—**5** • Interface xe-0/0/22 CNP: CNP name—**fcoe_p3_p5_cnp** Input CNP code points—**011** and **101** MRU—**2240** bytes (both priorities) Cable length—**100** meters Output CNP code points—**011** (for queue **3**) and **101** (for queue **5**) Output CNP flow control queues—**3** for priority 3 (code point 011) and **5** for priority 5 (code point 101) NOTE: When you apply a CNP with an explicit output queue flow control configuration to an interface, the explicit CNP overwrites the default output CNP. The output queues that are enabled for pause in the default configuration (queues 3 and 4) are not enabled for pause unless they are included in the explicitly configured output CNP.

Table 513: Components of the Two Lossless FCoE Priorities Configuration Topology *(continued)*

Component	Settings
DCBX application mapping	Interface xe-0/0/20 does not need an application map because DCBX exchanges application protocol TLVs only on the default FCoE priority (priority 3). Interface xe-0/0/21 requires an application map that enables DCBX application protocol TLV exchange on priority 5 (code point 101) for FCoE traffic. Interface xe-0/0/22 requires an application map that enables DCBX application protocol TLV exchange both on priority 3 (code point 011) and on priority 5 (code point 101) for FCoE traffic. • Interface xe-0/0/21 DCBX application mapping: Application name—**fcoe_p5_app** Application ether-type—**0x8906** Application map name—**fcoe_p5_app_map** Application map code points—**101** • Interface xe-0/0/22 DCBX application mapping: Application name—**fcoe_all_app** Application ether-type—**0x8906** Application map name—**fcoe_all_app_map** Application map code points—**011** and **101** NOTE: LLDP and DCBX must be enabled on the interface. By default, LLDP and DCBX are enabled on all Ethernet interfaces.

NOTE: This example does not include scheduling (bandwidth allocation) configuration or the FIP snooping configuration. This examples focuses only on the lossless FCoE priority configuration.

Configuration

CLI Quick Configuration

To quickly configure two lossless FCoE forwarding classes that use different priorities on an FCoE transit switch, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set class-of-service forwarding-classes class fcoe1 queue-num 5 no-loss
set class-of-service classifiers ieee-802.1 fcoe_p3 forwarding-class fcoe loss-priority low
code-points 011
set class-of-service classifiers ieee-802.1 fcoe_p5 forwarding-class fcoe1 loss-priority low
code-points 101
set class-of-service classifiers ieee-802.1 fcoe_p3_p5 forwarding-class fcoe loss-priority low
code-points 011
set class-of-service classifiers ieee-802.1 fcoe_p3_p5 forwarding-class fcoe1 loss-priority low
code-points 101
set class-of-service interfaces xe-0/0/20 unit 0 classifiers ieee-802.1 fcoe_p3
set class-of-service interfaces xe-0/0/21 unit 0 classifiers ieee-802.1 fcoe_p5
set class-of-service interfaces xe-0/0/22 unit 0 classifiers ieee-802.1 fcoe_p3_p5
set class-of-service congestion-notification-profile fcoe_p3_cnp input ieee-802.1 code-point 011
pfc mru 2240
```

set class-of-service congestion-notification-profile fcoe_p3_cnp input cable-length 100
set class-of-service congestion-notification-profile fcoe_p5_cnp input ieee-802.1 code-point 101 pfc mru 2240
set class-of-service congestion-notification-profile fcoe_p5_cnp input cable-length 150
set class-of-service congestion-notification-profile fcoe_p5_cnp output ieee-802.1 code-point 101 pfc flow-control-queue 5
set class-of-service congestion-notification-profile fcoe_p3_p5_cnp input ieee-802.1 code-point 011 pfc mru 2240
set class-of-service congestion-notification-profile fcoe_p3_p5_cnp input ieee-802.1 code-point 101 pfc mru 2240
set class-of-service congestion-notification-profile fcoe_p3_p5_cnp input cable-length 100
set class-of-service congestion-notification-profile fcoe_p3_p5_cnp output ieee-802.1 code-point 011 pfc flow-control-queue 3
set class-of-service congestion-notification-profile fcoe_p3_p5_cnp output ieee-802.1 code-point 101 pfc flow-control-queue 5
set class-of-service interfaces xe-0/0/20 congestion-notification-profile fcoe_p3_cnp
set class-of-service interfaces xe-0/0/21 congestion-notification-profile fcoe_p5_cnp
set class-of-service interfaces xe-0/0/22 congestion-notification-profile fcoe_p3_p5_cnp
set applications application fcoe_p5_app ether-type 0x8906
set applications application fcoe_all_app ether-type 0x8906
set policy-options application-maps fcoe_p5_app_map application fcoe_p5_app code-points 101
set policy-options application-maps fcoe_all_app_map application fcoe_all_app code-points [011 101]
set protocols dcbx interface xe-0/0/21 application-map fcoe_p5_app_map
set protocols dcbx interface xe-0/0/22 application-map fcoe_all_app_map

Step-by-Step Procedure

To configure two lossless forwarding classes for FCoE traffic on different interfaces, classify FCoE traffic into the forwarding classes, configure congestion notification profiles to enable PFC on the FCoE priorities and output queues, and configure DCBX application protocol TLV exchange for traffic on both FCoE priorities:

1. Configure lossless forwarding class **fcoe1** and map it to output queue **5** for FCoE traffic that uses IEEE 802.1p priority 5:

   ```
   [edit class-of-service]
   user@switch# set forwarding-classes class fcoe1 queue-num 5 no-loss
   ```

   NOTE: This examples uses the default **fcoe** forwarding class as the other lossless FCoE forwarding class.

2. Configure the ingress classifier (**fcoe_p3**) for interface **xe-0/0/20**. The classifier maps the FCoE priority (IEEE 802.1p code point **011**) to lossless FCoE forwarding class **fcoe**:

   ```
   [edit class-of-service classifiers]
   user@switch# set ieee-802.1 fcoe_p3 forwarding-class fcoe loss-priority low code-points 011
   ```

3. Configure the ingress classifier (**fcoe_p5**) for interface **xe-0/0/21**. The classifier maps the FCoE priority (IEEE 802.1p code point **101**) to lossless FCoE forwarding class **fcoe1**:

   ```
   [edit class-of-service classifiers]
   user@switch# set ieee-802.1 fcoe_p5 forwarding-class fcoe1 loss-priority low code-points 101
   ```

4. Configure the ingress classifier (**fcoe_p3_p5**) for interface **xe-0/0/22**. The classifier maps the two FCoE priorities (IEEE 802.1p code points **011** and **101**) to the two lossless FCoE forwarding classes **fcoe** and **fcoe1**, respectively:

   ```
   [edit class-of-service classifiers]
   user@switch# set ieee-802.1 fcoe_p3_p5 forwarding-class fcoe loss-priority low code-points 011
   user@switch# set ieee-802.1 fcoe_p3_p5 forwarding-class fcoe1 loss-priority low code-points 101
   ```

5. Apply each classifier to the appropriate interface:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/20 unit 0 classifiers ieee-802.1 fcoe_p3
   user@switch# set interfaces xe-0/0/21 unit 0 classifiers ieee-802.1 fcoe_p5
   user@switch# set interfaces xe-0/0/22 unit 0 classifiers ieee-802.1 fcoe_p3_p5
   ```

6. Configure the CNP input stanza for interface xe-0/0/20 to enable PFC on the FCoE priority (IEEE 802.1p code point 011), set the MRU value (2240 bytes), and set the cable length value (100 meters). No output stanza is needed because queue 3 is paused by default on priority 3, and we are not explicitly configuring output queue flow control for any other queues.

   ```
   [edit class-of-service]
   user@switch# set congestion-notification-profile fcoe_p3_cnp input ieee-802.1 code-point 011 pfc mru 2240
   user@switch# set congestion-notification-profile fcoe_p3_cnp input cable-length 100
   ```

7. Configure the CNP for interface xe-0/0/21. The input stanza enables PFC on the FCoE priority (IEEE 802.1p code point 101), sets the MRU value (2240 bytes), and sets the cable length value (150 meters). The output stanza configures flow control on output queue 5 on the FCoE priority:

   ```
   [edit class-of-service]
   user@switch# set congestion-notification-profile fcoe_p5_cnp input ieee-802.1 code-point 101 pfc mru 2240
   user@switch# set congestion-notification-profile fcoe_p5_cnp input cable-length 150
   user@switch# set congestion-notification-profile fcoe_p5_cnp output ieee-802.1 code-point 101 pfc flow-control-queue 5
   ```

8. Configure the CNP for interface xe-0/0/22. The input stanza enables PFC on the FCoE priorities (IEEE 802.1p code points 011 and 101), sets the MRU value (2240 bytes), and sets the cable length value (100 meters). The output stanza configures flow control on output queues 3 and 5 on the FCoE priorities:

   ```
   [edit class-of-service]
   user@switch# set congestion-notification-profile fcoe_p3_p5_cnp input ieee-802.1 code-point 011 pfc mru 2240
   user@switch# set congestion-notification-profile fcoe_p3_p5_cnp input ieee-802.1 code-point 101 pfc mru 2240
   user@switch# set congestion-notification-profile fcoe_p3_p5_cnp input cable-length 100
   user@switch# set congestion-notification-profile fcoe_p3_p5_cnp output ieee-802.1 code-point 011 pfc flow-control-queue 3
   user@switch# set congestion-notification-profile fcoe_p3_p5_cnp output ieee-802.1 code-point 101 pfc flow-control-queue 5
   ```

9. Apply each CNP to the appropriate interface:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/20 congestion-notification-profile fcoe_p3_cnp
   ```

```
user@switch# set interfaces xe-0/0/21 congestion-notification-profile fcoe_p5_cnp
user@switch# set interfaces xe-0/0/22 congestion-notification-profile fcoe_p3_p5_cnp
```

10. Configure the DCBX FCoE application and application map to apply to interface xe-0/0/21. Interface xe-0/0/21 uses priority 5 (IEEE 802.1p code point 101) for FCoE traffic, which requires DCBX to exchange FCoE application protocol TLVs on priority 5 on interface xe-0/0/21. Configure an application named **fcoe_p5_app** for FCoE traffic (EtherType **0x8906**) and configure an application map named **fcoe_p5_app_map** to map the application to code point 101:

    ```
    [edit]
    user@switch# set applications application fcoe_p5_app ether-type 0x8906
    user@switch# set policy-options application-maps fcoe_p5_app_map application
    fcoe_p5_app code-points 101
    ```

    NOTE: Interface xe-0/0/20 uses the default FCoE configuration (priority 3). DCBX exchanges protocol TLVs for the FCoE application by default, so you do not need to configure DCBX explicitly on interface xe-0/0/20.

11. Configure the DCBX FCoE application and application map to apply to interface xe-0/0/22. Interface xe-0/0/22 uses both priority 3 (IEEE 802.1p code point 011) and priority 5 for FCoE traffic, which requires DCBX to exchange FCoE application protocol TLVs on both priority 3 and priority 5. Configure an application named **fcoe_all_app** for FCoE traffic (EtherType **0x8906**) and configure an application map named **fcoe_all_app_map** to map the application to code points 011 and 101:

    ```
    [edit]
    user@switch# set applications application fcoe_all_app ether-type 0x8906
    user@switch# set policy-options application-maps fcoe_all_app_map application
    fcoe_all_app code-points [011 101]
    ```

12. Apply the application maps to the interfaces xe-0/0/21 and xe-0/0/22 so that DCBX exchanges FCoE application TLVs on the correct code points on each interface:

    ```
    [edit]
    user@switch# set protocols dcbx interface xe-0/0/21 application-map fcoe_p5_app_map
    user@switch# set protocols dcbx interface xe-0/0/22 application-map fcoe_all_app_map
    ```

Verification

To verify the configuration and proper operation of the lossless forwarding classes and IEEE 802.1p priorities, perform these tasks:

- Verifying the Forwarding Class Configuration on page 5610
- Verifying the Behavior Aggregate Classifier Configuration on page 5610
- Verifying the PFC Flow Control Configuration (CNP) on page 5611
- Verifying the Interface Configuration on page 5613
- Verifying the DCBX Application Configuration on page 5613
- Verifying the DCBX Application Map Configuration on page 5614
- Verifying the DCBX Application Protocol Exchange Interface Configuration on page 5614

Verifying the Forwarding Class Configuration

Purpose Verify that the lossless forwarding class **fcoe1** has been created.

Action Show the forwarding class configuration by using the operational command **show class-of-service forwarding class**:

```
user@switch# show class-of-service forwarding-class
Forwarding class                      ID      Queue  Policing priority  No-Loss

  best-effort                        0         0         normal       Disabled

  fcoe                               1         3          normal       Enabled

  no-loss                            2         4          normal       Enabled

  network-control                    3        7         normal       Disabled

  fcoe1                              4         5          normal       Enabled

  mcast                              8         8         normal       Disabled
```

Meaning The **show class-of-service forwarding-class** command shows all of the forwarding classes. The command output shows that the **fcoe1** forwarding class is configured on output queue **5** with the no-loss packet drop attribute enabled.

Because we did not explicitly configure the default forwarding classes, they remain in their default state, including the lossless configuration of the **fcoe** and **no-loss** default forwarding classes.

Verifying the Behavior Aggregate Classifier Configuration

Purpose Verify that the three classifiers map the forwarding classes to the correct IEEE 802.1p code points (priorities) and packet loss priorities.

Action List the classifiers configured to support lossless FCoE transport using the operational mode command **show class-of-service classifier**:

```
user@switch>  show class-of-service classifier
Classifier: fcoe_p3, Code point type: ieee-802.1, Index: 13913
  Code point         Forwarding class                       Loss priority
  011                fcoe                                   low

Classifier: fcoe_p5, Code point type: ieee-802.1, Index: 63065
  Code point         Forwarding class                       Loss priority
  101                fcoe1                                  low

Classifier: fcoe_p3_p5, Code point type: ieee-802.1, Index: 10964
  Code point         Forwarding class                       Loss priority
  011                fcoe                                   low
  101                fcoe1                                  low
```

Meaning The **show class-of-service classifier** command shows the IEEE 802.1p code points and the loss priorities that are mapped to the forwarding classes in each classifier. The command output shows that there are three classifiers, **fcoe_p3**, **fcoe_p5**, and **fcoe_p3_p5**.

Classifier **fcoe_p3** maps code point **011** (priority 3) to default lossless forwarding class **fcoe** and a packet loss priority of **low**.

Classifier **fcoe_p5** maps code point **101** (priority 5) to explicitly configured lossless forwarding class **fcoe1** and a packet loss priority of **low**.

Classifier **fcoe_p3_p5** maps code point **011** to default lossless forwarding class **fcoe** and a packet loss priority of **low**, and maps code point **101** to explicitly configured lossless forwarding class **fcoe1** and a packet loss priority of **low**.

Verifying the PFC Flow Control Configuration (CNP)

Purpose Verify that PFC is enabled on the correct input priorities and that flow control is configured on the correct output queues and priorities in each CNP.

Action List the congestion notification profiles using the operational mode command **show class-of-service congestion-notification**:

```
user@switch> show class-of-service congestion-notification
Name: fcoe_p3_cnp, Index: 12037
Type: Input
Cable Length: 100 m
  Priority     PFC         MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Enabled      2240
  100          Disabled
  101          Disabled
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  000
               0
  001
               1
  010
               2
  011
               3
  100
               4
  101
               5
  110
               6
  111
               7

Name: fcoe_p3_p5_cnp, Index: 46484
Type: Input
Cable Length: 100 m
  Priority     PFC         MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Enabled      2240
```

```
  100          Disabled
  101          Enabled      2240
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  011
               3
  101
               5

Name: fcoe_p5_cnp, Index: 12133
Type: Input
Cable Length: 150 m
  Priority     PFC          MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Disabled
  100          Disabled
  101          Enabled      2240
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  101
               5
```

Meaning The **show class-of-service congestion-notification** command shows the input and output stanzas of the three CNPs. For CNP **fcoe_p3_cnp**, the input stanza shows that PFC is enabled on IEEE 802.1p code point **011** (priority 3), the MRU is **2240** bytes, and the cable length is **100** meters. The CNP output stanza shows the default mapping of priorities to output queues.

NOTE: By default, only queues 3 and 4 are enabled to respond to pause messages from the connected peer. For queue 3 to respond to pause messages, priority 3 (code point 011) must be enabled for PFC in the input stanza. For queue 4 to respond to pause messages, priority 4 (code point 100) must be enabled for PFC in the input stanza. In this example, only queue 3 responds to pause messages from the connected peer on interfaces that use CNP **fcoe_p3_cnp**, because the input stanza enables PFC priority 3 only.

For CNP **fcoe_p3_p5_cnp**, the input stanza shows that PFC is enabled on code points **011** and **101**, the MRU is **2240** bytes on both priorities, and the cable length is **100** meters. The CNP output stanza shows that output flow control is configured on queues **3** and **5** for code points **011** and **101**, respectively.

For CNP **fcoe_p5_cnp**, the input stanza shows that PFC is enabled on code point **101** (priority 5), the MRU is **2240** bytes, and the cable length is **150** meters. The CNP output stanza shows that output flow control is configured on queue **5** for code point **101** (priority 5).

Verifying the Interface Configuration

Purpose Verify that the correct classifiers and congestion notification profiles are configured on the correct interfaces.

Action List the ingress interfaces using the operational mode commands **show configuration class-of-service interfaces xe-0/0/20**, **show configuration class-of-service interfaces xe-0/0/21**, and **show configuration class-of-service interfaces xe-0/0/22**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/20
ccongestion-notification-profile fcoe_p3_cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe_p3;
    }
}

user@switch> show configuration class-of-service interfaces xe-0/0/21
congestion-notification-profile fcoe_p5_cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe_p5;
    }
}

user@switch> show configuration class-of-service interfaces xe-0/0/22
congestion-notification-profile fcoe_p3_p5_cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe_p3_p5;
    }
}
```

Meaning The **show configuration class-of-service interfaces xe-0/0/20** command shows that the congestion notification profile **fcoe_p3_cnp** is configured on the interface, and that the IEEE 802.1p classifier associated with the interface is **fcoe_p3**.

The **show configuration class-of-service interfaces xe-0/0/21** command shows that the congestion notification profile **fcoe_p5_cnp** is configured on the interface, and that the IEEE 802.1p classifier associated with the interface is **fcoe_p5**.

The **show configuration class-of-service interfaces xe-0/0/22** command shows that the congestion notification profile **fcoe_p3_p5_cnp** is configured on the interface, and that the IEEE 802.1p classifier associated with the interface is **fcoe_p3_p5**.

Verifying the DCBX Application Configuration

Purpose Verify that the two DCBX applications for FCoE are configured.

Action List the DCBX applications by using the configuration mode command **show applications**:

```
user@switch# show applications
application fcoe_all_app {
    ether-type 0x8906;
```

```
application fcoe_p5_app {
    ether-type 0x8906;
```

Meaning The **show applications** configuration mode command shows all of the configured applications. The output shows that the application **fcoe_all_app** is configured with an EtherType of **0x8906** (the correct EtherType for FCoE traffic) and that the application **fcoe_p5_app** is also configured with an EtherType of **0x8906**.

Verifying the DCBX Application Map Configuration

Purpose Verify that the application maps are configured.

Action List the application maps by using the configuration mode command **show policy-options application-maps**:

```
user@switch# show policy-options application-maps
fcoe_all_app_map {
    application fcoe_all_app code-points [011 101];
}
fcoe_p5_app_map {
    application fcoe_p5_app code-points 101;
}
```

Meaning The **show policy-options application-maps** configuration mode command lists all of the configured application maps and the applications that belong to each application map. The output shows that there are two application maps.

Application map **fcoe_all_app_map** consists of the application named **fcoe_all_app** mapped to IEEE 802.1p code points **011** (priority 3) and **101** (priority 5).

Application map **fcoe_p5_app_map** consists of the application named **fcoe_p5_app** mapped to IEEE 802.1p code point **101** (priority 5).

Verifying the DCBX Application Protocol Exchange Interface Configuration

Purpose Verify that the application maps are applied to the correct interfaces.

Action List the application maps on each interface using the configuration mode command **show protocols dcbx**:

```
user@switch# show protocols dcbx
interface xe-0/0/21.0 {
    application-map fcoe_p5_app_map;
}
interface xe-0/0/22.0 {
    application-map fcoe_all_app_map;
}
```

Meaning The **show protocols dcbx** configuration mode command lists the application map association with interfaces. The output shows that interface **xe-0/0/21.0** uses application map **fcoe_p5_app_map** and interface **xe-0/0/22.0** uses application map **fcoe_all_app_map**.

NOTE: Because interface xe-0/0/20 uses the default lossless FCoE configuration, you do not configure application mapping to interface xe-0/0/20. The default configuration automatically exchanges application protocol TLVs for the default FCoE configuration on priority 3 (IEEE 802.1p code point 011).

Related Documentation

- Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface on page 5593
- Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch) on page 5584
- Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI) on page 5615
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- Example: Configuring Unicast Classifiers on page 5495
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI)

Although the default configuration provides two lossless forwarding classes mapped to two different IEEE 802.1p priorities (code points), you can explicitly configure up to six lossless forwarding classes and map them to different priorities. You can support up to six different types of lossless traffic, and you can support the same type of traffic on different priorities in different parts of your converged network.

This example shows you how to configure two lossless forwarding classes for FCoE traffic and one lossless forwarding class for iSCSI traffic, and map the forwarding classes to three different priorities. (The converged Ethernet network includes two FCoE networks, each of which uses a different priority to identify FCoE traffic, and an iSCSI network.)

Requirements

This example uses the following hardware and software components:

- One Juniper Networks QFX3500 Switch in transit switch (FIP snooping) mode

- Junos OS Release 12.3 or later for the QFX Series

Overview

Some converged Ethernet networks support FCoE on more than one IEEE 802.1p priority and also require supporting other lossless traffic classes. Interfaces that carry multiple lossless forwarding classes need to support lossless behavior for the priorities mapped to those forwarding classes. To support the two FCoE forwarding classes and the iSCSI forwarding class used in this example, you need to configure:

- At least one lossless forwarding class for FCoE traffic (this example uses the default **fcoe** forwarding class as one of the two lossless FCoE forwarding classes, so we need to explicitly configure only one FCoE forwarding class)
- A lossless forwarding class for iSCSI traffic
- Behavior aggregate (BA) classifiers to map the lossless forwarding classes to the appropriate IEEE 802.1p code points (priorities) on each interface
- Congestion notification profiles (CNPs) for each interface to enable PFC on the FCoE and iSCSI code points at the interface ingress, and to configure PFC flow control on the interface egress so that the interface can respond to PFC messages received from the connected peer

NOTE: **Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.**

- DCBX applications and an application map to support DCBX application TLV exchange for the FCoE and iSCSI traffic on the configured lossless priorities. By default, DCBX is enabled on all Ethernet interfaces for FCoE, but only on priority 3 (IEEE 802.1p code point 011). To support DCBX application TLV exchange when you are not using the default configuration, you must configure all of the applications and map them to interfaces and priorities.

The priorities specified in the BA classifiers, CNPs, and DCBX application map must match, or the configuration does not work. You must specify the same lossless FCoE forwarding class in each configuration and use the same IEEE 802.1p code point (priority) so that the FCoE traffic is properly classified into flows and so that those flows receive lossless treatment.

Topology

This example shows how to configure two lossless FCoE traffic classes and one lossless iSCSI traffic class, map them to three different priorities, and configure flow control to ensure lossless behavior for those priorities on the interfaces. This example uses four Ethernet interfaces, xe-0/0/31, xe-0/0/32, xe-0/0/33, and xe-0/0/34:

- Interface xe-0/0/31 handles FCoE traffic on priority 3 (IEEE 802.1p code point 011) and iSCSI traffic on priority 4 (code point 100).
- Interface xe-0/0/32 handles FCoE traffic on priority 5 (code point 101) and iSCSI traffic on priority 4.
- Interface xe-0/0/33 handles FCoE traffic on priority 3 and priority 5.
- Interface xe-0/0/34 handles iSCSI traffic on priority 4.

Figure 205 on page 5617 shows the topology for this example, and Table 514 on page 5617 shows the configuration components for this example.

Figure 205: Topology of the Lossless FCoE and iSCSI Priorities Example

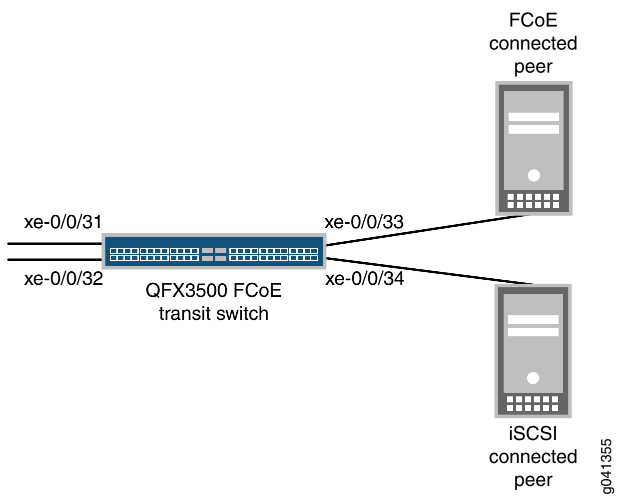


Table 514: Components of the Lossless FCoE and iSCSI Priorities Configuration Topology

Component	Settings
Hardware	QFX3500 switch

Table 514: Components of the Lossless FCoE and iSCSI Priorities Configuration Topology *(continued)*

Component	Settings
Forwarding classes	This example uses one explicitly configured lossless FCoE forwarding class, the default lossless FCoE forwarding class, and one explicitly configured iSCSI forwarding class. • iSCSI forwarding class: Name—**iscsi** Queue mapping—queue **4** Packet drop attribute—**no-loss** • FCoE forwarding class (explicitly configured): Name—**fcoe1** Queue mapping—queue **5** Packet drop attribute—**no-loss** NOTE: A lossless forwarding class can be mapped to any output queue. However, because the **fcoe1** forwarding class uses priority 5 in this example, matching that traffic to a forwarding class that uses queue 5 creates a configuration that is logical and easy to map because the priority and the queue are identified by the same number. • FCoE forwarding class (default) Name—**fcoe** The default **fcoe** forwarding class is mapped to priority 3 (IEEE 802.1p code point 011) and to output queue 3 with a packet drop attribute of **no-loss**.
BA classifiers	Each interface requires a different classifier because each interface handles a different subset of FCoE traffic. • Interface xe-0/0/31 classifier: Name—**fcoe_p3_iscsi** FCoE priority mapping—Forwarding class **fcoe** mapped to code point **011** (IEEE 802.1p priority 3) and a packet loss priority of **low**. iSCSI priority mapping—Forwarding class **iscsi** mapped to code point **100** (priority 4) and a packet loss priority of **low**. • Interface xe-0/0/32 classifier: Name—**fcoe_p5_iscsi** FCoE priority mapping—Forwarding class **fcoe1** mapped to code point **101** (IEEE 802.1p priority 5) and a packet loss priority of **low**. iSCSI priority mapping—Forwarding class **iscsi** mapped to code point **100** (priority 4) and a packet loss priority of **low**. • Interface xe-0/0/33 classifier: Name—**fcoe_p3_p5** FCoE priority mapping—Forwarding class **fcoe1** mapped to code point **101** (priority 5) and a packet loss priority of **low**, and forwarding class **fcoe** mapped to code point **011** and a packet loss priority of **low**. • Interface xe-0/0/34 classifier: Name—**iscsi_classifier** iSCSI priority mapping—Forwarding class **iscsi** mapped to code point **100** (priority 4) and a packet loss priority of **low**.

Table 514: Components of the Lossless FCoE and iSCSI Priorities Configuration Topology *(continued)*

Component	Settings
PFC configuration (CNPs)	Each interface requires a different CNP because each interface handles a different subset of FCoE and iSCSI traffic, and must pause that traffic on different priorities. • Interface xe-0/0/31 CNP: CNP name—**fcoe_p3_cnp** Input CNP code points—**011** and **100** MRU—2240 bytes for code point **011**, default value (2500 bytes) for code point **100** Cable length—100 meters NOTE: On interface xe-0/0/31, the FCoE forwarding class is mapped to queue 3 and priority 3 (code point 011), and the iSCSI forwarding class is mapped to queue 4 and priority 4 (code point 100). Therefore, interface xe-0/0/31 does not require an output CNP configuration because queue 3 and queue 4 are enabled for PFC flow control by default on code points 011 and 100, respectively. • Interface xe-0/0/32 CNP: CNP name—**fcoe_p5_cnp** Input CNP code points—**100** and **101** MRU—Default value (2500 bytes) for code point **100**, **2240** bytes for code point **101** Cable length—**150** meters Output CNP code points—**100** and **101** Output CNP flow control queues—**4** and **5** • Interface xe-0/0/33 CNP: CNP name—**fcoe_p3_p5_cnp** Input CNP code points—**011** and **101** MRU—**2240** bytes (both priorities) Cable length—**100** meters Output CNP code points—**011** and **101** Output CNP flow control queues—**3** and **5** • Interface xe-0/0/34 CNP: CNP name—**iscsi_cnp** Input CNP code point—**100** MRU—**2500** bytes (default value) Cable length—**100** meters NOTE: On interface xe-0/0/34, the iSCSI forwarding class is mapped to queue 4 and priority 4 (code point 100). Interface xe-0/0/34 does not require an output CNP configuration because queue 4 is enabled for PFC flow control by default on code point 100. NOTE: When you apply a CNP with an explicit output queue flow control configuration to an interface, the explicit CNP overwrites the default output CNP. The output queues that are enabled for PFC pause in the default configuration (queues 3 and 4) are not enabled for pause unless they are included in the explicitly configured output CNP.

Table 514: Components of the Lossless FCoE and iSCSI Priorities Configuration Topology *(continued)*

Component	Settings
DCBX application mapping	This example requires configuring applications for FCoE and iSCSI, including them in the same application map, and applying the application map to all four interfaces. Application map name—**dcbx_iscsi_fcoe_app_map** • FCoE application name—**fcoe_app** Application ether-type—**0x8906** Application map code points—**011** and **101** • iSCSI application name—**iscsi_app** Application protocol type—**tcp** Application destination port—**3260** Application map code point—**100** NOTE: LLDP and DCBX must be enabled on the interface. By default, LLDP and DCBX are enabled on all Ethernet interfaces.

NOTE: This example does not include scheduling (bandwidth allocation) configuration or the FIP snooping configuration. This examples focuses only on the lossless FCoE priority configuration.

Configuration

CLI Quick Configuration

To quickly configure two lossless FCoE forwarding classes and one lossless iSCSI forwarding class and map them to different priorities, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set class-of-service forwarding-classes class iscsi queue-num 4 no-loss
set class-of-service forwarding-classes class fcoe1 queue-num 5 no-loss
set class-of-service classifiers ieee-802.1 fcoe_p3_iscsi forwarding-class fcoe loss-priority low
code-points 011
set class-of-service classifiers ieee-802.1 fcoe_p3_iscsi forwarding-class iscsi loss-priority low
code-points 100
set class-of-service classifiers ieee-802.1 fcoe_p5_iscsi forwarding-class iscsi loss-priority low
code-points 100
set class-of-service classifiers ieee-802.1 fcoe_p5_iscsi forwarding-class fcoe1 loss-priority low
code-points 101
set class-of-service classifiers ieee-802.1 fcoe_p3_p5 forwarding-class fcoe loss-priority low
code-points 011
set class-of-service classifiers ieee-802.1 fcoe_p3_p5 forwarding-class fcoe1 loss-priority low
code-points 101
set class-of-service classifiers ieee-802.1 iscsi_classifier forwarding-class iscsi loss-priority low
code-points 100
set class-of-service interfaces xe-0/0/31 unit 0 classifiers ieee-802.1 fcoe_p3_iscsi
set class-of-service interfaces xe-0/0/32 unit 0 classifiers ieee-802.1 fcoe_p5_iscsi
set class-of-service interfaces xe-0/0/33 unit 0 classifiers ieee-802.1 fcoe_p3_p5set
class-of-service interfaces xe-0/0/34 unit 0 classifiers ieee-802.1 iscsi_classifier
```


set class-of-service congestion-notification-profile fcoe_p3_cnp input ieee-802.1 code-point 011 pfc mru 2240
set class-of-service congestion-notification-profile fcoe_p3_cnp input ieee-802.1 code-point 100 pfc
set class-of-service congestion-notification-profile fcoe_p3_cnp input cable-length 100
set class-of-service congestion-notification-profile fcoe_p5_cnp input ieee-802.1 code-point 100 pfc
set class-of-service congestion-notification-profile fcoe_p5_cnp input ieee-802.1 code-point 101 pfc mru 2240
set class-of-service congestion-notification-profile fcoe_p5_cnp input cable-length 150
set class-of-service congestion-notification-profile fcoe_p5_cnp output ieee-802.1 code-point 100 pfc flow-control-queue 4
set class-of-service congestion-notification-profile fcoe_p5_cnp output ieee-802.1 code-point 101 pfc flow-control-queue 5
set class-of-service congestion-notification-profile fcoe_p3_p5_cnp input ieee-802.1 code-point 011 pfc mru 2240
set class-of-service congestion-notification-profile fcoe_p3_p5_cnp input ieee-802.1 code-point 101 pfc mru 2240
set class-of-service congestion-notification-profile fcoe_p3_p5_cnp input cable-length 100
set class-of-service congestion-notification-profile fcoe_p3_p5_cnp output ieee-802.1 code-point 011 pfc flow-control-queue 3
set class-of-service congestion-notification-profile fcoe_p3_p5_cnp output ieee-802.1 code-point 101 pfc flow-control-queue 5
set class-of-service congestion-notification-profile iscsi_cnp input ieee-802.1 code-point 100 pfc
set class-of-service congestion-notification-profile iscsi_cnp input cable-length 100
set class-of-service interfaces xe-0/0/31 congestion-notification-profile fcoe_p3_cnp
set class-of-service interfaces xe-0/0/32 congestion-notification-profile fcoe_p5_cnp
set class-of-service interfaces xe-0/0/33 congestion-notification-profile fcoe_p3_p5_cnp
set class-of-service interfaces xe-0/0/34 congestion-notification-profile iscsi_cnp
set applications application iscsi_app protocol tcp destination-port 3260
set applications application fcoe_app ether-type 0x8906
set policy-options application-maps dcbx_iscsi_fcoe_app_map application iscsi_app code-points 100
set policy-options application-maps dcbx_iscsi_fcoe_app_map application fcoe_app code-points [011 101]
set protocols dcbx interface xe-0/0/31 application-map dcbx_iscsi_fcoe_app_map
set protocols dcbx interface xe-0/0/32 application-map dcbx_iscsi_fcoe_app_map
set protocols dcbx interface xe-0/0/33 application-map dcbx_iscsi_fcoe_app_map
set protocols dcbx interface xe-0/0/34 application-map dcbx_iscsi_fcoe_app_map

Step-by-Step Procedure

To configure two lossless forwarding classes for FCoE traffic and one lossless forwarding class for iSCSI traffic, classify the traffic into the three forwarding classes, configure congestion notification profiles to enable PFC on the FCoE priorities and output queues, and configure DCBX application protocol TLV exchange for traffic on both FCoE priorities:

1. Configure lossless forwarding classes **iscsi** for iSCSI traffic and **fcoe1** for FCoE traffic (this example uses the default **fcoe** forwarding class as the other lossless FCoE forwarding class) and map them to output queues:

   ```
   [edit class-of-service]
   user@switch# set forwarding-classes class iscsi queue-num 4 no-loss
   user@switch# set forwarding-classes class fcoe1 queue-num 5 no-loss
   ```

2. Configure the ingress classifier (**fcoe_p3_iscsi**) for interface **xe-0/0/31**. The classifier maps the FCoE priority (code point **011**) to lossless FCoE forwarding class **fcoe** and the iSCSI priority (code point **100**) to lossless iSCSI forwarding class **iscsi**:

   ```
   [edit class-of-service classifiers]
   ```

user@switch# **set ieee-802.1 fcoe_p3_iscsi forwarding-class fcoe loss-priority low code-points 011**
user@switch# **set ieee-802.1 fcoe_p3_iscsi forwarding-class iscsi loss-priority low code-points 100**

3. Configure the ingress classifier (**fcoe_p5_iscsi**) for interface **xe-0/0/32**. The classifier maps the FCoE priority (code point **101**) to lossless FCoE forwarding class **fcoe1** and the iSCSI priority (code point **100**) to lossless iSCSI forwarding class **iscsi**:

   [edit class-of-service classifiers]
   user@switch# **set ieee-802.1 fcoe_p5_iscsi forwarding-class iscsi loss-priority low code-points 100**
   user@switch# **set ieee-802.1 fcoe_p5_iscsi forwarding-class fcoe1 loss-priority low code-points 101**

4. Configure the ingress classifier (**fcoe_p3_p5**) for interface **xe-0/0/33**. The classifier maps the two FCoE priorities (code points **011** and **101**) to lossless FCoE forwarding classes **fcoe** and **fcoe1**, respectively:

   [edit class-of-service classifiers]
   user@switch# **set ieee-802.1 fcoe_p3_p5 forwarding-class fcoe loss-priority low code-points 011**
   user@switch# **set ieee-802.1 fcoe_p3_p5 forwarding-class fcoe1 loss-priority low code-points 101**

5. Configure the ingress classifier (**iscsi_classifier**) for interface **xe-0/0/34**. The classifier maps the iSCSI priority (code point **101**) to lossless iSCSI forwarding class **iscsi**:

   [edit class-of-service classifiers]
   user@switch# **set ieee-802.1 iscsi_classifier forwarding-class iscsi loss-priority low code-points 100**

6. Apply each classifier to the appropriate interface:

   [edit class-of-service]
   user@switch# **set interfaces xe-0/0/31 unit 0 classifiers ieee-802.1 fcoe_p3_iscsi**
   user@switch# **set interfaces xe-0/0/32 unit 0 classifiers ieee-802.1 fcoe_p5_iscsi**
   user@switch# **set interfaces xe-0/0/33 unit 0 classifiers ieee-802.1 fcoe_p3_p5**
   user@switch# **set interfaces xe-0/0/34 unit 0 classifiers ieee-802.1 iscsi_classifier**

7. Configure the CNP input stanza for interface xe-0/0/31 to enable PFC on the FCoE and iSCSI priorities that the interface handles (code points 011 and 100), set the MRU value for the FCoE traffic (2240 bytes), and set the cable length value (100 meters). No output stanza is needed because queues 3 and 4 are paused by default on priorities 3 and 4, respectively, and we are not explicitly configuring output queue flow control for any other queues.

   [edit class-of-service]
   user@switch# **set congestion-notification-profile fcoe_p3_cnp input ieee-802.1 code-point 011 pfc mru 2240**
   user@switch# **set congestion-notification-profile fcoe_p3_cnp input ieee-802.1 code-point 100 pfc**
   user@switch# **set congestion-notification-profile fcoe_p3_cnp input cable-length 100**

8. Configure the CNP for interface xe-0/0/32. The input stanza enables PFC on the FCoE priority (code point 101), sets the MRU value for FCoE traffic (2240 bytes), enables PFC on the iSCSI priority (code point 100), and sets the cable length value (150 meters). The output stanza configures flow control on output queue 5 on the FCoE priority and on output queue 4 on the iSCSI priority:


```
[edit class-of-service]
user@switch# set congestion-notification-profile fcoe_p5_cnp input ieee-802.1 code-point 100 pfc
user@switch# set congestion-notification-profile fcoe_p5_cnp input ieee-802.1 code-point 101 pfc mru 2240
user@switch# set congestion-notification-profile fcoe_p5_cnp input cable-length 150
user@switch# set congestion-notification-profile fcoe_p5_cnp output ieee-802.1 code-point 100 pfc flow-control-queue 4
user@switch# set congestion-notification-profile fcoe_p5_cnp output ieee-802.1 code-point 101 pfc flow-control-queue 5
```

9. Configure the CNP for interface xe-0/0/33. The input stanza enables PFC on the FCoE priorities (IEEE 802.1p code points 011 and 101), sets the MRU value (2240 bytes), and sets the cable length value (100 meters). The output stanza configures flow control on output queues 3 and 5 on the FCoE priorities:

```
[edit class-of-service]
user@switch# set congestion-notification-profile fcoe_p3_p5_cnp input ieee-802.1 code-point 011 pfc mru 2240
user@switch# set congestion-notification-profile fcoe_p3_p5_cnp input ieee-802.1 code-point 101 pfc mru 2240
user@switch# set congestion-notification-profile fcoe_p3_p5_cnp input cable-length 100
user@switch# set congestion-notification-profile fcoe_p3_p5_cnp output ieee-802.1 code-point 011 pfc flow-control-queue 3
user@switch# set congestion-notification-profile fcoe_p3_p5_cnp output ieee-802.1 code-point 101 pfc flow-control-queue 5
```

10. Configure the CNP input stanza for interface xe-0/0/34 to enable PFC on the iSCSI priority (code point 100) and set the cable length value (100 meters). No output stanza is needed because queue 4 is paused by default on priority 4, and we are not explicitly configuring output queue flow control for any other queues.

```
[edit class-of-service]
user@switch# set congestion-notification-profile iscsi_cnp input ieee-802.1 code-point 100 pfc
user@switch# set congestion-notification-profile iscsi_cnp input cable-length 100
```

11. Apply each CNP to the appropriate interface:

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/31 congestion-notification-profile fcoe_p3_cnp
user@switch# set interfaces xe-0/0/32 congestion-notification-profile fcoe_p5_cnp
user@switch# set interfaces xe-0/0/33 congestion-notification-profile fcoe_p3_p5_cnp
user@switch# set interfaces xe-0/0/34 congestion-notification-profile iscsi_cnp
```

12. Configure the DCBX applications for FCoE and iSCSI to map to the interfaces so that DCBX can exchange application protocol TLVs on the IEEE 802.1p priorities used for FCoE and iSCSI traffic:

```
[edit]
user@switch# set applications application fcoe_app ether-type 0x8906
user@switch# set applications application iscsi_app protocol tcp destination-port 3260
```

13. Configure a DCBX application map to map the FCoE and iSCSI applications to the correct priorities:

```
[edit]
user@switch# set policy-options application-maps dcbx_iscsi_fcoe_app_map application fcoe_app code-points [011 101]
user@switch# set policy-options application-maps dcbx_iscsi_fcoe_app_map application iscsi_app code-points 100
```


14. Apply the application map to the interfaces so that DCBX exchanges FCoE application TLVs on the correct code points:

```
[edit]
user@switch# set protocols dcbx interface xe-0/0/31 application-map
dcbx_iscsi_fcoe_app_map
user@switch# set protocols dcbx interface xe-0/0/32 application-map
dcbx_iscsi_fcoe_app_map
user@switch# set protocols dcbx interface xe-0/0/33 application-map
dcbx_iscsi_fcoe_app_map
user@switch# set protocols dcbx interface xe-0/0/34 application-map
dcbx_iscsi_fcoe_app_map
```

Verification

To verify the configuration and proper operation of the lossless forwarding classes and IEEE 802.1p priorities, perform these tasks:

- Verifying the Forwarding Class Configuration on page 5624
- Verifying the Behavior Aggregate Classifier Configuration on page 5625
- Verifying the PFC Flow Control Configuration (CNP) on page 5625
- Verifying the Interface Configuration on page 5628
- Verifying the DCBX Application Configuration on page 5629
- Verifying the DCBX Application Map Configuration on page 5629
- Verifying the DCBX Application Protocol Exchange Interface Configuration on page 5630

Verifying the Forwarding Class Configuration

Purpose Verify that the lossless forwarding classes **iscsi** and **fcoe1** have been created and that the default lossless forwarding class **fcoe** is still enabled for lossless transport.

Action Show the forwarding class configuration by using the operational command **show class-of-service forwarding class**:

```
user@switch> show class-of-service forwarding-class
Forwarding class                        ID      Queue  Policing priority  No-Loss

  best-effort                          0         0         normal        Disabled

  fcoe                                 1          3         normal         Enabled

  iscsi                                2          4         normal         Enabled

  network-control                      3         7         normal        Disabled

  fcoe1                                4          5         normal         Enabled

  mcast                                8         8         normal        Disabled
```

Meaning The **show class-of-service forwarding-class** command shows all of the forwarding classes. The command output shows that the **iscsi** and **fcoe1** forwarding classes are configured on output queues **4** and **5**, respectively, with the no-loss packet drop attribute enabled.

Because we did not explicitly configure the default **fcoe** forwarding class, it remains in its default state (lossless configuration).

Verifying the Behavior Aggregate Classifier Configuration

Purpose Verify that the four classifiers map the forwarding classes to the correct IEEE 802.1p code points (priorities) and packet loss priorities.

Action List the classifiers configured to support lossless FCoE transport using the operational mode command **show class-of-service classifier**:

```
user@switch> show class-of-service classifier
Classifier: fcoe_p3_iscsi, Code point type: ieee-802.1, Index: 13915
  Code point         Forwarding class                    Loss priority
  011                fcoe                                low
  100                iscsi                               low

Classifier: fcoe_p5_iscsi, Code point type: ieee-802.1, Index: 62035
  Code point         Forwarding class                    Loss priority
  100                iscsi                               low
  101                fcoe1                               low

Classifier: fcoe_p3_p5, Code point type: ieee-802.1, Index: 17774
  Code point         Forwarding class                    Loss priority
  011                fcoe                                low
  101                fcoe1                               low

Classifier: iscsi_classifier, Code point type: ieee-802.1, Index: 31635
  Code point         Forwarding class                    Loss priority
  100                iscsi                               low
```

Meaning The **show class-of-service classifier** command shows the IEEE 802.1p code points and the loss priorities that are mapped to the forwarding classes in each classifier. The command output shows that there are four classifiers, **fcoe_p3_iscsi**, **fcoe_p5_iscsi**, **fcoe_p3_p5**, and **iscsi_classifier**.

Classifier **fcoe_p3_iscsi** maps code point **011** (priority 3) to default lossless forwarding class **fcoe** and a packet loss priority of **low**, and code point **100** (priority 4) to explicitly configured lossless forwarding class **iscsi**.

Classifier **fcoe_p5_iscsi** maps code point **100** to explicitly configured forwarding class **iscsi** and a packet loss priority of **low**, and code point **101** (priority 5) to explicitly configured lossless forwarding class **fcoe1** and a packet loss priority of **low**.

Classifier **fcoe_p3_p5** maps code point **011** to default lossless forwarding class **fcoe** and a packet loss priority of **low**, and maps code point **101** to explicitly configured lossless forwarding class **fcoe1** and a packet loss priority of **low**.

Classifier **iscsi_classifier** maps code point **100** to explicitly configured forwarding class **iscsi** and a packet loss priority of **low**.

Verifying the PFC Flow Control Configuration (CNP)

Purpose Verify that PFC is enabled on the correct input priorities and that flow control is configured on the correct output queues and priorities in each CNP.

Action List the congestion notification profiles using the operational mode command **show class-of-service congestion-notification**:

```
user@switch> show class-of-service congestion-notification
Name: fcoe_p3_cnp, Index: 12037
Type: Input
Cable Length: 100 m
  Priority     PFC          MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Enabled      2240
  100          Enabled      9216
  101          Disabled
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  000
               0
  001
               1
  010
               2
  011
               3
  100
               4
  101
               5
  110
               6
  111
               7

Name: fcoe_p3_p5_cnp, Index: 46484
Type: Input
Cable Length: 100 m
  Priority     PFC          MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Enabled      2240
  100          Disabled
  101          Enabled      2240
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  011
               3
  101
               5

Name: fcoe_p5_cnp, Index: 12133
Type: Input
Cable Length: 150 m
  Priority     PFC          MRU
  000          Disabled
  001          Disabled
  010          Disabled
```



```
  011          Disabled
  100          Enabled      9216
  101          Enabled      2240
  110          Disabled
  111          Disabled
Type: Output
  100
               4
  101
               5

Name: iscsi_cnp, Index: 19342
Type: Input
Cable Length: 100 m
  Priority     PFC          MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Disabled
  100          Enabled      9216
  101          Disabled
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  000
               0
  001
               1
  010
               2
  011
               3
  100
               4
  101
               5
  110
               6
  111
               7
```

Meaning The **show class-of-service congestion-notification** command shows the input and output stanzas of the four CNPs.

For CNP **fcoe_p3_cnp**, the input stanza shows that PFC is enabled on IEEE 802.1p code point **011** (priority 3) with an MRU of **2240** bytes, and cable length of **100** meters. The input stanza also shows that PFC is enabled on code point **100** (priority 4) with the default MRU value of **9216** bytes. The CNP output stanza shows the default mapping of priorities to output queues because no explicit output CNP is configured.

NOTE: By default, only queues 3 and 4 are enabled respond to pause messages from the connected peer. For queue 3 to respond to pause messages, priority 3 (code point 011) must be enabled for PFC in the input stanza. For queue 4 to respond to pause messages, priority 4 (code point 100) must be enabled for PFC in the input stanza. In this example, only queues 3 and 4 respond to pause messages from the connected peer on interfaces that use CNP **fcoe_p3_cnp** because the input stanza enables PFC only on priorities 3 and 4.

For CNP **fcoe_p3_p5_cnp**, the input stanza shows that PFC is enabled on code points **011** and **101** (priority 5), the MRU is **2240** bytes on both priorities, and the cable length is **100** meters. The CNP output stanza shows that output flow control is configured on queues **3** and **5** for code points **011** and **101**, respectively.

For CNP **fcoe_p5_cnp**, the input stanza shows that PFC is enabled on code points **100** and **101**. The MRU for code point **101** (FCoE traffic) is **2240** bytes and the MRU for code point **100** is **9216**. The interface cable length is **150** meters. The CNP output stanza shows that output flow control is configured on queue **4** for code point **100** and on queue **5** for code point **101**.

For CNP **iscsi_cnp**, the input stanza shows that PFC is enabled on code point **100**, the MRU value is **9216** bytes, and the interface cable length is **100** meters. The CNP output stanza shows the default mapping of priorities to output queues because no explicit output CNP is configured.

Verifying the Interface Configuration

Purpose Verify that the correct classifiers and congestion notification profiles are configured on the correct interfaces.

Action List the ingress interfaces using the operational mode commands **show configuration class-of-service interfaces xe-0/0/31**, **show configuration class-of-service interfaces xe-0/0/32**, **show configuration class-of-service interfaces xe-0/0/33**, and **show configuration class-of-service interfaces xe-0/0/34**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/31
congestion-notification-profile fcoe_p3_cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe_p3_iscsi;
    }
}

user@switch> show configuration class-of-service interfaces xe-0/0/32
congestion-notification-profile fcoe_p5_cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe_p5_iscsi;
    }
}
```



```
user@switch> show configuration class-of-service interfaces xe-0/0/33
congestion-notification-profile fcoe_p3_p5_cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe_p3_p5;
    }
}

user@switch> show configuration class-of-service interfaces xe-0/0/34
congestion-notification-profile iscsi_cnp;
unit 0 {
    classifiers {
        ieee-802.1 iscsi_classifier;
    }
}
```

Meaning The **show configuration class-of-service interfaces xe-0/0/31** command shows that the congestion notification profile **fcoe_p3_cnp** is configured on the interface, and that the IEEE 802.1p classifier associated with the interface is **fcoe_p3_iscsi**.

The **show configuration class-of-service interfaces xe-0/0/32** command shows that the congestion notification profile **fcoe_p5_cnp** is configured on the interface, and that the IEEE 802.1p classifier associated with the interface is **fcoe_p5_iscsi**.

The **show configuration class-of-service interfaces xe-0/0/33** command shows that the congestion notification profile **fcoe_p3_p5_cnp** is configured on the interface, and that the IEEE 802.1p classifier associated with the interface is **fcoe_p3_p5**.

The **show configuration class-of-service interfaces xe-0/0/34** command shows that the congestion notification profile **iscsi_cnp** is configured on the interface, and that the IEEE 802.1p classifier associated with the interface is **iscsi_classifier**.

Verifying the DCBX Application Configuration

Purpose Verify that the DCBX applications for FCoE and iSCSI are configured.

Action List the DCBX applications by using the configuration mode command **show applications**:

```
user@switch# show applications
application iscsi_app {
    protocol tcp;
    destination-port 3260;
}
application fcoe_app {
    ether-type 0x8906;
```

Meaning The **show applications** configuration mode command shows all of the configured applications. The output shows that the application **iscsi_app** is configured with a protocol value of **tcp** and a destination port value of **3260**, and that the application **fcoe_app** is configured with an EtherType of **0x8906** (the correct EtherType for FCoE traffic).

Verifying the DCBX Application Map Configuration

Purpose Verify that the application map is configured.

Action List the application maps by using the configuration mode command **show policy-options application-maps**:

```
user@switch# show policy-options application-maps
dcbx-iscsi-fcoe-app-map {
    application iscsi_app code-points 100;
    application fcoe_app code-points [011 101];
}
```

Meaning The **show policy-options application-maps** configuration mode command lists all of the configured application maps and the applications that belong to each application map. The output shows that there is one application map named **dcbx-iscsi-fcoe_app_map**. It consists of the application **iscsi_app** mapped to code point **100** and the application **fcoe_app** mapped to code points **011** and **101**.

Verifying the DCBX Application Protocol Exchange Interface Configuration

Purpose Verify that the application maps are applied to the correct interfaces.

Action List the application maps on each interface using the configuration mode command **show protocols dcbx**:

```
user@switch# show protocols dcbx
interface xe-0/0/31.0 {
    application-map dcbx-iscsi-fcoe-app-map;
}
interface xe-0/0/32.0 {
    application-map dcbx-iscsi-fcoe-app-map;
}
interface xe-0/0/33.0 {
    application-map dcbx-iscsi-fcoe-app-map;
}
interface xe-0/0/34.0 {
    application-map dcbx-iscsi-fcoe-app-map;
}
```

Meaning The **show protocols dcbx** configuration mode command lists the application map association with interfaces. The output shows that all four interfaces use the application map **dcbx-iscsi-fcoe-app-map**.

Related Documentation

- Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface on page 5593
- Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch) on page 5584
- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- Example: Configuring Unicast Classifiers on page 5495
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427

- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

Example: Configuring IEEE 802.1p Priority Remapping on an FCoE-FC Gateway

FCoE traffic typically uses IEEE 802.1p priority 3 (code point 011). However, if your FCoE network uses a different IEEE 802.1p priority than priority 3 for FCoE traffic, then you can use priority remapping to classify FCoE traffic into a lossless forwarding class mapped to that priority. You specify the lossless forwarding class used for the FCoE traffic by configuring a fixed classifier and applying it to the native FC (NP_Port) interface. All traffic received from the FC SAN on that NP_Port interface is classified into the forwarding class specified in the fixed classifier.

When native FC interfaces on the FCoE-FC gateway encapsulate incoming FC traffic in Ethernet to create FCoE frames, by default they assign IEEE 802.1p code point 011 to the FCoE traffic, forward the traffic internally to the gateway Ethernet interfaces, and then forward the traffic to the FCoE network. Setting a rewrite value for the IEEE 802.1p code point configures the gateway native FC interface to assign the rewrite value priority to the FCoE frames when the native FC interface forwards the FCoE frames to the gateway Ethernet interface. Instead of a priority of 3, the FCoE frames use the priority specified in the rewrite value.

You can configure one rewrite value for each local FCoE-FC gateway fabric. All of the native FC interfaces in a particular fabric must use the same rewrite value. Native FC interfaces that belong to different FCoE-FC gateway fabrics can use different rewrite values.

This example shows how to configure FCoE priority remapping for a converged Ethernet network that uses priority 5 (IEEE code point 101) for FCoE traffic. If your network uses priority 3 for FCoE traffic, then you do not need to remap the FCoE priority, because the default configuration supports lossless FCoE transport on priority 3.

Requirements

This example uses the following hardware and software components:

- One Juniper Networks QFX3500 Switch
- Junos OS Release 12.3 or later for the QFX Series

Overview

Native FC interfaces on an FCoE-FC gateway receive native FC traffic from the FC SAN and encapsulate it in Ethernet to create FCoE frames. Priority remapping enables you to map the encapsulated FC traffic (the FCoE traffic) to any IEEE 802.1p priority.

To support lossless FCoE traffic flows, you must configure the remapped priority correctly on the native FC interfaces and also on the Ethernet interfaces that connect to the FCoE network. Achieving lossless behavior for FCoE traffic when you remap the FCoE priority requires configuring:

- A lossless forwarding class for FCoE traffic (or using the default **fcoe** forwarding class)
- A behavior aggregate (BA) classifier on the FCoE Ethernet interfaces to map the FCoE forwarding class to the IEEE 802.1p code points (priority) used for FCoE traffic on the FCoE network (the ingress classifier priority for the forwarding class must be the same as the rewrite value priority)
- A fixed classifier on the FCoE-FC gateway FC interface that maps all traffic from the FC network into the lossless FCoE forwarding class (the forwarding class must be lossless)
- A priority rewrite value that remaps the IEEE 802.1p code point on the FCoE-FC gateway FC interface to the priority used for FCoE traffic on the FCoE network
- An input congestion notification profile (CNP) to enable priority-based flow control (PFC) on the FCoE code point (the code point used as the rewrite value) at the Ethernet interface ingress and an output CNP to configure flow control to pause the correct output queue at the Ethernet interface egress

> NOTE: **Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.**

- A DCBX application and application map on the Ethernet interface to support DCBX application TLV exchange for the lossless FCoE traffic on the FCoE priority

The priority specified in the BA classifier, CNP, and DCBX application map on the Ethernet ingress interfaces must match the priority specified in the fixed classifier and rewrite value configurations on the FC interfaces. You must specify the same lossless FCoE forwarding class in each configuration and use the same IEEE 802.1p code point (priority) so that the FCoE traffic is properly classified into flows and so that those flows receive lossless treatment.

Topology

This example shows how to configure priority remapping of FCoE traffic on one native FC interface (fc-0/0/2) connected to the FC SAN and on one Ethernet interface (xe-0/0/27) connected to the converged Ethernet (FCoE) network. Both the native FC interface and the Ethernet interface belong to the same local FC fabric on the FCoE-FC gateway.

The converged Ethernet network uses priority 5 (IEEE 80.21p code point 101) for FCoE traffic. The native FC interface on the FCoE-FC gateway receives FC traffic from the FC SAN. The native FC interface encapsulates the FC traffic in Ethernet to create FCoE frames, tags the frames with the IEEE 802.1p priority value 101, and then forwards the

FCoE frames to the FCoE-FC gateway Ethernet interface. Because traffic marked with IEEE 802.1p priority 5 is mapped to a lossless FCoE forwarding class, the traffic receives lossless treatment. The Ethernet interface forwards the FCoE traffic on to the Ethernet network.

FCoE traffic (tagged with priority 5) arriving at the FCoE-FC gateway from the Ethernet network receives lossless treatment and is forwarded to the native FC interface. The native FC interface removes the Ethernet encapsulation from the FCoE frames and forwards the resulting native FC traffic to the FC SAN.

Figure 206 on page 5633 shows the topology for this example, and Table 515 on page 5633 shows the configuration components for this example.

Figure 206: Topology of the IEEE 802.1p Priority Remapping Example

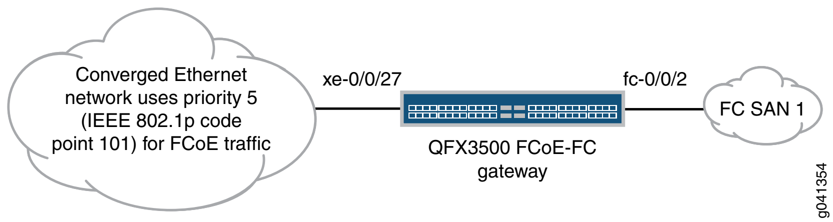


Table 515: Components of the IEEE 802.1p Priority Remapping Configuration Topology

Component	Settings
Hardware	QFX3500 switch
Forwarding class configuration	Name—**fcoe1** Queue mapping—queue **5** Packet drop attribute—**no-loss** NOTE: The lossless forwarding class can be mapped to any output queue. However, because FCoE uses priority 5 in this example, matching that traffic to a forwarding class that uses queue 5 creates a configuration that is logical and easy to map because the priority and the queue are identified by the same number.
BA classifier (Ethernet interface)	Name—**fcoe_gw_classifier** Maps code point **101** (IEEE 802.1p priority 5) to the **fcoe1** forwarding class and assigns traffic a packet loss priority of **low**. The classifier is applied to Ethernet interface **xe-0/0/27**.
Fixed classifier (native FC interface)	Forwarding class—**fcoe1** The classifier is applied to native FC interface **fc-0/0/2**
Rewrite value	IEEE 802.1p code point—**101** The rewrite value is applied to native FC interface **fc-0/0/2**

Table 515: Components of the IEEE 802.1p Priority Remapping Configuration Topology *(continued)*

Component	Settings
PFC configuration (CNP on Ethernet interface)	Name—**fcoe1_p5_rewrite_cnp** Input CNP code point—**101** Output CNP code point—**101** Output CNP flow control queue—**5** Interface—**xe-0/0/27**
DCBX application mapping	Application name—**myfcoe5** Application ether-type—**0x8906** Application map name—**myfcoe5_map** Application map code points—**101** Interface—**xe-0/0/27** NOTE: LLDP and DCBX must be enabled on the interface. By default, LLDP and DCBX are enabled on all Ethernet interfaces.

The priority used to identify FCoE traffic (5, IEEE 802.1p code point 101) is configured for lossless transport across the QFX device on interfaces xe-0/0/27 and fc-0/0/2, which belong to the same local FC fabric on the FCoE-FC gateway.

On the Ethernet interface, the classifier maps priority 5 to a lossless forwarding class (fcoe1), the input CNP enables PFC on incoming priority 5 traffic, and the output CNP enables output queue 5 to respond to pause messages received from the peer on traffic tagged with priority 5. On the native FC interface, FC traffic is remapped from priority 3 (the default mapping) to priority 5 and assigned to the same lossless forwarding class, fcoe1, because of the fixed classifier configuration. In this way, traffic tagged with priority 5 on interfaces xe-0/0/27 and fc-0/0/2 receives lossless treatment.

NOTE: To avoid fate sharing, ensure that the remapped priority is classified only to the forwarding class used in the fixed classifier on all other interfaces. For example, if you configure a fixed classifier on an FC interface that classifies all of the traffic into lossless forwarding class fcoe1 and remaps the priority to priority 5 (IEEE 802.1p code point 101), then in all other classifier configurations on all other interfaces, priority 5 should always be classified to forwarding class fcoe1. If you classify priority 6 on another interface to forwarding class fcoe1, then congestion on priority 6 traffic affects priority 5 traffic unfairly.

NOTE: This example does not include scheduling (bandwidth allocation) configuration or the local FC fabric configuration. This examples focuses only on priority remapping.

Configuration

CLI Quick Configuration

To quickly configure IEEE 802.1p priority remapping on an FCoE-FC gateway, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set class-of-service forwarding-classes class fcoe1 queue-num 5 no-loss
set class-of-service classifiers ieee-802.1 fcoe_gw_classifier forwarding-class fcoe1 loss-priority
low code-points 101
set class-of-service interfaces xe-0/0/27 unit 0 classifiers ieee-802.1 fcoe_gw_classifier
set class-of-service interfaces fc-0/0/2 forwarding-class fcoe1
set class-of-service interfaces fc-0/0/2 rewrite-value input ieee-802.1p code-point 101
set class-of-service congestion-notification-profile fcoe1_p5_rewrite_cnp input ieee-802.1
code-point 101 pfc
set class-of-service congestion-notification-profile fcoe1_p5_rewrite_cnp output ieee-802.1
code-point 101 flow-control-queue 5
set class-of-service interfaces xe-0/0/27 congestion-notification-profile fcoe1_p5_rewrite_cnp
set applications application myfcoe5 ether-type 0x8906
set policy-options application-maps myfcoe5_app_map application myfcoe5 code-points 101
set protocols dcbx interface xe-0/0/27 application-map myfcoe5_app_map
```

Step-by-Step Procedure

To configure a lossless forwarding class for FCoE traffic, classify FCoE traffic into that forwarding class, configure a rewrite value on the native FC interface for the FCoE traffic, and enable PFC on the Ethernet interface, and configure DCBX application protocol TLV exchange for FCoE traffic:

1. Configure the lossless forwarding class (named **fcoe1** and mapped to output queue **5**) for FCoE traffic that uses IEEE 802.1p priority 5:

   ```
   [edit class-of-service]
   user@switch# set forwarding-classes class fcoe1 queue-num 5 no-loss
   ```

2. Configure an ingress classifier named **fcoe_gw_classifier** to map the FCoE priority (IEEE 802.1p code point **101**) to the lossless FCoE forwarding class (**fcoe1**):

   ```
   [edit class-of-service classifiers]
   user@switch# set ieee-802.1 fcoe_gw_classifier forwarding-class fcoe1 loss-priority low
   code-points 101
   ```

3. Apply the classifier named **fcoe_gw_classifier** to Ethernet interface **xe-0/0/27**:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/27 unit 0 classifiers ieee-802.1 fcoe_gw_classifier
   ```

4. Configure the fixed classifier on the native FC interface, using the lossless FCoE forwarding class **fcoe1** (all traffic from the FC SAN is classified into the specified forwarding class). The traffic classified into this forwarding class is tagged with the priority value configured in the next step.

   ```
   [edit class-of-service]
   user@switch# set interfaces fc-0/0/2 forwarding-class fcoe1
   ```

5. Configure the rewrite value (IEEE 802.1p code point **101**) applied to all incoming traffic from the FC SAN on the native FC interface. The rewrite value is the IEEE 802.1p priority that the encapsulated FCoE traffic classified into the **fcoe1** forwarding class uses on the converged Ethernet network.

   ```
   [edit class-of-service]
   user@switch# set interfaces fc-0/0/2 rewrite-value input ieee-802.1p code-point 101
   ```

6. Configure the input stanza of the CNP (named **fcoe1_p5_rewrite_cnp**) to enable PFC on the FCoE priority on the Ethernet interface:

   ```
   [edit class-of-service]
   user@switch# set congestion-notification-profile fcoe1_p5_rewrite_cnp input ieee-802.1 code-point 101 pfc
   ```

7. Configure the output stanza of the CNP to enable output queue 5 to respond to pause messages received from the peer on traffic tagged with priority 5:

   ```
   [edit class-of-service]
   user@switch# set congestion-notification-profile fcoe1_p5_rewrite_cnp output ieee-802.1 code-point 101 flow-control-queue 5
   ```

8. Apply the CNP named **fcoe1_p5_rewrite_cnp** to Ethernet interface **xe-0/0/27**:

   ```
   [edit class-of-service]
   user@switch# set interfaces xe-0/0/27 congestion-notification-profile fcoe1_p5_rewrite_cnp
   ```

9. Configure a DCBX application for FCoE to map to the Ethernet interface, so that DCBX can exchange application protocol TLVs on the correct (remapped) IEEE 802.1p FCoE priority:

   ```
   [edit]
   user@switch# set applications application myfcoe5 ether-type 0x8906
   ```

10. Configure a DCBX application map to map the FCoE application to the correct (remapped) IEEE 802.1p FCoE priority:

    ```
    [edit]
    user@switch# set policy-options application-maps myfcoe5_app_map application myfcoe5 code-points 101
    ```

11. Apply the application map to the Ethernet interface so that DCBX exchanges FCoE application TLVs on the correct code point:

    ```
    [edit]
    user@switch# set protocols dcbx interface xe-0/0/27 application-map myfcoe5_app_map
    ```

Verification

To verify the configuration and proper operation of IEEE 802.1p priority remapping on an FCoE-FC gateway, perform these tasks:

- Verifying the Forwarding Class Configuration on page 5637
- Verifying the Behavior Aggregate Classifier Configuration on page 5637
- Verifying the FC Interface Configuration (Fixed Classifier, Rewrite Value) on page 5638
- Verifying the Ethernet Interface PFC Configuration (CNP) on page 5638
- Verifying the Ethernet Interface Configuration on page 5639

- Verifying the DCBX Application Configuration on page 5639
- Verifying the DCBX Application Map Configuration on page 5639
- Verifying the DCBX Application Protocol Exchange Interface Configuration on page 5640

Verifying the Forwarding Class Configuration

Purpose Verify that the lossless forwarding class **fcoe1** has been created.

Action Show the forwarding class configuration by using the operational command **show class-of-service forwarding class**:

```
user@switch# show class-of-service forwarding-class
Forwarding class                       ID      Queue  Policing priority  No-Loss

  best-effort                         0        0          normal         Disabled

  fcoe                                 1        3          normal         Enabled

  no-loss                              2        4          normal         Enabled

  network-control                     3        7          normal         Disabled

  fcoe1                                4        5          normal         Enabled

  mcast                               8        8          normal         Disabled
```

Meaning The **show class-of-service forwarding-class** command shows all of the forwarding classes. The command output shows that the **fcoe1** forwarding class is configured on output queue **5** with the no-loss packet drop attribute enabled.

Because we did not explicitly configure the default forwarding classes, they remain in their default state, including the lossless configuration of the **fcoe** and **no-loss** default forwarding classes.

Verifying the Behavior Aggregate Classifier Configuration

Purpose Verify that the classifier maps the forwarding classes to the correct IEEE 802.1p code points (priorities) and packet loss priorities.

Action List the classifier configured for priority remapping using the operational mode command **show class-of-service classifier name fcoe_gw_classifier**:

```
user@switch> show class-of-service classifier name fcoe_gw_classifier
Classifier: fcoe_gw_classifier, Code point type: ieee-802.1, Index: 13100
  Code point         Forwarding class                    Loss priority
  101                fcoe1                               low
```

Meaning The **show class-of-service classifier name fcoe_gw_classifier** command shows the IEEE 802.1p code points and the loss priorities that are mapped to the forwarding classes in the classifier. The command output shows that the classifier maps forwarding class **fcoe1** to IEEE 802.1p code point **101** (priority 5) with a packet loss priority of **low**.

Verifying the FC Interface Configuration (Fixed Classifier, Rewrite Value)

Purpose Verify that the native FC interface (NP_Port) classifies incoming traffic into forwarding class **fcoe1** and that the interface rewrite value is priority 5 (IEEE code point 101).

Action Display the FC interface configuration using the operational mode command **show configuration class-of-service interfaces fc-0/0/2**:

```
user@switch> show configuration class-of-service interfaces fc-0/0/2
rewrite-value {
    input {
        ieee-802.1 {
            code-point {
                101;
            }
        }
    }
}
forwarding-class fcoe1;
```

Meaning The **show configuration class-of-service interfaces fc-0/0/2** command shows that the rewrite value for incoming (input) traffic is IEEE 802.1p code point **101** (priority 5), and that the interface uses forwarding class **fcoe1** as the fixed classifier for all incoming traffic.

Verifying the Ethernet Interface PFC Configuration (CNP)

Purpose Verify that PFC is enabled on the correct priority (IEEE 802.1p code point **101**) for lossless transport and that flow control is enabled on the correct output queue (queue **5**) on the Ethernet interface.

Action List the congestion notification profile using the operational mode command **show class-of-service congestion-notification fcoe1_p5_rewrite_cnp**:

```
user@switch> show class-of-service congestion-notification fcoe1_p5_rewrite_cnp
Name: fcoe1_p5_rewrite_cnp, Index: 7061
Type: Input
Cable Length: 100 m
  Priority     PFC          MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Disabled
  100          Disabled
  101          Enabled      2500
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  101
               5
```

Meaning The **show class-of-service congestion-notification fcoe1_p5_rewrite_cnp** command shows the input and output stanzas of the CNP. The input stanza shows that PFC is enabled on IEEE 802.1p code point 101 (priority 5). The input stanza also shows that the CNP uses the default values of 100 meters for the cable length value and 2500 bytes for the maximum receive unit (MRU) value.

The output stanza shows that flow control is enabled on output queue **5** for IEEE 802.1p priority code point **101** (priority 5).

Verifying the Ethernet Interface Configuration

Purpose Verify that the classifier **fcoe_gw_classifier** and the congestion notification profile **fcoe1_p5_rewrite_cnp** are configured on Ethernet interface **xe-0/0/27**.

Action List the ingress interfaces using the operational mode command **show configuration class-of-service interfaces xe-0/0/27**:

```
user@switch> show configuration class-of-service interfaces xe-0/0/27
congestion-notification-profile fcoe1_p5_rewrite_cnp;
unit 0 {
    classifiers {
        ieee-802.1 fcoe_gw_classifier;
    }
}
```

Meaning The **show configuration class-of-service interfaces xe-0/0/27** command shows that the congestion notification profile **fcoe1_p5_rewrite_cnp** is configured on the interface, and that the IEEE 802.1p classifier associated with the interface is **fcoe_gw_classifier**.

Verifying the DCBX Application Configuration

Purpose Verify that the DCBX application named **myfcoe5** for FCoE is configured.

Action List the DCBX applications by using the configuration mode command **show applications**:

```
user@switch# show applications
application myfcoe5 {
    ether-type 0x8906;
}
```

Meaning The **show applications** configuration mode command shows all of the configured applications. The output shows that the application **myfcoe5** is configured with an EtherType of **0x8906** (the correct EtherType for FCoE traffic).

Verifying the DCBX Application Map Configuration

Purpose Verify that the application map **myfcoe5_app_map** is configured.

Action List the application map by using the configuration mode command **show policy-options application-maps**:

```
user@switch# show policy-options application-maps
myfcoe5_app_map {
    application myfcoe5 code-points 101;
}
```


Meaning

The **show policy-options application-maps** configuration mode command lists all of the configured application maps and the applications that belong to each application map. The output shows that there is one application map, **myfcoe5_app_map**, which consists of the application named **myfcoe5** mapped to IEEE 802.1p code point **101** (priority 5).

Verifying the DCBX Application Protocol Exchange Interface Configuration

Purpose

Verify that the application map is applied to the correct interface (**xe-0/0/27**).

Action

List the application maps using the configuration mode command **show protocols dcbx**:

```
user@switch# show protocols dcbx
interface xe-0/0/27.0 {
    application-map myfcoe5_app_map;
}
```

Meaning

The **show protocols dcbx** configuration mode command lists the application map association with interfaces. The output shows that interface **xe-0/0/27** uses application map **myfcoe5_app_map**.

Related Documentation

- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- Example: Configuring Unicast Classifiers on page 5495
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Configuring CoS Fixed Classifier Rewrite Values for Native FC Interfaces (NP_Ports) on page 5698
- Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5446

Example: Configuring DCBX Application Protocol TLV Exchange

Data Center Bridging Capability Exchange protocol (DCBX) discovers the data center bridging (DCB) capabilities of connected peers by exchanging application configuration information. DCBX detects feature misconfiguration and mismatches and can configure DCB on peers. DCBX is an extension of the Link Layer Discovery Protocol (LLDP). LLDP must remain enabled on every interface on which you want to use DCBX.

NOTE: **LLDP and DCBX are enabled by default on all interfaces.**

The switch supports DCBX application protocol exchange for Layer 2 and Layer 4 applications such as the Internet Small Computer System Interface (iSCSI). You specify applications by EtherType (for Layer 2 applications) or by the destination port and protocol (for Layer 4 applications; the protocol can be either TCP or UDP).

The QFX Series handles Fibre Channel over Ethernet (FCoE) application protocol exchange differently than other protocols in some cases:

- If FCoE is the only application for which you want to enable DCBX application protocol TLV exchange on an interface, you do not have to explicitly configure the FCoE application or an application map. By default, the QFX Series exchanges FCoE application protocol TLVs on all interfaces that carry FCoE traffic (traffic mapped to the **fcoe** forwarding class) and have priority-based flow control (PFC) enabled on the FCoE priority (the FCoE IEEE 802.1p code point). The default priority mapping for the FCoE application is IEEE 802.1p code point 011 (the default **fcoe** forwarding class code point).

- If you want an interface to use DCBX to exchange application protocol TLVs for any other applications in addition to FCoE, you must configure the applications (including FCoE), define an application map (including FCoE), and apply the application map to the interface. If you apply an application map to an interface, you must explicitly configure the FCoE application, or the interface does not exchange FCoE application protocol TLVs.

This example shows how to configure interfaces to exchange both Layer 2 and Layer 4 applications by configuring one interface to exchange iSCSI and FCoE application protocol information and configuring another interface to exchange iSCSI and Precision Time Protocol (PTP) application protocol information.

Requirements

This example uses the following hardware and software components:

- Juniper Networks QFX Series device
- Junos OS Release 12.1 or later for the QFX Series

Overview

The switch supports DCBX application protocol exchange for:

- Layer 2 applications, defined by EtherType
- Layer 4 applications, defined by destination port and protocol

NOTE: DCBX also advertises PFC and enhanced transmission selection (ETS) information. See “Configuring DCBX Autonegotiation” on page 5076 for how DCBX negotiates and advertises configuration information for these features and for the applications.

DCBX is configured on a per-interface basis for each supported feature or application. For applications that you want to enable for DCBX application protocol exchange, you must:

- Define the application name and configure the EtherType or the destination port and protocol (TCP or UDP) of the application. Use the EtherType for Layer 2 applications, and use the destination port and protocol for Layer 4 protocols.
- Map the application to an IEEE 802.1p code point in an application map.
- Add the application map to DCBX interface.

In addition, for all applications (including FCoE, even when you do not use an application map), you either must create an IEEE 802.1p classifier and apply it to the appropriate ingress interfaces or use the default classifier. A classifier maps the code points of incoming traffic to a forwarding class and a loss priority so that ingress traffic is assigned to the correct class of service (CoS). The forwarding class determines the output queue on the egress interface.

If you do not create classifiers, trunk and tagged-access ports use the unicast IEEE 802.1 default trusted classifier. Table 380 on page 4931 shows the default mapping of IEEE 802.1 code-point values to unicast forwarding classes and loss priorities for ports in trunk mode or tagged-access mode. Table 381 on page 4932 shows the default untrusted classifier IEEE 802.1 code-point values to unicast forwarding class mapping for ports in access mode.

Table 516: Default IEEE 802.1 Classifiers for Trunk Ports and Tagged-Access Ports (Default Trusted Classifier)

Code Point	Forwarding Class	Loss Priority
be (000)	best-effort	low
be1 (001)	best-effort	low
ef (010)	best-effort	low
ef1 (011)	fcoe	low
af11 (100)	no-loss	low
af12 (101)	best-effort	low
nc1 (110)	network-control	low
nc2 (111)	network-control	low

Table 517: Default IEEE 802.1 Unicast Classifiers for Access Ports (Default Untrusted Classifier)

Code Point	Forwarding Class	Loss Priority
000	best-effort	low
001	best-effort	low

Table 517: Default IEEE 802.1 Unicast Classifiers for Access Ports (Default Untrusted Classifier) *(continued)*

Code Point	Forwarding Class	Loss Priority
010	best-effort	low
011	best-effort	low
100	best-effort	low
101	best-effort	low
110	best-effort	low
111	best-effort	low

Topology

This example shows how to configure DCBX application protocol exchange for three protocols (iSCSI, PTP, and FCoE) on two interfaces. One interface exchanges iSCSI and FCoE application protocol information, and the other interface exchanges iSCSI and PTP application protocol information.

NOTE: You must map FCoE traffic to the interfaces on which you want to forward FCoE traffic. You must also enable PFC on the FCoE interfaces and create an ingress classifier for FCoE traffic, or else use the default classifier.

Table 382 on page 4932 shows the configuration components for this example.

Table 518: Components of DCBX Application Protocol Exchange Configuration Topology

Component	Settings
Hardware	QFX Series device
LLDP	Enabled by default on Ethernet interfaces
DCBX	Enabled by default on Ethernet interfaces
iSCSI application (Layer 4)	Application name—**iscsi** protocol—**TCP** destination-port—**3260** code-points—**111**

Table 518: Components of DCBX Application Protocol Exchange Configuration Topology *(continued)*

Component	Settings
PTP application (Layer 2)	Application name—**ptp** ether-type—**0x88F7** code-points—**001, 101**
FCoE application (Layer 2)	Application name—**fcoe** ether-type—**0x8906** code-points—**011** NOTE: You explicitly configure the FCoE application because you are applying an application map to the interface. When you apply an application map to an interface, all applications must be explicitly configured and included in the application map.
Application maps	**dcbx-iscsi-fcoe-app-map**—Maps the iSCSI and FCoE applications to IEEE 802.1p code points **dcbx-iscsi-ptp-app-map**—Maps iSCSI and PTP applications to IEEE 802.1p code points
Interfaces	**xe-0/0/10**—Configured to exchange FCoE and iSCSI application TLVs (uses application map **dcbx-iscsi-fcoe-app-map**, carries FCoE traffic, and has PFC enabled on the FCoE priority) **xe-0/0/11**—Configured to exchange iSCSI and PTP application TLVs (uses application map **dcbx-iscsi-ptp-app-map**)
PFC congestion notification profile for FCoE application exchange	**fcoe-cnp**: • Code point—**011** • Interface—**xe-0/0/10**
Behavior aggregate classifiers (map forwarding classes to incoming packets by the packet's IEEE 802.1 code point)	**fcoe-iscsi-cl1**: • Maps the **fcoe** forwarding class to the IEEE 802.1p code point used for the FCoE application (**011**) and a loss priority of **high** • Maps the **network-control** forwarding class to the IEEE 802.1p code point used for the iSCSI application (**111**) and a loss priority of **high** • Applied to interface **xe-0/0/10** **iscsi-ptp-cl2**: • Maps the **network-control** forwarding class to the IEEE 802.1p code point used for the iSCSI application (**111**) and a loss priority of **low** • Maps the **best-effort** forwarding class to the IEEE 802.1p code points used for the PTP application (**001** and **101**) and a loss priority of **low** • Applied to interface **xe-0/0/11**

NOTE: This example does not include scheduling (bandwidth allocation) configuration or lossless configuration for the iSCSI forwarding class.

Configuration

CLI Quick Configuration

To quickly configure DCBX application protocol exchange, copy the following commands, paste them in a text file, remove line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set applications application iSCSI protocol tcp destination-port 3260
set applications application FCoE ether-type 0x8906
set applications application PTP ether-type 0x88F7
set policy-options application-maps dcbx-iscsi-fcoe-app-map application iSCSI code-points 111
set policy-options application-maps dcbx-iscsi-fcoe-app-map application FCoE code-points 011
set policy-options application-maps dcbx-iscsi-ptp-app-map application iSCSI code-points 111
set policy-options application-maps dcbx-iscsi-ptp-app-map application PTP code-points [001 101]
set protocols dcbx interface xe-0/0/10 application-map dcbx-iscsi-fcoe-app-map
set protocols dcbx interface xe-0/0/11 application-map dcbx-iscsi-ptp-app-map
set class-of-service congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
set class-of-service interfaces xe-0/0/10 congestion-notification-profile fcoe-cnp
set class-of-service classifiers ieee-802.1 fcoe-iscsi-cl1 import default forwarding-class fcoe loss-priority high code-points 011
set class-of-service classifiers ieee-802.1 fcoe-iscsi-cl1 import default forwarding-class network-control loss-priority high code-points 111
set class-of-service classifiers ieee-802.1 iscsi-ptp-cl2 import default forwarding-class network-control loss-priority low code-points 111
set class-of-service classifiers ieee-802.1 iscsi-ptp-cl2 import default forwarding-class best-effort loss-priority low code-points [001 101]
set class-of-service interfaces xe-0/0/10 unit 0 classifiers ieee-802.1 fcoe-iscsi-cl1
set class-of-service interfaces xe-0/0/11 unit 0 classifiers ieee-802.1 iscsi-ptp-cl2
```

Configuring DCBX Application Protocol TLV Exchange

Step-by-Step Procedure

To define the applications, map the applications to IEEE 802.1p code points, apply the applications to interfaces, and create classifiers for DCBX application protocol exchange:

1. Define the iSCSI application by specifying its protocol and destination port, and define the FCoE and PTP applications by specifying their EtherTypes.

   ```
   [edit applications]
   user@switch# set application iSCSI protocol tcp destination-port 3260
   user@switch# set application FCoE ether-type 0x8906
   user@switch# set application PTP ether-type 0x88F7
   ```

2. Define an application map that maps the iSCSI and FCoE applications to IEEE 802.1p code points.

   ```
   [edit policy-options]
   user@switch# set application-maps dcbx-iscsi-fcoe-app-map application iSCSI code-points 111
   user@switch# set application-maps dcbx-iscsi-fcoe-app-map application FCoE code-points 011
   ```

3. Define the application map that maps the iSCSI and PTP applications to IEEE 802.1p code points.

```
[edit policy-options]
user@switch# set application-maps dcbx-iscsi-ptp-app-map application iSCSI code-points 111
user@switch# set application-maps dcbx-iscsi-ptp-app-map application PTP code-points [001 101]
```

4. Apply the iSCSI and FCoE application map to interface **xe-0/0/10**, and apply the iSCSI and PTP application map to interface **xe-0/0/11**.

```
[edit protocols dcbx]
user@switch# set interface xe-0/0/10 application-map dcbx-iscsi-fcoe-app-map
user@switch# set interface xe-0/0/11 application-map dcbx-iscsi-ptp-app-map
```

5. Create the congestion notification profile to enable PFC on the FCoE code point (**011**), and apply the congestion notification profile to interface **xe-0/0/10**.

```
[edit class-of-service]
user@switch# set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc
user@switch# set interfaces xe-0/0/10 congestion-notification-profile fcoe-cnp
```

6. Configure the classifier to apply to the interface that exchanges iSCSI and FCoE application information.

```
[edit class-of-service classifiers]
user@switch# set ieee-802.1 fcoe-iscsi-cl1 import default forwarding-class fcoe loss-priority high code-points 011
user@switch# set ieee-802.1 fcoe-iscsi-cl1 import default forwarding-class network-control loss-priority high code-points 111
```

7. Configure the classifier to apply to the interface that exchanges iSCSI and PTP application information.

```
[edit class-of-service classifiers]
user@switch# set ieee-802.1 iscsi-ptp-cl2 import default forwarding-class network-control loss-priority low code-points 111
user@switch# set ieee-802.1 iscsi-ptp-cl2 import default forwarding-class best-effort loss-priority low code-points [001 101]
```

8. Apply the classifiers to the appropriate interfaces.

```
[edit class-of-service]
user@switch# set interfaces xe-0/0/10 unit 0 classifiers ieee-802.1 fcoe-iscsi-cl1
user@switch# set interfaces xe-0/0/11 unit 0 classifiers ieee-802.1 iscsi-ptp-cl2
```

Verification

To verify that DCBX application protocol exchange configuration has been created and is operating properly, perform these tasks:

- Verifying the Application Configuration on page 5646
- Verifying the Application Map Configuration on page 5647
- Verifying DCBX Application Protocol Exchange Interface Configuration on page 5648
- Verifying the PFC Configuration on page 5648
- Verifying the Classifier Configuration on page 5649

Verifying the Application Configuration

Purpose Verify that DCBX applications have been configured.

Action List the applications by using the configuration mode command **show applications**:

```
user@switch# show applications
application iSCSI {
   protocol tcp;
   destination-port 3260;
}

application fcoe {
   ether-type 0x8906;
}

application ptp {
   ether-type 0x88F7;
}
```

Meaning The **show applications** configuration mode command lists all of the configured applications and either their protocol and destination port (Layer 4 applications) or their EtherType (Layer 2 applications). The command output shows that the iSCSI application is configured with the **tcp** protocol and destination port **3260**, the FCoE application is configured with the EtherType **0x8906**, and that the PTP application is configured with the EtherType **0x88F7**.

Verifying the Application Map Configuration

Purpose Verify that the application maps have been configured.

Action List the application maps by using the configuration mode command **show policy-options application-maps**:

```
user@switch# show policy-options application-maps
dcbx-iscsi-fcoe-app-map {
   application iSCSI code-points 111;
   application FCoE code-points 011;
}

dcbx-iscsi-ptp-app-map {
   application iSCSI code-points 111;
   application PTP code-points [001 101];
}
```

Meaning The **show policy-options application-maps** configuration mode command lists all of the configured application maps and the applications that belong to each application map. The command output shows that there are two application maps, **dcbx-iscsi-fcoe-app-map** and **dcbx-iscsi-ptp-app-map**.

The application map **dcbx-iscsi-fcoe-app-map** consists of the iSCSI application, which is mapped to IEEE 802.1p code point **111**, and the FCoE application, which is mapped to IEEE 802.1p code point **011**.

The application map **dcbx-iscsi-ptp-app-map** consists of the iSCSI application, which is mapped to IEEE 802.1p code point **111**, and the PTP application, which is mapped to IEEE 802.1p code points **001** and **101**.

Verifying DCBX Application Protocol Exchange Interface Configuration

Purpose Verify that the application maps have been applied to the correct interfaces.

Action List the application maps by using the configuration mode command **show protocols dcbx**:

```
user@switch# show protocols dcbx
interface xe-0/0/10.0 {
   application-map dcbx-iscsi-fcoe-app-map;
}

interface xe-0/0/11.0 {
   application-map dcbx-iscsi-ptp-app-map;
}
```

Meaning The **show protocols dcbx** configuration mode command lists whether the interfaces are enabled for DCBX and lists the application map applied to each interface. The command output shows that interfaces **xe-0/0/10.0** and **xe-0/0/11.0** are enabled for DCBX, and that interface **xe-0/0/10.0** uses application map **dcbx-iscsi-fcoe-app-map**, and interface **xe-0/0/11.0** uses application map **dcbx-iscsi-ptp-app-map**.

Verifying the PFC Configuration

Purpose Verify that PFC has been enabled on the FCoE code point and applied to the correct interface.

Action Display the PFC configuration to verify that PFC is enabled on the FCoE code point (**011**) in the congestion notification profile **fcoe-cnp** by using the configuration mode command **show class-of-service congestion-notification-profile**:

```
user@switch# show class-of-service congestion-notification-profile
fcoe-cnp {
    input {
        ieee-802.1 {
            code-point 011 {
                pfc;
            }
        }
    }
}
```

Display the class-of-service (CoS) interface information to verify that the correct interface has PFC enabled for the FCoE application by using the configuration mode command **show class-of-service interfaces**:

```
user@switch# show class-of-service interfaces
xe-0/0/10 {
    congestion-notification-profile fcoe-cnp;
}
```

NOTE: The sample output does not include all of the information this command can show. The output is abbreviated to focus on verifying the PFC configuration.

Meaning The **show class-of-service congestion-notification-profile** configuration mode command lists the configured congestion notification profiles. The command output shows that the congestion notification profile **fcoe-cnp** has been configured and has enabled PFC on the IEEE 802.1p code point **011** (the default FCoE code point).

The **show class-of-service interfaces** configuration mode command shows the interface CoS configuration. The command output shows that the congestion notification profile **fcoe-cnp**, which enables PFC on the FCoE code point, is applied to interface **xe-0/0/10**.

Verifying the Classifier Configuration

Purpose Verify that the classifiers have been configured and applied to the correct interfaces.

Action Display the classifier configuration by using the configuration mode command **show class-of-service**:

```
user@switch# show class-of-service
classifiers {
    ieee-802.1 fcoe-iscsi-cl1 {
        import default;
        forwarding-class network-control {
            loss-priority high code-points 111;
        }
        forwarding-class fcoe {
            loss-priority high code-points 011;
        }
    }
    ieee-802.1 iscsi-ptp-cl2 {
        import default;
        forwarding-class network-control {
            loss-priority low code-points 111;
        }
        forwarding-class best-effort {
            loss-priority low code-points [ 001 101 ];
        }
    }
}
interfaces {
    xe-0/0/10 {
        congestion-notification-profile fcoe-cnp;
        unit 0 {
            classifiers {
                ieee-802.1 fcoe-iscsi-cl1;
            }
        }
    }
    xe-0/0/11 {
        unit 0 {
            classifiers {
                ieee-802.1 iscsi-ptp-cl2;
            }
        }
    }
}
```


NOTE: The sample output does not include all of the information this command can show. The output is abbreviated to focus on verifying the classifier configuration.

Meaning

The **show class-of-service** configuration mode command lists the classifier and CoS interface configuration, as well as other information not shown in this example. The command output shows that there are two classifiers configured, **fcoe-iscsi-cl1** and **iscsi-ptp-cl2**.

Classifier **fcoe-iscsi-cl1** uses the **default** classifier as a template and edits the template as follows:

- The forwarding class **network-control** is set to a loss priority of **high** and is mapped to code point **111** (the code point mapped to the iSCSI application).
- The forwarding class **fcoe** is set to a loss priority of **high** and is mapped to code point **011** (the code point mapped by default to the FCoE application).

Classifier **iscsi-ptp-cl2** uses the **default** classifier as a template and edits the template as follows:

- The forwarding class **network-control** is set to a loss priority of **low** and is mapped to IEEE 802.1p code point **111** (the code point mapped to the iSCSI application).
- The forwarding class **best-effort** is set to a loss priority of **low** and is mapped to IEEE 802.1p code points **001** and **101** (the code points mapped by default to the PTP application).

The command output also shows that classifier **fcoe-iscsi-cl1** is mapped to interface **xe-0/0/10.0** and that classifier **iscsi-ptp-cl2** is mapped to interface **xe-0/0/11.0**.

Related Documentation

- Example: Configuring Unicast Classifiers on page 5495
- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082
- Configuring DCBX Autonegotiation on page 5076
- **show dcbx on page 5176**
- **show dcbx neighbors on page 5177**
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Using DCBX Protocol to Lower Costs*

Configuration Examples (QFX5100 Switches Only)

Example: Configuring PFC Across Layer 3 Interfaces

Priority-based flow control (PFC) helps ensure lossless transport across data center bridging interfaces by pausing incoming traffic when output queue buffers fill to a certain threshold. On a QFX5100 switch running the Enhanced Layer 2 Software (ELS) CLI, in addition to configuring PFC on Layer 2 (bridging) interfaces, you can configure PFC on traffic that traverses Layer 3 interfaces. This enables you to preserve the lossless characteristics that PFC provides on traffic, even when the traffic crosses Layer 3 interfaces that connect two Layer 2 networks.

Requirements

This example uses the following hardware and software components:

- Two Juniper Networks QFX5100 Switches
- Junos OS Release 13.2 or later for the QFX Series
- Two Ethernet hosts

Overview

On a network that uses two QFX5100 switches to connect hosts on two different Ethernet networks across a Layer 3 network, to configure PFC across the Layer 2 and Layer 3 interfaces, you must:

- Configure the Layer 2 and Layer 3 interfaces on the switches
- Configure VLANs to carry the traffic across the Layer 2 and Layer 3 networks
- Configure integrated routing and bridging (IRB) interfaces on the Layer 2 interfaces to move the Layer 2 VLAN traffic to Layer 3
- Configure and apply the appropriate classifiers to the interfaces
- Configure and apply congestion notification profiles (CNPs) on the interfaces to enable PFC on the traffic that you want to be lossless

NOTE: Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

- Configure lossless forwarding classes and hierarchical port scheduling (also known as enhanced transmission selection) on the interfaces

NOTE: PFC operates at the queue level, based on the IEEE 802.1p code point in the priority code point (PCP) field of the Ethernet frame header (sometimes known as the CoS bits). For this reason, traffic on Layer 3 interfaces on which you want to enable PFC must use an IEEE 802.1p classifier to map incoming traffic to forwarding classes (which are in turn mapped to output queues) and loss priorities. You cannot use a DSCP or DSCP IPv6 classifier to classify Layer 3 traffic if you want to enable PFC on traffic flows.

Topology

Figure 207 on page 5652 shows the topology for this example.

Figure 207: Enabling PFC Across Layer 3 Interface Hops

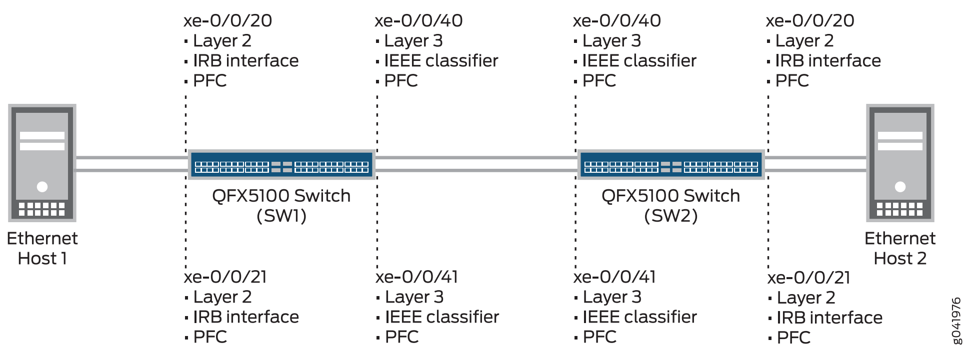


Table 519 on page 5652 shows the configuration components for this example. On the two QFX5100 switches, the Ethernet host-facing interfaces use the same interface names and configuration, and the Layer 3 network-facing interfaces use the same interface names and configuration.

Table 519: Components of the PFC Across Layer 3 Interfaces Topology

Component	Settings
Hardware	Two QFX5100 switches Two Ethernet hosts

Table 519: Components of the PFC Across Layer 3 Interfaces Topology *(continued)*

Component	Settings
Layer 3 interfaces (xe-0/0/40 and xe-0/0/41) and VLANs	Interface xe-0/0/40: • Interface family—inet • Interface IP address—100.103.1.2/24 • VLAN tagging—enabled • Interface VLAN ID—103 Interface xe-0/0/41: • Interface family—inet • Interface IP address—100.104.1.2/24 • VLAN tagging—enabled • Interface VLAN ID—104
Layer 2 interfaces (xe-0/0/20 and xe-0/0/21) and VLAN membership	Family: Ethernet switching Interface mode—trunk Interface xe-0/0/20 VLAN membership—vlan105 Interface xe-0/0/21 VLAN membership—vlan106
VLANs for the IRB interfaces	VLAN unit 105—family inet, IP address 100.105.1.1/24 VLAN unit 106—family inet, IP address 100.106.1.1/24
Layer 2 IRB interfaces	Interface xe-0/0/20: • IRB interface unit—105 • IRB interface family—inet • IRB interface IP address—100.105.1.1/24 • IRB interface VLAN ID—105 • Layer 3 interface name—irb.105 Interface xe-0/0/21: • IRB interface unit—106 • IRB interface family—inet • IRB interface IP address—100.106.1.1/24 • IRB interface VLAN ID—106 • Layer 3 interface name—irb.106

Table 519: Components of the PFC Across Layer 3 Interfaces Topology *(continued)*

Component	Settings
Forwarding classes (both switches)	Name—lossless-3 Queue mapping—queue 3 Packet drop attribute—no-loss Name—lossless-4 Queue mapping—queue 4 Packet drop attribute—no-loss NOTE: Matching the forwarding class names (lossless-*3* and lossless-*4*) to the queue number and to the classified IEEE 802.1p code point (priority) creates a configuration that is logical and easy to map because the forwarding class, queue, and priority all use the same number. Name—all-others Queue mapping—queue 0 Packet drop attribute—none NOTE: The forwarding class *all-others* is for best-effort traffic that traverses the interfaces.
Layer 2 interface behavior aggregate (BA) classifier	Name—lossless-3-4-ieee Forwarding class lossless-3—mapped to code point 011 (IEEE 802.1p priority 3) and a packet loss priority of low Forwarding class lossless-4—mapped to code point 100 (IEEE 802.1p priority 4) and a packet loss priority of low Apply the Layer 2 IEEE 802.1p classifier to both the Layer 2 and the Layer 3 interfaces (xe-0/0/20, xe-0/0/21, xe-0/040, and xe-0/0/41).
Congestion notification profile (PFC, both switches)	Name—lossless-cnp PFC enabled on IEEE 802.1p code points—011 (lossless-3 forwarding class and priority), 100 (lossless-4 forwarding class and priority) Apply the CNP to both the Layer 2 and the Layer 3 interfaces (xe-0/0/20, xe-0/0/21, xe-0/040, and xe-0/0/41) to enable PFC on IEEE 802.1p code points 011 and 100.

Table 519: Components of the PFC Across Layer 3 Interfaces Topology *(continued)*

Component	Settings
Hierarchical port scheduling (ETS)	Hierarchical port scheduling (ETS) includes configuring: • Schedulers to assign bandwidth to traffic • Scheduler mapping to forwarding classes • Grouping of the forwarding classes (priorities) in forwarding class sets (priority groups) • A traffic control profile to assign bandwidth to the forwarding class set and to associate the forwarding class set with the scheduler mapping Hierarchical port scheduling also includes applying the hierarchical scheduler (defined in the traffic control profile) to the interfaces. This example focuses on configuring PFC across the Layer 2 and Layer 3 interfaces. To maintain this focus, this example includes the CLI statements needed to configure hierarchical port scheduling, but does not include descriptive explanations of the configuration. The *Related Documentation* section provides links to example documents that show how to configure hierarchical port scheduling. Apply the scheduling configuration to both the Layer 2 and the Layer 3 interfaces (xe-0/0/20, xe-0/0/21, xe-0/040, and xe-0/0/41).

Configuration

CLI Quick Configuration

To configure PFC across Layer 3 interfaces, copy the following commands, paste them in a text file, remove the line breaks, change variables and details to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level. The same configuration applies to both QFX5100 Switch SW1 and QFX5100 Switch SW2:

```
set interfaces xe-0/0/40 vlan-tagging
set interfaces xe-0/0/40 unit 0 vlan-id 103
set interfaces xe-0/0/40 unit 0 family inet address 100.103.1.2/24
set interfaces xe-0/0/41 vlan-tagging
set interfaces xe-0/0/41 unit 0 vlan-id 104
set interfaces xe-0/0/41 unit 0 family inet address 100.104.1.2/24
set interfaces xe-0/0/20 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/20 unit 0 family ethernet-switching vlan members vlan105
set interfaces xe-0/0/21 unit 0 family ethernet-switching interface-mode trunk
set interfaces xe-0/0/21 unit 0 family ethernet-switching vlan members vlan106
set interfaces vlan unit 105 family inet address 100.105.1.1/24
set interfaces vlan unit 106 family inet address 100.106.1.1/24
set interfaces irb unit 105 family inet address 100.105.1.1/24
set interfaces irb unit 106 family inet address 100.106.1.1/24
set vlans vlan105 vlan-id 105
set vlans vlan106 vlan-id 106
set vlans vlan105 l3-interface irb.105
set vlans vlan106 l3-interface irb.106
```



```
set class-of-service forwarding-classes class lossless-3 queue-num 3 no-loss
set class-of-service forwarding-classes class lossless-4 queue-num 4 no-loss
set class-of-service forwarding-classes class all-others queue-num 0
set class-of-service classifiers ieee-802.1 lossless-3-4-ieee forwarding-class lossless-3 loss-priority low code-points 011
set class-of-service classifiers ieee-802.1 lossless-3-4-ieee forwarding-class lossless-4 loss-priority low code-points 100
set class-of-service congestion-notification-profile lossless-cnp input ieee-802.1 code-point 011 pfc
set class-of-service congestion-notification-profile lossless-cnp input ieee-802.1 code-point 100 pfc
set class-of-service schedulers lossless_sch transmit-rate 6g
set class-of-service schedulers lossless_sch shaping-rate percent 100
set class-of-service schedulers all-others_sch transmit-rate 4g
set class-of-service scheduler-maps lossless_map forwarding-class lossless-3 scheduler lossless_sch
set class-of-service scheduler-maps lossless_map forwarding-class lossless-4 scheduler lossless_sch
set class-of-service scheduler-maps all-others_map forwarding-class all-others scheduler all-others_sch
set class-of-service forwarding-class-sets lossless_fc_set class lossless-3
set class-of-service forwarding-class-sets lossless_fc_set class lossless-4
set class-of-service forwarding-class-sets all-others_fc_set class all-others
set class-of-service traffic-control-profiles lossless_tcp scheduler-map lossless_map
set class-of-service traffic-control-profiles lossless_tcp guaranteed-rate percent 60
set class-of-service traffic-control-profiles lossless_tcp shaping-rate percent 100
set class-of-service traffic-control-profiles all-others_tcp scheduler-map all-others_map
set class-of-service traffic-control-profiles all-others_tcp guaranteed-rate percent 40
set class-of-service interfaces xe-0/0/20 forwarding-class-set lossless_fc_set output-traffic-control-profile lossless_tcp
set class-of-service interfaces xe-0/0/20 forwarding-class-set all-others_fc_set output-traffic-control-profile all-others_tcp
set class-of-service interfaces xe-0/0/20 congestion-notification-profile lossless-cnp
set class-of-service interfaces xe-0/0/20 unit 0 classifiers ieee-802.1 lossless-3-4-ieee
set class-of-service interfaces xe-0/0/21 forwarding-class-set lossless_fc_set output-traffic-control-profile lossless_tcp
set class-of-service interfaces xe-0/0/21 forwarding-class-set all-others_fc_set output-traffic-control-profile all-others_tcp
set class-of-service interfaces xe-0/0/21 congestion-notification-profile lossless-cnp
set class-of-service interfaces xe-0/0/21 unit 0 classifiers ieee-802.1 lossless-3-4-ieee
set class-of-service interfaces xe-0/0/40 forwarding-class-set lossless_fc_set output-traffic-control-profile lossless_tcp
set class-of-service interfaces xe-0/0/40 forwarding-class-set all-others_fc_set output-traffic-control-profile all-others_tcp
set class-of-service interfaces xe-0/0/40 congestion-notification-profile lossless-cnp
set class-of-service interfaces xe-0/0/40 classifiers ieee-802.1 lossless-3-4-ieee
set class-of-service interfaces xe-0/0/41 forwarding-class-set lossless_fc_set output-traffic-control-profile lossless_tcp
set class-of-service interfaces xe-0/0/41 forwarding-class-set all-others_fc_set output-traffic-control-profile all-others_tcp
set class-of-service interfaces xe-0/0/41 congestion-notification-profile lossless-cnp
set class-of-service interfaces xe-0/0/41 classifiers ieee-802.1 lossless-3-4-ieee
```


Step-by-Step Procedure

Step-by-Step Procedure

The following step-by-step procedure shows you how to configure the interfaces, VLANs, lossless forwarding classes, classifiers, and PFC settings to enable PFC across Layer 3 interfaces. For completeness, the class-of-service scheduling configuration (hierarchical port scheduling) is included in the procedure, but without explanatory text. See the *Related Documentation* links for detailed examples of the scheduling elements of the configuration.

1. Configure the Layer 3 interface VLANs and IP addresses:

```
[edit interfaces]
user@switch# set xe-0/0/40 vlan-tagging
user@switch# set xe-0/0/40 unit 0 vlan-id 103
user@switch# set xe-0/0/40 unit 0 family inet address 100.103.1.2/24
user@switch# set xe-0/0/41 vlan-tagging
user@switch# set xe-0/0/41 unit 0 vlan-id 104
user@switch# set xe-0/0/41 unit 0 family inet address 100.104.1.2/24
```

2. Configure the Layer 2 interface VLAN membership and interface mode:

```
[edit interfaces]
user@switch# set xe-0/0/20 unit 0 family ethernet-switching interface-mode trunk
user@switch# set xe-0/0/20 unit 0 family ethernet-switching vlan members vlan105
user@switch# set xe-0/0/21 unit 0 family ethernet-switching interface-mode trunk
user@switch# set xe-0/0/21 unit 0 family ethernet-switching vlan members vlan106
```

3. Configure the VLANs for the IRB interfaces:

```
[edit interfaces]
user@switch# set vlan unit 105 family inet address 100.105.1.1/24
user@switch# set vlan unit 106 family inet address 100.106.1.1/24
```

4. Configure the IRB interfaces and VLANs to transport incoming Layer 2 traffic assigned to VLANs vlan105 (of which interface xe-0/0/20 is a member) and vlan106 (of which interface xe-0/0/21 is a member) across Layer 3:

```
[edit]
user@switch# set interfaces irb unit 105 family inet address 100.105.1.1/24
user@switch# set interfaces irb unit 106 family inet address 100.106.1.1/24
user@switch# set vlans vlan105 vlan-id 105
user@switch# set vlans vlan106 vlan-id 106
user@switch# set vlans vlan105 l3-interface irb.105
user@switch# set vlans vlan106 l3-interface irb.106
```

5. Configure the lossless forwarding classes and a best-effort forwarding class for any other traffic that might use the interfaces:

```
[edit class-of-service]
user@switch# set forwarding-classes class lossless-3 queue-num 3 no-loss
user@switch# set forwarding-classes class lossless-4 queue-num 4 no-loss
user@switch# set forwarding-classes class all-others queue-num 0
```

6. Configure the IEEE classifier for the Layer 2 and Layer 3 interfaces to classify incoming traffic into the lossless forwarding classes based on the IEEE 802.1p code point of the traffic:

```
[edit class-of-service classifiers]
user@switch# set ieee-802.1 lossless-3-4-ieee forwarding-class lossless-3 loss-priority low code-points 011
```

```
user@switch# set ieee-802.1 lossless-3-4-ieee forwarding-class lossless-4 loss-priority low code-points 100
```

7. Configure the CNP to enable PFC on the lossless priorities (the lossless forwarding classes mapped to IEEE 802.1p code points 3 and 4):

```
[edit class-of-service congestion-notification-profile]
user@switch# set lossless-cnp input ieee-802.1 code-point 011 pfc
user@switch# set lossless-cnp input ieee-802.1 code-point 100 pfc
```

8. Configure hierarchical scheduling to support the lossless configuration (included here for completeness; see the *Related Documentation* links for detailed examples of scheduling configuration) and apply it to the Layer 2 and Layer 3 interfaces:

```
[edit class-of-service]
set schedulers lossless_sch transmit-rate 6g
set schedulers lossless_sch shaping-rate percent 100
set schedulers all-others_sch transmit-rate 4g
set scheduler-maps lossless_map forwarding-class lossless-3 scheduler lossless_sch
set scheduler-maps lossless_map forwarding-class lossless-4 scheduler lossless_sch
set scheduler-maps all-others_map forwarding-class all-others scheduler all-others_sch
set forwarding-class-sets lossless_fc_set class lossless-3
set forwarding-class-sets lossless_fc_set class lossless-4
set forwarding-class-sets all-others_fc_set class all-others
set traffic-control-profiles lossless_tcp scheduler-map lossless_map
set traffic-control-profiles lossless_tcp guaranteed-rate percent 60
set traffic-control-profiles lossless_tcp shaping-rate percent 100
set traffic-control-profiles all-others_tcp scheduler-map all-others_map
set traffic-control-profiles all-others_tcp guaranteed-rate percent 40
set interfaces xe-0/0/20 forwarding-class-set lossless_fc_set output-traffic-control-profile lossless_tcp
set interfaces xe-0/0/20 forwarding-class-set all-others_fc_set output-traffic-control-profile all-others_tcp
set interfaces xe-0/0/21 forwarding-class-set lossless_fc_set output-traffic-control-profile lossless_tcp
set interfaces xe-0/0/21 forwarding-class-set all-others_fc_set output-traffic-control-profile all-others_tcp
set interfaces xe-0/0/40 forwarding-class-set lossless_fc_set output-traffic-control-profile lossless_tcp
set interfaces xe-0/0/40 forwarding-class-set all-others_fc_set output-traffic-control-profile all-others_tcp
set interfaces xe-0/0/41 forwarding-class-set lossless_fc_set output-traffic-control-profile lossless_tcp
set interfaces xe-0/0/41 forwarding-class-set all-others_fc_set output-traffic-control-profile all-others_tcp
```

9. Apply the Layer 2 IEEE 802.1p classifier and the CNP to the Layer 3 interfaces:

```
[edit class-of-service interfaces]
user@switch# set xe-0/0/40 classifiers ieee-802.1 lossless-3-4-ieee
user@switch# set xe-0/0/40 congestion-notification-profile lossless-cnp
user@switch# set xe-0/0/41 classifiers ieee-802.1 lossless-3-4-ieee
user@switch# set xe-0/0/41 congestion-notification-profile lossless-cnp
```

10. Apply the Layer 2 IEEE 802.1p classifier and the CNP to the Layer 2 interfaces:

```
[edit class-of-service interfaces]
user@switch# xe-0/0/20 unit 0 classifiers ieee-802.1 lossless-3-4-ieee
user@switch# xe-0/0/20 congestion-notification-profile lossless-cnp
user@switch# xe-0/0/21 unit 0 classifiers ieee-802.1 lossless-3-4-ieee
user@switch# xe-0/0/21 congestion-notification-profile lossless-cnp
```

Results

Display the results of the interface, VLAN, and class-of-service configurations (the system shows only the explicitly configured parameters; it does not show default parameters). The results are valid for both QFX5100 Switch SW1 and QFX5100 Switch SW2 because the same configuration is used on both switches.

Display the results of the interface configuration:

```
user@switch# show configuration interfaces
xe-0/0/20 {
    unit 0 {
        family ethernet-switching {
            interface-mode trunk;
            vlan {
                members vlan105;
            }
        }
    }
}
xe-0/0/21 {
    unit 0 {
        family ethernet-switching {
            interface-mode trunk;
            vlan {
                members vlan106;
            }
        }
    }
}
xe-0/0/40 {
    vlan-tagging;
    unit 0 {
        vlan-id 103;
        family inet {
            address 100.103.1.2/24;
        }
    }
}
xe-0/0/41 {
    vlan-tagging;
    unit 0 {
        vlan-id 104;
        family inet {
            address 100.104.1.2/24;
        }
    }
}
irb {
    unit 105 {
        family inet {
            address 100.105.1.1/24;
        }
    }
    unit 106 {
        family inet {
            address 100.106.1.1/24;
        }
    }
}
```

```
vlan {
    unit 105 {
        family inet {
            address 100.105.1.1/24;
        }
    }
    unit 106 {
        family inet {
            address 100.106.1.1/24;
        }
    }
}
```

Display the results of the vlan configuration:

```
user@switch# show configuration vlans
vlan105 {
    vlan-id 105;
    l3-interface irb.105;
}
vlan106 {
    vlan-id 106;
    l3-interface irb.106;
}
```

Display the results of the class-of-service configuration:

```
user@switch# show configuration class-of-service
classifiers {
    ieee-802.1 lossless-3-4-ieee {
        forwarding-class lossless-3 {
            loss-priority low code-points 011;
        }
        forwarding-class lossless-4 {
            loss-priority low code-points 100;
        }
    }
}
forwarding-classes {
    class lossless-3 queue-num 3 no-loss;
    class lossless-4 queue-num 4 no-loss;
    class all-others queue-num 0;
}
traffic-control-profiles {
    lossless_tcp {
        scheduler-map lossless_map;
        shaping-rate percent 100;
        guaranteed-rate percent 60;
    }
    all-others_tcp {
        scheduler-map all-others_map;
        guaranteed-rate percent 40;
    }
}
forwarding-class-sets {
    lossless_fc_set {
        class lossless-3;
        class lossless-4;
    }
    all-others_fc_set {
```



```
        class all-others;
    }
}
congestion-notification-profile {
    lossless-cnp {
        input {
            ieee-802.1 {
                code-point 011 {
                    pfc;
                }
                code-point 100 {
                    pfc;
                }
            }
        }
    }
}
interfaces {
    xe-0/0/20 {
        forwarding-class-set {
            lossless_fc_set {
                output-traffic-control-profile lossless_tcp;
            }
            all-others_fc_set {
                output-traffic-control-profile all-others_tcp;
            }
        }
        congestion-notification-profile lossless-cnp;
        unit 0 {
            classifiers {
                ieee-802.1 lossless-3-4-ieee;
            }
        }
    }
    xe-0/0/21 {
        forwarding-class-set {
            all-others_fc_set {
                output-traffic-control-profile all-others_tcp;
            }
            lossless_fc_set {
                output-traffic-control-profile lossless_tcp;
            }
        }
        congestion-notification-profile lossless-cnp;
        unit 0 {
            classifiers {
                ieee-802.1 lossless-3-4-ieee;
            }
        }
    }
    xe-0/0/40 {
        forwarding-class-set {
            lossless_fc_set {
                output-traffic-control-profile lossless_tcp;
            }
            all-others_fc_set {
                output-traffic-control-profile all-others_tcp;
            }
        }
        congestion-notification-profile lossless-cnp;
        classifiers {
```

```
                ieee-802.1 lossless-3-4-ieee;
            }
        }
        xe-0/0/41 {
            forwarding-class-set {
                lossless_fc_set {
                    output-traffic-control-profile lossless_tcp;
                }
                all-others_fc_set {
                    output-traffic-control-profile all-others_tcp;
                }
            }
            congestion-notification-profile lossless-cnp;
            classifiers {
                ieee-802.1 lossless-3-4-ieee;
            }
        }
    }
    scheduler-maps {
        lossless_map {
            forwarding-class lossless-3 scheduler lossless_sch;
            forwarding-class lossless-4 scheduler lossless_sch;
        }
        all-others_map {
            forwarding-class all-others scheduler all-others_sch;
        }
    }
    schedulers {
        lossless_sch {
            transmit-rate 6g;
            shaping-rate percent 100;
        }
        all-others_sch {
            transmit-rate 4g;
        }
    }
```

TIP: To quickly configure the switch, issue the **load merge terminal** command, and then copy the hierarchies and paste them into the switch terminal window.

Verification

To verify that the PFC across Layer 3 interfaces configuration has been created and is operating properly, perform these tasks:

- Verifying the Interface Configuration on page 5663
- Verifying the VLAN Configuration on page 5665
- Verifying the PFC Configuration (Congestion Notification Profile) on page 5665
- Verify the Forwarding Class Configuration on page 5666

Verifying the Interface Configuration

Purpose Verify that the Layer 2 Ethernet interfaces, Layer 3 IP interfaces, IRB interfaces, and VLAN interfaces have been created on the switch and are correctly configured.

Action Display the switch interface configuration using the **show configuration interfaces** command:

```
user@switch> show configuration interfaces
xe-0/0/20 {
    unit 0 {
        family ethernet-switching {
            interface-mode trunk;
            vlan {
                members vlan105;
            }
        }
    }
}
xe-0/0/21 {
    unit 0 {
        family ethernet-switching {
            interface-mode trunk;
            vlan {
                members vlan106;
            }
        }
    }
}
xe-0/0/40 {
    vlan-tagging;
    unit 0 {
        vlan-id 103;
        family inet {
            address 100.103.1.2/24;
        }
    }
}
xe-0/0/41 {
    vlan-tagging;
    unit 0 {
        vlan-id 104;
        family inet {
            address 100.104.1.2/24;
        }
    }
}
irb {
    unit 105 {
        family inet {
            address 100.105.1.1/24;
        }
    }
    unit 106 {
        family inet {
            address 100.106.1.1/24;
        }
    }
}
vlan {
    unit 105 {
        family inet {
            address 100.105.1.1/24;
        }
    }
```



```
        unit 106 {
            family inet {
                address 100.106.1.1/24;
            }
        }
    }
```

Meaning The **show configuration interfaces** command displays all of the interfaces configured on the switch. The command output shows that:

- Interfaces xe-0/0/20 and xe-0/0/21 are Ethernet interfaces (family ethernet-switching) in trunk interface mode. Interface xe-0/0/20 is a member of VLAN vlan105, and interface xe-0/0/21 is a member of VLAN vlan106.
- Interfaces xe-0/0/40 and xe-0/0/41 are IP interfaces (family inet) with VLAN tagging enabled. Interface xe-0/0/40 has an IP address of 100.103.1.2/24 and a VLAN ID of 103. Interface xe-0/0/41 has an IP address of 100.104.1.2/24 and a VLAN ID of 104.
- Two IRB interfaces are configured, IRB unit 105 with an IP address of 100.105.1.1/24 and IRB unit 106 with an IP address of 100.106.1.1/24.
- Two VLAN interfaces are configured, VLAN unit 105 with an IP address of 100.105.1.1/24 (for IRB interface unit 105) and VLAN unit 106 with an IP address of 100.106.1.1/24 (for IRB interface unit 106).

Verifying the VLAN Configuration

Purpose Verify that VLANs have been created on the switch and are correctly configured.

Action Display the VLAN configuration using the **show configuration vlans** command:

```
user@switch> show configuration vlans
vlan105 {
    vlan-id 105;
    l3-interface irb.105;
}
vlan106 {
    vlan-id 106;
    l3-interface irb.106;
}
```

Meaning The **show configuration vlans** command displays all of the VLANs configured on the switch. The command output shows that:

- VLAN vlan105 has been configured with VLAN ID 105 on IRB interface irb.105.
- VLAN vlan106 has been configured with VLAN ID 106 on IRB interface irb.106.

Verifying the PFC Configuration (Congestion Notification Profile)

Purpose Verify that PFC has been enabled on the correct IEEE 802.1p code points (priorities) in the CNP.

Action Display the PFC configuration using the **show configuration class-of-service congestion-notification-profile** command:

```
user@switch> show configuration class-of-service congestion-notification-profile
lossless-cnp {
    input {
        ieee-802.1 {
            code-point 011 {
                pfc;
            }
            code-point 100 {
                pfc;
            }
        }
    }
}
```

Meaning The **show configuration class-of-service congestion-notification-profile** command displays all of the CNPs configured on the switch. The command output shows that:

- The CNP named **lossless-cnp** is configured on the switch.
- The CNP **lossless-cnp** enables PFC on IEEE 802.1p code points 100 and 100.

Verify the Forwarding Class Configuration

Purpose Verify that the two lossless forwarding classes and the best-effort forwarding class have been configured on the switch.

Action Display the forwarding class configuration using the **show configuration class-of-service forwarding-classes** command:

```
user@switch> show configuration class-of-service forwarding-classes
class lossless-3 queue-num 3 no-loss;
class lossless-4 queue-num 4 no-loss;
class all-others queue-num 0;
```

Meaning The **show configuration class-of-service forwarding-classes** command displays all of the forwarding classes configured on the switch (default forwarding classes are not displayed). The command output shows that:

- Forwarding class **lossless-3** is mapped to queue 3 and is configured as a lossless forwarding class (the **no-loss** attribute is applied)
- Forwarding class **lossless-4** is mapped to queue 4 and is configured as a lossless forwarding class (the **no-loss** attribute is applied)
- Forwarding class **all-others** is mapped to queue 0. It is not a lossless forwarding class (the **no-loss** attribute is not applied).

Verifying the Classifier Configuration

Purpose Verify that the IEEE 802.1p classifier has been configured on the switch.

Action Display the classifier configuration using the **show configuration class-of-service classifiers** command:

```
user@switch> show configuration class-of-service classifiers
ieee-802.1 lossless-3-4-ieee {
    forwarding-class lossless-3 {
        loss-priority low code-points 011;
    }
    forwarding-class lossless-4 {
        loss-priority low code-points 100;
    }
}
```

Meaning The **show configuration class-of-service classifiers** command displays all of the classifiers configured on the switch. The command output shows that the Layer 2 IEEE 802.1p classifier **lossless-3-4-ieee** classifiers traffic with the code point 011 into the **lossless-3** forwarding class with a loss priority of **low**, and classifies traffic with the code point 100 into the **lossless-4** forwarding class with a loss priority of **low**.

Verifying the Interface CoS Configuration (Hierarchical Scheduling, PFC, and Classifier Mapping to Interfaces)

Purpose Verify that the interfaces have the correct hierarchical scheduling, PFC, and classifier configurations.

Action Display the interface CoS configuration using the **show configuration class-of-service interfaces** command:

```
user@switch> show configuration class-of-service interfaces
xe-0/0/20 {
    forwarding-class-set {
        lossless_fc_set {
            output-traffic-control-profile lossless_tcp;
        }
        all-others_fc_set {
            output-traffic-control-profile all-others_tcp;
        }
    }
    congestion-notification-profile lossless-cnp;
    unit 0 {
        classifiers {
            ieee-802.1 lossless-3-4-ieee;
        }
    }
}
xe-0/0/21 {
    forwarding-class-set {
        all-others_fc_set {
            output-traffic-control-profile all-others_tcp;
        }
        lossless_fc_set {
            output-traffic-control-profile lossless_tcp;
        }
    }
    congestion-notification-profile lossless-cnp;
    unit 0 {
        classifiers {
            ieee-802.1 lossless-3-4-ieee;
        }
    }
}
xe-0/0/40 {
    forwarding-class-set {
        lossless_fc_set {
            output-traffic-control-profile lossless_tcp;
        }
        all-others_fc_set {
            output-traffic-control-profile all-others_tcp;
        }
    }
    congestion-notification-profile lossless-cnp;
    classifiers {
        ieee-802.1 lossless-3-4-ieee;
    }
}
xe-0/0/41 {
    forwarding-class-set {
        lossless_fc_set {
            output-traffic-control-profile lossless_tcp;
        }
        all-others_fc_set {
            output-traffic-control-profile all-others_tcp;
        }
    }
    congestion-notification-profile lossless-cnp;
```



```
    classifiers {
        ieee-802.1 lossless-3-4-ieee;
    }
}
```

Meaning The **show configuration class-of-service interfaces** command displays all of the CoS components configured on the switch interfaces. The command output shows that:

- The configuration on Layer 2 Ethernet interfaces xe-0/0/20 and xe-0/0/21 includes:
  - Hierarchical scheduling—The forwarding class set **lossless_fc_set** with the traffic control profile **lossless_tcp** for the lossless traffic, and the forwarding class set **all-others_fc_set** with the traffic control profile **all-others_tcp** for the best-effort traffic are applied to both interfaces.
  - PFC—The **lossless-cnp** congestion notification profile is applied to both interfaces.
  - Classifiers—The Layer 2 IEEE 802.1p classifier **lossless-3-4-ieee** is applied to both interfaces.
- The configuration on Layer 3 IP interfaces xe-0/0/40 and xe-0/0/41 includes:
  - Hierarchical scheduling—The forwarding class set **lossless_fc_set** with the traffic control profile **lossless_tcp** for the lossless traffic, and the forwarding class set **all-others_fc_set** with the traffic control profile **all-others_tcp** for the best-effort traffic are applied to both interfaces.
  - PFC—The **lossless-cnp** congestion notification profile is applied to both interfaces.
  - Classifiers—The Layer 2 IEEE 802.1p classifier **lossless-3-4-ieee** is applied to both interfaces. Traffic that would use a DSCP or a DSCP IPv6 classifier if it were configured uses the IEEE 802.1p classifier instead. Using the IEEE 802.1p classifier allows the interface to use PFC to pause traffic during periods of congestion to prevent packet loss.

Related Documentation

- Understanding PFC Functionality Across Layer 3 Interfaces on page 5465
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Unicast Classifiers on page 5495
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Forwarding Classes on page 5505
- Example: Configuring Forwarding Class Sets on page 5508
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519

Configuration Tasks

Configuring CoS

The class-of-service topics describe how to configure the Junos CoS components for the QFX Series. You can configure forwarding classes for transmitting packets, define which packets are placed into each output queue, and schedule the transmission service level for each queue. After defining the CoS components, you assign classifiers to the required physical and logical interfaces.

You can configure various CoS components individually or in combination to define CoS services.

NOTE: **When you change or when you deactivate and then reactivate the class-of-service configuration, the system experiences packet drops because the system momentarily blocks traffic to change the mapping of incoming traffic to input queues.**

The following topics describe how to configure CoS components :

- Example: Configuring Unicast Classifiers on page 5495
- Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers on page 5498
- Example: Configuring Tail-Drop Profiles on page 5501
- Example: Configuring Drop Profile Maps on page 5503
- Example: Configuring Forwarding Classes on page 5505

- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082

Defining CoS Code-Point Aliases

You can use code-point aliases to streamline the process of configuring CoS features on your switch. A code-point alias assigns a name to a pattern of code-point bits. You can use this name instead of the bit pattern when you configure other CoS components such as classifiers, drop-profile maps, and rewrite rules.

You can configure code-point aliases for the following CoS marker types:

- DSCP or DSCP IPv6—Handles incoming IPv4 or IPv6 packets.
- IEEE 802.1p—Handles Layer 2 CoS.

To configure a code-point alias:

1. Specify a CoS marker type (IEEE 802.1 or DSCP).
2. Assign an alias.
3. Specify the code point that corresponds to the alias.

```
[edit class-of-service code-point-aliases]
user@switch# set (dscp | dscp-ipv6 | ieee-802.1) alias-name code-point-bits
```

For example, to configure a code-point alias for an IEEE 802.1 CoS marker type that has the alias name fcoe1 and maps to the code-point bits 011:

```
[edit class-of-service code-point-aliases]
user@switch# set ieee-802.1 fcoe1 011
```

Related Documentation

- Monitoring CoS Value Aliases on page 5814
- Understanding CoS Code-Point Aliases on page 5332

Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p)

Packet classification associates incoming packets with a particular CoS servicing level. Behavior aggregate (BA) classifiers examine the Differentiated Services code point (DSCP or DSCP IPv6) value, the IEEE 802.1p CoS value, or the MPLS EXP value in the packet header to determine the CoS settings applied to the packet. (See "Configuring a Global MPLS EXP Classifier" on page 3782 for how to define EXP classifiers for MPLS traffic.) BA classifiers allow you to set the forwarding class and loss priority of a packet based on the incoming CoS value.

Unicast traffic must use different classifiers than multidestination (mulitcast, broadcast, and destination lookup fail) traffic.

To configure a unicast DSCP, DSCP IPv6, or IEEE 802.1p BA classifier using the CLI:

1. Create a unicast BA classifier:

   - To create a unicast DSCP, DSCP IPv6, or IEEE 802.1p BA classifier based on the default classifier, import the default DSCP, DSCP IPv6, or IEEE 802.1p classifier and associate it with a forwarding class, a loss priority, and a code point:

     `[edit class-of-service classifiers]`
     `user@switch#` **set (dscp | ieee-802.1)** ***classifier-name*** **import default forwarding-class** ***forwarding-class-name*** **loss-priority** ***level*** **code-points [*aliases*] [*bit-patterns*]**

   - To create a unicast BA classifier that is not based on the default classifier, create a DSCP, DSCP IPv6, or IEEE 802.1p classifier and associate it with a forwarding class, a loss priority, and a code point:

     `[edit class-of-service classifiers]`
     `user@switch#` **set (dscp | ieee-802.1)** ***classifier-name*** **forwarding-class** ***forwarding-class-name*** **loss-priority** ***level*** **code-points [*aliases*] [*bit-patterns*]**

2. Apply the unicast classifier to a specific 10-Gigabit Ethernet interface or to all 10-Gigabit Ethernet interfaces or to all Fibre Channel interfaces on the switch.

   - To apply the classifier to a specific interface:

     `[edit class-of-service interfaces]`
     `user@switch#` **set** ***interface-name*** **unit** ***unit*** **classifiers (dscp | ieee-802.1)** ***classifier-name***

   - To apply the classifier to all 10-Gigabit Ethernet interfaces on the switch, use wildcards for the interface name and the logical-interface (unit) number:

     `[edit class-of-service interfaces]`
     `user@switch#` **set xe-* unit * classifiers (dscp | ieee-802.1)** ***classifier-name***

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Unicast Classifiers on page 5495
- Defining CoS Multidestination (Multicast, Broadcast, DLF) BA Classifiers on page 5675
- Configuring a Global MPLS EXP Classifier on page 3782
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Monitoring CoS Classifiers on page 5809

- Understanding CoS Classifiers on page 5334
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

Configuring a Global MPLS EXP Classifier

EXP packet classification associates incoming packets with a particular MPLS CoS servicing level. EXP behavior aggregate (BA) classifiers examine the MPLS EXP value in the packet header to determine the CoS settings applied to the packet. EXP BA classifiers allow you to set the forwarding class and loss priority of an MPLS packet based on the incoming CoS value.

You can configure as many EXP classifiers as you want, however, the switch uses only one MPLS EXP classifier as a global classifier on all interfaces. All switch interfaces use the global EXP classifier to classify MPLS traffic.

If an EXP classifier is configured, MPLS traffic uses the EXP classifier. If an EXP classifier is not configured, then if a fixed classifier is applied to the interface, the MPLS traffic uses the fixed classifier. If no EXP classifier and no fixed classifier is applied to the interface, MPLS traffic is treated as best-effort traffic. DSCP classifiers are not applied to MPLS traffic.

NOTE: There is no default MPLS EXP classifier. If you want to use an MPLS EXP classifier, you must configure it. The MPLS EXP classifier is global and applies to all interfaces on the switch that transport MPLS traffic. You can configure as many MPLS EXP classifiers as you want, but you can only use one MPLS EXP classifier on switch interfaces at any time.

To configure a unicast MPLS EXP classifier using the CLI:

1. Create an EXP classifier and associate it with a forwarding class, a loss priority, and a code point:

   [edit class-of-service classifiers]
   user@switch# **set (dscp | ieee-802.1 | exp)** ***classifier-name*** **forwarding-class** ***forwarding-class-name*** **loss-priority** ***level*** **code-points [*aliases*] [*bit-patterns*]**
2. Apply the EXP classifier to the switch interfaces:

   [edit class-of-service]
   user@switch# **set system-defaults classifiers exp** ***classifier-name***

Related Documentation

- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344
- Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 5673
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783

Defining CoS Multidestination (Multicast, Broadcast, DLF) BA Classifiers

Packet classification associates incoming packets with a particular CoS servicing level. Behavior aggregate (BA) classifiers examine the Differentiated Services code point (DSCP) value or IEEE 802.1p CoS value in the packet header to determine the CoS settings applied to the packet. BA classifiers allow you to set the forwarding class and loss priority of a packet based on the incoming CoS value.

NOTE: **DSCP IPv6 multidestination classifiers are not supported. IPv6 multidestination traffic uses the DSCP multidestination classifier.**

Multidestination classifiers apply to all of the switch interfaces and handle multicast, broadcast, and destination lookup fail (DLF) traffic. You cannot apply a multidestination classifier to a single interface or to a range of interfaces.

Unicast and multidestination traffic must use different classifiers.

To configure a multidestination BA classifier using the CLI:

1. Create a DSCP or IEEE 802.1p classifier and associate it with a forwarding class, a loss priority, and a code point:

   ```
   [edit class-of-service classifiers]
   user@switch# set (dscp | ieee-802.1) classifier-name forwarding-class forwarding-class-name loss-priority level code-points [aliases] [bit-patterns]
   ```
2. Configure the classifier as a multidestination classifier:

   ```
   [edit class-of-service]
   user@switch# set multi-destination classifiers (dscp | ieee-802.1) classifier-name
   ```

Related Documentation

- Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers on page 5498
- Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 5673
- Monitoring CoS Classifiers on page 5809
- Understanding CoS Classifiers on page 5334
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

Configuring CoS Tail-Drop Profiles

You can configure an interpolated weighted random early detection (WRED) tail-drop profile to control packet drop characteristics for different traffic loss priorities.

NOTE: You cannot enable WRED on multidestination (multicast) queues. You can enable WRED only on unicast queues.

Also, do not enable WRED on lossless traffic flows. Use priority-based flow control (PFC) to prevent packet loss on lossless forwarding classes.

Interpolated means that the switch creates a smooth drop curve from a drop start point to a drop end point, with a maximum drop rate that is reached at the drop end point.

The drop start point is the average queue fill level when the WRED algorithm starts to drop packets. Before the drop start point, no packets are scheduled to drop. Specify the drop start point using the first of two **fill-level** statements.

The drop end point is the average queue fill level at which all subsequently arriving packets are dropped. When the queue fill levels falls below the drop end point, packets begin to be forwarded again. (At the drop end point, the packet drop probability becomes 100 percent.) Specify the drop end point using the second of two **fill-level** statements.

The minimum drop rate is always **0**. Specify the minimum drop rate using the first of two **drop-probability** statements. The maximum drop rate is the drop probability when the average queue fill level reaches the drop end point. Specify the maximum drop rate using the second of two **drop-probability** statements.

The drop rate is zero until the queue fill level reaches the drop start point. As the queue continues to fill, packets drop in smooth linear curve until the queue reaches the drop end point, when packets drop at the maximum drop rate. If the queue fills beyond the drop end point, all packets that match the drop profile are dropped.

To configure a tail-drop profile using the CLI:

- Name the drop profile and set the drop start point, drop end point, minimum drop rate, and maximum drop rate for the drop profile:

  `[edit class-of-service]`
  `user@switch#` **set drop-profile** ***drop-profile-name*** **interpolate fill-level** ***percentage*** **fill-level** ***percentage*** **drop-probability 0 drop-probability** ***percentage***

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Tail-Drop Profiles on page 5501
- Defining CoS Queue Schedulers on page 5679
- Configuring CoS Drop Profile Maps on page 5677
- Understanding CoS Tail-Drop Profiles on page 5409

Configuring CoS Drop Profile Maps

A drop-profile map associates a tail-drop profile for traffic of a specified loss priority with a scheduler. When you use a scheduler map to map a scheduler to a forwarding class, the drop profile map associated with the scheduler applies the specified tail-drop profile to traffic in the forwarding class that matches the specified loss priority.

Drop profile maps enable you to configure different drop profiles for traffic of different loss priorities within the same scheduler. You can associate different drop profiles with low-priority, medium-high priority, and high-priority traffic within a single scheduler, and then map that scheduler to a forwarding class. This applies the appropriate drop profile to traffic of each loss priority in a forwarding class. Drop profile maps apply to all traffic protocols.

To configure a drop-profile map using the CLI:

- For the desired scheduler, configure the traffic loss priority and specify the drop profile you want to use to control the drop characteristics for traffic of that loss priority:

  `[edit class-of-service]`
  `user@switch#` **set schedulers *scheduler-name* drop-profile-map loss-priority *level* protocol any drop-profile *drop-profile-name***

Related Documentation

- Example: Configuring Drop Profile Maps on page 5503
- Configuring CoS Tail-Drop Profiles on page 5676
- Defining CoS Queue Schedulers on page 5679
- Understanding CoS Tail-Drop Profiles on page 5409

Defining CoS Forwarding Classes

Forwarding classes allow you to group packets for transmission. The switch supports a total of 12 forwarding classes. In order to forward traffic, you map (assign) the forwarding classes to unicast or multidestination (multicast, broadcast, and destination lookup fail) output queues.

The switch has 12 output queues. Queues 0 through 7 are for unicast traffic and queues 8 through 11 are for multicast traffic. Forwarding classes mapped to unicast queues must carry unicast traffic, and forwarding classes mapped to multidestination queues must carry multidestination traffic. There are four default unicast forwarding classes and one default multidestination forwarding class.

The default unicast forwarding classes are:

- **best-effort**—Best-effort traffic
- **fcoe**—Guaranteed delivery for FCoE traffic
- **no-loss**—Guaranteed delivery for TCP no-loss traffic
- **network-control**—Network control traffic

The default multidestination forwarding class is:

- **mcast**—Multidestination traffic

Map forwarding classes to queues using the **class** statement, which enables you to configure up to 12 forwarding classes. You can map more than one forwarding class to a single queue, but all forwarding classes mapped to a particular queue must be of the same type, either unicast or multicast. In addition, all forwarding classes mapped to a particular queue must be either lossless or lossy. You cannot mix lossless and lossy forwarding classes (traffic) on the same queue. Also, you cannot mix unicast and multicast forwarding classes on the same queue.

```
[edit class-of-service forwarding-classes]
user@switch# class class-name queue-num queue-number <no-loss>
```

NOTE: If you are using Junos OS Release 12.2 or later, use the default forwarding-class-to-queue mapping for the lossless **fcoe** and **no-loss** forwarding classes. If you explicitly configure the lossless forwarding classes, the traffic mapped to those forwarding classes is treated as lossy (**best-effort**) traffic and does *not* receive lossless treatment unless you include the optional **no-loss** packet drop attribute introduced in Junos OS Release 12.3 in the forwarding class configuration..

NOTE: Junos OS Release 11.3R1 and earlier supported an alternate method of mapping forwarding classes to queues that allowed you to map only one forwarding class to a queue using the statement:

```
[edit class-of-service forwarding-classes]
user@switch# queue queue-number class-name
```

The **queue** statement has been deprecated and is no longer valid in Junos OS Release 11.3R2 and later. If you have a configuration that uses the **queue** statement to map forwarding classes to queues, edit the configuration to replace the **queue** statement with the **class** statement.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Forwarding Classes on page 5505
- Monitoring CoS Forwarding Classes on page 5810
- Understanding CoS Forwarding Classes on page 5354

Defining CoS Forwarding Class Sets

A forwarding class set is a priority group for enhanced transmission selection (ETS) traffic control. Each forwarding class set consists of one or more forwarding classes (priorities, which can also be considered as output queues).

You can configure up to three unicast forwarding class sets and one multicast forwarding class set.

To configure a forwarding class set using the CLI:

1. Assign one or more forwarding classes to the forwarding class set:

   `[edit class-of-service]`
   `user@switch#` **set forwarding-class-sets** ***forwarding-class-set-name*** **class** ***forwarding-class-name***

2. Map the forwarding class set to an interface:

   `[edit class-of-service]`
   `user@switch#` **set interfaces** ***interface-name*** **forwarding-class-set** ***forwarding-class-set-name***

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Forwarding Class Sets on page 5508
- Defining CoS Queue Schedulers on page 5679
- Defining CoS Traffic Control Profiles (Priority Group Scheduling) on page 5684
- Understanding CoS Forwarding Class Sets (Priority Groups) on page 5359

Defining CoS Queue Schedulers

Schedulers define the CoS properties of output queues. These properties include the amount of interface bandwidth assigned to the queue, the priority of the queue, the tail-drop profiles associated with the queue, and the queue buffer size.

The parameters you configure in a scheduler define the following characteristics for the queues mapped to the scheduler:

- **transmit-rate**—Minimum bandwidth, also known as the committed information rate (CIR), set as a percentage rate or as an absolute value in bits per second. The transmit rate also determines the amount of excess (extra) priority group bandwidth that the queue can share. Extra priority group bandwidth is allocated among the queues in the priority group in proportion to the transmit rate of each queue.

  NOTE: **Include the preamble bytes and interframe gap (IFG) bytes as well as the data bytes in your bandwidth calculations.**

  NOTE: **You cannot configure a transmit rate for strict-high priority queues. Queues (forwarding classes) with a configured transmit rate cannot be included in a forwarding class set that has strict-high priority queues.**

- **shaping-rate**—Maximum bandwidth, also known as the peak information rate (PIR), set as a percentage rate or as an absolute value in bits per second.

  NOTE: **Include the preamble bytes and interframe gap (IFG) bytes as well as the data bytes in your bandwidth calculations.**

- **priority**—One of two bandwidth priorities that queues associated with a scheduler can receive:
  - **low**—The scheduler has low priority.
  - **strict-high**—The scheduler has strict-high priority. You can configure only one queue as a strict-high priority queue. Strict-high priority allocates the scheduled bandwidth to the queue before any other queue receives bandwidth. Other queues receive the bandwidth that remains after the strict-high queue has been serviced.
- **drop-profile-map**—Drop profile mapping to a loss priority and protocol to apply WRED to the scheduler.
- **buffer-size**—Size of the queue buffer as a percentage of the dedicated buffer space on the port, or as a proportional share of the dedicated buffer space on the port that remains after the explicitly configured queues are served.

NOTE: Ingress port congestion can occur during periods of egress port congestion if an ingress port forwards traffic to more than one egress port, and at least one of those egress ports experiences congestion. If this occurs, the congested egress port can cause the ingress port to exceed its fair allocation of ingress buffer resources. When the ingress port exceeds its buffer resource allocation, frames are dropped at the ingress. Ingress port frame drop affects not only the congested egress ports, but also all of the egress ports to which the congested ingress port forwards traffic.

If a congested ingress port drops traffic that is destined for one or more uncongested egress ports, configure a weighted random early detection (WRED) drop profile and apply it to the egress queue that is causing the congestion. The drop profile prevents the congested egress queue from affecting egress queues on other ports by dropping frames at the egress instead of causing congestion at the ingress port.

NOTE: Do not configure drop profiles for the fcoe and no-loss forwarding classes. FCoE and other lossless traffic queues require lossless behavior. Use priority-based flow control (PFC) to prevent frame drop on lossless priorities.

To apply scheduling properties to traffic, map schedulers to forwarding classes using a scheduler map, and then associate the scheduler map with the interfaces. This applies the configured scheduling to the traffic in the specified forwarding class on the associated interface. Using different scheduler maps, you can map different schedulers to the same traffic (the same forwarding class) to apply different scheduling to that traffic on different interfaces.

To configure a scheduler using the CLI:

1. Name the scheduler and define the minimum guaranteed bandwidth for the queue:

   `[edit class-of-service]`
   `user@switch#` **set schedulers *scheduler-name* transmit-rate (*rate* | percent *percentage*)**

2. Define the maximum bandwidth for the queue:

   `[edit class-of-service schedulers scheduler-name]`
   `user@switch#` **set shaping-rate (*rate* | percent *percentage*)**

3. Define the queue priority:

   `[edit class-of-service schedulers scheduler-name]`
   `user@switch#` **set priority *level***

4. Define the drop profile using a drop profile map:

   `[edit class-of-service schedulers scheduler-name]`
   `user@switch#` **set drop-profile-map loss-priority (low | medium-high | high) protocol *protocol* drop-profile *drop-profile-name***

5. Configure the size of the port dedicated buffer space for the queue:

   `[edit class-of-service schedulers scheduler-name]` user@switch# **set buffer-size percent 20**

6. Configure a scheduler map to map the scheduler to a forwarding class, which applies the scheduler's properties to the traffic in that forwarding class:

   [edit class-of-service]
   user@switch# **set scheduler-maps *scheduler-map-name* forwarding-class *forwarding-class-name* scheduler *scheduler-name***

7. Assign the scheduler map and its associated schedulers to one or more interfaces using hierarchical scheduling. See "Example: Configuring CoS Hierarchical Port Scheduling (ETS)" on page 5474 for a detailed example of hierarchical scheduling.

   [edit class-of-service]
   user@switch# **set traffic-control-profiles *tcp-name* scheduler-map *scheduler-map-name***
   user@switch# **set interfaces *interface-name* forwarding-class-set *fc-set-name* output-traffic-control-profile *tcp-name***

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Minimum Guaranteed Output Bandwidth on page 5521
- Example: Configuring Maximum Output Bandwidth on page 5526
- Defining CoS Queue Scheduling Priority on page 5682
- Configuring CoS Tail-Drop Profiles on page 5676
- Monitoring CoS Scheduler Maps on page 5813
- Understanding CoS Output Queue Schedulers on page 5371
- Understanding CoS Priority Group Scheduling on page 5378
- Understanding CoS Buffer Configuration on page 5391

Defining CoS Queue Scheduling Priority

You can configure the scheduling priority of individual queues by specifying the priority in a scheduler, and then associating the scheduler with a queue by using a scheduler map. Queues can have one of two bandwidth priorities:

- **strict-high** —The scheduler has strict-high priority. You can configure only one queue as a strict-high priority queue. Strict-high priority allocates the scheduled bandwidth to the queue before any other queue receives bandwidth. Other queues receive the bandwidth that remains after the strict-high queue has been serviced.
- **low**—Low priority. Traffic with this priority is serviced after any queue that has a **strict-high** priority.

- To configure queue priority using the CLI:

  [edit class-of-service]
  user@switch# **set schedulers *scheduler-name* priority *level***

Related Documentation

- Example: Configuring Queue Scheduling Priority on page 5516
- Defining CoS Queue Schedulers on page 5679
- Monitoring CoS Scheduler Maps on page 5813
- Understanding CoS Output Queue Schedulers on page 5371

Changing the Host Outbound Traffic Default Queue Mapping

If you do not want to use the default mapping of host Routing Engine and CPU outbound traffic to queues, you can change the default output queue. You can also change the default DSCP bits used in the type of service (ToS) field of packets generated by the Routing Engine.

Configuring a queue for host outbound traffic maps all traffic that the host generates to one forwarding class (queue). The configuration is global and applies to all host-generated traffic on the switch. Configuring a forwarding class for host outbound traffic does not affect transit or incoming traffic.

NOTE: Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) packets generated by the CPU are always transmitted on the fcoe queue (queue 3), even if you configure a queue for host outbound traffic. This helps to ensure lossless behavior for FCoE traffic. QFabric systems classify FIP control packets into the same traffic class (fcoe) across the Interconnect device (fabric) and the egress Node device.

To change the host outbound traffic egress queue by including the **host-outbound-traffic** statement at the **[edit class-of-service]** hierarchy level:

```
[edit class-of-service]
host-outbound-traffic {
  forwarding-class class-name;
  dscp-code-point code-point;
}
```

For example, to map host outbound traffic to queue 7 (the network control forwarding class) and set the DSCP code point value to 101010:

```
[edit class-of-service]
host-outbound-traffic {
  forwarding-class network-control;
  dscp-code-point 101010
}
```

Related Documentation

- Understanding Host Routing Engine Outbound Traffic Queues and Defaults on page 5330

Defining CoS Traffic Control Profiles (Priority Group Scheduling)

A traffic control profile defines the output bandwidth and scheduling characteristics of forwarding class sets (priority groups). The forwarding classes (queues) contained in a forwarding class set share the bandwidth resources that you configure in the traffic control profile. A scheduler map associates forwarding classes with schedulers to define how the individual queues in a forwarding class set share the bandwidth allocated to that forwarding class set.

The parameters you configure in a traffic control profile define the following characteristics for the priority group:

- **guaranteed-rate**—Minimum bandwidth, also known as the committed information rate (CIR). The guaranteed rate also determines the amount of excess (extra) port bandwidth that the priority group can share. Extra port bandwidth is allocated among the priority groups on a port in proportion to the guaranteed rate of each priority group.

  NOTE: You cannot configure a guaranteed rate for a forwarding class set (priority group) that includes strict-high priority queues. If the traffic control profile is for a forwarding class set that contains strict-high priority queues, do not configure a guaranteed rate.

- **shaping-rate**—Maximum bandwidth, also known as the peak information rate (PIR).
- **scheduler-map**—Bandwidth and scheduling characteristics for the queues, defined by mapping forwarding classes to schedulers. (The queue scheduling characteristics represent amounts or percentages of the priority group bandwidth, not the amounts or percentages of total link bandwidth.)

NOTE: Because a port can have more than one priority group, when you assign resources to a priority group, keep in mind that the total port bandwidth must serve all of the queues associated with that port.

To configure a traffic control profile using the CLI:

1. Name the traffic control profile and define the minimum guaranteed bandwidth for the priority group:

   ```
   [edit class-of-service ]
   user@switch# set traffic-control-profiles traffic-control-profile-name guaranteed-rate (rate | percent percentage)
   ```

2. Define the maximum bandwidth for the priority group:

   ```
   [edit class-of-service traffic-control-profiles traffic-control-profile-name]
   user@switch# set shaping-rate (rate | percent percentage)
   ```

3. Attach a scheduler map to the traffic control profile:

   ```
   [edit class-of-service traffic-control-profiles traffic-control-profile-name]
   user@switch# set scheduler-map scheduler-map-name
   ```

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Minimum Guaranteed Output Bandwidth on page 5521
- Example: Configuring Maximum Output Bandwidth on page 5526
- Defining CoS Queue Schedulers on page 5679
- Understanding CoS Traffic Control Profiles on page 5381

Configuring CoS PFC (Congestion Notification Profiles)

A congestion notification profile (CNP) enables priority-based flow control (PFC) on specified IEEE 802.1p priorities (code points). A CNP has two components:

- Input CNP:
  - Enable PFC on a specified priority.
  - Configure the maximum receive unit (MRU) on an interface for traffic that matches the PFC priority (optional).
  - Specify the length of the attached cable on the ingress interface (optional)
- Output CNP (optional): Configure flow control to enable PFC pause on specific output queues for specified priorities.

NOTE: By default, output queues 3 and 4 (which are mapped to default lossless forwarding classes **fcoe** and **no-loss**, respectively) are configured to respond to PFC pause messages received from the connected peer on priorities 3 and 4 (code points 011 and 100, respectively). If you explicitly configure flow control on any output queue, you must configure flow control on every output queue that you want to respond to pause messages. (The explicit configuration overrides the default configuration.)

To achieve lossless behavior, the output queue priorities on which you enable PFC flow control must match the PFC priorities on which you enable PFC on the input interfaces. For example, if you program output queues to pause priorities 3 (011) and 5 (101) in the output component of the CNP, then you must also enable pause on priorities 3 and 5 on the input component of the CNP. (In addition, the forwarding classes mapped to the paused output queues must be lossless forwarding classes.)

Associating a CNP with an interface enables PFC on the ingress traffic that matches the priority specified in the input CNP, and programs the queues listed in the output CNP to pause when the interface receives a PFC pause message from the connected peer. Configure PFC on a priority end to end along the entire data path to create a lossless lane of traffic on the network.

NOTE: You must enable PFC on the priority used by FCoE traffic on ingress interfaces (input CNP). Enable PFC on the FCoE priority on every interface that carries FCoE traffic. By convention, FCoE traffic uses priority 3 (code point 011), which maps to queue 3. If your network uses priority 3 for FCoE traffic, the default forwarding class and classifier configuration support lossless transport, but you must still configure a CNP and apply it to the correct ingress interfaces to enable PFC and achieve lossless transport.

If your network does not use priority 3 for FCoE traffic, you need to configure a classifier that classifies FCoE traffic into a lossless forwarding class, based on the priority your network uses for FCoE traffic. If you are not using the default lossless forwarding class configuration, then you also need to ensure that the output queue mapped to the lossless FCoE forwarding class is programmed to pause.

You can attach only one CNP to an interface. There is no limit to the total number of CNPs you can create.

Configuring a CNP consists of:

- Naming the CNP.
- Specifying the IEEE 802.1 code point (priority) on which you want to enable PFC on ingress interfaces (input CNP).
- Optionally, specifying the MRU and the length of the attached cable on ingress interfaces (input CNP).
- Optionally, configuring flow control (PFC pause) on specified output queues if you want queues other than queues 3 and 4 to respond to pause messages received from the connected peer (output CNP).
- Mapping the CNP to an interface.

NOTE: Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

1. Enable PFC on the desired priority in the input CNP and optionally configure the interface MRU for traffic on that priority:

   `[edit class-of-service]`
   `user@switch#` **set congestion-notification-profile** ***cnp-name*** **input ieee-802.1 code-point** ***code-point bits*** **pfc mru** ***mru-value***

   For example, to configure a CNP named **fcoe-cnp** that enables PFC on IEEE 802.1 code point **011** and configures an MRU value of **2240**:

   `[edit class-of-service]`
   `user@switch#` **set congestion-notification-profile fcoe-cnp input ieee-802.1 code-point 011 pfc mru 2240**

2. Configure the length of the cable attached to the ingress interface (optional):

   `[edit class-of-service]`
   `user@switch#` **set congestion-notification-profile** ***cnp-name*** **input cable-length** ***cable-length-value***

   For example, to configure a CNP named **fcoe-cnp** that sets the length of the ingress interface cable to **100** meters:

   `[edit class-of-service]`
   `user@switch#` **set congestion-notification-profile fcoe-cnp input cable-length 100**

3. (Optional) Configure flow control on output queues:

   `[edit class-of-service]`
   `user@switch#` **set congestion-notification-profile** ***cnp-name*** **output ieee-802.1 code-point** ***code-point-bits*** **flow-control-queue [*queue* | *list-of-queues*]**

   For example, to configure a CNP named **fcoe-cnp** that enables PFC pause flow control on output queues 3 and 5 for FCoE traffic that uses priority 3 (code point **011**) and on output queue 4 for traffic that uses priority 4 (code point **100**):

   `[edit class-of-service]`
   `user@switch#` **set congestion-notification-profile** ***cnp-name*** **output ieee-802.1 code-point 011 flow-control-queue [3 5]**
   `user@switch#` **set congestion-notification-profile** ***cnp-name*** **output ieee-802.1 code-point 100 flow-control-queue 4**

4. Map the CNP to an interface:

   `[edit class-of-service]`
   `user@switch#` **set interfaces** ***interface*** **congestion-notification-profile** ***cnp-name***

   For example, to map the CNP **fcoe-cnp** to the interface **xe-0/0/7**:

   `[edit class-of-service]`
   `user@switch#` **set interfaces xe-0/0/7 congestion-notification-profile fcoe-cnp**

Related Documentation

- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Example: Configuring IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5631
- Assigning CoS Components to Interfaces on page 5696
- Monitoring Interfaces That Have CoS Components on page 5811
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427

Enabling and Disabling CoS Symmetric Ethernet PAUSE Flow Control

Ethernet PAUSE flow control is a congestion relief feature that works by providing link-level flow control for all traffic on a full-duplex Ethernet link, including Ethernet links that belong to Ethernet link aggregated (LAG) interfaces. Ethernet PAUSE works in both directions on the link. In one direction, an interface generates and sends PAUSE messages to stop the connected peer from sending more traffic. In the other direction, the interface responds to PAUSE messages it receives from the connected peer to stop sending traffic.

Symmetric flow control means that an interface has the same PAUSE configuration in both directions. The PAUSE generation and PAUSE response functions are both configured as enabled, or they are both disabled.

Asymmetric flow control allows you to configure the PAUSE functionality in each direction independently on an interface. The configuration for generating PAUSE messages and for responding to PAUSE messages does not have to be the same. It can be enabled in both directions, disabled in both directions, or enabled in one direction and disabled in the other direction. If you do not want to PAUSE all of the traffic on a link, you can use priority-based flow control (PFC) to selectively pause traffic based on its IEEE 802.1p code point.

On any particular interface, symmetric and asymmetric flow control are mutually exclusive. If you attempt to configure both features, the switch returns a commit error. Ethernet PAUSE and PFC are also mutually exclusive features, so you cannot configure both of them on the same interface. If you attempt to configure both Ethernet PAUSE and PFC on an interface, the switch returns a commit error.

By default, all flow control features are disabled. You enable symmetric flow control on the interfaces on which you want to PAUSE all of the traffic on a link.

- To enable symmetric flow control on an interface:

```
[edit interfaces interface-name ether-options]
user@switch# set flow-control
```

- To disable symmetric flow control on an interface:

```
[edit interfaces interface-name ether-options]
user@switch# set no-flow-control
```

Related Documentation

- Configuring CoS Asymmetric Ethernet PAUSE Flow Control on page 5689
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

Configuring CoS Asymmetric Ethernet PAUSE Flow Control

Ethernet PAUSE flow control is a congestion relief feature that works by providing link-level flow control for all traffic on a full-duplex Ethernet link, including Ethernet links that belong to link aggregated (LAG) interfaces. Ethernet PAUSE works in both directions on the link. In one direction, an interface generates and sends PAUSE messages to stop the connected peer from sending more traffic. In the other direction, the interface responds to PAUSE messages it receives from the connected peer to stop sending traffic.

Asymmetric flow control allows you to configure the PAUSE functionality in each direction independently on an interface. The configuration for generating PAUSE messages and for responding to PAUSE messages does not have to be the same. It can be enabled in both directions, disabled in both directions, or enabled in one direction and disabled in the other direction.

Symmetric flow control means that the interface has the same configuration in both directions. The PAUSE generation and PAUSE response functions are both configured as enabled or they are both disabled. If you do not want to PAUSE all of the traffic on a link, you can use priority-based flow control (PFC) to selectively pause traffic based on its IEEE 802.1p code point.

Asymmetric flow control provides the ability to configure the receive buffer and transmit buffer Ethernet PAUSE actions independently on an interface. The buffers perform the following actions:

- The receive buffers generate and send PAUSE messages to the connected peer to ask the peer to stop sending traffic for a time period specified in the PAUSE frame. The peer interface's buffers may store outgoing frames until the PAUSE period elapses and the interface can resume sending traffic.
- The transmit buffers respond to PAUSE messages received from the connected peer to stop sending traffic to the peer. The transmit buffer may store outgoing frames until the PAUSE period elapses and the interface can resume sending traffic.

Asymmetric flow control enables you to specify independently whether or not the interface receive buffer generates and sends PAUSE messages to stop the connected peer from transmitting traffic, and whether or not the interface transmit buffer responds to PAUSE messages it receives from the connected peer and stops transmitting traffic. The receive buffer configuration determines if the interface transmits PAUSE messages, and the transmit buffer configuration determines if the interface receives and responds to PAUSE messages:

- Receive buffers on—Enable PAUSE transmission (generate and send PAUSE frames)
- Transmit buffers on—Enable PAUSE reception (respond to received PAUSE frames)

You must explicitly set both the receive buffer and the transmit buffer to configure asymmetric flow control.

- To configure asymmetric flow control on an interface:

  `[edit interfaces *interface-name* ether-options]` `user@switch#` **set configured-flow-control rx-buffers (on | off) tx-buffers (on | off)**

For example, to configure interface **xe-0/0/24** to generate and send PAUSE messages but not to respond to received PAUSE messages:

set interfaces xe-0/0/24 ether-options configured-flow-control rx-buffers on tx-buffers off

For example, to configure interface **xe-0/0/30** to respond to received PAUSE messages but not to generate and send PAUSE messages:

set interfaces xe-0/0/30 ether-options configured-flow-control rx-buffers off tx-buffers on

NOTE: If you configure both buffers to be on, that is equivalent to symmetric flow control. If you configure both buffers to be off, there is no flow control (flow control is disabled).

Related Documentation

- Enabling and Disabling CoS Symmetric Ethernet PAUSE Flow Control on page 5688
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

Configuring Global Ingress and Egress Shared Buffers

Although the switch reserves some buffer space to ensure a minimum memory allocation for ports and queues, you can configure how the system uses the rest of the buffer space to optimize the buffer allocation for your particular mix of network traffic. The global shared buffer pool is memory space that all of the ports on the switch share dynamically as they need buffers. You can allocate global shared memory space to different types of ingress and egress buffers to better support different mixes of network traffic.

CAUTION: Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.

Use the default shared buffer settings (for a network with a balanced mix of lossless, best-effort, and multicast traffic) or one of the recommended shared buffer configurations for your mix of network traffic (mostly best-effort unicast traffic, mostly best-effort traffic on links enabled for Ethernet PAUSE, mostly multicast traffic, or mostly lossless traffic). Either the default configuration or one of the recommended configurations provides a buffer allocation that satisfies the needs of most networks.

After starting from one of the recommended configurations, you can fine-tune the shared buffer settings, but do so with caution to prevent traffic loss due to buffer misconfiguration.

You can configure the percentage of available (user-configurable) buffer space allocated to the global shared buffers. Any space that you do not allocate to the global shared buffer pool is added to the dedicated buffer pool. The default configuration allocates 100 percent of the available buffer space to the global shared buffers.

You can partition the ingress and egress shared buffer pools to allocate more buffers to the types of traffic your network predominantly carries, and fewer buffers to other traffic. From the buffer space allocated to the ingress shared buffer pool, you can allocate space to:

- Lossless buffers—Percentage of shared buffer pool for all lossless ingress traffic. The minimum value for the lossless buffers is 5 percent.
- Lossless headroom buffers—Percentage of shared buffer pool for packets received while a pause is asserted. If Ethernet PAUSE is configured on a port or if priority-based flow control (PFC) is configured on priorities on a port, when the port sends a pause message to the connected peer, the port uses the headroom buffers to store the packets that arrive between the time the port sends the pause message and the time the last packet arrives after the peer pauses traffic. The minimum value for the lossless headroom buffers is 0 (zero) percent. (Lossless headroom buffers are the only buffers that can have a minimum value of less than 5 percent.)
- Lossy buffers—Percentage of shared buffer pool for all best-effort ingress traffic (best-effort unicast, multidestination, and strict-high priority traffic). The minimum value for the lossy buffers is 5 percent.

The combined percentage values of the ingress lossless, lossless headroom, and lossy buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. All ingress buffer partitions must be explicitly configured, even when the lossless headroom buffer partition has a value of 0 (zero) percent.

From the buffer space allocated to the egress shared buffer pool, you can allocate space to:

- Lossless buffers—Percentage of shared buffer pool for all lossless egress queues. The minimum value for the lossless buffers is 5 percent.
- Lossy buffers—Percentage of shared buffer pool for all best-effort egress queues (best-effort unicast, and strict-high priority queues). The minimum value for the lossy buffers is 5 percent.
- Multicast buffers—Percentage of shared buffer pool for all multidestination (multicast, broadcast, and destination lookup fail) egress queues. The minimum value for the multicast buffers is 5 percent.

The combined percentage values of the egress lossless, lossy, and multicast buffer partitions must total exactly 100 percent. If the buffer percentages total more than 100 percent or less than 100 percent, the switch returns a commit error. All egress buffer partitions must be explicitly configured and must have a value of at least 5 percent.

To configure the shared buffer allocation and partitioning using the CLI:

1. Configure the percentage of available (nonreserved) buffers used for the ingress global shared buffer pool:

   ```
   [edit class-of-service shared-buffer]
   user@switch# set ingress percent percent
   ```

2. Configure the global ingress buffer partitions for lossless, lossless-headroom, and lossy traffic:

```
[edit class-of-service shared-buffer]
user@switch# set ingress buffer-partition lossless percent percent
user@switch# set ingress buffer-partition lossless-headroom percent percent
user@switch# set ingress buffer-partition lossy percent percent
```

3. Configure the percentage of available (nonreserved) buffers used for the egress global shared buffer pool:

```
[edit class-of-service shared-buffer]
user@switch# set egress percent percent
```

4. Configure the global egress buffer partitions for lossless, lossy, and multicast queues:

```
[edit class-of-service shared-buffer]
user@switch# set egress buffer-partition lossless percent percent
user@switch# set egress buffer-partition lossy percent percent
user@switch# set egress buffer-partition multicast percent percent
```

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Traffic on Links with Ethernet PAUSE Enabled on page 5535
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Understanding CoS Buffer Configuration on page 5391

Defining CoS Rewrite Rules

You configure rewrite rules to alter CoS values in outgoing packets on the outbound interfaces of a switch to match the policies of a targeted peer. Policy matching allows the downstream routing platform or switch in a neighboring network to classify each packet into the appropriate service group.

To configure a CoS rewrite rule, create the rule by giving it a name and associating it with a forwarding class, loss priority, and code point. This creates a rewrite table. After the rewrite rule is created, enable it on an interface (EXP rewrite rules can only be enabled on logical interfaces, not on physical interfaces). You can also apply an existing rewrite rule on an interface.

NOTE: On each physical interface, either all forwarding classes that are being used on the interface must have rewrite rules configured, or no forwarding classes that are being used on the interface can have rewrite rules configured. On any physical port, do not mix forwarding classes with rewrite rules and forwarding classes without rewrite rules.

NOTE: To replace an existing rewrite rule on the interface with a new rewrite rule of the same type, first explicitly remove the existing rewrite rule and then apply the new rule.

NOTE: For packets that carry both an inner VLAN tag and an outer VLAN tag, the rewrite rule rewrites only the outer VLAN tag.

To create rewrite rules and enable them on interfaces:

- To create an 802.1p rewrite rule named **customup-rw** in the rewrite table for all Layer 2 interfaces:

```
[edit class-of-service rewrite-rules]
user@switch# set ieee-802.1 customup-rw forwarding-class be loss-priority low code-point 000
user@switch# set ieee-802.1 customup-rw forwarding-class be loss-priority high code-point 001
user@switch# set ieee-802.1 customup-rw forwarding-class be loss-priority low code-point 010
user@switch# set ieee-802.1 customup-rw forwarding-class fcoe loss-priority low code-point 011
user@switch# set ieee-802.1 customup-rw forwarding-class ef-no-loss loss-priority low code-point 100
user@switch# set ieee-802.1 customup-rw forwarding-class ef-no-loss loss-priority high code-point 101
user@switch# set ieee-802.1 customup-rw forwarding-class nc loss-priority low code-point 110
user@switch# set ieee-802.1 customup-rw forwarding-class nc loss-priority high code-point 111
```

- To enable an 802.1p rewrite rule named **customup-rw** on a Layer 2 interface:

```
[edit]
user@switch# set class-of-service interfaces xe-0/0/7 unit 0 rewrite-rules ieee-802.1
customup-rw
```

NOTE: All forwarding classes assigned to port xe-0/0/7 must have rewrite rules. Do not mix forwarding classes that have rewrite rules with forwarding classes that do not have rewrite rules on the same physical interface.

- To enable an 802.1p rewrite rule named **customup-rw** on all 10-Gigabit Ethernet interfaces on the switch, use wildcards for the interface name and logical interface (unit) number:

```
[edit]
user@switch# set class-of-service interfaces xe-* unit * rewrite-rules customup-rw
```

NOTE: In this case, *all* forwarding classes assigned to *all* 10-Gigabit Ethernet ports must have rewrite rules. Do not mix forwarding classes that have rewrite rules with forwarding classes that do not have rewrite rules on the same physical interface.

Related Documentation

- Monitoring CoS Rewrite Rules on page 5812
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Configuring a Global MPLS EXP Classifier on page 3782
- Understanding CoS Rewrite Rules on page 5414
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

Configuring Rewrite Rules for MPLS EXP Classifiers

You configure EXP rewrite rules to alter CoS values in outgoing MPLS packets on the outbound interfaces of a switch to match the policies of a targeted peer. Policy matching allows the downstream routing platform or switch in a neighboring network to classify each packet into the appropriate service group.

To configure an EXP CoS rewrite rule, create the rule by giving it a name and associating it with a forwarding class, loss priority, and code point. This creates a rewrite table. After the rewrite rule is created, enable it on a logical interface. EXP rewrite rules can only be enabled on logical interfaces, not on physical interfaces. You can also apply an existing EXP rewrite rule on a logical interface.

NOTE: There are no default rewrite rules.

You can configure as many EXP rewrite rules as you want, but you can only use 16 EXP rewrite rules at any time on the switch. On a given logical interface, all pushed MPLS labels have the same EXP rewrite rule applied to them. You can apply different EXP rewrite rules to different logical interfaces on the same physical interface.

NOTE: On each physical interface, either all forwarding classes that are being used on the interface must have rewrite rules configured, or no forwarding classes that are being used on the interface can have rewrite rules configured. On any physical port, do not mix forwarding classes with rewrite rules and forwarding classes without rewrite rules.

NOTE: To replace an existing rewrite rule on the interface with a new rewrite rule of the same type, first explicitly remove the existing rewrite rule and then apply the new rule.

To create an EXP rewrite rule for MPLS traffic and enable it on a logical interface:

1. Create an EXP rewrite rule:

   `user@switch#` **set class-of-service rewrite-rules exp *rewrite-rule-name* forwarding-class *forwarding-class-name* loss-priority *level* code-points [*aliases*] [*bit-patterns*]**

   For example, to configure an EXP rewrite rule named **exp-rr-1** for a forwarding class named **mpls-1** with a loss priority of **low** that rewrites the EXP code point value to **001**:

   `user@switch#` **set class-of-service rewrite-rules exp exp-rr-1 forwarding-class mpls-1 loss-priority low code-points 001**

2. Apply the rewrite rule to a logical interface:

   `user@switch #` **set class-of-service interfaces *interface-name* unit *logical-unit* rewrite-rules exp *rewrite-rule-name***

   For example, to apply a rewrite rule named **exp-rr-1** to logical interface **xe-0/0/10.0**:

```
user@switch# set class-of-service interfaces xe-0/0/10 unit 0 rewrite-rules exp exp-rr-1
```

NOTE: In this example, all forwarding classes assigned to port xe-0/0/10 must have rewrite rules. Do not mix forwarding classes that have rewrite rules with forwarding classes that do not have rewrite rules on the same interface.

Related Documentation

- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344
- Monitoring CoS Rewrite Rules on page 5812
- Defining CoS Rewrite Rules on page 5693
- Configuring a Global MPLS EXP Classifier on page 3782

Assigning CoS Components to Interfaces

After you define the following CoS components, you assign them to physical or logical interfaces. Components that you assign to physical interfaces are valid for all of the logical interfaces configured on the physical interface. Components that you assign to a logical interface are valid only for that logical interface.

- Classifiers—Assign only to logical interfaces.
- Congestion notification profiles—Assign only to physical interfaces.
- Forwarding classes—Assign to interfaces by mapping to forwarding class sets.
- Forwarding class sets—Assign only to physical interfaces.
- Output traffic control profiles—Assign only to physical interfaces (with a forwarding class set).
- Rewrite rules—Assign only to logical interfaces.

You can assign a CoS component to a single interface or to multiple interfaces using wildcards. You can also assign a congestion notification profile or a forwarding class set globally to all interfaces.

To assign CoS components to interfaces:

Assign CoS components to a single interface by associating a CoS component (for example a forwarding class set named **san-priority-group**) with an interface:

```
[edit class-of-service interfaces]
user@switch# set xe-0/0/7 forwarding-class-set san-priority-group
```

Assign a CoS component to multiple interfaces by associating a CoS component (for example, a rewrite rule named **customup-rw**) to all 10-Gigabit Ethernet interfaces on the switch, use wildcard characters for the interface name and logical interface (unit) number:

```
[edit class-of-service interfaces]
user@switch# set xe-* unit * rewrite-rules ieee-802.1 customup-rw
```

Assign a congestion notification profile or a forwarding class set globally to all interfaces using the **set class-of-service interfaces all** statement. For example, to assign a forwarding class set named **be_fcset** to all interfaces:

```
[edit class-of-service interfaces]
user@switch# set all forwarding-class-set be_fcset
```

NOTE: If there is an existing CoS configuration of any type on an interface, the global configuration is not applied to that particular interface. The global configuration is applied to all interfaces that do not have an existing CoS configuration.

For example, if you configure a rewrite rule, assign it to interfaces xe-0/0/20.0 and xe-0/0/22.0, and then configure a congestion notification profile and apply it to all interfaces, the congestion notification profile is applied to every interface except xe-0/0/20 and xe-0/0/22.

Related Documentation

- Monitoring Interfaces That Have CoS Components on page 5811
- Understanding Junos CoS Components on page 5315
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

Configuration Tasks (QFX Series Standalone Switches, QFabric Systems Only)

Configuring CoS Fixed Classifier Rewrite Values for Native FC Interfaces (NP_Ports)

Fibre Channel over Ethernet (FCoE) traffic typically uses IEEE 802.1p priority 3 (code point 011). When Fibre Channel (FC) traffic arrives on a native FC interface (NP_Port) on an FCoE-FC gateway, the interface encapsulates the FC traffic in Ethernet to create FCoE frames. By default, the native FC interface assigns priority 3 to the FCoE traffic. The traffic is then forwarded internally to the gateway Ethernet interfaces, and then forwarded to the FCoE network.

If your FCoE network uses priority 3 for FCoE traffic, you do not need to use a rewrite value to remap the FCoE priority on native FC interfaces, because the default configuration maps priority 3 to the FCoE forwarding class.

However, if the FCoE network uses a different priority than priority 3 for FCoE traffic, then you can configure a rewrite value to remap incoming traffic from the FC SAN to that priority after the interface encapsulates the FC packets in Ethernet. Setting a rewrite value for the IEEE 802.1p code point (priority) configures the gateway native FC interface to assign the rewrite value to the encapsulated FCoE frames before forwarding the FCoE frames to the gateway Ethernet interface. Instead of a priority of 3, the FCoE frames use the priority specified in the rewrite value.

Traffic coming from the FC SAN is classified into a lossless forwarding class, and that lossless forwarding class is mapped to the rewrite value (the priority used for FCoE traffic on the converged Ethernet network). You specify the lossless forwarding class used for FCoE traffic on a native FC interface by configuring a fixed classifier and applying it to the native FC interface. (The same forwarding class must also be mapped to the rewrite value priority in the ingress classifier applied to the FCoE Ethernet interfaces.) All traffic received from the FC SAN on that FC interface is encapsulated in Ethernet, classified into the forwarding class specified in the fixed classifier, and assigned the rewrite value priority.

Configuring a rewrite value consists of:

- Configuring a fixed classifier on the native FC interface. The fixed classifier assigns all the traffic that arrives at the interface from the connected peer in the FC SAN to one fixed forwarding class. The forwarding class must be a lossless forwarding class and must be classified to the rewrite value priority in the ingress classifier configuration on the FCoE Ethernet interfaces.
- Specifying an IEEE 802.1p rewrite value for the native FC interface. The traffic mapped to the forwarding class in the fixed classifier is marked with the priority you specify in the rewrite value when the traffic is encapsulated in Ethernet. The rewrite value must be the IEEE 802.1p priority used for FCoE traffic in your converged Ethernet network.

You can configure one rewrite value for each local FCoE-FC gateway fabric. All of the native FC interfaces in a particular fabric must use the same rewrite value. Native FC interfaces that belong to different FCoE-FC gateway fabrics can use different rewrite values.

1. Configure a fixed classifier on the native FC interface:

   ```
   [edit class-of-service]
   ```


user@switch# **set** interfaces ***fc-interface-name*** forwarding-class ***lossless-forwarding-class-name***

For example, to configure a fixed classifier on native FC interface **fc-0/0/2** that specifies the lossless forwarding class **fcoe1**:

```
[edit class-of-service]
user@switch# set interfaces fc-0/0/2 forwarding-class fcoe1
```

2. Configure a rewrite value for the traffic classified into the fixed classifier (this must be the IEEE 802.1p priority used for the traffic on your converged Ethernet network):

   [edit class-of-service]
   user@switch# **set** interfaces ***fc-interface-name*** rewrite-value input ieee-802.1 code-point ***code-point-bits***

   For example, to configure a rewrite value on native FC interface **fc-0/0/2** that specifies an IEEE 802.1p priority of **101** (the lossless forwarding class specified in the fixed classifier must be classified to this priority in the ingress classifier configuration on the FCoE Ethernet interfaces):

   ```
   [edit class-of-service]
   user@switch# set interfaces fc-0/0/2 rewrite-value input ieee-802.1 code-point 101
   ```

In the example, all traffic from the FC SAN that arrives at FCoE-FC gateway interface fc-0/0/2 is encapsulated in Ethernet, classified into the lossless fcoe1 forwarding class, and tagged with the IEEE 802.1p priority 5 (code point 101). In this example, we assume that the converged Ethernet network uses priority 5 for FCoE traffic, and that the fcoe1 forwarding class is mapped to priority 5 in the ingress classifier configuration on the Ethernet interfaces. To achieve lossless transport, you must also enable PFC on priority 5 on the Ethernet interfaces that connect the FCoE traffic to the Ethernet network.

Related Documentation

- Example: Configuring IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5631
- Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5446

Configuring the DCBX Mode

You can configure the DCBX mode that an interface uses to communicate with the connected peer. QFX Systems support three DCBX modes:

- Autonegotiation—The interface negotiates with the connected peer to determine the DCBX mode. This is the default DCBX mode.
- IEEE DCBX—The interface uses IEEE DCBX type, length, and value (TLV) to exchange DCBX information with the connected peer. QFX3500 Node devices come up with IEEE DCBX enabled by default and then autonegotiate with the connected peer to determine the final DCBX mode.
- DCBX Version 1.01—The interface uses Converged Enhanced Ethernet (CEE) DCBX version 1.01 TLVs to exchange DCBX information with the connected peer. QFabric Node devices come up with DCBX version 1.01 enabled by default and then autonegotiate with the connected peer to determine the final DCBX mode.

NOTE: QFX Systems do not support pre-CEE (pre-DCB) versions of DCBX such as DCBX version 1.00. If a QFX Series interface receives an LLDP frame with pre-CEE DCBX TLVs, the system drops the frame.

Configure the DCBX mode by specifying the mode for one interface or for all interfaces.

- To configure the DCBX mode, specify the interface and the mode:

  ```
  [edit protocols dcbx]
  user@switch# set interface interface-name mode (auto-negotiate | ieee-dcbx |
  dcbx-version-1.01)
  ```

  For example, to configure DCBX version 1.01 on interface **xe-0/0/21**:

  ```
  user@switch# set protocols dcbx interface xe-0/0/21 mode dcbx-version-1.01
  ```

  To configure IEEE DCBX on all interfaces:

  ```
  user@switch# set protocols dcbx interface all mode ieee-dcbx
  ```

Related Documentation

- Configuring DCBX Autonegotiation on page 5076
- Disabling the ETS Recommendation TLV on page 5079
- Understanding DCBX on page 4905
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- show dcbx neighbors on page 5177

Configuring DCBX Autonegotiation

Data Center Bridging Capability Exchange protocol (DCBX) discovers the data center bridging (DCB) capabilities of peers by exchanging feature configuration information. DCBX also detects feature misconfiguration and mismatches, and can configure DCB on peers. DCBX is an extension of the Link Layer Discovery Protocol (LLDP), and LLDP must remain enabled on every interface for which you want to use DCBX. If you attempt to enable DCBX on an interface on which LLDP is disabled, the configuration commit operation fails.

NOTE: **LLDP and DCBX are enabled by default on all interfaces.**

The switch supports DCBX autonegotiation for:

- Priority-based flow control (PFC) configuration
- Layer 2 and Layer 4 applications such as Fibre Channel over Ethernet (FCoE) and Internet Small Computer System Interface (iSCSI)
- Enhanced transmission selection (ETS) advertisement

DCBX autonegotiation is configured on a per-interface basis for each supported feature or application. The PFC and application DCBX exchanges use autonegotiation by default. The default autonegotiation behavior is:

- DCBX is enabled on the interface if the connected peer device also supports DCBX.
- DCBX is disabled on the interface if the connected peer device does not support DCBX.

You can override the default behavior for each feature by turning off autonegotiation to force an interface to enable or disable the feature.

Autonegotiation of ETS means that when ETS is enabled on an interface (priority groups are configured), the interface advertises its ETS configuration to the peer device. In this case, priorities (forwarding classes) that are not part of a priority group (forwarding class set) receive no bandwidth and are advertised in an automatically generated default forwarding class. If ETS is not enabled on an interface (no priority groups are configured), all of the priorities are advertised in one automatically generated default priority group that receives 100 percent of the port bandwidth.

Disabling ETS autonegotiation prevents the interface from sending the Recommendation TLV or the Configuration TLV to the connected peer.

On interfaces that use IEEE DCBX mode to exchange DCBX parameters, you can disable autonegotiation of the enhanced transmission selection (ETS) Recommendation TLV to the peer if you want an asymmetric ETS configuration between the peers. DCBX still exchanges the ETS Configuration TLV if you disable the ETS Recommendation TLV.

Autonegotiation of PFC means that when PFC is enabled on an interface, if the peer device connected to the interface supports PFC and is provisioned compatibly with the switch, DCBX sets the PFC operational state to enabled. If the peer device connected to the interface does not support PFC or is not provisioned compatibly with the switch, DCBX sets the operational state to disabled.

In addition, if the peer advertises that it is “willing” to learn its PFC configuration from the switch, DCBX pushes the switch’s PFC configuration to the peer and does not check the peer’s administrative state. The switch does not learn PFC configuration from peers (the switch does not advertise its state as “willing”).

Disabling PFC autonegotiation prevents the interface from exchanging PFC configuration information with the peer. It forces the interface to enable PFC if PFC is configured on the interface or to disable PFC if PFC is not configured on the interface. If you disable PFC autonegotiation, the assumption is that the peer is also configured manually.

Autonegotiation of applications depends on whether or not you apply an application map to an interface. If you apply an application map to an interface, the interface autonegotiates DCBX for each application in the application map. PFC must be enabled on the FCoE priority (the FCoE IEEE 802.1p code point) for the interface to advertise the FCoE application. The interface only advertises applications that are included in the application map.

For example, if you apply an application map to an interface and the application map does not include the FCoE application, then that interface does not perform DCBX advertisement of FCoE.

If you do not apply an application map to an interface, DCBX does not advertise applications on that interface, with the exception of FCoE, which is handled differently than other applications.

NOTE: **If you do not apply an application map to an interface, the interface performs autonegotiation of FCoE if the interface carries traffic in the FCoE forwarding class and also has PFC enabled on the FCoE priority. On such interfaces, if DCBX detects that the peer device connected to the interface supports FCoE, the switch advertises its FCoE capability and IEEE 802.1p code point on that interface. If DCBX detects that the peer device connected to the interface does not support FCoE, DCBX marks that interface as “FCoE down” and disables FCoE on the interface.**

When DCBX marks an interface as “FCoE down,” the behavior of the switch depends on how you use it in the network:

- When the switch acts as an FCoE-FC gateway, it does not send or receive FCoE Initialization Protocol (FIP) packets.
- When the switch acts as an FCoE transit switch, the interface drops all of the FIP packets it receives. In addition, FIP packets received from an FCoE forwarder (FCF) are not forwarded to interfaces marked as “FCoE down.”

Disabling autonegotiation prevents the interface from exchanging application information with the peer. In this case, the assumption is that the peer is also configured manually.

To disable DCBX autonegotiation of PFC, applications (including FCoE), and ETS using the CLI:

1. Turn off autonegotiation for PFC.

   [edit]
   user@switch# **set protocols dcbx interface *interface-name* priority-flow-control no-auto-negotiation**

2. Turn off autonegotiation for applications.

   [edit]
   user@switch# **set protocols dcbx interface *interface-name* applications no-auto-negotiation**

3. Turn off autonegotiation for ETS.

   [edit]
   user@switch# **set protocols dcbx interface *interface-name* enhanced-transmission-selection no-auto-negotiation**

To disable autonegotiation of the ETS Recommendation TLV so that DCBX exchanges only the ETS Configuration TLV:

- [edit protocols dcbx interface *interface-name*]
  user@switch# **set enhanced-transmission-selection no-recommendation-tlv**

Related Documentation

- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Disabling the ETS Recommendation TLV on page 5079
- Understanding DCBX Application Protocol TLV Exchange on page 4915

Disabling the ETS Recommendation TLV

The enhanced transmission selection (ETS) Recommendation TLV communicates the ETS settings that the switch wants the connected peer interface to use. If the peer interface is “willing,” the peer interface changes its configuration to match the configuration in the ETS Recommendation TLV. By default, the switch interfaces send the ETS Recommendation TLV to the peer. The settings communicated are the egress ETS settings defined by configuring hierarchical scheduling on the interface.

We recommend that you use the same ETS settings on the connected peer that you use on the switch interface and that you leave the ETS Recommendation TLV enabled. However, on interfaces that use IEEE DCBX as the DCBX mode, if you want an asymmetric configuration between the switch interface and the connected peer, you can disable the ETS Recommendation TLV.

NOTE: **Disabling the ETS Recommendation TLV on interfaces that use DCBX version 1.01 as the DCBX mode has no effect and does not change DCBX behavior.**

If you disable the ETS Recommendation TLV, the switch still sends the ETS Configuration TLV to the connected peer. The result is that the connected peer is informed about the switch DCBX ETS configuration, but even if the peer is “willing,” the peer does not change its configuration to match the switch configuration. This is asymmetric configuration—the two interfaces can have different parameter values for the ETS attribute.

To disable the ETS Recommendation TLV:

- `[edit protocols dcbx interface` *`interface-name`*`]`
  `user@switch#` **set enhanced-transmission-selection no-recommendation-tlv**

Related Documentation

- Configuring the DCBX Mode on page 5075
- Configuring DCBX Autonegotiation on page 5076
- Understanding DCBX on page 4905

- *Understanding Data Center Bridging Capability Exchange Protocol for EX Series Switches*

Defining an Application for DCBX Application Protocol TLV Exchange

Define each application for which you want DCBX to exchange application protocol information. You can define Layer 2 and Layer 4 applications. After you define applications, you map them to IEEE 802.1p code points, and then apply the application map to the interfaces on which you want DCBX to exchange application protocol information with connected peers. (See *Related Documentation* for how to configure application maps and apply them to interfaces, and for an example of the entire procedure that also includes classifier configuration.)

NOTE: In Junos OS Release 12.1, the FCoE application was configured by default, so you did not need to configure it in an application map. In Junos OS Release 12.2, if you want DCBX to advertise the FCoE application on an interface and you apply an application map to that interface, you must explicitly configure FCoE in the application map. You also must enable priority-based flow control (PFC) on the FCoE code point on all interfaces that you want to advertise FCoE. If you apply an application map to an interface, the interface sends DCBX TLVs only for the applications configured in the application map.

Define Layer 2 applications by mapping an application name to an EtherType. Define Layer 4 applications by mapping an application name to a protocol (TCP or UDP) and a destination port.

- To define a Layer 2 application, specify the name of the application and its EtherType:

  `[edit applications]`
  `user@switch#` **set application *application-name* ether-type *ether-type***

  For example, to configure an application named **PTP** (for Precision Time Protocol) that uses the EtherType **0x88F7**:

  `user@switch#` **set applications application ptp ether-type 0x88F7**

- To define a Layer 4 application, specify the name of the application, its protocol (TCP or UDP), and its destination port:

  `[edit]`
  `user@switch#` **set applications application *application-name* protocol (tcp | udp) destination-port** *`port-value`*

  For example, to configure an application named **iscsi** (for Internet Small Computer System Interface) that uses the protocol **TCP** and the destination port **3260**:

  `user@switch#` **set applications application iscsi protocol tcp destination-port 3260**

Related Documentation

- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082
- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- **show dcbx neighbors on page 5177**

Configuring an Application Map for DCBX Application Protocol TLV Exchange

After you define applications for which you want to exchange DCBX application protocol information, map the applications to IEEE 802.1p code points. The IEEE 802.1p code points identify incoming traffic and allow you to map that traffic to the desired application. You then apply the application map to the interfaces on which you want DCBX to exchange application protocol information with connected peers. (See *Related Documentation* for how to define applications and apply the application map to interfaces, and for an example of the entire procedure that also includes classifier configuration.)

NOTE: In Junos OS Release 12.1, the FCoE application was configured by default, so you did not need to configure it in an application map. In Junos OS Release 12.2, if you want DCBX to advertise the FCoE application on an interface and you apply an application map to that interface, you must explicitly configure FCoE in the application map. You also must enable priority-based flow control (PFC) on the FCoE code point on all interfaces that you want to advertise FCoE. If you apply an application map to an interface, the interface sends DCBX TLVs only for the applications configured in the application map.

Configure an application map by creating an application map name and mapping an application to one or more IEEE 802.1p code points.

- To define an application map, specify the name of the application map, the name of the application, and the IEEE 802.1p code points of the incoming traffic that you want to associate with the application in the application map:

  `[edit policy-options]`
  `user@switch#` **set application-maps** ***application-map-name*** **application** ***application-name*** **code-points [** ***aliases*** **] [** ***bit-patterns*** **]**

  For example, to configure an application map named **ptp-app-map** that includes an application named **PTP** (for Precision Time Protocol) and map the application to IEEE 802.1p code points **001** and **101**:

  `user@switch#` **set policy-options application-maps ptp-app-map application ptp code points [001 101]**

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082
- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- show dcbx neighbors on page 5177

Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange

After you define applications and map them to IEEE 802.1p code points in an application map, apply the application map to the interfaces on which you want DCBX to exchange the application protocol information with connected peers. (See *Related Documentation* for how to define applications and configure application maps to interfaces, and for an example of the entire procedure that also includes classifier configuration.)

NOTE: **In Junos OS Release 12.1, the FCoE application was configured by default, so you did not need to configure it in an application map. In Junos OS Release 12.2, if you want DCBX to advertise the FCoE application on an interface and you apply an application map to that interface, you must explicitly configure FCoE in the application map. You also must enable priority-based flow control (PFC) on the FCoE code point on all interfaces that you want to advertise FCoE. If you apply an application map to an interface, the interface sends DCBX TLVs only for the applications configured in the application map.**

- To apply an application map to a DCBX interface, specify the DCBX interface and the application map name:

  ```
  [edit protocols]
  user@switch# set dcbx interface interface-name application-map application-map-name
  ```

  For example, to apply an application map named **ptp-app-map** on interface **xe-0/0/11**:

  ```
  user@switch# set protocols dcbx interface xe-0/0/11 application-map ptp-app-map
  ```

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- **show dcbx neighbors on page 5177**

Configuration Statements

buffer-partition (Egress)

Syntax

```
buffer-partition (lossless | lossy | multicast) {
  percent percent;
}
```

Hierarchy Level [edit class-of-service shared-buffer egress]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description The egress shared buffer pool is divided into three partitions. Each partition reserves a percentage of the available shared buffer pool for a type of traffic, so that the switch provides enough resources to support a mix of best-effort, lossless, and multicast traffic (multicast also includes broadcast and destination lookup fail traffic). To better support the mix of traffic on your network, you can optimize the allocation of egress shared buffers to different types of traffic by fine-tuning the shared buffer partitions.

The percentages you configure for the three egress shared buffer partitions must total exactly 100 percent. If the total of the three shared buffer percentages is not 100 percent, the system returns a commit error and does not commit the configuration. You can configure any partition to 0 (zero) percent as long as the allocation to other partitions totals 100 percent.

This is a global allocation that applies to all ports. All ports on the switch receive the same allocation of egress shared buffers.

If you do not configure buffer partitions, the switch uses the default partitioning.

CAUTION: **Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.**

Default The default egress buffer partition shown in Table 520 on page 5710 supports networks with a balanced mix of best-effort, multicast, and lossless traffic. It is the recommended configuration if you are using the default configuration with two lossless forwarding classes.

Table 520: Default Egress Shared Buffer Partitioning

Lossless Partition	Lossy Partition	Multicast Partition
50%	31%	19%

The sum of the default percentages configured for each partition is 100 percent. The sum of the partition percentages must always total 100 percent.

Options **lossless**—Shared buffer space reserved for all lossless egress traffic.

lossy—Shared buffer space for best-effort unicast egress traffic.

multicast—Shared buffer space reserved for all multicast (including broadcast and destination lookup fail) egress traffic.

percent *percent*—The percentage of buffer space to allocate to the specified buffer partition (lossless, lossy, or multicast buffers). The sum of the percentages for the three buffer partitions must total 100 percent.

Required Privilege Level

interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Configuring Global Ingress and Egress Shared Buffers on page 5690
- Understanding CoS Buffer Configuration on page 5391

buffer-partition (Ingress)

Syntax

```
buffer-partition (lossless | lossless-headroom | lossy) {
  percent percentage;
}
```

Hierarchy Level [edit class-of-service shared-buffer ingress]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description The ingress shared buffer pool is divided into three partitions. Each partition reserves a percentage of the available shared buffer pool for a type of traffic, so that the switch provides enough resources to support a mix of best effort (best-effort unicast and multicast) and lossless traffic. To better support the mix of traffic on your network, you can optimize the allocation of ingress shared buffers to different types of traffic by fine-tuning the shared buffer partitions.

The percentages you configure for the three ingress shared buffer partitions must total exactly 100 percent. If the total of the three shared buffer percentages is not 100 percent, the system returns a commit error and does not commit the configuration. You can configure any partition to 0 (zero) percent as long as the allocation to other partitions totals 100 percent.

This is a global allocation that applies to all ingress traffic. All ports on the switch receive the same allocation of ingress shared buffers.

If you do not configure buffer partitions, the switch uses the default partitioning.

CAUTION: **Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.**

Default The default ingress buffer partition shown in Table 521 on page 5712 supports networks with a balanced mix of best-effort, multicast, and lossless traffic. It is the recommended configuration if you are using the default configuration with two lossless forwarding classes.

Table 521: Default Ingress Shared Buffer Partitioning

Lossless Partition	Lossless-Headroom Partition	Lossy Partition
9%	45%	46%

The sum of the default percentages configured for each partition is 100 percent. The sum of the partition percentages always must total 100 percent.

Options **lossless**—Shared buffer space reserved for all lossless ingress traffic.

lossless-headroom—Shared buffer space reserved to store packets received while either an 802.3x Ethernet PAUSE or a priority-based flow control (PFC) pause is asserted. (When an ingress interface pauses traffic, it must have the buffer space to store all of the packets currently in the buffer, and also all of the packets received before the connected peer stops sending traffic and the wire is cleared of packets.)

lossy—Shared buffer space for best-effort ingress traffic.

percent *percent*—The percentage of buffer space to allocate to the specified buffer partition (lossless, lossless-headroom, or lossy buffers). The sum of the percentages for the three buffer partitions must total 100 percent.

Required Privilege Level

interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Configuring Global Ingress and Egress Shared Buffers on page 5690
- Understanding CoS Buffer Configuration on page 5391

buffer-size

Syntax buffer-size (percent *percent* | remainder);

Hierarchy Level [edit class-of-service schedulers *scheduler-name*]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Set the dedicated buffer size of the egress queue that you bind the scheduler to in the scheduler map configuration. The switch allocates space from the global dedicated buffer pool to ports and queues in a hierarchical manner. The switch allocates an equal number of dedicated buffers to each egress port, so each egress port receives the same amount of dedicated buffer space. The amount of dedicated buffer space per port is not configurable.

However, the **buffer-size** statement allows you to control the way each port allocates its share of dedicated buffers to its queues. For example, if a port only uses two queues to forward traffic, you can configure the port to allocate all of its dedicated buffer space to those two ports and avoid wasting buffer space on queues that are not in use. We recommend that the buffer size should be the same size as the minimum guaranteed transmission rate (the **transmit-rate**).

You configure the proportion of port dedicated buffers allocated to a particular output queue using the following process:

1. Configure a scheduler and set the **buffer-size** option to match the scheduler **transmit-rate** value.
2. Use a scheduler map to map the scheduler to the forwarding class that is mapped to the queue to which you want to apply the buffer size.

   For example, suppose that you want to change the dedicated buffer allocation for FCoE traffic. FCoE traffic is mapped to the fcoe forwarding class, and the fcoe forwarding class is mapped to queue 3 (this is the default configuration). To use default FCoE traffic mapping, in the scheduler map configuration, map the scheduler to the **fcoe** forwarding class.
3. Associate the scheduler map with the traffic control profile you want to use on the egress ports that carry FCoE traffic.
4. Associate the traffic control profile that includes the scheduler map with the desired egress ports. For this example, you associate the traffic control profile with the ports that carry FCoE traffic.

   Queue 3, which is mapped to the fcoe forwarding class and therefore to the FCoE traffic, receives the dedicated buffer allocation specified in the **buffer-size** statement.

NOTE: The total of all of the explicitly configured buffer size percentages for all of the queues on a port cannot exceed 100 percent.

Default The port allocates dedicated buffers to queues that have an explicitly configured scheduler buffer size. If you do not explicitly configure a scheduler buffer size for a queue, the port serves the explicitly configured queues first. Then the port divides the remaining dedicated buffers equally among the queues that have an explicitly attached scheduler *without* an explicitly configured buffer size configuration. (If you configure a scheduler, but you do not configure the buffer size parameter, the default is equivalent to configuring the buffer size with the **remainder** option.)

If you use the default scheduler and scheduler map on a port (no explicit scheduler configuration), then the port allocates its dedicated buffer pool to queues based on the default scheduling, as shown in Table 522 on page 5715. The default buffer size is the same as the default transmit rate for each default queue:

Table 522: Default Output Queue Buffer Sizes

Queue Number	Forwarding Class	Transmit Rate	Buffer Size
0	best-effort	5%	5%
3	fcoe	35%	35%
4	no-loss	35%	35%
7	network-control	5%	5%
8	mcast	20%	20%

Because the default scheduler includes only five forwarding classes, only the queues mapped to those forwarding classes receive dedicated buffers from the port buffer pool. (Buffers are not wasted on queues that do not carry traffic.)

Options **percent** ***percent***—Percentage of the port dedicated buffer pool allocated to the queue (or queues) mapped to the scheduler.

remainder—Remaining dedicated buffer pool after the port satisfies the needs of the explicitly configured buffers. The port divides the remaining buffers equally among the queues that are explicitly attached to a scheduler but that do not have an explicit buffer size configuration (or are configured with **remainder** as the buffer size).

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Understanding CoS Buffer Configuration on page 5391

cable-length (Congestion Notification)

Syntax cable-length *cable-length-value*;

Hierarchy Level [edit class-of-service congestion-notification-profile *profile-name* input]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Specify the length of the cable between the interface and its peer interface in meters. The system uses the cable length and the maximum receive unit (MRU) to calculate the amount of buffer headroom reserved to support priority-based flow control (PFC). The the shorter the cable length and lower the MRU, the less headroom buffer space is required for PFC.

NOTE: You can also set a maximum transmission unit (MTU) value (the largest packet size the interface sends) for interfaces by including the **mtu** statement at the **[edit interfaces *interface-name*]** hierarchy level.

Default The default cable length value is 100 meters (approximately 328 feet).

Options *cable-length-value*—Length of the cable in meters. (Generally from 1 to 300 meters, but there is no configuration restriction.)

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427

class-of-service

Syntax

```
class-of-service {
  classifiers {
    (dscp | dscp-ipv6 | ieee-802.1 | exp) classifier-name {
      import (classifier-name | default);
      forwarding-class class-name {
        loss-priority level {
          code-points [ aliases ] [ bit-patterns ];
        }
      }
    }
  }
  code-point-aliases {
    (dscp| dscp-ipv6 | ieee-802.1) {
      alias-name bits;
    }
  }
  congestion-notification-profile profile-name {
    input {
      ieee-802.1 {
        code-point [code-point-bits] {
          pfc {
            mru mru-value;
          }
        }
      }
      cable-length cable-length-value;
    }
    output {
      ieee-802.1 {
        code-point [code-point-bits] {
          flow-control-queue [queue | list-of-queues];
        }
      }
    }
  }
  drop-profiles {
    profile-name {
      interpolate {
        fill-level low-value fill-level high-value drop-probability 0 drop-probability high-value;
      }
    }
  }
  forwarding-class class-name {
    loss-priority level {
      code-points [ aliases ] [ bit-patterns ];
    }
  }
  forwarding-class class-name {
    scheduler scheduler-name;
  }
  forwarding-class-sets forwarding-class-set-name {
    class class-name;
```

```
}
forwarding-classes {
  class {
    class-name {
      queue-num queue-number <no-loss>;
    }
  }
}
host-outbound-traffic{
  forwarding-class class-name;
  dscp-code-point code-point;
}
interfaces {
  interface-name  {
    congestion-notification-profile profile-name {
    }
    forwarding-class lossless-forwarding-class-name;
    forwarding-class-set forwarding-class-set-name {
      output-traffic-control-profile profile-name;
    }
    rewrite-value {
      input {
        ieee-802.1{
          code-point code-point-bits;
        }
      }
    }
    unit logical-unit-number {
      classifiers {
        (dscp | dscp-ipv6 | ieee-802.1 exp) (classifier-name | default);
      }
      forwarding-class class-name;
      rewrite-rules {
        (dscp | dscp-ipv6 | ieee-802.1) (classifier-name | default);
      }
    }
  }
}
multi-destination {
  classifiers {
    (dscp | ieee-802.1) classifier-name;
  }
}
rewrite-rules {
  (dscp | dscp-ipv6 | ieee-802.1 | exp) classifier-name {
    import (rewrite-name | default);
    forwarding-class class-name {
      loss-priority priority code-point (alias | bits);
    }
  }
}
scheduler-maps {
  map-name {
    forwarding-class class-name scheduler scheduler-name;
  }
}
```



```
schedulers {
  scheduler-name  {
    buffer-size (percent percentage | remainder);
    drop-profile-map loss-priority (low | medium-high | high) protocol protocol drop-profile
      drop-profile-name;
    priority priority;
    shaping-rate (rate | percent percentage);
    transmit-rate (percent percentage);
  }
}
shared-buffer {
  egress {
    percent percent;
    buffer-partition (lossless | lossy | multicast) {
      percent percent
    }
  }
  ingress {
    percent percent;
    buffer-partition (lossless | lossless-headroom | lossy) {
      percent percent
    }
  }
}
system-defaults {
  classifiers exp classifier-name;
}
traffic-control-profiles profile-name {
  guaranteed-rate(rate| percent percentage);
  scheduler-map map-name;
  shaping-rate (rate| percent percentage);
}
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure class-of-service parameters on the switch.

The remaining statements are explained separately.

Default If you do not configure any CoS features, the default CoS settings are used.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Assigning CoS Components to Interfaces on page 5696
- Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 5673
- Defining CoS Multidestination (Multicast, Broadcast, DLF) BA Classifiers on page 5675
- Configuring a Global MPLS EXP Classifier on page 3782
- Defining CoS Code-Point Aliases on page 5672
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Configuring CoS Drop Profile Maps on page 5677
- Defining CoS Forwarding Class Sets on page 5679
- Defining CoS Forwarding Classes on page 5677
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Defining CoS Rewrite Rules on page 5693
- Defining CoS Queue Schedulers on page 5679
- Configuring CoS Tail-Drop Profiles on page 5676
- Defining CoS Traffic Control Profiles (Priority Group Scheduling) on page 5684
- Overview of Junos OS CoS for the QFX Series on page 5307

class (Forwarding Classes)

Syntax

```
class {
  class-name {
    queue-num queue-number <no-loss>;
  }
}
```

Hierarchy Level [edit class-of-service forwarding-classes]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
No-loss option introduced in Junos OS Release 12.3 for the QFX Series.

Description Map one or more forwarding classes to a single queue. You can map unicast forwarding classes to a unicast queue (0 through 7) and multidestination forwarding classes to a multicast queue (8 through 11). The queue to which you map a forwarding class determines if the forwarding class is a unicast or multicast forwarding class.

NOTE: If you are using Junos OS Release 12.2, use the default forwarding-class-to-queue mapping for the lossless **fcoe** and **no-loss** forwarding classes. If you explicitly configure the lossless forwarding classes, the traffic mapped to those forwarding classes is treated as lossy (best effort) traffic and does *not* receive lossless treatment.

If you are using Junos OS Release 12.3 or later, the default configuration is the same as the default configuration for Junos OS Release 12.2, and the default behavior is the same (the **fcoe** and **no-loss** forwarding classes receive lossless treatment). However, if you explicitly configure lossless forwarding classes, you can configure up to six lossless forwarding classes by specifying the **no-loss** option. If you do not specify the **no-loss** option in an explicit forwarding class configuration, the forwarding class is lossy. For example, if you explicitly configure the **fcoe** forwarding class and you do not include the **no-loss** option, the **fcoe** forwarding class is lossy, not lossless.

Options *class-name* —Name of the forwarding class.

The remaining statement is explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Forwarding Classes on page 5505
- Understanding CoS Forwarding Classes on page 5354

class (Forwarding Class Sets)

Syntax class *class-name*;

Hierarchy Level [edit class-of-service forwarding-class-sets *forwarding-class-set-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Group forwarding classes into sets of forwarding classes (priority groups). You can group some or all of the configured forwarding classes into up to three unicast forwarding class sets and one multidestination forwarding class set.

Options ***class-name*** —Name of the forwarding class.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Forwarding Class Sets on page 5508
- Understanding CoS Forwarding Class Sets (Priority Groups) on page 5359

classifiers

Syntax

```
classifiers {
  (dscp | dscp-ipv6 | ieee-802.1 | exp) classifier-name {
    import (classifier-name | default);
    forwarding-class class-name {
      loss-priority level {
        code-points [ aliases ] [ bit-patterns ];
      }
    }
  }
}
```

Multidestination BA Classifiers

```
classifiers {
  (dscp | ieee-802.1) classifier-name;
}
```

Interface Classifier Association (DSCP, DSCP IPv6, IEEE)

```
classifiers {
  (dscp | dscp-ipv6 | ieee-802.1) (default | classifier-name);
}
```

Global Interface Classifier Association with Interfaces (EXP)

```
classifiers {
  exp classifier-name;
}
```

Hierarchy Level [edit class-of-service],

Multidestination BA Classifiers [edit class-of-service multi-destination],

Interface Classifier Association (DSCP, DSCP IPv6, IEEE) [edit class-of-service interfaces *interface-name* unit *logical-unit-number*]

Global EXP Classifier [edit class-of-service system-defaults]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
EXP statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Define a unicast or multidestination CoS behavior aggregate (BA) classifier.

Options The statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 5673
- Configuring a Global MPLS EXP Classifier on page 3782
- Example: Configuring Unicast Classifiers on page 5495
- Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers on page 5498

- Understanding CoS Classifiers on page 5334
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744

code-point (Input Congestion Notification)

Syntax

```
code-point [code-point-bits] {
  pfc {
    mru mru-value;
  }
}
```

Hierarchy Level [edit class-of-service congestion-notification-profile *profile-name* input ieee-802.1]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Enable priority-based flow control (PFC) on an IEEE 802.1p code point (priority).

Options ***code-point-bits***—3-bit value in decimal form.

The remaining statements are described separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

code-point (Output Congestion Notification)

Syntax

```
code-point [ code-point-bits ] {
  flow-control-queue [ queue | list-of-queues ];
}
```

Hierarchy Level [edit class-of-service congestion-notification-profile *profile-name* output ieee-802.1]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Specify the IEEE 802.1p code point bits that identify the traffic you want to enable for priority-based flow control (PFC) pause.

Default By default, IEEE 802.1p priorities 3 and 4 (code points 011 and 100, respectively) are enabled for PFC pause on all Ethernet interfaces. If you explicitly configure priorities to pause and the output queues on which to enable pause, the explicit configuration overrides the default configuration. When you apply an explicit output congestion notification profile to an interface, only the priorities and queues specified in the output congestion notification profile are enabled for pause on that interface.

For example, if you configure an output congestion notification profile that specifies priority 2 (code point 010), then traffic with IEEE 802.1p priority 2 is paused on the configured output queue during periods of congestion. However, traffic with priority 3 and priority 4 is not programmed to pause, because the explicit configuration overwrites the default configuration, and the explicit configuration does not pause priority 3 and priority 4. If you configure an explicit output congestion notification profile, all of the priorities you want to enable for PFC and all of the output queues you want to pause must be explicitly configured.

Options ***code-point-bits***—3-bit value in decimal form.

The remaining statements are described separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface on page 5593
- Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch) on page 5584
- Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI) on page 5615
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427

code-point (Rewrite Rules)

Syntax code-point [*alias*] [*bit-pattern*];

Hierarchy Level [edit class-of-service rewrite-rules (dscp | dscp-ipv6 | ieee-802.1) forwarding-class *class-name* loss-priority *level*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a code-point alias or bit set to apply to a forwarding class for a rewrite rule.

Options ***alias***—Name of the alias.

bit-pattern—Value of the code-point bits, in decimal form.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining CoS Rewrite Rules on page 5693
- Understanding CoS Classifiers on page 5334

code-point-aliases

Syntax

```
code-point-aliases {
  (dscp| dscp-ipv6 | ieee-802.1) {
    alias-name bits;
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define an alias for a CoS marker. You can use the alias instead of the bit pattern when you specify the code point during configuration.

Options **(dcsp | dscp-ipv6 | ieee-802.1)**—Set the type of classifier for which you are creating an alias.

alias-name—Name of the code-point alias.

bits —Value of the code-point bits, in decimal form.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining CoS Code-Point Aliases on page 5672
- Understanding CoS Code-Point Aliases on page 5332

code-points (Application Maps)

Syntax code-points [*aliases*] [*bit-patterns*];

Hierarchy Level [edit policy-options application-maps *application-map-name* application *application-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Define one or more code-point aliases or bit sets for an application.

Options ***aliases***—Name of the alias or aliases.

bit-patterns—Value of the code-point bits, in decimal form.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

code-points (CoS)

Syntax code-points [*aliases*] [*bit-patterns*];

Hierarchy Level [edit class-of-service classifiers (dscp | dscp-ipv6 | ieee-802.1) *classifier-name* forwarding-class *class-name* loss-priority *level*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure one or more code-point aliases or bit sets to apply to a forwarding class.

Options ***aliases***—Name of the alias or aliases.

bit-patterns—Value of the code-point bits, in decimal form.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Unicast Classifiers on page 5495
- Understanding CoS Classifiers on page 5334

configured-flow-control

Syntax

```
configured-flow-control {
  rx-buffers (on | off);
  tx-buffers (on | off);
}
```

Hierarchy Level [edit interfaces *interface-name* ether-options]

Description Configure Ethernet PAUSE asymmetric flow control on an interface. You can set an interface to generate and send PAUSE messages, and you can set an interface to respond to PAUSE messages sent by the connected peer. You must set both the **rx-buffers** and the **tx-buffers** values when you configure asymmetric flow control.

Use the **flow-control** and **no-flow-control** statements to enable and disable symmetric PAUSE on an interface. Symmetric flow control and asymmetric flow control are mutually exclusive features. If you attempt to configure both, the switch returns a commit error.

NOTE: Ethernet PAUSE temporarily stops transmitting all traffic on a link when the buffers fill to a certain threshold. To temporarily pause traffic on individual “lanes” of traffic (each lane contains the traffic associated with a particular IEEE 802.1p code point, so there can be eight lanes of traffic on a link), use priority-based flow control (PFC) by applying a congestion notification profile to the interface.

Ethernet PAUSE and PFC are mutually exclusive features, so you cannot configure both of them on the same interface. If you attempt to configure both Ethernet PAUSE and PFC on an interface, the switch returns a commit error.

Default Flow control is disabled. You must explicitly configure Ethernet PAUSE flow control on interfaces.

Options The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- congestion-notification-profile on page 5729
- flow-control on page 2060

congestion-notification-profile

Syntax

```
congestion-notification-profile profile-name {
  input {
    ieee-802.1 {
      code-point [code-point-bits] {
        pfc {
          mru mru-value;
        }
      }
    }
    cable-length cable-length-value;
  }
  output {
    ieee-802.1 {
      code-point [code-point-bits] {
        flow-control-queue [queue | list-of-queues];
      }
    }
  }
}
```

Interface Congestion Notification Profile Association

congestion-notification-profile *profile-name* {

Hierarchy Level

[edit class-of-service],
[edit class-of-service interfaces *interface-name*]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure a congestion notification profile to enable priority-based flow control (PFC) on traffic specified by an IEEE 802.1 code point, and apply the profile to an interface.

NOTE: You must configure PFC for FCoE traffic. Each interface that carries FCoE traffic should be configured for PFC on the FCoE code point (usually 011).

You can attach a maximum of one congestion notification profile to an interface. There is no limit to the total number of congestion notification profiles you can create.

NOTE: Configuring or changing PFC on an interface blocks the entire port until the PFC change is completed. After a PFC change is completed, the port is unblocked and traffic resumes. Blocking the port stops ingress and egress traffic, and causes packet loss on all queues on the port until the port is unblocked.

Options ***profile-name***—Name of the congestion notification profile.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface on page 5593
- Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch) on page 5584
- Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI) on page 5615
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427

drop-probability

Syntax drop-probability 0 drop-probability *high-value*;

Hierarchy Level [edit class-of-service drop-profiles *profile-name* interpolate]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description When configuring WRED, map the packet **drop-probability** to the fullness of a queue (fill-level). You configure the **fill-level** and **drop-probability** statements in related pairs by specifying a low **fill-level** value at which packets begin to drop (the drop probability is zero until the queue reaches this level of fullness) and a high **fill-level** value at which packets drop at the highest drop probability. As the queue fills from the low fill level to the high fill level, the rate of packet drop increases in a linear pattern from zero to the high drop probability.

Options 0—Probability that packets will drop at the lowest **fill-level** value. This is always zero, because until the queue reaches the specified low **fill-level** value, no packets are scheduled to drop.

high-value—The maximum probability that packets will drop before queue fullness exceeds the high value of the queue **fill-level**, expressed as a percentage. If the queue fills beyond the high **fill-level** value, all packets drop.

Range: 0 through 100

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Tail-Drop Profiles on page 5501
- Understanding CoS Tail-Drop Profiles on page 5409

drop-profile

Syntax drop-profile *profile-name*;

Hierarchy Level [edit class-of-service schedulers *scheduler-name* drop-profile-map loss-priority (low | medium-high | high) protocol *protocol*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define drop profiles for random early detection (RED). When a packet arrives, RED checks the queue fill level specified in the drop profile. If the fill level corresponds to a nonzero drop probability, the RED algorithm determines whether to drop the arriving packet.

Options ***profile-name***—Name of the drop profile.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Drop Profile Maps on page 5503
- Example: Configuring Tail-Drop Profiles on page 5501
- Understanding CoS Tail-Drop Profiles on page 5409

drop-profile-map

Syntax drop-profile-map loss-priority (low | medium-high | high) protocol *protocol* drop-profile *drop-profile-name*;

Hierarchy Level [edit class-of-service schedulers *scheduler-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Map a drop profile to a loss priority and protocol for random early detection (RED). When a packet arrives, RED checks the queue fill level. If the fill level corresponds to a nonzero drop probability, the RED algorithm determines whether to drop the arriving packet.

Options The statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Drop Profile Maps on page 5503
- Example: Configuring Tail-Drop Profiles on page 5501
- Understanding CoS Tail-Drop Profiles on page 5409

drop-profiles

Syntax

```
drop-profiles {
  profile-name {
    interpolate {
      fill-level low-value fill-level high-value drop-probability 0 drop-probability high-value;
    }
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define drop profiles for weighted random early detection (WRED).

For a packet to be dropped, it must match the drop profile. When a packet arrives, WRED checks the queue fill level. If the fill level corresponds to a nonzero drop probability, the WRED algorithm determines whether to drop the arriving packet.

Options ***profile-name***—Name of the drop profile.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Tail-Drop Profiles on page 5501
- Understanding CoS Tail-Drop Profiles on page 5409

dscp

Syntax

```
dscp classifier-name {
  import (classifier-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-points [ aliases ] [ bit-patterns ];
    }
  }
}
```

Code-Point Alias Configuration

dscp *alias-name bit-pattern*;

Multidestination Classifier Configuration

dscp *classifier-name*;

Interface Classifier Association

dscp (*classifier-name* | default);

Rewrite Rule Configuration

```
dscp rewrite-name {
  import (rewrite-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-point [ aliases ] [ bit-patterns ];
    }
  }
}
```

Hierarchy Level

[edit class-of-service classifiers],
[edit class-of-service code-point-aliases],
[edit class-of-service multi-destination classifiers],
[edit class-of-service interfaces *interface-name* unit *logical-unit-number* classifiers],
[edit class-of-service interfaces *interface-name* unit *logical-unit-number* rewrite-rules],
[edit class-of-service rewrite-rules]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Define the Differentiated Services code point (DSCP) mapping that is applied to the packets.

Options

classifier-name—Name of the classifier.

The remaining statements are explained separately.

Required Privilege Level

interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Unicast Classifiers on page 5495
- Defining CoS Code-Point Aliases on page 5672
- Defining CoS Rewrite Rules on page 5693

- Assigning CoS Components to Interfaces on page 5696
- Understanding CoS Classifiers on page 5334
- Understanding CoS Rewrite Rules on page 5414
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

dscp-ipv6

Syntax

```
dscp-ipv6 classifier-name {
  import (classifier-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-points [ aliases ] [ bit-patterns ];
    }
  }
}
```

Code-Point Alias Configuration

```
dscp-ipv6 alias-name bit-pattern;
```

Interface Classifier Association

```
dscp-ipv6 (classifier-name | default);
```

Rewrite Rule Configuration

```
dscp-ipv6 rewrite-name {
  import (rewrite-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-point [ aliases ] [ bit-patterns ];
    }
  }
}
```

Hierarchy Level

[edit class-of-service classifiers],
[edit class-of-service code-point-aliases],
[edit class-of-service interfaces *interface-name* unit *logical-unit-number* classifiers],
[edit class-of-service interfaces *interface-name* unit *logical-unit-number* rewrite-rules],
[edit class-of-service rewrite-rules]

Release Information

Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description

Define the Differentiated Services code point (DSCP) IPv6 mapping that is applied to the packets.

NOTE: There is no DSCP IPv6 classifier for multidestination (multicast, broadcast, and destination lookup fail) traffic. Multidestination IPv6 traffic uses the multidestination DSCP classifier.

Options

The statements are explained separately.

Required Privilege Level

interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Unicast Classifiers on page 5495
- Defining CoS Code-Point Aliases on page 5672
- Defining CoS Rewrite Rules on page 5693

- Assigning CoS Components to Interfaces on page 5696
- Understanding CoS Classifiers on page 5334
- Understanding CoS Rewrite Rules on page 5414
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

dscp-code-point

Syntax dscp-code-point *code-point*;

Hierarchy Level [edit class-of-service **host-outbound-traffic**]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Set the value of the DSCP code point in the type of service (ToS) field of the packet generated by the Routing Engine (host).

Options **code-point**—Six-bit DSCP code point value.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Changing the Host Outbound Traffic Default Queue Mapping on page 5683
- Understanding Host Routing Engine Outbound Traffic Queues and Defaults on page 5330

egress (Buffer Configuration)

Syntax

```
egress {
  percent percent;
  buffer-partition (lossless | lossy | multicast) {
    percent percent;
  }
}
```

Hierarchy Level [edit class-of-service shared-buffer]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure the global shared buffer pool allocation for egress traffic. The system allocates the shared buffer pool dynamically across its ports as the ports require memory space. Some buffer space is reserved for other buffers such as dedicated buffers (buffers allocated permanently to ports).

The percentage you specify is the percentage of available (user-configurable) buffer space allocated to the global shared egress buffer pool. If you allocate less than 100 percent of the available buffer space to the shared buffer pool, the remaining buffer space is added to the dedicated buffer pool. (You cannot directly configure the dedicated buffer pool for each port; dedicated buffers are allocated evenly across all the ports. However, on a port, you can configure the portion of dedicated port buffer space allocated to each queue in the scheduler configuration using the **buffer-size** option.)

CAUTION: **Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.**

You can also partition the shared buffer pool to adjust the egress buffer allocations for different mixes of network traffic using the **buffer-partition** statement.

Default The default shared buffer percentage is 100 percent. (All available buffer space is allocated to the shared buffer pool.)

Options **percent *percent***—Percentage of available egress buffer space allocated to the shared buffer pool. If the percentage is less than 100 percent, the remaining buffer space is allocated to the dedicated buffer pool.

The remaining statement is explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Configuring Global Ingress and Egress Shared Buffers on page 5690
- Understanding CoS Buffer Configuration on page 5391

enhanced-transmission-selection

Syntax

```
enhanced-transmission-selection {
  no-auto-negotiation;
  no-recommendation-tlv;
  recommendation-tlv {
    no-auto-negotiation;
  }
}
```

Hierarchy Level [edit protocols dcbx interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Disable advertising the enhanced transmission selection (ETS) state of the interface to the peer. To disable ETS on the interface, do not enable ETS on the interface in the class-of-service (CoS) configuration.

Disabling ETS autonegotiation stops the QFX Series from advertising the ETS Configuration TLV and the ETS Recommendation TLV.

Disabling the ETS recommendation TLV stops the QFX Series from advertising the ETS Recommendation TLV, but the ETS Configuration TLV is still advertised.

Options **no-auto-negotiation**—Disable automatic negotiation of ETS (Configuration TLV and Recommendation TLV)

no-recommendation-tlv—Disable automatic negotiation of the ETS Recommendation TLV

recommendation-tlv—Enable automatic negotiation of ETS Recommendation TLV

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show dcbx neighbors on page 5177**
- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Understanding DCB Features and Requirements on page 4795

exp

Syntax

```
exp classifier-name {
  import (classifier-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-points [ aliases ] [ bit-patterns ];
    }
  }
}
```

Rewrite Rule Configuration

```
exp rewrite-name {
  import (rewrite-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-point [ aliases ] [ bit-patterns ];
    }
  }
}
```

Global Classifier Association with Interfaces

exp *classifier-name*;

Hierarchy Level

[edit class-of-service classifiers],
[edit class-of-service rewrite-rules]
[edit class-of-service system-defaults classifiers]

Release Information

Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description

Define the EXP code point mapping that is applied to MPLS packets. EXP classifiers are not applied to any traffic except MPLS traffic.

You can configure as many EXP classifiers as you want. However, the switch uses only one EXP classifier as a global MPLS classifier on all interfaces. You specify the global EXP classifier in the **[edit class-of-service system-defaults]** hierarchy.

Options

classifier-name—Name of the EXP classifier.

Required Privilege Level

interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring a Global MPLS EXP Classifier on page 3782
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

fill-level

Syntax fill-level *low-value* fill-level *high-value*;

Hierarchy Level [edit class-of-service drop-profiles *profile-name* interpolate]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description When configuring random early detection (RED), map the fullness of a queue to a packet drop-probability value. You configure the **fill-level** and **drop-probability** statements in related pairs by specifying a low **fill-level** value at which packets begin to drop (the drop probability is zero until the queue reaches this level of fullness) and a high **fill-level** value at which packets drop at the highest drop probability. As the queue fills from the low fill level to the high fill level, the rate of packet drop increases in a linear pattern from zero to the high drop probability.

Options *low-value*—Fullness of the queue before packets begin to drop, expressed as a percentage. The low value must be less than the high value.

Range: 0 through 100

high-value—Fullness of the queue before it reaches the maximum drop probability. If the queue fills beyond the fill level high value, all packets drop. The high value must be greater than the low value.

Range: 0 through 100

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Tail-Drop Profiles on page 5501
- Understanding CoS Tail-Drop Profiles on page 5409

flow-control

Syntax (flow-control | no-flow-control);

Hierarchy Level [edit interfaces *interface-name* ether-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Explicitly enable or disable symmetric Ethernet PAUSE flow control, which regulates the flow of packets from the switch to the remote side of the connection by pausing all traffic flows on a link during periods of network congestion. Symmetric flow control means that Ethernet PAUSE is enabled in both directions. The interface generates and sends Ethernet PAUSE messages when the receive buffers fill to a certain threshold and the interface responds to PAUSE messages received from the connected peer. By default, flow control is disabled.

You can configure asymmetric flow control by including the **configured-flow-control** statement at the **[edit interfaces *interface-name* ether-options** hierarchy level. Symmetric flow control and asymmetric flow control are mutually exclusive features. If you attempt to configure both, the switch returns a commit error.

NOTE: Ethernet PAUSE temporarily stops transmitting all traffic on a link when the buffers fill to a certain threshold. To temporarily pause traffic on individual "lanes" of traffic (each lane contains the traffic associated with a particular IEEE 802.1p code point, so there can be eight lanes of traffic on a link), use priority-based flow control (PFC).

Ethernet PAUSE and PFC are mutually exclusive features, so you cannot configure both of them on the same interface. If you attempt to configure both Ethernet PAUSE and PFC on an interface, the switch returns a commit error.

- **flow-control**—Enable flow control; flow control is useful when the remote device is a Gigabit Ethernet switch.
- **no-flow-control**—Disable flow control.

Default Flow control is disabled.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- **configured-flow-control on page 2048**
- Configuring Gigabit and 10-Gigabit Ethernet Interfaces on page 2015
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- *Junos OS Network Interfaces Library for Routing Devices*

flow-control-queue (Output Congestion Notification)

Syntax flow-control-queue [*queue* | *list-of-queues*];

Hierarchy Level [edit class-of-service congestion-notification-profile *profile-name* output ieee-802.1 code-point *code-point-bits*]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Specify one or more output queues to pause, to support priority-based flow control (PFC). The specified queues pause when the interface receives a PFC frame with a matching IEEE 802.1p code point.

Default Queue 3 (mapped to the fcoe forwarding class) and queue 4 (mapped to the no-loss forwarding class) are programmed as flow control queues to pause. No other output queues are programmed to pause by default.

If you configure flow control queues explicitly, only the queues that you specify are programmed to pause. The explicit flow control queue to pause configuration overrides the default setting, so the queues paused in the default configuration are no longer paused by default.

For example, if you configure queue 2 as a flow control queue, then queue 2 pauses when congestion occurs, but queues 3 and 4 do not pause because they were not explicitly specified. To enable pause on output queues 2, 3, and 4, you must explicitly configure all three of the queues as flow control queues.

The same behavior applies to the IEEE 802.1p code points (priorities) on which PFC is enabled. By default, priorities 3 (011) and 4 (100) are enabled for PFC pause. If you explicitly configure flow control queues to pause, you must also explicitly configure pause for each priority (code point) that you want to pause, because the explicit configuration overrides the default configuration.

Options [***queue*** | ***list-of-queues***]—The output queue or a list of output queues to pause.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface on page 5593
- Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch) on page 5584
- Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI) on page 5615

- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427

forwarding-class

Syntax

```
forwarding-class class-name {
  loss-priority level {
    code-points [ aliases ] [ bit-patterns ];
  }
}
```

Rewrite Rule Configuration

```
forwarding-class class-name {
  loss-priority level {
    code-point [ aliases ] [ bit-patterns ];
  }
}
```

Scheduler Map Configuration

```
forwarding-class class-name {
  scheduler scheduler-name;
}
```

Interface Configuration

```
forwarding-class class-name;
```

Hierarchy Level

[edit class-of-service classifiers (dscp | dscp-ipv6 | ieee-802.1) *classifier-name*],
[edit class-of-service rewrite-rules] (dscp | dscp-ipv6 | ieee-802.1) *rewrite-name*],
[edit class-of-service scheduler-maps *map-name*],
[edit class-of-service interfaces *interface-name* unit *logical-unit-number*]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure forwarding class name and option values (classifier configuration), map rewrite rules to forwarding classes (rewrite rules), map forwarding classes to schedulers (scheduler maps), or map forwarding classes to logical interfaces (interfaces).

Options

class-name—Name of the forwarding class.

The remaining statements are explained separately.

Required Privilege Level

interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Forwarding Classes on page 5505
- Example: Configuring Queue Schedulers on page 5511
- Defining CoS Rewrite Rules on page 5693
- Understanding CoS Forwarding Classes on page 5354
- Understanding CoS Rewrite Rules on page 5414
- Understanding CoS Output Queue Schedulers on page 5371

forwarding-class (Host Outbound Traffic)

Syntax forwarding-class *class-name*;

Hierarchy Level [edit class-of-service host-outbound-traffic]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Define forwarding class name for outbound host traffic (traffic generated by the Routing Engine).

Options *class-name*—Name of the forwarding class.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Changing the Host Outbound Traffic Default Queue Mapping on page 5683
- Understanding Host Routing Engine Outbound Traffic Queues and Defaults on page 5330

forwarding-class-set

Syntax

```
forwarding-class-set forwarding-class-set-name {
  output-traffic-control-profile profile-name;
}
```

Hierarchy Level [edit class-of-service interfaces *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Apply a previously defined forwarding class set to an output traffic control profile.

Options *fowarding-class-set-name*—Name of the forwarding class set.

The remaining statement is explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Assigning CoS Components to Interfaces on page 5696
- Understanding CoS Forwarding Class Sets (Priority Groups) on page 5359

forwarding-class-sets

Syntax

```
forwarding-class-sets forwarding-class-set-name {
   class class-name;
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Assign forwarding classes to forwarding class sets (priority groups).

Options ***fowarding-class-set-name***—Name of the forwarding class set.

The remaining statement is explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Forwarding Class Sets on page 5508
- Understanding CoS Forwarding Class Sets (Priority Groups) on page 5359

forwarding-classes

Syntax

```
forwarding-classes {
  class {
    class-name {
      queue-num queue-number <no-loss>;
    }
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
No-loss option introduced in Junos OS Release 12.3 for the QFX Series.

Description Map one or more forwarding classes to a single queue. You can configure up to 12 forwarding classes (8 unicast forwarding classes on queues 0 through 7 and 4 multidestination forwarding classes on queues 8 through 11) and map them to queues. You can map multiple forwarding classes to a single queue using the **class** statement. All forwarding classes mapped to a particular queue must be of the same type, either unicast or multicast. You cannot mix unicast and multicast forwarding classes on the same queue.

You cannot configure weighted random early detection (WRED) packet drop on forwarding classes configured with the no-loss packet drop attribute. Do not associate a drop profile with lossless forwarding classes.

NOTE: If you map more than one forwarding class to a queue, all of the forwarding classes mapped to the queue must to the same queue must have the same packet drop attribute (all of the forwarding classes must be lossy, or all of the forwarding classes mapped to a queue must be lossless).

NOTE: If you are using Junos OS Release 12.2, use the default forwarding-class-to-queue mapping for the lossless **fcoe** and **no-loss** forwarding classes. If you explicitly configure the lossless forwarding classes, the traffic mapped to those forwarding classes is treated as lossy (best effort) traffic and does *not* receive lossless treatment.

If you are using Junos OS Release 12.3 or later, the default configuration is the same as the default configuration for Junos OS Release 12.2, and the default behavior is the same (the **fcoe** and **no-loss** forwarding classes receive lossless treatment). However, if you explicitly configure lossless forwarding classes, you can configure up to six lossless forwarding classes by specifying the **no-loss** option. If you do not specify the **no-loss** option in an explicit forwarding class configuration, the forwarding class is lossy. For example, if you explicitly configure the **fcoe** forwarding class and you do not include the **no-loss** option, the **fcoe** forwarding class is lossy, not lossless.

Options The statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Forwarding Classes on page 5505
- Understanding CoS Forwarding Classes on page 5354

guaranteed-rate

Syntax guaranteed-rate (*rate*| percent *percentage*);

Hierarchy Level [edit class-of-service traffic-control-profiles *traffic-control-profile-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a guaranteed minimum rate of transmission for a traffic control profile. The sum of the guaranteed rates of all of the forwarding class sets (priority groups) on a port should not exceed the total port bandwidth. The guaranteed rate also determines the amount of excess (extra) port bandwidth that the priority group (forwarding class set) can share. Extra port bandwidth is allocated among the priority groups on a port in proportion to the guaranteed rate of each priority group.

NOTE: You cannot configure a guaranteed rate for a forwarding class set (priority group) that includes strict-high priority queues. If the traffic control profile is for a forwarding class set that contains strict-high priority queues, do not configure a guaranteed rate.

Default If you do not specify a guaranteed rate, the guaranteed rate is zero (0) and there is no minimum guaranteed bandwidth.

NOTE: If you do not configure a guaranteed rate for a traffic control profile, the queues that belong to any forwarding class set (priority group) that uses that traffic control profile cannot have a configured transmit rate. The result is that there is no minimum guaranteed bandwidth for those queues and that those queues can be starved during periods of congestion.

Options percent *percentage*—Minimum percentage of transmission capacity allocated to the forwarding class set or logical interface.

Range: 1 through 100 percent

rate—Minimum transmission rate allocated to the forwarding class set or logical interface, in bits per second (bps). You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation **k** (1000), **m** (1,000,000), or **g** (1,000,000,000).

Range: 1000 through 10,000,000,000 bps

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Minimum Guaranteed Output Bandwidth on page 5521
- Understanding CoS Traffic Control Profiles on page 5381
- **output-traffic-control-profile on page 5765**

host-outbound-traffic

Syntax

```
host-outbound-traffic {
  forwarding-class class-name;
  dscp-code-point code-point;
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Allow queue selection for traffic generated by the Routing Engine (host). The selected queue must be configured properly. You can also configure specific DSCP code point bits for the type of service (ToS) field of the generated packets. This configuration does not affect transit packets or incoming packets. This is a global configuration that only affects packets originating on the Routing Engine. If you do not configure an output queue for host outbound traffic, the switch uses the default queue mapping.

Options The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Changing the Host Outbound Traffic Default Queue Mapping on page 5683
- Understanding Host Routing Engine Outbound Traffic Queues and Defaults on page 5330

ieee-802.1

Syntax

```
ieee-802.1 classifier-name {
  import (classifier-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-points [ aliases ] [ bit-patterns ];
    }
  }
}
```

Code-Point Alias Configuration

```
ieee-802.1 alias-name bit-pattern;
```

Multidestination Classifier Configuration

```
ieee-802.1 classifier-name;
```

Interface Classifier Association

```
ieee-802.1 (classifier-name | default);
```

Rewrite Rule Configuration

```
ieee-802.1 rewrite-name {
  import (rewrite-name | default);
  forwarding-class class-name {
    loss-priority level {
      code-point [ aliases ] [ bit-patterns ];
    }
  }
}
```

Hierarchy Level

[edit class-of-service classifiers],
[edit class-of-service code-point-aliases],
[edit class-of-service multi-destination classifiers],
[edit class-of-service interfaces *interface-name* unit *logical-unit-number* classifiers],
[edit class-of-service interfaces *interface-name* unit *logical-unit-number* rewrite-rules],
[edit class-of-service rewrite-rules]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure an IEEE 802.1 classifier, configure an IEEE 802.1 code-point alias, apply a fixed IEEE 802.1 classifier to an interface, or apply an IEEE-802.1 rewrite rule.

Options

classifier-name—Name of the classifier.

The remaining statements are explained separately.

Required Privilege Level

interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Unicast Classifiers on page 5495
- Defining CoS Code-Point Aliases on page 5672
- Defining CoS Rewrite Rules on page 5693

- Assigning CoS Components to Interfaces on page 5696
- Understanding CoS Classifiers on page 5334
- Understanding CoS Rewrite Rules on page 5414

ieee-802.1 (Input Congestion Notification)

Syntax

```
ieee-802.1 {
  code-point [code-point-bits] {
    pfc {
      mru mru-value;
    }
  }
}
```

Hierarchy Level [edit class-of-service congestion-notification-profile *profile-name* input]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure an IEEE 802.1 code point and apply priority-based flow control (PFC) to packets with that code point.

Options The statements are described separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

ieee-802.1 (Output Congestion Notification)

Syntax

```
ieee-802.1 {
  code-point [ code-point-bits ] {
    flow-control-queue [ queue | list-of-queues ];
  }
}
```

Hierarchy Level [edit class-of-service congestion-notification-profile *profile-name* output]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure an IEEE 802.1 code point and apply priority-based flow control (PFC) to packets with that code point on output queues.

Options The statements are described separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface on page 5593
- Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch) on page 5584
- Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI) on page 5615
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427

import

Syntax import (*import* | default);

Hierarchy Level [edit class-of-service classifiers (dscp | dscp-ipv6 | ieee-802.1) *classifier-name*],
[edit class-of-service rewrite-rules (dscp | dscp-ipv6 | ieee-802.1) *classifier-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify a default or previously defined classifier.

Options *import* —Name of the classifier mapping configured at the **[edit class-of-service classifiers]** hierarchy level.

default—Default classifier mapping.

The remaining statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Unicast Classifiers on page 5495
- Defining CoS Rewrite Rules on page 5693
- Understanding CoS Classifiers on page 5334
- Understanding CoS Rewrite Rules on page 5414

ingress (Buffer Configuration)

Syntax

```
ingress {
  buffer-partition (lossless | lossless-headroom | lossy) {
    percent percent;
  }
  percent percent;
}
```

Hierarchy Level [edit class-of-service shared-buffer]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure the global shared buffer pool allocation for ingress traffic. The system allocates the shared buffer pool dynamically across its ports as the ports require memory space. Some buffer space is reserved for buffers such as dedicated buffers (buffers allocated permanently to ports) and headroom buffers (buffers that help prevent packet loss on lossless flows).

The percentage you specify is the percentage of available (user-configurable) buffer space allocated to the global shared ingress buffer pool. If you allocate less than 100 percent of the available buffer space to the shared buffer pool, the remaining buffer space is added to the dedicated buffer pool. (You cannot directly configure the dedicated buffer pool for each port; dedicated buffers are allocated evenly across all the ports.)

CAUTION: **Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until buffer reprogramming is complete.**

You can also partition the shared buffer pool to adjust the ingress buffer allocations for different mixes of network traffic using the **buffer-partition** statement.

Default The default shared buffer percentage is 100 percent. (All available buffer space is allocated to the shared buffer pool.)

Options **percent *percent***—Percentage of available ingress buffer space allocated to the shared buffer pool. If the percentage is less than 100 percent, the remaining buffer space is allocated to the dedicated buffer pool.

The remaining statement is explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Configuring Global Ingress and Egress Shared Buffers on page 5690
- Understanding CoS Buffer Configuration on page 5391

input (Congestion Notification)

Syntax

```
input {
  ieee-802.1 {
    code-point [code-point-bits] {
      pfc {
        mru mru-value;
      }
    }
  }
  cable-length cable-length-value;
}
```

Hierarchy Level [edit class-of-service congestion-notification-profile *profile-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure priority-based flow control (PFC) on incoming traffic.

Options The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

interfaces (Class of Service)

Syntax

```
interfaces {
interface-name  {
  congestion-notification-profile profile-name {
  }
  forwarding-class lossless-forwarding-class-name;
  forwarding-class-set forwarding-class-set-name {
    output-traffic-control-profile profile-name;
  }
  rewrite-value {
    input {
      ieee-802.1{
        code-point code-point-bits;
      }
    }
  }
  unit logical-unit-number {
    classifiers {
      (dscp | dscp-ipv6 | ieee-802.1 | exp) (classifier-name | default);
    }
    forwarding-class class-name;
    rewrite-rules {
      (dscp | dscp-ipv6 | ieee-802.1) (classifier-name | default);
    }
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure interface-specific CoS properties for incoming packets.

Options *interface-name*—Name of the interface.

The statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Unicast Classifiers on page 5495
- Example: Configuring Forwarding Classes on page 5505
- Example: Configuring Forwarding Class Sets on page 5508
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Assigning CoS Components to Interfaces on page 5696
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Defining CoS Rewrite Rules on page 5693

- Interfaces Overview on page 1839

interpolate

Syntax

```
interpolate {
  fill-level low-value fill-level high-value;
  drop-probability 0 drop-probability high-value;
}
```

Hierarchy Level [edit class-of-service drop-profiles *profile-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify values for interpolating the relationship between queue fill level and drop probability.

The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Tail-Drop Profiles on page 5501
- Understanding CoS Tail-Drop Profiles on page 5409

loss-priority (Classifiers)

Syntax

```
loss-priority level {
  code-points [ aliases ] [ bit-patterns ];
}
```

Hierarchy Level [edit class-of-service classifiers (dscp | dscp-ipv6 | ieee-802.1) *classifier-name* forwarding-class *class-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure packet loss priority value for a specific set of code-point aliases and bit patterns.

Options *level*—Can be one of the following:

- **low**—Packet has low loss priority.
- **medium-high**—Packet has medium-high loss priority.
- **high**—Packet has high loss priority.

The remaining statement is explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Unicast Classifiers on page 5495
- Understanding CoS Classifiers on page 5334

loss-priority (Drop Profiles)

Syntax loss-priority *level* protocol *protocol* drop-profile *profile-name*;

Hierarchy Level [edit class-of-service schedulers *scheduler-name* drop-profile-map]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure packet loss priority value for a drop profile mapped to a system drop profile.

Options *level*—Can be one of the following:

- **low**—Packet has low loss priority.
- **medium-high**—Packet has medium-high loss priority.
- **high**—Packet has high loss priority.

The remaining statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Drop Profile Maps on page 5503
- Example: Configuring Tail-Drop Profiles on page 5501
- Understanding CoS Tail-Drop Profiles on page 5409

loss-priority (Rewrite Rules)

Syntax

```
loss-priority level {
  code-point (alias | bit-pattern);
}
```

Hierarchy Level

[edit class-of-service rewrite-rules (dscp | dscp-ipv6 | ieee-802.1) *rewrite-name*
forwarding-class *class-name*]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Specify a loss priority to which to apply a rewrite rule. The rewrite rule sets the code-point aliases and bit patterns for a specific forwarding class and loss priority. Packets that match the forwarding class and loss priority are rewritten with the rewrite code-point alias or bit pattern.

Options

level—Can be one of the following:

- **low**—Packet has low loss priority.
- **medium-high**—Packet has medium-high loss priority.
- **high**—Packet has high loss priority.

The remaining statement is explained separately.

Required Privilege Level

interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining CoS Rewrite Rules on page 5693
- Understanding CoS Rewrite Rules on page 5414

multi-destination

Syntax

```
multi-destination {
  classifiers {
    (dscp | ieee-802.1) classifier-name;
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define a multicast CoS behavior aggregate (BA) classifier.

Options The statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Multidestination (Multicast, Broadcast, DLF) Classifiers on page 5498
- Assigning CoS Components to Interfaces on page 5696
- Understanding CoS Classifiers on page 5334

mru

Syntax mru *mru-value*;

Hierarchy Level [edit class-of-service congestion-notification-profile *profile-name* input ieee-802.1 code-point *code-point-bits* pfc]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure the maximum receive unit (MRU) of the interface in bytes (incoming packet sizes must be less than or equal to the MRU, or the packets are dropped). The system uses the MRU and the cable length to calculate the amount of buffer headroom reserved to support priority-based flow control (PFC). The lower the MRU and the shorter the cable length, the less headroom buffer space is required for PFC.

NOTE: You can also set a maximum transmission unit (MTU) value (the largest packet size the interface sends) for interfaces by including the **mtu** statement at the **[edit interfaces** ***interface-name*****]** hierarchy level.

Default For priority 3 traffic, the default MRU value is 2500 bytes.

For priority 4 traffic, the default MRU value is 9612 bytes.

Options *mru-value*—Value of the maximum packet receive unit size in bytes (generally from 1500 to 9216 bytes, but there is no configuration restriction).

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface on page 5593
- Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch) on page 5584
- Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI) on page 5615
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427

output (Congestion Notification)

Syntax

```
output {
  ieee-802.1 {
    code-point [code-point-bits] {
      flow-control-queue [queue | list-of-queues];
    }
  }
}
```

Hierarchy Level [edit class-of-service congestion-notification-profile *profile-name*]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure priority-based flow control (PFC) on output queues.

Options The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface on page 5593
- Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch) on page 5584
- Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI) on page 5615
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427

output-traffic-control-profile

Syntax output-traffic-control-profile *profile-name*;

Hierarchy Level [edit class-of-service interfaces *interface-name* forwarding-class-set *forwarding-class-set-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Apply an output traffic scheduling and shaping profile to a forwarding class set (priority group).

Options ***profile-name***—Name of the traffic-control profile to apply to the specified forwarding class set.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Assigning CoS Components to Interfaces on page 5696
- Understanding CoS Traffic Control Profiles on page 5381

pfc (Input Congestion Notification)

Syntax

```
pfc {
  mru mru-value;
}
```

Hierarchy Level [edit class-of-service congestion-notification-profile *profile-name* input ieee-802.1 code-point *code-point-bits*]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Enable and configure ingress interface priority-based flow control (PFC).

Options The remaining statement is explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Example: Configuring Two or More Lossless FCoE IEEE 802.1p Priorities on Different FCoE Transit Switch Interfaces on page 5601
- Example: Configuring Two or More Lossless FCoE Priorities on the Same FCoE Transit Switch Interface on page 5593
- Example: Configuring Lossless FCoE Traffic When the Converged Ethernet Network Does Not Use IEEE 802.1p Priority 3 for FCoE Traffic (FCoE Transit Switch) on page 5584
- Example: Configuring Lossless IEEE 802.1p Priorities on Ethernet Interfaces for Multiple Applications (FCoE and iSCSI) on page 5615
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885
- Understanding CoS IEEE 802.1p Priorities for Lossless Traffic Flows on page 5427

policy-options

Syntax

```
policy-options
  application-maps application-map-name {
    application application-name {
      code-points [ aliases ] [ bit-patterns ];
    }
  }
  policy-statement policy-name {
    term term-name {
      from {
        family family-name;
        match-conditions;
        policy subroutine-policy-name;
        prefix-list prefix-list-name;
        prefix-list-filter prefix-list-name match-type <actions>;
        route-filter destination-prefix match-type <actions>;
        source-address-filter source-prefix match-type <actions>;
      }
      to {
        match-conditions;
        policy subroutine-policy-name;
      }
      then actions;
    }
  }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 12.1 for the EX Series.

Description Configure options such as application maps for DCBX application protocol exchange and policy statements.

Required Privilege Level storage—To view this statement in the configuration.
storage-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

priority (Schedulers)

Syntax priority *priority*;

Hierarchy Level [edit class-of-service schedulers *scheduler-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the packet-scheduling drop priority value.

Options *priority*—It can be one of the following:

- **low**—Scheduler has low priority.
- **strict-high**—Scheduler has strict high priority. You can configure only one queue as a strict-high priority queue. Strict-high priority allocates the scheduled bandwidth to the queue before any other queue receives bandwidth. Other queues receive the bandwidth that remains after the strict-high queue has been serviced.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Understanding CoS Output Queue Schedulers on page 5371

priority-flow-control

Syntax

```
priority-flow-control {
  no-auto-negotiation;
}
```

Hierarchy Level [edit protocols dcbx interface (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 11.3 for EX Series switches.

Description Disable autonegotiation of priority-based flow control (PFC) on one or more Ethernet interfaces. Autonegotiation enables PFC on an interface only if the switch and the peer device connected to the switch both support PFC and have the same PFC configuration. Disabling autonegotiation on an interface forces the interface to use the PFC state (enabled or disabled) that is configured on the switch by the configuration and assignment of the congestion notification profile.

Options **no-auto-negotiation**—Disable automatic negotiation of PFC.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show dcbx neighbors on page 5177**
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- *Configuring Priority-Based Flow Control for an EX Series Switch (CLI Procedure)*
- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- *Understanding Data Center Bridging Capability Exchange Protocol for EX Series Switches*
- *Understanding Priority-Based Flow Control*
- Understanding DCB Features and Requirements on page 4795

protocol (Drop Profile Map)

Syntax protocol *protocol* drop-profile *profile-name*;

Hierarchy Level [edit class-of-service schedulers *scheduler-name* drop-profile-map loss-priority (low | medium-high | high)]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the protocol type for the specified drop profile.

Options *protocol*—Type of protocol. The protocol can be:

- **any**—Accept any protocol type.

The remaining statement is explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Drop Profile Maps on page 5503
- Example: Configuring Tail-Drop Profiles on page 5501
- Understanding CoS Tail-Drop Profiles on page 5409

queue-num

Syntax queue-num *queue-number* <no-loss>;

Hierarchy Level [edit class-of-service forwarding-classes class *class-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
No-loss option introduced in Junos OS Release 12.3 for the QFX Series.

Description Map a forwarding class to an output queue number. Optionally, configure the forwarding class as a lossless forwarding class.

You can map some or all of the eight unicast forwarding classes to a unicast queue (0 through 7) or some or all of the four multidestination (multicast, broadcast, destination lookup fail) forwarding classes to the same multidestination queue (8 through 11), providing that you do not map one forwarding class to more than one queue. The queue to which you map a forwarding class determines if the forwarding class is a unicast or multidestination forwarding class.

You cannot configure weighted random early detection (WRED) packet drop on forwarding classes configured with the no-loss packet drop attribute. Do not associate a drop profile with lossless forwarding classes.

NOTE: If you map more than one forwarding class to a queue, all of the forwarding classes mapped to the queue must to the same queue must have the same packet drop attribute (all of the forwarding classes must be lossy, or all of the forwarding classes mapped to a queue must be lossless).

NOTE: If you are using Junos OS Release 12.2, use the default forwarding-class-to-queue mapping for the lossless **fcoe** and **no-loss** forwarding classes. If you explicitly configure lossless forwarding classes, the traffic mapped to those forwarding classes is treated as lossy (best effort) traffic and does *not* receive lossless treatment.

If you are using Junos OS Release 12.3 or later, the default configuration is the same as the default configuration for Junos OS Release 12.2, and the default behavior is the same (the **fcoe** and **no-loss** forwarding classes receive lossless treatment). However, if you explicitly configure lossless forwarding classes, you can configure up to six lossless forwarding classes by specifying the **no-loss** option. If you do not specify the **no-loss** option in an explicit forwarding class configuration, the forwarding class is lossy. For example, if you explicitly configure the **fcoe** forwarding class and you do not include the **no-loss** option, the **fcoe** forwarding class is lossy, not lossless.

Options *queue-number*—Number of the CoS unicast queue (0 through 7) or the CoS multidestination queue (8 through 11).

no-loss—Optional packet drop attribute keyword to configure the forwarding class as lossless.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Forwarding Classes on page 5505
- Understanding CoS Forwarding Classes on page 5354

rewrite-rules

Syntax

```
rewrite-rules {
  (dscp | dscp-ipv6 | ieee-802.1 | exp) rewrite-name {
    import (rewrite-name | default);
    forwarding-class class-name {
      loss-priority priority code-point (alias | bits);
    }
  }
}
```

Interface Association

```
rewrite-rules {
  (dscp | dscp-ipv6 | ieee-802.1 | exp) rewrite-name;
}
```

Hierarchy Level [edit class-of-service],
[edit class-of-service interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
EXP statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure rewrite rules that map traffic to code points when traffic exits the system, and apply the rewrite rules to a specific interface.

MPLS EXP rewrite rules can only be bound to logical interfaces, not to physical interfaces. You can configure as many EXP rewrite rules as you want, but you can use only 16 EXP rewrite rules on switch interfaces at any given time.

Options The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining CoS Rewrite Rules on page 5693
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Understanding CoS Rewrite Rules on page 5414
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744

rx-buffers

Syntax rx-buffers (on | off);

Hierarchy Level [edit interfaces *interface-name* ether-options configured-flow-control]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable or disable an interface to generate and send Ethernet PAUSE messages. If you enable the receive buffers to generate and send PAUSE messages, when the receive buffers reach a certain level of fullness, the interface sends a PAUSE message to the connected peer. If the connected peer is properly configured, it stops transmitting frames to the interface on the entire link. When the interface receive buffer empties below a certain threshold, the interface sends a message to the connected peer to resume sending frames.

Ethernet PAUSE prevents buffers from overflowing and dropping packets during periods of network congestion. If the other devices in the network are also configured to support PAUSE, PAUSE supports lossless operation. Use the **rx-buffers** statement with the **tx-buffers** statement to configure asymmetric Ethernet PAUSE on an interface. (Use the **flow-control** statement to enable symmetric PAUSE and the **no-flow-control** statement to disable symmetric PAUSE on an interface. Symmetric flow control and asymmetric flow control are mutually exclusive features. If you attempt to configure both, the switch returns a commit error.)

NOTE: Ethernet PAUSE temporarily stops transmitting all traffic on a link when the buffers fill to a certain threshold. To temporarily pause traffic on individual “lanes” of traffic (each lane contains the traffic associated with a particular IEEE 802.1p code point, so there can be eight lanes of traffic on a link), use priority-based flow control (PFC).

Ethernet PAUSE and PFC are mutually exclusive features, so you cannot configure both of them on the same interface. If you attempt to configure both Ethernet PAUSE and PFC on an interface, the switch returns a commit error.

Default Flow control is disabled. You must explicitly configure Ethernet PAUSE flow control on interfaces.

Options **on | off**—Enable or disable an interface to generate and send Ethernet PAUSE messages.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- flow-control on page 2060
- tx-buffers on page 2113

- Enabling and Disabling CoS Symmetric Ethernet PAUSE Flow Control on page 5688
- Configuring CoS Asymmetric Ethernet PAUSE Flow Control on page 5689
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

scheduler

Syntax scheduler *scheduler-name*;

Hierarchy Level [edit class-of-service scheduler-maps *map-name* forwarding-class *class-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Map a scheduler to a forwarding class using a scheduler map.

Options ***scheduler-name***—Name of the scheduler to map to the forwarding class.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Understanding CoS Output Queue Schedulers on page 5371

scheduler-map

Syntax scheduler-map *map-name*;

Hierarchy Level [edit class-of-service traffic-control-profiles *traffic-control-profile-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Associate a scheduler map with a traffic control profile.

Options ***map-name***—Name of the scheduler map.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Queue Schedulers on page 5511
- Understanding CoS Traffic Control Profiles on page 5381
- Understanding CoS Output Queue Schedulers on page 5371

scheduler-maps

Syntax

```
scheduler-maps {
  map-name {
    forwarding-class class-name scheduler scheduler-name;
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify a scheduler map name to map a scheduler configuration to a forwarding class.

Options *map-name*—Name of the scheduler map.

The remaining statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Understanding CoS Output Queue Schedulers on page 5371

schedulers

Syntax

```
schedulers {
  scheduler-name {
    buffer-size (percent percentage | remainder);
    drop-profile-map loss-priority (low | medium-high | high) protocol protocol drop-profile
      drop-profile-name;
    priority priority;
    shaping-rate (rate | percent percentage);
    transmit-rate (percent percentage);
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify scheduler name and parameter values such minimum bandwidth (**transmit-rate**), maximum bandwidth (**shaping-rate**), and priority (**priority**).

Options ***scheduler-name*** —Name of the scheduler.

The remaining statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Drop Profile Maps on page 5503
- Understanding CoS Output Queue Schedulers on page 5371

shaping-rate

Syntax shaping-rate (*rate* | percent *percentage*);

Hierarchy Level [edit class-of-service schedulers *scheduler-name*],
[edit class-of-service traffic-control-profiles *profile-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the shaping rate. The shaping rate throttles the rate of packet transmission by setting a maximum bandwidth (rate in bits per second) or a maximum percentage of bandwidth for a queue or a forwarding class set. You specify the maximum bandwidth for a queue by using a scheduler map to associate a forwarding class (queue) with a scheduler that has a configured shaping rate. You specify the maximum bandwidth for a forwarding class set by setting the shaping rate for a traffic control profile, and then applying the traffic control profile and a forwarding class set to an interface.

We recommend that you configure the shaping rate as an absolute maximum usage and not as additional usage beyond the configured transmit rate (the minimum guaranteed bandwidth for a queue) or the configured guaranteed rate (the minimum guaranteed bandwidth for a forwarding class set).

NOTE: When you set the maximum bandwidth (**shaping-rate** value) for a queue or for a priority group at 100 Kbps or less, the traffic shaping behavior is accurate only within +/– 20 percent of the configured **shaping-rate** value.

Default If you do not configure a shaping rate, the default shaping rate is 100 percent (all of the available bandwidth), which is the equivalent of no rate shaping.

Options **percent *percentage***—Shaping rate as a percentage of the available interface bandwidth.

Range: 1 through 100 percent

rate—Peak (maximum) rate, in bits per second (bps). You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000).

Range: 1000 through 10,000,000,000 bps

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Understanding CoS Output Queue Schedulers on page 5371

- Understanding CoS Traffic Control Profiles on page 5381

shared-buffer

Syntax

```
shared-buffer {
  egress {
    buffer-partition (lossless | lossy | multicast) {
      percent percent
    }
    percent percent;
  }
  ingress {
    percent percent;
    buffer-partition (lossless | lossless-headroom | lossy) {
      percent percent
    }
  }
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure the global shared buffer pool allocation to ports. Shared buffers are a pool of buffer space that the system can allocate dynamically across all of its ports as memory space is needed. Some buffer space is reserved for dedicated buffers (buffers allocated permanently to ports), headroom buffers (buffers that help prevent packet loss on lossless flows), and other buffers.

Configure the way the system uses the available (user-configurable) buffer space by setting the **shared-buffer** percentage for the ingress buffer pool and for the egress buffer pool.

The percentage you specify is the percentage of available buffer space allocated to the global shared ingress buffer pool or to the global shared egress buffer pool. If you allocate less than 100 percent of the available buffer space to the shared buffer pool, the remaining buffer space is added to the dedicated buffer pool. (You cannot directly configure the dedicated buffer pool for each port; dedicated buffers are allocated evenly across all the ports.)

CAUTION: **Changing the buffer configuration is a disruptive event. Traffic stops on *all* ports until the buffer reprogramming is complete.**

You can also partition the ingress shared buffer pool and the egress shared buffer pool to adjust the buffer allocations for different mixes of network traffic (best-effort, lossless, multicast) using the **buffer-partition** statement.

Options The statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Configuring Global Ingress and Egress Shared Buffers on page 5690
- Understanding CoS Buffer Configuration on page 5391

system-defaults

Syntax

```
system-defaults {
  classifiers exp classifier-name;
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure the global EXP classifier used on all interfaces to classify MPLS traffic.

Although you can configure as many EXP classifiers as you want, the switch uses only one EXP classifier as a global MPLS classifier on all interfaces. All switch interfaces use the EXP classifier specified as the system default to classify MPLS traffic.

Options The statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring a Global MPLS EXP Classifier on page 3782
- Configuring Rewrite Rules for MPLS EXP Classifiers on page 3783
- Understanding CoS MPLS EXP Classifiers and Rewrite Rules on page 3744
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344

traceoptions (Class of Service)

Syntax

```
traceoptions {
  file filename <size size> <files number>
  <world-readable | no-world-readable>;
  flag flag <flag-modifier>;
  no-remote-trace
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set class-of-service (CoS) tracing options.

NOTE: **The traceoptions statement is not supported on the QFabric system.**

Default Traceoptions is disabled.

Options **file *filename***—Name of the file to receive the tracing operation output. Enclose the name in quotation marks. Traceoption output files are located in the **/var/log/** directory.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**. The traceoption output continues in a second trace file named ***trace-file*.1**. When ***trace-file*.1** reaches its maximum size, output continues in a third file named ***trace-file*.2**, and so on. When the maximum number of trace files is reached, the oldest trace file is overwritten.

If you specify a maximum number of files, you must also specify a maximum file size with the size option.

Range: 2 through 1000 files

Default: 1 trace file

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements:

- **all**—Trace all operations.
- **asynch**—Trace asynchronous configuration processing.
- **chassis-scheduler**—Trace chassis stream scheduler processing.
- **cos-adjustment**—Trace CoS rate adjustments.
- **dynamic**—Trace dynamic CoS functions.
- **hardware-database**—Trace the chassis hardware database related processing.
- **init**—Trace initialization events.

- **performance-monitor**—Trace performance monitor countors.
- **process**—Trace configuration processing.
- **restart**—Trace restart processing.
- **route-socket**—Trace route-socket events.
- **show**—Trace show command servicing.
- **snmp**—Trace SNMP-related processing.
- **util**—Trace utilities.

The following are the global tracing options:

- **all**—Perform all tracing operations
- **parse**—Trace parser processing.

no-remote-trace—(Optional) Disable remote tracing.

no-world-readable—(Optional) Prevent any user from reading the log file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0.** Incoming tracefile data is logged in the now empty ***trace-file***. When ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size of 4 GB (maximum is lower if 4 GB is not supported on your system)

Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

traffic-control-profiles

Syntax

```
traffic-control-profiles profile-name {
  guaranteed-rate (rate| percent percentage);
  scheduler-map map-name;
  shaping-rate (rate| percent percentage);
}
```

Hierarchy Level [edit class-of-service]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure traffic shaping and scheduling profiles for forwarding class sets (priority groups) to implement enhanced transmission selection (ETS) or for logical interfaces.

Options ***profile-name***—Name of the traffic-control profile. This name is also used to specify an output traffic control profile.

The remaining statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Forwarding Class Sets on page 5508
- Assigning CoS Components to Interfaces on page 5696
- **output-traffic-control-profile on page 5765**
- Understanding CoS Traffic Control Profiles on page 5381

transmit-rate

Syntax transmit-rate (*rate* | percent *percentage*);

Hierarchy Level [edit class-of-service schedulers *scheduler-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the minimum transmission rate or percentage for a queue (forwarding class) scheduler. The transmit rate also determines the amount of excess (extra) priority group bandwidth that the queue can share. Extra priority group bandwidth is allocated among the queues in the priority group in proportion to the transmit rate of each queue.

NOTE: The **transmit-rate** setting works only if you also configure the guaranteed-rate in the traffic control profile that is attached to the forwarding class set to which the queue belongs. If you do not configure the guaranteed rate, the minimum guaranteed rate for individual queues that you set using the **transmit-rate** statement does not work. The sum of all queue transmit rates in a forwarding class set should not exceed the traffic control profile guaranteed rate.

NOTE: You cannot configure a transmit rate for strict-high priority queues. Queues (forwarding classes) with a configured transmit rate cannot be included in a forwarding class set that has strict-high priority queues.

NOTE: For transmit rates below 1 Gbps, we recommend that you configure the transmit rate as a percentage instead of as a fixed rate. This is because the system converts fixed rates into percentages and may round small fixed rates to a lower percentage. For example, a fixed rate of 350 Mbps is rounded down to 3 percent instead of 3.5 percent.

Default If you do not include this statement, the default scheduler transmission rate and buffer size percentages for queues 0 through 11 are:

Queue Number	Default Minimum Guaranteed Bandwidth
0 (best-effort)	5 %
1	0
2	0
3 (fcoe)	35 %
4 (no-loss)	35 %
5	0
6	0
7 (network control)	5 %
8 (mcast)	20 %
9	0
10	0
11	0

Configure schedulers if you want to change the minimum guaranteed bandwidth and other queue characteristics.

Options

rate—Minimum transmission rate for the queue, in bps. You can specify a value in bits-per-second either as a complete decimal number or as a decimal number followed by the abbreviation **k** (1000), m (1,000,000), or **g** (1,000,000,000).

Range: 1000 through 10,000,000,000 bps

percent ***percentage***—Minimum percentage of transmission capacity allocated to the queue. A percentage of zero means that there is no minimum bandwidth guarantee for the queue.

Range: 0 through 100 percent

Required Privilege Level

interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Example: Configuring Queue Schedulers on page 5511
- Understanding CoS Output Queue Schedulers on page 5371

tx-buffers

Syntax tx-buffers (on | off);

Hierarchy Level [edit interfaces *interface-name* ether-options configured-flow-control]

Release Information Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Enable or disable an interface to respond to received Ethernet PAUSE messages. If you enable the transmit buffers to respond to PAUSE messages, when the interface receives a PAUSE message from the connected peer, the interface stops transmitting frames on the entire link. When the receive buffer on the connected peer empties below a certain threshold, the peer interface sends a message to the paused interface to resume sending frames.

Ethernet PAUSE prevents buffers from overflowing and dropping packets during periods of network congestion. If the other devices in the network are also configured to support PAUSE, PAUSE supports lossless operation. Use the **tx-buffers** statement with the **rx-buffers** statement to configure asymmetric Ethernet PAUSE on an interface. (Use the **flow-control** statement to enable symmetric PAUSE and the **no-flow-control** statement to disable symmetric PAUSE on an interface. Symmetric flow control and asymmetric flow control are mutually exclusive features. If you attempt to configure both, the switch returns a commit error.)

NOTE: Ethernet PAUSE temporarily stops transmitting all traffic on a link when the buffers fill to a certain threshold. To temporarily pause traffic on individual “lanes” of traffic (each lane contains the traffic associated with a particular IEEE 802.1p code point, so there can be eight lanes of traffic on a link), use priority-based flow control (PFC).

Ethernet PAUSE and PFC are mutually exclusive features, so you cannot configure both of them on the same interface. If you attempt to configure both Ethernet PAUSE and PFC on an interface, the switch returns a commit error.

Default Flow control is disabled. You must explicitly configure Ethernet PAUSE flow control on interfaces.

Options **on | off**—Enable or disable an interface to respond to an Ethernet PAUSE message.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- flow-control on page 2060
- rx-buffers on page 2103

- Enabling and Disabling CoS Symmetric Ethernet PAUSE Flow Control on page 5688
- Configuring CoS Asymmetric Ethernet PAUSE Flow Control on page 5689
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

unit

Syntax

```
unit logical-unit-number {
  classifiers {
    (dscp | dscp-ipv6 | ieee-802.1 | exp) (classifier-name | default);
  }
  forwarding-class class-name;
  rewrite-rules {
    (dscp | dscp-ipv6 | ieee-802.1) (classifier-name | default);
  }
}
```

Hierarchy Level [edit class-of-service interfaces *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a logical interface on the physical device. You must configure a logical interface to use the physical device.

Options ***logical-unit-number***—Number of the logical unit.

Range: 0 through 16,385

The remaining statements are explained separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Assigning CoS Components to Interfaces on page 5696

Configuration Statements (QFX Series Standalone Switches, QFabric Systems Only)

- disable (DCBX) on page 5798
- ether-type on page 5799
- forwarding-class (Fibre Channel Interfaces) on page 5800
- ieee-802.1 (Fibre Channel Interfaces) on page 5802
- input (Fibre Channel Interfaces) on page 5803
- interface (DCBX) on page 5804
- protocol (Applications) on page 5805
- recommendation-tlv on page 5806
- rewrite-value (Fibre Channel Interfaces) on page 5807

application (Application Maps)

Syntax

```
application application-name {
  code-points [ aliases ] [ bit-patterns ];
}
```

Hierarchy Level [edit policy-options application-maps *application-map-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Add an application to an application map and define the application's code points.

Options *application-name*—Name of the application.

The remaining statement is explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

application (Applications)

Syntax

```
application application-name {
  destination-port port-value;
  protocol (tcp | udp);
  ether-type type;
}
```

Hierarchy Level [edit applications]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Configure properties to define an application.

Options *application-name*—Name of the application.

The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

application-map

Syntax application-map *application-map-name*;

Hierarchy Level [edit protocols dcbx interface *interface-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Specify an application map to apply to an interface.

Options *application-map-name*—Name of the application map.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show dcbx neighbors on page 5177**
- Applying an Application Map to an Interface for DCBX Application Protocol TLV Exchange on page 5082
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

application-maps

Syntax

```
application-maps application-map-name {
  application application-name {
    code-points [ aliases ] [ bit-patterns ];
  }
}
```

Hierarchy Level [edit policy-options]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Define an application map by specifying the applications that belong to the application map.

Options *application-map-name*—Name of the application map.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring an Application Map for DCBX Application Protocol TLV Exchange on page 5081
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

applications (Applications)

Syntax

```
applications {
  application application-name {
    destination-port port-value;
    protocol (tcp | udp);
    ether-type type;
  }
}
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Define applications that DCBX advertises.

Options The statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

applications (DCBX)

Syntax

```
applications {
  no-auto-negotiation;
}
```

Hierarchy Level [edit protocols dcbx interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 12.1 for the EX Series

Description Configure Data Center Bridging Capability Exchange protocol (DCBX) applications on an interface.

Options The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

-
- show dcbx neighbors on page 5177
- Understanding DCB Features and Requirements on page 4795

code-point (Fibre Channel Interfaces)

Syntax code-point *code-point-bits*;

Hierarchy Level [edit class-of-service interfaces *fibre-channel-interface-name* rewrite-value input ieee-802.1]

Description Configure the IEEE 802.1p code point value assigned to all traffic received from the Fibre Channel (FC) network on the specified FC interface (NP_Port). When native FC traffic from the FC SAN arrives at the NP_Port interface, the NP_Port interface encapsulates it in Ethernet to create FCoE packets before forwarding the traffic onto the FCoE network. Instead of using the default value of priority 3 (code point 011) for the FCoE traffic, the interface rewrites the IEEE 802.1p code point to the value specified in the rewrite value code points.

After the code point value is rewritten, the interface forwards the traffic to the Ethernet (FCoE) network. This works in conjunction with configuring a fixed classifier on the FC interface. The fixed classifier maps all traffic from the FC network into one lossless forwarding class (the lossless forwarding class must be mapped to the code point specified in the rewrite value). Traffic mapped to the lossless forwarding class uses the IEEE 802.1p priority specified by the code point bits in the rewrite value.

FCoE traffic typically uses priority 3 (IEEE code point 011). The QFX Series default configuration uses IEEE 802.1p priority 3 for FCoE traffic. Rewriting the code point value enables you to change the IEEE 802.1p priority of the FCoE traffic if the Ethernet network uses a different priority than priority 3 (code point 011).

The system supports only one IEEE 802.1p code point value per FC interface. You cannot configure more than one IEEE 802.1p rewrite value per FC interface. In addition, you can specify only one rewrite value per local FCoE-FC gateway fabric; all interfaces in the local fabric must use the same rewrite value. Attempting to configure FC interfaces in the same local fabric with different rewrite values generates a commit error. You can specify different rewrite values for interfaces that belong to different local FCoE-FC gateway fabrics.

Options ***code-point-bits***—Value of the code-point bits, in decimal form.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- **forwarding-class (Fibre Channel Interfaces) on page 5800**
- Example: Configuring IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5631
- Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5446
- Understanding CoS Classifiers on page 5334

dcbx

Syntax

```
dcbx {
  disable;
  interface (interface-name | all) {
    disable;
    application-map application-map-name;
    applications {
      no-auto-negotiation;
    }
    enhanced-transmission-selection {
      no-auto-negotiation;
      no-recommendation-tlv;
      recommendation-tlv {
        no-auto-negotiation;
      }
    }
    dcbx-version (auto-negotiate | ieee-dcbx | dcbx-version-1.01);
    priority-flow-control {
      no-auto-negotiation;
    }
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 11.3 for EX Series switches.
mode and **recommendation-tlv** statements introduced in Junos OS Release 12.2 for the QFX Series.

Description Configure DCBX properties.

Options The statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show dcbx neighbors on page 5177**
- Understanding DCB Features and Requirements on page 4795
- Configuring DCBX Autonegotiation on page 5076
- *Understanding DCB Features and Requirements on EX Series Switches*
- *Disabling DCBX to Disable PFC Autonegotiation on EX Series Switches (CLI Procedure)*

dcbx-version

Syntax dcbx-version (auto-negotiate | ieee-dcbx | dcbx-version-1.01);

Hierarchy Level [edit protocols dcbx interface (all | *interface-name*)]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Set the DCBX version for the specified interface or interfaces.

QFX3500 switches come up in IEEE DCBX mode and then autonegotiate with the connected peer to set the DCBX version.

QFabric system Node devices come up using DCBX version 1.01, and then autonegotiate with the connected peer to set the DCBX mode.

Default The default DCBX mode is autonegotation.

Options **auto-negotiate**—Automatically negotiate the DCBX version with the connected peer.

ieee-dcbx—Force the interface to use IEEE DCBX mode, regardless of the peer configuration.

dcbx-version-1.01—Force the interface to use version 1.01 DCBX mode, regardless of the peer configuration.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show dcbx neighbors on page 5177**
- Configuring DCBX Autonegotiation on page 5076
- Understanding DCBX on page 4905

destination-port (Applications)

Syntax destination-port *port-value*;

Hierarchy Level [edit applications application *application-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Transmission Control Protocol (TCP) or User Datagram Protocol (UDP) destination port number, which combines with **protocol** to identify an application type. The Internet Assigned Numbers Authority (IANA) assigns port numbers. See the IANA *Service Name and Transport Protocol Port Number Registry* at http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xml for a list of assigned port numbers.

NOTE: To create an application for iSCSI, use the protocol **tcp** with the destination port number **3260**.

Options ***port-value***—Identifier for the port.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

disable (DCBX)

Syntax disable

Hierarchy Level [edit protocols dcbx]

[edit protocols dcbx interface *interface-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 11.3 for EX Series switches.

Description Disable Data Center Bridging Capability Exchange protocol (DCBX) on one or more 10-Gigabit Ethernet interfaces.

Default DCBX is enabled by default on all 10-Gigabit or higher Ethernet interfaces.

DCBX is enabled by default on all 10-Gigabit Ethernet interfaces on EX4500 CEE-enabled switches.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring DCBX Autonegotiation on page 5076
- *Disabling DCBX to Disable PFC Autonegotiation on EX Series Switches (CLI Procedure)*
- Understanding DCB Features and Requirements on page 4795
- *Understanding DCB Features and Requirements on EX Series Switches*

ether-type

Syntax ether-type *ether-type*;

Hierarchy Level [edit applications application *application-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Two-octet field in an Ethernet frame that defines the protocol encapsulated in the frame payload. See http://standards.ieee.org/develop/regauth/ethertype/eth.txt for a list of Institute of Electrical and Electronics Engineers (IEEE) EtherTypes.

NOTE: To create a FIP application, use the EtherType 0x8914.

Options ***type***—Identifier for the EtherType.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- Understanding DCBX Application Protocol TLV Exchange on page 4915

forwarding-class (Fibre Channel Interfaces)

Syntax forwarding-class *lossless-forwarding-class-name*;

Hierarchy Level [edit class-of-service interfaces *fibre-channel-interface-name*]

Release Information Statement introduced in Junos OS Release 12.3 for the QFX Series.

Description Configure a Layer 3 fixed classifier on a Fibre Channel (FC) interface. The fixed classifier places all traffic received from the FC network into the specified forwarding class. The forwarding class must be lossless. (That is, the forwarding class must be either the default **fcoe** or **no-loss** forwarding class, or the forwarding class must be configured with the **no-loss** drop attribute.) If you attempt to specify a lossy forwarding class, the system returns a commit error.

FCoE networks typically use priority 3 (IEEE code point 011) for FCoE traffic. The QFX Series default configuration uses IEEE 802.1p priority 3 for FCoE traffic. If the IEEE 802.1p code point value that the Ethernet network uses for FCoE traffic is different than code point 3, you can rewrite the code point to the value used in your Ethernet (FCoE) network. The lossless forwarding class specified in the fixed classifier uses the **rewrite-value** statement as the IEEE 802.1p code point (priority) for FCoE traffic on the FCoE network.

To rewrite the code point value, include the **rewrite-value input ieee code-point *code-point-bits*** statement at the [**edit class-of-service interfaces *fc-interface-name***] hierarchy level.

NOTE: If you are not using the default configuration (priority 3 for FCoE traffic), the lossless forwarding class specified in the FC interface fixed classifier must be mapped to the IEEE 802.1p code point specified in the rewrite value statement.

In order to avoid fate sharing (separate flows that affect each other's throughput), the code point (priority) used for the lossless forwarding class (the code point specified in the rewrite value statement) should be the only code point classified to that forwarding class (at the [**edit class-of-service classifiers**] hierarchy level). For example, if the rewrite value uses code point 101 for lossless FCoE forwarding class fcoe_fc1, then in the classifier configuration attached to ingress Ethernet interfaces, code point 101 is the only code point that should be classified to the fcoe_fc1 forwarding class. Now if you also attach a classifier to an interface that maps code point 110 to forwarding class fcoe_fc1, then congestion on priority 110 unfairly (and unintentionally) affects the FCoE traffic that uses priority 101. Both priorities 101 and 110 are classified into forwarding class fcoe_fc1, so the traffic from both priorities shares the same fate.

Options ***lossless-forwarding-class-name***—Name of the lossless forwarding class.

Required Privilege Level
interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5631
- Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5446
- Understanding CoS Classifiers on page 5334

ieee-802.1 (Fibre Channel Interfaces)

Syntax

```
ieee-802.1 {
  code-point code-point-bits;
}
```

Hierarchy Level [edit class-of-service interfaces *fibre-channel-interface-name* rewrite-value input]

Description Configure the IEEE 802.1p code point value to which all traffic received from the Fibre Channel (FC) network on the specified FC interface is rewritten. After the code point value is rewritten, the interface forwards the traffic to the Ethernet (FCoE) network. This works in conjunction with configuring a fixed classifier on the FC interface. The fixed classifier maps all traffic from the FC network into one lossless forwarding class (the lossless forwarding class must be mapped to the code point specified in the rewrite value). Traffic mapped to the lossless forwarding class uses the IEEE 802.1p priority specified by the code point bits in the rewrite value.

FCoE networks typically use priority 3 (IEEE code point 011) for FCoE traffic. The QFX Series default configuration uses IEEE 802.1p priority 3 for FCoE traffic. Rewriting the code point value enables you to change the IEEE 802.1p priority of the FCoE traffic if the Ethernet network uses a different priority than priority 3 (code point 011).

The system supports only one IEEE 802.1p code point value per FC interface. You cannot configure more than one IEEE 802.1p rewrite value per FC interface. In addition, you can specify only one rewrite value per local FCoE-FC gateway fabric; all interfaces in the local fabric must use the same rewrite value. Attempting to configure FC interfaces in the same local fabric with different rewrite values generates a commit error. You can specify different rewrite values for interfaces that belong to different local FCoE-FC gateway fabrics.

The statement is described separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- **forwarding-class (Fibre Channel Interfaces) on page 5800**
- Example: Configuring IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5631
- Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5446
- Understanding CoS Classifiers on page 5334

input (Fibre Channel Interfaces)

Syntax

```
input {
  ieee-802.1{
    code-point code-point-bits;
  }
}
```

Hierarchy Level [edit class-of-service interfaces *fibre-channel-interface-name* rewrite-value]

Description Configure the IEEE 802.1p code point value to which all traffic received from the Fibre Channel (FC) network on the specified FC interface is rewritten. After the code point value is rewritten, the interface forwards the traffic to the Ethernet (FCoE) network. This works in conjunction with configuring a fixed classifier on the FC interface. The fixed classifier maps all traffic from the FC network into one lossless forwarding class (the lossless forwarding class must be mapped to the code point specified in the rewrite value). Traffic mapped to the lossless forwarding class uses the IEEE 802.1p priority specified by the code point bits in the rewrite value.

FCoE networks typically use priority 3 (IEEE code point 011) for FCoE traffic. The QFX Series default configuration uses IEEE 802.1p priority 3 for FCoE traffic. Rewriting the code point value enables you to change the IEEE 802.1p priority of the FCoE traffic if the Ethernet network uses a different priority than priority 3 (code point 011).

The system supports only one IEEE 802.1p code point value per FC interface. You cannot configure more than one IEEE 802.1p rewrite value per FC interface. In addition, you can specify only one rewrite value per local FCoE-FC gateway fabric; all interfaces in the local fabric must use the same rewrite value. Attempting to configure FC interfaces in the same local fabric with different rewrite values generates a commit error. You can specify different rewrite values for interfaces that belong to different local FCoE-FC gateway fabrics.

The statements are described separately.

Required Privilege Level interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- **forwarding-class (Fibre Channel Interfaces) on page 5800**
- Example: Configuring IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5631
- Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5446
- Understanding CoS Classifiers on page 5334

interface (DCBX)

Syntax

```
interface (interface-name | all) {
  disable;
  application-map application-map-name;
  applications {
    no-auto-negotiation;
  }
  enhanced-transmission-selection {
    no-auto-negotiation;
    no-recommendation-tlv;
    recommendation-tlv {
      no-auto-negotiation;
    }
  }
  dcbx-version (auto-negotiate | ieee-dcbx | dcbx-version-1.01);
  priority-flow-control {
    no-auto-negotiation;
  }
}
```

Hierarchy Level [edit protocols dcbx]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 11.3 for the EX Series switches.
Mode and **recommendation-tlv** statements introduced in Junos OS Release 12.2 for the QFX Series.

Description Configure DCBX properties on an interface.

Options ***interface-name***—Name of the interface.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- **show dcbx neighbors on page 5177**
- Configuring DCBX Autonegotiation on page 5076
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCB Features and Requirements on page 4795
- *Understanding DCB Features and Requirements on EX Series Switches*
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

protocol (Applications)

Syntax protocol (tcp | udp);

Hierarchy Level [edit applications application *application-name*]

Release Information Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.

Description Networking protocol type, which combines with **destination-port** to identify an application type.

NOTE: To create an application for iSCSI, use the protocol **tcp** with the destination port number **3260**.

Options **tcp**—Transmission Control Protocol

udp—User Datagram Protocol

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Defining an Application for DCBX Application Protocol TLV Exchange on page 5079
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCBX Application Protocol TLV Exchange on page 4915
- *Understanding DCBX Application Protocol TLV Exchange on EX Series Switches*

recommendation-tlv

Syntax

```
recommendation-tlv {
  no-auto-negotiation;
}
```

Hierarchy Level [edit protocols dcbx interface *interface-name* enhanced-transmission-selection]

Release Information Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description Disable or enable DCBX to send the ETS Recommendation TLV (also known as the Information TLV) on egress. This feature is valid only if the interface DCBX mode is IEEE DCBX. If the interface DCBX mode is DCBX version 1.01, this statement has no effect. (DCBX version 1.01 does not advertise separate TLVs for individual attributes.)

Default DCBX-enabled interfaces send the ETS recommendation TLV unless it is disabled.

Options **no-auto-negotiation**—Disable sending of the ETS recommendation TLV.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- show dcbx neighbors on page 5177
- Configuring DCBX Autonegotiation on page 5076

rewrite-value (Fibre Channel Interfaces)

Syntax

```
rewrite-value {
  input {
    ieee-802.1{
      code-point code-point-bits;
    }
  }
}
```

Hierarchy Level [edit class-of-service interfaces *fibre-channel-interface-name*]

Description Configure the IEEE 802.1p code point value (priority) for all traffic received from the Fibre Channel (FC) network on the specified FC interface. Instead of using the default priority 3 (011) for FCoE traffic, the priority is rewritten to the specified priority before being forwarded. This works in conjunction with configuring a fixed classifier on the FC interface. The fixed classifier maps all traffic from the FC network into one lossless forwarding class (the lossless forwarding class must be mapped to the code point specified in the rewrite value). Traffic mapped to the lossless forwarding class uses the IEEE 802.1p priority specified by the code point bits in the rewrite value.

FCoE traffic typically uses priority 3 (IEEE code point 011). The QFX Series default configuration uses IEEE 802.1p priority 3 for FCoE traffic. Rewriting the code point value enables you to change the IEEE 802.1p priority of the FCoE traffic if the Ethernet network uses a different priority than priority 3 (code point 011) for FCoE traffic.

The system supports only one IEEE 802.1p code point value per FC interface, so you cannot configure more than one IEEE 802.1p rewrite value per FC interface. In addition, you can specify only one rewrite value per local FCoE-FC gateway fabric; all interfaces in the local fabric must use the same rewrite value. Attempting to configure FC interfaces in the same local fabric with different rewrite values generates a commit error. You can specify different rewrite values for interfaces that belong to different local FCoE-FC gateway fabrics.

NOTE: In order to avoid fate sharing (separate flows that affect each others' throughput), the code point used for the rewrite value should be the only code point used for the lossless FCoE forwarding class (the forwarding class used for the fixed classifier on the Fibre Channel interface). When you configure classifiers for ingress Ethernet interfaces, map only the rewrite value code point to the forwarding class.

For example, if the rewrite value uses code point 101 for lossless FCoE forwarding class fcoe_fc1, then in the classifier configuration attached to ingress Ethernet interfaces, code point 101 is the only code point that should be classified to the fcoe_fc1 forwarding class. Now if you also attach a classifier to an interface that maps code point 110 to forwarding class fcoe_fc1, then congestion on priority 110 unfairly (and unintentionally) affects the FCoE traffic that uses priority 101. Both priorities 101 and 110 are classified into forwarding class fcoe_fc1, so the traffic from both priorities shares the same fate.

The remaining statements are described separately.

Required Privilege Level

interfaces—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- **forwarding-class (Fibre Channel Interfaces) on page 5800**
- Example: Configuring IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5631
- Understanding CoS IEEE 802.1p Priority Remapping on an FCoE-FC Gateway on page 5446
- Understanding CoS Classifiers on page 5334

CHAPTER 64

Administration

Routine Monitoring

Monitoring CoS Classifiers

Purpose Display the mapping of incoming CoS values to forwarding class and loss priority for each classifier.

Action To monitor CoS classifiers in the CLI, enter the CLI command:

user@switch> **show class-of-service classifier**

To monitor a particular classifier in the CLI, enter the CLI command:

user@switch> **show class-of-service classifier name *classifier-name***

To monitor a particular type of classifier in the CLI, enter the CLI command:

user@switch> **show class-of-service classifier type *classifier-type***

Meaning Table 523 on page 5809 summarizes key output fields for CoS classifiers.

Table 523: Summary of Key CoS Classifier Output Fields

Field	Values
Classifier	Name of a classifier.

Table 523: Summary of Key CoS Classifier Output Fields *(continued)*

Field	Values
Code point type	Type of classifier: • **dscp**—All classifiers of the DSCP type. • **ieee-802.1**—All classifiers of the IEEE 802.1 type. • **ieee-mcast**—All classifiers of the IEEE 802.1 multicast type.
Index	Internal index of the classifier.
Code point	DSCP or IEEE 802.1 code point value of the incoming packets, in bits. These values are used for classification.
Forwarding Class	Name of the forwarding class that the classifier assigns to an incoming packet. This class affects the forwarding and scheduling policies that are applied to the packet as it transits the switch.
Loss Priority	Loss priority value that the classifier assigns to the incoming packet based on its code point value.

Related Documentation

- Defining CoS Unicast BA Classifiers (DSCP, DSCP IPv6, IEEE 802.1p) on page 5673
- Defining CoS Multidestination (Multicast, Broadcast, DLF) BA Classifiers on page 5675

Monitoring CoS Forwarding Classes

Purpose Use the monitoring functionality to view the current assignment of CoS forwarding classes to queue numbers on the system.

Action To monitor CoS forwarding classes in the CLI, enter the following CLI command:

user@switch> **show class-of-service forwarding-class**

Meaning Table 524 on page 5811 summarizes key output fields for CoS forwarding classes.

Table 524: Summary of Key CoS Forwarding Class Output Fields

Field	Values
Forwarding Class	Names of forwarding classes assigned to queue numbers. By default, the following unicast forwarding classes are assigned to queues 0, 3, 4, and 7, respectively: • **best-effort**—Provides no special CoS handling of packets. Loss priority is typically not carried in a CoS value. • **fcoe**—Provides guaranteed delivery for Fibre Channel over Ethernet (FCoE) traffic. • **no-loss**—Provides guaranteed delivery for TCP lossless traffic • **network-control**—Packets can be delayed but not dropped. By default, the following multidestination forwarding class is assigned to queue 8: • **mcast**—Provides no special CoS handling of packets.
Queue	Queue number corresponding to the forwarding class name. By default, four queues (0, 3, 4, and 7) are assigned to unicast forwarding classes and one queue (8) is assigned to a multidestination forwarding class.
No-Loss	Packet drop attribute associated with each forwarding class: • Disabled—The forwarding class is configured for lossy transport (packets might drop during periods of congestion) • Enabled—The forwarding class is configured for lossless transport NOTE: To achieve lossless transport, you must ensure that priority-based flow control (PFC) and DCBX are properly configured on the lossless priority (IEEE 802.1p code point), and that sufficient port bandwidth is reserved for the lossless traffic flows.

Related Documentation

- Defining CoS Forwarding Classes on page 5677
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474

Monitoring Interfaces That Have CoS Components

Purpose Use the monitoring functionality to display details about the physical and logical interfaces and the CoS components assigned to them.

Action To monitor interfaces that have CoS components in the CLI, enter the command:

user@switch> **show class-of-service interface**

To monitor a specific interface in the CLI, enter the command:

user@switch> **show class-of-service interface** ***interface-name***

Meaning Table 525 on page 5812 summarizes key output fields for CoS interfaces.

Table 525: Summary of Key CoS Interfaces Output Fields

Field	Values
Physical interface	Name of a physical interface to which CoS components are assigned.
Index	Index of this interface or the internal index of a specific object.
Queues supported	Number of queues you can configure on the interface.
Queues in use	Number of queues currently configured.
Scheduler map	Name of the scheduler map associated with this interface.
Congestion-notification	Status of congestion notification (enabled or disabled).
Rewrite Input IEEE Code-point	(Fibre Channel NP_Port interfaces only) IEEE 802.1p code point (priority) the interface assigns to incoming Fibre Channel (FC) traffic when the interface encapsulates the FC traffic in Ethernet before forwarding it onto the FCoE network.
Logical Interface	Name of a logical interface on the physical interface to which CoS components are assigned.
Object	Category of an object—for example, **classifier**, **scheduler-map**, or **rewrite**.
Name	Name of the object—for example, **ba-classifier**.
Type	Type of the object—for example, **ieee8021p** for a classifier.

Related Documentation

- Assigning CoS Components to Interfaces on page 5696

Monitoring CoS Rewrite Rules

Purpose Use the monitoring functionality to display information about CoS value rewrite rules, which are based on the forwarding class and loss priority.

Action To monitor CoS rewrite rules in the CLI, enter the CLI command:

user@switch> **show class-of-service rewrite-rule**

To monitor a particular rewrite rule in the CLI, enter the CLI command:

user@switch> **show class-of-service rewrite-rule name *rewrite-rule-name***

To monitor a particular type of rewrite rule (for example, DSCP, DSCP IPv6, or IEEE-802.1) in the CLI, enter the CLI command:

user@switch> **show class-of-service rewrite-rule type *rewrite-rule-type***

Meaning Table 526 on page 5813 summarizes key output fields for CoS rewrite rules.

Table 526: Summary of Key CoS Rewrite Rule Output Fields

Field	Values
Rewrite rule	Name of the rewrite rule.
Code point type	Rewrite rule type: • **dscp**—For IPv4 DiffServ traffic. • **dscp-ipv6**—For IPv6 Diffserv traffic. • **ieee-802.1**—For Layer 2 traffic.
Index	Internal index for the rewrite rule.
Forwarding class	Name of the forwarding class that is used to determine CoS values for rewriting in combination with loss priority. Rewrite rules are applied to CoS values in outgoing packets based on forwarding class and loss priority setting.
Loss priority	Level of loss priority that is used to determine CoS values for rewriting in combination with forwarding class.
Code point	Rewrite code point value.

Related Documentation

- Defining CoS Rewrite Rules on page 5693

Monitoring CoS Scheduler Maps

Purpose Use the monitoring functionality to display assignments of CoS forwarding classes to schedulers.

Action To monitor CoS scheduler maps in the CLI, enter the CLI command:

user@switch> **show class-of-service scheduler-map**

To monitor a specific scheduler map in the CLI, enter the CLI command:

user@switch> **show class-of-service scheduler-map *scheduler-map-name***

Meaning Table 527 on page 5813 summarizes key output fields for CoS scheduler maps.

Table 527: Summary of Key CoS Scheduler Maps Output Fields

Field	Values
Scheduler map	Name of the scheduler map.
Index	Index of a specific object—scheduler maps, schedulers, or drop profiles.

Table 527: Summary of Key CoS Scheduler Maps Output Fields *(continued)*

Field	Values
Scheduler	Name of the scheduler.
Forwarding class	Names of the forwarding classes to which the scheduler is assigned.
Transmit rate	Configured transmit rate of the scheduler as a percentage of the total interface bandwidth.
Priority	Scheduling priority of a queue: • **strict-high** or **high**—Packets in this queue are transmitted first. Only one queue can be configured as **strict-high** or **high**. • **low**—Packets in this queue are transmitted after packets in the **strict-high** queue.
Drop Profiles	Name and index of a drop profile that is assigned to a specific loss priority and protocol pair.
Loss Priority	Drop profile associated with each packet loss priority. You can configure different drop profiles for **low**, **medium-high**, and **high** loss priority traffic.
Protocol	Transport protocol of the drop profile for the particular priority.
Name	Name of the drop profile.

Related Documentation

- Defining CoS Queue Schedulers on page 5679

Monitoring CoS Value Aliases

Purpose Use the monitoring functionality to display information about the CoS value aliases that the system is currently using to represent DSCP and IEEE 802.1p code point bits.

Action To monitor CoS value aliases in the CLI, enter the CLI command:

user@switch> **show class-of-service code-point-aliases**

To monitor a specific type of code-point alias (for example, DSCP or IEEE 802.1) in the CLI, enter the CLI command:

user@switch> **show class-of-service code-point-aliases ieee-802.1**

Meaning Table 528 on page 5815 summarizes key output fields for CoS value aliases.

Table 528: Summary of Key CoS Value Alias Output Fields

Field	Values
Code point type	Type of the CoS value: • **dscp**—Examines Layer 3 packet headers for IP packet classification. • **ieee-802.1**—Examines Layer 2 packet headers for packet classification.
Alias	Name given to a set of bits—for example, **af11** is a name for bits **001010**.
Bit pattern	Set of bits associated with the alias.

Related Documentation

- Defining CoS Code-Point Aliases on page 5672

Operational Commands

- show class-of-service
- show class-of-service classifier
- show class-of-service code-point-aliases
- show class-of-service congestion-notification
- show class-of-service drop-profile
- show class-of-service forwarding-class
- show class-of-service forwarding-class-set
- show class-of-service forwarding-table
- show class-of-service forwarding-table classifier
- show class-of-service forwarding-table classifier mapping
- show class-of-service forwarding-table drop-profile
- show class-of-service forwarding-table rewrite-rule
- show class-of-service forwarding-table rewrite-rule mapping
- show class-of-service forwarding-table scheduler-map
- show class-of-service interface
- show class-of-service multi-destination
- show class-of-service rewrite-rule
- show class-of-service scheduler-map
- show class-of-service shared-buffer
- show class-of-service traffic-control-profile
- show dcbx
- show dcbx neighbors
- show interfaces queue
- show pfe next-hop

- show pfe route
- show pfe terse
- show pfe version

show class-of-service

Syntax show class-of-service

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the class-of-service (CoS) information.

Required Privilege Level view

Related Documentation

- Monitoring CoS Value Aliases on page 5814
- Monitoring CoS Classifiers on page 5809
- Monitoring CoS Forwarding Classes on page 5810
- Monitoring Interfaces That Have CoS Components on page 5811
- Monitoring CoS Scheduler Maps on page 5813
- Monitoring CoS Rewrite Rules on page 5812

List of Sample Output show class-of- service on page 5818

Output Fields Table 529 on page 5817 lists the output fields for the **show class-of-service** command. Output fields are listed in the approximate order in which they appear.

Table 529: show class-of-service Output Fields

Field Name	Field Description	Level of Output
Forwarding class	The forwarding class configuration: • **Forwarding class**—Name of the forwarding class. • **ID**—Forwarding class ID. • **Queue**—Queue number.	All levels
Code point type	The type of code-point alias: • **dscp**—Aliases for DiffServ code point (DSCP) values. • **ieee–802.1**—Aliases for IEEE 802.1p values.	All levels
Alias	Names given to CoS values.	All levels
Bit pattern	Set of bits associated with an alias.	All levels
Classifier	Name of the classifier.	All levels
Code point	Code-point values.	All levels
Loss priority	Loss priority assigned to specific CoS values and aliases of the classifier.	All levels
Rewrite rule	Name of the rewrite rule if one has been configured.	All levels

Table 529: show class-of-service Output Fields *(continued)*

Field Name	Field Description	Level of Output
Drop profile	Name of the drop profile.	All levels
Type	Type of drop profile. QFX Series supports only the **discrete** type of drop-profile.	All levels
Fill level	Percentage of queue buffer fullness in a drop profile at which packets begin to drop during periods of congestion.	All levels
Scheduler map	Name of the scheduler map.	All levels
Scheduler	Name of the scheduler.	All levels
Transmit rate	Transmission rate of the scheduler.	All levels
Buffer size	Delay buffer size in the queue.	All levels
Drop profiles	Drop profiles configured for the specified scheduler.	All levels
Protocol	Transport protocol corresponding to the drop profile.	All levels
Name	Name of the drop profile.	All levels
Queues supported	Number of queues that can be configured on the interface.	All levels
Queues in use	Number of queues currently configured.	All levels
Physical interface	Name of the physical interface.	All levels
Scheduler map	Name of the scheduler map.	All levels
Congestion-notification	Enabled if a congestion notification profile is applied to the interface; disabled if no congestion notification profile is applied to the interface.	All levels
Forwarding class set	Name of the forwarding class set (priority group).	
Index	Internal index of an object.	All levels

Sample Output

show class-of- service

```
user@switch> show class-of-service
Forwarding class                       ID      Queue
  best-effort                           0        0
  fcoe                                  1        3
  no-loss                               2        4
  network-control                       3        7
  mcast                                 8        8

Code point type: dscp
```



```
  Alias              Bit pattern
  af11               001010
  af12               001100
  ...                ...

Code point type: ieee-802.1
  Alias              Bit pattern
  af11               100
  ...                ...

Classifier: dscp-default, Code point type: dscp, Index: 7
  Code point         Forwarding class                    Loss priority
  000000             best-effort                         low
  000001             best-effort                         low
  ...                ...                                 ...

Classifier: ieee8021p-default, Code point type: ieee-802.1, Index: 11
  Code point         Forwarding class                    Loss priority
  000                best-effort                         low
  001                best-effort                         low
  010                best-effort                         low
  011                fcoe                                low
  100                no-loss                             low
  101                best-effort                         low
  110                network-control                     low
  111                network-control                     low

Drop profile:<default-drop-profile>, Type: discrete, Index: 1
  Fill level
         100

Scheduler map: <default>, Index: 2

  Scheduler: <default-be>, Forwarding class: best-effort, Index: 21
    Transmit rate: 5 percent, Rate Limit: none, Buffer size: 5 percent, Buffer
Limit: none,
    Priority: low
    Excess Priority: low
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    <default-drop-profile>
      Medium high     any             1    <default-drop-profile>
      High            any             1    <default-drop-profile>

  Scheduler: <default-fcoe>, Forwarding class: fcoe, Index: 50
    Transmit rate: 35 percent, Rate Limit: none, Buffer size: 35 percent, Buffer
 Limit: none,
    Priority: low
    Excess Priority: low
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    <default-drop-profile>
      Medium high     any             1    <default-drop-profile>
      High            any             1    <default-drop-profile>

  Scheduler: <default-noloss>, Forwarding class: no-loss, Index: 51
    Transmit rate: 35 percent, Rate Limit: none, Buffer size: 35 percent, Buffer
 Limit: none,
    Priority: low
```

```
    Excess Priority: low
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    <default-drop-profile>
      Medium high     any             1    <default-drop-profile>
      High            any             1    <default-drop-profile>

  Scheduler: <default-nc>, Forwarding class: network-control, Index: 23
    Transmit rate: 5 percent, Rate Limit: none, Buffer size: 5 percent, Buffer
Limit: none,
    Priority: low
    Excess Priority: low
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    <default-drop-profile>
      Medium high     any             1    <default-drop-profile>
      High            any             1    <default-drop-profile>

  Scheduler: <default-mcast>, Forwarding class: mcast, Index: 49
    Transmit rate: 20 percent, Rate Limit: none, Buffer size: 20 percent, Buffer
 Limit: none,
    Priority: low
    Excess Priority: low
    drop-profile-map-set-type: mark
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    <default-drop-profile>
      Medium high     any             1    <default-drop-profile>
      High            any             1    <default-drop-profile>

Physical interface: xe-0/0/0, Index: 129
Queues supported: 12, Queues in use: 12
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled

Physical interface: xe-0/0/1, Index: 130
Queues supported: 12, Queues in use: 12
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled

...             ...              ...

Forwarding class set: lan-fcset, Type: normal-type, Forwarding class set index:
7
  Forwarding class                             Index
  best-effort                                    0
```

show class-of-service classifier

Syntax

show class-of-service classifier
<name *name*>
<type dscp | type dscp-ipv6 | type exp | type ieee-802.1 | type inet-precedence>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

For each class-of-service (CoS) classifier, display the mapping of code point value to forwarding class and loss priority.

Options

none—Display all classifiers.

name ***name***—(Optional) Display named classifier.

type dscp—(Optional) Display all classifiers of the Differentiated Services code point (DSCP) type.

type dscp-ipv6—(Optional) Display all classifiers of the DSCP for IPv6 type.

type exp—(Optional) Display all classifiers of the MPLS experimental (EXP) type.

type ieee-802.1—(Optional) Display all classifiers of the ieee-802.1 type.

type inet-precedence—(Optional) Display all classifiers of the inet-precedence type.

Required Privilege Level

view

List of Sample Output

show class-of-service classifier type ieee-802.1 on page 5822
show class-of-service classifier type ieee-802.1 (QFX Series) on page 5822

Output Fields

Table 530 on page 5821 describes the output fields for the **show class-of-service classifier** command. Output fields are listed in the approximate order in which they appear.

Table 530: show class-of-service classifier Output Fields

Field Name	Field Description
Classifier	Name of the classifier.
Code point type	Type of the classifier: **exp** (not on EX Series switch), **dscp**, **dscp-ipv6** (not on EX Series switch), **ieee-802.1**, or **inet-precedence**.
Index	Internal index of the classifier.
Code point	Code point value used for classification
Forwarding class	Classification of a packet affecting the forwarding, scheduling, and marking policies applied as the packet transits the router.

Table 530: show class-of-service classifier Output Fields *(continued)*

Field Name	Field Description
Loss priority	Loss priority value used for classification. For most platforms, the value is **high** or **low**. For some platforms, the value is **high**, **medium-high**, **medium-low**, or **low**.

Sample Output

show class-of-service classifier type ieee-802.1

```
user@host> show class-of-service classifier type ieee-802.1
Classifier: ieee802.1-default, Code point type: ieee-802.1, Index: 3
Code Point         Forwarding Class                  Loss priority
  000              best-effort                         low
  001              best-effort                         high
  010              expedited-forwarding                low
  011              expedited-forwarding                high
  100              assured-forwarding                  low
  101              assured-forwarding                  medium-high
  110              network-control                     low
  111              network-control                     high

Classifier: users-ieee802.1, Code point type: ieee-802.1
  Code point         Forwarding class                    Loss priority
  100                expedited-forwarding                low
```

show class-of-service classifier type ieee-802.1 (QFX Series)

```
user@switch> show class-of-service classifier type ieee-802.1
Classifier: ieee8021p-default, Code point type: ieee-802.1, Index: 11
  Code point         Forwarding class                    Loss priority
  000                best-effort                         low
  001                best-effort                         low
  010                best-effort                         low
  011                fcoe                                low
  100                no-loss                             low
  101                best-effort                         low
  110                network-control                     low
  111                network-control                     low

Classifier: ieee-mcast, Code point type: ieee-802.1, Index: 46
  Code point         Forwarding class                    Loss priority
  000                mcast                               low
  001                mcast                               low
  010                mcast                               low
  011                mcast                               low
  100                mcast                               low
  101                mcast                               low
  110                mcast                               low
  111                mcast                               low
```


show class-of-service code-point-aliases

Syntax show class-of-service code-point-aliases
<dscp | dscp-ipv6 | exp | ieee-802.1 | inet-precedence>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the mapping of class-of-service (CoS) code point aliases to corresponding bit patterns.

Options **none**—Display code point aliases of all code point types.

dscp—(Optional) Display Differentiated Services code point (DSCP) aliases.

dscp-ipv6—(Optional) Display IPv6 DSCP aliases.

exp—(Optional) Display MPLS EXP code point aliases.

ieee-802.1—(Optional) Display IEEE-802.1 code point aliases.

inet-precedence—(Optional) Display IPv4 precedence code point aliases.

Required Privilege Level view

List of Sample Output show class-of-service code-point-aliases exp on page 5824

Output Fields Table 531 on page 5823 describes the output fields for the **show class-of-service code-point-aliases** command. Output fields are listed in the approximate order in which they appear.

Table 531: show class-of-service code-point-aliases Output Fields

Field Name	Field Description
Code point type	Type of the code points displayed: **dscp**, **dscp-ipv6** (not on EX Series switch), **exp** (not on EX Series switch or the QFX Series), **ieee-802.1**, or **inet-precedence** (not on the QFX Series).
Alias	Alias for a bit pattern.
Bit pattern	Bit pattern for which the alias is displayed.

Sample Output

show class-of-service code-point-aliases exp

```
user@host> show class-of-service code-point-aliases exp
Code point type: exp
  Alias              Bit pattern
  af11               100
  af12               101
  be                 000
  be1                001
  cs6                110
  cs7                111
  ef                 010
  ef1                011
  nc1                110
  nc2                111
```


show class-of-service congestion-notification

Syntax show class-of-service congestion-notification

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display whether priority-based flow control (PFC) is enabled for each IEEE 802.1p code point.

Options **none**—Display the PFC state for all IEEE 802.1p code points.

Required Privilege Level view

Related Documentation

- show class-of-service interface on page 5850
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Troubleshooting Dropped FCoE Traffic on page 5279

Output Fields Table 532 on page 5825 describes the output fields for the **show class-of-service congestion-notification** command. Output fields are listed in the approximate order in which they appear.

Table 532: show class-of-service congestion-notification Output Fields

Field Name	Field Description
Type	Type of interfaces on which congestion notification is applied. Congestion notification is applied on input interfaces.
Index	Index of this congestion notification profile.
Name	Name of the congestion notification profile.
Cable Length	Length of the attached physical cable in meters. The default value is 100 meters.
Priority	IEEE 802.1p code point.
PFC	State of PFC for the corresponding code point, either **enabled** or **disabled**.
MRU	Maximum receive unit of the interface in bytes. (Incoming traffic that exceeds the MRU size of an interface is dropped.) The default values are: • 2500 bytes for priority 3 traffic • 9216 bytes for priority 4 traffic NOTE: If you configure flow control on a priority that is not one of the default flow control priorities, the default MRU value is 2500 bytes. For example, if you configure flow control on priority 5 and you do not configure an MRU value, the default MRU value is 2500 bytes.

Table 532: show class-of-service congestion-notification Output Fields *(continued)*

Field Name	Field Description
Flow-Control-Queues	Output queue mapping to IEEE 802.1p code points (priorities). Explicit output queue to priority mapping overwrites the default configuration, and only explicitly mapped queues are displayed in the output. Flow control is only enabled on a queue when you enable PFC on the corresponding priority in the input stanza of the congestion notification profile.

Sample Output

show class-of-service congestion-notification

```
user@switch> show class-of-service congestion-notification
Name: fcoe_p3_cnp, Index: 12037
Type: Input
Cable Length: 100 m
  Priority      PFC         MRU
  000           Disabled
  001           Disabled
  010           Disabled
  011           Enabled     2500
  100           Enabled     9216
  101           Disabled
  110           Disabled
  111           Disabled
Type: Output
  Priority      Flow-Control-Queues
  000
                0
  001
                1
  010
                2
  011
                3
  100
                4
  101
                5
  110
                6
  111
                7

Name: fcoe_p3_p5_cnp, Index: 46484
Type: Input
Cable Length: 100 m
  Priority      PFC         MRU
  000           Disabled
  001           Disabled
  010           Disabled
  011           Enabled     2240
  100           Disabled
  101           Enabled     2240
  110           Disabled
  111           Disabled
Type: Output
  Priority      Flow-Control-Queues
```


011	3
101	5

show class-of-service drop-profile

Syntax

show class-of-service drop-profile
<profile-name *profile-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display data points for each class-of-service (CoS) random early detection (RED) drop profile.

Options

none—Display all drop profiles.

profile-name ***profile-name***—(Optional) Display the specified profile only.

Required Privilege Level

view

List of Sample Output

show class-of-service drop-profile on page 5829
show class-of-service drop-profile (EX4200 Switch) on page 5829
show class-of-service drop-profile (EX8200 Switch) on page 5829

Output Fields

Table 533 on page 5828 describes the output fields for the **show class-of-service drop-profile** command. Output fields are listed in the approximate order in which they appear.

Table 533: show class-of-service drop-profile Output Fields

Field Name	Field Description
Drop profile	Name of a drop profile.
Type	Type of drop profile: • **discrete** (default) • **interpolated** (EX8200 switches only)
Index	Internal index of this drop profile.
Fill Level	Percentage fullness of a queue.
Drop probability	Drop probability at this fill level.

Sample Output

show class-of-service drop-profile

```
user@host> show class-of-service drop-profile
Drop profile: <default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: user-drop-profile, Type: interpolated, Index: 2989
  Fill level    Drop probability
           0                   0
           1                   1
           2                   2
           4                   4
           5                   5
           6                   6
           8                   8
          10                  10
          12                  15
          14                  20
          15                  23
        ... 64 entries total
          90                  96
          92                  96
          94                  97
          95                  98
          96                  98
          98                  99
          99                  99
         100                 100
```

show class-of-service drop-profile (EX4200 Switch)

```
user@switch> show class-of-service drop-profile
Drop profile: <default-drop-profile>, Type: discrete, Index: 1
  Fill level
         100
Drop profile: dp1, Type: discrete, Index: 40496
  Fill level
          10
```

show class-of-service drop-profile (EX8200 Switch)

```
user@switch> show class-of-service drop-profile
Drop profile: <default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: dp1, Type: interpolated, Index: 40496
  Fill level    Drop probability
           0                   0
           1                  80
           2                  90
           4                  90
           5                  90
           6                  90
           8                  90
          10                  90
          12                  91
          14                  91
          15                  91
          16                  91
```

```
             18                  91
             20                  91
             22                  92
             24                  92
             25                  92
             26                  92
             28                  92
             30                  92
             32                  93
             34                  93
             35                  93
             36                  93
             38                  93
             40                  93
             42                  94
             44                  94
             45                  94
             46                  94
             48                  94
             49                  94
             51                  95
             52                  95
             54                  95
             55                  95
             56                  95
             58                  95
             60                  95
             62                  96
             64                  96
             65                  96
             66                  96
             68                  96
             70                  96
             72                  97
             74                  97
             75                  97
             76                  97
             78                  97
             80                  97
             82                  98
             84                  98
             85                  98
             86                  98
             88                  98
             90                  98
             92                  99
             94                  99
             95                  99
             96                  99
             98                  99
             99                  99
            100                 100
Drop profile: dp2, Type: discrete, Index: 40499
  Fill level    Drop probability
             10                   5
             50                  50
```


show class-of-service forwarding-class

Syntax show class-of-service forwarding-class

Release Information Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display information about forwarding classes, including the mapping of forwarding classes to queue numbers.

Required Privilege Level view

Related Documentation

- *Example: Configuring CoS on EX Series Switches*
- *Monitoring CoS Forwarding Classes*
- *Defining CoS Forwarding Classes (CLI Procedure)*
- *Configuring CoS Traffic Classification for Ingress Queuing on Oversubscribed Ports on EX8200 Line Cards (CLI Procedure)*

List of Sample Output

Output Fields Table 534 on page 5831 describes the output fields for the **show class-of-service forwarding-class** command. Output fields are listed in the approximate order in which they appear.

Table 534: show class-of-service forwarding-class Output Fields

Field Name	Field Description
Forwarding class	Name of the forwarding class.
ID	Forwarding class identifier.
Queue	CoS queue mapped to the forwarding class.
Policing priority	Not supported on EX Series switches or the QFX Series and can be ignored.
Fabric priority	(EX8200 switches only) Fabric priority for the forwarding class, either **high** or **low**. Determines the priority of packets entering the switch fabric.

Table 534: show class-of-service forwarding-class Output Fields *(continued)*

Field Name	Field Description
No-Loss	(QFX Series only) Packet loss attribute to differentiate lossless forwarding classes from lossy forwarding classes: • Disabled—Lossless transport is not configured on the forwarding class (packet drop attribute is **drop**). • Enabled—Lossless transport is configured on the forwarding class (packet drop attribute is **no-loss**).

Sample Output

show class-of-service forwarding-class

```
user@switch> show class-of-service forwarding-class
Forwarding class                ID                        Queue  Policing priority
  best-effort                         0                        0            normal
  expedited-forwarding                1                        5            normal
  assured-forwarding                  2                        1            normal
  network-control                     3                        7            normal
```

Sample Output

show class-of-service forwarding-class (EX8200 Switch)

```
user@switch> show class-of-service forwarding-class
Forwarding class                        ID       Queue   Fabric priority
  best-effort                            0        0       low
  expedited-forwarding                   1        5       low
  assured-forwarding                     2        1       low
  network-control                        3        7       low
  mcast-be                               4        2       low
  mcast-ef                               5        4       low
  mcast-af                               6        6       low
```

Sample Output

show class-of-service forwarding-class (QFX Series)

```
user@switch> show class-of-service forwarding-class
Forwarding class                        ID       Queue   Policing priority  No-Loss

  best-effort                           0         0         normal         Disabled

  fcoe                                   1         3         normal         Enabled

  no-loss                                2         4         normal         Enabled

  network-control                       3         7         normal         Disabled

  mcast                                 8         8         normal         Disabled
```

show class-of-service forwarding-class-set

Syntax show class-of-service forwarding-class-set
<*forwarding-class-set-name*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the forwarding classes associated with each forwarding class set.

Options **none**—Display all forwarding class sets.

forwarding-class-set-name—(Optional) Display the forwarding classes associated with the specified forwarding class set.

Required Privilege Level view

Related Documentation

- *Understanding CoS Fabric Forwarding Class Sets*
- Troubleshooting Dropped FCoE Traffic on page 5279

Output Fields Table 535 on page 5833 describes the output fields for the **show class-of-service forwarding-class-set** command. Output fields are listed in the approximate order in which they appear.

Table 535: show class-of-service forwarding-class-set Output Fields

Field Name	Field Description
Forwarding class set	Name of the forwarding class set.
Type	Internal Junos OS type.
Forwarding class set index	Index of this forwarding class set.
Forwarding class	Name of a forwarding class.
Index	Index of this forwarding class.

Sample Output

show class-of-service forwarding-class-set

```
user@switch> show class-of-service forwarding-class-set
Forwarding class set: san_fcset, Type: normal-type, Forwarding class set index:
37839
  Forwarding class                       Index
  fcoe                                     1

Forwarding class set: lan_fcset, Type: normal-type, Forwarding class set index:
37840
  Forwarding class                       Index
```



```
  best-effort                              0

Forwarding class set: multicast_fcset, Type: normal-type, Forwarding class set
index: 37841
  Forwarding class                       Index
  mcast                                    8
```

show class-of-service forwarding-table

Syntax show class-of-service forwarding-table

Syntax (TX Matrix and TX Matrix Plus Router) show class-of-service forwarding-table
<lcc *number*> | <sfc *number*>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the entire class-of-service (CoS) configuration as it exists in the forwarding table. Executing this command is equivalent to executing all **show class-of-service forwarding-table** commands in succession.

Options **lcc** ***number***—(TX Matrix and TX Matrix Plus router only) (Optional) On a TX Matrix router, display the forwarding table configuration for a specific T640 router (or line-card chassis) configured in a routing matrix. On a TX Matrix Plus router, display the forwarding table configuration for a specific router (or line-card chassis) configured in the routing matrix.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

sfc ***number***—(TX Matrix Plus routers only) (Optional) Display the forwarding table configuration for the TX Matrix Plus router. Replace ***number*** with **0**.

Required Privilege Level view

List of Sample Output show class-of-service forwarding-table on page 5836
show class-of-service forwarding-table lcc (TX Matrix Plus Router) on page 5837

Output Fields See the output field descriptions for **show class-of-service forwarding-table** commands:

- show class-of-service forwarding-table classifier
- show class-of-service forwarding-table classifier mapping
- show class-of-service forwarding-table drop-profile
- *show class-of-service forwarding-table fabric scheduler-map*
- *show class-of-service forwarding-table loss-priority-map*

- *show class-of-service forwarding-table loss-priority-map mapping*
- show class-of-service forwarding-table rewrite-rule
- show class-of-service forwarding-table rewrite-rule mapping
- show class-of-service forwarding-table scheduler-map

Sample Output

show class-of-service forwarding-table

```
user@host> show class-of-service forwarding-table
Classifier table index: 9, # entries: 8, Table type: EXP
Entry #    Code point   Forwarding-class #    PLP
   0          000         0                   0
   1          001         0                   1
   2          010         1                   0
   3          011         1                   1
   4          100         2                   0
   5          101         2                   1
   6          110         3                   0
   7          111         3                   1

                       Table Index/
Interface        Index       Q num       Table type
sp-0/0/0.1001      66          11        IPv4 precedence
sp-0/0/0.2001      67          11        IPv4 precedence
sp-0/0/0.16383     68          11        IPv4 precedence
fe-0/0/0.0         69          11        IPv4 precedence

Interface: sp-0/0/0 (Index: 129, Map index: 2, Map type: FINAL,
 Num of queues: 2):
  Entry 0 (Scheduler index: 16, Forwarding-class #: 0):
    Tx rate: 0 Kb (95%), Buffer size: 95 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 1 (Scheduler index: 18, Forwarding-class #: 3):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1

Interface: fe-0/0/0 (Index: 137, Map index: 2, Map type: FINAL,
 Num of queues: 2):
  Entry 0 (Scheduler index: 16, Forwarding-class #: 0):
    Tx rate: 0 Kb (95%), Buffer size: 95 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 1 (Scheduler index: 18, Forwarding-class #: 3):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
Interface: fe-0/0/1 (Index: 138, Map index: 2, Map type: FINAL,
 Num of queues: 2):
  Entry 0 (Scheduler index: 16, Forwarding-class #: 0):
    Tx rate: 0 Kb (95%), Buffer size: 95 percent
Priority low
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1
  Entry 1 (Scheduler index: 18, Forwarding-class #: 3):
    Tx rate: 0 Kb (5%), Buffer size: 5 percent
Priority low
```



```
    PLP high: 1, PLP low: 1, PLP medium-high: 1, PLP medium-low: 1

...

RED drop profile index: 1, # entries: 1
                             Drop
Entry      Fullness(%)   Probability(%)
    0              100               100
```

show class-of-service forwarding-table lcc (TX Matrix Plus Router)

```
user@host> show class-of-service forwarding-table lcc 0
lcc0-re0:
--------------------------------------------------------------------------

Classifier table index: 9, # entries: 64, Table type: IPv6 DSCP
Entry #   Code point   Forwarding-class #   PLP
   0        000000        0        0
   1        000001        0        0
   2        000010        0        0
   3        000011        0        0
   4        000100        0        0
   5        000101        0        0
   6        000110        0        0
   7        000111        0        0
   8        001000        0        0
   9        001001        0        0
  10        001010        0        0
  11        001011        0        0
  12        001100        0        0
  13        001101        0        0
  14        001110        0        0
  15        001111        0        0
  16        010000        0        0
  17        010001        0        0
  18        010010        0        0
  19        010011        0        0
  20        010100        0        0
  21        010101        0        0
  22        010110        0        0
  23        010111        0        0
  24        011000        0        0
  25        011001        0        0
  26        011010        0        0
  27        011011        0        0
  28        011100        0        0
  29        011101        0        0
  30        011110        0        0
  31        011111        0        0
  32        100000        0        0
  33        100001        0        0
  34        100010        0        0
  35        100011        0        0
  36        100100        0        0
  37        100101        0        0
  38        100110        0        0
  39        100111        0        0
  40        101000        0        0
  41        101001        0        0
  42        101010        0        0
  43        101011        0        0
```



```
    44          101100          0          0
    45          101101          0          0
    46          101110          0          0
...
```

show class-of-service forwarding-table classifier

Syntax show class-of-service forwarding-table classifier

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the mapping of code point value to queue number and loss priority for each classifier as it exists in the forwarding table.

Options This command has no options.

Required Privilege Level view

List of Sample Output show class-of-service forwarding-table classifier on page 5839

Output Fields Table 536 on page 5839 describes the output fields for the **show class-of-service forwarding-table classifier** command. Output fields are listed in the approximate order in which they appear.

Table 536: show class-of-service forwarding-table classifier Output Fields

Field Name	Field Description
Classifier table index	Index of the classifier table.
entries	Total number of entries.
Table type	Type of code points in the table: **DSCP**, **EXP** (not on the QFX Series), **IEEE 802.1**, **IPv4 precedence** (not on the QFX Series), or **IPv6 DSCP**.
Entry #	Entry number.
Code point	Code point value used for classification.
Forwarding-class #	Forwarding class to which the code point is assigned.
PLP	Packet loss priority value set by classification. For most platforms, the value can be **0** or **1**. For some platforms, the value is **0**, **1**, **2**, or **3**. The value **0** represents low PLP. The value **1** represents **high** PLP. The value **2** represents medium-low PLP. The value **3** represents medium-high PLP.

Sample Output

show class-of-service forwarding-table classifier

```
user@host> show class-of-service forwarding-table classifier
Classifier table index: 62436, # entries: 64, Table type: DSCP

Entry #    Code point    Forwarding-class #    PLP
```



```
    0          000000       0                   0
    1          000001       0                   0
    2          000010       0                   0
    3          000011       0                   0
    4          000100       0                   0
    5          000101       0                   0
    6          000110       0                   0
    7          000111       0                   0
    8          001000       0                   0
    9          001001       0                   0
   10          001010       1                   1
   11          001011       0                   0
. . .
   60          111100       0                   0
   61          111101       0                   0
   62          111110       0                   0
   63          111111       0                   0
```


show class-of-service forwarding-table classifier mapping

Syntax show class-of-service forwarding-table classifier mapping

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description For each logical interface, display either the table index of the classifier for a given code point type or the queue number (if it is a fixed classification) in the forwarding table.

Options This command has no options.

Required Privilege Level view

List of Sample Output show class-of-service forwarding-table classifier mapping on page 5841

Output Fields Table 537 on page 5841 describes the output fields for the**show class-of-service forwarding-table classifier mapping** command. Output fields are listed in the approximate order in which they appear.

Table 537: show class-of-service forwarding-table classifier mapping Output Fields

Field Name	Field Description
Table index/ Q num	If the table type is **Fixed**, the number of the queue to which the interface is mapped. For all other types, this value is the classifier index number.
Interface	Name of the logical interface. This field can also show the physical interface (QFX Series).
Index	Logical interface index.
Table type	Type of code points in the table: **DSCP**, **EXP** (not on the QFX Series), **Fixed**, **IEEE 802.1**, **IPv4 precedence** (not on the QFX Series),or **IPv6 DSCP**.

Sample Output

show class-of-service forwarding-table classifier mapping

```
user@host> show class-of-service forwarding-table classifier mapping
                       Table index/
Interface      Index     Q num      Table type
so-5/0/0.0        10     62436      DSCP
so-0/1/0.0        11     62436      DSCP
so-0/2/0.0        12         1      Fixed
so-0/2/1.0        13     62436      DSCP
so-0/2/1.0        13     62437      IEEE 802.1
so-0/2/2.0        14     62436      DSCP
so-0/2/2.0        14     62438      IPv4 precedence
```


show class-of-service forwarding-table drop-profile

Syntax show class-of-service forwarding-table drop-profile

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the data points of all random early detection (RED) drop profiles as they exist in the forwarding table.

Options This command has no options.

Required Privilege Level view

List of Sample Output show class-of-service forwarding-table drop-profile on page 5843

Output Fields Table 538 on page 5843 describes the output fields for the **show class-of-service forwarding-table drop-profile** command. Output fields are listed in the approximate order in which they appear.

Table 538: show class-of-service forwarding-table drop-profile Output Fields

Field Name	Field Description
RED drop profile index	Index of this drop profile.
# entries	Number of entries in a particular RED drop profile index.
Entry	Drop profile entry number.
Fullness(%)	Percentage fullness of a queue.
Drop probability(%)	Drop probability at this fill level.

Sample Output

show class-of-service forwarding-table drop-profile

```
user@host> show class-of-service forwarding-table drop-profile
RED drop profile index: 4, # entries: 1
                                 Drop
Entry       Fullness(%)   Probability(%)
    0               100              100

RED drop profile index: 8742, # entries: 3
                                 Drop
Entry       Fullness(%)   Probability(%)
    0                10               10
    1                20               20
    2                30               30
```



```
RED drop profile index: 24627, # entries: 64
                             Drop
Entry      Fullness(%)   Probability(%)
    0                0                0
    1                1                1
    2                2                2
    3                4                4
 ...
   61               98               99
   62               99               99
   63              100              100

RED drop profile index: 25393, # entries: 64
                             Drop
Entry      Fullness(%)   Probability(%)
    0                0                0
    1                1                1
    2                2                2
    3                4                4
 ...
   61               98               98
   62               99               99
   63              100              100
```

show class-of-service forwarding-table rewrite-rule

Syntax show class-of-service forwarding-table rewrite-rule

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display mapping of queue number and loss priority to code point value for each rewrite rule as it exists in the forwarding table.

Options This command has no options.

Required Privilege Level view

List of Sample Output show class-of-service forwarding-table rewrite-rule on page 5845

Output Fields Table 539 on page 5845 describes the output fields for the **show class-of-service forwarding-table rewrite-rule** command. Output fields are listed in the approximate order in which they appear.

Table 539: show class-of-service forwarding-table rewrite-rule Output Fields

Field Name	Field Description
Rewrite table index	Index for this rewrite rule.
# entries	Number of entries in this rewrite rule.
Table type	Type of table: **DSCP**, **EXP** (not on the QFX Series), **EXP-PUSH-3** (not on the QFX Series), **EXP-SWAP-PUSH-2**,(J Series routers only), **IEEE 802.1**,**IPv4 precedence** (not on the QFX Series), **IPv6 DSCP**, or **Fixed**.
Q#	Queue number to which this entry is assigned.
Low bits	Code point value for low-priority loss profile.
State	State of this code point: **enabled**, **rewritten**, or **disabled**.
High bits	Code point value for high-priority loss profile.

Sample Output

show class-of-service forwarding-table rewrite-rule

```
user@host> show class-of-service forwarding-table rewrite-rule
Rewrite table index: 3753, # entries: 4, Table type: DSCP
Q#     Low bits  State      High bits  State
 0      000111   Enabled     001010    Enabled
 2      000000   Disabled    001100    Enabled
```

```
1       101110  Enabled       110111   Enabled
3       110000  Enabled       111000   Enabled
```


show class-of-service forwarding-table rewrite-rule mapping

Syntax show class-of-service forwarding-table rewrite-rule mapping

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description For each logical interface, display the table identifier of the rewrite rule map for each code point type.

Options This command has no options.

Required Privilege Level view

List of Sample Output show class-of-service forwarding-table rewrite-rule mapping on page 5847

Output Fields Table 540 on page 5847 describes the output fields for the **show class-of-service forwarding-table rewrite-rule mapping** command. Output fields are listed in the approximate order in which they appear.

Table 540: show class-of-service forwarding-table rewrite-rule mapping Output Fields

Field Name	Field Description
Interface	Name of the logical interface. This field can also show the physical interface (QFX Series).
Index	Logical interface index.
Table index	Rewrite table index.
Type	Type of classifier: **DSCP**, **EXP** (not on the QFX Series), **EXP-PUSH-3** (not on the QFX Series), **EXP-SWAP-PUSH-2** (not on the QFX Series),**Frame-Relay DE** (J Series routers only)**, IEEE 802.1**, **IPv4 precedence** (not on the QFX Series), **IPv6 DSCP**, or **Fixed**.

Sample Output

show class-of-service forwarding-table rewrite-rule mapping

```
user@host> show class-of-service forwarding-table rewrite-rule mapping
Interface       Index   Table index   Type
so-5/0/0.0         10          3753   DSCP
so-0/1/0.0         11          3753   DSCP
so-0/2/0.0         12          3753   DSCP
so-0/2/1.0         13          3753   DSCP
so-0/2/2.0         14          3753   DSCP
so-0/2/3.0         15          3753   DSCP
```


show class-of-service forwarding-table scheduler-map

Syntax show class-of-service forwarding-table scheduler-map

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description For each physical interface, display the scheduler map information as it exists in the forwarding table.

Options This command has no options.

Required Privilege Level view

List of Sample Output show class-of-service forwarding-table scheduler-map on page 5849

Output Fields Table 541 on page 5848 describes the output fields for the **show class-of-service forwarding-table scheduler-map** command. Output fields are listed in the approximate order in which they appear.

Table 541: show class-of-service forwarding-table scheduler-map Output Fields

Field Name	Field Description
Interface	Name of the physical interface.
Index	Physical interface index.
Map index	Scheduler map index.
Num of queues	Number of queues defined in this scheduler map.
Entry	Number of this entry in the scheduler map.
Scheduler index	Scheduler policy index.
Forwarding-class #	Forwarding class number to which this entry is applied.
Tx rate	Configured transmit rate of the scheduler (in bps). The rate is a percentage of the total interface bandwidth, or the keyword **remainder**, which indicates that the scheduler receives the remaining bandwidth of the interface.
Max buffer delay	Amount of transmit delay (in milliseconds) or buffer size of the queue. This amount is a percentage of the total interface buffer allocation or the keyword **remainder**, which indicates that the buffer is sized according to what remains after other scheduler buffer allocations.
Priority	• **high**—Queue priority is high. • **low**—Queue priority is low.
PLP high	Drop profile index for a high packet loss priority profile.

Table 541: show class-of-service forwarding-table scheduler-map Output Fields *(continued)*

Field Name	Field Description
PLP low	Drop profile index for a low packet loss priority profile.
PLP medium-high	Drop profile index for a medium-high packet loss priority profile.
PLP medium-low	Drop profile index for a medium-low packet loss priority profile.
TCP PLP high	Drop profile index for a high TCP packet loss priority profile.
TCP PLP low	Drop profile index for a low TCP packet loss priority profile.
Policy is exact	If this line appears in the output, exact rate limiting is enabled. Otherwise, no rate limiting is enabled.

Sample Output

show class-of-service forwarding-table scheduler-map

```
user@host> show class-of-service forwarding-table scheduler-map
Interface: so-5/0/0 (Index: 9, Map index: 17638, Num of queues: 2):
  Entry 0 (Scheduler index: 6090, Forwarding-class #: 0):
    Tx rate: 0 Kb (30%), Max buffer delay: 39 bytes (0%)
    Priority low
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low:8742
    Policy is exact
  Entry 1 (Scheduler index: 38372, Forwarding-class #: 1):
    Traffic chunk: Max = 0 bytes, Min = 0 bytes
    Tx rate: 0 Kb (40%), Max buffer delay: 68 bytes (0%)
    Priority high
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low: 8742

Interface: at-6/1/0 (Index: 10, Map index: 17638, Num of queues: 2):
  Entry 0 (Scheduler index: 6090, Forwarding-class #: 0):
    Traffic chunk: Max = 0 bytes, Min = 0 bytes
    Tx rate: 0 Kb (30%), Max buffer delay: 39 bytes (0%)
    Priority high
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low: 8742
  Entry 1 (Scheduler index: 38372, Forwarding-class #: 1):
    Traffic chunk: Max = 0 bytes, Min = 0 bytes
    Tx rate: 0 Kb (40%), Max buffer delay: 68 bytes (0%)
    Priority low
    PLP high: 25393, PLP low: 24627, TCP PLP high: 25393, TCP PLP low: 8742
```


show class-of-service interface

Syntax

show class-of-service interface
<**comprehensive | detail**> <*interface-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Forwarding class map information added in Junos OS Release 9.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 12.1 for the PTX Series Packet Transport Routers.
Command introduced in Junos OS Release 12.2 for the ACX Series Universal Access routers.
Options **detail** and **comprehensive** introduced in Junos OS Release 11.4.

Description

Display the logical and physical interface associations for the classifier, rewrite rules, and scheduler map objects.

Options

none—Display CoS associations for all physical and logical interfaces.

comprehensive—(M Series, MX Series, and T Series routers) (Optional) Display comprehensive quality-of-service (QoS) information about all physical and logical interfaces.

detail—(M Series, MX Series, and T Series routers) (Optional) Display QoS and CoS information based on the interface.

If the **interface** *interface-name* is a physical interface, the output includes:

- Brief QoS information about the physical interface
- Brief QoS information about the logical interface
- CoS information about the physical interface
- Brief information about filters or policers of the logical interface
- Brief CoS information about the logical interface

If the **interface** *interface-name* is a logical interface, the output includes:

- Brief QoS information about the logical interface
- Information about filters or policers for the logical interface
- CoS information about the logical interface

interface-name—(Optional) Display class-of-service (CoS) associations for the specified interface.

Required Privilege Level

view

List of Sample Output

show class-of-service interface (Physical) on page 5861

show class-of-service interface (Logical) on page 5862
show class-of-service interface (Gigabit Ethernet) on page 5862
show class-of-service interface (PPPoE Interface) on page 5862
show class-of-service interface (T4000 Routers with Type 5 FPCs) on page 5862
show class-of-service interface detail on page 5863
show class-of-service interface comprehensive on page 5863
show class-of-service interface (ACX Series Routers) on page 5873

Output Fields

Table 542 on page 5851 describes the output fields for the **show class-of-service interface** command. Output fields are listed in the approximate order in which they appear.

Table 542: show class-of-service interface Output Fields

Field Name	Field Description
Physical interface	Name of a physical interface.
Index	Index of this interface or the internal index of this object.
Dedicated Queues	Status of dedicated queues configured on an interface. Supported only on Trio MPC/MIC interfaces on MX Series routers.
Queues supported	Number of queues you can configure on the interface.
Queues in use	Number of queues currently configured.
Total non-default queues created	Number of queues created in addition to the default queues. Supported only on Trio MPC/MIC interfaces on MX Series routers.
Rewrite Input IEEE Code-point	(QFX Series only) IEEE 802.1p code point (priority) rewrite value. Incoming traffic from the Fibre Channel (FC) SAN is classified into the forwarding class specified in the native FC interface (NP_Port) fixed classifier and uses the priority specified as the IEEE 802.1p rewrite value.
Shaping rate	Maximum transmission rate on the physical interface. You can configure the shaping rate on the physical interface, or on the logical interface, but not on both. Therefore, the **Shaping rate** field is displayed for either the physical interface or the logical interface.
Scheduler map	Name of the output scheduler map associated with this interface.
Scheduler map forwarding class sets	(QFX Series only) Name of the fabric forwarding class set scheduler map associated with a QFabric system Interconnect device interface.
Input shaping rate	For Gigabit Ethernet IQ2 PICs, maximum transmission rate on the input interface.
Input scheduler map	For Gigabit Ethernet IQ2 PICs, name of the input scheduler map associated with this interface.
Chassis scheduler map	Name of the scheduler map associated with the packet forwarding component queues.
Rewrite	Name and type of the rewrite rules associated with this interface.
Classifier	Name and type of classifiers associated with this interface.

Table 542: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Forwarding-class-map	Name of the forwarding map associated with this interface.
Congestion-notification	(QFX Series only) Congestion notification state, **enabled** or **disabled**.
Logical interface	Name of a logical interface.
Object	Category of an object: **Classifier**, **Fragmentation-map** (for LSQ interfaces only), **Scheduler-map**, **Rewrite**, or **Translation Table** (for IQE PICs only).
Name	Name of an object.
Type	Type of an object: **dscp**, **dscp-ipv6**, **exp**, **ieee-802.1**, **ip**, or **inet-precedence**.
Link-level type	Encapsulation on the physical interface.
MTU	MTU size on the physical interface.
Speed	Speed at which the interface is running.
Loopback	Whether loopback is enabled and the type of loopback.
Source filtering	Whether source filtering is enabled or disabled.
Flow control	Whether flow control is enabled or disabled.
Auto-negotiation	(Gigabit Ethernet interfaces) Whether autonegotiation is enabled or disabled.
Remote-fault	(Gigabit Ethernet interfaces) Remote fault status. • **Online**—Autonegotiation is manually configured as online. • **Offline**—Autonegotiation is manually configured as offline.

Table 542: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Device flags	The **Device flags** field provides information about the physical device and displays one or more of the following values: • **Down**—Device has been administratively disabled. • **Hear-Own-Xmit**—Device receives its own transmissions. • **Link-Layer-Down**—The link-layer protocol has failed to connect with the remote endpoint. • **Loopback**—Device is in physical loopback. • **Loop-Detected**—The link layer has received frames that it sent, thereby detecting a physical loopback. • **No-Carrier**—On media that support carrier recognition, no carrier is currently detected. • **No-Multicast**—Device does not support multicast traffic. • **Present**—Device is physically present and recognized. • **Promiscuous**—Device is in promiscuous mode and recognizes frames addressed to all physical addresses on the media. • **Quench**—Transmission on the device is quenched because the output buffer is overflowing. • **Recv-All-Multicasts**—Device is in multicast promiscuous mode and therefore provides no multicast filtering. • **Running**—Device is active and enabled.

Interface flags	The **Interface flags** field provides information about the physical interface and displays one or more of the following values:
	• **Admin-Test**—Interface is in test mode and some sanity checking, such as loop detection, is disabled.
	• **Disabled**—Interface is administratively disabled.
	• **Down**—A hardware failure has occurred.
	• **Hardware-Down**—Interface is nonfunctional or incorrectly connected.
	• **Link-Layer-Down**—Interface keepalives have indicated that the link is incomplete.
	• **No-Multicast**—Interface does not support multicast traffic.
	• **No-receive No-transmit**—Passive monitor mode is configured on the interface.
	• **Point-To-Point**—Interface is point-to-point.
	• **Pop all MPLS labels from packets of depth**—MPLS labels are removed as packets arrive on an interface that has the **pop-all-labels** statement configured. The depth value can be one of the following:
	  ◦ **1**—Takes effect for incoming packets with one label only.
	  ◦ **2**—Takes effect for incoming packets with two labels only.
	  ◦ **[1 2]**—Takes effect for incoming packets with either one or two labels.
	• **Promiscuous**—Interface is in promiscuous mode and recognizes frames addressed to all physical addresses.
	• **Recv-All-Multicasts**—Interface is in multicast promiscuous mode and provides no multicast filtering.
	• **SNMP-Traps**—SNMP trap notifications are enabled.
	• **Up**—Interface is enabled and operational.

Table 542: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Flags	The **Logical interface flags** field provides information about the logical interface and displays one or more of the following values: • **ACFC Encapsulation**—Address control field Compression (ACFC) encapsulation is enabled (negotiated successfully with a peer). • **Device-down**—Device has been administratively disabled. • **Disabled**—Interface is administratively disabled. • **Down**—A hardware failure has occurred. • **Clear-DF-Bit**—GRE tunnel or IPsec tunnel is configured to clear the Don't Fragment (DF) bit. • **Hardware-Down**—Interface protocol initialization failed to complete successfully. • **PFC**—Protocol field compression is enabled for the PPP session. • **Point-To-Point**—Interface is point-to-point. • **SNMP-Traps**—SNMP trap notifications are enabled. • **Up**—Interface is enabled and operational.
Encapsulation	Encapsulation on the logical interface.
Admin	Administrative state of the interface (**Up** or **Down**)
Link	Status of physical link (**Up** or **Down**).
Proto	Protocol configured on the interface.
Input Filter	Names of any firewall filters to be evaluated when packets are received on the interface, including any filters attached through activation of dynamic service.
Output Filter	Names of any firewall filters to be evaluated when packets are transmitted on the interface, including any filters attached through activation of dynamic service.
Link flags	Provides information about the physical link and displays one or more of the following values: • **ACFC**—Address control field compression is configured. The Point-to-Point Protocol (PPP) session negotiates the ACFC option. • **Give-Up**—Link protocol does not continue connection attempts after repeated failures. • **Loose-LCP**—PPP does not use the Link Control Protocol (LCP) to indicate whether the link protocol is operational. • **Loose-LMI**—Frame Relay does not use the Local Management Interface (LMI) to indicate whether the link protocol is operational. • **Loose-NCP**—PPP does not use the Network Control Protocol (NCP) to indicate whether the device is operational. • **Keepalives**—Link protocol keepalives are enabled. • **No-Keepalives**—Link protocol keepalives are disabled. • **PFC**—Protocol field compression is configured. The PPP session negotiates the PFC option.
Hold-times	Current interface hold-time up and hold-time down, in milliseconds.
CoS queues	Number of CoS queues configured.

Table 542: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Last flapped	Date, time, and how long ago the interface went from down to up. The format is **Last flapped:** ***year-month-day hour:minute:second:timezone*** **(*hour:minute:second* ago)**. For example, **Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).**
Statistics last cleared	Number and rate of bytes and packets received and transmitted on the physical interface. • **Input bytes**—Number of bytes received on the interface. • **Output bytes**—Number of bytes transmitted on the interface. • **Input packets**—Number of packets received on the interface. • **Output packets**—Number of packets transmitted on the interface.
IPv6 transit statistics	Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.
Input errors	Input errors on the interface. The labels are explained in the following list: • **Errors**—Sum of the incoming frame aborts and FCS errors. • **Drops**—Number of packets dropped by the input queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. • **Framing errors**—Number of packets received with an invalid frame checksum (FCS). • **Runts**—Number of frames received that are smaller than the runt threshold. • **Giants**—Number of frames received that are larger than the giant threshold. • **Bucket Drops**—Drops resulting from the traffic load exceeding the interface transmit or receive leaky bucket configuration. • **Policed discards**—Number of frames that the incoming packet match code discarded because they were not recognized or not of interest. Usually, this field reports protocols that Junos OS does not handle. • **L3 incompletes**—Number of incoming packets discarded because they failed Layer 3 (usually IPv4) sanity checks of the header. For example, a frame with less than 20 bytes of available IP header is discarded. Layer 3 incomplete errors can be ignored by configuring the **ignore-l3-incompletes** statement. • **L2 channel errors**—Number of times the software did not find a valid logical interface for an incoming frame. • **L2 mismatch timeouts**—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable. • **HS link CRC errors**—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces. • **HS link FIFO overflows**—Number of FIFO overflows on the high-speed links between the ASICs responsible for handling the router interfaces.

Table 542: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Output errors	Output errors on the interface. The labels are explained in the following list: • **Carrier transitions**—Number of times the interface has gone from **down** to **up**. This number does not normally increment quickly, increasing only when the cable is unplugged, the far-end system is powered down and up, or another problem occurs. If the number of carrier transitions increments quickly (perhaps once every 10 seconds), the cable, the far-end system, or the PIC is malfunctioning. • **Errors**—Sum of the outgoing frame aborts and FCS errors. • **Drops**—Number of packets dropped by the output queue of the I/O Manager ASIC. If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism. NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), the **Drops** field does not always use the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs. • **Aged packets**—Number of packets that remained in shared packet SDRAM so long that the system automatically purged them. The value in this field should never increment. If it does, it is most likely a software bug or possibly malfunctioning hardware. • **HS link FIFO underflows**—Number of FIFO underflows on the high-speed links between the ASICs responsible for handling the router interfaces. • **MTU errors**—Number of packets whose size exceeds the MTU of the interface.
Egress queues	Total number of egress queues supported on the specified interface.
Queue counters	CoS queue number and its associated user-configured forwarding class name. • **Queued packets**—Number of queued packets. • **Transmitted packets**—Number of transmitted packets. • **Dropped packets**—Number of packets dropped by the ASIC's RED mechanism. NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), the **Dropped packets** field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.
SONET alarms **SONET defects**	(SONET) SONET media-specific alarms and defects that prevent the interface from passing packets. When a defect persists for a certain period, it is promoted to an alarm. Based on the router configuration, an alarm can ring the red or yellow alarm bell on the router or light the red or yellow alarm LED on the craft interface. See these fields for possible alarms and defects: **SONET PHY**, **SONET section**, **SONET line**, and **SONET path**.
SONET PHY	Counts of specific SONET errors with detailed information. • **Seconds**—Number of seconds the defect has been active. • **Count**—Number of times that the defect has gone from inactive to active. • **State**—State of the error. A state other than **OK** indicates a problem. The **SONET PHY** field has the following subfields: • **PLL Lock**—Phase-locked loop • **PHY Light**—Loss of optical signal

Table 542: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
SONET section	Counts of specific SONET errors with detailed information. • **Seconds**—Number of seconds the defect has been active. • **Count**—Number of times that the defect has gone from inactive to active. • **State**—State of the error. A state other than **OK** indicates a problem. The **SONET section** field has the following subfields: • **BIP-B1**—Bit interleaved parity for SONET section overhead • **SEF**—Severely errored framing • **LOS**—Loss of signal • **LOF**—Loss of frame • **ES-S**—Errored seconds (section) • **SES-S**—Severely errored seconds (section) • **SEFS-S**—Severely errored framing seconds (section)
SONET line	Active alarms and defects, plus counts of specific SONET errors with detailed information. • **Seconds**—Number of seconds the defect has been active. • **Count**—Number of times that the defect has gone from inactive to active. • **State**—State of the error. A state other than **OK** indicates a problem. The **SONET line** field has the following subfields: • **BIP-B2**—Bit interleaved parity for SONET line overhead • **REI-L**—Remote error indication (near-end line) • **RDI-L**—Remote defect indication (near-end line) • **AIS-L**—Alarm indication signal (near-end line) • **BERR-SF**—Bit error rate fault (signal failure) • **BERR-SD**—Bit error rate defect (signal degradation) • **ES-L**—Errored seconds (near-end line) • **SES-L**—Severely errored seconds (near-end line) • **UAS-L**—Unavailable seconds (near-end line) • **ES-LFE**—Errored seconds (far-end line) • **SES-LFE**—Severely errored seconds (far-end line) • **UAS-LFE**—Unavailable seconds (far-end line)

Table 542: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
SONET path	Active alarms and defects, plus counts of specific SONET errors with detailed information. • **Seconds**—Number of seconds the defect has been active. • **Count**—Number of times that the defect has gone from inactive to active. • **State**—State of the error. A state other than **OK** indicates a problem. The **SONET path** field has the following subfields: • **BIP-B3**—Bit interleaved parity for SONET section overhead • **REI-P**—Remote error indication • **LOP-P**—Loss of pointer (path) • **AIS-P**—Path alarm indication signal • **RDI-P**—Path remote defect indication • **UNEQ-P**—Path unequipped • **PLM-P**—Path payload (signal) label mismatch • **ES-P**—Errored seconds (near-end STS path) • **SES-P**—Severely errored seconds (near-end STS path) • **UAS-P**—Unavailable seconds (near-end STS path) • **ES-PFE**—Errored seconds (far-end STS path) • **SES-PFE**—Severely errored seconds (far-end STS path) • **UAS-PFE**—Unavailable seconds (far-end STS path)
Received SONET overhead **Transmitted SONET overhead**	Values of the received and transmitted SONET overhead: • **C2**—Signal label. Allocated to identify the construction and content of the STS-level SPE and for PDI-P. • **F1**—Section user channel byte. This byte is set aside for the purposes of users. • **K1** and **K2**—These bytes are allocated for APS signaling for the protection of the multiplex section. • **J0**—Section trace. This byte is defined for STS-1 number 1 of an STS-*N* signal. Used to transmit a 1-byte fixed-length string or a 16-byte message so that a receiving terminal in a section can verify its continued connection to the intended transmitter. • **S1**—Synchronization status. The S1 byte is located in the first STS-1 number of an STS-*N* signal. • **Z3** and **Z4**—Allocated for future use.
Received path trace **Transmitted path trace**	SONET/SDH interfaces allow path trace bytes to be sent inband across the SONET/SDH link. Juniper Networks and other router manufacturers use these bytes to help diagnose misconfigurations and network errors by setting the transmitted path trace message so that it contains the system hostname and name of the physical interface. The received path trace value is the message received from the router at the other end of the fiber. The transmitted path trace value is the message that this router transmits.
HDLC configuration	Information about the HDLC configuration. • **Policing bucket**—Configured state of the receiving policer. • **Shaping bucket**—Configured state of the transmitting shaper. • **Giant threshold**—Giant threshold programmed into the hardware. • **Runt threshold**—Runt threshold programmed into the hardware.

Table 542: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Packet Forwarding Engine configuration	Information about the configuration of the Packet Forwarding Engine: • **Destination slot**—FPC slot number. • **PLP byte**—Packet Level Protocol byte.
CoS information	Information about the CoS queue for the physical interface. • **CoS transmit queue**—Queue number and its associated user-configured forwarding class name. • **Bandwidth %**—Percentage of bandwidth allocated to the queue. • **Bandwidth bps**—Bandwidth allocated to the queue (in bps). • **Buffer %**—Percentage of buffer space allocated to the queue. • **Buffer usec**—Amount of buffer space allocated to the queue, in microseconds. This value is nonzero only if the buffer size is configured in terms of time. • **Priority**—Queue priority: **low** or **high**. • **Limit**—Displayed if rate limiting is configured for the queue. Possible values are **none** and **exact**. If **exact** is configured, the queue transmits only up to the configured bandwidth, even if excess bandwidth is available. If **none** is configured, the queue transmits beyond the configured bandwidth if bandwidth is available.
Forwarding classes	Total number of forwarding classes supported on the specified interface.
Egress queues	Total number of egress queues supported on the specified interface.
Queue	Queue number.
Forwarding classes	Forwarding class name.
Queued Packets	Number of packets queued to this queue.
Queued Bytes	Number of bytes queued to this queue. The byte counts vary by PIC type.
Transmitted Packets	Number of packets transmitted by this queue. When fragmentation occurs on the egress interface, the first set of packet counters shows the postfragmentation values. The second set of packet counters (displayed under the **Packet Forwarding Engine Chassis Queues** field) shows the prefragmentation values.
Transmitted Bytes	Number of bytes transmitted by this queue. The byte counts vary by PIC type.
Tail-dropped packets	Number of packets dropped because of tail drop.

Table 542: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description

RED-dropped packets	Number of packets dropped because of random early detection (RED).
	• (M Series and T Series routers only) On M320 and M120 routers and the T Series routers, the total number of dropped packets is displayed. On all other M Series routers, the output classifies dropped packets into the following categories:
	  ◦ **Low, non-TCP**—Number of low-loss priority non-TCP packets dropped because of RED.
	  ◦ **Low, TCP**—Number of low-loss priority TCP packets dropped because of RED.
	  ◦ **High, non-TCP**—Number of high-loss priority non-TCP packets dropped because of RED.
	  ◦ **High, TCP**—Number of high-loss priority TCP packets dropped because of RED.
	• (MX Series routers with enhanced DPCs, and T Series routers with enhanced FPCs only) The output classifies dropped packets into the following categories:
	  ◦ **Low**—Number of low-loss priority packets dropped because of RED.
	  ◦ **Medium-low**—Number of medium-low loss priority packets dropped because of RED.
	  ◦ **Medium-high**—Number of medium-high loss priority packets dropped because of RED.
	  ◦ **High**—Number of high-loss priority packets dropped because of RED.
	NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), this field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.

RED-dropped bytes	Number of bytes dropped because of RED. The byte counts vary by PIC type.
	• (M Series and T Series routers only) On M320 and M120 routers and the T Series routers, only the total number of dropped bytes is displayed. On all other M Series routers, the output classifies dropped bytes into the following categories:
	  ◦ **Low, non-TCP**—Number of low-loss priority non-TCP bytes dropped because of RED.
	  ◦ **Low, TCP**—Number of low-loss priority TCP bytes dropped because of RED.
	  ◦ **High, non-TCP**—Number of high-loss priority non-TCP bytes dropped because of RED.
	  ◦ **High, TCP**—Number of high-loss priority TCP bytes dropped because of RED.
	NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), this field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.

Transmit rate	Configured transmit rate of the scheduler. The rate is a percentage of the total interface bandwidth.
Rate Limit	Rate limiting configuration of the queue. Possible values are : • **None**—No rate limit. • **exact**—Queue transmits at the configured rate.
Buffer size	Delay buffer size in the queue.
Priority	Scheduling priority configured as **low** or **high**.
Excess Priority	Priority of the excess bandwidth traffic on a scheduler: **low**, **medium-low**, **medium-high**, **high**, or **none**.

Table 542: show class-of-service interface Output Fields *(continued)*

Field Name	Field Description
Drop profiles	Display the assignment of drop profiles. • **Loss priority**—Packet loss priority for drop profile assignment. • **Protocol**—Transport protocol for drop profile assignment. • **Index**—Index of the indicated object. Objects that have indexes in this output include schedulers and drop profiles. • **Name**—Name of the drop profile. • **Type**—Type of the drop profile: **discrete** or **interpolated**. • **Fill Level**—Percentage fullness of a queue. • **Drop probability**—Drop probability at this fill level.
Excess Priority	Priority of the excess bandwidth traffic on a scheduler.
Drop profiles	Display the assignment of drop profiles. • **Loss priority**—Packet loss priority for drop profile assignment. • **Protocol**—Transport protocol for drop profile assignment. • **Index**—Index of the indicated object. Objects that have indexes in this output include schedulers and drop profiles. • **Name**—Name of the drop profile. • **Type**—Type of the drop profile: **discrete** or **interpolated**. • **Fill Level**—Percentage fullness of a queue. • **Drop probability**—Drop probability at this fill level.

Adjustment information	Display the assignment of shaping-rate adjustments on a scheduler node or queue.
	• **Adjusting application**—Application that is performing the shaping-rate adjustment.
	  ◦ The adjusting application can appear as **ancp LS-0**, which is the Junos OS Access Node Control Profile process (**ancpd**) that performs shaping-rate adjustments on schedule nodes.
	  ◦ The adjusting application can also appear as **pppoe**, which adjusts the shaping-rate and overhead-accounting class-of-service attributes on dynamic subscriber interfaces in a broadband access network based on access line parameters in Point-to-Point Protocol over Ethernet (PPPoE) Tags [TR-101]. This feature is supported on MPC/MIC interfaces on MX Series routers. The shaping rate is based on the actual-data-rate-downstream attribute. The overhead accounting value is based on the access-loop-encapsulation attribute and specifies whether the access loop uses Ethernet (frame mode) or ATM (cell mode).
	• **Adjustment type**—Type of adjustment: **absolute** or **delta**.
	• **Configured shaping rate**—Shaping rate configured for the scheduler node or queue.
	• **Adjustment value**—Value of adjusted shaping rate.
	• **Adjustment target**—Level of shaping-rate adjustment performed: **node** or **queue**.
	• **Adjustment overhead-accounting mode**—Configured shaping mode: **frame** or **cell**.

Sample Output

show class-of-service interface (Physical)

```
user@host> show class-of-service interface so-0/2/3
Physical interface: so-0/2/3, Index: 135
Queues supported: 8, Queues in use: 4
```



```
Total non-default queues created: 4
  Scheduler map: <default>, Index: 2032638653

  Logical interface: fe-0/0/1.0, Index: 68, Dedicated Queues: no
    Shaping rate: 32000
    Object                 Name                   Type            Index
    Scheduler-map          <default>                               27
    Rewrite                exp-default            exp              21
    Classifier             exp-default            exp              5
    Classifier             ipprec-compatibility   ip               8
    Forwarding-class-map   exp-default            exp              5
```

show class-of-service interface (Logical)

```
user@host> show class-of-service interface so-0/2/3.0
Logical interface: so-0/2/3.0, Index: 68, Dedicated Queues: no
    Shaping rate: 32000
    Object                 Name                   Type              Index
    Scheduler-map          <default>                                 27
    Rewrite                exp-default            exp                21
    Classifier             exp-default            exp                5
    Classifier             ipprec-compatibility   ip                 8
    Forwarding-class-map   exp-default            exp                5
```

show class-of-service interface (Gigabit Ethernet)

```
user@host> show class-of-service interface ge-6/2/0
Physical interface: ge-6/2/0, Index: 175
Queues supported: 4, Queues in use: 4
  Scheduler map: <default>, Index: 2
  Input scheduler map: <default>, Index: 3
  Chassis scheduler map: <default-chassis>, Index: 4
```

show class-of-service interface (PPPoE Interface)

```
user@host> show class-of-service interface pp0.1
Logical interface: pp0.1, Index: 85
    Object                 Name                   Type            Index
    Traffic-control-profile tcp-pppoe.o.pp0.1     Output          2726446535
    Classifier             ipprec-compatibility   ip              13

    Adjusting application: PPPoE
      Adjustment type: absolute
      Adjustment value: 5000000
      Adjustment overhead-accounting mode: cell
      Adjustment target: node
```

show class-of-service interface (T4000 Routers with Type 5 FPCs)

```
user@host> show class-of-service interface xe-4/0/0
Physical interface: xe-4/0/0, Index: 153
    Queues supported: 8, Queues in use: 4
      Shaping rate: 5000000000 bps
      Scheduler map: <default>, Index: 2
      Congestion-notification: Disabled

      Logical interface: xe-4/0/0.0, Index: 77
        Object                 Name                   Type
Index
        Classifier             ipprec-compatibility   ip
  13
```


show class-of-service interface detail

user@host> **show class-of-service interface ge-0/3/0 detail**

```
Physical interface: ge-0/3/0, Enabled, Physical link is Up
  Link-level type: Ethernet, MTU: 1518, Speed: 1000mbps, Loopback: Disabled,
Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled,
Remote fault: Online
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000

  Physical interface: ge-0/3/0, Index: 138
  Queues supported: 4, Queues in use: 5
  Shaping rate: 50000 bps
  Scheduler map: interface-schedular-map, Index: 58414
  Input shaping rate: 10000 bps
878674  Input scheduler map: schedular-map, Index: 15103
  Chassis scheduler map: <default-chassis>, Index: 4
  Congestion-notification: Disabled

  Logical interface ge-0/3/0.0
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    inet
    mpls
Interface       Admin Link Proto Input Filter         Output Filter
ge-0/3/0.0      up    up   inet
                           mpls
Interface       Admin Link Proto Input Policer         Output Policer
ge-0/3/0.0      up    up   inet
                           mpls

  Logical interface: ge-0/3/0.0, Index: 68
    Object                 Name                   Type               Index
    Rewrite                exp-default            exp (mpls-any)       33
    Classifier             exp-default            exp                  10
    Classifier             ipprec-compatibility   ip                   13


  Logical interface ge-0/3/0.1
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.2 ]  Encapsulation: ENET2
    inet
Interface       Admin Link Proto Input Filter         Output Filter
ge-0/3/0.1      up    up   inet
Interface       Admin Link Proto Input Policer         Output Policer
ge-0/3/0.1      up    up   inet

  Logical interface: ge-0/3/0.1, Index: 69
    Object                 Name                   Type            Index
    Classifier             ipprec-compatibility   ip                13
```

show class-of-service interface comprehensive

user@host> **show class-of-service interface ge-0/3/0 comprehensive**

```
Physical interface: ge-0/3/0, Enabled, Physical link is Up
  Interface index: 138, SNMP ifIndex: 601, Generation: 141
  Link-level type: Ethernet, MTU: 1518, Speed: 1000mbps, BPDU Error: None,
MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled, Flow
control: Enabled,
  Auto-negotiation: Enabled, Remote fault: Online
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
```

```
  CoS queues     : 4 supported, 4 maximum usable queues
  Schedulers     : 256
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:14:f6:f4:b4:5d, Hardware address: 00:14:f6:f4:b4:5d
  Last flapped   : 2010-09-07 06:35:22 PDT (15:14:42 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                   0                    0 bps
   Output bytes  :                   0                    0 bps
   Input  packets:                   0                    0 pps
   Output packets:                   0                    0 pps
   IPv6 total statistics:
    Input  bytes  :                  0
    Output bytes  :                  0
    Input  packets:                  0
    Output packets:                  0
  Ingress traffic statistics at Packet Forwarding Engine:
   Input  bytes  :                   0                    0 bps
   Input  packets:                   0                    0 pps
   Drop   bytes  :                   0                    0 bps
   Drop   packets:                   0                    0 pps
  Label-switched interface (LSI) traffic statistics:
   Input  bytes  :                   0                    0 bps
   Input  packets:                   0                    0 pps
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 5, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
 FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
  Ingress queues: 4 supported, 5 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 af3                            0                    0                    0

    1 af2                            0                    0                    0

    2 ef2                            0                    0                    0

    3 ef1                            0                    0                    0

  Egress queues: 4 supported, 5 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 af3                            0                    0                    0

    1 af2                            0                    0                    0

    2 ef2                            0                    0                    0

    3 ef1                            0                    0                    0

  Active alarms  : None
  Active defects : None
  MAC statistics:                      Receive         Transmit
    Total octets                             0                0
    Total packets                            0                0
    Unicast packets                          0                0
    Broadcast packets                        0                0
    Multicast packets                        0                0
```

```
    CRC/Align errors                        0                0
    FIFO errors                             0                0
    MAC control frames                      0                0
    MAC pause frames                        0                0
    Oversized frames                        0
    Jabber frames                           0
    Fragment frames                         0
    VLAN tagged frames                      0
    Code violations                         0
  Filter statistics:
    Input packet count                      0
    Input packet rejects                    0
    Input DA rejects                        0
    Input SA rejects                        0
    Output packet count                                      0
    Output packet pad count                                  0
    Output packet error count                                0
    CAM destination filters: 0, CAM source filters: 0
  Autonegotiation information:
    Negotiation status: Complete
    Link partner:
       Link mode: Full-duplex, Flow control: Symmetric/Asymmetric, Remote fault:
 OK
    Local resolution:
      Flow control: Symmetric, Remote fault: Link OK
  Packet Forwarding Engine configuration:
    Destination slot: 0
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %            bps     %           usec
    2 ef2                    39          19500     0            120     high
none
    Direction : Input
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %            bps     %           usec
    0 af3                    30           3000    45              0      low
none

Physical interface: ge-0/3/0, Enabled, Physical link is Up
  Interface index: 138, SNMP ifIndex: 601
Forwarding classes: 16 supported, 5 in use
Ingress queues: 4 supported, 5 in use
Queue: 0, Forwarding classes: af3
  Queued:
    Packets             :                    0                     0 pps
    Bytes               :                    0                     0 bps
  Transmitted:
    Packets             :                    0                      0 pps
    Bytes               :                    0                     0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                   0                     0 pps
    RED-dropped bytes    :                   0                     0 bps
Queue: 1, Forwarding classes: af2
  Queued:
    Packets             :                    0                     0 pps
    Bytes               :                    0                     0 bps
  Transmitted:
    Packets             :                    0                      0 pps
```

```
      Bytes                :                    0                     0 bps
      Tail-dropped packets : Not Available
      RED-dropped packets  :                    0                     0 pps
      RED-dropped bytes    :                    0                     0 bps
  Queue: 2, Forwarding classes: ef2
    Queued:
      Packets              :                    0                     0 pps
      Bytes                :                    0                     0 bps
    Transmitted:
      Packets              :                    0                      0 pps
      Bytes                :                    0                     0 bps
      Tail-dropped packets : Not Available
      RED-dropped packets  :                    0                     0 pps
      RED-dropped bytes    :                    0                     0 bps
  Queue: 3, Forwarding classes: ef1
    Queued:
      Packets              :                    0                     0 pps
      Bytes                :                    0                     0 bps
    Transmitted:
      Packets              :                    0                      0 pps
      Bytes                :                    0                     0 bps
      Tail-dropped packets : Not Available
      RED-dropped packets  :                    0                     0 pps
      RED-dropped bytes    :                    0                     0 bps
  Forwarding classes: 16 supported, 5 in use
  Egress queues: 4 supported, 5 in use
  Queue: 0, Forwarding classes: af3
    Queued:
      Packets              :                    0                     0 pps
      Bytes                :                    0                     0 bps
    Transmitted:
      Packets              :                    0                      0 pps
      Bytes                :                    0                     0 bps
      Tail-dropped packets : Not Available
      RL-dropped packets   :                    0                     0 pps
      RL-dropped bytes     :                    0                     0 bps
      RED-dropped packets  :                    0                     0 pps
      RED-dropped bytes    :                    0                     0 bps
  Queue: 1, Forwarding classes: af2
    Queued:
      Packets              :                    0                     0 pps
      Bytes                :                    0                     0 bps
    Transmitted:
      Packets              :                    0                      0 pps
      Bytes                :                    0                     0 bps
      Tail-dropped packets : Not Available
      RL-dropped packets   :                    0                     0 pps
      RL-dropped bytes     :                    0                     0 bps
      RED-dropped packets  :                    0                     0 pps
      RED-dropped bytes    :                    0                     0 bps
  Queue: 2, Forwarding classes: ef2
    Queued:
      Packets              :                    0                     0 pps
      Bytes                :                    0                     0 bps
    Transmitted:
      Packets              :                    0                      0 pps
      Bytes                :                    0                     0 bps
      Tail-dropped packets : Not Available
      RL-dropped packets   :                    0                     0 pps
      RL-dropped bytes     :                    0                     0 bps
      RED-dropped packets  :                    0                     0 pps
```

```
      RED-dropped bytes    :                    0                    0 bps
  Queue: 3, Forwarding classes: ef1
    Queued:
      Packets              :                    0                    0 pps
      Bytes                :                    0                    0 bps
    Transmitted:
      Packets              :                    0                     0 pps
      Bytes                :                    0                    0 bps
      Tail-dropped packets : Not Available
      RL-dropped packets   :                    0                    0 pps
      RL-dropped bytes     :                    0                    0 bps
      RED-dropped packets  :                    0                    0 pps
      RED-dropped bytes    :                    0                    0 bps

  Packet Forwarding Engine Chassis Queues:
  Queues: 4 supported, 5 in use
  Queue: 0, Forwarding classes: af3
    Queued:
      Packets              :                    0                    0 pps
      Bytes                :                    0                    0 bps
    Transmitted:
      Packets              :                    0                     0 pps
      Bytes                :                    0                    0 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  : Not Available
      RED-dropped bytes    : Not Available
  Queue: 1, Forwarding classes: af2
    Queued:
      Packets              :                    0                    0 pps
      Bytes                :                    0                    0 bps
    Transmitted:
      Packets              :                    0                     0 pps
      Bytes                :                    0                    0 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  : Not Available
      RED-dropped bytes    : Not Available
  Queue: 2, Forwarding classes: ef2
    Queued:
      Packets              :                    0                    0 pps
      Bytes                :                    0                    0 bps
    Transmitted:
      Packets              :                    0                     0 pps
      Bytes                :                    0                    0 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  : Not Available
      RED-dropped bytes    : Not Available
  Queue: 3, Forwarding classes: ef1
    Queued:
      Packets              :               108546                    0 pps
      Bytes                :             12754752                  376 bps
    Transmitted:
      Packets              :               108546                     0 pps
      Bytes                :             12754752                  376 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  : Not Available
      RED-dropped bytes    : Not Available

  Physical interface: ge-0/3/0, Index: 138
  Queues supported: 4, Queues in use: 5
    Shaping rate: 50000 bps
```

```
Scheduler map: interface-schedular-map, Index: 58414

  Scheduler: ef2, Forwarding class: ef2, Index: 39155
    Transmit rate: 39 percent, Rate Limit: none, Buffer size: 120 us, Buffer
Limit: none, Priority: high
    Excess Priority: unspecified
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    < default-drop-profile>
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any             1    < default-drop-profile>
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
  Input shaping rate: 10000 bps
  Input scheduler map: schedular-map

Scheduler map: schedular-map, Index: 15103

  Scheduler: af3, Forwarding class: af3, Index: 35058
    Transmit rate: 30 percent, Rate Limit: none, Buffer size: 45 percent, Buffer
 Limit: none, Priority: low
    Excess Priority: unspecified
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any         40582    green
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any         18928    yellow
Drop profile: green, Type: discrete, Index: 40582
  Fill level    Drop probability
         50                   0
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
        100                 100
Drop profile: yellow, Type: discrete, Index: 18928
  Fill level    Drop probability
         50                   0
        100                 100
  Chassis scheduler map: < default-drop-profile>
Scheduler map: < default-drop-profile>, Index: 4

  Scheduler: < default-drop-profile>, Forwarding class: af3, Index: 25
    Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
 Limit: none, Priority: low
    Excess Priority: low
    Drop profiles:
```

```
      Loss priority   Protocol    Index    Name
      Low             any             1    < default-drop-profile>
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any             1    < default-drop-profile>
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                100

  Scheduler: < default-drop-profile>, Forwarding class: af2, Index: 25
    Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
 Limit: none, Priority: low
    Excess Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    < default-drop-profile>
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any             1    < default-drop-profile>
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                100

  Scheduler: < default-drop-profile>, Forwarding class: ef2, Index: 25
    Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
 Limit: none, Priority: low
    Excess Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    < default-drop-profile>
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any             1    < default-drop-profile>
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
```

```
  Fill level    Drop probability
         100                 100

  Scheduler: < default-drop-profile>, Forwarding class: ef1, Index: 25
    Transmit rate: 25 percent, Rate Limit: none, Buffer size: 25 percent, Buffer
 Limit: none, Priority: low
    Excess Priority: low
    Drop profiles:
      Loss priority   Protocol    Index    Name
      Low             any             1    < default-drop-profile>
      Medium low      any             1    < default-drop-profile>
      Medium high     any             1    < default-drop-profile>
      High            any             1    < default-drop-profile>
Drop profile: , Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
Drop profile: < default-drop-profile>, Type: discrete, Index: 1
  Fill level    Drop probability
         100                 100
  Congestion-notification: Disabled
Forwarding class                       ID      Queue  Restricted queue  Fabric
priority  Policing priority
  af3                                   0       0          0              low
            normal
  af2                                   1       1          1              low
            normal
  ef2                                   2       2          2              high
            normal
  ef1                                   3       3          3              high
            normal
  af1                                   4       4          0              low
            normal

  Logical interface ge-0/3/0.0 (Index 68) (SNMP ifIndex 152) (Generation 159)
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Transit statistics:
     Input  bytes  :                   0                    0 bps
     Output bytes  :                   0                    0 bps
     Input  packets:                   0                    0 pps
     Output packets:                   0                    0 pps
    Protocol inet, MTU: 1500, Generation: 172, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Input Filters: filter-in-ge-0/3/0.0-i,
      Policer: Input: p1-ge-0/3/0.0-inet-i
    Protocol mpls, MTU: 1488, Maximum labels: 3, Generation: 173, Route table: 0
```

```
      Flags: Is-Primary
      Output Filters: exp-filter,,,,,

  Logical interface ge-0/3/0.0 (Index 68) (SNMP ifIndex 152)
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.1 ]  Encapsulation: ENET2
    Input packets : 0
    Output packets: 0

Interface       Admin Link Proto Input Filter         Output Filter
ge-0/3/0.0      up    up   inet  filter-in-ge-0/3/0.0-i
                           mpls                       exp-filter
Interface       Admin Link Proto Input Policer         Output Policer
ge-0/3/0.0      up    up
                           inet  p1-ge-0/3/0.0-inet-i
                           mpls

Filter: filter-in-ge-0/3/0.0-i
Counters:
Name                                                Bytes              Packets
count-filter-in-ge-0/3/0.0-i                            0                    0

Filter: exp-filter
Counters:
Name                                                Bytes              Packets
count-exp-seven-match                                   0                    0
count-exp-zero-match                                    0                    0
Policers:
Name                                              Packets
p1-ge-0/3/0.0-inet-i                                    0


  Logical interface: ge-0/3/0.0, Index: 68
    Object                 Name                   Type                    Index

    Rewrite                exp-default            exp (mpls-any)             33

Rewrite rule: exp-default, Code point type: exp, Index: 33
  Forwarding class                    Loss priority       Code point
  af3                                 low                 000
  af3                                 high                001
  af2                                 low                 010
  af2                                 high                011
  ef2                                 low                 100
  ef2                                 high                101
  ef1                                 low                 110
  ef1                                 high                111
    Object                 Name                   Type                    Index

    Classifier             exp-default            exp                        10

Classifier: exp-default, Code point type: exp, Index: 10
  Code point         Forwarding class                    Loss priority
  000                af3                                 low
  001                af3                                 high
  010                af2                                 low
  011                af2                                 high
  100                ef2                                 low
  101                ef2                                 high
  110                ef1                                 low
  111                ef1                                 high
```

```
    Object                 Name                   Type                   Index

    Classifier             ipprec-compatibility   ip                        13

Classifier: ipprec-compatibility, Code point type: inet-precedence, Index: 13
  Code point         Forwarding class                    Loss priority
  000                af3                                 low
  001                af3                                 high
  010                af3                                 low
  011                af3                                 high
  100                af3                                 low
  101                af3                                 high
  110                ef1                                 low
  111                ef1                                 high
Forwarding class                       ID      Queue  Restricted queue  Fabric
priority  Policing priority
  af3                                   0       0          0             low
            normal
  af2                                   1       1          1             low
            normal
  ef2                                   2       2          2             high
            normal
  ef1                                   3       3          3             high
            normal
  af1                                   4       4          0             low
            normal

  Logical interface ge-0/3/0.1 (Index 69) (SNMP ifIndex 154) (Generation 160)
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.2 ]  Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Local statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Transit statistics:
     Input  bytes  :                    0                    0 bps
     Output bytes  :                    0                    0 bps
     Input  packets:                    0                    0 pps
     Output packets:                    0                    0 pps
    Protocol inet, MTU: 1500, Generation: 174, Route table: 0
      Flags: Sendbcast-pkt-to-re

  Logical interface ge-0/3/0.1 (Index 69) (SNMP ifIndex 154)
    Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.2 ]  Encapsulation: ENET2
    Input packets : 0
    Output packets: 0


Interface       Admin Link Proto Input Filter         Output Filter
ge-0/3/0.1      up    up   mpls
Interface       Admin Link Proto Input Policer         Output Policer
ge-0/3/0.1      up    up
                           mpls

  Logical interface: ge-0/3/0.1, Index: 69
    Object                 Name                   Type                   Index
```



```
   Classifier            ipprec-compatibility   ip                        13

Classifier: ipprec-compatibility, Code point type: inet-precedence, Index: 13
  Code point          Forwarding class                    Loss priority
  000                 af3                                 low
  001                 af3                                 high
  010                 af3                                 low
  011                 af3                                 high
  100                 af3                                 low
  101                 af3                                 high
  110                 ef1                                 low
  111                 ef1                                 high
Forwarding class                   ID      Queue  Restricted queue  Fabric
priority  Policing priority
  af3                               0       0          0             low
            normal
  af2                               1       1          1             low
            normal
  ef2                               2       2          2             high
            normal
  ef1                               3       3          3             high
            normal
  af1                               4       4          0             low
            normal
```

show class-of-service interface (ACX Series Routers)

```
user@host-g11# show class-of-service interface
Physical interface: at-0/0/0, Index: 130
Queues supported: 4, Queues in use: 4
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled

  Logical interface: at-0/0/0.0, Index: 69

  Logical interface: at-0/0/0.32767, Index: 70

Physical interface: at-0/0/1, Index: 133
Queues supported: 4, Queues in use: 4
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled

  Logical interface: at-0/0/1.0, Index: 71

  Logical interface: at-0/0/1.32767, Index: 72

Physical interface: ge-0/1/0, Index: 146
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                 Name                   Type                    Index
Rewrite                dscp-default           dscp                       31
Classifier             d1                     dscp                    11331
Classifier             ci                     ieee8021p                 583

  Logical interface: ge-0/1/0.0, Index: 73
Object                 Name                   Type                    Index
Rewrite                custom-exp             exp (mpls-any)          46413
```

```
  Logical interface: ge-0/1/0.1, Index: 74

  Logical interface: ge-0/1/0.32767, Index: 75

Physical interface: ge-0/1/1, Index: 147
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                  Name                    Type                    Index
Classifier              ipprec-compatibility    ip                         13

  Logical interface: ge-0/1/1.0, Index: 76

Physical interface: ge-0/1/2, Index: 148
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                  Name                    Type                    Index
Rewrite                 ri                      ieee8021p (outer)       35392
Classifier              ci                      ieee8021p                 583

Physical interface: ge-0/1/3, Index: 149
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                  Name                    Type                    Index
Classifier              ipprec-compatibility    ip                         13

  Logical interface: ge-0/1/3.0, Index: 77
Object                  Name                    Type                    Index
Rewrite                 custom-exp2             exp (mpls-any)          53581

Physical interface: ge-0/1/4, Index: 150
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                  Name                    Type                    Index
Classifier              ipprec-compatibility    ip                         13

Physical interface: ge-0/1/5, Index: 151
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                  Name                    Type                    Index
Classifier              ipprec-compatibility    ip                         13

Physical interface: ge-0/1/6, Index: 152
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                  Name                    Type                    Index
Classifier              ipprec-compatibility    ip                         13

Physical interface: ge-0/1/7, Index: 153
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                  Name                    Type                    Index
Classifier              d1                      dscp                    11331
```

```
Physical interface: ge-0/2/0, Index: 154
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                 Name                   Type                    Index
Classifier             ipprec-compatibility   ip                         13

Physical interface: ge-0/2/1, Index: 155
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                 Name                   Type                    Index
Classifier             ipprec-compatibility   ip                         13

  Logical interface: ge-0/2/1.0, Index: 78

  Logical interface: ge-0/2/1.32767, Index: 79

Physical interface: xe-0/3/0, Index: 156
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                 Name                   Type                    Index
Classifier             ipprec-compatibility   ip                         13

  Logical interface: xe-0/3/0.0, Index: 80

Physical interface: xe-0/3/1, Index: 157
Queues supported: 8, Queues in use: 5
  Scheduler map: <default>, Index: 2
  Congestion-notification: Disabled
Object                 Name                   Type                    Index
Classifier             ipprec-compatibility   ip                         13

  Logical interface: xe-0/3/1.0, Index: 81

[edit]
user@host-g11#
```


show class-of-service multi-destination

Syntax

show class-of-service multi-destination

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

For each class-of-service (CoS) multidestination classifier, display the classifier type.

Options

none—Display all multidestination classifiers.

Required Privilege Level

view

Related Documentation

- show class-of-service classifier on page 5821
- Understanding Applying CoS Classifiers and Rewrite Rules to Interfaces on page 5344
- *Understanding CoS Fabric Forwarding Class Sets*

Output Fields

Table 543 on page 5876 describes the output fields for the **show class-of-service multi-destination** command. Output fields are listed in the approximate order in which they appear.

Table 543: show class-of-service multi-destination Output Fields

Field Name	Field Description
Family ethernet	Family to which the classifier belongs.
Classifier Name	Name of the classifier.
Classifier Type	Type of the classifier: **dscp** or **ieee-802.1**.
Classifier Index	Internal index of the classifier.

Sample Output

show class-of-service multi-destination

user@switch> show class-of-service multi-destination

```
Family ethernet:
Classifier Name             Classifier Type            Classifier Index
  ba-mcast-classifier         ieee-802.1                 62376
```


show class-of-service rewrite-rule

Syntax

show class-of-service rewrite-rule
<name *name*>
<type *type*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the mapping of forwarding classes and loss priority to code point values.

Options

none—Display all rewrite rules.

name *name*—(Optional) Display the specified rewrite rule.

type *type*—(Optional) Display the rewrite rule of the specified type. The rewrite rule type can be one of the following:

- **dscp**—For IPv4 traffic.
- **dscp-ipv6**—For IPv6 traffic.
- **exp**—For MPLS traffic.
- **frame-relay-de**—(J Series routers only) For Frame Relay traffic.
- **ieee-802.1**—For Layer 2 traffic.
- **inet-precedence**—For IPv4 traffic.

Required Privilege Level

view

List of Sample Output

show class-of-service rewrite-rule type dscp on page 5878
show class-of-service rewrite-rule type dscp (QFX Series) on page 5878

Output Fields

Table 544 on page 5877 describes the output fields for the **show class-of-service rewrite-rule** command. Output fields are listed in the approximate order in which they appear.

Table 544: show class-of-service rewrite-rule Output Fields

Field Name	Field Description
Rewrite rule	Name of the rewrite rule.
Code point type	Type of rewrite rule: **dscp**, **dscp-ipv6**, **exp**, **frame-relay-de**, or **inet-precedence**.
Forwarding class	Classification of a packet affecting the forwarding, scheduling, and marking policies applied as the packet transits the router or switch.
Index	Internal index for this particular rewrite rule.
Loss priority	Loss priority for rewriting.

Table 544: show class-of-service rewrite-rule Output Fields *(continued)*

Field Name	Field Description
Code point	Code point value to rewrite.

Sample Output

show class-of-service rewrite-rule type dscp

```
user@host> show class-of-service rewrite-rule type dscp
Rewrite rule: dscp-default, Code point type: dscp
  Forwarding class                    Loss priority       Code point
  gold                                high                000000
  silver                              low                 110000
  silver                              high                111000
  bronze                              low                 001010
  bronze                              high                001100
  lead                                high                101110

Rewrite rule: abc-dscp-rewrite, Code point type: dscp, Index: 3245
Forwarding class                    Loss priority       Code point
  gold                                low                 000111
  gold                                high                001010
  silver                              low                 110000
  silver                              high                111000
  bronze                              high                001100
  lead                                low                 101110
  lead                                high                110111
```

Sample Output

show class-of-service rewrite-rule type dscp (QFX Series)

```
user@host> show class-of-service rewrite-rule type dscp
Rewrite rule: dscp-default, Code point type: dscp, Index: 31
  Forwarding class                    Loss priority       Code point
  best-effort                         low                 000000
  best-effort                         high                000000
  fcoe                                low                 101110
  fcoe                                high                101110
  no-loss                             low                 001010
  no-loss                             high                001100
  network-control                     low                 110000
  network-control                     high                111000
```


show class-of-service scheduler-map

Syntax show class-of-service scheduler-map
<*name*>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the mapping of schedulers to forwarding classes and a summary of scheduler parameters for each entry.

Options **none**—Display all scheduler maps.

name—(Optional) Display a summary of scheduler parameters for each forwarding class to which the named scheduler is assigned.

Required Privilege Level view

List of Sample Output show class-of-service scheduler-map on page 5880

Output Fields Table 545 on page 5879 describes the output fields for the **show class-of-service scheduler-map** command. Output fields are listed in the approximate order in which they appear.

Table 545: show class-of-service scheduler-map Output Fields

Field Name	Field Description
Scheduler map	Name of the scheduler map.
Index	Index of the indicated object. Objects having indexes in this output include scheduler maps, schedulers, and drop profiles.
Scheduler	Name of the scheduler.
Forwarding class	Classification of a packet affecting the forwarding, scheduling, and marking policies applied as the packet transits the router.
Transmit rate	Configured transmit rate of the scheduler (in bps). The rate is a percentage of the total interface bandwidth, or the keyword **remainder**, which indicates that the scheduler receives the remaining bandwidth of the interface.
Rate Limit	Rate limiting configuration of the queue. Possible values are **none**, meaning no rate limiting, and **exact**, meaning the queue only transmits at the configured rate.
Maximum buffer delay	Amount of transmit delay (in milliseconds) or the buffer size of the queue. The buffer size is shown as a percentage of the total interface buffer allocation, or by the keyword **remainder** to indicate that the buffer is sized according to what remains after other scheduler buffer allocations.
Priority	Scheduling priority: **low** or **high**.

Table 545: show class-of-service scheduler-map Output Fields *(continued)*

Field Name	Field Description
Excess priority	Priority of excess bandwidth: **low**, **medium-low**, **medium-high**, **high**, or **none**.
Adjust minimum	Minimum shaping rate for an adjusted queue, in bps.
Adjust percent	Bandwidth adjustment applied to a queue, in percent.
Drop profiles	Table displaying the assignment of drop profiles by name and index to a given loss priority and protocol pair.
Loss priority	Packet loss priority for drop profile assignment.
Protocol	Transport protocol for drop profile assignment.
Name	Name of the drop profile.

Sample Output

show class-of-service scheduler-map

```
user@host> show class-of-service scheduler-map
Scheduler map: dd-scheduler-map, Index: 84

  Scheduler: aa-scheduler, Index: 8721, Forwarding class: aa-forwarding-class
   Transmit rate: 30 percent, Rate Limit: none, Maximum buffer delay: 39 ms,
   Priority: high
   Drop profiles:
    Loss priority    Protocol    Index    Name
     Low             non-TCP     8724     aa-drop-profile
     Low             TCP         9874     bb-drop-profile
     High            non-TCP     8833     cc-drop-profile
     High            TCP         8484     dd-drop-profile

  Scheduler: bb-scheduler, Forwarding class: aa-forwarding-class
   Transmit rate: 40 percent, Rate limit: none, Maximum buffer delay: 68 ms,
   Priority: high
   Drop profiles:
    Loss priority    Protocol    Index    Name
     Low             non-TCP     8724     aa-drop-profile
     Low             TCP         9874     bb-drop-profile
     High            non-TCP     8833     cc-drop-profile
     High            TCP         8484     dd-drop-profile
```

show class-of-service shared-buffer

Syntax

show class-of-service shared-buffer
<egress | ingress>

Release Information

Command introduced in Junos OS Release 12.3 for the QFX Series.

Description

Display the shared buffer allocation and partitioning configuration.

Options

none—Display ingress and egress shared buffer settings.

egress—(Optional) Display the egress shared buffer settings.

ingress—(Optional) Display the ingress shared buffer settings.

Required Privilege Level

view

Related Documentation

- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Best-Effort Unicast Traffic on page 5530
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Multicast Traffic on page 5541
- Example: Recommended Configuration of the Shared Buffer Pool for Networks with Mostly Lossless Traffic on page 5547
- Configuring Global Ingress and Egress Shared Buffers on page 5690
- Understanding CoS Buffer Configuration on page 5391

List of Sample Output

show class-of-service shared-buffer on page 5882

Output Fields

Table 546 on page 5881 describes the output fields for the **show class-of-service shared-buffer** command. Output fields are listed in the approximate order in which they appear.

Table 546: show class-of-service shared-buffer Output Fields

Field Name	Field Description
Ingress	Ingress shared buffer configuration.
Total Buffer	Total buffer space available to the ports in KB. This is the combined dedicated buffer pool and shared buffer pool.
Dedicated Buffer	Buffer space allocated to the dedicated buffer pool in KB.
Shared Buffer	Buffer space allocated to the shared buffer pool in KB.
Lossless	Buffer space allocated to the lossless traffic buffer pool in KB.

Table 546: show class-of-service shared-buffer Output Fields *(continued)*

Field Name	Field Description
Lossless Headroom	Buffer space allocated to the lossless headroom traffic buffer pool to support priority-based flow control (PFC) and Ethernet PAUSE in KB. (Ingress ports only.)
Lossy	Buffer space allocated to the lossy (best-effort) traffic buffer pool in KB.
Lossless Headroom Utilization	Utilization of the ingress lossless headroom buffer pool. (These fields can help you to determine how much headroom buffer space you need to reserve to support PFC and Ethernet PAUSE for lossless flows.)
Node Device	Index number that identifies the switch. On a QFX3500 switch, this field always has a value of zero (0).
Total	Size of the lossless headroom ingress buffer pool in KB.
Used	Amount in KB of lossless headroom ingress buffer used.
Free	Amount in KB of lossless headroom ingress buffer free (unused).
Egress	Egress shared buffer configuration.
Multicast	Buffer space allocated to the multicast traffic buffer pool in KB. (Egress ports only.)

Sample Output

show class-of-service shared-buffer

```
user@switch> show class-of-service shared-buffer
Ingress:
  Total Buffer     :  9360.00 KB
  Dedicated Buffer :  2158.00 KB
  Shared Buffer    :  7202.00 KB
    Lossless          :  648.18 KB
    Lossless Headroom :  3240.90 KB
    Lossy             :  3312.92 KB

  Lossless Headroom Utilization:
  Node Device         Total          Used                  Free
  0                   3240.90 KB     0.00 KB               3240.90 KB

Egress:
  Total Buffer     :  9360.00 KB
  Dedicated Buffer :  2704.00 KB
  Shared Buffer    :  6656.00 KB
    Lossless          :  3328.00 KB
    Multicast         :  1264.64 KB
    Lossy             :  2063.36 KB
```

show class-of-service traffic-control-profile

Syntax

show class-of-service traffic-control-profile
<*profile-name*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 12.2 for ACX Series Routers.

Description

For Gigabit Ethernet IQ PICs, Channelized IQ PICs, EQ DPCs, and Trio MPC/MIC interfaces only, display traffic shaping and scheduling profiles.

(ACX Series routers) For ATM IMA pseudowire interfaces, display traffic shaping and scheduling profiles.

Options

none—Display all profiles.

profile-name—(Optional) Display information about a single profile.

Required Privilege Level

view

List of Sample Output

show class-of-service traffic-control-profile on page 5885
show class-of-service traffic-control-profile (MX Series routers with Clear Channel Multi-Rate CE MIC) on page 5885
show class-of-service traffic-control-profile (ACX Series routers with ATM IMA pseudowire interfaces) on page 5885

Output Fields

Table 547 on page 5883 describes the output fields for the **show class-of-service traffic-control-profile** command. Output fields are listed in the approximate order in which they appear.

Table 547: show class-of-service traffic-control-profile Output Fields

Field Name	Field Description
Traffic control profile	Name of the traffic control profile.
Index	Index number of the traffic control profile.
ATM Service	(MX Series routers with ATM Multi-Rate CE MIC) Configured category of ATM service. Possible values: • cbr—Constant bit rate. • rtvbr—Real time variable bit rate. • nrtvbr—Non real time variable bit rate. • ubr—Unspecified bit rate.
Maximum Burst Size	Configured maximum burst size, in cells.
Peak rate	Configured peak rate, in cps.

Table 547: show class-of-service traffic-control-profile Output Fields *(continued)*

Field Name	Field Description
Sustained rate	Configured sustained rate, in cps.
Shaping rate	Configured shaping rate, in bps. NOTE: (MX Series routers with ATM Multi-Rate CE MIC) Configured peak rate, in cps.
Shaping rate burst	Configured burst size for the shaping rate, in bytes. NOTE: (MX Series routers with ATM Multi-Rate CE MIC) Configured maximum burst rate, in cells.
Shaping rate priority high	Configured shaping rate for high-priority traffic, in bps.
Shaping rate priority medium	Configured shaping rate for medium-priority traffic, in bps.
Shaping rate priority low	Configured shaping rate for low-priority traffic, in bps.
Shaping rate excess high	Configured shaping rate for high-priority excess traffic, in bps.
Shaping rate excess low	Configured shaping rate for low-priority excess traffic, in bps.
Scheduler map	Name of the associated scheduler map.
Delay Buffer rate	Configured delay buffer rate, in bps.
Excess rate	Configured excess rate, in percent or proportion.
Excess rate high	Configured excess rate for high priority traffic, in percent or proportion.
Excess rate low	Configured excess rate for low priority traffic, in percent or proportion.
Guaranteed rate	Configured guaranteed rate, in bps or cps. NOTE: (MX Series routers with ATM Multi-Rate CE MIC) This value depends on the ATM service category chosen. Possible values: • **cbr**—Guaranteed rate is equal to the configured peak rate in cps. • **rtvbr**—Guaranteed rate is equal to the configured sustained rate in cps. • **nrtvbr**—Guaranteed rate is equal to the configured sustained rate in cps.
Guaranteed rate burst	Configured burst size for the guaranteed rate, in bytes.
adjust-minimum	Configured minimum shaping rate for an adjusted queue, in bps.

Table 547: show class-of-service traffic-control-profile Output Fields *(continued)*

Field Name	Field Description
overhead accounting mode	Configured shaping mode: **Frame Mode** or **Cell Mode**.
Overhead bytes	Configured byte adjustment value.

Sample Output

show class-of-service traffic-control-profile

```
user@host> show class-of-service traffic-control-profile
Traffic control profile: Profile1, Index: 57625
  Scheduler map: m1
  Delay Buffer rate: 500000
  Guaranteed rate: 1000000

Traffic control profile: Profile2, Index: 57624
  Scheduler map: m2
  Delay Buffer rate: 600000
  Guaranteed rate: 2000000

Traffic control profile: Profile3, Index: 57627
  Scheduler map: m3
  Delay Buffer rate: 800000
  Guaranteed rate: 3000000
 .Excess rate high: proportion 4

Traffic control profile: Profile4, Index: 57626
  Scheduler map: m4
  Delay Buffer rate: 750000
  Guaranteed rate: 4000000
..adjust-minimum 20000000
```

show class-of-service traffic-control-profile (MX Series routers with Clear Channel Multi-Rate CE MIC)

```
user@host> show class-of-service traffic-control-profile
Traffic control profile: at-vbr1, Index: 11395
  ATM Service: RTVBR
  Scheduler map: m3
  overhead accounting mode: Frame Mode
  Shaping rate: 1000 cps
  Shaping rate burst: 500 cells
  Delay Buffer rate: 2000 cps
  Guaranteed rate: 1000 cps

Traffic control profile: foo, Index: 38286
  ATM Service: UBR
  Scheduler map: m3
  overhead accounting mode: Frame Mode
```

show class-of-service traffic-control-profile (ACX Series routers with ATM IMA pseudowire interfaces)

```
user@host> show class-of-service traffic-control-profile
Traffic control profile: foo, Index: 38286
  ATM Service: RTVBR
  Shaping rate: 2000 cps
```

```
Shaping rate burst: 200 cells
Scheduler map: <default>
Delay Buffer rate: 1000 cps
Guaranteed rate: 1700 cps
```


show dcbx

Syntax show dcbx

Release Information Command introduced in Junos OS Release 11.3 for the QFX Series.

Description List DCBX status (enabled or disabled) and the interfaces on which DCBX is enabled.

Required Privilege Level view

Related Documentation

- show dcbx neighbors on page 5177
- Configuring DCBX Autonegotiation on page 5076

Output Fields Table 395 on page 5176 lists the output fields for the **show dcbx** command. Output fields are listed in the approximate order in which they appear.

Table 548: show dcbx output fields

Field Name	Field Description
DCBX	Status of DCBX on the switch or for the specified interface: • Enabled—DCBX is enabled on the switch or on the specified interface • Disabled—DCBX is disabled on the switch or on the specified interface
Interface	Name of the interface

Sample Output

show dcbx

```
user@switch> show dcbx
DCBX                                : Enabled
Interface         DCBX
xe-0/0/9.0        enabled
xe-0/0/32.0       enabled
xe-0/0/36.0       enabled
```

show dcbx neighbors

Syntax

show dcbx neighbors
<**interface** *interface-name*>
<**terse**>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 11.3 for EX Series switches.

Description

Display information about Data Center Bridging Capability Exchange protocol (DCBX) neighbor interfaces.

Options

none—Display information about all DCBX neighbor interfaces.

interface-name—(Optional) Display information for the specified interface.

terse—Display the specified level of output.

Required Privilege Level

view

Related Documentation

- Configuring DCBX Autonegotiation on page 5076
- Example: Configuring DCBX Application Protocol TLV Exchange on page 4929
- *Example: Configuring an FCoE Transit Switch*
- *Example: Configuring DCBX to Support an iSCSI Application*
- Understanding DCB Features and Requirements on page 4795
- *Understanding Data Center Bridging Capability Exchange Protocol for EX Series Switches*
- dcbx on page 5092

List of Sample Output

show dcbx neighbors interface (QFX Series, DCBX Version 1.01 Mode) on page 5901
show dcbx neighbors interface (QFX Series, IEEE DCBX Mode) on page 5903
show dcbx neighbors terse (QFX Series) on page 5905
show dcbx neighbors (EX4500 Switch: FCoE Interfaces on Both Local and Peer with PFC Configured Compatibly) on page 5905
show dcbx neighbors (EX4500 Switch: DCBX Interfaces on Local and Peer Are Configured Compatibly with iSCSI Application) on page 5906
show dcbx neighbors (EX4500 Switch: Includes ETS) on page 5907

Output Fields

Table 396 on page 5177 lists the output fields for the **show dcbx neighbors** command. Output fields are listed in the approximate order in which they appear.

Table 549: show dcbx neighbors Output Fields

Field Name	Field Description
Interface	Name of the interface.

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
Parent Interface		Name of the link aggregation group (LAG) interface to which the DCBX interface belongs.
Active-application-map		Name of the application map applied to the interface.
Protocol-Mode		(QFX Series) DCBX protocol mode the interface uses: • IEEE DCBX Version—The interface uses IEEE DCBX mode. • DCBX Version 1.01—The interface uses DCBX version 1.01. NOTE: On interfaces that use the IEEE DCBX mode, the **show dcbx neighbors interface** ***interface-name*** operational command does not include application, PFC, or ETS operational state in the output.
Protocol-State		(DCBX Version 1.01 only) DCBX protocol state synchronization status: • **in-sync**—The local interface received an acknowledge message from the peer to indicate that the peer received a state change message sent by the local interface. • **ack-pending**—The local interface has not yet received an acknowledge message from the peer to indicate that the peer received a state change message sent by the local interface.
Local-Advertisement		(DCBX Version 1.01 only) Status of advertisements that the local interface sends to the peer.
	Operational version	Version of the DCBX standard used.
	sequence-number	Number of state change messages sent to the peer. If the interface **Protocol-State** value is **in-sync**, this number should match the **acknowledge-id** number in the **Peer-Advertisement** section. If the interface **Protocol-State** value is **ack-pending**, this number does not match the **acknowledge-id** number in the **Peer-Advertisement** section.
	acknowledge-id	Number of acknowledge messages received from the peer. If the **Protocol-State** value is **in-sync**, this number should match the **sequence-number** value in the **Peer-Advertisement** section. If the **Protocol-State** value is **ack-pending**, this number does not match the **sequence-number** value in the **Peer-Advertisement** section.

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
Peer-Advertisement		(DCBX Version 1.01 only) Status of advertisements that the peer sends to the local interface.
	Operational version	Version of the DCBX standard used.
	sequence-number	Number of state change messages the peer sent to the local interface. If this number matches the **acknowledge-id** number in the **Local-Advertisement** field, this indicates that the local interface has acknowledged all of the peer's state change messages and is synchronized. If this number does not match the **acknowledge-id** number in the **Local-Advertisement** field, this indicates that the peer has not yet received an acknowledgment for a state change message from the local interface.
	acknowledge-id	Number of acknowledge messages the peer has received from the local interface. If this number matches the **sequence-number** value in the **Local-Advertisement** field, this indicates that the peer has acknowledged all of the local interface's state change messages and is in synchronization. If this number does not match the **sequence-number** value in the **Local-Advertisement** field, this indicates that the peer has not yet sent an acknowledgment for a state change message from the local interface.

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name			Field Description
Feature: PFC			Priority-based flow control (PFC) feature DCBX state information.
	Protocol-State		(DCBX Version 1.01 only) DCBX protocol state synchronization status: • **ack-pending**—The local interface has not yet received an acknowledge message from the peer to indicate that the peer received a PFC state change message sent by the local interface. • **in-sync**—The local interface received an acknowledge message from the peer to indicate that the peer received a PFC state change message sent by the local interface. • **not-applicable**—PFC autonegotiation is disabled.
	Operational State		(DCBX Version 1.01 only) Operational state of the feature: **enabled** or **disabled**.
	Local-Advertisement		Status of advertisements that the local interface sends to the peer.
		Enable	(DCBX Version 1.01 only) State that the local interface advertises to the peer: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
		Willing	Willingness of the local interface to learn the PFC configuration from the peer using DCBX: • **Yes**—The local interface is willing to learn the PFC configuration from the peer. • **No**—The local interface is not willing to learn the PFC configuration from the peer.
		Mac auth Bypass Capability	(IEEE DCBX only) (QFX Series) Media access controller (MAC) authentication bypass provides access to devices based on MAC address authentication. This is not supported, so the only value seen in the local advertisement field is **no**.
		Error	(DCBX Version 1.01 only) Configuration compatibility error status: • **No**—No error detected. Local and peer configuration are compatible. • **Yes**—Error detected. Local and peer configuration are not compatible.

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name			Field Description
		Operational State	PFC operational state on the interface: • Enabled—PFC is enabled on the interface • Disabled—PFC is disabled on the interface
		Maximum Traffic Classes capable to support PFC	Largest number of traffic classes the local interface supports for PFC: • **6** (EX Series switches) • **8** (QFX Series)
		Code Point	PFC code point, which is specified in the 3-bit class-of-service field in the VLAN header.
		Admin Mode	PFC administrative state for each code point on the local interface: • **Enabled**—PFC is enabled for the code point. • **Disabled**—PFC is disabled for the code point.
		Operational Mode	(QFX Series) PFC operational mode for each code point: • Enable—PFC is enabled on the code point. • Disable—PFC is disabled on the code point.
	Peer-Advertisement		Status of advertisements that the peer sends to the local interface.
		Enable	(DCBX Version 1.01 only) State that the peer advertises to the local interface: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
		Willing	Willingness of the peer to learn the PFC configuration from the local interface using DCBX: • **Yes**—The peer is willing to learn the PFC configuration from the local interface. • **No**—The peer is not willing to learn the PFC configuration from the local interface.
		Error	(DCBX Version 1.01 only) Configuration compatibility error status: • **No**—No error detected. Local and peer configuration are compatible. • **Yes**—Error detected. Local and peer configuration are not compatible.

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
	Operational State	PFC operational state on the interface: • Enabled—PFC is enabled on the interface • Disabled—PFC is disabled on the interface
	Mac auth Bypass Capability	(IEEE DCBX only) (QFX Series) Media access controller (MAC) authentication bypass provides access to devices based on MAC address authentication. Although the QFX Series does not support this feature, the connected peer might support it. This field reports the peer state: • **Yes**—The connected peer supports MAC authentication bypass. • **No**—The connected peer does not support MAC authentication bypass.
	Maximum Traffic Classes capable to support PFC	Largest number of traffic classes the peer supports for PFC: • **6** (EX Series switches) • **8** (QFX Series)
	Code Point	PFC code point, which is specified in the 3-bit class-of-service field in the VLAN header.
	Admin Mode	PFC administrative state for each code point on the peer: • **Enabled**—PFC is enabled for the code point. • **Disabled**—PFC is disabled for the code point.

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name			Field Description
Feature: Application			State information for the DCBX application.
	Protocol-State		(DCBX Version 1.01 only) DCBX protocol state synchronization status: • **in-sync**—The local interface received an acknowledge message from the peer to indicate that the peer received an FCoE state change message sent by the local interface. • **ack-pending**—The local interface has not yet received an acknowledge message from the peer to indicate that the peer received an FCoE state change message sent by the local interface. • **not-applicable**—The local interface is set to **no-auto-negotiation** (autonegotiation is disabled). If the interface is associated with an FCoE forwarding class, the interface advertises FCoE capability even if the connected peer does not advertise FCoE capability.
	Local-Advertisement		Status of advertisements that the local interface sends to the peer. If the local interface is set to **no-auto-negotiation** (autonegotiation is disabled), the local advertisement portion of the output is not shown.
		Enable	(DCBX Version 1.01 only) State that the local interface advertises to the peer: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
		Willing	(DCBX Version 1.01 only) Willingness of the local interface to learn the FCoE interface state from the peer using DCBX: • **Yes**—The local interface is willing to learn the FCoE interface state from the peer. • **No**—The local interface is not willing to learn the FCoE interface state from the peer.
		Error	(DCBX Version 1.01 only) Configuration compatibility error status: • **No**—No error detected. The local and peer configuration are compatible. • **Yes**—Error detected. The local and peer configuration are not compatible.
		Appl-Name	Name of the application:

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
	Ethernet-Type	(DCBX Version 1.01 only) Ethernet type (EtherType) of the application. For example, **0x8906** indicates the EtherType for the FCoE application. Either the EtherType (for Layer 2 applications) or the Socket Number (for Layer 4 applications) of the application is displayed in the output.
	Socket-Number	Destination port socket number of the application, if applicable. Either the EtherType (for Layer 2 applications) or the Socket Number (for Layer 4 applications) of the application is displayed in the output.
	Priority-Field or **Priority-Map**	Priority assigned to the application. For EX Series switches, the priority of the FCoE application is determined by the PFC congestion notification profile that has been configured and associated with the FCoE interface. For other applications, the priority is based on the application map.
	Status	(DCBX Version 1.01 only) Local status when autonegotiation is enabled: • **Enabled**—The application feature is enabled on both the local interface and the peer interface. (The local configuration and the peer configuration match.) • **Disabled**—The local configuration and the peer configuration do not match. NOTE: If there is a configuration mismatch in one application between the switch and the peer, all the other applications including FCoE are disabled.
Peer-Advertisement		Status of advertisements that the peer sends to the local interface.
	Enable	(DCBX Version 1.01 only) State that the peer advertises to the local interface: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
	Willing	(DCBX Version 1.01 only) Willingness of the peer to learn the FCoE interface state from the local interface using DCBX: • **Yes**—The peer is willing to learn the FCoE interface state from the local interface. • **No**—The peer is not willing to learn the FCoE interface state from the local interface.

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name	Field Description
Error	(DCBX Version 1.01 only) Configuration compatibility error status: • **No**—No error detected. Local and peer configuration are compatible. • **Yes**—Error detected. Local and peer configuration are not compatible.
Appl-Name	Name of the application: • **FCoE**—Fibre Channel over Ethernet
Ethernet-Type	Ethernet type (EtherType) of the application. For example, **0x8906** indicates the EtherType for the FCoE application. Either the EtherType (for Layer 2 applications) or the Socket-Number (for Layer 4 applications) of the application is displayed in the output.
Socket-Number	Destination port socket number of the application, if applicable. Either the EtherType (for Layer 2 applications) or the Socket Number (for Layer 4 applications) of the application is displayed in the output.
Priority-Field or **Priority-Map**	Priority assigned to the application.
Status	(DCBX Version 1.01 only) Peer interface status: • **Enabled**—The application feature is enabled on both the local interface and the peer interface. (The local configuration and the peer configuration match.) • **Disabled**—The local configuration and the peer configuration do not match.

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name			Field Description
Feature: ETS			Enhanced Transmission Selection (ETS) DCBX state information.
	Protocol-State		(DCBX Version 1.01 only) ETS protocol state synchronization status: • **in-sync**—The local interface received an acknowledge message from the peer to indicate that the peer received an ETS state change message sent by the local interface. • **ack-pending**—The local interface has not yet received an acknowledge message from the peer to indicate that the peer received an ETS state change message sent by the local interface.
	Operational State		(DCBX Version 1.01 only) Operational state of the feature, **enabled** or **disabled**.
	Local-Advertisement		Status of advertisements that the local interface sends to the peer.
		Enable	(DCBX Version 1.01 only) State that the local interface advertises to the peer: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
		TLV Type	(IEEE DCBX only) Type of ETS TLV: • Configuration—Advertises the Configuration TLV, which communicates the local ETS configuration to the peer but does not ask the peer to use the configuration. • Recommendation—Advertises the Recommendation TLV, which communicates the local ETS configuration to the peer, and if the peer is “willing,” configures the peer interface to match the local ETS configuration. • Recommendation-or-Configuration—Advertises both TLVs.
		Willing	Willingness of the local interface to learn the ETS state from the peer using DCBX (EX Series switches always advertise **No** for this field): • **Yes**—Local interface is willing to learn the ETS state from the peer. • **No**—Local interface is not willing to learn the ETS state from the peer.
		Credit Based Shaper	

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name			Field Description
			(IEEE DCBX only) Alternative method of flow control to buffer-to-buffer credit. The QFX Series does not support a credit-based shaper, so the value of this field is always **No**.
		Error	(DCBX Version 1.01 only) Configuration error status: • **No**—No error. This should always be the switch ETS error state. • **Yes**—Error detected.
		Maximum Traffic Classes capable to support PFC	(DCBX Version 1.01 only) Largest number of traffic classes the local interface supports for PFC.
		Maximum Traffic Classes supported	(IEEE DCBX only) Largest number of traffic classes the local interface supports for ETS. (EX Series switches support only one traffic class for ETS. However, a different value might be shown for this field.)
		Code Point	PFC code point, which is specified in the 3-bit class-of-service field in the VLAN header.
		Priority-Group	Class-of-service (CoS) priority group (forwarding class set) identification number.
		Percentage B/W	Configured minimum percentage of link bandwidth allocated to the priority group. Only explicitly configured values appear in this output column. If the link bandwidth is the default percentage, it is not shown. (EX Series switches allocate 100% of link bandwidth to the default priority group, group 7.)
		Transmission Selection Algorithm	(IEEE DCBX only) The transmission selection algorithm used by the interface. The QFX Series supports ETS but does not support using the credit-based shaper algorithm, so the only value shown in this field is **ETS**.
	Peer-Advertisement		Status of advertisements that the peer sends to the local interface.
		Enable	

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
		(DCBX Version 1.01 only) State that the peer advertises to the local interface: • **Yes**—The feature is enabled. • **No**—The feature is disabled.
	TLV Type	(IEEE DCBX only) Type of ETS TLV: • Configuration—Advertises the Configuration TLV, which communicates the local ETS configuration to the peer but does not ask the peer to use the configuration. • Recommendation—Advertises the Recommendation TLV, which communicates the local ETS configuration to the peer, and if the peer is “willing,” configures the peer interface to match the local ETS configuration. • Configuration/Recommendation—Advertises both TLVs.
	Willing	Willingness of the peer to learn the ETS state from the local interface using DCBX: • **Yes**—Peer is willing to learn the ETS state from the local interface. • **No**—Peer is not willing to learn the ETS state from the local interface.
	Credit Based Shaper	(IEEE DCBX only) Alternative method of flow control to buffer-to-buffer credit. The QFX Series does not support a credit-based shaper, so the value of this field is always **No**.
	Error	(DCBX Version 1.01 only) Configuration error status of the peer: • **No**—No error in peer ETS TLV. • **Yes**—Error in peer ETS TLV.
	Maximum Traffic Classes capable to support PFC	(DCBX Version 1.01 only) Largest number of traffic classes the local interface supports for PFC.
	Maximum Traffic Classes supported	(IEEE DCBX only) Largest number of traffic classes the local interface supports for ETS. (EX Series switches support only one traffic class for ETS. However, a different value might be shown for this field.)
	Code Point	

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name		Field Description
		PFC code point, which is specified in the 3-bit class-of-service field in the VLAN header.
	Priority-Group	CoS priority group (forwarding class set) identification number.
	Percentage B/W	Configured minimum percentage of link bandwidth allocated to the priority group. (EX Series switches allocate 100% of link bandwidth to the default priority group, group 7.)
	Transmission Selection Algorithm	(IEEE DCBX only) Transmission selection algorithm used by the interface. The QFX Series supports ETS but does not support using the credit-based shaper algorithm, so the only value shown in this field is **ETS**.
PFC		(QFX Series, **terse** option only) DCBX TLV advertisement state for PFC: • Disabled—PFC configuration matches the configuration on the connected peer and PFC is disabled • Enabled—PFC configuration matches the configuration on the connected peer and PFC is enabled • Not Advt—Interface does not advertise PFC to the connected peer
ETS		(**terse** option only) Local DCBX TLV advertisement state for ETS: • Advt—Interface advertises ETS TLVs • Disabled—ETS is disabled on the interface (interface does not advertise ETS)
ETS Rec		(**terse** option only) DCBX TLV peer advertisement state for ETS (state received from the connected DCBX peer): • Advt—Peer interface advertises ETS TLVs • Not Advt—Peer interface does not advertise ETS NOTE: When the DCBX mode is DCBX version 1.01, no peer information is displayed.

Table 549: show dcbx neighbors Output Fields *(continued)*

Field Name	Field Description
Version	(**terse** option only) The DCBX version used on the interface and whether the DCBX version was autonegotiated or explicitly configured: • **IEEE**—The interface uses IEEE DCBX. • **1.01**—The interface uses DCBX version 1.01. When the DCBX version used is the result of autonegotiation, the term **(Auto)** appears next to the version. For example, **IEEE (Auto)** indicates that the interface autonegotiated with the connected peer to use IEEE DCBX. Autonegotiation is enabled by default.

Sample Output

show dcbx neighbors interface (QFX Series, DCBX Version 1.01 Mode)

```
user@switch> show dcbx neighbors interface xe-0/0/0
Interface : xe-0/0/0.0 - Parent Interface: ae0.0
    Active-application-map: app-map-1
    Protocol-State: in-sync
    Protocol-Mode: DCBX Version 1.01

    Local-Advertisement:
        Operational version: 1
        sequence-number: 130, acknowledge-id: 102

    Peer-Advertisement:
        Operational version: 1
        sequence-number: 102, acknowledge-id: 130

    Feature: PFC, Protocol-State: in-sync

      Operational State: Enabled

      Local-Advertisement:
        Enable: Yes, Willing: No, Error: No
        Maximum Traffic Classes capable to support PFC: 8

        Code Point           Admin Mode   Operational Mode
          000                 Disabled     Disable
          001                 Disabled     Disable
          010                 Disabled     Disable
          011                 Enabled      Enable
          100                 Enabled      Enable
          101                 Disabled     Disable
          110                 Disabled     Disable
          111                 Disabled     Disable

      Peer-Advertisement:
        Enable: Yes, Willing: No, Error: No
        Maximum Traffic Classes capable to support PFC: 8

        Code Point           Admin Mode
          000                 Disabled
```

```
    001                 Disabled
    010                 Disabled
    011                 Enabled
    100                 Enabled
    101                 Disabled
    110                 Disabled
    111                 Disabled

Feature: Application, Protocol-State: in-sync

  Local-Advertisement:
    Enable: Yes, Willing: No, Error: No

    Appl-Name    Ethernet-Type    Socket-Number    Priority-Map    Status
      FCoE         0x8906                            00001110        Enabled

      iSCSI                           3260           10000000        Enabled


  Peer-Advertisement:
    Enable: Yes, Willing: Yes, Error: No

    Appl-Name    Ethernet-Type    Socket-Number    Priority-Map    Status

      FCoE         0x8906             N/A            00001110        Enabled


Feature: ETS, Protocol-State: in-sync

  Operational State: Enabled

  Local-Advertisement:
    Enable: Yes, Willing: No, Error: No
    Maximum Traffic Classes capable to support PFC: 8

    Code Point           Priority-Group
      000                  0
      001                  7
      010                  7
      011                  7
      100                  0
      101                  1
      110                  1
      111                  7

    Priority-Group       Percentage B/W
      0                    40%
      1                    5%

  Peer-Advertisement:
    Enable: Yes, Willing: No, Error: No
    Maximum Traffic Classes capable to support PFC: 8

    Code Point           Priority-Group
      000                  0
      001                  7
      010                  7
      011                  7
      100                  0
      101                  1
      110                  1
```



```
    111                   7

  Priority-Group        Percentage B/W
    0                     40%
    1                     5%
```

show dcbx neighbors interface (QFX Series, IEEE DCBX Mode)

```
user@switch> show dcbx neighbors interface xe-0/0/0
Interface : xe-0/0/0.0 - Parent Interface: ae0.0
    Active-application-map: app-map-1
    Protocol-Mode: IEEE-DCBX Version

    Feature: PFC

      Local-Advertisement:
        Willing: No
        Mac auth Bypass Capability: No
        Operational State: Enabled

        Maximum Traffic Classes capable to support PFC: 8

        Code Point           Admin Mode
          000                  Disabled
          001                  Disabled
          010                  Disabled
          011                  Enabled
          100                  Enabled
          101                  Disabled
          110                  Disabled
          111                  Disabled

      Peer-Advertisement:
        Willing: No
        Mac auth Bypass Capability: No
        Operational State: Enabled

        Maximum Traffic Classes capable to support PFC: 8

        Code Point          Admin Mode
          000                 Disabled
          001                 Disabled
          010                 Disabled
          011                 Enabled
          100                 Enabled
          101                 Disabled
          110                 Disabled
          111                 Disabled

    Feature: Application

      Local-Advertisement:

        Appl-Name     Ethernet-Type     Socket-Number     Priority-field
          FCoE          0x8906                              00001110
          iSCSI                               3260          10000000

      Peer-Advertisement:
        Appl-Name     Ethernet-Type     Socket-Number     Priority-field
```

```
      FCoE         0x8906             N/A            00001110

Feature: ETS

  Local-Advertisement:
    TLV Type: Configuration/Recommendation
    Willing: No
    Credit Based Shaper: No
    Maximum Traffic Classes supported: 3

    Code Point           Priority-Group
      000                  0
      001                  7
      010                  7
      011                  7
      100                  0
      101                  1
      110                  1
      111                  7

    Priority-Group       Percentage B/W
      0                    40%
      1                    5%

    Priority-Group   Transmission Selection Algorithm
      0              Enhanced Transmission Selection
      1              Enhanced Transmission Selection

  Peer-Advertisement:
    TLV Type: Configuration
    Willing: No
    Credit Based Shaper: No

    Code Point           Priority-Group
      000                  0
      001                  7
      010                  7
      011                  7
      100                  0
      101                  1
      110                  1
      111                  7

    Priority-Group       Percentage B/W
      0                    40%
      1                    5%

    Priority-Group   Transmission Selection Algorithm
      0              Enhanced Transmission Selection
      1              Enhanced Transmission Selection

  Peer-Advertisement:

    TLV Type: Recommendation

    Code Point           Priority-Group
      000                  0
      001                  7
      010                  7
      011                  7
      100                  0
```



```
    101                  1
    110                  1
    111                  7

  Priority-Group       Percentage B/W
    0                    40%
    1                    5%

  Priority-Group   Transmission Selection Algorithm
    0              Enhanced Transmission Selection
    1              Enhanced Transmission Selection
```

show dcbx neighbors terse (QFX Series)

```
user@switch> show dcbx neighbors terse
Interface    Parent      PFC        ETS        ETS        Version
             Interface                                    Rec
xe-0/0/8.0   -           Enabled    Advt       Advt       IEEE (Auto)
xe-0/0/9.0   -           Disabled   Disabled              1.01
xe-0/0/11.0 ae0.0        Enabled    Advt       Advt       IEEE (Auto)
xe-0/0/12.0 ae0.0        Enabled    Advt       Advt       IEEE (Auto)
xe-0/0/32.0 -            Enabled    Advt       Not Advt   IEEE
xe-0/0/36.0 -            Not Advt   Advt       Advt       IEEE
```

show dcbx neighbors (EX4500 Switch: FCoE Interfaces on Both Local and Peer with PFC Configured Compatibly)

```
user@switch> show dcbx neighbors interface xe-0/0/14

   Interface : xe-0/0/14.0 - Parent Interface: ae0.0
    Protocol-State: in-sync

    Local-Advertisement:
        Operational version: 0
        sequence-number: 6, acknowledge-id: 6

    Peer-Advertisement:
        Operational version: 0
        sequence-number: 6, acknowledge-id: 6

    Feature: PFC, Protocol-State: in-sync

      Operational State: Enabled

      Local-Advertisement:
        Enable: Yes, Willing: No, Error: No
        Maximum Traffic Classes capable to support PFC: 6

         Code Point            Admin Mode
          000                 Disabled
          001                 Disabled
          010                 Disabled
          011                 Enabled
          100                 Disabled
          101                 Disabled
          110                 Disabled
          111                 Disabled
```



```
      Peer-Advertisement:
        Enable: Yes, Willing: No, Error: No
        Maximum Traffic Classes capable to support PFC: 6

        Code Point             Admin Mode
          000                 Disabled
          001                 Disabled
          010                 Disabled
          011                 Enabled
          100                 Disabled
          101                 Disabled
          110                 Disabled
          111                 Disabled


    Feature: Application, Protocol-State: in-sync

      Local-Advertisement:
        Enable: Yes, Willing: No, Error: No   <<< Error bit will not be set as
there is no miss configuration between local and peer.


        Appl-Name    Ethernet-Type    Socket-Number    Priority-Map    Status
        FCoE          0x8906                           00001000        Enabled


      Peer-Advertisement:
        Enable: Yes, Willing: No, Error: No

                 Appl-Name    Ethernet-Type    Socket-Number    Priority-Map
Status
                 FCoE          0x8906                           00001000
Enabled
```

show dcbx neighbors (EX4500 Switch: DCBX Interfaces on Local and Peer Are Configured Compatibly with iSCSI Application)

user@switch> **show dcbx neighbors interface xe-0/0/14**

```
  Interface : xe-0/0/14.0 - Parent Interface: ae0.0

    Protocol-State: in-sync

    Active-application-map: iscsi-map

     Local-Advertisement:
        Operational version: 0
        sequence-number: 9, acknowledge-id: 12


    Peer-Advertisement:
        Operational version: 0
        sequence-number: 12, acknowledge-id: 9


    Feature: PFC, Protocol-State: in-sync
      Operational State: Enabled
```



```
  Local-Advertisement:
   Enable: Yes, Willing: No, Error: No
   Maximum Traffic Classes capable to support PFC: 6


Code Point             Admin Mode
     000                 Disabled
     001                 Disabled
     010                 Disabled
     011                 Enabled
     100                 Disabled
     101                 Disabled
     110                 Disabled
     111                 Disabled

 Peer-Advertisement:
   Enable: Yes, Willing: No, Error: No
   Maximum Traffic Classes capable to support PFC: 6

Code Point             Admin Mode
     000                 Disabled
     001                 Disabled
     010                 Disabled
     011                 Enabled
     100                 Disabled
     101                 Disabled
     110                 Disabled
     111                 Disabled

Feature: Application, Protocol-State: in-sync
 Local-Advertisement:
   Enable: Yes, Willing: No, Error: No

       Appl-Name    Ethernet-Type    Socket-Number   Priority-Map    Status

        FCoE         0x8906                           00001000        Enabled

        iscsi                         3260            00100000        Enabled



 Peer-Advertisement:
   Enable: Yes, Willing: No, Error: No

       Appl-Name    Ethernet-Type    Socket-Number   Priority-Map    Status

        FCoE         0x8906                           00001000        Enabled

        iscsi                         3260            00100000        Enabled
```

show dcbx neighbors (EX4500 Switch: Includes ETS)

user@switch> **show dcbx neighbors interface xe-0/0/3**

```
Interface : xe-0/0/3.0
 Protocol-State: in-sync
 Active-application-map: map_iscsi

 Local-Advertisement:
     Operational version: 0
```

```
    sequence-number: 1, acknowledge-id: 5

Peer-Advertisement:
    Operational version: 0
    sequence-number: 5, acknowledge-id: 1

Feature: PFC, Protocol-State: in-sync

  Operational State: Enabled

  Local-Advertisement:
    Enable: Yes, Willing: No, Error: No
    Maximum Traffic Classes capable to support PFC: 6

    Code Point          Admin Mode
      000                 Enabled
      001                 Enabled
      010                 Disabled
      011                 Disabled
      100                 Disabled
      101                 Disabled
      110                 Disabled
      111                 Disabled

  Peer-Advertisement:
    Enable: Yes, Willing: Yes, Error: No
    Maximum Traffic Classes capable to support PFC: 8

    Code Point          Admin Mode
      000                 Enabled
      001                 Disabled
      010                 Disabled
      011                 Disabled
      100                 Enabled
      101                 Disabled
      110                 Disabled
      111                 Disabled

Feature: Application, Protocol-State: in-sync

  Local-Advertisement:
    Enable: Yes, Willing: No, Error: No

    Appl-Name    Ethernet-Type    Socket-Number    Priority-Map    Status
      FCoE         0x8906                            00000001       Enabled

      iscsi                         3260             00000010       Enabled


  Peer-Advertisement:
    Enable: Yes, Willing: Yes, Error: No

    Appl-Name    Ethernet-Type    Socket-Number    Priority-Map    Status
      FCoE         0x8906                            00001000       Enabled

      iscsi                         3260             00010000       Enabled


Feature: ETS, Protocol-State: in-sync

  Operational State: Enabled
```



```
Local-Advertisement:
  Enable: Yes, Willing: No, Error: No
  Maximum Traffic Classes supported : 3

  Code Point           Priority-Group
    000                  7
    001                  7
    010                  7
    011                  7
    100                  7
    101                  7
    110                  7
    111                  7

  Priority-Group       Percentage B/W
    7                    100%

Peer-Advertisement:
  Enable: Yes, Willing: Yes, Error: No
  Maximum Traffic Classes supported : 8

  Code Point           Priority-Group
    000                  0
    001                  1
    010                  0
    011                  0
    100                  2
    101                  0
    110                  0
    111                  0

  Priority-Group       Percentage B/W
    0                    30%
    1                    40%
    2                    30%
```

show interfaces queue

Syntax

show interfaces queue
<aggregate | remaining-traffic>
<both-ingress-egress>
<egress>
<forwarding-class *forwarding-class*>
<ingress>
<interface-name *interface-name*>
<l2-statistics>

Release Information

Command introduced before Junos OS Release 7.4.
both-ingress-egress, **egress**, and **ingress** options introduced in Junos OS Release 7.6.
Command introduced in Junos OS Release 11.1 for the QFX Series.
l2-statistics option introduced in Junos OS Release 12.1.

Description

Display class-of-service (CoS) queue information for physical interfaces.

Options

none—Show detailed CoS queue statistics for all physical interfaces.

aggregate—(Optional) Display the aggregated queuing statistics of all logical interfaces that have traffic-control profiles configured. (Not on the QFX Series.)

both-ingress-egress—(Optional) On Gigabit Ethernet Intelligent Queuing 2 (IQ2) PICs, display both ingress and egress queue statistics. (Not on the QFX Series.)

egress—(Optional) Display egress queue statistics.

forwarding-class *forwarding-class*—(Optional) Forwarding class name for this queue. Shows detailed CoS statistics for the queue associated with the specified forwarding class.

ingress—(Optional) On Gigabit Ethernet IQ2 PICs, display ingress queue statistics. (Not on the QFX Series.)

interface-name *interface-name*—(Optional) Show detailed CoS queue statistics for the specified interface.

l2-statistics—(Optional) Display Layer 2 statistics for MLPPP, FRF.15, and FRF.16 bundles

remaining-traffic—(Optional) Display the remaining-traffic queue statistics of all logical interfaces that have traffic-control profiles configured.

Overhead for Layer 2 Statistics

Transmitted packets and transmitted byte counts are displayed for the Layer 2 level with the addition of encapsulation overheads applied for fragmentation, as shown in Table 189 on page 2201. Others counters, such as packets and bytes queued (input) and drop counters, are displayed at the Layer 3 level. In the case of link fragmentation and interleaving (LFI) for which fragmentation is not applied, corresponding Layer 2 overheads are added, as shown in Table 189 on page 2201.

Table 550: Layer 2 Overhead, Transmitted Packets/Bytes

Protocol	Fragmentation		LFI
	First fragmentation	Second to n fragmentations	
	Bytes	Bytes	
MLPPP (Long)	13	12	8
MLPPP (short)	11	10	8
MLFR (FRF15)	12	10	8
MFR (FRF16)	10	8	-
MCMLPPP(Long)	13	12	-
MCMLPPP(Short)	11	10	-

Layer 2 Statistics - Fragmentation Overhead Calculation

```
MLPPP/MC-MLPPP Overhead details:
   ===============================
   Fragment 1:

    Outer PPP header                           : 4 bytes
    Long or short sequence MLPPP header        : 4 bytes or 2 bytes
    Inner PPP header                           : 1 byte
    HDLC flag and FCS bytes                    : 4 bytes

   Fragments 2 .. n :

    Outer PPP header                           : 4 bytes
    Long or short sequence MLPPP header        : 4 bytes or 2 bytes
    HDLC flag and FCS bytes                    : 4 bytes


   MLFR (FRF15) Overhead details:
   =============================
   Fragment 1:
       Framerelay header     :  2 bytes
       Control,NLPID         :  2 bytes
       Fragmentaion header   :  2 bytes
       Inner proto           :  2 bytes
       HDLC flag and  FCS    :  4 bytes

   Fragments 2 ...n :

       Framerelay header     :  2 bytes
       Control,NLPID         :  2 bytes
       Fragmentaion header   :  2 bytes
       HDLC flag and  FCS    :  4 bytes


   MFR (FRF16) Overhead details:
   ==============================
```



```
   Fragment 1:
      Fragmentaion header   :  2 bytes
      Framerelay header     :  2 bytes
      Inner proto           :  2 bytes
      HDLC flag and  FCS    :  4 bytes

   Fragments 2 ...n :
      Fragmentaion header   :  2 bytes
      Framerelay header     :  2 bytes
      HDLC flag and  FCS    :  4 bytes
```

Overhead with LFI

```
MLPPP(Long & short sequence):
   ============================
       Outer PPP header      :  4 bytes
       HDLC flag and  FCS    :  4 bytes

  MLFR (FRF15):
  =============
       Framerelay header     :  2 bytes
       Control,NLPID         :  2 bytes
       HDLC flag and  FCS    :  4 bytes
```

The following examples show overhead for different cases:

- A 1000-byte packet is sent to a mlppp bundle without any fragmentation. At the Layer 2 level, bytes transmitted is 1013 in 1 packet. This overhead is for MLPPP long sequence encap.
- A 1000-byte packet is sent to a mlppp bundle with a fragment threshold of 250byte. At the Layer 2 level, bytes transmitted is 1061 bytes in 5 packets.
- A 1000-byte LFI packet is sent to an mlppp bundle. At the Layer 2 level, bytes transmitted is 1008 in 1 packet.

remaining-traffic—(Optional) Display the queuing statistics of all logical interfaces that do not have traffic-control profiles configured. (Not on the QFX Series.)

Additional Information

For rate-limited interfaces hosted on Modular Interface Cards (MICs) or Modular Port Concentrators (MPCs), rate-limit packet-drop operations occur *before* packets are queued for transmission scheduling. For such interfaces, the statistics for queued traffic do not include the packets that have already been dropped due to rate limiting, and consequently the displayed statistics for queued traffic are the same as the displayed statistics for transmitted traffic.

NOTE: For rate-limited interfaces hosted on other types of hardware, rate-limit packet-drop operations occur *after* packets are queued for transmission scheduling. For these other interface types, the statistics for queued traffic include the packets that are later dropped due to rate limiting, and consequently the displayed statistics for queued traffic equals the sum of the statistics for transmitted and rate-limited traffic.

On M Series routers (except for the M320 and M120 routers), this command is valid only for a PIC installed on an enhanced Flexible PIC Concentrator (FPC).

Queue statistics for aggregated interfaces are supported on the M Series and T Series routers only. Statistics for an aggregated interface are the summation of the queue statistics of the child links of that aggregated interface. You can view the statistics for a child interface by using the **show interfaces statistics** command for that child interface.

When you configure tricolor marking on a 10-port 1-Gigabit Ethernet PIC, for queues 6 and 7 only, the output does not display the number of queued bytes and packets, or the number of bytes and packets dropped because of RED. If you do not configure tricolor marking on the interface, these statistics are available for all queues.

For the 4-port Channelized OC12 IQE PIC and 1-port Channelized OC48 IQE PIC, the **Packet Forwarding Engine Chassis Queues** field represents traffic bound for a particular physical interface on the PIC. For all other PICs, the **Packet Forwarding Engine Chassis Queues** field represents the total traffic bound for the PIC.

For Gigabit Ethernet IQ2 PICs, the **show interfaces queue** command output does not display the number of tail-dropped packets. This limitation does not apply to Packet Forwarding Engine chassis queues.

When fragmentation occurs on the egress interface, the first set of packet counters shows the postfragmentation values. The second set of packet counters (under the **Packet Forwarding Engine Chassis Queues** field) shows the prefragmentation values.

The behavior of the **egress** queues for the **Routing Engine-Generated Traffic** is not same as the configured queue for MLPPP and MFR configurations.

For information about how to configure CoS, see the *Junos OS Network Interfaces Library for Routing Devices*. For related CoS operational mode commands, see the CLI Explorer.

Required Privilege Level view

List of Sample Output

show interfaces queue (Rate-Limited Interface on a Gigabit Ethernet MIC in an MPC) on page 5918
show interfaces queue (Aggregated Ethernet on a T320 Router) on page 5919
show interfaces queue (Fast Ethernet on a J4300 Router) on page 5921
show interfaces queue (Gigabit Ethernet on a T640 Router) on page 5921
show interfaces queue aggregate (Gigabit Ethernet Enhanced DPC) on page 5922
show interfaces queue (Gigabit Ethernet IQ2 PIC) on page 5926
show interfaces queue both-ingress-egress (Gigabit Ethernet IQ2 PIC) on page 5929
show interfaces queue ingress (Gigabit Ethernet IQ2 PIC) on page 5931
show interfaces queue egress (Gigabit Ethernet IQ2 PIC) on page 5932
show interfaces queue remaining-traffic (Gigabit Ethernet Enhanced DPC) on page 5933
show interfaces queue (Channelized OC12 IQE Type 3 PIC in SONET Mode) on page 5936
show interfaces queue (QFX Series) on page 5946
show interfaces queue l2-statistics (lsq interface) on page 5947

Output Fields Table 190 on page 2204 lists the output fields for the **show interfaces queue** command. Output fields are listed in the approximate order in which they appear.

Table 551: show interfaces queue Output Fields

Field Name	Field Description
Physical interface	Name of the physical interface.
Enabled	State of the interface. Possible values are described in the “Enabled Field” section under *Common Output Fields Description*.
Interface index	Physical interface's index number, which reflects its initialization sequence.
SNMP ifIndex	SNMP index number for the interface.
Forwarding classes supported	Total number of forwarding classes supported on the specified interface.
Forwarding classes in use	Total number of forwarding classes in use on the specified interface.
Ingress queues supported	On Gigabit Ethernet IQ2 PICs only, total number of ingress queues supported on the specified interface.
Ingress queues in use	On Gigabit Ethernet IQ2 PICs only, total number of ingress queues in use on the specified interface.
Output queues supported	Total number of output queues supported on the specified interface.
Output queues in use	Total number of output queues in use on the specified interface.
Egress queues supported	Total number of egress queues supported on the specified interface.
Egress queues in use	Total number of egress queues in use on the specified interface.
Queue counters (Ingress)	CoS queue number and its associated user-configured forwarding class name. Displayed on IQ2 interfaces. • **Queued packets**—Number of queued packets. • **Transmitted packets**—Number of transmitted packets. • **Dropped packets**—Number of packets dropped by the ASIC's RED mechanism.
Burst size	(Logical interfaces on IQ PICs only) Maximum number of bytes up to which the logical interface can burst. The burst size is based on the shaping rate applied to the interface.
The following output fields are applicable to both interface component and Packet Forwarding component in the **show interfaces queue** command:	
Queue	Queue number.
Forwarding classes	Forwarding class name.

Table 551: show interfaces queue Output Fields *(continued)*

Field Name	Field Description
Queued Packets	Number of packets queued to this queue. NOTE: For Gigabit Ethernet IQ2 interfaces, the Queued Packets count is calculated by the Junos OS interpreting one frame buffer as one packet. If the queued packets are very large or very small, the calculation might not be completely accurate for transit traffic. The count is completely accurate for traffic terminated on the router. For rate-limited interfaces hosted on MICs or MPCs only, this statistic does not include traffic dropped due to rate limiting. For more information, see "Additional Information" on page 2202.
Queued Bytes	Number of bytes queued to this queue. The byte counts vary by interface hardware. For more information, see Table 191 on page 2207. For rate-limited interfaces hosted on MICs or MPCs only, this statistic does not include traffic dropped due to rate limiting. For more information, see "Additional Information" on page 2202.
Transmitted Packets	Number of packets transmitted by this queue. When fragmentation occurs on the egress interface, the first set of packet counters shows the postfragmentation values. The second set of packet counters (displayed under the **Packet Forwarding Engine Chassis Queues** field) shows the prefragmentation values. NOTE: For Layer 2 statistics, see "Overhead for Layer 2 Statistics" on page 2200
Transmitted Bytes	Number of bytes transmitted by this queue. The byte counts vary by interface hardware. For more information, see Table 191 on page 2207. NOTE: On MX Series routers, this number can be inaccurate when you issue the command for a physical interface repeatedly and in quick succession, because the statistics for the child nodes are collected infrequently. Wait ten seconds between successive iterations to avoid this situation. NOTE: For Layer 2 statistics, see "Overhead for Layer 2 Statistics" on page 2200
Tail-dropped packets	Number of packets dropped because of tail drop.
RL-dropped packets	Number of packets dropped due to rate limiting. For rate-limited interfaces hosted on MICs or MPCs only, this statistic is not included in the queued traffic statistics. For more information, see "Additional Information" on page 2202.
RL-dropped bytes	Number of bytes dropped due to rate limiting. For rate-limited interfaces hosted on MICs or MPCs only, this statistic is not included in the queued traffic statistics. For more information, see "Additional Information" on page 2202.

Table 551: show interfaces queue Output Fields *(continued)*

<table>
<tr><th>Field Name</th><th>Field Description</th></tr>
<tr><td>RED-dropped packets</td><td>Number of packets dropped because of random early detection (RED).
(M Series and T Series routers only) On M320 and M120 routers and the T Series routers, the total number of dropped packets is displayed. On all other M Series routers, the output classifies dropped packets into the following categories:
Low, non-TCP—Number of low-loss priority non-TCP packets dropped because of RED.
Low, TCP—Number of low-loss priority TCP packets dropped because of RED.
High, non-TCP—Number of high-loss priority non-TCP packets dropped because of RED.
High, TCP—Number of high-loss priority TCP packets dropped because of RED.
(J Series routers and MX Series routers with enhanced DPCs, and T Series routers with enhanced FPCs only) The output classifies dropped packets into the following categories:
Low—Number of low-loss priority packets dropped because of RED.
Medium-low—Number of medium-low loss priority packets dropped because of RED.
Medium-high—Number of medium-high loss priority packets dropped because of RED.
High—Number of high-loss priority packets dropped because of RED.
NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), this field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.</td></tr>
<tr><td>RED-dropped bytes</td><td>Number of bytes dropped because of RED. The byte counts vary by interface hardware. For more information, see Table 191 on page 2207.
(M Series and T Series routers only) On M320 and M120 routers and the T Series routers, only the total number of dropped bytes is displayed. On all other M Series routers, the output classifies dropped bytes into the following categories:
Low, non-TCP—Number of low-loss priority non-TCP bytes dropped because of RED.
Low, TCP—Number of low-loss priority TCP bytes dropped because of RED.
High, non-TCP—Number of high-loss priority non-TCP bytes dropped because of RED.
High, TCP—Number of high-loss priority TCP bytes dropped because of RED.
(J Series routers only) The output classifies dropped bytes into the following categories:
Low—Number of low-loss priority bytes dropped because of RED.
Medium-low—Number of medium-low loss priority bytes dropped because of RED.
Medium-high—Number of medium-high loss priority bytes dropped because of RED.
High—Number of high-loss priority bytes dropped because of RED.
NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), this field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.</td></tr>
</table>

Byte counts vary by interface hardware. Table 191 on page 2207 shows how the byte counts on the outbound interfaces vary depending on the interface hardware. Table 191 on page 2207 is based on the assumption that outbound interfaces are sending IP traffic with 478 bytes per packet.

Table 552: Byte Count by Interface Hardware

Interface Hardware	Output Level	Byte Count Includes	Comments
Gigabit Ethernet IQ and IQE PICs	Interface	Queued: 490 bytes per packet, representing 478 bytes of Layer 3 packet + 12 bytes Transmitted: 490 bytes per packet, representing 478 bytes of Layer 3 packet + 12 bytes RED dropped: 496 bytes per packet representing 478 bytes of Layer 3 packet + 18 bytes	The 12 additional bytes include 6 bytes for the destination MAC address + 4 bytes for the VLAN + 2 bytes for the Ethernet type. For RED dropped, 6 bytes are added for the source MAC address.
	Packet forwarding component	Queued: 478 bytes per packet, representing 478 bytes of Layer 3 packet Transmitted: 478 bytes per packet, representing 478 bytes of Layer 3 packet	–
Non-IQ PIC	Interface	T Series, TX Series, T1600, and MX Series routers: • Queued: 478 bytes of Layer 3 packet. • Transmitted: 478 bytes of Layer 3 packet. T4000 routers with Type 5 FPCs : • Queued: 478 bytes of Layer 3 packet + the full Layer 2 overhead including 4 bytes CRC + the full Layer 1 overhead 8 bytes preamble + 12 bytes Inter frame Gap. • Transmitted: 478 bytes of Layer 3 packet + the full Layer 2 overhead including 4 bytes CRC + the full Layer 1 overhead 8 bytes preamble + 12 bytes Interframe Gap. M Series routers: • Queued: 478 bytes of Layer 3 packet. • Transmitted: 478 bytes of Layer 3 packet + the full Layer 2 overhead. PTX Series Packet Transport Routers: • Queued: 478 bytes of Layer 3 packet + the full Layer 2 overhead including 4 bytes FCS + the full Layer 1 overhead of the MAC header DA + SA + EtherType (non-VLAN). • Transmitted: 478 bytes of Layer 3 packet + the full Layer 2 overhead including 4 bytes CRC + the full Layer 1 overhead of the MAC header DA + SA + EtherType (non-VLAN). • RED dropped: 478 bytes of Layer 3 packet + 22 bytes special header. To the TQ, this packet has 4 bytes more than queued or transmitted.	The Layer 2 overhead is 14 bytes for non-VLAN traffic and 18 bytes for VLAN traffic.

Table 552: Byte Count by Interface Hardware *(continued)*

Interface Hardware	Output Level	Byte Count Includes	Comments
IQ and IQE PICs with a SONET/SDH interface	Interface	Queued: 482 bytes per packet, representing 478 bytes of Layer 3 packet + 4 bytes Transmitted: 482 bytes per packet, representing 478 bytes of Layer 3 packet + 4 bytes RED dropped: 482 bytes per packet, representing 478 bytes of Layer 3 packet + 4 bytes	The additional 4 bytes are for the Layer 2 Point-to-Point Protocol (PPP) header.
	Packet forwarding component	Queued: 478 bytes per packet, representing 478 bytes of Layer 3 packet Transmitted: 486 bytes per packet, representing 478 bytes of Layer 3 packet + 8 bytes	For transmitted packets, the additional 8 bytes includes 4 bytes for the PPP header and 4 bytes for a cookie.
Non-IQ PIC with a SONET/SDH interface	Interface	T Series, TX Series, T1600, and MX Series routers: • Queued: 478 bytes of Layer 3 packet. • Transmitted: 478 bytes of Layer 3 packet. M Series routers: • Queued: 478 bytes of Layer 3 packet. • Transmitted: 483 bytes per packet, representing 478 bytes of Layer 3 packet + 5 bytes • RED dropped: 478 bytes per packet, representing 478 bytes of Layer 3 packet	For transmitted packets, the additional 5 bytes includes 4 bytes for the PPP header and 1 byte for the packet loss priority (PLP).
Interfaces configured with Frame Relay Encapsulation	Interface	The default Frame Relay overhead is 7 bytes. If you configure the Frame Check Sequence (FCS) to 4 bytes, then the overhead increases to 10 bytes.	
1-port 10-Gigabit Ethernet IQ2 and IQ2–E PICs 4-port 1G IQ2 and IQ2-E PICs 8-port 1G IQ2 and IQ2-E PICs	Interface	Queued: 478 bytes of Layer 3 packet + the full Layer 2 overhead including CRC. Transmitted: 478 bytes of Layer 3 packet + the full Layer 2 overhead including CRC.	The Layer 2 overhead is 18 bytes for non-VLAN traffic and 22 bytes for VLAN traffic.
	Packet forwarding component	Queued: 478 bytes of Layer 3 packet. Transmitted: 478 bytes of Layer 3 packet.	–

Sample Output

show interfaces queue (Rate-Limited Interface on a Gigabit Ethernet MIC in an MPC)

The following example shows queue information for the rate-limited interface ge-4/2/0 on a Gigabit Ethernet MIC in an MPC. For rate-limited queues for interfaces hosted on MICs or MPCs, rate-limit packet drops occur prior to packet output queuing. In the command output, the nonzero statistics displayed in the **RL-dropped packets** and **RL-dropped bytes** fields quantify the traffic dropped to rate-limit queue 0 output to 10 percent of 1 gigabyte (100 megabits) per second. Because the RL-dropped traffic is not included in the **Queued** statistics, the statistics displayed for queued traffic are the same as the statistics for transmitted traffic.

```
user@host> show interfaces queue ge-4/2/0
Physical interface: ge-4/2/0, Enabled, Physical link is Up
  Interface index: 203, SNMP ifIndex: 1054
Forwarding classes: 16 supported, 4 in use
Egress queues: 8 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :            131300649              141751 pps
    Bytes                :          11287964840            99793248 bps
  Transmitted:
    Packets              :            131300649              141751 pps
    Bytes                :          11287964840            99793248 bps
    Tail-dropped packets :                    0                   0 pps
    RL-dropped packets   :            205050862              602295 pps
    RL-dropped bytes     :          13595326612           327648832 bps
    RED-dropped packets  :                    0                   0 pps
     Low                 :                    0                   0 pps
     Medium-low          :                    0                   0 pps
     Medium-high         :                    0                   0 pps
     High                :                    0                   0 pps
    RED-dropped bytes    :                    0                   0 bps
     Low                 :                    0                   0 bps
     Medium-low          :                    0                   0 bps
     Medium-high         :                    0                   0 bps
     High                :                    0                   0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :                    0                   0 pps
    Bytes                :                    0                   0 bps
```

show interfaces queue (Aggregated Ethernet on a T320 Router)

The following example shows that the aggregated Ethernet interface, **ae1**, has traffic on queues **af1** and **af12**:

```
user@host> show interfaces queue ae1
Physical interface: ae1, Enabled, Physical link is Up
Interface index: 158, SNMP ifIndex: 33 Forwarding classes: 8 supported, 8 in use
Output queues: 8 supported, 8 in use
Queue: 0, Forwarding classes: be
  Queued:
    Packets              :                    5                   0 pps
    Bytes                :                  242                   0 bps
  Transmitted:
    Packets              :                    5                   0 pps
    Bytes                :                  242                   0 bps
    Tail-dropped packets :                    0                   0 pps
    RED-dropped packets  :                    0                   0 pps
    RED-dropped bytes    :                    0                   0 bps
Queue: 1, Forwarding classes: af1
  Queued:
    Packets              :             42603765              595484 pps
```

```
    Bytes               :           5453281920             609776496 bps
  Transmitted:
    Packets             :             42603765                595484 pps
    Bytes               :           5453281920             609776496 bps
    Tail-dropped packets :                   0                     0 pps
    RED-dropped packets  :                   0                     0 pps
    RED-dropped bytes    :                   0                     0 bps
Queue: 2, Forwarding classes: ef1
  Queued:
    Packets             :                    0                     0 pps
    Bytes               :                    0                     0 bps
  Transmitted:
    Packets             :                    0                     0 pps
    Bytes               :                    0                     0 bps
    Tail-dropped packets :                   0                     0 pps
    RED-dropped packets  :                   0                     0 pps
    RED-dropped bytes    :                   0                     0 bps
Queue: 3, Forwarding classes: nc
  Queued:
    Packets             :                   45                     0 pps
    Bytes               :                 3930                     0 bps
  Transmitted:
    Packets             :                   45                     0 pps
    Bytes               :                 3930                     0 bps
    Tail-dropped packets :                   0                     0 pps
    RED-dropped packets  :                   0                     0 pps
    RED-dropped bytes    :                   0                     0 bps
Queue: 4, Forwarding classes: af11
  Queued:
    Packets             :                    0                     0 pps
    Bytes               :                    0                     0 bps
  Transmitted:
    Packets             :                    0                     0 pps
    Bytes               :                    0                     0 bps
    Tail-dropped packets :                   0                     0 pps
    RED-dropped packets  :                   0                     0 pps
    RED-dropped bytes    :                   0                     0 bps
Queue: 5, Forwarding classes: ef11
  Queued:
    Packets             :                    0                     0 pps
    Bytes               :                    0                     0 bps
  Transmitted:
    Packets             :                    0                     0 pps
    Bytes               :                    0                     0 bps
    Tail-dropped packets :                   0                     0 pps
    RED-dropped packets  :                   0                     0 pps
    RED-dropped bytes    :                   0                     0 bps
Queue: 6, Forwarding classes: af12
  Queued:
    Packets             :             31296413                437436 pps
    Bytes               :           4005940864             447935200 bps
  Transmitted:
    Packets             :             31296413                437436 pps
    Bytes               :           4005940864             447935200 bps
    Tail-dropped packets :                   0                     0 pps
    RED-dropped packets  :                   0                     0 pps
    RED-dropped bytes    :                   0                     0 bps
Queue: 7, Forwarding classes: nc2
  Queued:
    Packets             :                    0                     0 pps
    Bytes               :                    0                     0 bps
```



```
  Transmitted:
    Packets            :              0                   0 pps
    Bytes              :              0                   0 bps
    Tail-dropped packets :            0                   0 pps
    RED-dropped packets  :            0                   0 pps
    RED-dropped bytes    :            0                   0 bps
```

show interfaces queue (Fast Ethernet on a J4300 Router)

```
user@host> show interfaces queue fe-4/0/0.0
Logical interface fe-4/0/0.0 (Index 71) (SNMP ifIndex 42)
Forwarding classes: 8 supported, 8 in use
Output queues: 8 supported, 8 in use
Queue: 0, Forwarding classes: be
  Queued:
    Packets            :        5240762                3404 pps
    Bytes              :     3020710354            15934544 bps
  Transmitted:
    Packets            :        5240762                3404 pps
    Bytes              :     3020710354            15934544 bps
    Tail-dropped packets :            0                   0 pps
    RED-dropped packets  :            0                   0 pps
     Low               :              0                   0 pps
     Medium-low        :              0                   0 pps
     Medium-high       :              0                   0 pps
     High              :              0                   0 pps
    RED-dropped bytes    :            0                   0 bps
     Low               :              0                   0 pps
     Medium-low        :              0                   0 pps
     Medium-high       :              0                   0 pps
     High              :              0                   0 pps
Queue: 1, Forwarding classes: af1
  Queued:
    Packets            :        2480391                1650 pps
    Bytes              :     1304685666             6945704 bps
  Transmitted:
    Packets            :        2478740                1650 pps
    Bytes              :     1303817240             6945704 bps
    Tail-dropped packets :            0                   0 pps
    RED-dropped packets  :         1651                   0 pps
     Low               :              0                   0 pps
     Medium-low        :              0                   0 pps
     Medium-high       :              0                   0 pps
     High              :           1651                   0 pps
    RED-dropped bytes    :       868426                   0 bps
     Low               :              0                   0 pps
     Medium-low        :              0                   0 pps
     Medium-high       :              0                   0 pps
     High              :         868426                   0 pps
```

show interfaces queue (Gigabit Ethernet on a T640 Router)

```
user@host> show interfaces queue
Physical interface: ge-7/0/1, Enabled, Physical link is Up
   Interface index: 150, SNMP ifIndex: 42
 Forwarding classes: 8 supported, 8 in use
 Output queues: 8 supported, 8 in use
 Queue: 0, Forwarding classes: be
   Queued:
```

```
      Packets             :                  13                    0 pps
      Bytes               :                 622                    0 bps
    Transmitted:
      Packets             :                  13                    0 pps
      Bytes               :                 622                    0 bps
      Tail-dropped packets :                  0                    0 pps
      RED-dropped packets  :                  0                    0 pps
      RED-dropped bytes    :                  0                    0 bps
  Queue: 1, Forwarding classes: af1
    Queued:
      Packets             :          1725947945               372178 pps
      Bytes               :        220921336960            381110432 bps
    Transmitted:
      Packets             :          1725947945               372178 pps
      Bytes               :        220921336960            381110432 bps
      Tail-dropped packets :                  0                    0 pps
      RED-dropped packets  :                  0                    0 pps
      RED-dropped bytes    :                  0                    0 bps
  Queue: 2, Forwarding classes: ef1
    Queued:
      Packets             :                   0                    0 pps
      Bytes               :                   0                    0 bps
    Transmitted:
      Packets             :                   0                    0 pps
      Bytes               :                   0                    0 bps
      Tail-dropped packets :                  0                    0 pps
      RED-dropped packets  :                  0                    0 pps
      RED-dropped bytes    :                  0                    0 bps
  Queue: 3, Forwarding classes: nc
    Queued:
      Packets             :                 571                    0 pps
      Bytes               :               49318                  336 bps
    Transmitted:
      Packets             :                 571                    0 pps
      Bytes               :               49318                  336 bps
      Tail-dropped packets :                  0                    0 pps
      RED-dropped packets  :                  0                    0 pps
      RED-dropped bytes    :                  0                    0 bps
```

show interfaces queue aggregate (Gigabit Ethernet Enhanced DPC)

```
user@host> show interfaces queue ge-2/2/9 aggregate
Physical interface: ge-2/2/9, Enabled, Physical link is Up
  Interface index: 238, SNMP ifIndex: 71
Forwarding classes: 16 supported, 4 in use
Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets             :           148450735               947295 pps
    Bytes               :          8016344944            409228848 bps
  Transmitted:
    Packets             :            76397439               487512 pps
    Bytes               :          4125461868            210602376 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :           72053285               459783 pps
     Low                 :           72053285               459783 pps
     Medium-low          :                  0                    0 pps
     Medium-high         :                  0                    0 pps
     High                :                  0                    0 pps
    RED-dropped bytes    :          3890877444            198626472 bps
```



```
      Low               :          3890877444           198626472 bps
      Medium-low        :                   0                   0 bps
      Medium-high       :                   0                   0 bps
      High              :                   0                   0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets             :                   0                   0 pps
    Bytes               :                   0                   0 bps
  Transmitted:
    Packets             :                   0                   0 pps
    Bytes               :                   0                   0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                  0                   0 pps
     Low                :                   0                   0 pps
     Medium-low         :                   0                   0 pps
     Medium-high        :                   0                   0 pps
     High               :                   0                   0 pps
    RED-dropped bytes   :                   0                   0 bps
     Low                :                   0                   0 bps
     Medium-low         :                   0                   0 bps
     Medium-high        :                   0                   0 bps
     High               :                   0                   0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets             :           410278257              473940 pps
    Bytes               :         22156199518           204742296 bps
  Transmitted:
    Packets             :             4850003                4033 pps
    Bytes               :           261900162             1742256 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :          405425693              469907 pps
     Low                :           405425693              469907 pps
     Medium-low         :                   0                   0 pps
     Medium-high        :                   0                   0 pps
     High               :                   0                   0 pps
    RED-dropped bytes   :         21892988124           203000040 bps
     Low                :         21892988124           203000040 bps
     Medium-low         :                   0                   0 bps
     Medium-high        :                   0                   0 bps
     High               :                   0                   0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets             :                   0                   0 pps
    Bytes               :                   0                   0 bps
  Transmitted:
    Packets             :                   0                   0 pps
    Bytes               :                   0                   0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                  0                   0 pps
     Low                :                   0                   0 pps
     Medium-low         :                   0                   0 pps
     Medium-high        :                   0                   0 pps
     High               :                   0                   0 pps
    RED-dropped bytes   :                   0                   0 bps
     Low                :                   0                   0 bps
     Medium-low         :                   0                   0 bps
     Medium-high        :                   0                   0 bps
     High               :                   0                   0 bps
Forwarding classes: 16 supported, 4 in use
Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
```

```
  Queued:
    Packets            :          76605230            485376 pps
    Bytes              :        5209211400         264044560 bps
  Transmitted:
    Packets            :          76444631            484336 pps
    Bytes              :        5198235612         263478800 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :          160475              1040 pps
     Low               :            160475              1040 pps
     Medium-low        :                 0                 0 pps
     Medium-high       :                 0                 0 pps
     High              :                 0                 0 pps
    RED-dropped bytes  :          10912300            565760 bps
     Low               :          10912300            565760 bps
     Medium-low        :                 0                 0 bps
     Medium-high       :                 0                 0 bps
     High              :                 0                 0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets            :                 0                 0 pps
    Bytes              :                 0                 0 bps
  Transmitted:
    Packets            :                 0                 0 pps
    Bytes              :                 0                 0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :               0                 0 pps
     Low               :                 0                 0 pps
     Medium-low        :                 0                 0 pps
     Medium-high       :                 0                 0 pps
     High              :                 0                 0 pps
    RED-dropped bytes  :                 0                 0 bps
     Low               :                 0                 0 bps
     Medium-low        :                 0                 0 bps
     Medium-high       :                 0                 0 bps
     High              :                 0                 0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets            :           4836136              3912 pps
    Bytes              :         333402032           2139056 bps
  Transmitted:
    Packets            :           3600866              1459 pps
    Bytes              :         244858888            793696 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :         1225034              2450 pps
     Low               :           1225034              2450 pps
     Medium-low        :                 0                 0 pps
     Medium-high       :                 0                 0 pps
     High              :                 0                 0 pps
    RED-dropped bytes  :          83302312           1333072 bps
     Low               :          83302312           1333072 bps
     Medium-low        :                 0                 0 bps
     Medium-high       :                 0                 0 bps
     High              :                 0                 0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets            :                 0                 0 pps
    Bytes              :                 0                 0 bps
  Transmitted:
    Packets            :                 0                 0 pps
    Bytes              :                 0                 0 bps
    Tail-dropped packets : Not Available
```



```
    RED-dropped packets  :                    0                    0 pps
     Low                 :                    0                    0 pps
     Medium-low          :                    0                    0 pps
     Medium-high         :                    0                    0 pps
     High                :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
     Low                 :                    0                    0 bps
     Medium-low          :                    0                    0 bps
     Medium-high         :                    0                    0 bps
     High                :                    0                    0 bps

Packet Forwarding Engine Chassis Queues:
Queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :             77059796               486384 pps
    Bytes                :           3544750624            178989576 bps
  Transmitted:
    Packets              :             77059797               486381 pps
    Bytes                :           3544750670            178988248 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
     Low                 :                    0                    0 pps
     Medium-low          :                    0                    0 pps
     Medium-high         :                    0                    0 pps
     High                :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
     Low                 :                    0                    0 bps
     Medium-low          :                    0                    0 bps
     Medium-high         :                    0                    0 bps
     High                :                    0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
     Low                 :                    0                    0 pps
     Medium-low          :                    0                    0 pps
     Medium-high         :                    0                    0 pps
     High                :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
     Low                 :                    0                    0 bps
     Medium-low          :                    0                    0 bps
     Medium-high         :                    0                    0 bps
     High                :                    0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              :              4846580                 3934 pps
    Bytes                :            222942680              1447768 bps
  Transmitted:
    Packets              :              4846580                 3934 pps
    Bytes                :            222942680              1447768 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
     Low                 :                    0                    0 pps
     Medium-low          :                    0                    0 pps
     Medium-high         :                    0                    0 pps
```

```
      High              :                    0                      0 pps
     RED-dropped bytes  :                    0                      0 bps
      Low               :                    0                      0 bps
      Medium-low        :                    0                      0 bps
      Medium-high       :                    0                      0 bps
      High              :                    0                      0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets             :                    0                      0 pps
    Bytes               :                    0                      0 bps
  Transmitted:
    Packets             :                    0                      0 pps
    Bytes               :                    0                      0 bps
    Tail-dropped packets :                   0                      0 pps
    RED-dropped packets :                    0                      0 pps
     Low                :                    0                      0 pps
     Medium-low         :                    0                      0 pps
     Medium-high        :                    0                      0 pps
     High               :                    0                      0 pps
    RED-dropped bytes   :                    0                      0 bps
     Low                :                    0                      0 bps
     Medium-low         :                    0                      0 bps
     Medium-high        :                    0                      0 bps
     High               :                    0                      0 bps
```

show interfaces queue (Gigabit Ethernet IQ2 PIC)

```
user@host> show interfaces queue ge-7/1/3
Physical interface: ge-7/1/3, Enabled, Physical link is Up
  Interface index: 170, SNMP ifIndex: 70 Forwarding classes: 16 supported, 4 in
use Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets             :            418390039                     10 pps
    Bytes               :          38910269752                   7440 bps
  Transmitted:
    Packets             :            418390039                     10 pps
    Bytes               :          38910269752                   7440 bps
    Tail-dropped packets : Not Available
    RED-dropped packets :                    0                      0 pps
    RED-dropped bytes   :                    0                      0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets             :                    0                      0 pps
    Bytes               :                    0                      0 bps
  Transmitted:
    Packets             :                    0                      0 pps
    Bytes               :                    0                      0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets :                    0                      0 pps
    RED-dropped bytes   :                    0                      0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets             :                    0                      0 pps
    Bytes               :                    0                      0 bps
  Transmitted:
    Packets             :                    0                      0 pps
    Bytes               :                    0                      0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets :                    0                      0 pps
```



```
    RED-dropped bytes    :                    0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              :                 7055                    1 pps
    Bytes                :               451552                  512 bps
  Transmitted:
    Packets              :                 7055                    1 pps
    Bytes                :               451552                  512 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Forwarding classes: 16 supported, 4 in use Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :                 1031                    0 pps
    Bytes                :               143292                    0 bps
  Transmitted:
    Packets              :                 1031                    0 pps
    Bytes                :               143292                    0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                    0                    0 pps
    RL-dropped bytes     :                    0                    0 bps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                    0                    0 pps
    RL-dropped bytes     :                    0                    0 bps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                    0                    0 pps
    RL-dropped bytes     :                    0                    0 bps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              :                77009                   11 pps
    Bytes                :              6894286                 7888 bps
  Transmitted:
    Packets              :                77009                   11 pps
    Bytes                :              6894286                 7888 bps
    Tail-dropped packets : Not Available
    RL-dropped packets   :                    0                    0 pps
    RL-dropped bytes     :                    0                    0 bps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
```



```
Packet Forwarding Engine Chassis Queues:
Queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :                  1031                     0 pps
    Bytes                :                147328                     0 bps
  Transmitted:
    Packets              :                  1031                     0 pps
    Bytes                :                147328                     0 bps
    Tail-dropped packets :                     0                     0 pps
    RED-dropped packets  :                     0                     0 pps
     Low, non-TCP        :                     0                     0 pps
     Low, TCP            :                     0                     0 pps
     High, non-TCP       :                     0                     0 pps
     High, TCP           :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
     Low, non-TCP        :                     0                     0 bps
     Low, TCP            :                     0                     0 bps
     High, non-TCP       :                     0                     0 bps
     High, TCP           :                     0                     0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
  Transmitted:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets :                     0                     0 pps
    RED-dropped packets  :                     0                     0 pps
     Low, non-TCP        :                     0                     0 pps
     Low, TCP            :                     0                     0 pps
     High, non-TCP       :                     0                     0 pps
     High, TCP           :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
     Low, non-TCP        :                     0                     0 bps
     Low, TCP            :                     0                     0 bps
     High, non-TCP       :                     0                     0 bps
     High, TCP           :                     0                     0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
  Transmitted:
    Packets              :                     0                     0 pps
    Bytes                :                     0                     0 bps
    Tail-dropped packets :                     0                     0 pps
    RED-dropped packets  :                     0                     0 pps
     Low, non-TCP        :                     0                     0 pps
     Low, TCP            :                     0                     0 pps
     High, non-TCP       :                     0                     0 pps
     High, TCP           :                     0                     0 pps
    RED-dropped bytes    :                     0                     0 bps
     Low, non-TCP        :                     0                     0 bps
     Low, TCP            :                     0                     0 bps
     High, non-TCP       :                     0                     0 bps
     High, TCP           :                     0                     0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              :                 94386                    12 pps
    Bytes                :              13756799                  9568 bps
  Transmitted:
```



```
      Packets              :                94386                  12 pps
      Bytes                :             13756799                9568 bps
      Tail-dropped packets :                    0                   0 pps
      RED-dropped packets  :                    0                   0 pps
       Low, non-TCP        :                    0                   0 pps
       Low, TCP            :                    0                   0 pps
       High, non-TCP       :                    0                   0 pps
       High, TCP           :                    0                   0 pps
      RED-dropped bytes    :                    0                   0 bps
       Low, non-TCP        :                    0                   0 bps
       Low, TCP            :                    0                   0 bps
       High, non-TCP       :                    0                   0 bps
       High, TCP           :                    0                   0 bps
```

show interfaces queue both-ingress-egress (Gigabit Ethernet IQ2 PIC)

```
user@host> show interfaces queue ge-6/2/0 both-ingress-egress
Physical interface: ge-6/2/0, Enabled, Physical link is Up
  Interface index: 175, SNMP ifIndex: 121
Forwarding classes: 8 supported, 4 in use
Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              : Not Available
    Bytes                :                    0                   0 bps
  Transmitted:
    Packets              :                  254                   0 pps
    Bytes                :                16274                   0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                   0 pps
    RED-dropped bytes    :                    0                   0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                    0                   0 bps
  Transmitted:
    Packets              :                    0                   0 pps
    Bytes                :                    0                   0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                   0 pps
    RED-dropped bytes    :                    0                   0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                    0                   0 bps
  Transmitted:
    Packets              :                    0                   0 pps
    Bytes                :                    0                   0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                   0 pps
    RED-dropped bytes    :                    0                   0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              : Not Available
    Bytes                :                    0                   0 bps
  Transmitted:
    Packets              :                    0                   0 pps
    Bytes                :                    0                   0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                   0 pps
```



```
    RED-dropped bytes    :                    0                    0 bps
Forwarding classes: 8 supported, 4 in use
Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    3                    0 pps
    Bytes                :                  126                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Packet Forwarding Engine Chassis Queues:
Queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :             80564692                    0 pps
    Bytes                :           3383717100                    0 bps
  Transmitted:
    Packets              :             80564692                    0 pps
    Bytes                :           3383717100                    0 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :             80564685                    0 pps
    Bytes                :           3383716770                    0 bps
  Transmitted:
    Packets              :             80564685                    0 pps
```



```
      Bytes                :           3383716770                    0 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  :                    0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
      Packets              :                    0                    0 pps
      Bytes                :                    0                    0 bps
  Transmitted:
      Packets              :                    0                    0 pps
      Bytes                :                    0                    0 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  :                    0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
      Packets              :                 9397                    0 pps
      Bytes                :              3809052                  232 bps
  Transmitted:
      Packets              :                 9397                    0 pps
      Bytes                :              3809052                  232 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  :                    0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
```

show interfaces queue ingress (Gigabit Ethernet IQ2 PIC)

```
user@host> show interfaces queue ge-6/2/0 ingress
Physical interface: ge-6/2/0, Enabled, Physical link is Up
  Interface index: 175, SNMP ifIndex: 121
Forwarding classes: 8 supported, 4 in use
Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
      Packets              : Not Available
      Bytes                :                    0                    0 bps
  Transmitted:
      Packets              :                  288                    0 pps
      Bytes                :                18450                    0 bps
      Tail-dropped packets : Not Available
      RED-dropped packets  :                    0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
      Packets              : Not Available
      Bytes                :                    0                    0 bps
  Transmitted:
      Packets              :                    0                    0 pps
      Bytes                :                    0                    0 bps
      Tail-dropped packets : Not Available
      RED-dropped packets  :                    0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
      Packets              : Not Available
      Bytes                :                    0                    0 bps
  Transmitted:
      Packets              :                    0                    0 pps
      Bytes                :                    0                    0 bps
      Tail-dropped packets : Not Available
```



```
      RED-dropped packets  :                    0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
  Queue: 3, Forwarding classes: network-control
    Queued:
      Packets              : Not Available
      Bytes                :                    0                    0 bps
    Transmitted:
      Packets              :                    0                    0 pps
      Bytes                :                    0                    0 bps
      Tail-dropped packets : Not Available
      RED-dropped packets  :                    0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
```

show interfaces queue egress (Gigabit Ethernet IQ2 PIC)

```
user@host> show interfaces queue ge-6/2/0 egress
Physical interface: ge-6/2/0, Enabled, Physical link is Up
  Interface index: 175, SNMP ifIndex: 121
Forwarding classes: 8 supported, 4 in use
Egress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    3                    0 pps
    Bytes                :                  126                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              : Not Available
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
```



```
Packet Forwarding Engine Chassis Queues:
Queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :            80564692                     0 pps
    Bytes                :          3383717100                     0 bps
  Transmitted:
    Packets              :            80564692                     0 pps
    Bytes                :          3383717100                     0 bps
    Tail-dropped packets :                   0                     0 pps
    RED-dropped packets  :                   0                     0 pps
    RED-dropped bytes    :                   0                     0 bps
Queue: 1, Forwarding classes: expedited-forwarding
  Queued:
    Packets              :            80564685                     0 pps
    Bytes                :          3383716770                     0 bps
  Transmitted:
    Packets              :            80564685                     0 pps
    Bytes                :          3383716770                     0 bps
    Tail-dropped packets :                   0                     0 pps
    RED-dropped packets  :                   0                     0 pps
    RED-dropped bytes    :                   0                     0 bps
Queue: 2, Forwarding classes: assured-forwarding
  Queued:
    Packets              :                   0                     0 pps
    Bytes                :                   0                     0 bps
  Transmitted:
    Packets              :                   0                     0 pps
    Bytes                :                   0                     0 bps
    Tail-dropped packets :                   0                     0 pps
    RED-dropped packets  :                   0                     0 pps
    RED-dropped bytes    :                   0                     0 bps
Queue: 3, Forwarding classes: network-control
  Queued:
    Packets              :                9538                     0 pps
    Bytes                :             3819840                     0 bps
  Transmitted:
    Packets              :                9538                     0 pps
    Bytes                :             3819840                     0 bps
    Tail-dropped packets :                   0                     0 pps
    RED-dropped packets  :                   0                     0 pps
    RED-dropped bytes    :                   0                     0 bps
```

show interfaces queue remaining-traffic (Gigabit Ethernet Enhanced DPC)

```
user@host> show interfaces queue ge-2/2/9 remaining-traffic
Physical interface: ge-2/2/9, Enabled, Physical link is Up
  Interface index: 238, SNMP ifIndex: 71
Forwarding classes: 16 supported, 4 in use
Ingress queues: 4 supported, 4 in use
Queue: 0, Forwarding classes: best-effort
  Queued:
    Packets              :           110208969                472875 pps
    Bytes                :          5951284434             204282000 bps
  Transmitted:
    Packets              :           110208969                472875 pps
    Bytes                :          5951284434             204282000 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                   0                     0 pps
     Low                 :                   0                     0 pps
```

```
        Medium-low          :                    0                    0 pps
        Medium-high         :                    0                    0 pps
        High                :                    0                    0 pps
       RED-dropped bytes    :                    0                    0 bps
        Low                 :                    0                    0 bps
        Medium-low          :                    0                    0 bps
        Medium-high         :                    0                    0 bps
        High                :                    0                    0 bps
   Queue: 1, Forwarding classes: expedited-forwarding
     Queued:
       Packets              :                    0                    0 pps
       Bytes                :                    0                    0 bps
     Transmitted:
       Packets              :                    0                    0 pps
       Bytes                :                    0                    0 bps
       Tail-dropped packets : Not Available
       RED-dropped packets  :                    0                    0 pps
        Low                 :                    0                    0 pps
        Medium-low          :                    0                    0 pps
        Medium-high         :                    0                    0 pps
        High                :                    0                    0 pps
       RED-dropped bytes    :                    0                    0 bps
        Low                 :                    0                    0 bps
        Medium-low          :                    0                    0 bps
        Medium-high         :                    0                    0 bps
        High                :                    0                    0 bps
   Queue: 2, Forwarding classes: assured-forwarding
     Queued:
       Packets              :                    0                    0 pps
       Bytes                :                    0                    0 bps
     Transmitted:
       Packets              :                    0                    0 pps
       Bytes                :                    0                    0 bps
       Tail-dropped packets : Not Available
       RED-dropped packets  :                    0                    0 pps
        Low                 :                    0                    0 pps
        Medium-low          :                    0                    0 pps
        Medium-high         :                    0                    0 pps
        High                :                    0                    0 pps
       RED-dropped bytes    :                    0                    0 bps
        Low                 :                    0                    0 bps
        Medium-low          :                    0                    0 bps
        Medium-high         :                    0                    0 bps
        High                :                    0                    0 bps
   Queue: 3, Forwarding classes: network-control
     Queued:
       Packets              :                    0                    0 pps
       Bytes                :                    0                    0 bps
     Transmitted:
       Packets              :                    0                    0 pps
       Bytes                :                    0                    0 bps
       Tail-dropped packets : Not Available
       RED-dropped packets  :                    0                    0 pps
        Low                 :                    0                    0 pps
        Medium-low          :                    0                    0 pps
        Medium-high         :                    0                    0 pps
        High                :                    0                    0 pps
       RED-dropped bytes    :                    0                    0 bps
        Low                 :                    0                    0 bps
        Medium-low          :                    0                    0 bps
        Medium-high         :                    0                    0 bps
```



```
      High               :                    0                   0 bps
  Forwarding classes: 16 supported, 4 in use
  Egress queues: 4 supported, 4 in use
  Queue: 0, Forwarding classes: best-effort
    Queued:
      Packets            :            109355853              471736 pps
      Bytes              :           7436199152           256627968 bps
    Transmitted:
      Packets            :            109355852              471736 pps
      Bytes              :           7436198640           256627968 bps
      Tail-dropped packets : Not Available
      RED-dropped packets  :                  0                   0 pps
       Low               :                    0                   0 pps
       Medium-low        :                    0                   0 pps
       Medium-high       :                    0                   0 pps
       High              :                    0                   0 pps
      RED-dropped bytes  :                    0                   0 bps
       Low               :                    0                   0 bps
       Medium-low        :                    0                   0 bps
       Medium-high       :                    0                   0 bps
       High              :                    0                   0 bps
  Queue: 1, Forwarding classes: expedited-forwarding
    Queued:
      Packets            :                    0                   0 pps
      Bytes              :                    0                   0 bps
    Transmitted:
      Packets            :                    0                   0 pps
      Bytes              :                    0                   0 bps
      Tail-dropped packets : Not Available
      RED-dropped packets  :                  0                   0 pps
       Low               :                    0                   0 pps
       Medium-low        :                    0                   0 pps
       Medium-high       :                    0                   0 pps
       High              :                    0                   0 pps
      RED-dropped bytes  :                    0                   0 bps
       Low               :                    0                   0 bps
       Medium-low        :                    0                   0 bps
       Medium-high       :                    0                   0 bps
       High              :                    0                   0 bps
  Queue: 2, Forwarding classes: assured-forwarding
    Queued:
      Packets            :                    0                   0 pps
      Bytes              :                    0                   0 bps
    Transmitted:
      Packets            :                    0                   0 pps
      Bytes              :                    0                   0 bps
      Tail-dropped packets : Not Available
      RED-dropped packets  :                  0                   0 pps
       Low               :                    0                   0 pps
       Medium-low        :                    0                   0 pps
       Medium-high       :                    0                   0 pps
       High              :                    0                   0 pps
      RED-dropped bytes  :                    0                   0 bps
       Low               :                    0                   0 bps
       Medium-low        :                    0                   0 bps
       Medium-high       :                    0                   0 bps
       High              :                    0                   0 bps
  Queue: 3, Forwarding classes: network-control
    Queued:
      Packets            :                    0                   0 pps
      Bytes              :                    0                   0 bps
```

```
  Transmitted:
    Packets              :                    0                     0 pps
    Bytes                :                    0                     0 bps
    Tail-dropped packets : Not Available
    RED-dropped packets  :                    0                     0 pps
     Low                 :                    0                     0 pps
     Medium-low          :                    0                     0 pps
     Medium-high         :                    0                     0 pps
     High                :                    0                     0 pps
    RED-dropped bytes    :                    0                     0 bps
     Low                 :                    0                     0 bps
     Medium-low          :                    0                     0 bps
     Medium-high         :                    0                     0 bps
     High                :                    0                     0 bps
```

show interfaces queue (Channelized OC12 IQE Type 3 PIC in SONET Mode)

```
user@host> show interfaces queue t3-1/1/0:7
 Physical interface: t3-1/1/0:7, Enabled, Physical link is Up

   Interface index: 192, SNMP ifIndex: 1948

   Description: full T3 interface connect to 6ce13 t3-3/1/0:7 for FR testing -
Lam

 Forwarding classes: 16 supported, 9 in use

 Egress queues: 8 supported, 8 in use

 Queue: 0, Forwarding classes: DEFAULT

   Queued:

     Packets              :               214886                 13449 pps

     Bytes                :              9884756               5164536 bps

   Transmitted:

     Packets              :               214886                 13449 pps

     Bytes                :              9884756               5164536 bps

     Tail-dropped packets :                    0                     0 pps

     RED-dropped packets  :                    0                     0 pps

      Low                 :                    0                     0 pps

      Medium-low          :                    0                     0 pps

      Medium-high         :                    0                     0 pps

      High                :                    0                     0 pps

     RED-dropped bytes    :                    0                     0 bps

      Low                 :                    0                     0 bps

      Medium-low          :                    0                     0 bps
```

```
      Medium-high        :                    0                    0 bps
      High               :                    0                    0 bps
 Queue: 1, Forwarding classes: REALTIME
   Queued:
     Packets             :                    0                    0 pps
     Bytes               :                    0                    0 bps
   Transmitted:
     Packets             :                    0                    0 pps
     Bytes               :                    0                    0 bps
     Tail-dropped packets :                   0                    0 pps
     RED-dropped packets  :                   0                    0 pps
      Low                :                    0                    0 pps
      Medium-low         :                    0                    0 pps
      Medium-high        :                    0                    0 pps
      High               :                    0                    0 pps
     RED-dropped bytes   :                    0                    0 bps
      Low                :                    0                    0 bps
      Medium-low         :                    0                    0 bps
      Medium-high        :                    0                    0 bps
      High               :                    0                    0 bps
 Queue: 2, Forwarding classes: PRIVATE
   Queued:
     Packets             :                    0                    0 pps
     Bytes               :                    0                    0 bps
   Transmitted:
     Packets             :                    0                    0 pps
     Bytes               :                    0                    0 bps
     Tail-dropped packets :                   0                    0 pps
     RED-dropped packets  :                   0                    0 pps
      Low                :                    0                    0 pps
```



```
      Medium-low          :                    0                    0 pps
      Medium-high         :                    0                    0 pps
      High                :                    0                    0 pps
     RED-dropped bytes    :                    0                    0 bps
      Low                 :                    0                    0 bps
      Medium-low          :                    0                    0 bps
      Medium-high         :                    0                    0 bps
      High                :                    0                    0 bps
 Queue: 3, Forwarding classes: CONTROL
   Queued:
     Packets              :                   60                    0 pps
     Bytes                :                 4560                    0 bps
   Transmitted:
     Packets              :                   60                    0 pps
     Bytes                :                 4560                    0 bps
     Tail-dropped packets :                    0                    0 pps
     RED-dropped packets  :                    0                    0 pps
      Low                 :                    0                    0 pps
      Medium-low          :                    0                    0 pps
      Medium-high         :                    0                    0 pps
      High                :                    0                    0 pps
     RED-dropped bytes    :                    0                    0 bps
      Low                 :                    0                    0 bps
      Medium-low          :                    0                    0 bps
      Medium-high         :                    0                    0 bps
      High                :                    0                    0 bps
 Queue: 4, Forwarding classes: CLASS_B_OUTPUT
   Queued:
     Packets              :                    0                    0 pps
     Bytes                :                    0                    0 bps
   Transmitted:
```



```
      Packets             :                     0                    0 pps
      Bytes               :                     0                    0 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  :                    0                    0 pps
       Low                :                     0                    0 pps
       Medium-low         :                     0                    0 pps
       Medium-high        :                     0                    0 pps
       High               :                     0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
       Low                :                     0                    0 bps
       Medium-low         :                     0                    0 bps
       Medium-high        :                     0                    0 bps
       High               :                     0                    0 bps
  Queue: 5, Forwarding classes: CLASS_C_OUTPUT
    Queued:
      Packets             :                     0                    0 pps
      Bytes               :                     0                    0 bps
    Transmitted:
      Packets             :                     0                    0 pps
      Bytes               :                     0                    0 bps
      Tail-dropped packets :                    0                    0 pps
      RED-dropped packets  :                    0                    0 pps
       Low                :                     0                    0 pps
       Medium-low         :                     0                    0 pps
       Medium-high        :                     0                    0 pps
       High               :                     0                    0 pps
      RED-dropped bytes    :                    0                    0 bps
       Low                :                     0                    0 bps
       Medium-low         :                     0                    0 bps
       Medium-high        :                     0                    0 bps
```

```
     High              :                  0                    0 bps
Queue: 6, Forwarding classes: CLASS_V_OUTPUT
  Queued:
    Packets            :                  0                    0 pps
    Bytes              :                  0                    0 bps
  Transmitted:
    Packets            :                  0                    0 pps
    Bytes              :                  0                    0 bps
    Tail-dropped packets :                0                    0 pps
    RED-dropped packets  :                0                    0 pps
     Low               :                  0                    0 pps
     Medium-low        :                  0                    0 pps
     Medium-high       :                  0                    0 pps
     High              :                  0                    0 pps
    RED-dropped bytes  :                  0                    0 bps
     Low               :                  0                    0 bps
     Medium-low        :                  0                    0 bps
     Medium-high       :                  0                    0 bps
     High              :                  0                    0 bps
Queue: 7, Forwarding classes: CLASS_S_OUTPUT, GETS
  Queued:
    Packets            :                  0                    0 pps
    Bytes              :                  0                    0 bps
  Transmitted:
    Packets            :                  0                    0 pps
    Bytes              :                  0                    0 bps
    Tail-dropped packets :                0                    0 pps
    RED-dropped packets  :                0                    0 pps
     Low               :                  0                    0 pps
     Medium-low        :                  0                    0 pps
     Medium-high       :                  0                    0 pps
```

```
     High               :                    0                    0 pps
    RED-dropped bytes   :                    0                    0 bps
     Low                :                    0                    0 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps

Packet Forwarding Engine Chassis Queues:
Queues: 8 supported, 8 in use
Queue: 0, Forwarding classes: DEFAULT
  Queued:
    Packets             :               371365                23620 pps
    Bytes               :             15597330              7936368 bps
  Transmitted:
    Packets             :               371365                23620 pps
    Bytes               :             15597330              7936368 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                   0                    0 pps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes   :                    0                    0 bps
     Low                :                    0                    0 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps
Queue: 1, Forwarding classes: REALTIME
  Queued:
    Packets             :                    0                    0 pps
```



```
    Bytes                :                    0                     0 bps
  Transmitted:
    Packets              :                    0                     0 pps
    Bytes                :                    0                     0 bps
    Tail-dropped packets :                    0                     0 pps
    RED-dropped packets  :                    0                     0 pps
     Low                 :                    0                     0 pps
     Medium-low          :                    0                     0 pps
     Medium-high         :                    0                     0 pps
     High                :                    0                     0 pps
    RED-dropped bytes    :                    0                     0 bps
     Low                 :                    0                     0 bps
     Medium-low          :                    0                     0 bps
     Medium-high         :                    0                     0 bps
     High                :                    0                     0 bps
Queue: 2, Forwarding classes: PRIVATE
  Queued:
    Packets              :                    0                     0 pps
    Bytes                :                    0                     0 bps
  Transmitted:
    Packets              :                    0                     0 pps
    Bytes                :                    0                     0 bps
    Tail-dropped packets :                    0                     0 pps
    RED-dropped packets  :                    0                     0 pps
     Low                 :                    0                     0 pps
     Medium-low          :                    0                     0 pps
     Medium-high         :                    0                     0 pps
     High                :                    0                     0 pps
    RED-dropped bytes    :                    0                     0 bps
     Low                 :                    0                     0 bps
     Medium-low          :                    0                     0 bps
```



```
      Medium-high        :                    0                     0 bps
      High               :                    0                     0 bps
 Queue: 3, Forwarding classes: CONTROL
   Queued:
     Packets             :                32843                     0 pps
     Bytes               :              2641754                    56 bps
   Transmitted:
     Packets             :                32843                     0 pps
     Bytes               :              2641754                    56 bps
     Tail-dropped packets :                   0                     0 pps
     RED-dropped packets  :                   0                     0 pps
      Low                :                    0                     0 pps
      Medium-low         :                    0                     0 pps
      Medium-high        :                    0                     0 pps
      High               :                    0                     0 pps
     RED-dropped bytes   :                    0                     0 bps
      Low                :                    0                     0 bps
      Medium-low         :                    0                     0 bps
      Medium-high        :                    0                     0 bps
      High               :                    0                     0 bps
 Queue: 4, Forwarding classes: CLASS_B_OUTPUT
   Queued:
     Packets             :                    0                     0 pps
     Bytes               :                    0                     0 bps
   Transmitted:
     Packets             :                    0                     0 pps
     Bytes               :                    0                     0 bps
     Tail-dropped packets :                   0                     0 pps
     RED-dropped packets  :                   0                     0 pps
      Low                :                    0                     0 pps
```



```
      Medium-low         :                     0                    0 pps
      Medium-high        :                     0                    0 pps
      High               :                     0                    0 pps
     RED-dropped bytes   :                     0                    0 bps
      Low                :                     0                    0 bps
      Medium-low         :                     0                    0 bps
      Medium-high        :                     0                    0 bps
      High               :                     0                    0 bps
Queue: 5, Forwarding classes: CLASS_C_OUTPUT
  Queued:
     Packets             :                     0                    0 pps
     Bytes               :                     0                    0 bps
  Transmitted:
     Packets             :                     0                    0 pps
     Bytes               :                     0                    0 bps
     Tail-dropped packets :                    0                    0 pps
     RED-dropped packets  :                    0                    0 pps
      Low                :                     0                    0 pps
      Medium-low         :                     0                    0 pps
      Medium-high        :                     0                    0 pps
      High               :                     0                    0 pps
     RED-dropped bytes   :                     0                    0 bps
      Low                :                     0                    0 bps
      Medium-low         :                     0                    0 bps
      Medium-high        :                     0                    0 bps
      High               :                     0                    0 bps
Queue: 6, Forwarding classes: CLASS_V_OUTPUT
  Queued:
     Packets             :                     0                    0 pps
     Bytes               :                     0                    0 bps
  Transmitted:
```



```
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                   0                    0 pps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes   :                    0                    0 bps
     Low                :                    0                    0 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
     High               :                    0                    0 bps
Queue: 7, Forwarding classes: CLASS_S_OUTPUT, GETS
  Queued:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
  Transmitted:
    Packets             :                    0                    0 pps
    Bytes               :                    0                    0 bps
    Tail-dropped packets :                   0                    0 pps
    RED-dropped packets  :                   0                    0 pps
     Low                :                    0                    0 pps
     Medium-low         :                    0                    0 pps
     Medium-high        :                    0                    0 pps
     High               :                    0                    0 pps
    RED-dropped bytes   :                    0                    0 bps
     Low                :                    0                    0 bps
     Medium-low         :                    0                    0 bps
     Medium-high        :                    0                    0 bps
```

```
              High                  :                      0                      0 bps
```

show interfaces queue (QFX Series)

```
user@switch> show interfaces queue xe-0/0/15
   Physical interface: xe-0/0/15, Enabled, Physical link is Up
     Interface index: 49165, SNMP ifIndex: 539
   Forwarding classes: 12 supported, 8 in use
   Egress queues: 12 supported, 8 in use
   Queue: 0, Forwarding classes: best-effort
     Queued:
       Packets              :                      0                      0 pps
       Bytes                :                      0                      0 bps
     Transmitted:
       Packets              :                      0                      0 pps
       Bytes                :                      0                      0 bps
       Tail-dropped packets : Not Available
       Total-dropped packets:                      0                      0 pps
       Total-dropped bytes  :                      0                      0 bps
   Queue: 3, Forwarding classes: fcoe
     Queued:
       Packets              :                      0                      0 pps
       Bytes                :                      0                      0 bps
     Transmitted:
       Packets              :                      0                      0 pps
       Bytes                :                      0                      0 bps
       Tail-dropped packets : Not Available
       Total-dropped packets:                      0                      0 pps
       Total-dropped bytes  :                      0                      0 bps
0 bps
   Queue: 4, Forwarding classes: no-loss
     Queued:
       Packets              :                      0                      0 pps
       Bytes                :                      0                      0 bps
     Transmitted:
       Packets              :                      0                      0 pps
       Bytes                :                      0                      0 bps
       Tail-dropped packets : Not Available
       Total-dropped packets:                      0                      0 pps
       Total-dropped bytes  :                      0                      0 bps
   Queue: 7, Forwarding classes: network-control
     Queued:
       Packets              :                      0                      0 pps
       Bytes                :                      0                      0 bps
     Transmitted:
       Packets              :                      0                      0 pps
       Bytes                :                      0                      0 bps
       Tail-dropped packets : Not Available
       Total-dropped packets:                      0                      0 pps
       Total-dropped bytes  :                      0                      0 bps
   Queue: 8, Forwarding classes: mcast
     Queued:
       Packets              :                      0                      0 pps
       Bytes                :                      0                      0 bps
     Transmitted:
       Packets              :                      0                      0 pps
       Bytes                :                      0                      0 bps
       Tail-dropped packets : Not Available
```



```
        Total-dropped packets:                0                    0 pps
        Total-dropped bytes  :                0                    0 bps
```

show interfaces queue l2-statistics (lsq interface)

```
user@switch> show interfaces queue lsq-2/2/0.2 l2-statistics
Logical interface lsq-2/2/0.2 (Index 69) (SNMP ifIndex 1598)
Forwarding classes: 16 supported, 4 in use
Egress queues: 8 supported, 4 in use
Burst size: 0
Queue: 0, Forwarding classes: be
  Queued:
    Packets              :                    1                    0 pps
    Bytes                :                 1001                    0 bps
  Transmitted:
    Packets              :                    5                     0 pps
    Bytes                :                 1062                    0 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 1, Forwarding classes: ef
  Queued:
    Packets              :                    1                    0 pps
    Bytes                :                 1500                    0 bps
  Transmitted:
    Packets              :                    6                     0 pps
    Bytes                :                 1573                    0 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 2, Forwarding classes: af
  Queued:
    Packets              :                    1                    0 pps
    Bytes                :                  512                    0 bps
  Transmitted:
    Packets              :                    3                     0 pps
    Bytes                :                  549                    0 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
Queue: 3, Forwarding classes: nc
  Queued:
    Packets              :                    0                    0 pps
    Bytes                :                    0                    0 bps
  Transmitted:
    Packets              :                    0                     0 pps
    Bytes                :                    0                    0 bps
    Tail-dropped packets :                    0                    0 pps
    RED-dropped packets  :                    0                    0 pps
    RED-dropped bytes    :                    0                    0 bps
=========
```


show pfe next-hop

Syntax

show pfe next-hop
<interface *interface-name*>

Syntax (TX Matrix and TX Matrix Plus Routers)

show pfe next-hop
<fpc *slot*>
<interface *interface-name*>
<lcc *number*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Packet Forwarding Engine next-hop information.

Options

none—Display all Packet Forwarding Engine next-hop information.

fpc ***slot***—(TX Matrix and TX Matrix Plus routers only) (Optional) Show the next hops for a Flexible PIC Concentrator (FPC) slot.

- On a TX Matrix router, if you specify the number of a T640 router by using the **lcc** *number* option (the recommended method), replace ***slot*** with a value from **0** through **7**. Otherwise, replace ***slot*** with a value from **0** through **31**.
- On a TX Matrix Plus router, if you specify the number of a T1600 router by using the **lcc** *number* option (the recommended method), replace ***slot*** with a value from **0** through **7**. Otherwise, replace ***slot*** with a value from **0** through **31**.
- On a TX Matrix Plus router in the TXP-T1600-3D, TXP-T4000-3D, or TXP-Mixed-LCC-3D configuration, if you specify the number of a T1600 or T4000 router by using the **lcc** *number* option (the recommended method), replace ***slot*** with a value from **0** through **7**. Otherwise, replace ***slot*** with a value from **0** through **63**.

For example, the following commands have the same result:

```
user@host> show pfe next-hop fpc 1 lcc 1
user@host> show pfe next-hop fpc 9
```

interface ***interface-name***—(Optional) Display the Packet Forwarding Engine next-hop interface.

lcc ***number***—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display Packet Forwarding Engine next-hop interface for a specific T640 router (or line-card chassis) that is connected to a TX Matrix router. On a TX Matrix Plus router, display Packet Forwarding Engine next-hop interface for the router (or line-card chassis) that is connected to a TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

Required Privilege Level admin

Related Documentation

- *Routing Matrix with TXP-T1600 Configuration*
- *Routing Matrix with TXP-T1600-3D Configuration*
- *Routing Matrix with TXP-T4000-3D Configuration*
- *Overview of a Routing Matrix with TXP-Mixed-LCC-3D Configuration*

List of Sample Output

show pfe next-hop on page 5950
show pfe next-hop fpc (TX Matrix Router) on page 5950
show pfe next-hop fpc (TX Matrix Plus Router) on page 5950

Sample Output

show pfe next-hop

```
user@host> show pfe next-hop
Nexthop Info:
   ID       Type      Interface    Protocol         Encap  Next Hop Addr    MTU
-----  --------  -------------  ---------  ------------  ---------------  -----
    4     Mcast  -                   IPv4             -  0.0.0.0              0
    5     Bcast  -                   IPv4             -  -                    0
    7   Discard  -                   IPv4             -  -                    0
    8  MDiscard  -                   IPv4             -  -                    0
    9    Reject  -                   IPv4             -  -                    0
   13     Local  -                   IPv4             -  192.168.4.60         0
   14   Resolve  fxp0.0              IPv4   Unspecified  -                    0
   17     Local  -                   IPv4             -  127.0.0.1            0
   18   Unicast  fxp0.0              IPv4   Unspecified  192.168.4.254        0
   21     Local  -                   IPv4             -  11.1.0.1             0
   22   Unicast  at-0/1/0.0          IPv4      ATM SNAP  11.1.0.2          4482
 ...
```

show pfe next-hop fpc (TX Matrix Router)

```
user@host> show pfe next-hop fpc 1
Slot 1
Nexthop Info:
   ID       Type      Interface    Next Hop Addr    Protocol       Encap     MTU
-----  --------  -------------  ---------------  ----------  ------------  ----
    5     Mcast  -              default               IPv4             -     0
    6     Bcast  -              -                     IPv4             -     0
    8   Discard  -              -                     IPv4             -     0
    9  MDiscard  -              -                     IPv4             -     0
   13     Mcast  -              default               IPV6             -     0
   17  MDiscard  -              -                     IPV6             -     0
   18    Reject  -              -                     IPV6             -     0
   24   Discard  -              -                     None             -     0
   68     Local  -              192.168.66.113        IPv4             -     0
   69   Resolve  fxp0.0         -                     IPv4   Unspecified     0
   70   Unicast  fxp0.0         192.168.71.254        IPv4   Unspecified     0
  256     Local  -              10.71.71.1            IPv4             -     0
  257     Local  -              127.0.0.1             IPv4             -     0
  258     Mcast.local..1      default               IPv4   Unspecified     0
  259     Bcast.local..1      -                     IPv4   Unspecified     0
  261   Discard.local..1      -                     IPv4   Unspecified     0
  262  MDiscard.local..1      -                     IPv4   Unspecified     0
  269     Mcast.local..1      default               IPV6   Unspecified     0
  271   Discard.local..1      -                     IPV6   Unspecified     0
...
```

show pfe next-hop fpc (TX Matrix Plus Router)

```
user@host> show pfe next-hop fpc 0

Slot 0

   ID       Type      Interface    Next Hop Addr    Protocol       Encap     MTU
-----  --------  -------------  ---------------  ----------  ------------  ----
   31     Mcast  -              default               IPv4             -     0
   32     Bcast  -              -                     IPv4             -     0
   34   Discard  -              -                     IPv4             -     0
   35  MDiscard  -              -                     IPv4             -     0
```

```
 36     Reject  -              -                       IPv4              -     0
 39      Mcast  -              default                 IPv6              -     0
 42    Discard  -              -                       IPv6              -     0
 43   MDiscard  -              -                       IPv6              -     0
 44     Reject  -              -                       IPv6              -     0
 49    Receive  -              -                       MPLS              -     0
 50    Discard  -              -                       MPLS              -     0
111      Mcast  .local..1      default                 IPv4    Unspecified     0
112      Bcast  .local..1      -                       IPv4    Unspecified     0
114    Discard  .local..1      -                       IPv4    Unspecified     0
115   MDiscard  .local..1      -                       IPv4    Unspecified     0
116     Reject  .local..1      -                       IPv4    Unspecified     0
119      Mcast  .local..1      default                 IPv6    Unspecified     0
122    Discard  .local..1      -                       IPv6    Unspecified     0
123   MDiscard  .local..1      -                       IPv6    Unspecified     0
124     Reject  .local..1      -                       IPv6    Unspecified     0
191      Mcast  .local..2      default                 IPv4    Unspecified     0
192      Bcast  .local..2      -                       IPv4    Unspecified     0
194    Discard  .local..2      -                       IPv4    Unspecified     0
195   MDiscard  .local..2      -                       IPv4    Unspecified     0
196     Reject  .local..2      -                       IPv4    Unspecified     0
322      Local  -              10.1.0.5                IPv4              -     0
323    Resolve  bcm0.0         -                       IPv4    Unspecified     0
326      Local  -              129.0.0.5               IPv4              -     0
327    Resolve  bcm0.0         -                       IPv4    Unspecified     0
328      Local  -              fe80::201:ff:fe01:5
                                                       IPv6              -     0
329    Receive  bcm0.0         ff02::1:ff01:5          IPv6    Unspecified     0
330    Receive  bcm0.0         fe80::                  IPv6    Unspecified     0
331    Resolve  bcm0.0         -                       IPv6    Unspecified     0
332      Local  -              fec0::a:1:0:5           IPv6              -     0
333    Receive  bcm0.0         ff02::1:ff00:5          IPv6    Unspecified     0
334    Receive  bcm0.0         fec0::                  IPv6    Unspecified     0
335    Resolve  bcm0.0         -                       IPv6    Unspecified     0
348      Local  -              192.168.178.4           IPv4              -     0
349    Resolve  em0.0          -                       IPv4    Unspecified     0
350    Unicast  em0.0          192.168.178.126         IPv4    Unspecified     0
357      Local  -              fe80::201:1ff:fe01:5
                                                       IPv6              -     0
512      Local  -              10.255.178.11           IPv4              -     0
513      Local  -              127.0.0.1               IPv4              -     0
515      Local  -              abcd::10:255:178:11
                                                       IPv6              -     0
516      Local  -              fe80::200:ff:fe00:0
                                                       IPv6              -     0
517      Local  -              127.0.0.1               IPv4              -     0
518      Mcast  .local..3      default                 IPv4    Unspecified     0
519      Bcast  .local..3      -                       IPv4    Unspecified     0
521    Discard  .local..3      -                       IPv4    Unspecified     0
522   MDiscard  .local..3      -                       IPv4    Unspecified     0
523     Reject  .local..3      -                       IPv4    Unspecified     0
531      Mcast  .local..3      default                 IPv6    Unspecified     0
533    Discard  .local..3      -                       IPv6    Unspecified     0
534   MDiscard  .local..3      -                       IPv6    Unspecified     0
535     Reject  .local..3      -                       IPv6    Unspecified     0
539     Mgroup  -              -                       IPv4              -     0
540      Bcast  ge-15/0/3.0    -                       IPv4       Ethernet     0
541    Receive  ge-15/0/3.0    14.2.1.0                IPv4       Ethernet     0
542      Local  -              14.2.1.1                IPv4              -     0
543    Resolve  ge-15/0/3.0    -                       IPv4       Ethernet     0
544      Bcast  ge-31/0/4.0    -                       IPv4       Ethernet     0
```

```
545   Receive  ge-31/0/4.0    14.1.1.0              IPv4      Ethernet     0
546     Local  -              14.1.1.1              IPv4             -     0
547   Resolve  ge-31/0/4.0    -                     IPv4      Ethernet     0
548   Unicast  ge-31/0/4.0    14.1.1.2              IPv4      Ethernet     0
549   Unicast  ge-15/0/3.0    14.2.1.2              IPv4      Ethernet     0
550     Bcast  ae1.0          -                     IPv4      Ethernet     0
551   Receive  ae1.0          11.1.1.0              IPv4      Ethernet     0
552     Local  -              11.1.1.1              IPv4             -     0
553   Resolve  ae1.0          -                     IPv4      Ethernet     0
554   Aggreg.  ae1.0          -                     IPv4      Ethernet     0
555   Unicast  ge-23/0/8.0    11.1.1.2              IPv4      Ethernet     0
556   Unicast  ge-7/0/9.0     11.1.1.2              IPv4      Ethernet     0
557   Aggreg.  ae1.0          -                     MPLS      Ethernet     0
558   Unicast  ge-23/0/8.0    -                     MPLS      Ethernet     0
559   Unicast  ge-7/0/9.0     -                     MPLS      Ethernet     0
560   Aggreg.  ae1.0          -                     MPLS      Ethernet     0
561   Unicast  ge-23/0/8.0    -                     MPLS      Ethernet     0
562   Unicast  ge-7/0/9.0     -                     MPLS      Ethernet     0
```


show pfe route

Syntax

show pfe route
<<inet6 | ip | iso> <prefix *prefix*> | <table <*table-name*> <index *index*> <prefix *prefix*>>>
<mpls>
<summary>

Syntax (EX Series Switch and QFX Series)

show pfe route
<<inet6 | ip> <prefix *prefix*> | <table <*table-name*> <index *index*> <prefix *prefix*>>>
<mpls>
<summary>

Syntax (TX Matrix and TX Matrix Plus Routers)

show pfe route
<fpc *slot*>
<<inet6 | ip | iso> <prefix *prefix*> | <table <*table-name*> <index *index*> <prefix *prefix*>>>
<lcc *number*>
<mpls>
<summary>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the routes in the Packet Forwarding Engine forwarding table. The Packet Forwarding Engine forwards packets between input and output interfaces.

NOTE: **The Routing Engine maintains a master copy of the forwarding table. It copies the forwarding table to the Packet Forwarding Engine, which is the part of the router or switch responsible for forwarding packets. To display the routes in the Routing Engine forwarding table, use the show route forwarding table command. For more information, see the** CLI Explorer.

Options

none—Display all Packet Forwarding Engine forwarding table information.

fpc ***slot***—(TX Matrix and TX Matrix Plus routers only) (Optional) Show the next hops for a Flexible PIC Concentrator (FPC) slot.

- On a TX Matrix router, if you specify the number of a T640 router by using the **lcc** *number* option (the recommended method), replace ***slot*** with a value from **0** through **7**. Otherwise, replace ***slot*** with a value from **0** through **31**.
- On a TX Matrix Plus router, if you specify the number of a T1600 router by using the **lcc** *number* option (the recommended method), replace ***slot*** with a value from **0** through **7**. Otherwise, replace ***slot*** with a value from **0** through **31**
- On a TX Matrix Plus router in the TXP-T1600-3D, TXP-T4000-3D, or TXP-Mixed-LCC-3D configuration, if you specify the number of a T1600 or T4000 router by using the **lcc** *number* option (the recommended method), replace ***slot***

with a value from **0** through **7**. Otherwise, replace ***slot*** with a value from **0** through **63**.

For example, the following commands have the same result:

```
user@host> show pfe route fpc 1 lcc 1
user@host> show pfe route fpc 9
```

index ***index***—(Optional) Display table index.

inet6—(Optional) Display Packet Forwarding Engine IPv6 routes.

ip—(Optional) Display Packet Forwarding Engine IPv4 routes.

iso —(Optional) Display ISO version routing tables.

lcc ***number***—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, the slot number of the T640 router (or line-card chassis) that houses the FPC. On a TX Matrix Plus router, the slot number of the router (line-card chassis) that houses the FPC.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

mpls—(Optional) Display Packet Forwarding Engine MPLS information.

prefix ***prefix***—(Optional) IPv4 or IPv6 prefix for which to show table entries.

summary—(Optional) Display summary of Packet Forwarding Engine information.

table <*table-name*>—(Optional) Display table information.

Required Privilege Level admin

Related Documentation

- *Routing Matrix with TXP-T1600 Configuration*
- *Routing Matrix with TXP-T1600-3D Configuration*
- *Routing Matrix with TXP-T4000-3D Configuration*
- *Overview of a Routing Matrix with TXP-Mixed-LCC-3D Configuration*

List of Sample Output show pfe route ip on page 5955

show pfe route iso on page 5955
show pfe route lcc summary (TX Matrix Router) on page 5955
show pfe route lcc summary (TX Matrix Plus Router) on page 5957

Sample Output

show pfe route ip

```
user@host> show pfe route ip

IPv4 Route Table 0, default.0, 0x0:
Destination                       NH IP Addr      Type     NH ID Interface
--------------------------------- --------------- -------- ----- ---------
default                                            Discard     8
127.0.0.1                         127.0.0.1          Local   256
172.16/12                         192.168.71.254   Unicast    68 fxp0.0
192.168.0/18                      192.168.71.254   Unicast    68 fxp0.0
192.168.40/22                     192.168.71.254   Unicast    68 fxp0.0
192.168.64/18                     192.168.71.254   Unicast    68 fxp0.0
192.168.64/21                                      Resolve    67 fxp0.0
192.168.71.249                    192.168.71.249     Local    66
192.168.220.0/30                                   Resolve   303 fe-0/0/0.0
192.168.220.0                     192.168.220.0    Receive   301 fe-0/0/0.0
224.0.0.1                                            Mcast     5
255.255.255.255                                      Bcast     6

...
```

show pfe route iso

```
user@host# show pfe route iso

CLNS Route Table 0, CLNP.0, 0x0:
Destination                                      Type     NH ID Interface
---------------------------------------- -------- ----- ---------
default                                            Reject    60
47.0005.80ff.f800.0000.0108.0001.0102.5508.2159/152      Local   514
49.0001.00a0.c96b.c491/72                            Local   536
```

show pfe route lcc summary (TX Matrix Router)

```
user@host> show pfe route lcc 2 summary

Slot 0

IPv4 Route Tables:
Index           Routes      Size(b)
--------  ----------  ----------
Default             43        3081
1                    4         281

MPLS Route Tables:
Index           Routes      Size(b)
--------  ----------  ----------
Default              1          68

IPV6 Route Tables:
Index           Routes      Size(b)
--------  ----------  ----------
Default              9         717
1                    5         389
```

```
Slot 1


IPv4 Route Tables:
Index          Routes     Size(b)
--------  ----------  ----------
Default           43        3081
1                  4         281

MPLS Route Tables:

Index          Routes     Size(b)
--------  ----------  ----------
Default            1          68

IPV6 Route Tables:
Index          Routes     Size(b)
--------  ----------  ----------
Default            9         717
1                  5         389

Slot 16

IPv4 Route Tables:
Index          Routes     Size(b)
--------  ----------  ----------
Default           41        2938
1                  4         281

MPLS Route Tables:
Index          Routes     Size(b)
--------  ----------  ----------
Default            1          68

IPV6 Route Tables:
Index          Routes     Size(b)
--------  ----------  ----------
Default            9         717
1                  5         389

Slot 17

IPv4 Route Tables:
Index          Routes     Size(b)
--------  ----------  ----------
Default           41        2938
1                  4         281


MPLS Route Tables:
Index          Routes     Size(b)
--------  ----------  ----------
Default            1          68

IPV6 Route Tables:
Index          Routes     Size(b)
--------  ----------  ----------
Default            9         717
1                  5         389
```

show pfe route lcc summary (TX Matrix Plus Router)

```
user@host> show pfe route lcc 2 summary

Slot 0


IPv4 Route Tables:
Index           Routes      Size(b)
--------    ----------   ----------
Default             25         2266
1                    9          815
2                    6          545
3                    5          453
4                   15         1371
5                    5          453
6                   13         1187

MPLS Route Tables:
Index           Routes      Size(b)
--------    ----------   ----------
Default              1           88
4                    5          452

IPv6 Route Tables:
Index           Routes      Size(b)
--------    ----------   ----------
Default              7          697
1                   13         1305
3                    4          385
4                    4          385
5                    4          385
6                   18         1833

Slot 6


IPv4 Route Tables:
Index           Routes      Size(b)
--------    ----------   ----------
Default             25         2266
1                    9          815
2                    6          545
3                    5          453
4                   15         1371
5                    5          453
6                   13         1187

MPLS Route Tables:
Index           Routes      Size(b)
--------    ----------   ----------
Default              1           88
4                    5          452

IPv6 Route Tables:
Index           Routes      Size(b)
--------    ----------   ----------
Default              7          697
1                   13         1305
3                    4          385
4                    4          385
```

```
5                        4           385
6                       18          1833
...
```


show pfe terse

Syntax

show pfe terse

Syntax (TX Matrix and TX Matrix Plus Router)

show pfe terse
<lcc *number* | scc>
<sfc *number*>

Syntax (MX Series Router)

show pfe terse
<all-members>
<local>
<member *member-id*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display Packet Forwarding Engine status information.

Options

none—Display brief information about the Packet Forwarding Engine.

all-members—(MX Series routers only) (Optional) Display Packet Forwarding Engine status information for all members in the Virtual Chassis configuration.

lcc *number*—(TX Matrix and TX Matrix Plus routers only) (Optional) On a TX Matrix router, display Packet Forwarding Engine information for a T640 router (or line-card chassis) that is connected to a TX Matrix router. On a TX Matrix Plus router, display Packet Forwarding Engine information for the router (or line-card chassis) that is connected to a TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

local—(MX Series routers only) (Optional) Display Packet Forwarding Engine status information for the local Virtual Chassis member.

member *member-id*—(MX Series routers only) (Optional) Display Packet Forwarding Engine status information for the specified member of the Virtual Chassis configuration. Replace ***member-id*** with a value of 0 or 1.

scc—(TX Matrix routers only) (Optional) Display Packet Forwarding Engine information for the TX Matrix router (or switch-card chassis).

sfc—(TX Matrix Plus routers only) (Optional) Display Packet Forwarding Engine information for the TX Matrix Plus router (or switch-fabric chassis).

Required Privilege Level admin

List of Sample Output

show pfe terse (TX Matrix Router) on page 5960
show pfe terse (TX Matrix Plus Router) on page 5960
show pfe terse sfc (TX Matrix Plus Router) on page 5960

Sample Output

show pfe terse (TX Matrix Router)

```
user@host> show pfe terse
Slot Type Slot    State   Flags Uptime
  0  SFM  Present Online  0x0bf 01:25:42
  2  SFM  Present Online  0x0bf 01:25:40
  0  FPC  Present Online  0x102 01:25:57
  1  FPC  Present Online  0x102 01:25:55
  2  FPC  Present Online  0x102 01:25:53
```

show pfe terse (TX Matrix Plus Router)

```
user@host> show pfe terse
sfc0-re0:
--------------------------------------------------------------------------
Slot Type Slot      State     Uptime
 0   LCC  Present   Online    2d 05:26

lcc0-re0:
--------------------------------------------------------------------------
Slot Type Slot      State     Uptime
 0   GFPC Present   Online    2d 05:25
 1   GFPC Present   Online    2d 05:25
```

show pfe terse sfc (TX Matrix Plus Router)

```
user@host> show pfe terse sfc 0
sfc0-re0:
--------------------------------------------------------------------------
Slot Type Slot      State     Uptime
 0   LCC  Present   Online    2d 05:25
```


show pfe version

Syntax show pfe version <brief | detail>

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display Packet Forwarding Engine version information.

Options **brief | detail**—Display the specified level of output.

Required Privilege Level admin

List of Sample Output show pfe version brief on page 5961
show pfe version detail on page 5961

Sample Output

show pfe version brief

```
user@host> show pfe version brief
PFED release 11.1D0 built by builder on 2010-11-11 05:16:11 UTC
```

show pfe version detail

```
user@host> show pfe version detail
PFED release 11.1D0 built by builder on 2010-11-11 05:16:11 UTC

junos-core01.juniper.net:/volume/build/junos/rpd_feb11/11.1/development/20101111.0/obj-i386/
junos/usr.sbin/pfed
```

CHAPTER 65

Troubleshooting

Troubleshooting Procedures

Troubleshooting Dropped FCoE Traffic

Problem Fibre Channel over Ethernet (FCoE) traffic for which you want guaranteed delivery is dropped.

Cause There are several possible causes of dropped FCoE traffic (the list numbers of the possible causes correspond to the list numbers of the solutions in the *Solution* section.):

1. Priority-based flow control (PFC) is not enabled on the FCoE priority (IEEE 802.1p code point) in both the input and output stanzas of the congestion notification profile.
2. The FCoE traffic is not classified correctly at the ingress interface. FCoE traffic should either use the default **fcoe** forwarding class and classifier configuration (maps the **fcoe** forwarding class to IEEE 802.1p code point 011) or be mapped to a lossless forwarding class and to the code point enabled for PFC on the input and output interfaces.
3. The congestion notification profile that enables PFC on the FCoE priority is not attached to the interface.
4. The forwarding class set (priority group) used for guaranteed delivery traffic does not include the forwarding class used for FCoE traffic.

5. Insufficient bandwidth has been allocated for the FCoE queue or for the forwarding class set to which the FCoE queue belongs.

6. If you are using Junos OS Release 12.2, the **fcoe** forwarding class has been explicitly configured instead of using the default **fcoe** forwarding class configuration (forwarding-class-to-queue mapping).

NOTE: If you are using Junos OS Release 12.2, use the default forwarding-class-to-queue mapping for the lossless **fcoe** and **no-loss** forwarding classes. If you explicitly configure the lossless forwarding classes, the traffic mapped to those forwarding classes is treated as lossy (best effort) traffic and does *not* receive lossless treatment.

7. If you are using Junos OS Release 12.3 or later and you are not using the default **fcoe** forwarding class configuration, the forwarding class used for FCoE is not configured with the **no-loss** packet drop attribute. In Junos OS 12.3 or later, explicit forwarding classes configurations must include the **no-loss** packet drop attribute to be treated as lossless forwarding classes.

Solution The list numbers of the possible solutions correspond to the list numbers of the causes in the *Cause* section.

1. Check the congestion notification profile (CNP) to see if PFC is enabled on the FCoE priority (the correct IEEE 802.1p code point) on both input and output interfaces. Use the **show class-of-service congestion-notification** operational command to show the code points that are enabled for PFC in each CNP.

   If you are using the default configuration, FCoE traffic is mapped to code point 011 (priority 3). In this case, the input stanza of the CNP should show that PFC is enabled on code point 011, and the output stanza should show that priority 011 is mapped to flow control queue 3.

   If you explicitly configured a forwarding class for FCoE traffic, ensure that:

   - You specified the **no-loss** packet drop attribute in the forwarding class configuration
   - The code point mapped to the FCoE forwarding class in the ingress classifier is the code point enabled for PFC in the CNP input stanza
   - The code point and output queue used for FCoE traffic are mapped to each other in the CNP output stanza (if you are not using the default priority and queue, you must explicitly configure each output queue that you want to respond to PFC messages)

   For example, if you explicitly configure a forwarding class for FCoE traffic that is mapped to output queue 5 and to code point 101 (priority 5), the output of the **show class-of-service congestion-notification** looks like:

```
Name: fcoe_p5_cnp, Index: 12183
Type: Input
Cable Length: 100 m
  Priority     PFC          MRU
  000          Disabled
  001          Disabled
  010          Disabled
  011          Disabled
  100          Disabled
  101          Enabled      2500
  110          Disabled
  111          Disabled
Type: Output
  Priority     Flow-Control-Queues
  101
               5
```

2. Use the **show class-of-service classifier type ieee-802.1p** operational command to check if the classifier maps the forwarding class used for FCoE traffic to the correct IEEE 802.1p code point.

3. Ensure that the congestion notification profile and classifier are attached to the correct ingress interface. Use the operational command **show configuration class-of-service interfaces** ***interface-name***.

4. Check that the forwarding class set includes the forwarding class used for FCoE traffic. Use the operational command **show configuration class-of-service forwarding-class-sets** to show the configured priority groups and their forwarding classes.

5. Verify the amount of bandwidth allocated to the queue mapped to the FCoE forwarding class and to the forwarding class set to which the FCoE traffic queue belongs. Use the **show configuration class-of-service schedulers *scheduler-name*** operational command (specify the scheduler for FCoE traffic as the ***scheduler-name***) to see the minimum guaranteed bandwidth (**transmit-rate**) and maximum bandwidth (**shaping-rate**) for the queue.

   Use the **show configuration class-of-service traffic-control-profiles *traffic-control-profile*** operational command (specify the traffic control profile used for FCoE traffic as the ***traffic-control-profile***) to see the minimum guaranteed bandwidth (**guaranteed-rate**) and maximum bandwidth (**shaping-rate**) for the forwarding class set.

6. Delete the explicit FCoE forwarding-class-to-queue mapping so that the system uses the default FCoE forwarding-class-to-queue mapping. Include the **delete forwarding-classes class fcoe queue-num 3** statement at the **[edit class-of-service]** hierarchy level to remove the explicit configuration. The system then uses the default configuration for the FCoE forwarding class and preserves the lossless treatment of FCoE traffic.

7. Use the **show class-of-service forwarding-class** operational command to display the configured forwarding classes. The *No-Loss* column shows whether lossless transport is enabled or disabled for each forwarding class. If the forwarding class used for FCoE traffic is not enabled for lossless transport, include the **no-loss** packet drop attribute in the forwarding class configuration (**set class-of-service forwarding-classes class *fcoe-forwarding-class-name* queue-num *queue-number* no-loss**).

See "Example: Configuring CoS PFC for FCoE Traffic" on page 4921 for step-by-step instructions on how to configure PFC for FCoE traffic, including classifier, interface, congestion notification profile, PFC, and bandwidth scheduling configuration.

Related Documentation

- **show class-of-service congestion-notification on page 5825**
- **show class-of-service forwarding-class-set on page 5833**
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Overview of CoS Changes Introduced in Junos OS Release 12.2 on page 5304
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

Troubleshooting Egress Bandwidth That Exceeds the Configured Maximum Bandwidth

Problem The maximum bandwidth of a queue when measured at the egress port exceeds the maximum bandwidth (shaping rate) configured for the queue.

Cause When you configure bandwidth for a queue or a priority group, the switch accounts for the configured bandwidth as data only. The switch does not rate-shape the preamble and the interframe gap (IFG) associated with frames, so the switch does not account for the bandwidth consumed by the preamble and the IFG in its maximum bandwidth calculations.

The measured egress bandwidth can exceed the configured maximum bandwidth when small packet sizes (64 or 128 bytes) are transmitted because the preamble and the IFG are a larger percentage of the total traffic. For larger packet sizes, the preamble and IFG overhead are a small portion of the total traffic, and the effect on egress bandwidth is minor.

Solution When you calculate the bandwidth requirements for queues on which you expect a significant amount of traffic with small packet sizes, consider the shaping rate as the maximum bandwidth for the data only. Add sufficient bandwidth to your calculations to account for the preamble and IFG so that the port bandwidth is sufficient to handle the combined maximum data rate (shaping rate) and the preamble and IFG.

If the maximum bandwidth measured at the egress port exceeds the amount of bandwidth that you want to allocate to the queue, reduce the shaping rate for that queue.

Related Documentation

- **shaping-rate on page 5777**
- Example: Configuring Maximum Output Bandwidth on page 5526
- Example: Configuring Queue Schedulers on page 5511
- Understanding CoS Output Queue Schedulers on page 5371

Troubleshooting Egress Bandwidth That Exceeds the Configured Minimum Bandwidth

Problem The minimum bandwidth of a queue or a priority group when measured at the egress port exceeds the minimum bandwidth configured for the queue (transmit-rate) or for the priority group (guaranteed-rate).

Cause When you configure bandwidth for a queue or a priority group, the switch accounts for the configured bandwidth as data only. The switch does not include the preamble and the interframe gap (IFG) associated with frames, so the switch does not account for the bandwidth consumed by the preamble and the IFG in its minimum bandwidth calculations.

The measured egress bandwidth can exceed the configured minimum bandwidth when small packet sizes (64 or 128 bytes) are transmitted because the preamble and the IFG are a larger percentage of the total traffic. For larger packet sizes, the preamble and IFG overhead are a small portion of the total traffic, and the effect on egress bandwidth is minor.

NOTE: **The sum of the queue transmit rates in a priority group should not exceed the guaranteed rate for the priority group. (You cannot guarantee a minimum bandwidth for the queues that is greater than the minimum bandwidth guaranteed for the entire set of queues.)**

Solution When you calculate the bandwidth requirements for queues and priority groups on which you expect a significant amount of traffic with small packet sizes, consider the transmit rate and the guaranteed rate as the minimum bandwidth for the data only. Add sufficient bandwidth to your calculations to account for the preamble and IFG so that the port bandwidth is sufficient to handle the combined minimum data rate and the preamble and IFG.

If the minimum bandwidth measured at the egress port exceeds the amount of bandwidth that you want to allocate to a queue or to a priority group, reduce the transmit rate for that queue and reduce the guaranteed rate of the priority group that contains the queue.

Related Documentation

- **guaranteed-rate on page 5749**
- **transmit-rate on page 5784**
- Example: Configuring Minimum Guaranteed Output Bandwidth on page 5521
- Example: Configuring Queue Schedulers on page 5511
- Understanding CoS Output Queue Schedulers on page 5371

Troubleshooting Egress Queue Bandwidth Impacted by Congestion

Problem Congestion on an egress port causes egress queues to receive less bandwidth than expected. Egress port congestion can impact the amount of bandwidth allocated to queues on the congested port and, in some cases, on ports that are not congested.

Cause Egress queue congestion can cause the ingress port buffer to fill above a certain threshold and affect the flow to the queues on the egress port. One queue receives its configured bandwidth, but the other queues on the egress port are affected and do not receive their configured share of bandwidth.

Solution The solution is to configure a drop profile to apply weighted random early detection (WRED) to the queue or queues on the congested ports.

Configure a drop profile on the queue that is receiving its configured bandwidth. This queue is preventing the other queues from receiving their expected bandwidth. The drop profile prevents the queue from affecting the other queues on the port.

To configure a tail-drop profile using the CLI:

- Name the drop profile and set the drop start point, drop end point, minimum drop rate, and maximum drop rate for the drop profile:

```
[edit class-of-service]
user@switch# set drop-profile drop-profile-name interpolate fill-level percentage fill-level
percentage drop-probability 0 drop-probability percentage
```

Related Documentation

- **drop-profile on page 5732**
- Example: Configuring Tail-Drop Profiles on page 5501
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Understanding CoS Tail-Drop Profiles on page 5409

Troubleshooting an Unexpected Rewrite Value

Problem Traffic from one or more forwarding classes on an egress port is assigned an unexpected rewrite value.

NOTE: For packets that carry both an inner VLAN tag and an outer VLAN tag, the rewrite rules rewrite only the outer VLAN tag.

Cause If you configure a rewrite rule for a forwarding class on an egress port but you do not configure a rewrite rule for every forwarding class on that egress port, then the forwarding classes that do not have a configured rewrite rule are assigned random rewrite values.

For example:

1. Configure forwarding classes **fc1**, **fc2**, and **fc3**.
2. Configure rewrite rules for forwarding classes **fc1** and **fc2**, but not for forwarding class **fc3**.
3. Assign forwarding classes **fc1**, **fc2**, and **fc3** to a port.

When traffic for these forwarding classes flows through the port, traffic for forwarding classes **fc1** and **fc2** is rewritten correctly. However, traffic for forwarding class **fc3** is assigned a random rewrite value.

Solution If any forwarding class on an egress port has a configured rewrite rule, then all forwarding classes on that egress port must have a configured rewrite rule. Configuring a rewrite rule for any forwarding class that is assigned a random rewrite value solves the problem.

TIP: If you want the forwarding class to use the same code point value assigned to it by the ingress classifier, specify that value as the rewrite rule value. For example, if a forwarding class has the IEEE 802.1 ingress classifier code point value 011, configure a rewrite rule for that forwarding class that uses the IEEE 802.1p code point value 011.

NOTE: There are no default rewrite rules. You can bind one rewrite rule for each type (DSCP and IEEE 802.1) to a given interface. A rewrite rule can contain multiple forwarding-class-to-rewrite-value associations.

1. Assign a rewrite value to a forwarding class. Add the new rewrite value to the same rewrite rule as the other forwarding classes on the port:

```
[edit class-of-service rewrite-rules]
```

```
user@switch# set (dscp | ieee-802.1) rewrite-name forwarding-class class-name loss-priority
priority code-point (alias | bits)
```

For example, if the other forwarding classes on the port use rewrite values defined in the rewrite rule **custom-rw**, the forwarding class **fcoe** is being randomly rewritten, and you want to use IEEE 802.1 code point **011** for the **fcoe** forwarding class:

```
[edit class-of-service rewrite-rules]
user@switch# set ieee-802.1 custom-rw forwarding-class fcoe loss-priority high code-point
011
```

2. Enable the rewrite rule on an interface if it is not already enabled on the desired interface:

```
[edit]
user@switch# set class-of-service interfaces interface-name unit unit rewrite-rules (dscp |
ieee-802.1) rewrite-rule-name
```

For example, to enable the rewrite rule **custom-rw** on interface **xe-0/0/24.0**:

```
[edit]
user@switch# set class-of-service interfaces xe-0/0/24 unit 0 rewrite-rules ieee-802.1
custom-rw
```

Related Documentation

- interfaces on page 5757
- rewrite-rules on page 5772
- Defining CoS Rewrite Rules on page 5693
- Monitoring CoS Rewrite Rules on page 5812

Troubleshooting a Port Reset on QFabric Systems When a Queue Stops Transmitting Traffic

Problem In QFabric systems, if any queue that contains outgoing packets does not transmit packets for 12 consecutive seconds, the port automatically resets.

Cause Failure of a queue to transmit packets for 12 consecutive seconds may be due to:

- A strict-high priority queue consuming all of the port bandwidth
- Several queues consuming all of the port bandwidth
- Any queue or port receiving continuous priority-based flow control (PFC) or 802.3x Ethernet PAUSE messages (received PFC and PAUSE messages prevent a queue or a port, respectively, from transmitting packets because of network congestion)
- Other conditions that prevent a queue from obtaining port bandwidth for 12 consecutive seconds

Solution If the cause is a strict-high priority queue or other queues consuming all of the port bandwidth, you can use rate shaping to configure a maximum rate for the queues that are using all of the port bandwidth and preventing other queues from obtaining bandwidth on the port. You configure a maximum rate by creating a scheduler, using a scheduler map to apply it to a forwarding class (which maps to an output queue), and applying the scheduler map to the port using a forwarding class set and a traffic control profile.

To configure rate shaping using the CLI:

1. Name the existing scheduler or create a scheduler and define the maximum bandwidth as a rate or as a percentage:

   [edit class-of-service]
   user@switch# **set schedulers *scheduler-name* shaping-rate (*rate* | percent *percentage*)**

2. Configure a scheduler map to associate the scheduler with the forwarding class (queue) that is consuming all of the port bandwidth:

   [edit class-of-service]
   user@switch# **set scheduler-maps *scheduler-map-name* forwarding-class *forwarding-class-name* scheduler *scheduler-name***

3. Associate the scheduler map with a traffic control profile:

   [edit class-of-service]
   user@switch# **set traffic-control-profiles *traffic-control-profile-name* scheduler-map *scheduler-map-name***

4. Associate the traffic control profile (and thus the scheduler map that contains the rate shaping queue scheduler) with a forwarding class set and apply them to the interface that is being reset:

   [edit class-of-service]
   user@switch# **set interfaces *interface-name* forwarding-class-set *fc-set-name* output-traffic-control-profile *traffic-control-profile-name***

For example, a strict-high priority queue is using all of the bandwidth on interface **shpnode:xe-0/0/10** and preventing other queues from transmitting for 12 consecutive seconds. You decide to set a maximum rate of 7 Gbps on the strict-high priority queue to ensure that at least 3 Gbps of the port bandwidth is available to service other queues. Table 553 on page 5971 shows the topology for this example:

Table 553: Components of the Rate Shaping Troubleshooting Example

Component	Settings
Affected interface	**shpnode:xe-0/0/10**
Scheduler (strict-high priority scheduler)	Name: **shp-sched** Shaping rate: **7g** Priority: **strict-high** NOTE: This example assumes that the scheduler already exists and has been configured as **strict-high** priority, but that rate shaping to prevent the strict-high priority traffic from using all of the port bandwidth has not been applied.
Scheduler map	Name: **shp-map** Forwarding class to associate with the **shp-sched** scheduler: **strict-high** NOTE: This example assumes that a strict-high priority forwarding class has been configured and assigned the name **strict-high**.
Traffic control profile	Name: **shp-tcp** NOTE: This example does not describe how to define a complete traffic control profile.

Table 553: Components of the Rate Shaping Troubleshooting Example *(continued)*

Component	Settings
Forwarding class set	Name: **shp-pg**

To configure the scheduler, map it to the strict-high priority forwarding class, and apply it to interface **shpnode:xe-0/0/10** using the CLI:

1. Specify the scheduler for the strict-high priority queue (**shp-sched**) with a maximum bandwidth of 7 Gbps:

   ```
   [edit class-of-service schedulers]
   user@switch# set shp-sched shaping-rate 7g
   ```

2. Configure a scheduler map (**shp-map**) that associates the scheduler (**shp-sched**) with the forwarding class (**strict-high**):

   ```
   [edit class-of-service scheduler-maps]
   user@switch# set shp-map forwarding-class strict-high scheduler shp-sched
   ```

3. Associate the scheduler map **shp-map** with a traffic control profile (**shp-tcp**):

   ```
   [edit class-of-service traffic-control-profiles]
   user@switch# set shp-tcp scheduler-map shp-map
   ```

4. Associate the traffic control profile **shp-tcp** with a forwarding class set (**shp-pg**) and the affected interface (**shpnode:xe-0/0/10**):

   ```
   [edit class-of-service]
   user@switch# set interfaces shpnode:xe-0/0/10 forwarding-class-set shp-pg
   output-traffic-control-profile shp-tcp
   ```

Related Documentation

- Understanding CoS Output Queue Schedulers on page 5371
- Defining CoS Queue Scheduling Priority on page 5682
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Forwarding Class Sets on page 5508
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474

PART 20

Network Management and Monitoring

CHAPTER 66

Overview

Network Management

Understanding Device and Network Management Features

After you install a QFX Series product in your network, you need to manage the device. The QFX Series products support features that you use to manage the device within the network, including the management of configuration, system performance, fault monitoring, and remote access.

Table 554 on page 5975 lists the device and network management features on the QFX Series.

Table 554: Device and Network Management Features on the QFX Series

Feature	Typical Uses	Documentation
AI-Scripts and Advanced Insight Manager (AIM)—Automatically detect and monitor faults on the switch, and depending on the configuration on the AIM application, send notifications of potential problems, and submit problem reports to Juniper Support Systems.	Fault management	*Advanced Insight Scripts (AI-Scripts) Release Notes*

Table 554: Device and Network Management Features on the QFX Series *(continued)*

Feature	Typical Uses	Documentation
Alarms and LEDs on the switch—Show status of hardware components and indicate warning or error conditions.	Fault management	"Chassis Alarm Messages on a QFX3500 Device" on page 6430
Firewall filters—Control the packets that are sent to and from the network, balance network traffic, and optimize performance.	Performance management	• *Routing Policy Feature Guide for Routing Devices* • Overview of Firewall Filters on page 4409
In-band management—Enables connection to the switch using the same interfaces through which customer traffic flows. Communication between the switch and a remote console is typically enabled using SSH and Telnet services. SSH provides secure encrypted communications, whereas Telnet provides unencrypted, and therefore less secure, access to the switch.	Remote access management	• Configuring SSH Service for Remote Access to the Router or Switch on page 1243 • *Configuring Telnet Service for Remote Access to a Router or Switch*
Juniper Networks Junos OS automation scripts—Configuration and operations automation tools provided by Junos OS. These tools include commit scripts, operation scripts, event scripts, and event policies. Commit scripts enforce custom configuration rules, whereas operation scripts, event policies, and event scripts automate network troubleshooting and management.	• Configuration management • Performance management • Fault management	*Junos OS Automation Library*
Junos OS command-line interface (CLI)—CLI configuration statements that enable you to configure the switch based on your networking requirements, such as security, service, and performance.	• Configuration management • Performance management • User access management • Remote access management	*CLI User Guide*
Junos Space software—Multipurpose GUI-based network management system that includes a base platform, the Network Application Platform, and other optional applications such as Ethernet Design, Service Now, Service Insight, and Virtual Control.	• Configuration management • Performance management • Fault management	• Understanding Junos Space Support on page 5999 • *Junos Space Network Application Platform User Guide*
Junos XML API—XML representation of Junos OS configuration statements and operational mode commands. Junos XML configuration tag elements are the content to which the Junos XML protocol operations apply. Junos XML operational tag elements are equivalent in function to operational mode commands in the CLI, which you can use to retrieve status information for a device. The Junos XML API also includes tag elements that are the counterpart to Junos CLI configuration statements.	• Configuration management • Performance management • Fault management	• *Junos XML API Configuration Developer Reference* • *Junos XML API Operational Developer Reference*

Table 554: Device and Network Management Features on the QFX Series *(continued)*

Feature	Typical Uses	Documentation
NETCONF XML management protocol—XML-based management protocol that client applications use to request and change configuration information on routing, switching, and security platforms running Junos OS. The NETCONF XML management protocol defines basic operations that are equivalent to Junos OS CLI configuration mode commands. Client applications use the protocol operations to display, edit, and commit configuration statements (among other operations), just as administrators use CLI configuration mode commands such as **show**, **set**, and **commit** to perform those operations.	• Configuration management • Performance management • Fault management	*NETCONF XML Management Protocol Developer Guide*
Operational mode commands—May be used to do the following: • Monitor switch performance. For example, the **show chassis routing-engine** command shows the CPU utilization of the Routing Engine. High CPU utilization of the Routing Engine can affect performance of the switch. • View current activity and status of the device or network. For example, you can use the **ping** command to monitor and diagnose connectivity problems, and the **traceroute** command to locate points of failure on the network.	• Performance management • Fault management	CLI Explorer
Out-of-band management—Enables connection to the switch through a management interface. Out-of-band management is supported on two dedicated management Ethernet interfaces as well as on the console and auxiliary ports. The management Ethernet interfaces connect directly to the Routing Engine. No transit traffic is allowed through the interfaces, separating customer and management traffic and ensuring that congestion or failures in the transit network do not affect the management of the switch.	Remote access management	• *Connecting a QFX3500 Device to a Network for Out-of-Band Management* • *Connecting a QFX Series Device to a Management Console* • Configuring Console and Auxiliary Port Properties on page 6101
SNMP Configuration Management MIB—Provides notification for configuration changes in the form of SNMP traps. Each trap contains the time at which the configuration change was committed, the name of the user who made the change, and the method by which the change was made. A history of the last 32 configuration changes is kept in jnxCmChgEventTable.	Configuration management	*SNMP MIBs and Traps Reference*

Table 554: Device and Network Management Features on the QFX Series *(continued)*

Feature	Typical Uses	Documentation
SNMP MIBs and traps—Enable the monitoring of network devices from a central location. Use SNMP requests such as **get** and **walk** to monitor and view system activity. The QFX3500 switch supports SNMP Version 1 (v1), v2, and v3, and both standard and Juniper Networks enterprise-specific MIBs and traps.	Fault management	• *SNMP MIBs and Traps Reference* • Understanding the Implementation of SNMP on page 6021
System log messages—Log details of system and user events, including errors. You can specify the severity and type of system log messages you wish to view or save, and configure the output to be sent to local or remote hosts.	• Fault management • User access management	• *Junos OS System Log Messages Reference* • Overview of Junos OS System Log Messages on page 6068 • Overview of Single-Chassis System Logging Configuration on page 6069

Understanding Network Management Implementation on the QFabric System

This topic describes network management features on the QFabric system that are implemented differently than on other devices running Junos OS.

The following network management features are supported on the QFabric system:

- **System log messages**—The QFabric system monitors events that occur on its component devices, distributes system log messages about those events to all external system log message servers (hosts) that are configured, and archives the messages. Component devices include Node devices, Interconnect devices, Director devices, and the Virtual Chassis. You configure system log messages at the **[edit system syslog]** hierarchy level. Use the **show log *filename*** operational mode command to view messages.
- **Simple Network Management Protocol (SNMP) Version 1 (v1) and v2c**—SNMP monitors network devices from a central location. The SNMP implementation on the QFabric system supports the basic SNMP architecture of Junos OS with some limitations, including a reduced set of MIB objects, read-only access for SNMP communities, and limited support for SNMP requests. You configure SNMP at the **[edit snmp]** hierarchy level. Only the **show snmp statistics** operational mode command is supported, but you can issue SNMP requests using external SNMP client applications.
- **Advanced Insight Solutions (AIS)**—AIS provides tools and processes to automate the delivery of support services for the QFabric system. AIS components include Advanced Insight Scripts (AI-Scripts) and Advanced Insight Manager (AIM). You install AI-Scripts using the **request system scripts add** operational mode command. However, the **jais-activate-scripts.slax** file used during installation is preconfigured for the QFabric system and cannot be changed.

Related Documentation

- *Advanced Insight Scripts (AI-Scripts) Release Notes*
- Understanding Device and Network Management Features on page 5975

- Overview of Junos OS System Log Messages on page 6068
- Understanding the Implementation of SNMP on the QFabric System on page 6023
- SNMP MIBs Support on page 6038

Understanding Telnet on the QFabric System

This topic describes the support for the Telnet protocol on QFabric systems.

Telnet service is available for devices running Junos OS, including QFX Series devices. However, on QFabric systems, Telnet support is limited and the following conditions apply:

- You can telnet from a QFabric system to external devices that are connected to the QFabric system by way of the network Node group. To connect to these external devices, issue the **telnet** command from the QFabric default partition CLI.
- You cannot use the Telnet protocol to connect from the QFabric system default partition CLI to individual components. To access system components, you must issue the **request component login** command instead.

Related Documentation

- request component login on page 1356
- *telnet*

Understanding Tracing and Logging Operations

Tracing and logging operations enable you to track events that occur in the switch—both normal operations and error conditions—and to track the packets that are generated by or passed through the switch. The results of tracing and logging operations are placed in files in the **/var/log** directory on the switch.

The Junos OS supports remote tracing for the following processes:

- **chassisd**—Chassis-control process
- **eventd**—Event-processing process
- **cosd**—Class-of-service process

You configure remote tracing by using the **tracing** statement at the **[edit system]** hierarchy level.

NOTE: **The tracing statement is not supported on the QFX3000 QFabric system.**

If you enabled remote tracing but wish to disable it for specific processes on the switch, use the **no-remote-trace** statement at the **[edit *process-name* traceoptions]** hierarchy level. This feature does not alter local tracing functionality in any way, and logging files are stored on the switch.

Logging operations use a system logging mechanism similar to the UNIX **syslogd** utility to record systemwide, high-level operations, such as interfaces going up or down and users logging in to or out of the switch. You configure these operations by using the **syslog** statement at the **[edit system]** hierarchy level and by using the **options** statement at the **[edit ethernet-switching-options]** hierarchy level.

Tracing operations record more detailed information about the operations of the switch, including packet forwarding and routing information. To configure tracing operations, use the **traceoptions** statement.

NOTE: **The traceoptions statement is not supported on the QFX3000 QFabric system.**

You can define tracing operations in different portions of the switch configuration:

- SNMP agent activity tracing operations—Define tracing of the activities of SNMP agents on the switch. You configure SNMP agent activity tracing operations at the **[edit snmp]** hierarchy level.
- Global switching tracing operations—Define tracing for all switching operations. You configure global switching tracing operations at the **[edit ethernet-switching-options]** hierarchy level of the configuration.
- Protocol-specific tracing operations—Define tracing for a specific routing protocol. You configure protocol-specific tracing operations in the **[edit protocols]** hierarchy when configuring the individual routing protocol. Protocol-specific tracing operations override any equivalent operations that you specify in the global **traceoptions** statement. If there are no equivalent operations, they supplement the global tracing options. If you do not specify any protocol-specific tracing, the routing protocol inherits all the global tracing operations.
- Tracing operations within individual routing protocol entities—Some protocols allow you to define more granular tracing operations. For example, in Border Gateway Protocol (BGP), you can configure peer-specific tracing operations. These operations override any equivalent BGP-wide operations or, if there are no equivalents, supplement them. If you do not specify any peer-specific tracing operations, the peers inherit, first, all the BGP-wide tracing operations and, second, the global tracing operations.
- Interface tracing operations—Define tracing for individual interfaces and for the interface process itself. You define interface tracing operations at the **[edit interfaces]** hierarchy level of the configuration.
- Remote tracing—To enable system-wide remote tracing, configure the **destination-override syslog host** statement at the **[edit system tracing]** hierarchy level. This specifies the remote host running the system log process (syslogd), which collects the traces. Traces are written to files on the remote host in accordance with the syslogd configuration in **/etc/syslog.conf**. By default, remote tracing is not configured.

  To override the system-wide remote tracing configuration for a particular process, include the **no-remote-trace** statement at the **[edit *process-name* traceoptions]** hierarchy. When **no-remote-trace** is enabled, the process does local tracing.

To collect traces, use the **local0** facility as the selector in the **/etc/syslog.conf** file on the remote host. To separate traces from various processes into different files, include the process name or trace-file name (if it is specified at the [edit ***process-name*** **traceoptions file**] hierarchy level) in the Program field in the **/etc/syslog.conf** file. If your system log server supports parsing hostname and program name, then you can separate traces from the various processes.

NOTE: During a commit check, warnings about the **traceoptions** configuration (for example, mismatch in trace file sizes or number of trace files) are not displayed on the console. However, these warnings are logged in the system log messages when the new configuration is committed.

Related Documentation

- Overview of Junos OS System Log Messages on page 6068

Automation

Overview of QFX5100 Switch Automation Enhancements

The QFX5100 switch automation enhancements introduced in Junos OS Release 13.2X51-D15 are designed to support the increasing needs of large data centers for more automation and programmability.

Features of the QFX5100 Switch Automation Enhancements

To use the QFX5100 switch automation enhancements, you must install the jinstall-qfx-5-flex-x.tgz software bundle. This software bundle is identical to the other QFX5100 switch software bundle except that Veriexec is disabled, which enables you to run unsigned programs, such as programs that you develop with Python, Chef, and Puppet. The QFX5100 switch automation enhancements include the following features:

- The factory default configuration is a Layer 3 configuration. (The standard default factory configuration is Layer 2.)
- Safeguards ensure that you cannot overwrite essential Junos OS files, including system log notifications.
- Zero Touch Provisioning (ZTP) allows you to provision new switches in your network automatically, without manual intervention. See *Understanding Zero Touch Provisioning*.
- The installation automatically sets up and reserves a 1-gigabit user partition on your system. You can use this partition to store your binaries and additional packages.
- The user partition is not overwritten when you upgrade or downgrade the software to a QFX5100 switch Junos OS image that does not contain the automation enhancements.

NOTE: **If you make changes to the user partition while performing a unified in-service software upgrade (unified ISSU), the changes might be lost.**

- The Python interpreter is included by default.
  - You can invoke Python directly from the shell. See "Invoking the Python Interpreter" on page 6104.
- Chef for Junos OS and Puppet for Junos OS automation tools for provisioning and managing computer networking and storage resources can be downloaded separately from the Juniper Networks site.
  - For further information on Chef, see Chef for Junos Getting Started Guide.
  - For further information on Puppet, see Puppet for Junos OS Documentation.

NOTE: **For full compatibility, you must use only Chef for Junos OS and Puppet for Junos OS rather than the standard FreeBSD versions of Chef and Puppet software.**

- The QFX5100 switch automation enhancements also support the following libraries:
  - **ncclient** (Juniper Networks edition) — NETCONF base library. See https://github.com/juniper/ncclient for more information.
  - **lxml** — XML programming library. See http://lxml.de/index.html for more information.
  - **jinja2** — Templating library. See http://jinja.pocoo.org/ for more information.
  - **JVAS** — Java script library.
  - **JDE2** — Java Development Environment for Emacs or XEmacs.

CAUTION: **Download additional third party packages at your own risk.**

Related Documentation

- *Installing Junos OS Software with QFX5100 Switch Automation Enhancements*
- Invoking the Python Interpreter on page 6104
- QFX5100 Switch with Automation Enhancements Frequently Asked Questions on page 6415

Overview of Python with QFX5100 Switch Automation Enhancements

Python is a programming language that lets you work more quickly and integrate your systems more effectively. The Python interpreter is included within the Junos operating system (Junos OS) jinstall-qfx-5-flex-x.tgz software bundle.

You can extend the Python interpreter with new functions and data types implemented in C or C++ (or other languages callable from C). Python is also suitable as an extension language for customizable applications. For information on using Python, refer to your Python documentation.

Related Documentation

- *Installing Junos OS Software with QFX5100 Switch Automation Enhancements*
- Invoking the Python Interpreter on page 6104
- QFX5100 Switch with Automation Enhancements Frequently Asked Questions on page 6415

Understanding Automation Scripts Support

This document describes the support for the Junos OS automation scripts on the QFabric system Director devices.

Junos OS automation consists of a suite of tools used to automate operational and configuration tasks on network devices running Junos OS. The automation tools, which leverage the native XML capabilities of the Junos OS, include commit scripts, operation (op) scripts, event policies and event scripts, and macros.

NOTE: Event policies and event scripts are not supported on the QFabric system at this time.

The QFabric system supports Junos OS automation scripts that are written in Stylesheet Language Alternative Syntax (SLAX) version 1.0.

Commit scripts automate the commit process and enforce custom configuration rules. You can use commit scripts to generate specific errors and warnings, and customize configurations and configuration templates. When a candidate configuration is committed, it is inspected by each active commit script. If a configuration violates your custom rules and the scripts generate an error, the commit fails. If the commit is successful, any configuration changes (both transient and permanent) are incorporated into the active configuration before it is passed to the Director software, which distributes the configuration to all applicable QFabric system components, including Node devices and Node servers.

Op scripts automate operational and troubleshooting tasks. Op scripts can be executed manually from the Junos OS CLI or NETCONF XML management protocol, or they can be called from another script.

The QFabric system supports the following automation script features:

- Commit scripts and op scripts are supported.
- Scripts written in SLAX version 1 are supported.
- Scripts are configured and deployed from the Director group. Since there is more than one Director device in a Director group, scripts must be deployed by each Director device or deployed in the shared media space.
- Scripts are stored in the shared media at this location: **/pbdata/mgd_shared/*partition-ip*/var/db/scripts**. Under this directory, commit scripts are stored in the **commit** subdirectory, and op scripts are stored in the **op** subdirectory.
- Scripts are not stored in flash memory.

Related Documentation

- How Commit Scripts Work on page 5984
- How Op Scripts Work on page 5996
- Required Boilerplate for Commit Scripts on page 5995
- Required Boilerplate for Op Scripts on page 5997
- Controlling the Execution of Commit Scripts on page 6105

How Commit Scripts Work

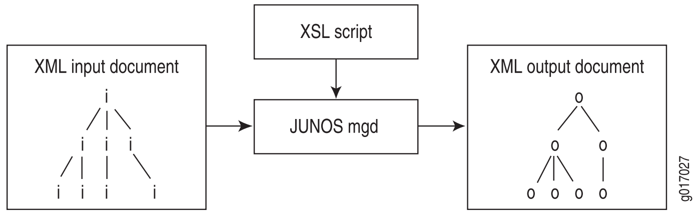
You enable commit scripts by listing the names of one or more commit script files at the **[edit system scripts commit]** hierarchy level. These scripts contain instructions that enforce custom configuration rules. Commit scripts are invoked during the commit process before the standard Junos OS validity checks are performed.

When you perform a commit operation, Junos OS executes each script in turn, passing the information in the candidate configuration to the scripts. The script inspects the configuration, performs the necessary tests and validations, and generates a set of instructions for performing certain actions. These actions include generating error, warning, and system log messages. If errors are generated, the commit operation fails and the candidate configuration remains unchanged. This is the same behavior that occurs with standard commit errors.

Commit scripts can also generate changes to the system configuration. Because the changes are loaded before the standard validation checks are performed, they are validated for correct syntax, just like statements already present in the configuration before the script is applied. If the syntax is correct, the configuration is activated and becomes the active, operational device configuration.

Figure 208 on page 5985 shows the flow of commit script input and output.

Figure 208: Commit Script Input and Output



Commit scripts cannot make configuration changes to protected statements or within protected hierarchies. If a commit script attempts to modify or delete a protected statement or hierarchy, Junos OS issues a warning that the change cannot be made. Failure to modify a protected configuration element does not halt the commit script or the commit process.

The following sections discuss several important concepts related to the commit script input and output:

- Commit Script Input on page 5985
- Commit Script Output on page 5986
- Commit Scripts and the Junos OS Commit Model on page 5987

Commit Script Input

The input for a commit script is the postinheritance candidate configuration in Junos XML API format. The term *postinheritance* means that all configuration group values have been inherited by their targets in the candidate configuration and the inactive portions of the configuration have been removed. For more information about configuration groups, see the *CLI User Guide*.

When you issue the **commit** command, Junos OS automatically generates the candidate configuration in XML format and reads it into the management (mgd) process, at which time the input is evaluated by any commit scripts.

To display the XML format of the postinheritance configuration, issue the **show | display commit-scripts view** command:

```
[edit]
user@host# show | display commit-scripts view
```

To display all configuration groups data, including script-generated changes to the groups, issue the **show groups | display commit-scripts** command:

```
[edit]
user@host# show groups | display commit-scripts
```

To save the commit script input to a file, add the **save** command to the command line:

```
[edit]
user@host# show | display commit-scripts view | save filename.xml
```

By default, the file is placed in your home directory on the switch, router, or security device.

Commit Script Output

To specify the desired commit script output—including warning, error, and system log messages, persistent changes, and transient changes—the script can contain tags that appear in any order, in any number. The tags for specifying output are as follows:

- **<xnm:warning>**—Generates a warning message
- **<xnm:error>**—Generates an error message.
- **<syslog><message>**—Generates a system log message.
- **<change>**—Generates a persistent change to the configuration.
- **<transient-change>**—Generates a transient change to the configuration.
- **<xsl:call-template name="jcs:emit-change">**
  <xsl:with-param name="content">—Generates a persistent change relative to the current context node as defined by an XPath expression.
- **<xsl:call-template name="jcs:emit-change">**
  <xsl:with-param name="tag" select="'transient-change'"/>
  <xsl:with-param name="content">—Generates a transient change relative to the current context node as defined by an XPath expression.
- **<xsl:call-template name="jcs:emit-change">**
  <xsl:with-param name="message">
  <xsl:text>—Generates a warning message in conjunction with a configuration change. You can use this set of tags to generate a notification that the configuration has been changed.

Junos OS processes this output and performs the appropriate actions. Errors and warnings are passed back to the Junos OS CLI or to a Junos XML protocol client application. The presence of an error automatically causes the commit operation to fail. Persistent and transient changes are loaded into the appropriate configuration database.

To test the output of error, warning, and system log messages from commit scripts, issue the **commit check | display xml** command:

```
[edit]
user@host# commit check | display xml
```

To display a detailed trace of commit script processing, issue the **commit check | display detail** command:

```
[edit]
user@host# commit check | display detail
```

NOTE: System log messages do not appear in the trace output, so you cannot use the commit check operation to test script-generated system log messages. Furthermore, system log messages are written to the system log during a commit operation, but not during a commit check operation.

Related Documentation

- *Example: Protecting the Junos OS Configuration from Modification or Deletion*.
- *jcs:emit-change Template*

Commit Scripts and the Junos OS Commit Model

Junos OS uses a commit model to update the device's configuration. This model allows you to make a series of changes to a candidate configuration without affecting the operation of the device. When the changes are complete, you can commit the configuration. The commit operation saves the candidate configuration changes into the current configuration.

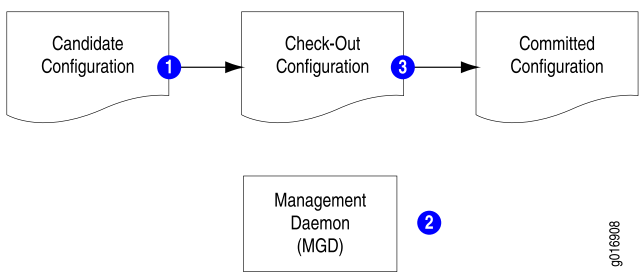
When you commit a set of changes in the candidate configuration, two methods are used to forward these changes to the current configuration:

- Standard commit model—Used when no commit scripts are active on the device.
- Commit script model—Incorporates commit scripts into the commit model.

Standard Commit Model

In the standard commit model, the management (mgd) process validates the candidate configuration based on standard Junos validation rules. If the configuration file is valid, it becomes the current active configuration. Figure 209 on page 5987 and the accompanying discussion explain how the standard commit model works:

Figure 209: Standard Commit Model



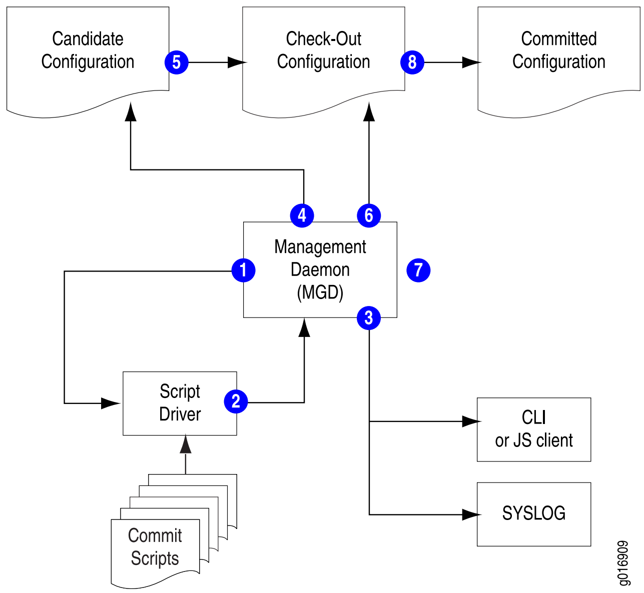
In the standard commit model, the software performs the following steps:

1. When the candidate configuration is committed, it is copied to become the checkout configuration.
2. The mgd process validates the checkout configuration.
3. If no error occurs, the checkout configuration is copied as the current active configuration.

Commit Model with Commit Scripts

When commit scripts are added to the standard commit model, the process becomes more complex. The mgd process first passes an XML-formatted checkout configuration to a script driver, which handles the verification of the checkout configuration by the commit scripts. When verification is complete, the script driver returns an XML *action file* to the mgd process. The mgd process follows the instructions in the action file to update the candidate and checkout configurations, issue messages to the CLI, and write information to the system log as required. After processing the action file, the mgd process performs the standard Junos OS validation. Figure 210 on page 5988 and the accompanying discussion explain this process.

Figure 210: Commit Model with Commit Scripts Added



In the commit script model, Junos OS performs the following steps:

1. When the candidate configuration is committed, the mgd process sends the XML-formatted candidate configuration to the script driver.
2. Each enabled commit script is invoked against the candidate configuration, and each script can generate a set of actions for the mgd process to perform. The actions are collected in an XML action file.
3. The mgd process performs the following actions in response to **<error>**, **<warning>**, and **<syslog>** tag elements in the action file:
   - **<error>**—The mgd process halts the commit process (that is, the commit operation fails), returns an error message to the CLI or Junos XML protocol client, and takes no further action.
   - **<warning>**—The mgd process forwards the message to the CLI or the Junos XML protocol client.
   - **<syslog>**—The mgd process forwards the message to the system log process.
4. If the action file includes any **<change>** tag elements, the mgd process loads the requested changes into the candidate configuration.
5. The candidate configuration is copied to become the checkout configuration.
6. If the action file includes any **<transient-change>** tag elements, the mgd process loads the requested changes into the checkout configuration.

7. The mgd process validates the checkout configuration.
8. If there are no validation errors, the checkout configuration is copied to become the current active configuration.

NOTE: **Commit scripts cannot make configuration changes to protected statements or within protected hierarchies. If a commit script attempts to modify or delete a protected statement or hierarchy, Junos OS issues a warning that the change cannot be made. Failure to modify a protected configuration element does not halt the commit script or the commit process.**

Changes that are made to the candidate configuration during the commit operation are not evaluated by the custom rules during that commit operation. However, persistent changes are maintained in the candidate configuration and are evaluated by the custom rules during subsequent commit operations. For more information about how commit scripts change the candidate configuration, see "Avoiding Potential Conflicts When Using Multiple Commit Scripts" on page 5989.

Transient changes are never evaluated by the custom rules in commit scripts, because they are made to the checkout configuration only after the commit scripts have evaluated the candidate configuration and the candidate is copied to become the checkout configuration. To remove a transient change from the configuration, remove, disable, or deactivate the commit script (as discussed in *Controlling Execution of Commit Scripts During Commit Operations*), or comment out the code that generates the transient change.

For more information about differences between persistent and transient changes, see "Overview of Generating Persistent or Transient Configuration Changes" on page 5990.

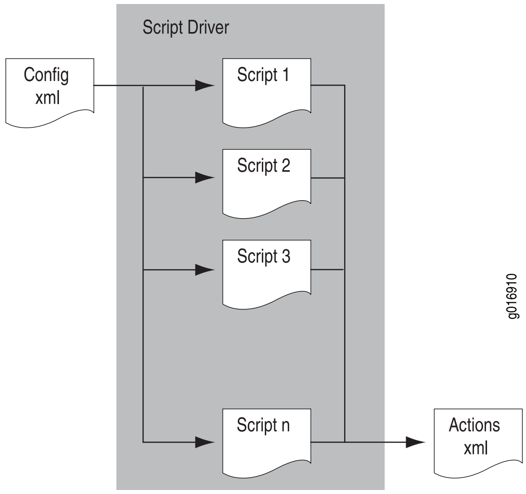
Related Documentation

- Avoiding Potential Conflicts When Using Multiple Commit Scripts on page 5989

Avoiding Potential Conflicts When Using Multiple Commit Scripts

When you use multiple commit scripts, each script evaluates the original candidate configuration file. Changes made by one script are not evaluated by the other scripts. This means that conflicts between scripts might not be resolved when the scripts are first applied to the configuration. The commit scripts are executed in the order they are listed at the **[edit system scripts commit]** hierarchy level, as illustrated in Figure 211 on page 5990.

Figure 211: Configuration Evaluation by Multiple Commit Scripts



As an example of a conflict between commit scripts, suppose that commit script **A.xsl** is created to ensure that the device uses the domain name server with IP address 192.168.0.255. Later, the DNS server's address is changed to 192.168.255.255 and a second script, **B.xsl**, is added to check that the device uses the DNS server with that address. However, script **A.xsl** is not removed or disabled.

Because each commit script evaluates the original candidate configuration, the final result of executing both scripts **A.xsl** and **B.xsl** depends on which DNS server address is configured in the original candidate configuration. If the now outdated address of 192.168.0.255 is configured, script **B.xsl** changes it to 192.168.255.255. However, if the correct address of 192.168.255.255 is configured, script **A.xsl** changes it to the incorrect value 192.168.0.255.

As another example of a potential conflict between commit scripts, suppose that a commit script protects a hierarchy using the **protect** attribute. If a second commit script attempts to modify or delete the hierarchy or the statements within the hierarchy, Junos OS issues a warning during the commit process and prevents the configuration change.

Exercise care to ensure that you do not introduce conflicts between scripts like those described in the examples. As a method of checking for conflicts with persistent changes, you can issue two separate **commit** commands.

Related Documentation

- How Commit Scripts Work on page 5984

Overview of Generating Persistent or Transient Configuration Changes

Junos OS commit scripts enforce custom configuration rules. When a candidate configuration includes statements that you have decided must not be included in your configuration, or when the candidate configuration omits statements that you have decided are required, commit scripts can automatically change the configuration and thereby correct the problem.

Differences Between Persistent and Transient Changes

Configuration changes made by commit scripts can be *persistent* or *transient*.

A persistent change remains in the candidate configuration and affects routing operations until you explicitly delete it, even if you subsequently remove or disable the commit script that generated the change and reissue the **commit** command. In other words, removing the commit script does not cause a persistent change to be removed from the configuration.

A transient change, in contrast, is made in the *checkout configuration* but not in the candidate configuration. The checkout configuration is the configuration database that is inspected for standard Junos OS syntax just before it is copied to become the active configuration on the device. If you subsequently remove or disable the commit script that made the change and reissue the **commit** command, the change is no longer made to the checkout configuration and so does not affect the active configuration. In other words, removing the commit script effectively removes a transient change from the configuration.

A common use for transient changes is to eliminate the need to repeatedly configure and display well-known policies, thus allowing these policies to be enforced implicitly. For example, if MPLS must be enabled on every interface with an International Organization for Standardization (ISO) protocol enabled, the change can be transient, so that the repetitive or redundant configuration data need not be carried or displayed in the candidate configuration. Furthermore, transient changes allow you to write script instructions that apply the change only if a set of conditions is met.

Persistent and transient changes are loaded into the configuration in the same manner that the **load replace** configuration mode command loads an incoming configuration. When generating a persistent or transient change, adding the **replace="replace"** attribute to a configuration element produces the same behavior as a **replace:** tag in a **load replace** operation.

By default, Junos OS merges the incoming configuration and the candidate configuration. New statements and hierarchies are added, and conflicting statements are overridden. When generating a persistent or transient change, if you add the **replace="replace"** attribute to a configuration element, Junos OS replaces the existing configuration element with the incoming configuration element. If the **replace="replace"** attribute is added to a configuration element, but there is no existing element of the same name in the current configuration, the incoming configuration element is added into the configuration. Elements that do not have the **replace** attribute are merged into the configuration.

Persistent and transient changes are loaded before the standard Junos validation checks are performed. This means any configuration changes introduced by a commit script are validated for correct syntax. If the syntax is correct, the new configuration becomes the active, operational device configuration.

Protected elements in the configuration hierarchy cannot be modified or deleted by either a persistent or a transient change. If a commit script attempts to modify or delete a protected statement or hierarchy, Junos OS issues a warning that the change cannot be made, and proceeds with the commit.

Persistent and transient changes have several important differences, as described in Table 555 on page 5992.

Table 555: Differences Between Persistent and Transient Changes

Persistent Changes	Transient Changes
A persistent change is represented in a commit script by the **<change>** tag. Another way to represent a persistent change is with the **content** parameter inside a call to the **jcs:emit-change** template. The **jcs:emit-change** template is a helper template contained in the **junos.xsl** import file.	A transient change is represented in a commit script by the **<transient-change>** tag. Another way to represent a transient change is to use the **content** parameter and the **tag transient** parameter inside a call to the **jcs:emit-change** template.
You can use persistent changes to perform any Junos XML protocol operation, such as activate, deactivate, delete, insert (reorder), comment (annotate), and replace sections of the configuration.	Like persistent changes, you can use transient changes to perform any Junos XML protocol operation. However, some Junos XML protocol operations do not make sense to use with transient changes, such as generating comments and inactive settings.
Persistent changes are always loaded during the commit process if no errors are generated by any commit scripts or by the standard Junos OS validity check.	For transient changes to be loaded, you must include the **allow-transients** statement at the **[edit system scripts commit]** hierarchy level. If you enable a commit script that generates transient changes and you do not include the **allow-transients** statement in the configuration, the CLI generates an error message and the commit operation fails. Like persistent changes, transient changes must pass the standard Junos OS validity check. You cannot use a commit script to generate the **allow-transients** statement at the **[edit system scripts commit]** hierarchy level. Rather, you must include this statement directly by using the CLI.

Table 555: Differences Between Persistent and Transient Changes *(continued)*

Persistent Changes	Transient Changes
Persistent changes work like the **load replace** configuration mode command, and the change is added to the candidate configuration. When generating a persistent change, if you add the **replace="replace"** attribute to a configuration element, Junos OS replaces the existing element in the candidate configuration with the incoming configuration element. If there is no existing element of the same name in the candidate configuration, the incoming configuration element is added into the configuration. Elements that do not have the **replace** attribute are merged into the configuration.	Transient changes work like the **load replace** configuration mode command, and the change is added to the checkout configuration. When generating a transient change, if you add the **replace="replace"** attribute to a configuration element, Junos OS replaces the existing element in the checkout configuration with the incoming configuration element. If there is no existing element of the same name in the checkout configuration, the incoming configuration element is added into the configuration. Elements that do not have the **replace** attribute are merged into the configuration. Transient changes are not copied to the candidate configuration. For this reason, transient changes are not saved in the configuration if the associated commit script is deleted or deactivated.
After a persistent change is committed, the software treats it like a change you make by directly editing and committing the candidate configuration. After the persistent changes are copied to the candidate configuration, they are copied to the checkout configuration. If the changes pass the standard Junos OS validity checks, the changes are propagated to the switch, router, or security device components.	Each time a transient change is committed, the software updates the checkout configuration database. After the transient changes pass the standard Junos OS validity checks, the changes are propagated to the device components.
After committing a script that causes a persistent change to be generated, you can view the persistent change by issuing the **show** configuration mode command: user@host# **show** This command displays persistent changes only, not transient changes.	After committing a script that causes a transient change to be generated, you can view the transient change by issuing the **show | display commit-scripts** configuration mode command: user@host# **show | display commit-scripts** This command displays both persistent and transient changes.
Persistent changes must conform to your custom configuration design rules as dictated by commit scripts. This does not become apparent until after a second commit operation because persistent changes are not evaluated by commit script rules on the current commit operation. The subsequent commit operation fails if the persistent changes do not conform to the rules imposed by the commit scripts configured during the first commit operation.	Transient changes are never tested by and do not need to conform to your custom rules. This is caused by the order of operations in the Junos OS commit model, which is explained in detail in "Commit Scripts and the Junos OS Commit Model" on page 5987.
A persistent change remains in the configuration even if you delete, disable, or deactivate the commit script instructions that generated the change.	If you delete, disable, or deactivate the commit script instructions that generate a transient change, the change is removed from the configuration after the next commit operation. In short, if the associated instructions or the entire commit script is removed, the transient change is also removed.

Table 555: Differences Between Persistent and Transient Changes *(continued)*

Persistent Changes	Transient Changes
As with direct CLI configuration, you can remove a persistent change by rolling back to a previous configuration that did not include the change and issuing the **commit** command. However, if you do not disable or deactivate the associated commit script, and the problem that originally caused the change to be generated still exists, the change is automatically regenerated when you issue another **commit** command.	You cannot remove a transient change by rolling back to a previous configuration.
You can alter persistent changes directly by editing the configuration using the CLI.	You cannot directly alter or delete a transient change by using the Junos OS CLI, because the change is not in the candidate configuration. To alter the contents of a transient change, you must alter the statements in the commit script that generates the transient change.

Interaction of Configuration Changes and Configuration Groups

Any configuration change you can make by directly editing the configuration using the Junos OS command-line interface (CLI) can also be generated by a commit script as a persistent or transient change. This includes values specified at a specific hierarchy level or in configuration groups. As with direct CLI configuration, values specified in the *target* override values inherited from a configuration group. The target is the statement to which you apply a configuration group by including the **apply-groups** statement.

If you define persistent or transient changes as belonging to a configuration group, the configuration groups are applied in the order you specify in the **apply-groups** statements, which you can include at any hierarchy level except the top level. You can also disable inheritance of a configuration group by including the **apply-groups-except** statement at any hierarchy level except the top level.

CAUTION: Each commit script inspects the postinheritance view of the configuration. If a candidate configuration contains a configuration group, be careful when using a commit script to change the related target configuration, because doing so might alter the intended inheritance from the configuration group.

Also be careful when using a commit script to change a configuration group, because the configuration group might be generated by an application that performs a **load replace** operation on the group during each commit operation.

For more information about configuration groups, see the *CLI User Guide*.

Tag Elements and Templates for Generating Changes

To generate changes, you can use the **jcs:emit-change** template, which implicitly includes **<change>** and **<transient-change>** XML elements; or you can explicitly include **<change>**

and **<transient-change>** XML elements. Using the **jcs:emit-change** template allows you to set the hierarchical context of the change once rather than multiple times.

The **<change>** and **<transient-change>** elements are similar to the **<load-configuration>** operation defined by the Junos XML management protocol. The possible contents of the **<change>** and **<transient-change>** elements are the same as the contents of the **<configuration>** tag element used in the Junos XML protocol operation **<load-configuration>**. For complete details about the **<load-configuration>** element, see the *Junos XML Management Protocol Developer Guide*.

Required Boilerplate for Commit Scripts

When you write commit scripts, you use Extensible Stylesheet Language Transformations (XSLT) or Stylesheet Language Alternative Syntax (SLAX) tools provided with Junos OS. These tools include basic boilerplate that you must include in all commit scripts, optional extension functions that accomplish scripting tasks more easily, and named templates that make commit scripts easier to read and write, which you import from a file called **junos.xsl**. For more information about the extension functions and templates, see *Junos Script Automation: Understanding Extension Functions in the jcs and slax Namespaces* and *Junos Script Automation: Named Templates in the jcs Namespace Overview*.

Commit scripts are based on Junos XML and Junos XML protocol tag elements. Like all XML elements, angle brackets enclose the name of a Junos XML or Junos XML protocol tag element in its opening and closing tags. This is an XML convention, and the brackets are a required part of the complete tag element name. They are not to be confused with the angle brackets used in the documentation to indicate optional parts of Junos OS CLI command strings.

You must include either XSLT or SLAX boilerplate as the starting point for all commit scripts that you create. The XSLT boilerplate follows:

XSLT Boilerplate for Commit Scripts

```
1  <?xml version="1.0" standalone="yes"?>
2  <xsl:stylesheet version="1.0"
3      xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
4      xmlns:junos="http://xml.juniper.net/junos/*/junos"
5      xmlns:xnm="http://xml.juniper.net/xnm/1.1/xnm"
6      xmlns:jcs="http://xml.juniper.net/junos/commit-scripts/1.0">
7      <xsl:import href="../import/junos.xsl"/>

8      <xsl:template match="configuration">
        <!-- ... Insert your code here ... -->
9      </xsl:template>
10 </xsl:stylesheet>
```

Line 1 is the Extensible Markup Language (XML) processing instruction (PI). This PI specifies that the code is written in XML using version 1.0. The XML PI, if present, must be the first noncomment token in the script file.

```
1  <?xml version="1.0"?>
```

Lines 2 through 6 set the style sheet element and the associated namespaces. Line 2 sets the style sheet version as 1.0. Lines 3 through 6 list all the namespace mappings commonly used in commit scripts. Not all of these prefixes are used in this example, but it is not an error to list namespace mappings that are not referenced. Listing all namespace mappings prevents errors if the mappings are used in later versions of the script.

```
2  <xsl:stylesheet version="1.0"
3    xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
4    xmlns:junos="http://xml.juniper.net/junos/*/junos"
5    xmlns:xnm="http://xml.juniper.net/xnm/1.1/xnm"
6    xmlns:jcs="http://xml.juniper.net/junos/commit-scripts/1.0">
```

Line 7 is an XSLT import statement. It loads the templates and variables from the file referenced as **../import/junos.xsl**, which ships as part of the Junos OS. The **junos.xsl** file contains a set of named templates you can call in your scripts. These named templates are discussed in *Junos Script Automation: Named Templates in the jcs Namespace Overview* and *Junos Named Templates in the jcs Namespace Summary*.

```
7    <xsl:import href="../import/junos.xsl"/>
```

Line 8 defines a template that matches the **<configuration>** element, which is the node selected by the **<xsl:template match="/">** template, contained in the **junos.xsl** import file. The **<xsl:template match="configuration">** element allows you to exclude the **/configuration/** root element from all XML Path Language (XPath) expressions in the script and begin XPath expressions with the top Junos OS hierarchy level. For more information, see *XPath Overview*.

```
8    <xsl:template match="configuration">
```

Add your code between Lines 8 and 9.

Line 9 closes the template.

```
9    </xsl:template>
```

Line 10 closes the style sheet and the commit script.

```
10  </xsl:stylesheet>
```

SLAX Boilerplate for Commit Scripts

The corresponding SLAX boilerplate is as follows:

```
version 1.0;
ns junos = "http://xml.juniper.net/junos/*/junos";
ns xnm = "http://xml.juniper.net/xnm/1.1/xnm";
ns jcs = "http://xml.juniper.net/junos/commit-scripts/1.0";
import "../import/junos.xsl";

match configuration {
  /*
  * Insert your code here
  */
}
```

How Op Scripts Work

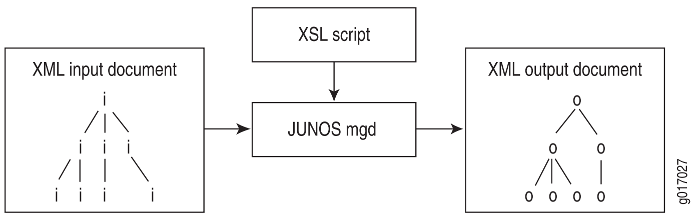
Op scripts execute Junos OS operational commands and inspect the resulting output. After inspection, op scripts can automatically correct errors within the device running Junos OS based on this output.

You add op scripts to device operations by listing the filenames of one or more op script files within the **[edit system scripts op]** hierarchy level. These files must be added to the appropriate op script file directory. For more information about op script file directories, see *Storing Scripts in Flash Memory*. Once added to the device, op scripts are invoked from the command line, using the **op *filename*** command.

You can use op scripts to generate changes to the device configuration by including the **<load-configuration>** tag element. Because the changes are loaded before the standard validation checks are performed, they are validated for correct syntax, just like statements already present in the configuration before the script is applied. If the syntax is correct, the configuration is activated and becomes the active, operational device configuration.

Figure 212 on page 5997 shows a high-level view of the flow of op script input and output.

Figure 212: Op Script Input and Output



Required Boilerplate for Op Scripts

When you write operation (op) scripts, you use Extensible Stylesheet Language Transformations (XSLT) or Stylesheet Language Alternative Syntax (SLAX) tools provided with Junos OS. These tools include basic boilerplate that you must include in all op scripts, optional extension functions that accomplish scripting tasks more easily, and named templates that make scripts easier to read and write, which you import from a file called **junos.xsl**. For more information about the extension functions and templates, see *Junos Script Automation: Understanding Extension Functions in the jcs and slax Namespaces* and *Junos Script Automation: Named Templates in the jcs Namespace Overview*.

Op scripts are based on Junos XML and Junos XML protocol tag elements. Like all XML elements, angle brackets enclose the name of a Junos XML or Junos XML protocol tag element in its opening and closing tags. This is an XML convention, and the brackets are a required part of the complete tag element name. They are not to be confused with the angle brackets used in the documentation to indicate optional parts of Junos OS CLI command strings.

You must include either XSLT or SLAX boilerplate as the starting point for all op scripts that you create. The XSLT boilerplate follows:

XSLT Boilerplate for Op Scripts

```
<?xml version="1.0" standalone="yes"?>
<xsl:stylesheet version="1.0"
    xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
    xmlns:junos="http://xml.juniper.net/junos/*/junos"
    xmlns:xnm="http://xml.juniper.net/xnm/1.1/xnm"
    xmlns:jcs="http://xml.juniper.net/junos/commit-scripts/1.0">
    <xsl:import href="../import/junos.xsl"/>

    <xsl:template match="/">
```

```
9        <op-script-results>
         <!-- ... insert your code here ... -->
10       </op-script-results>
11     </xsl:template>
   <!-- ... insert additional template definitions here ... -->
12 </xsl:stylesheet>
```

Line 1 is the Extensible Markup Language (XML) processing instruction (PI), which marks this file as XML and specifies the version of XML as 1.0. The XML PI, if present, must be the first non-comment token in the script file.

```
1 <?xml version="1.0"?>
```

Line 2 opens the style sheet and specifies the XSLT version as 1.0.

```
2 <xsl:stylesheet version="1.0"
```

Lines 3 through 6 list all the namespace mappings commonly used in operation scripts. Not all of these prefixes are used in this example, but it is not an error to list namespace mappings that are not referenced. Listing all namespace mappings prevents errors if the mappings are used in later versions of the script.

```
3     xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
4     xmlns:junos="http://xml.juniper.net/junos/*/junos"
5     xmlns:xnm="http://xml.juniper.net/xnm/1.1/xnm"
6     xmlns:jcs="http://xml.juniper.net/junos/commit-scripts/1.0">
```

Line 7 is an XSLT import statement. It loads the templates and variables from the file referenced as **../import/junos.xsl**, which ships as part of Junos OS (in the file **/usr/libdata/cscript/import/junos.xsl**). The **junos.xsl** file contains a set of named templates you can call in your scripts. These named templates are discussed in *Junos Script Automation: Named Templates in the jcs Namespace Overview* and *Junos Named Templates in the jcs Namespace Summary*.

```
7     <xsl:import href="../import/junos.xsl"/>
```

Line 8 defines a template that matches the **</>** element. The **<xsl:template match="/">** element is the root element and represents the top level of the XML hierarchy. All XML Path Language (XPath) expressions in the script must start at the top level. This allows the script to access all possible Junos XML and Junos XML protocol remote procedure calls (RPCs). For more information, see *XPath Overview*.

```
8     <xsl:template match="/">
```

After the **<xsl:template match="/">** tag element, the **<op-script-results>** and **</op-script-results>** container tags must be the top-level child tags, as shown in Lines 9 and 10.

```
9        <op-script-results>
         <!-- ... insert your code here ... -->
10       </op-script-results>
```

Line 11 closes the template.

```
11     </xsl:template>
```

Between Line 11 and Line 12, you can define additional XSLT templates that are called from within the **<xsl:template match="/">** template.

Line 12 closes the style sheet and the op script.

```
12   </xsl:stylesheet>
```

SLAX Boilerplate for Op Scripts

The corresponding SLAX boilerplate is as follows:

```
version 1.0;

ns junos = "http://xml.juniper.net/junos/*/junos";
ns xnm = "http://xml.juniper.net/xnm/1.1/xnm";
ns jcs = "http://xml.juniper.net/junos/commit-scripts/1.0";
import "../import/junos.xsl";

match / {
  <op-script-results> {
    /*
      * Insert your code here
    */
  }
}
```

Junos Space

Understanding Junos Space Support

The Juniper Networks Junos Space application, running on a JA1500 appliance or a Junos Space Virtual Appliance, is a comprehensive platform for building and deploying applications for collaboration, productivity, and network infrastructure and operations management. Junos Space provides a runtime environment implemented as a fabric of virtual and physical appliances.

The Junos Space Network Management Platform software comprises various applications for network management and configuration, including:

- Junos Space Administration—Provides management of Junos Space fabric, databases, licenses, applications, authentication servers, tags, permission labels, DMI schemas, and troubleshooting.
- Network Director—Provides unified management of supported Juniper Networks devices in your network. By providing full network life cycle management, Network Director simplifies the discovery, configuration, visualization, monitoring, and administration of large networks.
- Service Automation—Provides an end-to-end solution designed to streamline operations and enable proactive network management for Junos OS devices. The solution consists of Advanced Insight Scripts (AI-Scripts), Junos Space Service Now and Service Insight applications, and Juniper Support Systems (JSS).

NOTE: **Do not install Junos Space and AI-Scripts on the control plane network EX4200 switches or EX4200 Virtual Chassis in a QFX3000 QFabric system**

Before you can use Junos Space Network Director to manage the QFX Series device, you must ensure that the configuration on the device meets the requirements for all managed devices. For example:

- The device configuration has a static management IP address that is reachable from the Junos Space server.
- There is a user with full administrative privileges for Junos Space administration.
- SNMP is enabled (only if you plan on using SNMP as part of the device discovery).
- In Junos Space, set up a default device management interface (DMI) schema for the QFX Series device.

For more information about Network Director requirements, see the *Network Director Quick Start Guide* at:

http://www.juniper.net/techpubs/en_US/network-director1.5/information-products/pathway-pages/index.html

For more information about Junos Space, go to:

http://www.juniper.net/techpubs/en_US/release-independent/junos-space/index.html

Related Documentation

- Configuring SNMP on page 1237
- Configuring SSH Service for Remote Access to the Router or Switch on page 1243

Network Analytics

Network Analytics Overview

The network analytics feature provides visibility into the performance and behavior of the data center infrastructure. This feature collects data from the switch, analyzes the data using sophisticated algorithms, and captures the results in reports. Network administrators can use the reports to help troubleshoot problems, make decisions, and adjust resources as needed. The analytics manager (analyticsm) in the Packet Forwarding Engine collects traffic and queue statistics, and the analytics daemon (analyticsd) in the Routing Engine analyzes the data and generates reports. You can enable network analytics by configuring microburst monitoring and high-frequency traffic statistics monitoring.

NOTE: In Junos OS Release 13.2X51-D15, the network analytics feature has been enhanced, and extensive changes have been made to the CLI statements and hierarchies. If you upgrade to Junos OS Release 13.2X51-D15, network analytics configurations committed in previous releases will appear on your device, but the feature is disabled. To enable this feature, you must reconfigure it using the new CLI statements and hierarchies.

For more information, see:

- Analytics Feature Overview on page 6001
- Network Analytics Enhancements Overview on page 6002
- Summary of CLI Changes on page 6003

Analytics Feature Overview

You enable network analytics by configuring queue (microburst) monitoring and high-frequency traffic statistics monitoring.You use microburst monitoring to look at traffic queue conditions in the network. A microburst occurrence indicates to the Packet Forwarding Engine that a user-specified queue depth or latency threshold is reached. The queue depth is the buffer (in bytes) containing the data, and latency is the time (in nanoseconds or microseconds) the data stays in the queue.

You can configure queue monitoring based on either queue depth or latency (but not both), and configure the frequency (polling interval) at which the Packet Forwarding Engine checks for microbursts and sends the data to the Routing Engine for processing. You may configure queue monitoring globally for all physical interfaces on the system, or for a specific interface on the switch. However, the specified queue monitoring interval applies either to all interfaces, or none; you cannot configure the interval for each interface.

You use high-frequency traffic statistics monitoring to collect traffic statistics at specified polling intervals. Similar to the queue monitoring interval, the traffic monitoring interval applies either to all interfaces, or none; you cannot configure the interval for each interface.

Both traffic and queue monitoring are disabled by default. You must configure each type of monitoring using the CLI. In each case, the configuration for an interface always takes precedence over the global configuration.

NOTE: You can configure traffic and queue monitoring for physical interfaces only; logical interfaces and Virtual Chassis port (VCP) interfaces are not supported.

The analyticsd daemon in the Routing Engine generates local log files containing queue and traffic statistics records. You can specify the log filename and size, and the number of log files. If you do not configure a filename, the data is not saved.

You can display the local log file or specify a server to receive the streaming data containing the queue and traffic statistics.

For each port, information for the last 10 records of traffic statistics and 100 records of queue statistics is cached. You may view this information by using the **show analytics** commands.

To store traceoptions data, you configure the **traceoptions** statement at the **[edit services analytics]** hierarchy level.

Network Analytics Enhancements Overview

Beginning in Junos OS Release 13.2X51-D15, the network analytics feature provides the following enhancements:

- Resources—Consist of interfaces and system. The interfaces resource allows you to configure an interface name and an associated resource profile name for each interface. With the system resource, you can configure the polling intervals for queue monitoring and traffic monitoring, and an associated resource profile for the system.
- Resource profile—A template that contains the configurations for queue and traffic monitoring, such as depth threshold and latency threshold values, and whether each type of monitoring is enabled or disabled. Once a resource profile is configured, you apply it to a system or interfaces resource.
- Collector—A server for collecting queue and traffic monitoring statistics, and can be a local or remote server. You can configure a local server to store monitoring statistics in a log file, or a remote server to receive streamed statistics data.
- Export profile—You must configure an export profile if you wish to send streaming data to a remote collector. In the export profile, you define the category of streamed data (system-wide or interface-specific) to determine stream type the collector will receive. You can specify both system and interface stream categories. System data includes system information and status of queue and traffic monitoring. Interface-specific data includes interface information, queue and traffic statistics, and link, queue, and traffic status.
- Google Protocol Buffers (GBP) stream format—A new streaming format for monitoring statistics data that is sent to a remote collector in a single AnRecord message. This stream format provides nine types of information, including:
  - System information
  - System queue status
  - System traffic status
  - Interface information
  - Queue statistics for interfaces
  - Traffic statistics for interfaces
  - Link status for interfaces
  - Queue status for interfaces
  - Traffic status for interfaces

- The **analytics.proto** file—Provides a template for the GBP stream format. This file can be used for writing your analytics server application. To download the file, go to:

  http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/proto-files/analytics-proto.txt
- Use of threshold values—The Analytics Manager (analyticsm) will generate a queue statistics record when the lower queue depth or latency threshold value is exceeded.
- User Datagram Protocol (UDP)—Additional transport protocol you can configure, in addition to Transmission Control Protocol (TCP), for the remote streaming server port.
- Single file for local logging—Replaces the separate log files for queue and traffic statistics.
- Change in latency measurement—Configuration and reporting of latency values have changed from microseconds to nanoseconds.
- Change in reporting of the collection time in UTC format—Statistics collection time is reported in microseconds instead of milliseconds.
- New operational mode command **show analytics collector**—Replaces the **show analytics streaming-server** command.
- Changes in command output format—Includes the following changes:
  - Addition of unicast, multicast, and broadcast packet counters in queue and traffic statistics.
  - Reversal of the sequence of statistics information in the output. The most recent record is displayed at the beginning, and the oldest record at the end of the output.
  - Removal of the **Auto** status from the output for **show analytics configuration** command if there is no global configuration for traffic and queue monitoring.
  - Addition of **n/a** to the **show analytics configuration** and **show analytics status** commands if a parameter is not configured (for example, depth threshold or latency threshold).

Summary of CLI Changes

Beginning in Junos OS Release 13.2X51-D15, enhancements to the network analytics feature result in changes in the CLI when you configure the feature. See Table 556 on page 6004 for a summary of CLI changes.

Table 556: Network Analytics CLI Changes

Task	CLI for Junos OS Release 13.2X50-D15 and 13.2X51-D10	CLI for Junos OS Release 13.2X51-D15 and later

Configuring global queue and traffic monitoring polling interval	**[edit services]**
	
	analytics {
	traffic-statistics {
	interval *interval*;
	}
	queue-statistics {
	interval *interval*;
	}
	}
		[edit services analytics]
		
		resource {
		system {
		polling-interval {
		queue-monitoring *interval*;
		traffic-monitoring *interval*;
		}
		}
		}

Configuring local files for traffic and queue statistics reporting	**[edit services]**
	
	analytics {
	traffic-statistics {
	file *filename*;
	size *size*;
	files *number*;
	}
	queue-statistics {
	file *filename*;
	size *size*;
	files *number*;
	}
	}
		[edit services analytics]
		
		collector {
		local {
		file *filename* {
		files *number*;
		size *size*;
		}
		}
		}

Enabling queue statistics and traffic monitoring, and specifying the depth threshold for all interfaces (globally)	**[edit services]**
	
	analytics {
	interfaces {
	all {
	queue-statistics;
	traffic-statistics;
	depth-threshold {
	high *number*;
	low *number*;
	}
	}
	}
	}
		Requires defining a resource profile and applying it to the system:
		
		1. To define a resource profile:
		
		[edit services analytics]
		
		resource-profiles {
		profile-name{
		queue-monitoring;
		traffic-monitoring;
		depth-threshold {
		high *number*;
		low *number*;
		}
		}
		}
		
		2. To apply a profile to the system:
		
		[edit services analytics]
		
		resource {
		system {
		resource-profile *profile-name*;
		}
		}

Table 556: Network Analytics CLI Changes *(continued)*

Task	CLI for Junos OS Release 13.2X50-D15 and 13.2X51-D10	CLI for Junos OS Release 13.2X51-D15 and later

Enabling queue statistics and traffic monitoring, and specifying the latency threshold for one interface	**[edit services]**
	
	analytics {
	interfaces {
	interface{
	queue-statistics;
	traffic-statistics;
	latency-threshold
	high *number*;
	low *number*;
	}
	}
	}
		Requires defining a resource profile and applying it to the interface:
		
		1. To define a resource profile:
		
		[edit services analytics]
		
		resource-profiles {
		profile-name{
		queue-monitoring;
		traffic-monitoring;
		latency-threshold {
		high *number*;
		low *number*;
		}
		}
		}
		
		2. To apply a profile to the interface:
		
		[edit services analytics]
		
		resource {
		interfaces {
		interface-name {
		resource-profile *profile-name*;
		}
		}
		}

Configuring the streaming data format (JSON, CSV, or TSV) to send to a remote server
 	
NOTE: Junos OS Release 13.2X51-D15 adds support for the GPB stream format and configuration of the transport protocols (TCP or UDP).
	[edit services]
	
	analytics {
	streaming-servers {
	address *ip-address* {
	port *number* {
	stream-format *format*;
	}
	}
	}
	}
		Requires defining the stream format in an export profile and applying the profile to the collector.
		
		1. To configure the stream format:
		
		[edit services analytics]
		
		export-profiles {
		profile-name {
		stream-format *format*;
		}
		}
		
		2. To apply an export profile to the collector:
		
		[edit services analytics]
		
		collector {
		address *ip-address* {
		port *number* {
		transport *protocol* {
		export-profile *profile-name*;
		}
		}
		}
		}

Table 556: Network Analytics CLI Changes *(continued)*

Task	CLI for Junos OS Release 13.2X50-D15 and 13.2X51-D10	CLI for Junos OS Release 13.2X51-D15 and later

Configuring the streaming message types (queue or traffic statistics) to send to a remote server	**[edit services]**
	
	streaming-servers {
	address *ip-address* {
	port *number* {
	stream-type *type*;
	stream-type *type*;
	}
	}
	}
		Requires defining an export profile and applying it to the collector:
		
		1. To define an export profile:
		
		[edit services analytics]
		
		export-profiles {
		profile-name {
		interface {
		information;
		statistics {
		queue;
		traffic;
		}
		status {
		link;
		queue;
		traffic;
		}
		}
		system {
		information;
		status {
		queue;
		traffic;
		}
		}
		}
		}
		
		2. To apply an export profile to the collector:
		
		[edit services analytics]
		
		collector {
		address *ip-address* {
		port *number* {
		export-profile *profile-name*;
		}
		}
		}

Configuring the transport protocol for sending streaming data to an external server	Supports the TCP protocol only.	Supports both the TCP and UDP protocols.
		
		[edit services analytics]
		
		collector {
		address *ip-address* {
		port *number1* {
		transport tcp;
		}
		port *number2* {
		transport udp;
		}
		}
		}

Table 556: Network Analytics CLI Changes *(continued)*

Task	CLI for Junos OS Release 13.2X50-D15 and 13.2X51-D10	CLI for Junos OS Release 13.2X51-D15 and later
Show information about remote streaming server or collector	Issue the **show analytics streaming-sever** command.	Issue the **show analytics collector** command.

Related Documentation

- analytics on page 6176

Understanding Network Analytics Configuration and Status

The network analytics feature provides visibility into the performance and behavior of the data center infrastructure. You can enable network analytics by configuring traffic and queue statistics monitoring.

NOTE: This topic describes the configuration and status output from Junos OS Release 13.2X50-D15 and 13.2X51-D10 only.

If you had enabled traffic or queue monitoring, you can issue the **show analytics configuration** and **show analytics status** commands to view the global interface configuration and status and that of specific interfaces. The output that is displayed depends on your configuration at the global interface and specific interface levels. For example:

- A global interface configuration (for all interfaces) to disable monitoring supersedes the configuration to enable it on an interface.
- The interface configuration to enable or disable monitoring supersedes the global interface configuration, unless monitoring had been disabled globally for all interfaces.
- If there is no configuration, whether for all interfaces or a specific interface, monitoring is disabled by default (see Table 557 on page 6007).

Table 557 on page 6007 describes the correlation between the user configuration and the settings that are displayed.

Table 557: Configuration and Status Output in Junos OS Release 13.2X51-D10 and 13.2X50-D15

User Configuration	Global or System Settings		Specific Interface Settings	
	Configuration	Status	Configuration	Status
No global or specific interface configuration. This is the default setting.	Auto	Auto	Auto	Disabled
No global interface configuration but the specific interface monitoring is disabled.	Auto	Auto	Disabled	Disabled

Table 557: Configuration and Status Output in Junos OS Release 13.2X51-D10 and 13.2X50-D15 *(continued)*

User Configuration	Global or System Settings		Specific Interface Settings	
	Configuration	Status	Configuration	Status
No global interface configuration but the specific interface monitoring is enabled.	Auto	Auto	Enabled	Enabled
Monitoring is disabled globally and there is no interface configuration.	Disabled	Disabled	Auto	Disabled
Monitoring is disabled at both the global and specific interface levels.	Disabled	Disabled	Disabled	Disabled
Monitoring is disabled at the global interface level but is enabled at the specific interface level. The global interface *Disabled* setting supersedes the *Enabled* setting for a specific interface.	Disabled	Disabled	Enabled	Disabled
Monitoring is enabled for all interfaces but there is no configuration for the specific interface .	Enabled	Enabled	Auto	Enabled
Monitoring is enabled at both the global and specific interface levels.	Enabled	Enabled	Enabled	Enabled
Monitoring is enabled for all interfaces but is disabled for the specific interface.	Enabled	Enabled	Disabled	Disabled

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**
- **queue-statistics on page 6191**
- **traffic-statistics on page 6199**
- **show analytics configuration on page 6355**
- **show analytics status on page 6360**

Understanding Network Analytics Streaming Data

This topic describes the network analytics queue and traffic statistics that are streamed to remote servers.

You can configure one or more remote servers to receive streamed data containing queue and traffic statistics. The format of the streamed data can be Javascript Object Notification (JSON), Comma-separated Values (CSV), or Tab-separated Values (TSV).

NOTE: The output shown in this topic applies to Junos OS Release 13.2X51-D10 or later, and displays the time in the Unix epoch format (also known as Unix time or POSIX time).

The following examples show the streamed queue statistics data output in different formats.

- JSON format:

```
{"record-type":"queue-stats","time":1383453988263,"router-id":"qfx5100-switch",
"port":"xe-0/0/18","latency":0,"queue-depth":208}
```

- CSV format:

```
q,1383454067604,qfx5100-switch,xe-0/0/18,0,208
```

- TSV format:

```
q       585870192561703872      qfx5100-switch       xe-0/0/18       (null)
208     2
```

Table 558 on page 6009 describes the output fields for streamed queue statistics data in the order they appear.

Table 558: Streamed Queue Statistics Data Output Fields

Field	Description
record-type	Type of statistics. Displayed as: • **queue-stats** (JSON format) • **q** (CSV or TSV format)
time	Time (in Unix epoch format) at which the statistics were captured.
router-id	ID of the network analytics host device.
port	Name of the physical port configured for network analytics.
latency	Traffic queue latency in milliseconds.
queue depth	Depth of the traffic queue in bytes.

The following examples show the streamed traffic statistics data output in different formats.

- JSON format:

```
{"record-type":"traffic-stats","time":1383453986763,"router-id":"qfx5100-switch",
"port":"xe-0/0/16","rxpkt":26524223621,"rxpps":8399588,"rxbyte":3395100629632,
"rxbps":423997832,"rxdrop":0,"rxerr":0,"txpkt":795746503,"txpps":0,"txbyte":101855533467,
"txbps":0,"txdrop":0,"txerr":0}
```

- CSV format:

```
t,1383454072924,qfx5100-switch,xe-0/0/19,1274299748,82950,163110341556,85603312,0,0,
27254178291,8300088,3488534810679,600002408,27268587050,3490379142400
```

- TSV format:

```
t       1383454139025   qfx5100-switch  xe-0/0/19       1279874033      82022
163823850036    84801488        0       0       27811618258     8199630
3559887126455   919998736       27827356915     3561901685120
```

Table 559 on page 6010 describes the output fields for streamed traffic statistics data in the order they appear.

Table 559: Streamed Traffic Statistics Data Output Fields

Field	Description
record-type	Type of statistics. Displayed as: • **traffic-stats** (JSON format) • **t** (CSV or TSV format)
time	Time (in Unix epoch format) at which the statistics were captured.
router-id	ID of the network analytics host device.
port	Name of the physical port configured for network analytics.
rxpkt	Total packets received.
rxpps	Total packets received per second.
rxbyte	Total bytes received.
rxbps	Total bytes received per second.
rxdrop	Total incoming packets dropped.
rxerr	Total packets with errors.
txpkt	Total packets transmitted.
txpps	Total packets transmitted per second.
txbyte	Total bytes transmitted.
txbps	Total bytes transmitted per second.
txdrop	Total transmitted bytes dropped.
txerr	Total transmitted packets with errors (dropped).

Related Documentation

- Network Analytics Overview on page 6000
- **show analytics streaming-servers on page 6363**

- streaming-servers on page 6194

Understanding Enhanced Network Analytics Streaming Data

Network analytics monitoring data can be streamed to remote servers called collectors. You can configure one or more collectors to receive streamed data containing queue and traffic statistics. This topic describes the streamed data output in the formats supported, including information about enhancements introduced in Junos OS Release 13.2X51-D15.

Starting in Junos OS Release 13.2X51-D15, network analytics supports the following streaming data formats and output:

Google Protocol Buffer (GPB)

Support for the Google Protocol Buffer (GPB) streaming format has been added in Junos OS Release 13.2X51-D15. This streaming format provides:

- Support for nine types of messages, based on resource type (system-wide or interface-specific).
- Sends messages in a hierarchical format.
- You can generate other stream format messages (JSON, CSV, TSV) from GPB formatted messages.
- Includes a 12-byte message header. See Table 560 on page 6011 for more information.

Table 560 on page 6011 describes the GPB stream format message header.

Table 560: GPB Stream Format Message Header Information

Byte Position	Field	Additional Information
0, 1, 2, 3	Message length	Length prefixed message
4	Message version	Version = 1
5, 6	Message type	System = 1, interface = 2
7, 8, 9, 10, 11	Reserved	For future use

The following GPB prototype file (**analytics.proto**) provides details about the streamed data:

```
package analytics;

// Traffic statistics related info
message TrafficStatus {
    optional uint32             status          = 1;
    optional uint32             poll_interval   = 2;
}

// Queue statistics related info
message QueueStatus {
    optional uint32             status          = 1;
    optional uint32             poll_interval   = 2;
    optional uint64             lt_high         = 3;
    optional uint64             lt_low          = 4;
    optional uint64             dt_high         = 5;
    optional uint64             dt_low          = 6;
}

message LinkStatus {
    optional uint64             speed           = 1;
    optional uint32             duplex          = 2;
    optional uint32             mtu             = 3;
    optional bool               state           = 4;
    optional bool               auto_negotiation= 5;
}

message InterfaceInfo {
    optional uint32             snmp_index      = 1;
    optional uint32             index           = 2;
    optional uint32             slot            = 3;
    optional uint32             port            = 4;
    optional uint32             media_type      = 5;
    optional uint32             capability      = 6;
    optional uint32             porttype        = 7;
}

message InterfaceStatus {
    optional LinkStatus         link            = 1;
    optional QueueStatus        queue_status    = 2;
    optional TrafficStatus      traffic_status  = 3;
}

message QueueStats {
    optional uint64             timestamp       = 1;
    optional uint64             queue_depth     = 2;
    optional uint64             latency         = 3;
}

message TrafficStats {
    optional uint64             timestamp       = 1;
    optional uint64             rxpkt           = 2;
    optional uint64             rxucpkt         = 3;
    optional uint64             rxmcpkt         = 4;
    optional uint64             rxbcpkt         = 5;
    optional uint64             rxpps           = 6;
    optional uint64             rxbyte          = 7;
    optional uint64             rxbps           = 8;
    optional uint64             rxcrcerr        = 9;
```



```
    optional uint64             rxdroppkt       = 10;
    optional uint64             txpkt           = 11;
    optional uint64             txucpkt         = 12;
    optional uint64             txmcpkt         = 13;
    optional uint64             txbcpkt         = 14;
    optional uint64             txpps           = 15;
    optional uint64             txbyte          = 16;
    optional uint64             txbps           = 17;
    optional uint64             txcrcerr        = 18;
    optional uint64             txdroppkt       = 19;
}

message InterfaceStats {
    optional TrafficStats       traffic_stats   = 1;
    optional QueueStats         queue_stats     = 2;
}

//Interface message
message Interface {
    required string             name            = 1;
    optional bool               deleted         = 2;
    optional InterfaceInfo      information     = 3;
    optional InterfaceStats     stats           = 4;
    optional InterfaceStatus    status          = 5;
}

message SystemInfo {
    optional uint64             boot_time       = 1;
    optional string             model_info      = 2;
    optional string             serial_no       = 3;
    optional uint32             max_ports       = 4;
    optional string             collector       = 5;
    repeated string             interface_list  = 6;
}

message SystemStatus {
    optional QueueStatus        queue_status    = 1;
    optional TrafficStatus      traffic_status  = 2;
}

//System message
message System {
    required string             name            = 1;
    optional bool               deleted         = 2;
    optional SystemInfo         information     = 3;
    optional SystemStatus       status          = 4;
}

message AnRecord {
    optional uint64             timestamp       = 1;
    optional System             system          = 2;
    repeated Interface          interface       = 3;
}
```

Javascript Object Notification (JSON)

The Javascript Object Notification (JSON) streaming format supports the following data:

- Queue statistics data. For example:

```
{"record-type":"queue-stats","time":1383453988263,"router-id":"qfx5100-switch",
"port":"xe-0/0/18","latency":0,"queue-depth":208}
```

See Table 558 on page 6009 for more information about queue statistics output fields.

- Traffic statistics. For example:

```
{"record-type":"traffic-stats","time":1383453986763,"router-id":"qfx5100-switch",
"port":"xe-0/0/16","rxpkt":26524223621,"rxpps":8399588,"rxbyte":3395100629632,
"rxbps":423997832,"rxdrop":0,"rxerr":0,"txpkt":795746503,"txpps":0,"txbyte":101855533467,
"txbps":0,"txdrop":0,"txerr":0}
```

See Table 559 on page 6010 for more information about traffic statistics output fields.

Comma-separated Values (CSV)

The Comma-separated Values (CSV) streaming format supports the following data:

- Queue statistics. For example:

```
q,1383454067604,qfx5100-switch,xe-0/0/18,0,208
```

See Table 558 on page 6009 for more information about queue statistics output fields.

- Traffic statistics. For example:

```
t,1383454072924,qfx5100-switch,xe-0/0/19,1274299748,82950,163110341556,85603312,0,0,
27254178291,8300088,3488534810679,600002408,27268587050,3490379142400
```

See Table 559 on page 6010 for more information about traffic statistics output fields.

Tab-separated Values (TSV)

The Tab-separated Values (TSV) streaming format supports the following data:

- Queue statistics. For example:

```
q       585870192561703872      qfx5100-switch      xe-0/0/18       (null)
208     2
```

See Table 558 on page 6009 for more information about queue statistics output fields.

- Traffic statistics. For example:

```
t       1383454139025   qfx5100-switch  xe-0/0/19       1279874033      82022
163823850036    84801488        0       0       27811618258     8199630
3559887126455   919998736       27827356915     3561901685120
```

See Table 559 on page 6010 for more information about traffic statistics output fields.

Queue Statistics Output for JSON, CSV, and TSV

Table 558 on page 6009 describes the output fields for streamed queue statistics data in the order they appear.

Table 561: Streamed Queue Statistics Data Output Fields

Field	Description
record-type	Type of statistics. Displayed as: • **queue-stats** (JSON format) • **q** (CSV or TSV format)
time	Time (in Unix epoch format) at which the statistics were captured.
router-id	ID of the network analytics host device.
port	Name of the physical port configured for network analytics.
latency	Traffic queue latency in milliseconds.
queue depth	Depth of the traffic queue in bytes.

Traffic Statistics Output for JSON, CSV, and TSV

Table 559 on page 6010 describes the output fields for streamed traffic statistics data in the order they appear.

Table 562: Streamed Traffic Statistics Data Output Fields

Field	Description
record-type	Type of statistics. Displayed as: • **traffic-stats** (JSON format) • **t** (CSV or TSV format)
time	Time (in Unix epoch format) at which the statistics were captured.
router-id	ID of the network analytics host device.
port	Name of the physical port configured for network analytics.
rxpkt	Total packets received.
rxpps	Total packets received per second.
rxbyte	Total bytes received.
rxbps	Total bytes received per second.
rxdrop	Total incoming packets dropped.
rxerr	Total packets with errors.
txpkt	Total packets transmitted.

Table 562: Streamed Traffic Statistics Data Output Fields *(continued)*

Field	Description
txpps	Total packets transmitted per second.
txbyte	Total bytes transmitted.
txbps	Total bytes transmitted per second.
txdrop	Total transmitted bytes dropped.
txerr	Total transmitted packets with errors (dropped).

Related Documentation

- Network Analytics Overview on page 6000
- **address (Analytics Collector) on page 6175**
- **collector (Analytics) on page 6180**
- **show analytics collector on page 6353**

Prototype File for the Google Protocol Buffers Stream Format

The Google Protocol Buffers (GBP) stream format is used for streaming monitoring statistics data to a remote collector in a single AnRecord message.

The **analytics.proto** file provides a template for the GBP stream format. This file can be used for writing your analytics server application.

To download the GPB prototype file, go to:

http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/proto-files/analytics-proto.txt

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**
- **export-profiles on page 6182**

sFlow Techology

Understanding How to Use sFlow Technology for Network Monitoring on a Switch

The sFlow technology is a monitoring technology for high-speed switched or routed networks. sFlow monitoring technology randomly samples network packets and sends the samples to a monitoring station called a *collector*. You can configure sFlow technology on a Juniper Networks switch to continuously monitor traffic at wire speed on all interfaces simultaneously.

This topic describes:

Sampling Mechanism and Architecture of sFlow Technology on Switches

sFlow technology uses the following two sampling mechanisms:

- Packet-based sampling—Samples one packet out of a specified number of packets from an interface enabled for sFlow technology. Only the first 128 bytes of each packet are sent to the collector. Data collected include the Ethernet, IP, and TCP headers, along with other application-level headers (if present). Although this type of sampling might not capture infrequent packet flows, the majority of flows are reported over time, allowing the collector to generate a reasonably accurate representation of network activity. To configure packet-based sampling, you must specify a sample rate.
- Time-based sampling—Samples interface statistics at a specified interval from an interface enabled for sFlow technology. Statistics such as Ethernet interface errors are captured. To configure time-based sampling, you must specify a polling interval.

The sampling information is used to create a network traffic visibility picture. The Juniper Networks Junos operating system (Junos OS) fully supports the sFlow standard described in RFC 3176, *InMon Corporation's sFlow: A Method for Monitoring Traffic in Switched and Routed Networks* (see http://faqs.org/rfcs/rfc3176.html).

NOTE: **sFlow technology on the switches samples only raw packet headers. A raw Ethernet packet is the complete Layer 2 network frame.**

An sFlow monitoring system consists of an sFlow agent embedded in the switch and a centralized collector. The sFlow agent’s two main activities are random sampling and statistics gathering. It combines interface counters and flow samples and sends them across the network to the sFlow collector as UDP datagrams, directing those datagrams to the IP address and UDP destination port of the collector. Each datagram contains the following information:

- The IP address of the sFlow agent
- The number of samples
- The interface through which the packets entered the agent
- The interface through which the packets exited the agent
- The source and destination interface for the packets
- The source and destination VLAN for the packets

EX Series switches, QFX Series switches, and the QFabric systems adopt the distributed sFlow architecture. The sFlow agent has two separate sampling entities that are associated with each Packet Forwarding Engine in case of switches and nodes in case of a QFabric system. These sampling entities are known as subagents. Each subagent has a unique ID that is used by the collector to identify the data source. A subagent has its own independent state and forwards its own sample messages to the sFlow agent. The sFlow agent is responsible for packaging the samples into datagrams and sending them to the sFlow collector. Because sampling is distributed across subagents, the protocol overhead associated with sFlow technology is significantly reduced at the collector.

NOTE: On the QFabric system, an sFlow collector must be reachable through the data network. Because each Node device has all routes stored in the default routing instance, the collector IP address should be included in the default routing instance to ensure the collector's reachability from the Node device.

NOTE: You cannot configure sFlow monitoring on a link aggregation group (LAG), but you can configure it individually on a LAG member interface.

Infrequent sampling flows might not be reported in the sFlow information, but over time the majority of flows are reported. Based on a configured sampling rate *N*, 1 out of *N* packets is captured and sent to the collector. This type of sampling does not provide a 100 percent accurate result in the analysis, but it does provide a result with quantifiable accuracy. A user-configured polling interval defines how often the sFlow data for a specific interface are sent to the collector, but an sFlow agent can also schedule polling.

NOTE: We recommend that you configure the same sample rate for all the ports in a line card. If you configure different sample rates, the lowest value is used for all ports on the line card..

NOTE: If the mastership assignment changes in a Virtual Chassis setup, sFlow technology continues to function.

Adaptive Sampling

To ensure sampling accuracy and efficiency, EX Series switches and QFX Series devices use adaptive sFlow sampling. Adaptive sampling monitors the overall incoming traffic rate on the device and provides feedback to the interfaces to dynamically adapt their sampling rate to traffic conditions. The sFlow agent reads the statistics on the interfaces every few seconds (12 seconds for EX Series switches and 5 seconds for QFX Series devices) and identifies five interfaces with the highest number of samples.

On a Flexible PIC Concentrator (FPC), when the CPU processing limit is reached because of sflow sample processing, a binary backoff algorithm is initiated. This reduces the sampling load, arriving through the top five sample-producing interfaces on that FPC by half. The backoff algorithm achieves this by doubling the sampling rate on these five earmarked interfaces. This process is repeated until the CPU-load due to sflow on the given FPC comes down to an acceptable level.

On a QFabric system, sFlow technology monitors the interfaces on each node device as a group, and implements the binary backoff algorithm based on the traffic on that group of interfaces.

NOTE: **On the QFX Series standalone switches, if you configure sFlow technology monitoring on multiple interfaces and with a high sampling rate, we recommend that you specify a collector that is on the data network instead of on the management network. Having a high volume of sFlow technology monitoring traffic on the management network might interfere with other management interface traffic.**

Using adaptive sampling prevents overloading of the CPU and keeps the device operating at its optimum level even when there is a change in traffic patterns on the interfaces. The reduced sampling rate is used until the device is rebooted or when a new sampling rate is configured.

NOTE: **sFlow technology on EX Series switches does not support graceful restart. When a graceful restart occurs, the adaptive sampling rate is set to the user-configured sampling rate.**

sFlow Agent Address Assignment

The sFlow collector uses the sFlow agent's IP address to determine the source of the sFlow data. You can configure the IP address of the sFlow agent to ensure that the agent ID of the sFlow agent remains constant. If you do not specify the IP address to be assigned to the agent, an IP address is automatically assigned to the agent based on the following order of priority of interfaces configured on the device:

EX Series Devices	QFX Series Devices
1. Virtual Management Ethernet (VME) interface 2. Management Ethernet interface	1. Management Ethernet interface me0 IP address 2. Any Layer 3 interface if the me0 IP address is not available

If a particular interface is not configured, the IP address of the next interface in the priority list is used as the IP address for the agent. Once an IP address is assigned to the agent, the agent ID is not modified until the sFlow service is restarted. At least one interface has to be configured for an IP address to be assigned to the agent. When the agent's IP address is assigned automatically, the IP address is dynamic and changes when the switch reboots.

On the QFabric system, the following default values are used if the optional parameters are not configured:

- Agent ID is the management IP address of the default partition.
- Source IP is the management IP address of the default partition.

In addition, the QFabric system subagent ID (which is included in the sFlow datagrams) is the ID of the node group from which the datagram is sent to the collector.

sFlow data can be used to provide network traffic visibility information. You can explicitly configure the source IP address to be assigned to the sFlow datagrams. If you do not explicitly configure the IP address, the IP address of any of the configured Layer 3 network interfaces is used as the source IP address. If a Layer 3 IP address is not configured, then the agent IP address is used as the source IP address.

sFlow Limitations on Switches

On the QFX Series, limitations of sFlow traffic sampling include the following:

- sFlow sampling on ingress interfaces does not capture CPU-bound traffic.
- sFlow sampling on egress interfaces does not support broadcast and multicast packets.
- Egress samples do not contain modifications made to the packet in the egress pipeline.
- If a packet is discarded because of a firewall filter, the reason code for discarding the packet is not sent to the collector.
- The out-priority field for a VLAN is always set to 0 (zero) on ingress and egress samples.
- On QFX5100 standalone switches and the QFX Series Virtual Chassis (including mixed QFX Series Virtual Chassis), egress firewall filters are not applied to sFlow sampling packets. On these platforms, the software architecture is different from that on other QFX Series devices—sFlow packets are sent by the Routing Engine (not the line card on the host) and do not transit the switch. Egress firewall filters affect data packets that are transiting a switch, but do not affect packets sent by the Routing Engine. As a result, sFlow sampling packets are always sent to the sFlow collector.

EX9200 switches support configuration of only one sampling rate (inclusive of ingress and egress rates) on an FPC. To support compatibility with the sflow configuration of other Juniper Networks products, EX9200 switches still accept multiple rate configuration on different interfaces of the same FPC. However, the switch programs the lowest rate as the sampling rate for all the interfaces of that FPC. The sFlow show command (**show sflow interfaces**) displays the configured rate and the actual (effective) rate. However, different rates on different FPCs is still supported on EX9200 switches.

Related Documentation

- Example: Monitoring Network Traffic Using sFlow Technology on page 6079
- *Example: Configuring sFlow Technology to Monitor Network Traffic on EX Series Switches*
- Configuring sFlow Technology on page 6108
- *Configuring sFlow Technology for Network Monitoring (CLI Procedure)*
- *Monitoring Interface Status and Traffic*

SNMP

Understanding the Implementation of SNMP

The QFX Series products support the Simple Network Management Protocol (SNMP) that is implemented in the Junos OS software.

NOTE: By default, SNMP is not enabled on devices running Junos OS. For information on enabling SNMP on a device running Junos OS, see "Configuring SNMP" on page 1237.

A typical SNMP implementation includes the following components:

- Network management system (NMS)—The NMS is a combination of hardware and software that is used to monitor and administer a network. Software running on the NMS includes the SNMP manager, which collects information about network connectivity, activity, and events by polling the managed devices.
- Managed device—A managed device (also called a network element) is any device managed by the NMS. Routers and switches are common examples of managed devices. The SNMP agent is the SNMP process that resides on the managed device and communicates with the NMS.
- SNMP agent—The SNMP agent exchanges network management information with SNMP manager software running on an NMS, or host. The agent responds to requests for information and actions from the manager. The agent also controls access to the agent's MIB, the collection of objects that can be viewed or changed by the SNMP manager.

SNMP data is stored in a highly structured, hierarchical format known as a management information base (MIB). The MIB structure is based on a tree structure, which defines a grouping of objects into related sets. Each object in the MIB is associated with an object identifier (OID), which names the object. The “leaf” in the tree structure is the actual managed object instance, which represents a resource, event, or activity that occurs in your network device. The SNMP implementation in Junos OS uses both standard (developed by IETF and documented in RFCs) and Juniper Networks enterprise-specific MIBs.

Communication between the agent and the manager occurs in one of the following forms:

- **Get**, **GetBulk**, and **GetNext** requests—The manager requests information from the agent; the agent returns the information in a **Get** response message.
- **Set** requests—The manager changes the value of a MIB object controlled by the agent; the agent indicates status in a **Set** response message.
- **Traps** notification—The agent sends traps to notify the manager of significant events that occur on the network device.

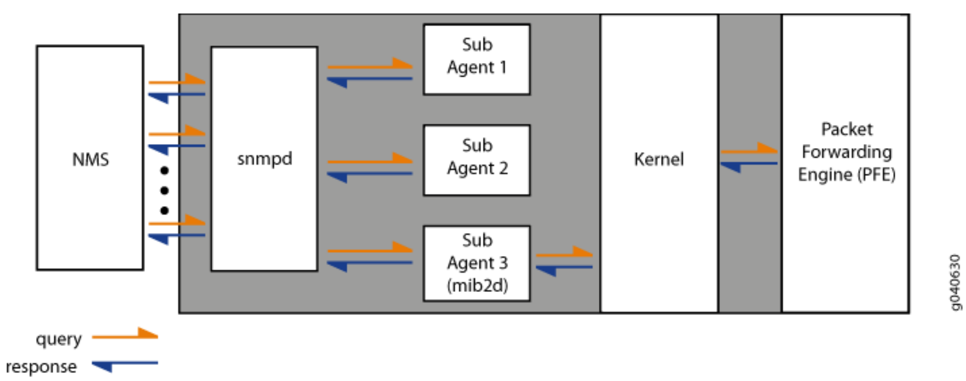
The processes maintaining the SNMP management data include:

- A master SNMP agent (known as SNMP process, or snmpd) that resides on the managed device and is managed by the NMS or host.
- Various subagents that reside on different modules of Junos OS, such as the Routing Engine, and are managed by the master SNMP agent.
- Junos OS processes that share data with the subagents when polled for SNMP data (for example, interface-related MIBs).

When an NMS polls the master agent for data, the master agent immediately shares the data with the NMS if the requested data is available from the master agent or one of the subagents. However, if the requested data is not maintained by the master agent or subagents, the subagent polls the Junos OS kernel or the process that maintains that data. The Junos OS kernel may need to get the data from the Packet Forwarding Engine. On receiving the required data, the subagent passes the response back on to the master agent, which in turn passes it on to the NMS.

Figure 213 on page 6022 shows the communication flow among the NMS, SNMP master agent (snmpd), SNMP subagents, Junos OS kernel, and Packet Forwarding Engine.

Figure 213: SNMP Communication Flow



When a significant event, most often an error or a failure, occurs on a network device, the SNMP agent sends notifications to the SNMP manager. SNMP notifications can be sent as traps (unconfirmed notifications) or inform requests (confirmed notifications).

Junos OS supports trap queuing to ensure that traps are not lost because of temporary unavailability of routes. Two types of queues, destination queues and a throttle queue, are formed to ensure delivery of traps and control the trap traffic. On QFX Series products, the maximum size of trap queues (throttle queue plus destination queue) is 40,960 traps. The maximum size of any one queue is 20,480 traps.

Junos OS forms a destination queue when a trap to a particular destination is returned because the host is not reachable, and it adds the subsequent traps to the same destination to the queue. Junos OS checks for availability of routes every 30 seconds, and sends the traps from the destination queue in a round-robin fashion.

If the trap delivery fails, the trap is added back to the queue, and the delivery attempt counter and the next delivery attempt timer for the queue are reset. Subsequent attempts occur at progressive intervals of 1 minute, 2 minutes, 4 minutes, and 8 minutes. The maximum delay between the attempts is 8 minutes, and the maximum number of attempts is ten. After ten unsuccessful attempts, the destination queue and all the traps in the queue are deleted.

Junos OS also has a throttle mechanism to control the number of traps (throttle threshold) sent during a particular time period (throttle interval). The throttle mechanism ensures consistency in trap traffic, especially when large numbers of traps are generated because of interface status changes. The throttle interval period begins when the first trap arrives at the throttle. All traps within the trap threshold are processed, and the traps beyond the threshold limit are queued. The default throttle threshold is 500 traps, and the throttle interval default is 5 seconds.

NOTE: You cannot configure trap queueing in Junos OS. You cannot view information about trap queues except for what is provided in the system logs.

Related Documentation

- Configuring SNMP on page 1237
- SNMP MIBs Support on page 6038
- SNMP Traps Support on page 6054

Understanding the Implementation of SNMP on the QFabric System

SNMP monitors network devices from a central location. The QFabric system supports the basic SNMP architecture of Junos OS, but its implementation of SNMP differs from that of other devices running Junos OS. This topic provides an overview of the SNMP implementation on the QFabric system.

As in other SNMP systems, the SNMP manager resides on the network management system (NMS) of the network to which the QFabric system belongs. The SNMP agent resides in the QFabric Director software and is responsible for receiving and distributing all traps as well as responding to all the queries of the SNMP manager. For example, traps that are generated by a Node device are sent to the SNMP agent in the Director software, which in turn processes and sends them to the target IP addresses that are defined in the SNMP configuration.

NOTE: In its SNMP implementation, the QFabric system acts as an SNMP proxy server, and requires more time to process SNMP requests than a typical Junos OS device does. The default timeout setting on most SNMP client applications is 3 seconds, which is not enough time for the QFabric system to respond to SNMP requests, so the results of your **mibwalk** command may be incomplete. For this reason, we recommend that you change the SNMP timeout setting to 5 seconds or longer for the QFabric system to complete the responses to your requests.

Support for SNMP on the QFabric system includes:

- Support for the SNMP Version 1 (v1) and v2.

  NOTE: Only SNMPv2 traps are supported on the QFabric system.

- Support for the following standard MIBs:
  - RFC 1155, *Structure and Identification of Management Information for TCP/IP-based Internets*
  - RFC 1157, *A Simple Network Management Protocol (SNMP)*
  - RFC 1212, *Concise MIB Definitions*
  - RFC 1213, *Management Information Base for Network Management of TCP/IP-Based Internets: MIB-II* (partial support, including the system group and interfaces group)
  - RFC 1215, *A Convention for Defining Traps for use with the SNMP*
  - RFC 1901, *Introduction to Community-based SNMPv2*
  - RFC 1905, *Protocol Operations for Version 2 of the Simple Network Management Protocol (SNMPv2)*
  - RFC 1907, *Management Information Base for Version 2 of the Simple Network Management Protocol (SNMPv2)*
  - RFC 2011, *SNMPv2 Management Information Base for the Internet Protocol Using SMIv2*
  - RFC 2012, *SNMPv2 Management Information Base for the Transmission Control Protocol Using SMIv2*
  - RFC 2013, *SNMPv2 Management Information Base for the User Datagram Protocol Using SMIv2*
  - RFC 2233, *The Interfaces Group MIB Using SMIv2*

- RFC 2571, *An Architecture for Describing SNMP Management Frameworks* (read-only access) (excluding SNMPv3)
- RFC 2572, *Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)* (read-only access) (excluding SNMPv3)
- RFC 2576, *Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework* (excluding SNMPv3)
- RFC 2578, *Structure of Management Information Version 2 (SMIv2)*
- RFC 2579, *Textual Conventions for SMIv2*
- RFC 2580, *Conformance Statements for SMIv2*
- RFC 2665, *Definitions of Managed Objects for the Ethernet-like Interface Types*
- RFC 2863, *The Interfaces Group MIB*
- RFC 3410, *Introduction and Applicability Statements for Internet Standard Management Framework* (excluding SNMPv3)
- RFC 3411, *An Architecture for Describing Simple Network Management Protocol (SNMP) Management Framework* (excluding SNMPv3)
- RFC 3412, *Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)* (excluding SNMPv3)
- RFC 3413, *Simple Network Management Protocol (SNMP) Applications* (excluding SNMPv3)
- RFC 3416, *Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)*
- RFC 3417, *Transport Mappings for the Simple Network Management Protocol (SNMP)*
- RFC 3418, *Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)*
- RFC 3584, *Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework* (excluding SNMPv3)
- RFC 4188, *Definitions of Managed Objects for Bridges*
- RFC 4293, *Management Information Base for the Internet Protocol (IP)*
- RFC 4363b, *Q-Bridge VLAN MIB*

- Support for the following Juniper Networks enterprise-specific MIBs:
  - Chassis MIB (mib-jnx-chassis.txt)
  - Class-of-Service MIB (mib-jnx-cos.txt)
  - Configuration Management MIB (mib-jnx-cfgmgmt.txt)
  - Fabric Chassis MIB (mib-jnx-fabric-chassis.txt)
  - Interface MIB Extensions (mib-jnx-if-extensions.txt)
  - Power Supply Unit MIB (mib-jnx-power-supply-unit.txt)

  - QFabric MIB (mib-jnx-qf-smi.txt)
  - Utility MIB (mib-jnx-util.txt)

- Support for operational mode commands—Limited to the **show snmp statistics** command. You may issue other SNMP requests, including **get**, **get next**, and **walk** requests, by using external SNMP client applications.

Related Documentation

- SNMP MIBs Support on page 6038
- SNMP Traps Support on page 6054

Fabric Chassis MIB

The Juniper Networks enterprise-specific SNMP Fabric Chassis MIB (mib-jnx-fabric-chassis) provides hardware information about the QFabric system and its component devices in a single MIB. The Fabric Chassis MIB is based on the Juniper Networks enterprise-specific Chassis MIB that provides information for individual devices. Unlike the Chassis MIB, the Fabric Chassis MIB represents the QFabric system component devices as part of the QFabric system. Only the information from the Fabric Chassis MIB (and not from individual Chassis MIBs) is available to SNMP management clients of the QFabric system.

The Fabric Chassis MIB uses the basic information structure of the Chassis MIB, but adds another level of indexing that provides detailed information about QFabric system devices. Each physical device in a QFabric system (such as a Node device or an Interconnect device) is represented with its hardware components, including the power supply, fans, and front and rear cards.

As in other SNMP systems, the SNMP manager resides on the network management system (NMS) of the network to which the QFabric system belongs. The SNMP agent (snmpd) resides in the QFabric system Director software and is responsible for receiving and distributing all traps as well as responding to all queries from the SNMP manager. In addition, there is an SNMP subagent running in the Routing Engine of each Node group and Interconnect device. The SNMP subagent manages the information about the component device, and that information is communicated to the SNMP agent in the Director software as needed. Traps that are generated by a Node device are sent to the SNMP agent in the Director software, which in turn processes and sends them to the target IP addresses that are defined in the SNMP configuration.

Table 563 on page 6026 describes the tables and objects in the Fabric Chassis MIB.

Table 563: Fabric Chassis MIB Tables and Objects

Table or Object Name	Root OID	Description
Tables with Counterparts in the Chassis MIB		

Table 563: Fabric Chassis MIB Tables and Objects *(continued)*

Table or Object Name	Root OID	Description
jnxFabricContainersTable	1.3.6.1.4.1.2636.3.42.2.2.2	Provides information about different types of containers in QFabric system devices. • Containers for Interconnect devices include fan trays, power supply units, control boards, and so on. • Containers for Node devices include fan trays, power supply units, Flexible PIC Concentrator (FPC), PICs, and so on. • Containers for the Director devices include CPU, memory, fan trays, power supply units, and hard disks. The containers have a non-hierarchical or flat structure, and components in them are organized as siblings to each other.
jnxFabricContentsTable	1.3.6.1.4.1.2636.3.42.2.2.3	Contains contents that are present across all devices represented in the jnxFabricDeviceTable object. This table includes all field replaceable units (FRUs) and non-FRUs for QFabric system devices. • Contents in the Interconnect devices include fan trays and control boards. • Contents in the Node devices include fan trays and power supply units. • Contents in the Director devices include CPUs, memory, fan trays, power supply units, and hard disks, but do not include network interface cards (NICs).
jnxFabricFilledTable	1.3.6.1.4.1.2636.3.42.2.2.4	Shows the status of containers in QFabric devices. The jnxFabricFilledState object represents the state of the component: (1) unknown, (2) empty, or (3) filled. NOTE: The jnxFabricFilledTable object does not contain information about the Director group.
jnxFabricOperatingTable	1.3.6.1.4.1.2636.3.42.2.2.5	Represents different operating parameters for the contents that are populated in the jnxFabricContentsTable object. • Contents in each Node device and Interconnect device include fan trays, power supply units, FPC, PIC, and Routing Engine. • Contents in the Director device include CPUs, memory, fan trays, power supply units, and hard disks, but do not include network interface cards (NICs). The jnxFabricOperatingState object provides the state of the device: (1) unknown, (2) running, (3) ready, (4) reset, (5) runningAtFullSpeed (for fans only), (6) down, (6) off (for power supply units), or (7) standby.

Table 563: Fabric Chassis MIB Tables and Objects *(continued)*

Table or Object Name	Root OID	Description
jnxFabricRedundancyTable	1.3.6.1.4.1.2636.3.42.2.2.6	Represents the redundancy information that is available at different subsystem levels across the QFabric system. Information about the Routing Engines in Node devices is included, but there are no corresponding entries for Interconnect devices in this table. The jnxFabricRedundancyState object indicates the state of the subsystem: (1) unknown, (2) master, (3) backup, or (4) disabled. NOTE: Information about redundant Director devices, virtual machines (VMs) within Director groups, and Virtual Chassis devices is not available at this time.
jnxFabricFruTable	1.3.6.1.4.1.2636.3.42.2.2.7	Contains all FRUs for the QFabric system in the jnxFabricDeviceTable table. The FRUs are listed regardless of whether or not they are installed or online. The jnxFabricFruState object represents the state of the FRU, including online, offline, or empty, and so on. This table also contains information about each FRU, such as name, type, temperature, time last powered on, and time last powered off. NOTE: The jnxFabricFruTable table does not include network interface cards (NICs) on Director devices.
Table Specific to the Fabric Chassis MIB		
jnxFabricDeviceTable	1.3.6.1.4.1.2636.3.42.2.2.1	Contains information about all devices in the QFabric system. This table organizes scalar variables represented in the Chassis MIB into a table format for the QFabric system component devices. Columns in this table include device information such as model, device alias, and serial number. The jnxFabricDeviceIndex identifies each QFabric system device (Node device, Interconnect device, and Director device). NOTE: At this time, information about the Virtual Chassis is not available. NOTE: The following objects are not supported: • jnxFabricDeviceEntryRevision • jnxFabricDeviceEntryFirmwareRevision • jnxFabricDeviceEntryKernelMemoryUsedPercent
Scalar Variables		

Table 563: Fabric Chassis MIB Tables and Objects *(continued)*

Table or Object Name	Root OID	Description
The following scalar variables are supported: • jnxFabricClass • jnxFabricDescr • jnxFabricSerialNo • jnxFabricRevision • jnxFabricLastInstalled • jnxFabricContentsLastChange • jnxFabricFilledLastChange	1.3.6.1.4.1.2636.3.42.2.1	Describe the QFabric system as a whole. NOTE: The jnxFabricFirmwareRevision scalar variable is not supported at this time.

Table 564 on page 6029 describes the SNMPv2 traps that are defined in the Fabric Chassis MIB.

NOTE: Only SNMPv2 traps are supported on the QFabric system.

Table 564: Fabric Chassis MIB SNMPv2 Traps

Trap Group and Name	Root OID	Description
jnxFabricChassisTraps group—Includes the following traps: • jnxFabricPowerSupplyFailure • jnxFabricFanFailure • jnxFabricOverTemperature • jnxFabricRedundancySwitchover • jnxFabricFruRemoval • jnxFabricFruInsertion • jnxFabricFruPowerOff • jnxFabricFruPowerOn • jnxFabricFruFailed • jnxFabricFruOffline • jnxFabricFruOnline • jnxFabricFruCheck • jnxFabricFEBSwitchover • jnxFabricHardDiskFailed • jnxFabricHardDiskMissing • jnxFabricBootFromBackup	1.3.6.1.4.1.2636.4.19	Indicates an alarm condition. NOTE: Hardware events on the Director group are detected by scanning. As a result, a trap may not be generated until up to 30 seconds after the event has occurred. NOTE: The software does not distinguish between the fan removal and fan failure events on the Director group. In each case, both the jnxFabricFanFailure and jnxFabricFruFailed traps are generated. NOTE: The software does not distinguish between the fan insertion and fan OK events on the Director group. In each case, both the jnxFabricFanOK and jnxFabricFruOK traps are generated.

Table 564: Fabric Chassis MIB SNMPv2 Traps *(continued)*

Trap Group and Name	Root OID	Description
jnxFabricChassisOKTraps group—Includes the following traps: • jnxFabricPowerSupplyOK • jnxFabricFanOK • jnxFabricTemperatureOK • jnxFabricFruOK	1.3.6.1.4.1.2636.4.20	Indicates an alarm cleared condition.

For more information, see the Fabric Chassis MIB at:

http://www.juniper.net/techpubs/en_US/junos13.1/topics/reference/mibs/mib-jnx-fabric-chassis.txt

Related Documentation

- Understanding the Implementation of SNMP on the QFabric System on page 6023
- *Chassis MIBs*

Utility MIB

The Juniper Networks enterprise-specific Utility MIB, whose object ID is {jnxUtilMibRoot 1}, defines objects for counters, integers, and strings. The Utility MIB contains one table for each of the following five data types:

- 32-bit counters
- 64-bit counters
- Signed integers
- Unsigned integers
- Octet strings

Each data type has an arbitrary ASCII name, which is defined when the data is populated, and a timestamp that shows the last time when the data instance was modified. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/ reference/mibs/mib-jnx-util.txt .

For information about the enterprise-specific Utility MIB objects, see the following topics:

- *jnxUtilCounter32Table*
- *jnxUtilCounter64Table*
- *jnxUtilIntegerTable*
- *jnxUtilUintTable*
- *jnxUtilStringTable*

Related Documentation

- *Juniper Networks Enterprise-Specific MIBs*
- *Juniper Networks Enterprise-Specific MIBs*

- *Standard SNMP MIBs Supported by Junos OS*
- Understanding the Implementation of SNMP on the QFabric System on page 6023

SNMPv3 Overview

The QFX3500 switch supports SNMP version 3 (SNMPv3). SNMPv3 enhances the functionality of SNMPv1 and SNMPv2c by supporting user authentication and data encryption. SNMPv3 uses the user-based security model (USM) to provide security for SNMP messages, and the view-based access control model (VACM) for user access control.

SNMPv3 features include:

- With USM, the SNMP messages between the SNMP manager and the agent can have the message source authenticated and the data integrity checked. USM reduces messaging delays and message replays by enforcing timeout limits and by checking for duplicate message request IDs.
- VACM complements USM by providing user access control for SNMP queries to the agent. You define access privileges that you wish to extend to a group of one or more users. Access privileges are determined by the security model parameters (**usm**, **v1**, or **v2**) and security level parameters (**authentication**, **privacy**, or **none**). For each security level, you must associate one MIB view for the group. Associating a MIB view with a group grants the read, write, or notify permission to a set of MIB objects for the group.
- You configure security parameters for each user, including the username, authentication type and authentication password, and privacy type and privacy password. The username given to each user is in a format that is dependent on the security model configured for that user.
- To ensure messaging security, another type of username, called the security name, is included in the messaging data that is sent between the local SNMP server and the destination SNMP server. Each user name is mapped to a security name, but the security name is in a format that is independent of the security model.
- Trap entries in SNMPv3 are created by configuring the notify, notify filter, target address, and target parameters. The **notify** statement specifies the type of notification (trap) and contains a single tag that defines a set of target addresses to receive a trap. The notify filter defines access to a collection of trap object identifiers (OIDs). The target address defines the address of an SNMP management application and other attributes used in sending notifications. Target parameters define the message processing and security parameters used in sending notifications to a particular target.

Related Documentation

- Assigning a Security Name to a Group on page 6123
- Configuring Access Privileges for a Group on page 6121
- Configuring SNMP Informs on page 6125
- Creating SNMPv3 Users on page 6120

Minimum SNMPv3 Configuration on a Device Running Junos OS

To configure the minimum requirements for SNMPv3, include the following statements at the **[edit snmp v3]** and **[edit snmp]** hierarchy levels:

NOTE: You must configure at least one view (notify, read, or write) at the **[edit snmp view-name]** hierarchy level.

```
[edit snmp]
view view-name {
  oid object-identifier (include | exclude);
}
[edit snmp v3]
notify name {
  tag tag-name;
}
notify-filter profile-name {
  oid object-identifier (include | exclude);
}
snmp-community community-index {
  security-name security-name;
}
target-address target-address-name {
  address address;
  target-parameters target-parameters-name;
}
target-parameters target-parameters-name {
  notify-filter profile-name;
  parameters {
    message-processing-model (v1 | v2c | v3);
    security-level (authentication | none | privacy);
    security-model (usm | v1 | v2c);
    security-name security-name;
  }
}
usm {
  local-engine {
    user username {
    }
  }
}
vacm {
  access {
    group group-name {
      (default-context-prefix | context-prefix context-prefix){
        security-model (any | usm | v1 | v2c) {
          security-level (authentication | none | privacy) {
            notify-view view-name;
            read-view view-name;
            write-view view-name;
          }
        }
      }
```



```
        }
      }
      security-to-group {
        security-model (usm | v1 | v2c) {
          security-name security-name {
            group group-name;
          }
        }
      }
    }
```

Related Documentation

- Creating SNMPv3 Users on page 6120
- Configuring MIB Views on page 6116
- *Defining Access Privileges for an SNMP Group*
- Configuring SNMPv3 Traps on a Device Running Junos OS on page 6123
- Configuring SNMP Informs on page 6125
- *Complete SNMPv3 Configuration Statements*
- *Example: SNMPv3 Configuration*

Understanding RMON

RMON Overview

The Junos OS supports the *Remote Network Monitoring* (RMON) MIB (RFC 2819), which allows a management device to monitor the values of MIB objects, or variables, against configured thresholds. When the value of a variable crosses a threshold, an alarm and its corresponding event are generated. The event can be logged and can generate an SNMP trap.

An operational support system (OSS) or a fault-monitoring system can be used to automatically monitor events that track many different metrics, including performance, availability, faults, and environmental data. For example, an administrator might want to know when the internal temperature of a chassis has risen above a configured threshold, which might indicate that a chassis fan tray is faulty, the chassis air flow is impeded, or the facility cooling system in the vicinity of the chassis is not operating normally.

The RMON MIB also defines tables that store various statistics for Ethernet interfaces, including the **etherStatsTable** and the **etherHistoryTable**. The **etherStatsTable** contains cumulative real-time statistics for Ethernet interfaces, such as the number of unicast, multicast, and broadcast packets received on an interface. The **etherHistoryTable** maintains a historical sample of statistics for Ethernet interfaces. The control of the **etherHistoryTable**, including the interfaces to track and the sampling interval, is defined by the RMON **historyControlTable**.

To enable RMON alarms, you perform the following steps:

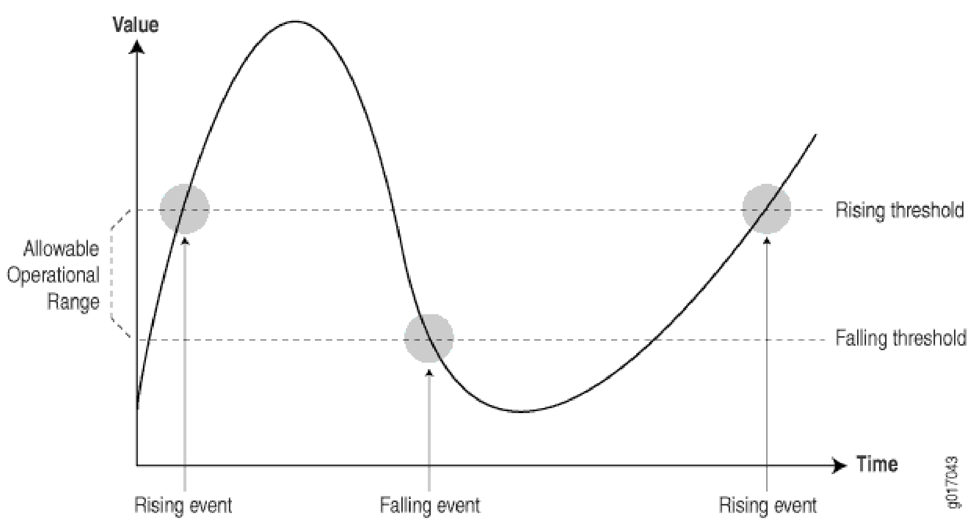
1. Configure SNMP, including trap groups. You configure SNMP at the [**edit snmp**] hierarchy level.
2. Configure rising and falling events in the **eventTable**, including the event types and trap groups. You can also configure events using the CLI at the [**edit snmp rmon event**] hierarchy level.
3. Configure alarms in the **alarmTable**, including the variables to monitor, rising and falling thresholds, the sampling types and intervals, and the corresponding events to generate when alarms occur. You can also configure alarms using the CLI at the [**edit snmp rmon alarm**] hierarchy level.

   Extensions to the **alarmTable** are defined in the Juniper Networks enterprise-specific MIB **jnxRmon** (mib-jnx-rmon.txt).

Alarm Thresholds and Events

By setting a rising and a falling threshold for a monitored variable, you can be alerted whenever the value of the variable falls outside the allowable operational range (see Figure 214 on page 6034).

Figure 214: Setting Thresholds



Events are only generated when the alarm threshold is first crossed in any one direction rather than after each sample interval. For example, if a rising threshold alarm, along with its corresponding event, is raised, no more threshold crossing events occur until a corresponding falling alarm occurs. This considerably reduces the quantity of events that are produced by the system, making it easier for operations staff to react when events do occur.

Before you configure remote monitoring, you should identify what variables need to be monitored and their allowable operational range. This requires some period of baselining to determine the allowable operational ranges. An initial baseline period of at least

3 months is not unusual when you first identify the operational ranges and define thresholds, but baseline monitoring should continue over the life span of each monitored variable.

Related Documentation

- Configuring RMON Alarms and Events on page 6117
- *Juniper Networks Enterprise-Specific MIBs*
- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035

RMON MIB Event, Alarm, Log, and History Control Tables

The Junos OS supports the *Remote Network Monitoring* (RMON) MIB (RFC 2819), which allows a management device to monitor the values of MIB objects, or variables, against configured thresholds. When the value of a variable crosses a threshold, an alarm and its corresponding event are generated. The event can be logged and can generate an SNMP trap.

Table 565 on page 6035 provides each field in the RMON eventTable, the description of the field, and the corresponding Junos OS statement that you can use to configure the field. The Junos OS statements reside at the [**edit snmp rmon**] hierarchy level.

Table 565: RMON Event Table

Field	Description	Statement [edit snmp rmon]
eventDescription	Text description of this event.	**description**
eventType	Type of event (for example, log, trap, or log and trap).	**type**
eventCommunity	Trap group to which to send this event, as defined in the Junos OS configuration. (This is not the same as the SNMP community.)	**community**
eventOwner	Entity (for example, manager) that created this event.	—
eventStatus	Status of this row (for example, valid, invalid, or createRequest).	—

Table 566 on page 6035 provides each field in the RMON alarmTable, the description of the field, and the corresponding Junos OS statement that you can use to configure the field. The Junos OS statements reside at the [**edit snmp rmon**] hierarchy level.

Table 566: RMON Alarm Table

Field	Description	Statement [edit snmp rmon]
alarmStatus	Status of this row (for example, valid, invalid, or createRequest)	—
alarmInterval	Sampling period (in seconds) of the monitored variable	**interval**
alarmVariable	Object identifier (OID) and instance of the variable to be monitored	—

Table 566: RMON Alarm Table *(continued)*

Field	Description	Statement [edit snmp rmon]
alarmValue	Actual value of the sampled variable	—
alarmSampleType	Sample type (absolute or delta changes)	**sample-type**
alarmStartupAlarm	Initial alarm (rising, falling, or either)	**startup-alarm**
alarmRisingThreshold	Rising threshold against which to compare the value	**rising-threshold**
alarmFallingThreshold	Falling threshold against which to compare the value	**falling-threshold**
alarmRisingEventIndex	Index (row) of the rising event in the event table	**rising-event-index**
alarmFallingEventIndex	Index (row) of the falling event in the event table	**falling-event-index**

Table 567 on page 6036 provides each field in the jnxRmon jnxRmonAlarmTable, which is an extension to the RMON alarmTable. You can troubleshoot the RMON agent, rmopd, that runs on a switch by inspecting the contents of the jnxRmonAlarmTable object.

Table 567: jnxRmon Alarm Table

Field	Description
jnxRmonAlarmGetFailCnt	Number of times the internal **Get** request for the variable failed
jnxRmonAlarmGetFailTime	Value of the sysUpTime object when the last failure occurred
jnxRmonAlarmGetFailReason	Reason why the **Get** request failed
jnxRmonAlarmGetOkTime	Value of the sysUpTime object when the variable moved out of failure state
jnxRmonAlarmState	Status of this alarm entry

Table 568 on page 6036 provides each field in the RMON historyControlTable, the description of the field, and the corresponding Junos OS statement that you can use to configure the field. The Junos OS statements reside at the [**edit snmp rmon history**] hierarchy level. The historyControlTable controls the RMON etherHistoryTable.

Table 568: RMON History Control Table

Field	Description	Statement [edit snmp rmon history]
historyControlDataSource	Identifies the source of the data for which historical data was collected.	**interface**

Table 568: RMON History Control Table *(continued)*

Field	Description	Statement [edit snmp rmon history]
historyControlBucketsRequested	Requested number of discrete time intervals over which data is to be saved.	**bucket-size**
historyControlBucketsGranted	Number of discrete sampling intervals over which data is to be saved.	—
historyControlInterval	Interval, in seconds, over which the data is sampled for each bucket.	**interval**
historyControlOwner	Entity that configured this entry.	**owner**
historyControlStatus	Status of this entry.	—

Related Documentation

- Configuring RMON Alarms and Events on page 6117
- *Juniper Networks Enterprise-Specific MIBs*
- Understanding RMON on page 6033

Understanding Health Monitoring

Health monitoring is an SNMP feature that extends the RMON alarm infrastructure to provide monitoring for a predefined set of objects (such as file system usage, CPU usage, and memory usage), and for Junos OS processes.

You enable the health monitor feature using the **health-monitor** statement at the **[edit snmp]** hierarchy level. You can also configure health monitor parameters such as a falling threshold, rising threshold, and interval. If the value of a monitored object exceeds the rising or falling threshold, an alarm is triggered and an event may be logged.

The falling threshold is the lower threshold for the monitored object instance. The rising threshold is the upper threshold for the monitored object instance. Each threshold is expressed as a percentage of the maximum possible value. The interval represents the period of time, in seconds, over which the object instance is sampled and compared with the rising and falling thresholds.

Events are only generated when a threshold is first crossed in any one direction, rather than after each sample interval. For example, if a rising threshold alarm, along with its corresponding event, is raised, no more threshold crossing events occur until a corresponding falling alarm occurs.

System log entries for health monitor events have a corresponding HEALTHMONITOR tag and not a generic SNMPD_RMON_EVENTLOG tag. However, the health monitor sends generic RMON risingThreshold and fallingThreshold traps. You can use the **show snmp health-monitor** operational command to view information about health monitor alarms and logs.

When you configure the health monitor, monitoring information for certain object instances is available, as shown in Table 569 on page 6038.

Table 569: Monitored Object Instances

Object	Description
jnxHrStoragePercentUsed.1	Monitors the **/dev/ad0s1a:** file system on the switch. This is the root file system mounted on /.
jnxHrStoragePercentUsed.2	Monitors the **/dev/ad0s1e:** file system on the switch. This is the configuration file system mounted on **/config**.
jnxOperatingCPU (RE0)	Monitors CPU usage by the Routing Engine (RE0).
jnxOperatingBuffer (RE0)	Monitors the amount of memory available on the Routing Engine (RE0).
sysApplElmtRunCPU	Monitors the CPU usage for each Junos OS process (also called daemon). Multiple instances of the same process are monitored and indexed separately.
sysApplElmtRunMemory	Monitors the memory usage for each Junos OS process. Multiple instances of the same process are monitored and indexed separately.

Related Documentation

- Configuring Health Monitoring on page 6119
- **falling-threshold (Health Monitor) on page 1296**
- **interval (Health Monitor) on page 1301**
- **rising-threshold (Health Monitor) on page 1331**
- **show snmp health-monitor on page 6385**

SNMP MIBs Support

The QFX Series standalone switches, QFX Series Virtual Chassis, and QFabric systems support standard MIBs and Juniper Networks enterprise-specific MIBs.

For more information, see:

- MIBs Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis on page 6038
- MIBs Supported on QFabric Systems on page 6047

MIBs Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis

The QFX Series standalone switches and QFX Series Virtual Chassis support both standard MIBs and Juniper Networks enterprise-specific MIBs. For more information, see:

- Table 570 on page 6039 for standard MIBs.
- Table 571 on page 6044 for Juniper Networks enterprise-specific MIBs.

Table 570: Standard MIBs Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis

RFC	Additional Information
IEEE 802.1ab section 12.1, *Link Layer Discovery Protocol (LLDP) MIB*	Supported tables and objects: • lldpRemManAddrOID • lldpLocManAddrOID • lldpReinitDelay • lldpNotificationInterval • lldpStatsRxPortFramesDiscardedTotal • lldpStatsRxPortFramesError • lldpStatsRxPortTLVsDiscardedTotal • lldpStatsRxPortTLVsUnrecognizedTotal • lldpStatsRxPortAgeoutsTotal
IEEE 802.3ad, *Aggregation of Multiple Link Segments*	The following tables and objects are supported: • dot3adAggPortTable, dot3adAggPortListTable, dot3adAggTable, and dot3adAggPortStatsTable • dot3adAggPortDebugTable (only dot3adAggPortDebugRxState, dot3adAggPortDebugMuxState, dot3adAggPortDebugActorSyncTransitionCount, dot3adAggPortDebugPartnerSyncTransitionCount, dot3adAggPortDebugActorChangeCount, and dot3adAggPortDebugPartnerChangeCount) • dot3adTablesLastChanged
RFC 1155, *Structure and Identification of Management Information for TCP/IP-based Internets*	—
RFC 1157, *A Simple Network Management Protocol (SNMP)*	—
RFC 1212, *Concise MIB Definitions*	—

RFC 1213, *Management Information Base for Network Management of TCP/IP-Based Internets: MIB-II*	The following areas are supported:
	• MIB II and its SNMP version 2 derivatives, including:
	  ◦ Statistics counters
	  ◦ IP, except for ipRouteTable, which has been replaced by ipCidrRouteTable (RFC 2096, *IP Forwarding Table MIB*)
	  ◦ ipAddrTable
	  ◦ SNMP management
	  ◦ Interface management
	• SNMPv1 **Get**, **GetNext** requests, and SNMPv2 **GetBulk** request
	• Junos OS-specific secured access list
	• Master configuration keywords
	• Reconfigurations upon SIGHUP

Table 570: Standard MIBs Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

RFC	Additional Information
RFC 1215, *A Convention for Defining Traps for use with the SNMP*	Support is limited to MIB II SNMP version 1 traps and version 2 notifications.
RFC 1286, *Definitions of Managed Objects for Bridges*	—
RFC 1657, *Definitions of Managed Objects for the Fourth Version of the Border Gateway Protocol (BGP-4) using SMIv2*	—
RFC 1850, *OSPF Version 2 Management Information Base*	The following table, objects, and traps are not supported: • Host Table • ospfOriginateNewLsas and ospfRxNewLsas objects • ospfOriginateLSA, ospfLsdbOverflow, and ospfLsdbApproachingOverflow traps
RFC 1901, *Introduction to Community-based SNMPv2*	—
RFC 1905, *Protocol Operations for Version 2 of the Simple Network Management Protocol (SNMPv2)*	—
RFC 1907, *Management Information Base for Version 2 of the Simple Network Management Protocol (SNMPv2)*	—
RFC 2011, *SNMPv2 Management Information Base for the Internet Protocol Using SMIv2*	—
RFC 2012, *SNMPv2 Management Information Base for the Transmission Control Protocol Using SMIv2*	—
RFC 2013, *SNMPv2 Management Information Base for the User Datagram Protocol Using SMIv2*	—
RFC 2233, *The Interfaces Group MIB Using SMIv2*	NOTE: RFC 2233 has been replaced by RFC 2863. However, Junos OS supports both RFC 2233 and RFC 2863.
RFC 2287, *Definitions of System-Level Managed Objects for Applications*	The following objects are supported: • sysApplInstallPkgTable • sysApplInstallElmtTable • sysApplElmtRunTable • sysApplMapTable

Table 570: Standard MIBs Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

RFC	Additional Information
RFC 2570, *Introduction to Version 3 of the Internet-standard Network Management Framework*	—
RFC 2571, *An Architecture for Describing SNMP Management Frameworks* (read-only access)	NOTE: RFC 2571 has been replaced by RFC 3411. However, Junos OS supports both RFC 2571 and RFC 3411.
RFC 2572, *Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)* (read-only access)	NOTE: RFC 2572 has been replaced by RFC 3412. However, Junos OS supports both RFC 2572 and RFC 3412.
RFC 2576, *Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework*	NOTE: RFC 2576 has been replaced by RFC 3584. However, Junos OS supports both RFC 2576 and RFC 3584.
RFC 2578, *Structure of Management Information Version 2 (SMIv2)*	—
RFC 2579, *Textual Conventions for SMIv2*	—
RFC 2580, *Conformance Statements for SMIv2*	—
RFC 2665, *Definitions of Managed Objects for the Ethernet-like Interface Types*	—
RFC 2787, *Definitions of Managed Objects for the Virtual Router Redundancy Protocol*	Support does not include row creation, the Set operation, and the vrrpStatsPacketLengthErrors object.
RFC 2790, *Host Resources MIB*	Support is limited to the following objects: • Only hrStorageTable. The file systems **/**, **/config**, **/var**, and **/tmp** always return the same index number. When SNMP restarts, the index numbers for the remaining file systems might change. • Only the objects of the hrSystem and hrSWInstalled groups.
RFC 2819, *Remote Network Monitoring Management Information Base*	The following objects are supported: • etherStatsTable (for Ethernet interfaces only), alarmTable, eventTable, and logTable. • historyControlTable and etherHistoryTable (except the etherHistoryUtilization object).
RFC 2863, *The Interfaces Group MIB*	NOTE: RFC 2233 has been replaced by RFC 2863. However, Junos OS supports both RFC 2233 and RFC 2863.
RFC 2932, *IPv4 Multicast Routing MIB*	—

Table 570: Standard MIBs Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

RFC	Additional Information
RFC 2933, *Internet Group Management Protocol (IGMP) MIB*	—
RFC 2934, *Protocol Independent Multicast MIB for IPv4*	In Junos OS, RFC 2934 is implemented based on a draft version, *pimmib.mib*, of the now standard RFC.
RFC 3410, *Introduction and Applicability Statements for Internet Standard Management Framework*	—
RFC 3411, *An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks*	NOTE: RFC 3411 replaces RFC 2571. However, Junos OS supports both RFC 3411 and RFC 2571.
RFC 3412, *Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)*	NOTE: RFC 3412 replaces RFC 2572. However, Junos OS supports both RFC 3412 and RFC 2572.
RFC 3413, *Simple Network Management Protocol (SNMP) Applications*	All MIBs are supported except for the Proxy MIB.
RFC 3414, *User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)*	—
RFC 3415, *View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)*	—
RFC 3416, *Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)*	NOTE: RFC 3416 replaces RFC 1905, which was supported in earlier versions of Junos OS.
RFC 3417, *Transport Mappings for the Simple Network Management Protocol (SNMP)*	—
RFC 3418, *Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)*	NOTE: RFC 3418 replaces RFC 1907, which was supported in earlier versions of Junos OS.
RFC 3584, *Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework*	—
RFC 3826, *The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model*	—

Table 570: Standard MIBs Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

RFC	Additional Information
RFC 4188, *Definitions of Managed Objects for Bridges*	The QFX3500 and QFX3600 switches support 802.1D STP (1998) and the following subtrees and objects only: • dot1dTp subtree—dot1dTpFdbAddress, dot1dTpFdbPort, and dot1dTpFdbStatus objects from the dot1dTpFdbTable table. • dot1dBase subtree—dot1dBasePort and dot1dBasePortIfIndex objects from the dot1dBasePortTable table. NOTE: On QFX3500 and QFX3600 switches, the dot1dTpFdbTable table is populated only with MAC addresses learned on the default VLAN. To see the MAC addresses of all VLANs, specify the dot1qTpFdbTable table (RFC 4363b, *Q-Bridge VLAN MIB*) when you issue the **show snmp mib walk** command.
RFC 4293, *Management Information Base for the Internet Protocol (IP)*	Supports the ipAddrTable table only.
RFC 4318, *Definitions of Managed Objects for Bridges with Rapid Spanning Tree Protocol*	Supports 802.1w and 802.1t extensions for RSTP.
RFC 4363b, *Q-Bridge VLAN MIB*	NOTE: On QFX3500 and QFX3600 switches, the dot1dTpFdbTable table (RFC 4188, *Definitions of Managed Objects for Bridges*) is populated only with MAC addresses learned on the default VLAN. To see the MAC addresses of all VLANs, specify the dot1qTpFdbTable table (in this MIB) when you issue the **show snmp mib walk** command.
RFC 4444, *IS-IS MIB*	—
Internet Assigned Numbers Authority, *IANAiftype Textual Convention MIB* (referenced by RFC 2233)	See http://www.iana.org/assignments/ianaiftype-mib .
Internet draft draft-reeder-snmpv3-usm-3desede-00.txt, *Extension to the User-Based Security Model (USM) to Support Triple-DES EDE in 'Outside' CBC Mode*	—
Internet draft draft-ietf-idmr-igmp-mib-13.txt, *Internet Group Management Protocol (IGMP) MIB*	—
ESO Consortium MIB	NOTE: The ESO Consortium MIB has been replaced by RFC 3826. See http://www.snmp.com/eso/ .

Table 571: Juniper Networks Enterprise-Specific MIBs Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis

MIB	Description
Alarm MIB (mib-jnx-chassis-alarm)	Provides support for alarms from the switch. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-chassis-alarm.txt . For more information, see *Alarm MIB*.
Analyzer MIB (mib-jnx-analyzer)	Contains analyzer and remote analyzer data related to port mirroring. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-analyzer.txt . For more information, see *Analyzer MIB*.
Chassis MIB (mib-jnx-chassis)	Provides support for environmental monitoring (power supply state, board voltages, fans, temperatures, and airflow) and inventory support for the chassis, Flexible PIC Concentrators (FPCs), and PICs. NOTE: The jnxLEDTable table has been deprecated. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-chassis.txt . For more information, see *Chassis MIBs*.
Chassis Definitions for Router Model MIB (mib-jnx-chas-defines)	Contains the object identifiers (OIDs) that are used by the Chassis MIB to identify routing and switching platforms and chassis components. The Chassis MIB provides information that changes often, whereas the Chassis Definitions for Router Model MIB provides information that changes less often. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-chas-defines.txt . For more information, see *Chassis MIBs*.
Class-of-Service MIB (mib-jnx-cos)	Provides support for monitoring interface output queue statistics per interface and per forwarding class. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-cos.txt . For more information, see *Class-of-Service MIB*.

Table 571: Juniper Networks Enterprise-Specific MIBs Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

MIB	Description
Configuration Management MIB (mib-jnx-cfgmgmt)	Provides notification for configuration changes and rescue configuration changes in the form of SNMP traps. Each trap contains the time at which the configuration change was committed, the name of the user who made the change, and the method by which the change was made. A history of the last 32 configuration changes is kept in jnxCmChgEventTable. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-cfgmgmt.txt . For more information, see *Configuration Management MIB*.
Ethernet MAC MIB (mib-jnx-mac)	Monitors media access control (MAC) statistics on Gigabit Ethernet intelligent queuing (IQ) interfaces. It collects MAC statistics; for example, inoctets, inframes, outoctets, and outframes on each source MAC address and virtual LAN (VLAN) ID for each Ethernet port. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-mac.txt . For more information, see *Ethernet MAC MIB*.
Event MIB (mib-jnx-event)	Defines a generic trap that can be generated using an operations script or event policy. This MIB provides the ability to specify a system log string and raise a trap if that system log string is found. In Junos OS release 13.2X51-D10 or later, if you configured an event policy to raise a trap when a new SNMP trap target is added, the SNMPD_TRAP_TARGET_ADD_NOTICE trap is generated with information about the new target. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-event.txt . For more information, see *Event MIB*.
Firewall MIB (mib-jnx-firewall)	Provides support for monitoring firewall filter counters. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-firewall.txt . For more information, see *Firewall MIB*.

Table 571: Juniper Networks Enterprise-Specific MIBs Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

MIB	Description
Host Resources MIB (mib-jnx-hostresources)	Extends the hrStorageTable object, providing a measure of the usage of each file system on the switch as a percentage. Previously, the objects in the hrStorageTable measured the usage in allocation units—hrStorageUsed and hrStorageAllocationUnits—only. Using the percentage measurement, you can more easily monitor and apply thresholds on usage. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-hostresources.txt . For more information, see *Host Resources MIB*.
Interface MIB (Extensions) (mib-jnx-if-extensions)	Extends the standard ifTable (RFC 2863) with additional statistics and Juniper Networks enterprise-specific chassis information in the ifJnxTable and ifChassisTable tables. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-if-extensions.txt . For more information, see *Interface MIB*.
MPLS MIB (mib-jnx-mpls)	Provides MPLS information and defines MPLS notifications. NOTE: This MIB is not supported on the QFX5100 switch. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-mpls.txt For more information, see *MPLS MIB*.
MPLS LDP MIB (mib-jnx-mpls-ldp)	Contains object definitions as described in RFC 3815, *Definitions of Managed Objects for the Multiprotocol Label Switching (MPLS), Label Distribution Protocol (LDP)*. NOTE: This MIB is not supported on the QFX5100 switch. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-mpls-ldp.txt For more information, see *MPLS LDP MIB*.
Ping MIB (mib-jnx-ping)	Extends the standard Ping MIB control table (RFC 2925). Items in this MIB are created when entries are created in pingCtlTable of the Ping MIB. Each item is indexed exactly as it is in the Ping MIB. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-ping.txt . For more information, see *PING MIB*.

Table 571: Juniper Networks Enterprise-Specific MIBs Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

MIB	Description
RMON Events and Alarms MIB (mib-jnx-rmon)	Supports Junos OS extensions to the standard Remote Monitoring (RMON) Events and Alarms MIB (RFC 2819). The extension augments the alarmTable object with additional information about each alarm. Two additional traps are also defined to indicate when problems are encountered with an alarm. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-rmon.txt . For more information, see *RMON Events and Alarms MIB*.
Structure of Management Information MIB (mib-jnx-smi)	Explains how the Juniper Networks enterprise-specific MIBs are structured. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-smi.txt . For more information, see *Structure of Management Information MIB*.
System Log MIB (mib-jnx-syslog)	Enables notification of an SNMP trap-based application when an important system log message occurs. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-syslog.txt . For more information, see *System Log MIB*.
Utility MIB (mib-jnx-util)	Provides you with SNMP MIB container objects of the following types: 32-bit counters, 64-bit counters, signed integers, unsigned integers, and octet strings. You can use these objects to store data that can be retrieved using other SNMP operations. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-util.txt . For more information, see “Utility MIB” on page 6030 and “Using the Enterprise-Specific Utility MIB to Enhance SNMP Coverage” on page 6330.
VLAN MIB (mib-jnx-vlan)	Contains information about prestandard IEEE 802.10 VLANs and their association with LAN emulation clients. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-vlan.txt . For more information, see *VLAN MIB*.

MIBs Supported on QFabric Systems

The QFabric systems support both standard MIBs and Juniper Networks enterprise-specific MIBs. For more information, see:

- Table 572 on page 6048 for standard MIBs.
- Table 573 on page 6051 for Juniper Networks enterprise-specific MIBs.

Table 572: Standard MIBs Supported on QFabric Systems

RFC	Additional Information
RFC 1155, *Structure and Identification of Management Information for TCP/IP-based Internets*	—
RFC 1157, *A Simple Network Management Protocol (SNMP)*	—
RFC 1212, *Concise MIB Definitions*	—

RFC 1213, *Management Information Base for Network Management of TCP/IP-Based Internets: MIB-II*	The following areas are supported:
	• MIB II and its SNMP version 2 derivatives, including:
	  ◦ Statistics counters
	  ◦ IP, except for ipRouteTable, which has been replaced by ipCidrRouteTable (RFC 2096, *IP Forwarding Table MIB*)
	  ◦ ipAddrTable
	  ◦ SNMP management
	  ◦ Interface management
	• SNMPv1 **Get**, **GetNext** requests, and version 2 **GetBulk** request
	• Junos OS-specific secured access list
	• Master configuration keywords
	• Reconfigurations upon SIGHUP

RFC 1215, *A Convention for Defining Traps for use with the SNMP*	Support is limited to MIB II SNMP version 1 traps and version 2 notifications.
RFC 1286, *Definitions of Managed Objects for Bridges*	—
RFC 1901, *Introduction to Community-based SNMPv2*	—
RFC 1905, *Protocol Operations for Version 2 of the Simple Network Management Protocol (SNMPv2)*	—
RFC 1907, *Management Information Base for Version 2 of the Simple Network Management Protocol (SNMPv2)*	—
RFC 2011, *SNMPv2 Management Information Base for the Internet Protocol Using SMIv2*	NOTE: On the QFabric system, for the SNMP mibwalk request to work, you must configure the IP address of at least one interface besides the management Ethernet interfaces (me0 and me1) in the Director group.

Table 572: Standard MIBs Supported on QFabric Systems *(continued)*

RFC	Additional Information
RFC 2012, *SNMPv2 Management Information Base for the Transmission Control Protocol Using SMIv2*	—
RFC 2013, *SNMPv2 Management Information Base for the User Datagram Protocol Using SMIv2*	—
RFC 2233, *The Interfaces Group MIB Using SMIv2*	NOTE: RFC 2233 has been replaced by RFC 2863. However, Junos OS supports both RFC 2233 and RFC 2863. NOTE: The QFabric system supports the following objects only: ifNumber, ifTable, and ifxTable.
RFC 2571, *An Architecture for Describing SNMP Management Frameworks* (read-only access)	NOTE: RFC 2571 has been replaced by RFC 3411. However, Junos OS supports both RFC 2571 and RFC 3411.
RFC 2572, *Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)* (read-only access)	NOTE: RFC 2572 has been replaced by RFC 3412. However, Junos OS supports both RFC 2572 and RFC 3412.
RFC 2576, *Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework*	NOTE: RFC 2576 has been replaced by RFC 3584. However, Junos OS supports both RFC 2576 and RFC 3584.
RFC 2578, *Structure of Management Information Version 2 (SMIv2)*	—
RFC 2579, *Textual Conventions for SMIv2*	—
RFC 2580, *Conformance Statements for SMIv2*	—
RFC 2665, *Definitions of Managed Objects for the Ethernet-like Interface Types*	The QFabric system supports the following tables only: • dot3StatsTable—There is one row with statistics for each Ethernet-like interface in the QFabric system. The dot3StatsIndex is an interface index that is unique across the system. • dot3ControlTable—There is one row in this table for each Ethernet-like interface in the QFabric system that implements the MAC control sublayer. OIDs supported are dot3ControlFunctionsSupported and dot3ControlInUnknownOpcode. • dot3PauseTable—There is one row in this table for each Ethernet-like interface in the QFabric system that supports the MAC control PAUSE function. OIDS supported are dot3PauseAdminMode, dot3PauseOperMode, dot3InPauseFrames, and dot3OutPauseFrames. NOTE: Scalar variables are not supported on the QFabric system.

Table 572: Standard MIBs Supported on QFabric Systems *(continued)*

RFC	Additional Information
RFC 2863, *The Interfaces Group MIB*	NOTE: RFC 2233 has been replaced by RFC 2863. However, Junos OS supports both RFC 2233 and RFC 2863. NOTE: The QFabric system supports the following objects only: ifNumber, ifTable, and ifxTable.
RFC 2933, *Internet Group Management Protocol (IGMP) MIB*	—
RFC 3410, *Introduction and Applicability Statements for Internet Standard Management Framework*	—
RFC 3411, *An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks*	NOTE: RFC 3411 replaces RFC 2571. However, Junos OS supports both RFC 3411 and RFC 2571.
RFC 3412, *Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)*	NOTE: RFC 3412 replaces RFC 2572. However, Junos OS supports both RFC 3412 and RFC 2572.
RFC 3416, *Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)*	NOTE: RFC 3416 replaces RFC 1905, which was supported in earlier versions of Junos OS.
RFC 3417, *Transport Mappings for the Simple Network Management Protocol (SNMP)*	—
RFC 3418, *Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)*	NOTE: RFC 3418 replaces RFC 1907, which was supported in earlier versions of Junos OS.
RFC 3584, *Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework*	—
RFC 4188, *Definitions of Managed Objects for Bridges*	The QFabric system support is limited to the following objects: • Under the dot1dBase OID, the dot1dBasePortTable table supports only the first two columns in the table: dot1dBasePort and dot1dBasePortIfIndex. • The system does not implement the optional traps supporting dot1dNotifications (dot1dBridge 0). • Under the dot1dStp OID, supports only the dot1dStpPortTable table. Does not support the scalar variables under dot1dStp. • The system does not support scalar variables under dot1dTp, but under that, the dot1dTpFdbTable table is supported (dot1dBridge 4). • For OIDS with tables support only, scalar values that are returned by the SNMP agent may not be meaningful and are therefore not recommended for use.

Table 572: Standard MIBs Supported on QFabric Systems *(continued)*

RFC	Additional Information
RFC 4293, *Management Information Base for the Internet Protocol (IP)*	Supports the ipAddrTable table only. On the QFabric system, supported objects in the ipAddrTable table include: ipAdEntAddr, ipAdEntIfIndex, ipAdEntNetMask, ipAdEntBcastAddr, and ipAdEntReasmMaxSize. NOTE: On the QFabric system, for the SNMP mibwalk request to work, you must configure the IP address of at least one interface besides the management Ethernet interfaces (me0 and me1) in the Director group.
RFC 4363b, *Q-Bridge VLAN MIB*	The QFabric system supports the following tables only: • dot1qTpFdbTable • dot1qVlanStaticTable • dot1qPortVlanTable • dot1qFdbTable

Table 573: Juniper Networks Enterprise-Specific MIBs Supported on QFabric Systems

MIB	Description
Analyzer MIB (mib-jnx-analyzer)	Contains analyzer and remote analyzer data related to port mirroring. The QFabric system supports: • Analyzer table—jnxAnalyzerName, jnxMirroringRatio, jnxLossPriority. • Analyzer input table—jnxAnalyzerInputValue, jnxAnalyzerInputOption, jnxAnalyzerInputType. • Analyzer output table—jnx AnalyzerOutputValue, jnxAnalyzerOutputType. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-analyzer.txt . For more information, see *Analyzer MIB*.
Chassis MIB (mib-jnx-chassis)	NOTE: The Chassis MIB has been deprecated for the QFabric system. We recommend that you use the Fabric Chassis MIB (mib-jnx-fabric-chassis) for information about the QFabric system.

Table 573: Juniper Networks Enterprise-Specific MIBs Supported on QFabric Systems *(continued)*

MIB	Description
Class-of-Service MIB (mib-jnx-cos)	Provides support for monitoring interface output queue statistics per interface and per forwarding class. The QFabric system supports the following tables and objects: • Jnxcosifstatflagtable—jnxCosIfstatFlags and jnxCosIfIndex. • Jnxcosqstattable—jnxCosQstatTxedPkts, jnxCosQstatTxedPktRate, jnxCosQstatTxedBytes, and jnxCosQstatTxedByteRate. • Jnxcosfcidtable—jnxCosFcIdToFcName. • Jnxcosfctable—jnxCosFcQueueNr. The QFabric system does not support any traps for this MIB. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-cos.txt . For more information, see *Class-of-Service MIB*.
Configuration Management MIB (mib-jnx-cfgmgmt)	Provides notification for configuration changes and rescue configuration changes in the form of SNMP traps. Each trap contains the time at which the configuration change was committed, the name of the user who made the change, and the method by which the change was made. A history of the last 32 configuration changes is kept in jnxCmChgEventTable. NOTE: On the QFabric system, these conditions apply: • All scalar variables under the jnxCmCfgChg table are supported. • Supported scalar OIDs are jnxCmCfgChgLatestIndex, jnxCmCfgChgLatestTime, jnxCmCfgChgLatestDate, jnxCmCfgChgLatestSource, jnxCmCfgChgLatestUser, and jnxCmCfgChgMaxEventEntries. • Scalar variables under the jnxCmRescueChg table are not supported. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-cfgmgmt.txt . For more information, see *Configuration Management MIB*.
Fabric Chassis MIB (mib-jnx-fabric-chassis)	Provides hardware information about the QFabric system and its component devices. This MIB is based on the Juniper Networks enterprise-specific Chassis MIB but adds another level of indexing that provides information for QFabric system component devices. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-fabric-chassis.txt . For more information, see “Fabric Chassis MIB” on page 6026.

Table 573: Juniper Networks Enterprise-Specific MIBs Supported on QFabric Systems *(continued)*

MIB	Description
Host Resources MIB (mib-jnx-hostresources)	Extends the hrStorageTable object, providing a measure of the usage of each file system on the switch as a percentage. Previously, the objects in the hrStorageTable measured the usage in allocation units—hrStorageUsed and hrStorageAllocationUnits—only. Using the percentage measurement, you can more easily monitor and apply thresholds on usage. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-hostresources.txt . For more information, see *Host Resources MIB*.
Interface MIB (Extensions) (mib-jnx-if-extensions)	Extends the standard ifTable (RFC 2863) with additional statistics and Juniper Networks enterprise-specific chassis information in the ifJnxTable and ifChassisTable tables. NOTE: On the QFabric system, scalar variables are not supported. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-if-extensions.txt . For more information, see *Interface MIB*.
Power Supply Unit MIB (mib-jnx-power-supply-unit)	Provides support for environmental monitoring of the power supply unit for the Interconnect device of the QFabric system. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-power-supply-unit.txt . For more information, see *Power Supply Unit MIB*. NOTE: On the QFabric system, scalar variables for the jnxPsuObjects 1 object ID in the jnxPsuScalars table are not supported.
QFabric MIB (jnx-qf-smi)	Explains how the Juniper Networks enterprise-specific QFabric MIBs are structured. Defines the MIB objects that are reported by the QFabric system and the contents of the traps that can be issued by the QFabric system. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-qf-smi.txt .
Utility MIB (mib-jnx-util)	Provides you with SNMP MIB container objects of the following types: 32-bit counters, 64-bit counters, signed integers, unsigned integers, and octet strings. You can use these objects to store data that can be retrieved using other SNMP operations. For a downloadable version of this MIB, see http://www.juniper.net/techpubs/en_US/junos13.2/topics/reference/mibs/mib-jnx-util.txt . For more information, see “Utility MIB” on page 6030 and “Using the Enterprise-Specific Utility MIB to Enhance SNMP Coverage” on page 6330.

Related Documentation

- *SNMP MIBs and Traps Reference*
- Understanding the Implementation of SNMP on page 6021
- Understanding the Implementation of SNMP on the QFabric System on page 6023
- SNMP Traps Support on page 6054

SNMP Traps Support

The QFX Series standalone switches, QFX Series Virtual Chassis, and QFabric systems support standard SNMP traps and Juniper Networks enterprise-specific traps.

For more information, see:

- SNMP Traps Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis on page 6054
- SNMP Traps Supported on QFabric Systems on page 6062

SNMP Traps Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis

QFX Series standalone switches and QFX Series Virtual Chassis support SNMPv1 and v2 traps. For more information, see:

- SNMPv1 Traps on page 6054
- SNMPv2 Traps on page 6058

SNMPv1 Traps

QFX Series standalone switches and QFX Series Virtual Chassis support both standard SNMPv1 traps and Juniper Networks enterprise-specific SNMPv1 traps. See:

- Table 574 on page 6054 for standard SNMPv1 traps.
- Table 575 on page 6057 for enterprise-specific SNMPv1 traps.

The traps are organized first by trap category and then by trap name. The system logging severity levels are listed for those traps that have them. Traps that do not have corresponding system logging severity levels are marked with an en dash (–).

Table 574: Standard SNMP Version 1 Traps Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis

Defined in	Trap Name	Enterprise ID	Generic Trap Number	Specific Trap Number	System Logging Severity Level	Syslog Tag
Link Notifications						
RFC 1215, *Conventions for Defining Traps for*	linkDown	1.3.6.1.4.1.2636	2	0	Warning	SNMP_TRAP_ LINK_DOWN

Table 574: Standard SNMP Version 1 Traps Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

Defined in	Trap Name	Enterprise ID	Generic Trap Number	Specific Trap Number	System Logging Severity Level	Syslog Tag
Use with the SNMP	linkUp	1.3.6.1.4.1.2636	3	0	Info	SNMP_TRAP_ LINK_UP
Remote Operations Notifications						
RFC 2925, *Definitions of Managed Objects for Remote Ping, Traceroute, and Lookup Operations*	pingProbeFailed	1.3.6.1.2.1.80.0	6	1	Info	SNMP_TRAP _PING_ PROBE_ FAILED
	pingTestFailed	1.3.6.1.2.1.80.0	6	2	Info	SNMP_TRAP_ PING_TEST _FAILED
	pingTestCompleted	1.3.6.1.2.1.80.0	6	3	Info	SNMP_TRAP_ PING_TEST_ COMPLETED
	traceRoutePathChange	1.3.6.1.2.1.81.0	6	1	Info	SNMP_TRAP_ TRACE_ROUTE_ PATH_CHANGE
	traceRouteTestFailed	1.3.6.1.2.1.81.0	6	2	Info	SNMP_TRAP_ TRACE_ROUTE_ TEST_FAILED
	traceRouteTestCompleted	1.3.6.1.2.1.81.0	6	3	Info	SNMP_TRAP_ TRACE_ROUTE_ TEST_COMPLETED
RMON Alarms						
RFC 2819a, *RMON MIB*	fallingAlarm	1.3.6.1.2.1.16	6	2	–	–
	risingAlarm	1.3.6.1.2.1.16	6	1	–	–
Routing Notifications						
BGP 4 MIB	bgpEstablished	1.3.6.1.2.1.15.7	6	1	–	–
	bgpBackwardTransition	1.3.6.1.2.1.15.7	6	2	–	–

Table 574: Standard SNMP Version 1 Traps Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

Defined in	Trap Name	Enterprise ID	Generic Trap Number	Specific Trap Number	System Logging Severity Level	Syslog Tag
OSPF TRAP MIB	ospfVirtIfStateChange	1.3.6.1.2.1.14.16.2	6	1	–	–
	ospfNbrStateChange	1.3.6.1.2.1.14.16.2	6	2	–	–
	ospfVirtNbrStateChange	1.3.6.1.2.1.14.16.2	6	3	–	–
	ospfIfConfigError	1.3.6.1.2.1.14.16.2	6	4	–	–
	ospfVirtIfConfigError	1.3.6.1.2.1.14.16.2	6	5	–	–
	ospfIfAuthFailure	1.3.6.1.2.1.14.16.2	6	6	–	–
	ospfVirtIfAuthFailure	1.3.6.1.2.1.14.16.2	6	7	–	–
	ospfIfRxBadPacket	1.3.6.1.2.1.14.16.2	6	8	–	–
	ospfVirtIfRxBadPacket	1.3.6.1.2.1.14.16.2	6	9	–	–
	ospfTxRetransmit	1.3.6.1.2.1.14.16.2	6	10	–	–
	ospfVirtIfTxRetransmit	1.3.6.1.2.1.14.16.2	6	11	–	–
	ospfMaxAgeLsa	1.3.6.1.2.1.14.16.2	6	13	–	–
	ospfIfStateChange	1.3.6.1.2.1.14.16.2	6	16	–	–
Startup Notifications						
RFC 1215, *Conventions for Defining Traps for Use with the SNMP*	authenticationFailure	1.3.6.1.4.1.2636	4	0	Notice	SNMPD_TRAP_GEN_FAILURE
	coldStart	1.3.6.1.4.1.2636	0	0	Critical	SNMPD_TRAP_COLD_START
	warmStart	1.3.6.1.4.1.2636	1	0	Error	SNMPD_TRAP_WARM_START
VRRP Notifications						
RFC 2787, *Definitions of Managed Objects for the Virtual Router Redundancy Protocol*	vrrpTrapNewMaster	1.3.6.1.2.1.68	6	1	Warning	VRRPD_NEW MASTER_TRAP
	vrrpTrapAuthFailure	1.3.6.1.2.1.68	6	2	Warning	VRRPD_AUTH_FAILURE_TRAP

Table 575: Enterprise-Specific SNMPv1 Traps Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis

Defined in	Trap Name	Enterprise ID	Generic Trap Number	Specific Trap Number	System Logging Severity Level	System Log Tag
Chassis Notifications (Alarm Conditions)						
Chassis MIB (jnx-chassis. mib)	jnxPowerSupplyFailure	1.3.6.1.4.1.2636.4.1	6	1	Warning	CHASSISD_ SNMP_ TRAP
	jnxFanFailure	1.3.6.1.4.1.2636.4.1	6	2	Critical	CHASSISD_ SNMP_ TRAP
	jnxOverTemperature	1.3.6.1.4.1.2636.4.1	6	3	Alert	CHASSISD_ SNMP_ TRAP
	jnxFruRemoval	1.3.6.1.4.1.2636.4.1	6	5	Notice	CHASSISD_ SNMP_ TRAP
	jnxFruInsertion	1.3.6.1.4.1.2636.4.1	6	6	Notice	CHASSISD_ SNMP_ TRAP
	jnxFruPowerOff	1.3.6.1.4.1.2636.4.1	6	7	Notice	CHASSISD_ SNMP_ TRAP
	jnxFruPowerOn	1.3.6.1.4.1.2636.4.1	6	8	Notice	CHASSISD_ SNMP_ TRAP
	jnxFruFailed	1.3.6.1.4.1.2636.4.1	6	9	Warning	CHASSISD_ SNMP_ TRAP
	jnxFruOffline	1.3.6.1.4.1.2636.4.1	6	10	Notice	CHASSISD_ SNMP_ TRAP
	jnxFruOnline	1.3.6.1.4.1.2636.4.1	6	11	Notice	CHASSISD_ SNMP_ TRAP
	jnxFruCheck	1.3.6.1.4.1.2636.4.1	6	12	Warning	CHASSISD_ SNMP_ TRAP
	jnxPowerSupplyOk	1.3.6.1.4.1.2636.4.2	6	1	Critical	CHASSISD_ SNMP_ TRAP
	jnxFanOK	1.3.6.1.4.1.2636.4.2	6	2	Critical	CHASSISD_ SNMP_ TRAP
	jnxTemperatureOK	1.3.6.1.4.1.2636.4.2	6	3	Alert	CHASSISD_ SNMP_ TRAP
Configuration Notifications						

Table 575: Enterprise-Specific SNMPv1 Traps Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

Defined in	Trap Name	Enterprise ID	Generic Trap Number	Specific Trap Number	System Logging Severity Level	System Log Tag
Configuration Management MIB (jnx- configmgmt. mib)	jnxCmCfgChange	1.3.6.1.4.1.2636.4.5	6	1	–	–
	jnxCmRescueChange	1.3.6.1.4.1.2636.4.5	6	2	–	–
Remote Operations						
Ping MIB (jnx-ping.mib)	jnxPingRttThresholdExceeded	1.3.6.1.4.1.2636.4.9	6	1	–	–
	jnxPingRttStdDevThreshold Exceeded	1.3.6.1.4.1.2636.4.9	6	2	–	–
	jnxPingRttJitterThreshold Exceeded	1.3.6.1.4.1.2636.4.9	6	3	–	–
	jnxPingEgressThreshold Exceeded	1.3.6.1.4.1.2636.4.9	6	4	–	–
	jnxPingEgressStdDev ThresholdExceeded	1.3.6.1.4.1.2636.4.9	6	5	–	–
	jnxPingEgressJitterThreshold Exceeded	1.3.6.1.4.1.2636.4.9	6	6	–	–
	jnxPingIngressThreshold Exceeded	1.3.6.1.4.1.2636.4.9	6	7	–	–
	jnxPingIngressStddevThreshold Exceeded	1.3.6.1.4.1.2636.4.9	6	8	–	–
	jnxPingIngressJitterThreshold Exceeded	1.3.6.1.4.1.2636.4.9	6	9	–	–
RMON Alarms						
RMON MIB (jnx-rmon. mib)	jnxRmonAlarmGetFailure	1.3.6.1.4.1.2636.4.3	6	1	–	–
	jnxRmonGetOk	1.3.6.1.4.1.2636.4.3	6	2	–	–

SNMPv2 Traps

- Table 576 on page 6059 lists the standard SNMP traps
- Table 577 on page 6061 lists the Juniper Networks enterprise-specific traps

Table 576: Standard SNMPv2 Traps Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis

Defined in	Trap Name	SNMP Trap OID	System Logging Severity Level	Syslog Tag
Link Notifications				
RFC 2863, *The Interfaces Group MIB*	linkDown	1.3.6.1.6.3.1.1.5.3	Warning	SNMP_TRAP_ LINK_DOWN
	linkUp	1.3.6.1.6.3.1.1.5.4	Info	SNMP_TRAP_ LINK_UP
Remote Operations Notifications				
RFC 2925, *Definitions of Managed Objects for Remote Ping, Traceroute, and Lookup Operations*	pingProbeFailed	1.3.6.1.2.1.80.0.1	Info	SNMP_TRAP_ PING_PROBE_ FAILED
	pingTestFailed	1.3.6.1.2.1.80.0.2	Info	SNMP_TRAP_PING_ TEST_FAILED
	pingTestCompleted	1.3.6.1.2.1.80.0.3	Info	SNMP_TRAP_PING_ TEST_COMPLETED
	traceRoutePathChange	1.3.6.1.2.1.81.0.1	Info	SNMP_TRAP_TRACE_ ROUTE_PATH_ CHANGE
	traceRouteTestFailed	1.3.6.1.2.1.81.0.2	Info	SNMP_TRAP_TRACE_ ROUTE_TEST_FAILED
	traceRouteTestCompleted	1.3.6.1.2.1.81.0.3	Info	SNMP_TRAP_TRACE_ ROUTE_TEST_ COMPLETED
RMON Alarms				
RFC 2819a, *RMON MIB*	fallingAlarm	1.3.6.1.2.1.16.0.1	–	–
	risingAlarm	1.3.6.1.2.1.16.0.2	–	–
Routing Notifications				
BGP 4 MIB	bgpEstablished	1.3.6.1.2.1.15.7.1	–	–
	bgpBackwardTransition	1.3.6.1.2.1.15.7.2	–	–

Table 576: Standard SNMPv2 Traps Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

Defined in	Trap Name	SNMP Trap OID	System Logging Severity Level	Syslog Tag
OSPF Trap MIB	ospfVirtIfStateChange	1.3.6.1.2.1.14.16.2.1	–	–
	ospfNbrStateChange	1.3.6.1.2.1.14.16.2.2	–	–
	ospfVirtNbrStateChange	1.3.6.1.2.1.14.16.2.3	–	–
	ospfIfConfigError	1.3.6.1.2.1.14.16.2.4	–	–
	ospfVirtIfConfigError	1.3.6.1.2.1.14.16.2.5	–	–
	ospfIfAuthFailure	1.3.6.1.2.1.14.16.2.6	–	–
	ospfVirtIfAuthFailure	1.3.6.1.2.1.14.16.2.7	–	–
	ospfIfRxBadPacket	1.3.6.1.2.1.14.16.2.8	–	–
	ospfVirtIfRxBadPacket	1.3.6.1.2.1.14.16.2.9	–	–
	ospfTxRetransmit	1.3.6.1.2.1.14.16.2.10	–	–
	ospfVirtIfTxRetransmit	1.3.6.1.2.1.14.16.2.11	–	–
	ospfMaxAgeLsa	1.3.6.1.2.1.14.16.2.13	–	–
	ospfIfStateChange	1.3.6.1.2.1.14.16.2.16	–	–
Startup Notifications				
RFC 1907, *Management Information Base for Version 2 of the Simple Network Management Protocol (SNMPv2)*	coldStart	1.3.6.1.6.3.1.1.5.1	Critical	SNMPD_TRAP_ COLD_START
	warmStart	1.3.6.1.6.3.1.1.5.2	Error	SNMPD_TRAP_ WARM_START
	authenticationFailure	1.3.6.1.6.3.1.1.5.5	Notice	SNMPD_TRAP_ GEN_FAILURE
VRRP Notifications				
RFC 2787, *Definitions of Managed Objects for the Virtual Router Redundancy Protocol*	vrrpTrapNewMaster	1.3.6.1.2.1.68.0.1	Warning	VRRPD_NEWMASTER_ TRAP
	vrrpTrapAuthFailure	1.3.6.1.2.1.68.0.2	Warning	VRRPD_AUTH_ FAILURE_ TRAP

Table 577: Enterprise-Specific SNMPv2 Traps Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis

Source MIB	Trap Name	SNMP Trap OID	System Logging Severity Level	System Log Tag
Chassis (Alarm Conditions) Notifications				
Chassis MIB (mib-jnx-chassis)	jnxPowerSupplyFailure	1.3.6.1.4.1.2636.4.1.1	Alert	CHASSISD_SNMP_ TRAP
	jnxFanFailure	1.3.6.1.4.1.2636.4.1.2	Critical	CHASSISD_SNMP_ TRAP
	jnxOverTemperature	1.3.6.1.4.1.2636.4.1.3	Critical	CHASSISD_SNMP_ TRAP
	jnxFruRemoval	1.3.6.1.4.1.2636.4.1.5	Notice	CHASSISD_SNMP_ TRAP
	jnxFruInsertion	1.3.6.1.4.1.2636.4.1.6	Notice	CHASSISD_SNMP_ TRAP
	jnxFruPowerOff	1.3.6.1.4.1.2636.4.1.7	Notice	CHASSISD_SNMP_ TRAP
	jnxFruPowerOn	1.3.6.1.4.1.2636.4.1.8	Notice	CHASSISD_SNMP_ TRAP
	jnxFruFailed	1.3.6.1.4.1.2636.4.1.9	Warning	CHASSISD_SNMP_ TRAP
	jnxFruOffline	1.3.6.1.4.1.2636.4.1.10	Notice	CHASSISD_SNMP_ TRAP
	jnxFruOnline	1.3.6.1.4.1.2636.4.1.11	Notice	CHASSISD_SNMP_ TRAP
	jnxFruCheck	1.3.6.1.4.1.2636.4.1.12	Notice	CHASSISD_SNMP_ TRAP
	jnxPowerSupplyOK	1.3.6.1.4.1.2636.4.2.1	Critical	CHASSISD_SNMP_ TRAP
	jnxFanOK	1.3.6.1.4.1.2636.4.2.2	Critical	CHASSISD_SNMP_ TRAP
	jnxTemperatureOK	1.3.6.1.4.1.2636.4.2.3	Alert	CHASSISD_SNMP_ TRAP
Configuration Notifications				

Table 577: Enterprise-Specific SNMPv2 Traps Supported on QFX Series Standalone Switches and QFX Series Virtual Chassis *(continued)*

Source MIB	Trap Name	SNMP Trap OID	System Logging Severity Level	System Log Tag
Configuration Management MIB (mib-jnx-cfgmgmt)	jnxCmCfgChange	1.3.6.1.4.1.2636.4.5.0.1	–	–
	jnxCmRescueChange	1.3.6.1.4.1.2636.4.5.0.2	–	–
Remote Operations Notifications				
Ping MIB (mib-jnx-ping)	jnxPingRttThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.1	–	–
	jnxPingRttStdDevThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.2	–	–
	jnxPingRttJitterThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.3	–	–
	jnxPingEgressThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.4	–	–
	jnxPingEgressStdDevThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.5	–	–
	jnxPingEgressJitterThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.6	–	–
	jnxPingIngressThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.7	–	–
	jnxPingIngressStddevThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.8	–	–
	jnxPingIngressJitterThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.9	–	–
RMON Alarms				
RMON MIB (mib-jnx-rmon)	jnxRmonAlarmGetFailure	1.3.6.1.4.1.2636.4. 3.0.1	–	–
	jnxRmonGetOk	1.3.6.1.4.1.2636.4. 3.0.2	–	–

SNMP Traps Supported on QFabric Systems

QFabric systems support standard SNMPv2 traps and Juniper Networks enterprise-specific SNMPv2 traps.

NOTE: QFabric systems do not support SNMPv1 traps.

For more information, see:

- Table 578 on page 6063 for standard SNMPv2 traps
- Table 579 on page 6064 for Juniper Networks enterprise-specific SNMPv2 traps

Table 578: Standard SNMPv2 Traps Supported on QFabric Systems

Defined in	Trap Name	SNMP Trap OID	System Logging Severity Level	Syslog Tag
Link Notifications				
RFC 2863, *The Interfaces Group MIB*	linkDown	1.3.6.1.6.3.1.1.5.3	Warning	SNMP_TRAP_ LINK_DOWN
	linkUp	1.3.6.1.6.3.1.1.5.4	Info	SNMP_TRAP_ LINK_UP
Startup Notifications				
RFC 1907, *Management Information Base for Version 2 of the Simple Network Management Protocol (SNMPv2)*	coldStart	1.3.6.1.6.3.1.1.5.1	Critical	SNMPD_TRAP_ COLD_START
	warmStart	1.3.6.1.6.3.1.1.5.2	Error	SNMPD_TRAP_ WARM_START
	authenticationFailure	1.3.6.1.6.3.1.1.5.5	Notice	SNMPD_TRAP_ GEN_FAILURE

Table 579: Enterprise-Specific SNMPv2 Traps Supported on QFabric Systems

Source MIB	Trap Name	SNMP Trap OID	System Logging Severity Level	System Log Tag
Fabric Chassis MIB (mib-jnx-fabric-chassis)	**Fabric Chassis (Alarm Conditions) Notifications**			
	jnxFabricPowerSupplyFailure	1.3.6.1.4.1.2636.4.19.1	Warning	–
	jnxFabricFanFailure	1.3.6.1.4.1.2636.4.19.2	Critical	–
	jnxFabricOverTemperature	1.3.6.1.4.1.2636.4.19.3	Alert	–
	jnxFabricRedundancySwitchover	1.3.6.1.4.1.2636.4.19.4	Notice	–
	jnxFabricFruRemoval	1.3.6.1.4.1.2636.4.19.5	Notice	–
	jnxFabricFruInsertion	1.3.6.1.4.1.2636.4.19.6	Notice	–
	jnxFabricFruPowerOff	1.3.6.1.4.1.2636.4.19.7	Notice	–
	jnxFabricFruPowerOn	1.3.6.1.4.1.2636.4.19.8	Notice	–
	jnxFabricFruFailed	1.3.6.1.4.1.2636.4.19.9	Warning	–
	jnxFabricFruOffline	1.3.6.1.4.1.2636.4.19.10	Notice	–
	jnxFabricFruOnline	1.3.6.1.4.1.2636.4.19.11	Notice	–
	jnxFabricFruCheck	1.3.6.1.4.1.2636.4.19.12	Warning	–
	jnxFabricFEBSwitchover	1.3.6.1.4.1.2636.4.19.13	Warning	–
	jnxFabricHardDiskFailed	1.3.6.1.4.1.2636.4.19.14	Warning	–
	jnxFabricHardDiskMissing	1.3.6.1.4.1.2636.4.19.15	Warning	–
	jnxFabricBootFromBackup	1.3.6.1.4.1.2636.4.19.16	Warning	–
	Fabric Chassis (Alarm Cleared Conditions) Notifications			
	jnxFabricPowerSupplyOK	1.3.6.1.4.1.2636.4.20.1	Critical	–
	jnxFabricFanOK	1.3.6.1.4.1.2636.4.20.2	Critical	–
	jnxFabricTemperatureOK	1.3.6.1.4.1.2636.4.20.3	Alert	–
	jnxFabricFruOK	1.3.6.1.4.1.2636.4.20.4	–	–

Table 579: Enterprise-Specific SNMPv2 Traps Supported on QFabric Systems *(continued)*

Source MIB	Trap Name	SNMP Trap OID	System Logging Severity Level	System Log Tag
QFabric MIB (mib-jnx-qf-smi)	**QFabric MIB Notifications**			
	jnxQFabricDownloadIssued	1.3.6.1.4.1.2636.3.42.1.0.1	–	–
	jnxQFabricDownloadFailed	1.3.6.1.4.1.2636.3.42.1.0.2	–	–
	jnxQFabricDownloadSucceeded	1.3.6.1.4.1.2636.3.42.1.0.3	–	–
	jnxQFabricUpgradeIssued	1.3.6.1.4.1.2636.3.42.1.0.4	–	–
	jnxQFabricUpgradeFailed	1.3.6.1.4.1.2636.3.42.1.0.5	–	–
	jnxQFabricUpgradeSucceeded	1.3.6.1.4.1.2636.3.42.1.0.6	–	–
Configuration Notifications				
Configuration Management MIB (mib-jnx-cfgmgmt)	jnxCmCfgChange	1.3.6.1.4.1.2636.4.5.0.1	–	–
	jnxCmRescueChange	1.3.6.1.4.1.2636.4.5.0.2	–	–
Remote Operations Notifications				
Ping MIB (mib-jnx-ping)	jnxPingRttThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.1	–	–
	jnxPingRttStdDevThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.2	–	–
	jnxPingRttJitterThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.3	–	–
	jnxPingEgressThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.4	–	–
	jnxPingEgressStdDevThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.5	–	–
	jnxPingEgressJitterThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.6	–	–
	jnxPingIngressThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.7	–	–
	jnxPingIngressStddevThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.8	–	–
	jnxPingIngressJitterThreshold Exceeded	1.3.6.1.4.1.2636.4.9.0.9	–	–

Related Documentation

- *SNMP MIBs and Traps Reference*
- Understanding the Implementation of SNMP on page 6021
- Understanding the Implementation of SNMP on the QFabric System on page 6023
- SNMP MIBs Support on page 6038

MIB Objects for the QFX Series

This topic lists the Juniper Networks enterprise-specific SNMP Chassis MIB definition objects for the QFX Series:

QFX Series Standalone Switches

```
jnxProductLineQFXSwitch       OBJECT IDENTIFIER ::= { jnxProductLine      82 }
  jnxProductNameQFXSwitch       OBJECT IDENTIFIER ::= { jnxProductName      82 }
  jnxProductModelQFXSwitch      OBJECT IDENTIFIER ::= { jnxProductModel     82 }
  jnxProductVariationQFXSwitch  OBJECT IDENTIFIER ::= { jnxProductVariation 82 }
    jnxProductQFX3500s          OBJECT IDENTIFIER ::= { jnxProductVariationQFXSwitch 1 }
    jnxProductQFX360016QS       OBJECT IDENTIFIER ::= { jnxProductVariationQFXSwitch 2 }
    jnxProductQFX350048T4QS     OBJECT IDENTIFIER ::= { jnxProductVariationQFXSwitch 3 }
    jnxProductQFX510024Q        OBJECT IDENTIFIER ::= { jnxProductVariationQFXSwitch 4 }
    jnxProductQFX510048S6Q      OBJECT IDENTIFIER ::= { jnxProductVariationQFXSwitch 5 }

  jnxChassisQFXSwitch           OBJECT IDENTIFIER ::= { jnxChassis          82 }

  jnxSlotQFXSwitch              OBJECT IDENTIFIER ::= { jnxSlot             82 }
    jnxQFXSwitchSlotFPC         OBJECT IDENTIFIER ::= { jnxSlotQFXSwitch   1 }
    jnxQFXSwitchSlotHM          OBJECT IDENTIFIER ::= { jnxSlotQFXSwitch   2 }
    jnxQFXSwitchSlotPower       OBJECT IDENTIFIER ::= { jnxSlotQFXSwitch   3 }
    jnxQFXSwitchSlotFan         OBJECT IDENTIFIER ::= { jnxSlotQFXSwitch   4 }
    jnxQFXSwitchSlotFPB         OBJECT IDENTIFIER ::= { jnxSlotQFXSwitch   5 }

  jnxMediaCardSpaceQFXSwitch    OBJECT IDENTIFIER ::= { jnxMediaCardSpace   82 }
    jnxQFXSwitchMediaCardSpacePIC OBJECT IDENTIFIER ::= { jnxMediaCardSpaceQFXSwitch 1 }
```

QFabric Systems

```
jnxProductLineQFX3000        OBJECT IDENTIFIER ::= { jnxProductLine 84 }
  jnxProductNameQFX3000         OBJECT IDENTIFIER ::= { jnxProductName 84 }
  jnxProductModelQFX3000        OBJECT IDENTIFIER ::= { jnxProductModel 84 }
  jnxProductVariationQFX3000    OBJECT IDENTIFIER ::= { jnxProductVariation 84 }
   jnxProductQFX3000-G          OBJECT IDENTIFIER ::= { jnxProductVariationQFX3000 1 }
   jnxProductQFX3000-M          OBJECT IDENTIFIER ::= { jnxProductVariationQFX3000 2 }
  jnxChassisQFX3000             OBJECT IDENTIFIER ::= { jnxChassis          84 }
```

QFabric System QFX3100 Director Device

```
jnxProductLineQFX3100 OBJECT IDENTIFIER ::= { jnxProductLine      100 }
  jnxProductNameQFX3100 OBJECT IDENTIFIER ::= { jnxProductName      100 }
  jnxProductModelQFX3100 OBJECT IDENTIFIER ::= { jnxProductModel      100 }
  jnxProductVariationQFX3100  OBJECT IDENTIFIER ::= { jnxProductVariation 100 }
  jnxChassisQFX3100      OBJECT IDENTIFIER ::= { jnxChassis          100 }

  jnxSlotQFX3100             OBJECT IDENTIFIER ::= { jnxSlot             100 }
    jnxQFX3100SlotCPU        OBJECT IDENTIFIER ::= { jnxSlotQFX3100    1 }
    jnxQFX3100SlotMemory     OBJECT IDENTIFIER ::= { jnxSlotQFX3100    2 }
    jnxQFX3100SlotPower      OBJECT IDENTIFIER ::= { jnxSlotQFX3100    3 }
    jnxQFX3100SlotFan        OBJECT IDENTIFIER ::= { jnxSlotQFX3100    4 }
    jnxQFX3100SlotHardDisk   OBJECT IDENTIFIER ::= { jnxSlotQFX3100    5 }
    jnxQFX3100SlotNIC        OBJECT IDENTIFIER ::= { jnxSlotQFX3100    6 }
```

QFabric System QFX3008-I Interconnect Device

```
jnxProductLineQFXInterconnect OBJECT IDENTIFIER ::= { jnxProductLine      60 }
  jnxProductNameQFXInterconnect OBJECT IDENTIFIER ::= { jnxProductName      60 }
  jnxProductModelQFXInterconnect OBJECT IDENTIFIER ::= { jnxProductModel      60 }
  jnxProductVariationQFXInterconnect  OBJECT IDENTIFIER ::= { jnxProductVariation 60 }
    jnxProductQFX3008            OBJECT IDENTIFIER ::= { jnxProductVariationQFXInterconnect 1 }
jnxProductQFXC083008         OBJECT IDENTIFIER ::= { jnxProductVariationQFXInterconnect 2 }
    jnxProductQFX3008I           OBJECT IDENTIFIER ::= { jnxProductVariationQFXInterconnect 3 }

  jnxChassisQFXInterconnect      OBJECT IDENTIFIER ::= { jnxChassis          60 }

  jnxSlotQFXInterconnect         OBJECT IDENTIFIER ::= { jnxSlot             60 }
    jnxQFXInterconnectSlotFPC    OBJECT IDENTIFIER ::= { jnxSlotQFXInterconnect    1 }
    jnxQFXInterconnectSlotHM     OBJECT IDENTIFIER ::= { jnxSlotQFXInterconnect    2 }
    jnxQFXInterconnectSlotPower OBJECT IDENTIFIER ::= { jnxSlotQFXInterconnect    3 }
    jnxQFXInterconnectSlotFan    OBJECT IDENTIFIER ::= { jnxSlotQFXInterconnect    4 }
    jnxQFXInterconnectSlotCBD    OBJECT IDENTIFIER ::= { jnxSlotQFXInterconnect    5 }
    jnxQFXInterconnectSlotFPB    OBJECT IDENTIFIER ::= { jnxSlotQFXInterconnect    6 }

  jnxMediaCardSpaceQFXInterconnect     OBJECT IDENTIFIER ::= { jnxMediaCardSpace    60 }
    jnxQFXInterconnectMediaCardSpacePIC OBJECT IDENTIFIER ::= { jnxMediaCardSpaceQFXInterconnect 1 }

  jnxMidplaneQFXInterconnect     OBJECT IDENTIFIER ::= { jnxBackplane        60 }
```

QFabric System QFX3600-I Interconnect Device

```
jnxProductLineQFXMInterconnect OBJECT IDENTIFIER ::= { jnxProductLine      91 }
  jnxProductNameQFXMInterconnect OBJECT IDENTIFIER ::= { jnxProductName      91 }
  jnxProductModelQFXMInterconnect OBJECT IDENTIFIER ::= { jnxProductModel      91 }
  jnxProductVariationQFXMInterconnect  OBJECT IDENTIFIER ::= { jnxProductVariation 91 }
    jnxProductQFX3600I           OBJECT IDENTIFIER ::= { jnxProductVariationQFXMInterconnect 1 }

  jnxChassisQFXMInterconnect      OBJECT IDENTIFIER ::= { jnxChassis          91 }

  jnxSlotQFXMInterconnect         OBJECT IDENTIFIER ::= { jnxSlot             91 }
    jnxQFXMInterconnectSlotFPC    OBJECT IDENTIFIER ::= { jnxSlotQFXMInterconnect    1 }
    jnxQFXMInterconnectSlotHM     OBJECT IDENTIFIER ::= { jnxSlotQFXMInterconnect    2 }
    jnxQFXMInterconnectSlotPower OBJECT IDENTIFIER ::= { jnxSlotQFXMInterconnect    3 }
    jnxQFXMInterconnectSlotFan    OBJECT IDENTIFIER ::= { jnxSlotQFXMInterconnect    4 }
    jnxQFXMInterconnectSlotFPB    OBJECT IDENTIFIER ::= { jnxSlotQFXMInterconnect    5 }
```

```
  jnxMediaCardSpaceQFXMInterconnect    OBJECT IDENTIFIER ::= { jnxMediaCardSpace   91 }
    jnxQFXMInterconnectMediaCardSpacePIC OBJECT IDENTIFIER ::= { jnxMediaCardSpaceQFXMInterconnect 1 }
```

QFabric System Node Devices

```
jnxProductLineQFXNode       OBJECT IDENTIFIER ::= { jnxProductLine      61 }
  jnxProductNameQFXNode       OBJECT IDENTIFIER ::= { jnxProductName      61 }
  jnxProductModelQFXNode      OBJECT IDENTIFIER ::= { jnxProductModel     61 }
  jnxProductVariationQFXNode  OBJECT IDENTIFIER ::= { jnxProductVariation 61 }
    jnxProductQFX3500         OBJECT IDENTIFIER ::= { jnxProductVariationQFXNode 1 }
    jnxProductQFX360016Q      OBJECT IDENTIFIER ::= { jnxProductVariationQFXNode 3 }

  jnxChassisQFXNode           OBJECT IDENTIFIER ::= { jnxChassis          61 }

  jnxSlotQFXNode              OBJECT IDENTIFIER ::= { jnxSlot             61 }
    jnxQFXNodeSlotFPC         OBJECT IDENTIFIER ::= { jnxSlotQFXNode    1 }
    jnxQFXNodeSlotHM          OBJECT IDENTIFIER ::= { jnxSlotQFXNode    2 }
    jnxQFXNodeSlotPower       OBJECT IDENTIFIER ::= { jnxSlotQFXNode    3 }
    jnxQFXNodeSlotFan         OBJECT IDENTIFIER ::= { jnxSlotQFXNode    4 }
    jnxQFXNodeSlotFPB         OBJECT IDENTIFIER ::= { jnxSlotQFXNode    5 }

  jnxMediaCardSpaceQFXNode    OBJECT IDENTIFIER ::= { jnxMediaCardSpace   61 }
    jnxQFXNodeMediaCardSpacePIC OBJECT IDENTIFIER ::= { jnxMediaCardSpaceQFXNode 1 }
```

Related Documentation

- Understanding the Implementation of SNMP on the QFabric System on page 6023
- Fabric Chassis MIB on page 6026

System Logging

Overview of Junos OS System Log Messages

The Junos OS, running on the QFX Series, generates system log messages (also called *syslog messages*) to record events that occur on the switch, including the following:

- Routine operations, such as a user login into the configuration database.
- Failure and error conditions, such as failure to access a configuration file.
- Emergency or critical conditions, such as power-down of the switch due to excessive temperature.

Each system log message identifies the Junos OS process that generated the message and briefly describes the operation or error that occurred. For detailed information about specific system log messages, see the *Junos OS System Log Messages Reference*.

Related Documentation

- Junos OS System Log Configuration Statements on page 6127
- Junos OS Minimum System Logging Configuration on page 6126

Overview of Single-Chassis System Logging Configuration

The Junos OS system logging utility on the QFX Series is similar to the UNIX **syslogd** utility. This topic describes how to configure system logging for a single-chassis system that runs the Junos OS.

Each system log message belongs to a *facility*, which groups together related messages. Each message is also preassigned a *severity level*, which indicates how seriously the triggering event affects router functions. You always specify the facility and severity of the messages to include in the log. For more information, see "Specifying the Facility and Severity of Messages to Include in the Log" on page 6141.

You direct messages to one or more destinations by including the appropriate statement at the **[edit system syslog]** hierarchy level:

- To a named file in a local file system, by including the **file** statement. See "Directing System Log Messages to a Log File" on page 6128.
- To the terminal session of one or more specific users (or all users) when they are logged in to the switch, by including the **user** statement. See "Directing System Log Messages to a User Terminal" on page 6130.
- To the switch console, by including the **console** statement. See "Directing System Log Messages to the Console" on page 6130.
- To a remote machine that is running the **syslogd** utility, by including the **host** statement. See "Directing System Log Messages to a Remote Machine" on page 6129.

By default, messages are logged in a standard format, which is based on a UNIX system log format; for detailed information about message formatting, see the *Junos OS System Log Messages Reference*. You can alter the content and format of logged messages in the following ways:

- You can log messages to a file in structured-data format instead of the standard Junos OS format. Structured-data format provides more information without adding significant length, and makes it easier for automated applications to extract information from the message. For more information, see "Logging Messages in Structured-Data Format" on page 6134.
- A message's facility and severity level are together referred to as its *priority*. By default, the standard Junos OS format for messages does not include priority information (structured-data format includes a priority code by default). To include priority information in standard-format messages directed to a file or a remote destination, include the **explicit-priority** statement. For more information, see "Including Priority Information in System Log Messages" on page 6132.
- By default, the standard Junos OS format for messages specifies the month, date, hour, minute, and second when the message was logged. You can modify the timestamp on standard-format system log messages to include the year, the millisecond, or both. (Structured-data format specifies the year and millisecond by default.) For more information, see "Including the Year or Millisecond in Timestamps" on page 6134.

- When directing messages to a remote machine, you can specify the IP address that is reported in messages as their source. You can also configure features that make it easier to separate messages generated by Junos OS or messages generated on particular switches. For more information, see "Directing System Log Messages to a Remote Machine" on page 6129.
- The predefined facilities group together related messages, but you can also use regular expressions to specify more exactly which messages from a facility are logged to a file, a user terminal, or a remote destination. For more information, see "Using Regular Expressions to Refine the Set of Logged Messages" on page 6146.

NOTE: During a commit check, warnings about the **traceoptions** configuration (for example, mismatch in trace file sizes or number of trace files) are not displayed on the console. However, these warnings are logged in the system log messages when the new configuration is committed.

Related Documentation

- Examples: Configuring System Logging on page 6073
- Specifying the Facility and Severity of Messages to Include in the Log on page 6141
- Junos OS System Logging Facilities and Message Severity Levels on page 6141
- Directing System Log Messages to a Log File on page 6128
- Directing System Log Messages to a Remote Machine on page 6129
- Directing System Log Messages to a User Terminal on page 6130
- Directing System Log Messages to the Console on page 6130

Understanding the Implementation of System Log Messages on the QFabric System

This topic provides an overview of system log (syslog) messages as implemented on the QFabric system.

The QFabric system monitors events that occur on its component devices and distributes system log messages about those events to all external system log message servers (hosts) that are configured. Component devices may include Node devices, Interconnect devices, Director devices, and the Virtual Chassis. Messages are stored for viewing only in the QFabric system database. To view the messages, issue the **show log** command.

You configure system log messages by using the **host** and **file** statements at the **[edit system syslog]** hierarchy level. Use the **show log *filename*** operational mode command to view the messages.

NOTE: On the QFabric system, a syslog file named **messages** with a size of 100 MB is configured by default. If you do not configure a filename, you can use the default filename **messages** with the **show log *filename*** command.

All messages with a severity level of **notice** or higher are logged. Messages with a facility level of **interactive-commands** on Node devices are not logged.

The QFabric system supports the following system log message features:

- The **file *filename*** and **host *hostname*** statements at the **[edit system syslog]** hierarchy level are supported. Other statements at that hierarchy level are not supported.
- You can specify the maximum amount of data that is displayed when you issue the **show log *filename*** command by configuring the **file *filename* archive *maximum-file-size*** statement.
- You can specify that one or more system log message servers receive messages, which are sent to each server that is configured.
- If you configured an alias for a device or interface, the alias is displayed in the message for the device or interface.
- The level of detail that is included in a message depends on the facility and severity levels that are configured. Messages include the highest level of detail available for the configured facility and severity levels.
- The unit of time is is measured and displayed in seconds, and not milliseconds. If you attempt to configure the **time-format** option in milliseconds, the log output displays 000.

Starting in Junos OS Release 13.1, the QFabric system supports these additional syslog features:

- You can filter the output of the **show log *filename*** operational mode command by device type and device ID or device alias when you specify the ***device-type* (*device-id* | *device-alias*)** optional parameters. Device types include **director-device**, **infrastructure-device**, **interconnect-device**, and **node-device**.
- You can specify the syslog structured data output format when you configure the **structured-data** statement at the **[edit system syslog file *filename*]** and **[edit system syslog host *hostname*]** hierarchy levels.

  NOTE: Information displayed in the structured data output for system logs originating from the Director software may not be complete.

- You can filter the types of logs that the Director group collects from a component device when you configure the **filter all *facility severity*** or **filter all match "*regular-expression*"** statements at the **[edit system syslog]** hierarchy level.

Unsupported syslog features include:

- File access to syslog messages
- Monitoring of syslog messages

Related Documentation

- Example: Configuring System Log Messages on page 6076
- **syslog (QFabric System) on page 6315**

CHAPTER 67

Configuration

Configuration Examples

Examples: Configuring System Logging

The system log provides an excellent way of tracking all management activity on the switch by recording events such as user authentication, access authorization, and command execution. Logged command executions include commands entered by users at the CLI prompt or by client applications such as the Junos XML protocol or NETCONF XML client. Because system log files contain information about commands executed on the switch and the user who executed the commands, checking system log files for failed authentication events can help identify attempts to hack in to the switch. You can also analyze network activity by correlating executed commands with events and changes that occurred on the network at a particular time.

System log files are stored locally on the switch in the default **/var/log** directory.

The following example shows how to configure system log messages to record all commands entered by users and all authentication or authorization attempts. Logged commands include those entered by users at the CLI prompt and by client applications. Authentication and authorization attempts include events that are saved in the file named **cli-commands** and those that are sent to the terminal of a user who is logged in.

```
[edit system]
syslog {
   file cli-commands {
      interactive-commands info;
      authorization info;
   }
   user * {
      interactive-commands info;
      authorization info;
   }
}
```

The following example shows how to log all alarms state changes to the file **/var/log/alarms**:

```
[edit system]
syslog {
   file alarms {
      kernel warning;
   }
}
```

The following example shows how to configure the handling of messages of various types, as described in the comments. Information is logged to two files, to the terminal of user alex, to a remote machine, and to the console:

```
[edit system]
syslog {
   /* write all security-related messages to file /var/log/security */
   file security {
      authorization info;
      interactive-commands info;
   }
   /* write messages about potential problems to file /var/log/messages: */
   /* messages from &ldquo;authorization&rdquo; facility at level &ldquo;notice&rdquo;
      and above, */
   /* messages from all other facilities at level &ldquo;warning&rdquo; and above */
   file messages {
      authorization notice;
      any warning;
   }
   /* write all messages at level &ldquo;critical&rdquo; and above to terminal of user
      &ldquo;alex&rdquo; if */
   /* that user is logged in */
   user alex {
```



```
        any critical;
    }
    /* write all messages from the &ldquo;daemon&rdquo; facility at level &ldquo;info&rdquo;
        and above, and */
    /* messages from all other facilities at level &ldquo;warning&rdquo; and above, to the
        */
    /* machine monitor.mycompany.com */
    host monitor.mycompany.com {
        daemon info;
        any warning;
    }
    /* write all messages at level &ldquo;error&rdquo; and above to the system console */
    console {
        any error;
    }
}
```

The following example shows how to configure the handling of messages generated when users issue Junos OS CLI commands, by specifying the interactive-commands facility at the info, notice, and warning severity levels:

```
[edit system]
file user-actions {
    interactive-commands info;
    }
    user philip {
        interactive-commands notice;
    }
    console {
        interactive-commands warning;
    }
}
```

The following list describes the security levels used in the example:

- **info**—Logs a message when users issue any command at the CLI operational or configuration mode prompt. The example writes the messages to the file **/var/log/user-actions**.
- **notice**—Logs a message when users issue the configuration mode command **commit**. The example writes the messages to the terminal of user philip.
- **warning**—Logs a message when users issue a command that restarts a software process. The example writes the messages to the console.

Related Documentation

- Overview of Single-Chassis System Logging Configuration on page 6069

Examples: Assigning an Alternative Facility

This topic contains examples of configuring system log messages to use an alternative facility for logging.

The following example shows how to log all messages generated on the switch at the **error** level or higher to the **local0** facility on the remote host called **monitor.mycompany.com**:

```
[edit system syslog]
host monitor.mycompany.com {
  any error;
  facility-override local0;
}
```

The following example contains two sets of statements that show how to configure switches located in California and in New York to send messages to a single remote host called **central-logger.mycompany.com.** The messages from California are assigned to alternative facility **local0** and the messages from New York are assigned to alternative facility **local2**.

- The following statements configure the California switch to aggregate messages in the **local0** facility:

  ```
  [edit system syslog]
  host central-logger.mycompany.com {
    change-log info;
    facility-override local0;
  }
  ```

- The following statements configure the New York switch to aggregate messages in the **local2** facility:

  ```
  [edit system syslog]
  host central-logger.mycompany.com {
    change-log info;
    facility-override local2;
  }
  ```

On the remote host named **central-logger** you can subsequently configure the system logging utility to write messages from the **local0** facility to one file (for example, **california-config**) and the messages from the **local2** facility to another file (for example, **new-york-config**).

Related Documentation

- Junos OS System Log Alternate Facilities for Remote Logging on page 6143

Example: Configuring System Log Messages

The QFabric system monitors events that occur on its component devices and distributes system log messages about those events to all external system log message servers (hosts) that are configured. Component devices may include Node devices, Interconnect devices, Director devices, and the Virtual Chassis. Messages are stored for viewing only in the QFabric system database. To view the messages, issue the **show log** command.

This example describes how to configure system log messages on the QFabric system.

- Requirements on page 6077
- Overview on page 6077
- Configuration on page 6077

Requirements

This example uses the following hardware and software components:

- Junos OS Release 12.2
- QFabric system
- External servers that can be configured as system log message hosts

Overview

Component devices that generate system log message events may include Node devices, Interconnect devices, Director devices, and the control plane switches. The following configuration example includes these components in the QFabric system:

- Director software running on the Director group
- Control plane switches
- Interconnect device
- Multiple Node devices

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set system syslog host 10.1.1.12 any error
set system syslog file qflogs
set system syslog file qflogs structured-data brief
set system syslog file qflogs archive size 1g
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure system messages from the QFabric Director device:

1. Specify a host, any facility, and the **error** severity level.

   ```
   [edit system syslog]
   user@switch# set host 10.1.1.12 any error
   ```

NOTE: You can configure more than one system log message server (host). The QFabric system sends the messages to each server configured.

2. (Optional) Specify a filename to capture log messages.

NOTE: On the QFabric system, a syslog file named **messages** is configured implicitly with facility and severity levels of **any any** and a file size of 100 MBs. Therefore, you cannot specify the filename **messages** in your configuration, and automatic command completion does not work for that filename.

```
[edit system syslog]
user@switch# set file qflogs structured-data brief
user@switch# set file qflogs
```

3. (Optional) Configure the maximum size of your system log message archive file. This example specifies an archive size of 1 GB.

```
[edit system syslog]
user@switch# set file qflogs archive size 1g
```

Results

From configuration mode, confirm your configuration by entering the **show system** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@switch# show system
syslog {
  file qflogs {
  }
  host 10.1.1.12 {
    any error;
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Related Documentation

- Understanding the Implementation of System Log Messages on the QFabric System on page 6070
- syslog (QFabric System) on page 6315
- show log on page 846

Example: Monitoring Network Traffic Using sFlow Technology

The sFlow technology is a monitoring technology for high-speed switched or routed networks. sFlow monitoring technology collects samples of network packets and sends them in a UDP datagram to a monitoring station called a *collector*. You can configure sFlow technology on a QFX Series device to monitor traffic continuously at wire speed on all interfaces simultaneously. You must enable sFlow monitoring on each interface individually; you cannot globally enable sFlow monitoring on all interfaces with a single configuration statement. Junos OS fully supports the sFlow technology standard described in RFC 3176, *InMon Corporation's sFlow: A Method for Monitoring Traffic in Switched and Routed Networks*.

This example describes how to configure and use sFlow monitoring on a QFX3500 switch in standalone mode.

Requirements

This example uses the following hardware and software components:

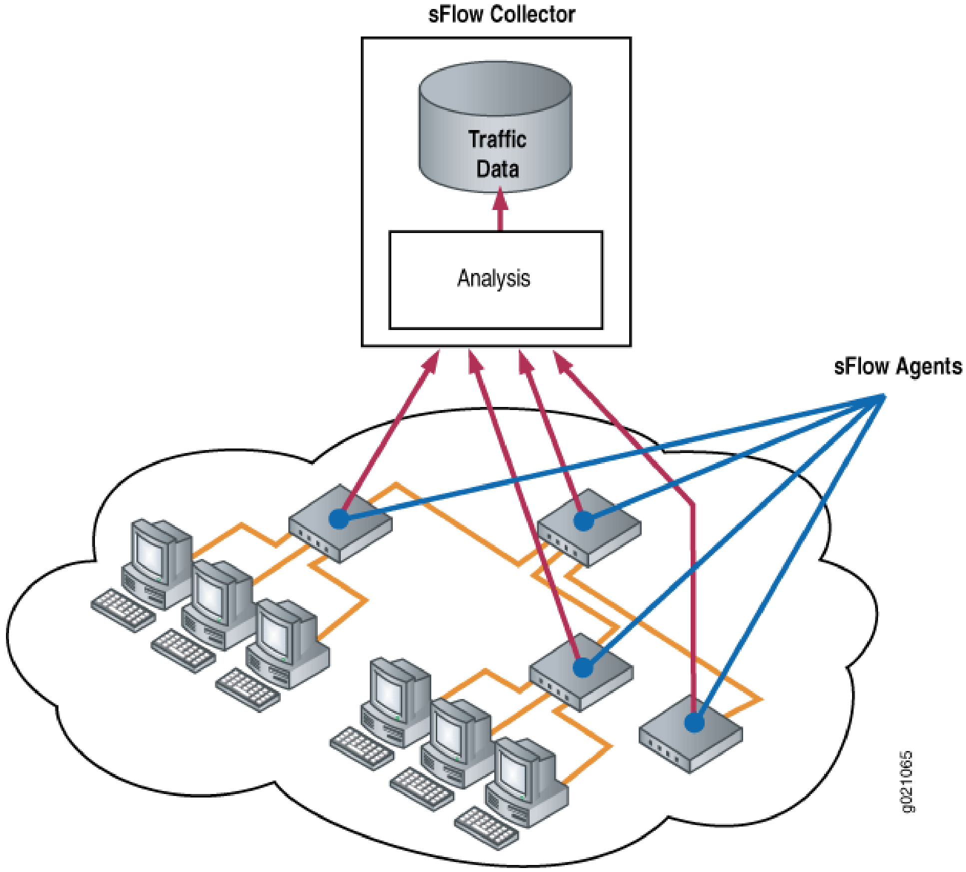
- Junos OS Release 11.3 or later
- One QFX3500 switch

Overview

An sFlow monitoring system consists of an sFlow agent embedded in the device and a centralized collector on the network. The two main activities of the sFlow agent are random sampling and statistics gathering. The sFlow agent combines interface counters and flow samples and sends them to the IP address and UDP destination port of the sFlow collector in UDP datagrams.

Figure 215 on page 6080 depicts the basic elements of an sFlow system.

Figure 215: sFlow Technology Monitoring System



Configuration

CLI Quick Configuration

To quickly configure sFlow technology, copy the following commands and paste them into the terminal window of the switch:

```
[edit protocols sflow]
set collector 10.204.32.46 udp-port 5600
set interfaces xe-0/0/1.0
set polling-interval 20
set sample-rate 1000
```

Step-by-Step Procedure

To configure sFlow features using the CLI:

1. Configure the IP address and UDP port of at least one collector:

   ```
   [edit protocols sflow]
   user@switch# set collector 10.204.32.46 udp-port 5600
   ```

   The default UDP port assigned is 6343.

2. Enable sFlow technology on a specific interface:

   ```
   [edit protocols sflow]
   user@switch# set interfaces xe-0/0/1.0
   ```

NOTE: You cannot enable sFlow technology on a Layer 3 VLAN-tagged interface.

You cannot enable sFlow technology on a LAG interface (for example, ae0), but you can enable sFlow technology on the member interfaces of the LAG (for example, xe-0/0/1).

3. Specify how often (in seconds) the sFlow agent polls all interfaces at the global level:

```
[edit protocols sflow]
user@switch# set polling-interval 20
```

NOTE: Specify 0 if you do not want to poll the interface.

4. Specify the rate at which packets must be sampled at the global level. The following example sets a sample rate of 1 in 1000 packets:

```
[edit protocols sflow]
user@switch# set sample-rate 1000
```

Results Check the results of the configuration:

```
[edit]
user@switch# show protocols
sflow {
  collector 10.204.32.46 {
    udp-port 5600;
  }
  interfaces xe-0/0/1.0 {
    polling-interval 20;
    sample-rate 1000;
  }
}
```

Verification

To confirm that the configuration is correct, perform these tasks:

- Verifying That sFlow Technology Has Been Configured Properly on page 6081
- Verifying That sFlow Technology Is Enabled on an Interface on page 6082
- Verifying the sFlow Collector Configuration on page 6082

Verifying That sFlow Technology Has Been Configured Properly

Purpose Verify that sFlow technology has been configured properly.

Action Enter the **show sflow** operational mode command:

```
user@switch> show sflow
```

```
sFlow            : Enabled
Sample limit     : 300 packets/second
Polling interval : 20 second
Sample rate      : 1:1000
Agent ID         : 10.1.1.2
```

NOTE: The sample limit cannot be configured and is set to 300 packets per second.

Meaning The output shows that sFlow technology is enabled and specifies the values for the sampling limit, polling interval, and sampling rate.

Verifying That sFlow Technology Is Enabled on an Interface

Purpose Verify that sFlow technology is enabled on interfaces and display the sampling parameters.

Action Enter the **show sflow interface** operational mode command:

```
user@switch> show sflow interface
Interface       Status      Sample     Polling
                             rate      interval
xe-0/0/1.0   Enabled       1000         20
```

Meaning The output indicates that sFlow technology is enabled on the **Node1:xe-0/0/1.0** interface on the Node device with a sampling rate of 1000 and a polling interval of 20 seconds.

Verifying the sFlow Collector Configuration

Purpose Verify the sFlow collector configuration.

Action Enter the **show sflow collector** operational mode command:

```
user@switch> show sflow collector
Collector        Udp-port     No. of samples
 address
10.204.32.46         5600           7516
```

Meaning The output displays the IP address of the collector, the UDP port, and the number of samples collected.

Related Documentation

- Configuring sFlow Technology on page 6108
- *Overview of sFlow Technology*

Example: Configuring SNMP

By default, SNMP is disabled on devices running Junos OS. This example describes the steps for configuring SNMP on the QFabric system.

- Requirements on page 6083
- Overview on page 6083
- Configuration on page 6083

Requirements

This example uses the following hardware and software components:

- Junos OS Release 12.2
- Network management system (NMS) (running the SNMP manager)
- QFabric system (running the SNMP agent) with multiple Node devices

Overview

Because SNMP is disabled by default on devices running Junos OS, you must enable SNMP on your device by including configuration statements at the **[edit snmp]** hierarchy level. At a minimum, you must configure the **community public** statement. The community defined as public grants read-only access to MIB data to any client.

If no **clients** statement is configured, all clients are allowed. We recommend that you always include the **restrict** option to limit SNMP client access to the switch.

The network topology in this example includes an NMS, a QFabric system with four Node devices, and external SNMP servers that are configured for receiving traps.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set snmp name “snmp qfabric” description “qfabric0 switch”
set snmp location “Lab 4 Row 11” contact “qfabric-admin@qfabric0”
set snmp community public authorization read-only
set snmp client-list list0 192.168.0.0/24
set snmp community public client-list-name list0
set snmp community public clients 192.170.0.0/24 restrict
set snmp trap-group “qf-traps” destination-port 155 targets 192.168.0.100
```


Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure SNMP on the QFabric system:

NOTE: **If the name, description, location, contact, or community name contains spaces, enclose the text in quotation marks (" ").**

1. Configure the SNMP system name:

   [edit snmp]
   user@switch# **set name “snmp qfabric”**

2. Specify a description.

   [edit snmp]
   user@switch# **set description “qfabric0 system”**

   This string is placed into the MIB II sysDescription object.

3. Specify the physical location of the QFabric system.

   [edit snmp]
   user@switch# **set location “Lab 4 Row 11”**

   This string is placed into the MIB II sysLocation object.

4. Specify an administrative contact for the SNMP system.

   [edit snmp]
   user@switch# **set contact “qfabric-admin@qfabric0”**

   This name is placed into the MIB II sysContact object.

5. Specify a unique SNMP community name and the read-only authorization level.

   NOTE: **The read-write option is not supported on the QFabric system.**

   [edit snmp]
   user@switch# **set community public authorization read-only**

6. Create a client list with a set of IP addresses that can use the SNMP community.

   [edit snmp]
   user@switch# **set client-list list0 192.168.0.0/24**
   user@switch# **set community public client-list-name list0**

7. Specify IP addresses of clients that are restricted from using the community.

   [edit snmp]
   user@switch# **set community public clients 192.170.0.0/24 restrict**

8. Configure a trap group, destination port, and a target to receive the SNMP traps in the trap group.


```
[edit snmp]
user@switch# set trap-group “qf-traps” destination-port 155 targets 192.168.0.100
```

NOTE: You do not need to include the **destination-port** statement if you use the default port 162.

The trap group qf-traps is configured to send traps to 192.168.0.100.

Results From configuration mode, confirm your configuration by entering the **show** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@switch# show
  snmp {
    name "snmp qfabric";
    description "qfabric0 system";
    location "Lab 4 Row 11";
    contact "qfabric-admin@qfabric0";
    client-list list0 {
      192.168.0.0/24;
    }
    community public {
      authorization read-only;
      clients {
        197.170.0.0/24 restrict;
      }
    }
    trap-group qf-traps {
      destination-port 155;
      targets {
        192.168.0.100;
      }
    }
  }
```

If you are done configuring the device, enter **commit** from configuration mode.

Related Documentation

- Understanding the Implementation of SNMP on the QFabric System on page 6023
- snmp on page 1334

Example: Configuring Network Analytics

This example shows how to configure network analytics which includes queue and traffic monitoring on a QFX3500 standalone switch.

NOTE: The configuration shown in this example is supported only on Junos OS Release 13.2X50-D15 and 13.2X51-D10.

Requirements

This example uses the following hardware and software components:

- A QFX3500 standalone switch
- A external streaming server to collect data
- Junos OS Release 13.2X50-D15 software
- TCP server software (for remote streaming servers)

Before you configure network analytics, be sure you have:

- Junos OS Release 13.2X50-D15 or later software installed and running on the QFX3500 switch
- (Optional for streaming servers) TCP server software set up for processing records separated by a newline character (\n) on the remote streaming server
- All other devices running

Overview

The network analytics feature provides visibility into the performance and behavior of the data center infrastructure. This feature collects data from the switch, analyzes the data using sophisticated algorithms, and captures the results in reports. Network administrators can use the reports to help troubleshoot problems, make decisions, and adjust resources as needed. You can enable network analytics by configuring queue and traffic statistics monitoring.

Topology

In this example, the QFX3500 switch is connected to an external server used for streaming statistics data.

Configuration

To configure network analytics, perform these tasks:

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
[edit]
set services analytics interfaces all queue-statistics
set services analytics interfaces all latency-threshold high 900 low 300
set services analytics interfaces xe-0/0/1 traffic-statistics
set services analytics queue-statistics file qstats1.qs files 3 size 10
set services analytics queue-statistics interval 10
set services analytics traffic-statistics file tstats1.ts files 3 size 10
set services analytics traffic-statistics interval 2
set services analytics streaming-servers address 10.94.198.11 port 50001 stream-format
  json stream-type queue-statistics
set services analytics streaming-servers address 10.94.198.11 port 50005 stream-format
  csv stream-type traffic-statistics
```

Configuring Queue and Traffic Statistics Monitoring

Step-by-Step Procedure

To configure queue and traffic monitoring on physical interfaces:

NOTE: You can configure queue and traffic monitoring on physical network interfaces only; logical interfaces and Virtual Chassis physical (VCP) interfaces are not supported.

NOTE: Disabling of the queue or traffic monitoring supersedes the configuration (enabling) of this feature. You disable monitoring by issuing the **no-queue-statistics** or **no-traffic-statistics** at the **[edit services analytics interfaces]** hierarchy level.

1. Configure all interfaces for queue monitoring and set the latency thresholds (in microseconds):

   ```
   [edit]
   set services analytics interfaces all queue-statistics
   set services analytics interfaces all latency-threshold high 900 low 300
   ```

2. Configure one interface for traffic monitoring:

   ```
   [edit]
   set services analytics interfaces xe-0/0/1 traffic-statistics
   ```

Configuring Local Statistics Files

Step-by-Step Procedure

To configure local statistics files:

1. Configure the number of queue statistics files, and each file size in MB:

   ```
   [edit]
   ```

set services analytics queue-statistics file qstats1.qs files 3 size 10m

2. Configure the queue statistics collection interval in milliseconds

   [edit]
   set services analytics queue-statistics interval 10

3. Configure the number of traffic statistics files, and each file size in MB:

   [edit]
   set services analytics traffic-statistics file tstats1.ts files 3 size 10m

4. Configure the traffic statistics collection interval in seconds:

   [edit]
   set services analytics traffic-statistics interval 2

Configuring Streaming Servers

Step-by-Step Procedure

To configure streaming servers for receiving monitoring data:

> NOTE: In addition to configuring streaming servers, you must also set up the TCP client software to process records that are separated by the newline character (\n) on the remote server.

1. Configure a server IP address and port for queue statistics monitoring:

   [edit]
   set services analytics streaming-servers address 10.94.198.11 port 50001 stream-format json stream-type queue-statistics

2. Configure a server IP address and port for traffic statistics monitoring:

   [edit]
   set services analytics streaming-servers address 10.94.198.11 port 50005 stream-format csv stream-type traffic-statistics

Results

Display the results of the configuration:

```
[edit services analytics]
user@switch> show configuration
  queue-statistics {
    file qstats1.qs size 10m files 3;
    interval 10;
  }
  traffic-statistics {
    file tstats1.ts size 10m files 3;
    interval 2;
  }
  interfaces {
    xe-0/0/1 {
      traffic-statistics;
    }
    all {
```

```
        queue-statistics;
        latency-threshold high 900 low 300;
      }
    }
```

Verification

Confirm that the configuration is correct and works as expected by performing these tasks:

Verifying the Network Analytics Configuration

Purpose Verify the configuration for network analytics.

Action From operational mode, enter the **show analytics configuration** command to display the traffic and queue monitoring configuration.

```
user@host> show analytics configuration
Global configurations:
   Traffic statistics: Auto, Poll interval: 2 seconds
   Queue statistics: Enabled, Poll interval: 10 milliseconds
   Depth threshold high: 0 bytes, low: 0 bytes
   Latency threshold high: 900 microseconds, low: 300 microseconds
Interface      Traffic       Queue        Depth-threshold      Latency-threshold
             Statistics    Statistics      High       Low         High       Low
                                              (bytes)             (microseconds)
xe-0/0/1      Enabled      Auto             0          0          900        300
```

Meaning The output displays information about traffic and queue monitoring on the switch.

Verifying the Network Analytics Status

Purpose Verify the network analytics operational status of the switch.

Action From operational mode, enter the **show analytics status** command to display the traffic and queue monitoring status.

```
user@host> show analytics status
Global configurations:
   Traffic statistics: Auto, Poll interval: 2 seconds
   Queue statistics: Auto, Poll interval: 10 milliseconds
   Depth threshold high: 1228800 bytes, low: 1024 bytes
   Latency threshold high: 900 microseconds, low: 300 microseconds
Interface     Traffic       Queue        Depth-threshold      Latency-threshold
            Statistics    Statistics      High      Low          High      Low
                                             (bytes)            (microseconds)
xe-0/0/1     Enabled       Auto          1228800   1024          900       300
xe-0/0/7     Auto          Auto          1228800   1024          900       300
xe-0/0/8     Auto          Auto          1228800   1024          900       300
```

Verifying Streaming Servers Configuration

Purpose Verify the configuration for streaming data to remote servers is working.

Action From operational mode, enter the **show analytics streaming-servers** command to display the streaming servers configuration.

```
user@host> show analytics streaming-servers
Address          Port     Stream-Format     Stream-Type   State         Sent
10.94.198.11     50001    json              QS            Established   1100
10.94.198.11     50005    csv               TS/QS         In Progress      0
```

Meaning The output displays information about the remote streaming server.

Verifying Queue Statistics

Purpose Verify that queue statistics collection is working.

Action From operational mode, enter the **show analytics queue-statistics** command to display the queue statistics.

```
user@host> show analytics queue-statistics
Time                Interface   Queue-length (bytes)   Latency (us)
Apr 6 0:17:18.224  xe-0/0/1            1043952            835
Apr 6 0:17:18.234  xe-0/0/1            1053520            842
Apr 6 0:17:18.244  xe-0/0/1            1055184            844
```

Meaning The output displays queue-statistics information as expected.

Verifying Traffic Statistics

Purpose Verify that traffic statistics collection is working.

Action From operational mode, enter the **show analytics traffic-statistics** command to display the traffic statistics.

```
user@host> show analytics traffic-statistics
Time: Apr 5 19:52:48.549, Physical interface: xe-0/0/1
  Traffic Statistics:                  Receive          Transmit
  Total octets:                  4797548752936      408886273632
  Total packet:                     5658257464        3190613435
  Octets per second:                         0                 0
  Packet per second:                         0                 0
  Octets dropped:                            0         252901000
  Packet dropped:                            0            252901
  Utilization:                            0.0%              0.0%
Time: Apr 5 19:52:48.549, Physical interface: xe-0/0/7
  Traffic Statistics:                  Receive          Transmit
  Total octets:                  4790866253100         477139024
  Total packet:                     5624473639            477944
  Octets per second:                         0                 0
  Packet per second:                         0                 0
  Octets dropped:                            0         166582000
  Packet dropped:                            0            166582
  Utilization:                            0.0%              0.0%
Time: Apr 5 19:52:48.549, Physical interface: xe-0/0/8
  Traffic Statistics:                  Receive          Transmit
  Total octets:                  4789797668456         764910024
  Total packet:                     5623280870            765715
  Octets per second:                         0                 0
  Packet per second:                         0                 0
  Octets dropped:                            0         156099000
  Packet dropped:                            0            156099
  Utilization:                            0.0%              0.0%
```

Meaning The output displays traffic-statistics information as expected.

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**
- **show analytics status on page 6360**
- **show analytics streaming-servers on page 6363**

Example: Configuring Enhanced Network Analytics Features

This example shows how to configure the enhanced network analytics feature, including queue and traffic monitoring, on a QFX5100 standalone switch.

Requirements

This example uses the following hardware and software components:

- A QFX5100 standalone switch
- A external streaming server to collect data
- Junos OS Release 13.2X51-D15 software
- TCP server software (for remote streaming servers)

Before you configure network analytics, be sure you have:

- Junos OS Release 13.2X51-D15 or later software installed and running on the QFX5100 switch.
- (Optional for streaming servers for the JSON, CSV, and TSV formats) TCP or UDP server software set up for processing records separated by a newline character (\n) on the remote streaming server.
- (Optional for streaming servers for the GPB format) TCP or UDP build streaming server using the **analytics.proto** file.
- All other network devices running.

Overview

The network analytics feature provides visibility into the performance and behavior of the data center infrastructure. This feature collects data from the switch, analyzes the data using sophisticated algorithms, and captures the results in reports. Network administrators can use the reports to help troubleshoot problems, make decisions, and adjust resources as needed.

You enable network analytics by first defining a resource profile template, and then applying the profile to the system (for a global configuration) or to individual interfaces.

NOTE: You can configure queue and traffic monitoring on physical network interfaces only; logical interfaces and Virtual Chassis physical (VCP) interfaces are not supported.

Disabling of the queue or traffic monitoring supersedes the configuration (enabling) of this feature. You disable monitoring by applying a resource profile that includes the **no-queue-monitoring** or **no-traffic-monitoring** configuration statement at the **[edit services analytics resource-profiles]** hierarchy level.

Topology

In this example, the QFX5100 switch is connected to an external server used for streaming statistics data.

Configuration

To configure the network analytics features, perform these tasks:

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
[edit]
set services analytics resource system polling-interval queue-monitoring 1000
set services analytics resource system polling-interval traffic-monitoring 5
set services analytics collector local file an.stats
set services analytics collector local file an files 3
set services analytics collector local file an size 10m
set services analytics resource-profiles sys-rp queue-monitoring
set services analytics resource-profiles sys-rp traffic-monitoring
set services analytics resource-profiles sys-rp depth threshold high 999999 low 99
set services analytics resource system resource-profile sys-rp
set services analytics resource-profiles if-rp queue-monitoring
set services analytics resource-profiles if-rp traffic-monitoring
set services analytics resource-profiles if-rp latency-threshold high 2300 low 20
set services analytics resource interfaces xe-0/0/16 resource-profile if-rp
set services analytics resource interfaces xe-0/0/18 resource-profile if-rp
set services analytics resource interfaces xe-0/0/19 resource-profile if-rp
set services analytics export-profiles ep stream-format gpb
set services analytics export-profiles ep interface information
set services analytics export-profiles ep interface statistics queue
set services analytics export-profiles ep interface statistics traffic
set services analytics export-profiles ep interface status link
set services analytics export-profiles ep system information
set services analytics export-profiles ep system status queue
set services analytics export-profiles ep system status traffic
set services analytics collector address 10.94.198.11 port 50001 transport tcp export-profile
  ep
set services analytics collector address 10.94.184.25 port 50013 transport udp
  export-profile ep
```

Configuring the Polling Interval for Queue and Traffic Monitoring

Step-by-Step Procedure

To configure the polling interval queue and traffic monitoring globally:

1. Configure the queue monitoring polling interval (in milliseconds) for the system:

   ```
   [edit]
   set services analytics resource system polling-interval queue-monitoring 1000
   ```

2. Configure the traffic monitoring polling interval (in seconds) for the system:


```
[edit]
set services analytics resource system polling-interval traffic-monitoring 5
```

Configuring a Local Statistics File

Step-by-Step Procedure

To configure a file for local statistics collection:

1. Configure the filename:

   ```
   [edit]
   set services analytics collector local file an.stats
   ```

2. Configure the number of files:

   ```
   [edit]
   set services analytics collector local file an files 3
   ```

3. Configure the file size:

   ```
   [edit]
   set services analytics collector local file an size 10m
   ```

Configuring and Applying a Resource Profile for the System

Step-by-Step Procedure

To define a resource profile template for queue and traffic monitoring resources:

1. Configure a resource profile and enable queue monitoring:

   ```
   [edit]
   set services analytics resource-profiles sys-rp queue-monitoring
   ```

2. Enable traffic monitoring in the profile:

   ```
   [edit]
   set services analytics resource-profiles sys-rp traffic-monitoring
   ```

3. Configure the depth-threshold (high and low values) for queue monitoring in the profile:

   ```
   [edit]
   set services analytics resource-profiles sys-rp depth threshold high 999999 low 99
   ```

4. Apply the resource profile template to the system resource type for a global configuration:

   ```
   [edit]
   set services analytics resource system resource-profile sys-rp
   ```

Configuring and Applying a Resource Profile for an Interface

Step-by-Step Procedure

You can configure queue and traffic monitoring for one or more specific interfaces. The interface-specific configuration supersedes the global (system) configuration. To define a resource profile template for queue and traffic monitoring resources for an interface:

1. Configure a resource profile and enable queue monitoring:

   ```
   [edit]
   set services analytics resource-profiles if-rp queue-monitoring
   ```

2. Enable traffic monitoring in the profile:

[edit]
set services analytics resource-profiles if-rp traffic-monitoring

3. Configure the latency-threshold (high and low values) for queue monitoring in the profile:

   [edit]
   set services analytics resource-profiles if-rp latency-threshold high 2300 low 20

4. Apply the resource profile template to the interfaces resource type for specific interfaces:

   [edit]
   set services analytics resource interfaces xe-0/0/16 resource-profile if-rp
   set services analytics resource interfaces xe-0/0/18 resource-profile if-rp
   set services analytics resource interfaces xe-0/0/19 resource-profile if-rp

Configuring an Export Profile and Collector for Streaming Data

Step-by-Step Procedure

To configure a collector (streaming server) for receiving monitoring data:

1. Create an export profile and specify the stream format:

   [edit]
   set services analytics export-profiles ep stream-format gpb

2. Configure the export profile to include interface information:

   [edit]
   set services analytics export-profiles ep interface information

3. Configure the export profile to include interface queue statistics:

   [edit]
   set services analytics export-profiles ep interface statistics queue

4. Configure the export profile to include interface traffic statistics:

   [edit]
   set services analytics export-profiles ep interface statistics traffic

5. Configure the export profile to include interface status link information:

   [edit]
   set services analytics export-profiles ep interface status link

6. Configure the export profile to include system information:

   [edit]
   set services analytics export-profiles ep system information

7. Configure the export profile to include system queue status:

   [edit]
   set services analytics export-profiles ep system status queue

8. Configure the export profile to include system traffic status:

   [edit]
   set services analytics export-profiles ep system status traffic

9. Configure the transport protocol for the collector addresses and apply an export profile:


```
[edit]
set services analytics collector address 10.94.198.11 port 50001 transport tcp
  export-profile ep
set services analytics collector address 10.94.184.25 port 50013 transport udp
  export-profile ep
```

NOTE: If you configure the **tcp** or **udp** option for the JSON, CSV, and TSV formats, you must also set up the TCP or UDP client software on the remote collector to process records that are separated by the newline character (\n) on the remote server.

If you configure the **tcp** or **udp** option for the GPB format, you must also set up the TCP or UDP build streaming server using the **analytics.proto** file.

Results Display the results of the configuration:

```
[edit services analytics]
user@switch# run show configuration
collector {
  local {
    file an.stats {
      size 10m;
      files 3;
    }
  }
  address 10.94.198.11 {
    port 50001 {
      transport tcp {
        export-profile ep;
      }
    }
  }
  address 10.94.184.25 {
    port 50013 {
      transport tcp {
        export-profile ep;
      }
    }
  }
}
export-profiles {
  ep {
    stream-format gpb;
      interface {
      information;
      statistics {
        queue;
        traffic;
      }
      status {
```



```
                link;
                queue;
                traffic;
            }
        }
        system {
            information;
            status {
                queue;
                traffic;
            }
        }
    }
}
resource {
    interfaces {
        xe-0/0/16 {
            resource-profile if-rp;
        }
        xe-0/0/18 {
            resource-profile if-rp;
        }
        xe-0/0/19 {
            resource-profile if-rp;
        }
    }
    system {
        polling-interval {
            queue-monitoring 1000;
            traffic-monitoring 5;
        }
        resource-profile sys-rp;
    }
}
resource-profiles {
    if-rp {
        latency-threshold {
            high 2300;
            low 20;
        }
        queue-monitoring;
        traffic-monitoring;
    }
    sys-rp {
        depth-threshold {
            high 99999;
            low 99;
        }
        queue-monitoring;
        traffic-monitoring;
    }
}
```


Verification

Confirm that the configuration is correct and works as expected by performing these tasks:

- Verifying the Network Analytics Configuration on page 6098
- Verifying the Network Analytics Status on page 6098
- Verifying the Collector Configuration on page 6099
- Verifying Queue Statistics on page 6099
- Verifying Traffic Statistics on page 6100

Verifying the Network Analytics Configuration

Purpose Verify the configuration for network analytics.

Action From operational mode, enter the **show analytics configuration** command to display the traffic and queue monitoring configuration.

```
user@host> show analytics configuration
Traffic monitoring polling interval : 5 seconds
Queue monitoring status is enabled
Queue monitoring polling interval : 1000 milliseconds
Queue depth high threshold : 1000000000 bytes
Queue depth low threshold : 99 bytes
Queue latency high threshold : 2300 nanoseconds
Queue latency low threshold : 20 nanoseconds

Interface      Traffic       Queue        Queue depth                 Latency
             Statistics    Statistics      threshold                 threshold
                                          High          Low       High       Low
                                             (bytes)              (nanoseconds)
xe-0/0/16    n/a           enabled        n/a           n/a       2300       20
xe-0/0/18    n/a           enabled        n/a           n/a       2300       20
xe-0/0/19    n/a           enabled        n/a           n/a       2300       20
```

Meaning The output displays the traffic and queue monitoring configuration information on the switch.

Verifying the Network Analytics Status

Purpose Verify the network analytics operational status of the switch.

Action From operational mode, enter the **show analytics status global** command to display global traffic and queue monitoring status.

```
user@host> show analytics status global
Traffic monitoring status is auto
Traffic monitoring polling interval : 5 seconds
Queue monitoring status is enabled
Queue monitoring polling interval : 1000 milliseconds
Queue depth high threshold : 1000000000 bytes
Queue depth low thresdhold : 99 bytes
```

From operational mode, enter the **show analytics status** command to display both the interface and global queue monitoring status.

```
user@host> show analytics status
Traffic monitoring status is auto
Traffic monitoring polling interval : 5 seconds
Queue monitoring status is enabled
Queue monitoring polling interval : 1000 milliseconds
Queue depth high threshold : 1000000000 bytes
Queue depth low thresdhold : 99 bytes

Interface     Traffic       Queue        Queue depth          Latency
            Statistics    Statistics      threshold          threshold
                                        High        Low      High      Low
                                           (bytes)           (nanoseconds)
xe-0/0/16     enabled     enabled       1000000000  99       n/a       n/a
xe-0/0/18     disabled    enabled       1000000000  99       n/a       n/a
xe-0/0/19     enabled     enabled       1000000000  99       n/a       n/a
```

Meaning The output displays the global and interface status of traffic and queue monitoring on the switch.

Verifying the Collector Configuration

Action Verify the configuration for the collector for streamed data is working.

From operational mode, enter the **show analytics collector** command to display the streaming servers configuration.

```
user@host> show analytics collector
Address         Port   Transport  Stream format  State            Sent
10.94.184.25    50013  udp        gpb            n/a              8710
10.94.198.11    50001  tcp        gpb            Not initialized  0
```

Meaning The output displays the collector configuration.

Verifying Queue Statistics

Purpose Verify that queue statistics collection is working.

Action From operational mode, enter the **show analytics queue-statistics** command to display the queue statistics.

```
user@host> show analytics queue-statistics
CLI issued at 2014-01-07 17:20:29.978561
Time                       Interface        Queue-depth        Latency
                                            (bytes)            (nanoseconds)
00:00:00.870058 ago        xe-0/0/19        1369680            1095744
00:00:01.875049 ago        xe-0/0/19        1381952            1105561
00:00:02.875053 ago        xe-0/0/19        1387776            1110220
00:00:03.876047 ago        xe-0/0/19        1387568            1110054
00:00:04.873045 ago        xe-0/0/19        1388192            1110553
00:00:05.871044 ago        xe-0/0/19        1385904            1108723
00:00:06.873354 ago        xe-0/0/19        1371552            1097241
```

Meaning The output displays queue-statistics information, with the latest record at the top of the report.

Verifying Traffic Statistics

Purpose Verify that traffic statistics collection is working.

Action From operational mode, enter the **show analytics traffic-statistics** command to display the traffic statistics.

```
user@host> show analytics traffic-statistics
CLI issued at 2014-01-07 17:22:28.952677
Time: 00:00:03.480244 ago, Physical interface: xe-0/0/19
  Traffic Statistics:                   Receive                Transmit
  Total octets:                   3929946593792         393001011519232
  Total packets:                    30702707784           3070320402462
  Unicast packet:                   30702707784           3070320402462
  Multicast packets:                          0                       0
  Broadcast packets:                          0                       0
  Octets per second:                   86407016                59044064
  Packets per second:                     84787                 8469688
  Octets dropped:                             0         392986110751744
  Packets dropped:                            0           3070203990248
```

Meaning The output displays traffic-statistics information.

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176
- show analytics status on page 6360
- show analytics streaming-servers on page 6363

Configuration Tasks for Network Management

Configuring Console and Auxiliary Port Properties

The console port and auxiliary port on a switch provide out-of-band remote access to the switch. You can configure the console and auxiliary ports so that an external data terminal may be connected to the switch. The console port is enabled by default, and its speed is 9600 baud. The auxiliary port is disabled by default.

By default, terminal connections to the console and auxiliary ports are secure. When you configure the console and auxiliary ports as insecure, root logins are not allowed to establish terminal connections, and superusers and anyone with a user identifier (UID) of 0 are not allowed to establish terminal connections in multiuser mode.

To configure the console and auxiliary port properties on the switch:

1. To specify that the console port session should terminate if the connection to the data carrier is lost:

   ```
   [edit system ports]
   user@switch# set console log-out-on-disconnect
   ```

2. To specify the auxiliary port terminal type:

   ```
   [edit system ports]
   user@switch# set auxiliary type (ansi | small-xterm | vt100 | xterm)
   ```

   For example, to specify the auxiliary port terminal type of **xterm** with a display of 80 columns by 65 rows:

   ```
   [edit system ports]
   user@switch# set auxiliary type xterm
   ```

3. To check the configuration:

   ```
   [edit system ports]
   user@switch# show
   console log-out-on-disconnect;
   auxiliary type xterm;
   ```

Related Documentation

- auxiliary on page 231
- console (Physical Port) on page 240
- ports on page 272

Configuring SSH Service for Remote Access to the Router or Switch

To configure the router or switch to accept SSH as an access service, include the **ssh** statement at the **[edit system services]** hierarchy level:

```
[edit system services]
ssh {
   ciphers [ cipher-1 cipher-2 cipher-3 ...]
   client-alive-count-max number;
   client-alive-interval seconds;
   connection-limit limit;
   hostkey-algorithm <algorithm | no-algorithm>;
   key-exchange algorithm;
   macs algorithm;
   max-sessions-per-connection number;
   no-tcp-forwarding;
   protocol-version [v1 v2] ;
   rate-limit limit;
   root-login <allow | deny | deny-password>;
}
```

By default, the router or switch supports a limited number of simultaneous SSH sessions and connection attempts per minute. Use the following statements to change the defaults:

- **connection-limit** *limit*—Maximum number of simultaneous connections per protocol (IPV4 and IPv6). The range is a value from 1 through 250. The default is 75. When you configure a connection limit, the limit is applicable to the number of SSH sessions per protocol (IPv4 and IPv6). For example, a connection limit of 10 allows 10 IPv6 SSH sessions and 10 IPv4 SSH sessions.
- **max-sessions-per-connection** *number*—Include this statement to specify the maximum number of SSH sessions allowed per single SSH connection. This allows you to limit the number of cloned sessions tunneled within a single SSH connection. The default value is 10.
- **rate-limit** *limit*—Maximum number of connection attempts accepted per minute (a value from 1 through 250). The default is 150. When you configure a rate limit, the limit is applicable to the number of connection attempts per protocol (IPv4 and IPv6). For example, a rate limit of 10 allows 10 IPv6 SSH session connection attempts per minute and 10 IPv4 SSH session connection attempts per minute.

For information about other configuration settings, see the following topics:

- Configuring the Root Login Through SSH on page 6102
- Configuring the SSH Protocol Version on page 6103
- Configuring the Client Alive Mechanism on page 6103

Configuring the Root Login Through SSH

By default, users are allowed to log in to the router or switch as **root** through SSH. To control user access through SSH, include the **root-login** statement at the **[edit systems services ssh]** hierarchy level:

```
[edit system services ssh]
root-login (allow | deny | deny-password);
```

allow—Allows users to log in to the router or switch as root through SSH. The default is **allow**.

deny—Disables users from logging in to the router or switch as root through SSH.

deny-password—Allows users to log in to the router or switch as root through SSH when the authentication method (for example, RSA) does not require a password.

Configuring the SSH Protocol Version

By default, both version 1 and version 2 of the SSH protocol are enabled. To configure the router or switch to use only version 1 of the SSH protocol, include the **protocol-version** statement and specify **v1** at the **[edit system services ssh]** hierarchy level:

```
[edit system services ssh]
protocol-version [ v1 ];
```

To configure the router or switch to use only version 2 of the SSH protocol, include the **protocol-version** statement and specify **v2** at the **[edit system services ssh]** hierarchy level:

```
[edit system services ssh]
protocol-version [ v2 ];
```

To explicitly configure the router or switch to use version 1 and 2 of the SSH protocol, include the **protocol-version** statement and specify **v1** and **v2** at the **[edit system services ssh]** hierarchy level:

```
[edit system services ssh]
protocol-version [ v1 v2 ];
```

For J Series Services Routers, the export license software supports SSH version 1 only.

Configuring the Client Alive Mechanism

The client alive mechanism is valuable when the client or server depends on knowing when a connection has become inactive. It differs from the standard keepalive mechanism because the client alive messages are sent through the encrypted channel. The client alive mechanism is not enabled at default. To enable it, configure the **client-alive-count-max** and the **client-alive-interval**. This option applies to SSH protocol version 2 only.

In the following example, unresponsive SSH clients will be disconnected after approximately 100 seconds (20 x 5).

```
[edit system services ssh]
client-alive-count-max 5;
client-alive-interval 20;
```

Configuring Telnet Service for Remote Access to a Switch

Telnet provides unencrypted access to network devices. Configuring Telnet service for a switch enables in-band remote access to the switch.

By default, the switch supports a limited number of simultaneous Telnet sessions and connection attempts per minute. Optionally, you can change the default Telnet settings by configuring the connection limit and rate limit at the **[edit system services telnet]** hierarchy level.

The connection limit is the maximum number of simultaneous connections per protocol (IPv4). The range is from **1** through **250**. The default is **75**.

The rate limit is the maximum number of connection attempts accepted per minute per protocol. The range is from **1** through **250**. The default is **150**.

To configure Telnet service:

1. To specify the connection limit:

   [edit system services]
   user@switch# **set telnet connection-limit** *connection-limit*

2. To specify the rate limit:

   [edit system services]
   user@switch# **set telnet rate-limit** *rate-limit*

3. Check that the Telnet connection limit and rate limit show the values you specified:

```
[edit system services]
user@switch# show
  telnet {
    connection-limit 50;
    rate-limit 100;
  }
```

Related Documentation

- Understanding Telnet on the QFabric System on page 5979
- Limiting the Number of User Login Attempts for SSH and Telnet Sessions on page 1250
- Example: Limiting the Number of Login Attempts for SSH and Telnet Sessions on page 1271

Configuration Tasks for Automation

Invoking the Python Interpreter

The Python interpreter is available by default with Junos operating system (Junos OS) software. You can invoke Python by entering the **python** command at the shell script.

To invoke the Python interpreter:

1. Start the shell interface:

   `user@switch>` **start shell**

2. Enter the **python** command without any parameters:

   `%` **python**

NOTE: The Python interpreter is designated with the prompt >>> at the beginning of a line or ... to indicate the continuation of a line.

Related Documentation

- Overview of Python with QFX5100 Switch Automation Enhancements on page 5983
- Overview of QFX5100 Switch Automation Enhancements on page 5981
- *Installing Junos OS Software with QFX5100 Switch Automation Enhancements*
- QFX5100 Switch with Automation Enhancements Frequently Asked Questions on page 6415

Controlling the Execution of Commit Scripts

This document describes the tasks that affect the way commit scripts are executed. In the QFabric system, commit scripts are stored in the in the **/pbdata/mgd_shared/*partition-ip*/var/db/scripts/commit** directory that is shared among Director devices in a Director group.

To determine which commit scripts are currently enabled on the QFabric system, use the **show** command to display the files included at the **[edit system scripts commit]** hierarchy level. To ensure that the enabled files are on the device, list the contents of the **/pbdata/mgd_shared/*partition-ip*/var/db/scripts/commit** directory using the **file list** operational mode command.

See the following tasks:

- Enabling Commit Scripts to Execute on page 6105
- Removing Commit Scripts from the Configuration on page 6106
- Deactivating Commit Scripts on page 6107
- Activating Inactive Commit Scripts on page 6107

Enabling Commit Scripts to Execute

The commit operation requires that all scripts be included in configuration at the **[edit system scripts commit file]** hierarchy level for all QFabric Director devices.

If you need to temporarily remove a script from a commit operation but do not want to remove it from the configuration permanently, you may configure the **optional** statement at the **[edit system scripts commit file *filename*]** hierarchy level to enable the commit operation to succeed even if a script is missing from the commit script directory.

CAUTION: When you include the **optional** statement at the **[edit system scripts commit file *filename*]** hierarchy level, no error message is generated during the commit operation if the file does not exist. As a result, you might not be aware that a script has not been executed as expected.

The filename of a commit script written in SLAX must include the **.slax** extension for the script to be executed.

To enable a commit script to execute during a commit operation:

1. Ensure that the commit script is located in the correct directory: **/pbdata/mgd_shared/*partition-ip*/var/db/scripts/commit** directory on the Director device.
2. Configure the commit script.

   ```
   [edit system scripts commit]
   user@switch# set file filename <optional>
   ```

3. Commit the configuration.

   ```
   [edit system scripts commit]
   user@switch# top
   [edit]
   user@switch# commit
   ```

Removing Commit Scripts from the Configuration

You can prevent commit scripts from executing during a commit operation by removing the scripts from the commit directory in the configuration.

NOTE: You can also deactivate a script using the **deactivate** statement instead of removing it from the configuration. Deactivated scripts may be reactivated later.

To prevent a commit script from executing during a commit operation:

1. Delete the commit script file from the commit directory in the configuration.

   ```
   [edit system scripts commit]
   user@switch# delete file filename
   ```

2. Commit the configuration.

   ```
   [edit system scripts commit]
   user@switch# top
   [edit]
   user@switch# commit
   ```

3. Remove the commit script from the **/pbdata/mgd_shared/** directory on the Director device.

   BEST PRACTICE: Although removing the commit script is not necessary, we recommend deleting unused files from the system.

Deactivating Commit Scripts

Deactivating a commit script results in its being marked as inactive in the configuration. The script is not executed during the commit operation, but you can reactivate the script by using the **activate** statement.

To deactivate the commit script:

1. Deactivate the script.

   [edit]
   user@switch **deactivate system scripts commit file** ***filename***

2. Commit your changes.

   [edit]
   user@switch# **commit**

3. Verify that the commit script is deactivated.

   [edit]
   user@switch# **show system scripts commit**
   inactive: file mycommit.slax

Activating Inactive Commit Scripts

Deactivating a commit script results in its being marked as inactive in the configuration and is therefore not executed during the commit operation.

To activate an inactive commit script:

1. Activate the script.

   [edit]
   user@switch# **activate system scripts commit file** ***filename***

2. Commit your changes.

   [edit]
   user@switch# **commit**

Configuration Tasks for sFlow Technology

• Configuring sFlow Technology on page 6108

Configuring sFlow Technology

The sFlow technology is a monitoring technology for high-speed switched or routed networks. sFlow monitoring technology collects samples of network packets and sends them in a UDP datagram to a monitoring station called a *collector*. You can configure sFlow technology on a QFX Series device to monitor traffic continuously at wire speed on all interfaces simultaneously. You must enable sFlow monitoring on each interface individually; you cannot globally enable sFlow monitoring on all interfaces with a single configuration statement. Junos OS fully supports the sFlow technology standard described in RFC 3176, *InMon Corporation's sFlow: A Method for Monitoring Traffic in Switched and Routed Networks*.

On the QFabric system, the sFlow monitoring global configuration that is defined on the Director device is distributed to Node groups that have sFlow sampling configured on the interfaces.

To configure sFlow features using the CLI:

1. Configure the IP address and UDP port of at least one collector:

   ```
   [edit protocols sflow]
   user@host# set collector ip-address udp-port port-number
   ```

   The default UDP port assigned is 6343.

2. Enable sFlow technology on a specific interface:

   ```
   [edit protocols sflow]
   user@host# set interfaces interface-name
   ```

   NOTE: You cannot enable sFlow technology on a Layer 3 VLAN-tagged interface.

   You cannot enable sFlow technology on a LAG interface (for example ae0), but you can enable sFlow technology on the member interfaces of the LAG (for example, xe-0/0/1).

3. Specify how often (in seconds) the sFlow agent polls all interfaces at the global level:

   ```
   [edit protocols sflow]
   user@host# set polling-interval seconds
   ```

   NOTE: Specify 0 if you do not want to poll the interface.

4. Specify the rate at which packets are sampled at the global level. For example, configuring a ***number*** of 1000 sets a sample rate of 1 in 1000 packets.

   ```
   [edit protocols sflow]
   user@host# set sample-rate number
   ```

5. (Optional) You can also configure the polling interval and sample rate at the interface level:

   ```
   [edit protocols sflow]
   ```



```
user@host# set interfaces interface-name polling-interval seconds sample-rate number
```

NOTE: The interface-level configuration overrides the global configuration for the specified interface.

Related Documentation

- Example: Monitoring Network Traffic Using sFlow Technology on page 6079
- *Overview of sFlow Technology*

Configuration Tasks for SNMP

Configuring SNMP

SNMP is implemented in the Junos OS Software running on the QFX Series products. By default, SNMP is not enabled. To enable SNMP, you must include the SNMP configuration statements at the **[edit]** hierarchy level.

To configure the minimum requirements for SNMP, include the following statements at the **[edit]** hierarchy level of the configuration:

```
[edit]
snmp {
  community public;
}
```

To configure complete SNMP features, include the following statements at the **[edit]** hierarchy level of the configuration:

```
snmp {
  client-list client-list-name {
    ip-addresses;
  }
```

```
community community-name {
  authorization authorization;
  client-list-name client-list-name;
  clients {
    address restrict;
  }
  logical-system logical-system-name {
    routing-instance routing-instance-name {
      clients {
      addresses;
      }
    }
  }
  routing-instance routing-instance-name {
    clients {
    addresses;
    }
  }
  view view-name;
}
contact contact;
description description;
filter-duplicates;
filter-interfaces;
health-monitor {
  falling-threshold integer;
  interval seconds;
  rising-threshold integer;
}
interface [ interface-names ];
location location;
name name;
nonvolatile {
  commit-delay seconds;
}
rmon {
  alarm index {
    description description;
    falling-event-index index;
    falling-threshold integer;
    falling-threshold-interval seconds;
    interval seconds;
    request-type;
    rising-event-index index;
    rising-threshold integer;
    sample-type (absolute-value | delta-value);
    startup-alarm (falling-alarm | rising-alarm | rising-or-falling alarm);
    syslog-subtag syslog-subtag;
    variable oid-variable;
  }
  event index {
    community community-name;
    description description;
    type type;
  }
  history history-index {
```

```
    bucket-size number;
    interface interface-name;
    interval seconds;
    owner owner-name;
  }
}
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable> <match
    regular-expression>;
  flag flag;
}
trap-group group-name {
  categories {
    category;
  }
  destination-port port-number;
  routing-instance routing-instance-name;
  targets {
    address;
  }
  version (all | v1 | v2);
}
trap-options {
  agent-address outgoing-interface;
  source-address address;
}
v3 {
  notify name {
    tag tag-name;
    type trap;
  }
  notify-filter profile-name {
    oid object-identifier (include | exclude);
  }
  snmp-community community-index {
    community-name community-name;
    security-name security-name;
    tag tag-name;
  }
  target-address target-address-name {
    address address;
    address-mask address-mask;
    logical-system logical-system;
    port port-number;
    retry-count number;
    routing-instance routing-instance-name;
    tag-list tag-list;
    target-parameters target-parameters-name;
    timeout seconds;
  }
  target-parameters target-parameters-name {
    notify-filter profile-name;
    parameters {
      message-processing-model (v1 | v2c | V3);
      security-level (authentication | none | privacy);
      security-model (usm | v1 | v2c);
```



```
        security-name security-name;
      }
    }
    usm {
      local-engine {
        user username {
          authentication-sha {
            authentication-password authentication-password;
          }
          authentication-md5 {
            authentication-password authentication-password;
          }
          authentication-none;
          privacy-aes128 {
            privacy-password privacy-password;
          }
          privacy-des {
            privacy-password privacy-password;
          }
          privacy-3des {
            privacy-password privacy-password;
          }
          privacy-none;
        }
      }
      remote-engine engine-id {
        user username {
          authentication-sha {
            authentication-password authentication-password;
          }
          authentication-md5 {
            authentication-password authentication-password;
          }
          authentication-none;
          privacy-aes128 {
            privacy-password privacy-password;
          }
          privacy-des {
            privacy-password privacy-password;
          }
          privacy-3des {
            privacy-password privacy-password;
          }
          privacy-none {
            privacy-password privacy-password;
          }
        }
      }
    }
    vacm {
      access {
        group group-name {
          (default-context-prefix | context-prefix context-prefix) {
            security-model (any | usm | v1 | v2c) {
              security-level (authentication | none | privacy) {
                notify-view view-name;
```



```
                        read-view view-name;
                        write-view view-name;
                    }
                }
            }
        }
    }
    security-to-group {
        security-model (usm | v1 | v2c) {
            security-name security-name {
                group group-name;
            }
        }
    }
  }
}
view view-name {
    oid object-identifier (include | exclude);
}
}
```

Related Documentation

- Understanding the Implementation of SNMP on page 6021
- snmp on page 1334

Configuring the SNMP Community String

The SNMP community string defines the relationship between an SNMP server system and the client systems. This string acts like a password to control the clients' access to the server. To configure a community string in a Junos OS configuration, include the **community** statement at the **[edit snmp]** hierarchy level:

```
[edit snmp]
community name {
    authorization authorization;
    clients {
        default restrict;
        address restrict;
    }
    view view-name;
}
```

If the community name contains spaces, enclose it in quotation marks (" ").

The default authorization level for a community is **read-only**. To allow **Set** requests within a community, you need to define that community as **authorization read-write**. For **Set** requests, you also need to include the specific MIB objects that are accessible with read-write privileges using the **view** statement. The default view includes all supported MIB objects that are accessible with read-only privileges; no MIB objects are accessible with read-write privileges. For more information about the **view** statement, see "Configuring MIB Views" on page 6116.

The **clients** statement lists the IP addresses of the clients (community members) that are allowed to use this community. If no **clients** statement is present, all clients are allowed. For ***address***, you must specify an IPv4 address, not a hostname. Include the **default restrict** option to deny access to all SNMP clients for which access is not explicitly granted. We recommend that you always include the **default restrict** option to limit SNMP client access to the local switch.

NOTE: Community names must be unique within each SNMP system.

Related Documentation

- Configuring SNMP on page 1237

Configuring SNMP Trap Groups

Before any SNMP traps can be sent, you must configure a trap group, the categories of traps the group can receive, and the targets (systems) that will receive the traps. To create and name an SNMP trap group, include the **trap-group** statement at the **[edit snmp]** hierarchy level:

```
[edit snmp]
trap-group group-name {
  categories {
    category;
  }
  destination-port port-number;
  targets {
    address;
  }
  version (all | v1 | v2);
}
```

The trap group name can be any string and is embedded in the community name field of the trap. To configure your own trap group port, include the **destination-port** statement. The default destination port is port 162.

For each trap group that you define, you must include the **target** statement to define at least one system as the recipient of the SNMP traps in the trap group. Specify the IPv4 address of each recipient and not its hostname.

Specify the types of traps the trap group can receive in the **categories** statement.

A trap group can receive the following categories of traps:

- **authentication**—Authentication failures
- **chassis**—Chassis or environment notifications
- **configuration**—Configuration notifications
- **link**—Link-related notifications such as up-down transitions
- **remote-operations**—Remote operation notifications
- **startup**—System warm and cold starts

The **version** statement allows you to specify the SNMP version of the traps sent to targets of the trap group. If you specify **v1** only, SNMPv1 traps are sent. If you specify **v2** only, SNMPv2 traps are sent. If you specify **all**, both an SNMPv1 and an SNMPv2 trap are sent for every trap condition. For more information about the **version** statement, see version.

Related Documentation

- *Standard SNMP Version 1 Traps*
- *Standard SNMP Version 2 Traps*
- *Juniper Networks Enterprise-Specific SNMP Version 1 Traps*
- *Juniper Networks Enterprise-Specific SNMP Version 2 Traps*

Adding a Group of Clients to an SNMP Community

Junos OS enables you to add one or more groups of clients to an SNMP community. You can include the **client-list-name *name*** statement at the **[edit snmp community *community-name*]** hierarchy level to add all the members of the client list or prefix list to an SNMP community.

To define a list of clients, include the **client-list** statement followed by the IP addresses of the clients at the **[edit snmp]** hierarchy level:

```
[edit snmp]
  client-list client-list-name {
  ip-addresses;
}
```

You can configure a prefix list at the **[edit policy options]** hierarchy level. Support for prefix lists in the SNMP community configuration enables you to use a single list to configure the SNMP and routing policies. For more information about the **prefix-list** statement, see the *Routing Policy Feature Guide for Routing Devices*.

To add a client list or prefix list to an SNMP community, include the **client-list-name** statement at the **[edit snmp community *community-name*]** hierarchy level:

```
[edit snmp community community-name]
client-list-name client-list-name;
```

NOTE: The client list and prefix list must not have the same name.

The following example shows how to define a client list:

```
[edit]
snmp {
  client-list clentlist1 {
    10.1.1.1/32;
    10.2.2.2/32;
  }
}
```

The following example shows how to add a client list to an SNMP community:

```
[edit]
```

```
snmp {
  community community1 {
    authorization read-only;
    client-list-name clientlist1;
  }
}
```

The following example shows how to add a prefix list to an SNMP community:

```
[edit]
policy-options {
  prefix-list prefixlist {
  10.3.3.3/32;
  10.5.5.5/32;
  }
}
snmp {
  community community2 {
  client-list-name prefixlist;
  }
}
```

Related Documentation

- client-list on page 1289
- client-list-name on page 1290

Configuring the Interfaces on Which SNMP Requests Can Be Accepted

By default, all router or switch interfaces have SNMP access privileges. To limit the access through certain interfaces only, include the **interface** statement at the **[edit snmp]** hierarchy level:

```
[edit snmp]
interface [ interface-names ];
```

Specify the names of any logical or physical interfaces that should have SNMP access privileges. Any SNMP requests entering the router or switch from interfaces not listed are discarded.

Related Documentation

- *Configuring SNMP on a Device Running Junos OS*
- *Configuration Statements at the [edit snmp] Hierarchy Level*
- *Example: Configuring Secured Access List Checking*
- Configuring SNMP on page 1237

Configuring MIB Views

By default, an SNMP community grants read access and denies write access to all supported MIB objects (even communities configured as **authorization read-write**). To restrict or grant read or write access to a set of MIB objects, you must configure a MIB view and associate the view with a community.

To configure MIB views, include the **view** statement at the **[edit snmp]** hierarchy level:

```
[edit snmp]
view view-name {
   oid object-identifier (include | exclude);
}
```

The **view** statement defines a MIB view and identifies a group of MIB objects. Each MIB object of a view has a common object identifier (OID) prefix. Each object identifier represents a subtree of the MIB object hierarchy. The subtree can be represented either by a sequence of dotted integers (such as **1.3.6.1.2.1.2**) or by its subtree name (such as **interfaces**). A configuration statement uses a view to specify a group of MIB objects on which to define access. You can also use a wildcard character asterisk (*) to include OIDs that match a particular pattern in the SNMP view. To enable a view, you must associate the view with a community.

NOTE: **To remove an OID completely, use the delete view all oid *oid-number* command but omit the include parameter.**

To associate MIB views with a community, include the **view** statement at the **[edit snmp community *community-name*]** hierarchy level:

```
[edit snmp community community-name]
view view-name;
```

For more information about the Ping MIB, see RFC 2925 and the *PING MIB* topic in the *SNMP MIBs and Traps Reference*.

Related Documentation

- *Configuring SNMP on a Device Running Junos OS*
- *Configuration Statements at the [edit snmp] Hierarchy Level*
- *Example: Ping Proxy MIB*
- *view (Configuring a MIB View)*
- view (Associating MIB View with a Community) on page 6297
- *oid*

Configuring RMON Alarms and Events

The Junos OS supports the *Remote Network Monitoring* (RMON) MIB (RFC 2819), which allows a management device to monitor the values of MIB objects, or variables, against configured thresholds. When the value of a variable crosses a threshold, an alarm and its corresponding event are generated. The event can be logged and can generate an SNMP trap.

To configure RMON alarms and events using the CLI, perform these tasks:

1. Configuring SNMP on page 6118
2. Configuring an Event on page 6118
3. Configuring an Alarm on page 6119

Configuring SNMP

To configure SNMP:

1. Grant read-only access to all SNMP clients:

   ```
   [edit snmp]
   user@switch# set community community-name authorization authorization
   ```

   For example:

   ```
   [edit snmp]
   user@switch# set community public authorization read-only
   ```
2. Grant read-write access to the **RMON** and **jnx-rmon** MIBs:

   ```
   [edit snmp]
   user@switch# set view view-name oid object-identifier include
   user@switch# set view view-name oid object-identifier include
   user@switch# set community community-name authorization authorization view view-name
   ```

   For example:

   ```
   [edit snmp]
   user@switch# set view rmon-mib-view oid .1.3.6.1.2.1.16 include
   user@switch# set view rmon-mib-view oid .1.3.6.1.4.1.2636.13 include
   user@switch# set community private authorization read-write view rmon-mib-view
   ```

   OIDs 1.3.6.1.2.1.16 and 1.3.6.1.4.1.2636.13 correspond to the **RMON** and **jnxRmon** MIBs.

3. Configure an SNMP trap group:

   ```
   [edit snmp]
   user@switch# set trap-group group-name categories category
   user@switch# set trap-group group-name targets address
   ```

   For example:

   ```
   [edit snmp]
   user@switch# set trap-group rmon-trap-group categories rmon-alarm
   user@switch# set trap-group rmon-trap-group targets 192.168.5.5
   ```

   The trap group **rmon-trap-group** is configured to send RMON traps to 192.168.5.5.

Configuring an Event

To configure an event:

1. Configure an event index, community name, and type:

   ```
   [edit snmp rmon]
   user@switch# set event index community community-name  typetype
   ```

   For example:

   ```
   [edit snmp rmon]
   user@switch# set event 1 community rmon-trap-group type log-and-trap
   ```

   The event community corresponds to the SNMP trap group and is not the same as an SNMP community. This event generates an SNMP trap and adds an entry to the **logTable** in the RMON MIB.

2. Configure a description for the event:

   ```
   [edit snmp rmon]
   user@switch# set event index description description
   ```

For example:

```
[edit snmp rmon]
user@switch# set event 1 description "rmon event"
```

Configuring an Alarm

To configure an alarm:

1. Configure an alarm index, the variable to monitor, the rising and falling thresholds, and the corresponding rising and falling events:

   ```
   [edit snmp rmon]
   user@switch# set alarm index variable oid-variable falling-threshold integer rising-threshold integer rising-event-index index falling-event-index index
   ```

   For example:

   ```
   [edit snmp rmon]
   user@switch# set alarm 5 variable .1.3.6.1.4.1.2636.3.1.13.1.8.9.1.0.0 falling-threshold 75 rising-threshold 90 rising-event-index 1 falling-event-index 1
   ```

   The variable .1.3.6.1.4.1.2636.3.1.13.1.8.9.1.0.0 corresponds to the **jnxRmon** MIB object **jnxOperatingCPU**, which represents the CPU utilization of the Routing Engine. The falling and rising threshold integers are 75 and 90. The rising and falling events both generate the same event (event index 1).

2. Configure the sample interval and type and the alarm type:

   ```
   [edit snmp rmon]
   user@switch# set alarm index interval seconds sample-type (absolute-value | delta-value) startup-alarm (falling-alarm | rising-alarm | rising-or-falling-alarm)
   ```

   For example:

   ```
   [edit snmp rmon]
   user@switch# set alarm 5 interval 30 sample-type absolute-value startup-alarm rising-or-falling-alarm
   ```

   The absolute value of the monitored variable is sampled every 30 seconds. The initial alarm can occur because of rising above the rising threshold or falling below the falling threshold.

Related Documentation

- Configuring SNMP on page 1237
- *Juniper Networks Enterprise-Specific MIBs*
- Monitoring RMON MIB Tables on page 6323
- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Understanding RMON on page 6033

Configuring Health Monitoring

This topic describes how to configure the health monitor feature for QFX Series devices.

The health monitor feature extends the SNMP RMON alarm infrastructure to provide predefined monitoring for a selected set of object instances (such as file system usage, CPU usage, and memory usage) and dynamic object instances (such as Junos OS processes).

To configure health monitoring:

1. Configure the health monitor:

   [edit snmp]
   user@switch# **set health-monitor**

2. Configure the falling threshold:

   [edit snmp]
   user@switch# **set health-monitor falling-threshold** *percentage*

   For example:

   user@switch# **set health-monitor falling-threshold 85**

3. Configure the rising threshold:

   [edit snmp]
   user@switch# **set health-monitor rising-threshold** *percentage*

   For example:

   user@switch# **set health-monitor rising-threshold 75**

4. Configure the interval:

   [edit snmp]
   user@switch# **set health-monitor interval** *seconds*

   For example:

   user@switch# **set health-monitor interval 600**

Related Documentation

- Understanding Health Monitoring on page 6037
- falling-threshold on page 1296
- interval (Health Monitor) on page 1301
- rising-threshold (Health Monitor) on page 1331

Creating SNMPv3 Users

For each SNMPv3 user, you can specify the username, authentication type, authentication password, privacy type, and privacy password. After a user enters a password, a key based on the engine ID and password is generated and is written to the configuration file. After the generation of the key, the password is deleted from this configuration file.

NOTE: You can configure only one encryption type for each SNMPv3 user.

To create users, include the **user** statement at the **[edit snmp v3 usm local-engine]** hierarchy level:

```
[edit snmp v3 usm local-engine]
user username;
```

username is the name that identifies the SNMPv3 user.

To configure user authentication and encryption, include the following statements at the **[edit snmp v3 usm local-engine user *username*]** hierarchy level:

```
[edit snmp v3 usm local-engine user username]
authentication-md5 {
  authentication-password authentication-password;
}
authentication-sha {
  authentication-password authentication-password;
}
authentication-none;
privacy-aes128 {
  privacy-password privacy-password;
}
privacy-des {
  privacy-password privacy-password;
}
privacy-3des {
  privacy-password privacy-password;
}
privacy-none;
```

Related Documentation

- *Complete SNMPv3 Configuration Statements*
- Minimum SNMPv3 Configuration on a Device Running Junos OS on page 6032
- *Example: Creating SNMPv3 Users Configuration*
- *Example: SNMPv3 Configuration*

Configuring Access Privileges for a Group

In SNMPv3, you can configure a group that sets the same access privileges for one or more users. Configuring a group includes defining the security model and security level, and associating one or more MIB view permissions for the group.

NOTE: You must associate at least one MIB view with the group. You can associate multiple MIB views (read, notify, write) to authorize different permissions based on the view. The view name cannot exceed 32 characters.

To configure access privileges for a group:

1. To configure the group:

   ```
   [edit snmp v3 vacm access]
   user@switch# edit group group-name
   ```

2. To configure the context prefix of the SNMP instance for the group:

   ```
   [edit snmp v3 vacm access group group-name]
   user@switch# edit (default-context-prefix | context-prefix context-prefix)
   ```

   For example, to configure the default context prefix:

   ```
   [edit snmp v3 vacm access group group-name]
   ```

user@switch# **edit default-context-prefix**

3. To configure the security model:

   [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*)]
   user@switch# **edit security-model (any | usm | v1 | v2c)**

   For example, to configure the SNMPv3 user-based security model (USM):

   [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*)]
   user@switch# **edit security-model usm**

4. To configure the security level:

   [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*) security-model (any | usm | v1 | v2c)]
   user@switch# **edit security-level (authentication | none | privacy)**

   For example, to configure a security level requiring user authentication and encryption:

   [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*) security-model (any | usm | v1 | v2c)]
   user@switch# **edit security-level privacy**

   NOTE: Access privileges are granted to all packets with a security level equal to or greater than that configured. If you are configuring the SNMPv1 or v2c security model, use **none** as your security level. If you are configuring the SNMPv3 security model (USM), use the **authentication**, **none**, or **privacy** security level.

5. (Optional) To associate a read-only MIB view with an SNMP group:

   [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*) security-model (any | usm | v1 | v2c) security-level (authentication | none | privacy)]
   user@switch# **edit read-view *view-name***

6. (Optional) To associate a MIB view with an SNMP notification permission for an SNMP group:

   [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*) security-model (any | usm | v1 | v2c) security-level (authentication | none | privacy)]
   user@switch# **edit notify-view *view-name***

7. (Optional) To associate a MIB view with write permission for an SNMP group:

   [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*) security-model (any | usm | v1 | v2c) security-level (authentication | none | privacy)]
   user@switch# **edit write-view *view-name***

Related Documentation

- SNMPv3 Overview on page 6031
- Minimum SNMPv3 Configuration on a Device Running Junos OS on page 6032

Assigning a Security Name to a Group

In SNMPv3, each username is associated with a security name. The security name, together with the SNMP engine ID, is included in SNMP messages to ensure messaging security.

Before you assign a security name to a group, first create the security name. For an SNMPv3 client, the security name is the username configured at the **[edit snmp v3 usm local-engine user *username*]** hierarchy level. For SNMPv1 or v2c clients, the security name is the community string configured at the **[edit snmp v3 snmp-community *community-index*]** hierarchy level.

Assigning a security name to a group includes configuring a security model for the group, assigning the security name to the group, and configuring the group.

To assign an SNMP security name to a group:

1. To configure a security model for the group:

   ```
   [edit snmp v3 vacm security-to-group]
   user@switch# edit security-model (usm | v1 | v2c)
   ```

   For example, to configure the SNMPv3 user-based security model (USM):

   ```
   [edit snmp v3 vacm security-to-group]
   user@switch# edit security-model usm
   ```

2. To associate the security name with a group:

   ```
   [edit snmp v3 vacm security-to-group security-model (usm | v1 | v2c)]
   user@switch# edit security-name security-name
   ```

3. To configure a group of SNMPv3 security names with the same security policy:

   ```
   [edit snmp v3 vacm security-to-group security-model (usm | v1 | v2c) security-name
     security-name]
   user@switch# edit group group-name
   ```

Related Documentation

- Creating SNMPv3 Users on page 6120
- group (Associating a Security Name) on page 6234
- security-model (Group) on page 6266
- security-name (Community String) on page 6268
- security-name (Security Group) on page 6269

Configuring SNMPv3 Traps on a Device Running Junos OS

In SNMPv3, you create traps and informs by configuring the **notify**, **target-address**, and **target-parameters** parameters. Traps are unconfirmed notifications, whereas informs are confirmed notifications. This section describes how to configure SNMP traps. For information about configuring SNMP informs, see “Configuring SNMP Informs” on page 6125.

The target address defines a management application's address and parameters to be used in sending notifications. Target parameters define the message processing and security parameters that are used in sending notifications to a particular management target. SNMPv3 also lets you define SNMPv1 and SNMPv2c traps.

NOTE: When you configure SNMP traps, make sure your configured access privileges allow the traps to be sent. Access privileges are configured at the **[edit snmp v3 vacm access]** and **[edit snmp v3 vacm security-to-group]** hierarchy levels.

To configure SNMP traps, include the following statements at the **[edit snmp v3]** hierarchy level:

```
[edit snmp v3]
notify name {
  tag tag-name;
  type trap;
}
notify-filter name {
  oid object-identifier (include | exclude);
}
target-address target-address-name {
  address address;
  address-mask address-mask;
  logical-system (SNMP logical-system;
  port port-number;
  routing-instance instance;
  tag-list tag-list;
  target-parameters target-parameters-name;
}
target-parameters target-parameters-name {
  notify-filter profile-name;
  parameters {
    message-processing-model (v1 | v2c | v3);
    security-level (authentication | none | privacy);
    security-model (usm | v1 | v2c);
    security-name security-name;
  }
}
```

Related Documentation

- *Configuring the SNMPv3 Trap Notification*
- *Configuring the Trap Notification Filter*
- *Configuring the Trap Target Address*
- *Defining and Configuring the Trap Target Parameters*
- Configuring SNMP Informs on page 6125
- *Configuring the Remote Engine and Remote User*
- *Configuring the Inform Notification Type and Target Address*
- *Complete SNMPv3 Configuration Statements*

- Minimum SNMPv3 Configuration on a Device Running Junos OS on page 6032

Configuring SNMP Informs

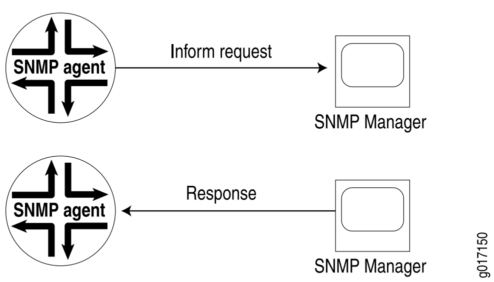
Junos OS supports two types of notifications: traps and informs. With traps, the receiver does not send any acknowledgment when it receives a trap. Therefore, the sender cannot determine if the trap was received. A trap may be lost because a problem occurred during transmission. To increase reliability, an inform is similar to a trap except that the inform is stored and retransmitted at regular intervals until one of these conditions occurs:

- The receiver (target) of the inform returns an acknowledgment to the SNMP agent.
- A specified number of unsuccessful retransmissions have been attempted and the agent discards the inform message.

If the sender never receives a response, the inform can be sent again. Thus, informs are more likely to reach their intended destination than traps are. Informs use the same communications channel as traps (same socket and port) but have different protocol data unit (PDU) types.

Informs are more reliable than traps, but they consume more network, router, and switch resources (see Figure 216 on page 6125). Unlike a trap, an inform is held in memory until a response is received or the timeout is reached. Also, traps are sent only once, whereas an inform may be retried several times. Use informs when it is important that the SNMP manager receive all notifications. However, if you are more concerned about network traffic, or router and switch memory, use traps.

Figure 216: Inform Request and Response



For information about configuring SNMP traps, see “Configuring SNMPv3 Traps on a Device Running Junos OS” on page 6123.

Related Documentation

- Configuring SNMPv3 Traps on a Device Running Junos OS on page 6123
- *Configuring the Remote Engine and Remote User*
- *Configuring the Inform Notification Type and Target Address*
- *Complete SNMPv3 Configuration Statements*
- Minimum SNMPv3 Configuration on a Device Running Junos OS on page 6032

Configuration Tasks for System Log Messages

Junos OS Minimum System Logging Configuration

To record or view system log messages, you must include the **syslog** statement at the **[edit system]** hierarchy level. Specify at least one destination for the messages, as described in Table 580 on page 6126. For more information about the configuration statements, see *Single-Chassis System Logging Configuration Overview*.

Table 580: Minimum Configuration Statements for System Logging

Destination	Minimum Configuration Statements

File	[edit system syslog]
	file *filename* {
	  facility severity;
	}

Terminal session of one, several, or all users	[edit system syslog]
	user (*username* | *) {
	  facility severity;
	}

Table 580: Minimum Configuration Statements for System Logging *(continued)*

Destination	Minimum Configuration Statements

Router or switch console	[edit system syslog]
	console {
	facility severity;
	}

Remote machine or the other Routing Engine on the router or switch	[edit system syslog]
	host (*hostname* | other-routing-engine) {
	facility severity;
	}

Related Documentation

- *Junos OS System Log Configuration Overview*
- Overview of Junos OS System Log Messages on page 6068
- Overview of Single-Chassis System Logging Configuration on page 6069

Junos OS System Log Configuration Statements

To configure the switch to log system messages, include the **syslog** statement at the **[edit system]** hierarchy level:

```
[edit system]
syslog {
  archive <files number> <size size> <world-readable | no-world-readable>;
  console {
    facility severity;
  }
  file filename {
    facility severity;
    archive <archive-sites (ftp-url <password password>)> <files number> <size size>
      <start-time "YYYY-MM-DD.hh:mm"> <transfer-interval minutes> <world-readable |
      no-world-readable>;
    explicit-priority;
    match "regular-expression";
    structured-data {
      brief;
    }
  }
  host hostname {
    facility severity;
    explicit-priority;
    facility-override facility;
    log-prefix string
    match "regular-expression";
  }
  source-address source-address;
  time-format (year | millisecond | year millisecond);
  user (username | *) {
    facility severity;
    match "regular-expression";
```



```
  }
}
```

Related Documentation

- Overview of Junos OS System Log Messages on page 6068

Adding a Text String to System Log Messages

To add a text string to every system log message directed to a remote machine or to the other Routing Engine, include the **log-prefix** statement at the **[edit system syslog host]** hierarchy level:

```
[edit system syslog host (hostname | other-routing-engine)]
facility severity;
log-prefix string;
```

The string can contain any alphanumeric or special character except the equal sign (=) and the colon (:). It also cannot include the space character; do not enclose the string in quotation marks (“ ”) in an attempt to include spaces in it.

The Junos OS system logging utility automatically appends a colon and a space to the specified string when the system log messages are written to the log. The string is inserted after the identifier for the Routing Engine that generated the message.

The following example shows how to add the string M120 to all messages to indicate that the router is an M120 router, and direct the messages to the remote machine hardware-logger.mycompany.com:

```
[edit system syslog]
host hardware-logger.mycompany.com {
  any info;
  log-prefix M120;
}
```

When these configuration statements are included on an M120 router called origin1, a message in the system log on hardware-logger.mycompany.com looks like the following:

```
Mar 9 17:33:23 origin1 M120: mgd[477]: UI_CMDLINE_READ_LINE: user ‘root’, command ‘run
  show version’
```

Related Documentation

- *Single-Chassis System Logging Configuration Overview*
- Specifying Log File Size, Number, and Archiving Properties on page 6139
- Overview of Single-Chassis System Logging Configuration on page 6069

Directing System Log Messages to a Log File

To direct system log messages to a file in the **/var/log** directory of the local Routing Engine, include the **file** statement at the **[edit system syslog]** hierarchy level:

```
[edit system syslog]
file filename {
  facility severity;
```



```
    archive <archive-sites (ftp-url <password password>)> <files number> <size size>
      <start-time "YYYY-MM-DD.hh:mm"> <transfer-interval minutes> <world-readable |
      no-world-readable>;
    explicit-priority;
    match "regular-expression";
    structured-data {
      brief;
    }
  }
```

For the list of facilities and severity levels, see *Specifying the Facility and Severity of Messages to Include in the Log*.

To prevent log files from growing too large, the Junos OS system logging utility by default writes messages to a sequence of files of a defined size. By including the **archive** statement, you can configure the number of files, their maximum size, and who can read them, either for all log files or for a certain log file. For more information, see "Specifying Log File Size, Number, and Archiving Properties" on page 6139.

For information about the following statements, see the indicated sections:

- **explicit-priority**—See "Including Priority Information in System Log Messages" on page 6132
- **match**—See "Using Regular Expressions to Refine the Set of Logged Messages" on page 6146
- **structured-data**—See *Logging Messages in Structured-Data Format*

Related Documentation

- *Single-Chassis System Logging Configuration Overview*
- Overview of Junos OS System Log Messages on page 6068
- Logging Messages in Structured-Data Format on page 6134
- *Examples: Configuring System Logging*
- Examples: Configuring System Logging on page 6073

Directing System Log Messages to a Remote Machine

To direct system log messages to a remote machine, include the **host** statement at the **[edit system syslog]** hierarchy level:

```
[edit system syslog]
host (hostname | other-routing-engine) {
  facility severity;
  explicit-priority;
  facility-override facility;
  log-prefix string;
  match "regular-expression";
}
source-address source-address;
```

To direct system log messages to a remote machine, include the **host *hostname*** statement to specify the remote machine's IP version 4 (IPv4) address or fully qualified hostname. The remote machine must be running the standard **syslogd** utility. We do not recommend directing messages to another Juniper Networks switch. In each system log message directed to the remote machine, the hostname of the local Routing Engine appears after the timestamp to indicate that it is the source for the message.

For the list of logging facilities and severity levels to configure under the **host** statement, see "Specifying the Facility and Severity of Messages to Include in the Log" on page 6141.

To record facility and severity level information in each message, include the **explicit-priority** statement. For more information, see "Including Priority Information in System Log Messages" on page 6132.

For information about the **match** statement, see "Using Regular Expressions to Refine the Set of Logged Messages" on page 6146.

When directing messages to remote machines, you can include the **source-address** statement to specify the IP address of the switch that is reported in the messages as their source. In each **host** statement, you can also include the **facility-override** statement to assign an alternative facility and the **log-prefix** statement to add a string to each message.

Related Documentation

- Overview of Single-Chassis System Logging Configuration on page 6069

Directing System Log Messages to a User Terminal

To direct system log messages to the terminal session of one or more specific users (or all users) when they are logged in to the local Routing Engine, include the **user** statement at the **[edit system syslog]** hierarchy level:

```
[edit system syslog]
user (username | *) {
  facility severity;
  match "regular-expression";
}
```

Specify one or more Junos OS usernames, separating multiple values with spaces, or use the asterisk (*****) to indicate all users who are logged in to the local Routing Engine.

For the list of logging facilities and severity levels, see *Specifying the Facility and Severity of Messages to Include in the Log*. For information about the **match** statement, see "Using Regular Expressions to Refine the Set of Logged Messages" on page 6146.

Related Documentation

- *Single-Chassis System Logging Configuration Overview*
- Overview of Single-Chassis System Logging Configuration on page 6069
- *Examples: Configuring System Logging*
- Examples: Configuring System Logging on page 6073

Directing System Log Messages to the Console

To direct system log messages to the console of the local Routing Engine, include the **console** statement at the **[edit system syslog]** hierarchy level:


```
[edit system syslog]
console {
   facility severity;
}
```

For the list of logging facilities and severity levels, see *Specifying the Facility and Severity of Messages to Include in the Log*.

Related Documentation

- *Single-Chassis System Logging Configuration Overview*
- Overview of Single-Chassis System Logging Configuration on page 6069
- *Examples: Configuring System Logging*
- Examples: Configuring System Logging on page 6073

Disabling the System Logging of a Facility

To disable the logging of messages that belong to a particular facility, include the ***facility*** **none** statement in the configuration. This statement is useful when, for example, you want to log messages that have the same severity level and belong to all but a few facilities. Instead of including a statement for each facility you want to log, you can include the **any *severity*** statement and then a ***facility*** **none** statement for each facility that you do not want to log. For example, the following logs all messages at the **error** level or higher to the console, except for messages from the **daemon** and **kernel** facilities. Messages from those facilities are logged to the file **>/var/log/internals** instead:

```
[edit system syslog]
console {
   any error;
   daemon none;
   kernel none;
}
file internals {
   daemon info;
   kernel info;
}
```

Related Documentation

- *Single-Chassis System Logging Configuration Overview*
- Overview of Single-Chassis System Logging Configuration on page 6069

Displaying a Log File from a Single-Chassis System

To display a log file stored on a single-chassis system such as the QFX3500 switch, enter Junos OS CLI operational mode and issue the following commands:

```
user@switch> show log log-filename
user@switch> file show log-file-pathname
```

By default, the commands display the file stored on the local Routing Engine.

The following example shows the output from the **show log messages** command:

```
user@switch1> show log messages
Nov  4 11:30:01 switch1 newsyslog[2283]: logfile turned over due to size>128K
```

```
Nov  4 11:30:01 switch1 newsyslog[2283]: logfile turned over due to size>128K
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 1
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 2
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 3
...
Nov  4 11:52:53  switch1 snmpd[944]: SNMPD_HEALTH_MON_INSTANCE: Health Monitor:
jroute daemon memory usage (Management
process): new instance detected (variable: sysApplElmtRunMemory.5.6.2293)
Nov  4 11:52:53  switch1 snmpd[944]: SNMPD_HEALTH_MON_INSTANCE: Health Monitor:
jroute daemon memory usage (Command-line
interface): new instance detected (variable: sysApplElmtRunMemory.5.8.2292)
...
Nov  4 12:08:30  switch1 rpdf[957]: task_connect: task BGP_100.10.10.1.6+179 addr
 10.10.1.6+179: Can't assign requested
address
Nov  4 12:08:30  switch1 rpdf[957]: bgp_connect_start: connect 10.10.1.6 (Internal
 AS 100): Can't assign requested address
Nov  4 12:10:24  switch1 mgd[2293]: UI_CMDLINE_READ_LINE: User 'jsmith', command
 'exit '
Nov  4 12:10:27  switch1 mgd[2293]: UI_DBASE_LOGOUT_EVENT: User 'jsmith' exiting
 configuration mode
Nov  4 12:10:31  switch1 mgd[2293]: UI_CMDLINE_READ_LINE: User 'jsmith', command
 'show log messages
```

The following example shows the output from the **file show** command. The file in the pathname **/var/log/processes** has been previously configured to include messages from the daemon facility.

```
user@switch1> file show /var/log/processes
Feb 22 08:58:24 switch1 snmpd[359]: SNMPD_TRAP_WARM_START: trap_generate_warm:
SNMP trap: warm start
Feb 22 20:35:07 switch1 snmpd[359]: SNMPD_THROTTLE_QUEUE_DRAINED:
trap_throttle_timer_handler: cleared all throttled traps
Feb 23 07:34:56 switch1 snmpd[359]: SNMPD_TRAP_WARM_START: trap_generate_warm:
SNMP trap: warm start
Feb 23 07:38:19 switch1 snmpd[359]: SNMPD_TRAP_COLD_START: trap_generate_cold:
SNMP trap: cold start
...
```

Related Documentation

- Interpreting Messages Generated in Standard Format on page 6138
- Interpreting Messages Generated in Structured-Data Format on page 6135

Including Priority Information in System Log Messages

The facility and severity level of a message are together referred to as its *priority*. By default, messages logged in the standard Junos OS format do not include information about priority. To include priority information in standard-format messages directed to a file, include the **explicit-priority** statement at the **[edit system syslog file *filename*]** hierarchy level:

[edit system syslog file *filename*]
facility severity;
explicit-priority;

NOTE: Messages logged in structured-data format include priority information by default. If you include the **structured-data** statement at the **[edit system syslog file *filename*]** hierarchy level along with the **explicit-priority** statement, the **explicit-priority** statement is ignored and messages are logged in structured-data format.

For information about the **structured-data** statement, see *Logging Messages in Structured-Data Format*. For information about the contents of a structured-data message, see the *Junos OS System Log Messages Reference*.

To include priority information in messages directed to a remote machine or the other Routing Engine, include the **explicit-priority** statement at the **[edit system syslog host (*hostname* | other-routing-engine)]** hierarchy level:

```
[edit system syslog host (hostname | other-routing-engine)]
facility severity;
explicit-priority;
```

NOTE: The **other-routing-engine** option does not apply to the QFX Series.

The priority recorded in a message always indicates the original, local facility name. If the **facility-override** statement is included for messages directed to a remote destination, the Junos OS system logging utility still uses the alternative facility name for the messages themselves when directing them to the remote destination. For more information, see "Changing the Alternative Facility Name for Remote System Log Messages" on page 6144.

When the **explicit-priority** statement is included, the Junos OS logging utility prepends codes for the facility name and severity level to the message tag name, if the message has one:

FACILITY-severity[-*TAG*]

(The tag is a unique identifier assigned to some Junos OS system log messages; for more information, see the *Junos OS System Log Messages Reference*.)

In the following example, the **CHASSISD_PARSE_COMPLETE** message belongs to the **daemon** facility and is assigned severity **info** (6):

```
Aug 21 12:36:30 router1 chassisd[522]: %DAEMON-6-CHASSISD_PARSE_COMPLETE:
  Using new configuration
```

When the **explicit-priority** statement is not included, the priority does not appear in the message:

```
Aug 21 12:36:30 router1 chassisd[522]: CHASSISD_PARSE_COMPLETE: Using new
  configuration
```

For more information about message formatting, see the *Junos OS System Log Messages Reference*.

Related Documentation

- *Single-Chassis System Logging Configuration Overview*
- Overview of Single-Chassis System Logging Configuration on page 6069
- *Examples: Configuring System Logging*

Including the Year or Millisecond in Timestamps

By default, the timestamp recorded in a standard-format system log message specifies the month, date, hour, minute, and second when the message was logged, as in the following example:

```
Aug 21 15:36:30
```

To include the year, the millisecond, or both, in the timestamp, include the **time-format** statement at the [**edit system syslog**] hierarchy level:

```
[edit system syslog]
time-format (year | millisecond | year millisecond);
```

The modified timestamp is used in messages directed to each destination configured by a **file**, **console**, or **user** statement at the [**edit system syslog**] hierarchy level, but not to destinations configured by a **host** statement.

The following example illustrates the format for a timestamp that includes both the millisecond (401) and the year (2010):

```
Aug 21 15:36:30.401 2010
```

NOTE: By default, messages logged in structured-data format include the year and millisecond. If you include the **structured-data** statement at the [**edit system syslog file *filename***] hierarchy level along with the **time-format** statement, the **time-format** statement is ignored and messages are logged in structured-data format.

For information about the **structured-data** statement, see "Logging Messages in Structured-Data Format" on page 6134. For information about interpreting messages in a structured-data format, see "Interpreting Messages Generated in Structured-Data Format" on page 6135.

Logging Messages in Structured-Data Format

You can log messages to a file in structured-data format instead of the standard Junos OS format. The structured-data format provides more information without adding significant length, and makes it easier for automated applications to extract information from a message.

The structured-data format complies with Internet draft **draft-ietf-syslog-protocol-21.txt**. The draft establishes a standard message format regardless of the source or transport protocol for logged messages.

To output messages to a file in structured-data format, include the **structured-data** statement at the [**edit system syslog file** *filename*] hierarchy level:

```
[edit system syslog file filename]
facility severity;
structured-data {
 brief;
}
```

The optional **brief** statement suppresses the English-language text that appears by default at the end of a message to describe the error or event. For information about the fields in a structured-data–format message, see "Interpreting Messages Generated in Structured-Data Format" on page 6135.

The structured format is used for all messages logged to the file that are generated by a Junos OS process or software library.

NOTE: If you include either or both of the **explicit-priority** and **time-format** statements along with the **structured-data** statement, they are ignored. These statements apply to the standard Junos OS system log format, not to structured-data format.

Interpreting Messages Generated in Structured-Data Format

By default, Junos OS processes and software libraries write messages to the system log file in structured-data format. For information about the **structured-data** statement, see *Logging Messages in Structured-Data Format*.

Structured-format makes it easier for automated applications to extract information from the message. In particular, the standardized format for reporting the value of variables (elements in the English-language message that vary depending on the circumstances that triggered the message) makes it easy for an application to extract those values.

The structured-data format for a message includes the following fields (which appear here on two lines only for legibility):

<priority code>version timestamp hostname process processID TAG [junos@2636.platform variable-value-pairs] message-text

Table 581 on page 6136 describes the fields. If the system logging utility cannot determine the value in a particular field, a hyphen (-) appears instead.

Table 581: Fields in Structured-Data Messages

Field	Description	Examples
<priority code>	Number that indicates the facility and severity of a message. It is calculated by multiplying the facility number by 8 and then adding the numerical value of the severity. For a mapping of the numerical codes to facility and severity, see *Specifying the Facility and Severity of Messages to Include in the Log*.	<165> for a message from the **pfe** facility (facility=20) with severity **notice** (severity=5).
version	Version of the Internet Engineering Task Force (IETF) system logging protocol specification.	1 for the initial version
timestamp	Time when the message was generated, in one of two representations: • *YYYY-MM-DDTHH:MM:SS.MSZ* is the year, month, day, hour, minute, second and millisecond in Universal Coordinated Time (UTC) • *YYYY-MM-DDTHH:MM:SS.MS+/-HH:MM* is the year, month, day, hour, minute, second and millisecond in local time; the hour and minute that follows the plus sign (+) or minus sign (-) is the offset of the local time zone from UTC	2007-02-15T09:17:15.719Z is 9:17 AM UTC on 15 February 2007. 2007-02-15T01:17:15.719 -08:00 is the same timestamp expressed as Pacific Standard Time in the United States.
hostname	Name of the host that originally generated the message.	switch1
process	Name of the Junos OS process that generated the message.	mgd
processID	UNIX process ID (PID) of the Junos process that generated the message.	3046
TAG	Junos OS system log message tag, which uniquely identifies the message.	UI_DBASE_LOGOUT_EVENT
junos@2636.*platform*	An identifier for the type of hardware platform that generated the message. The junos@2636 prefix indicates that the platform runs the Junos OS. It is followed by a dot-separated numerical identifier for the platform type.	junos@2636.1.1.1.2.18
variable-value-pairs	A variable-value pair for each element in the *message-text* string that varies depending on the circumstances that triggered the message. Each pair appears in the format ***variable* = "*value*"**.	username="regress"

Table 581: Fields in Structured-Data Messages *(continued)*

Field	Description	Examples
message-text	English-language description of the event or error (omitted if the brief statement is included at the [**edit system syslog file *filename* structured-data**] hierarchy level).	User 'regress' exiting configuration mode

By default, the structured-data version of a message includes English text at the end, as in the following example (which appears on multiple lines only for legibility):

```
<165>1 2007-02-15T09:17:15.719Z router1 mgd 3046 UI_DBASE_LOGOUT_EVENT
  [junos@2636.1.1.1.2.18 username="regress"] User 'regress' exiting configuration mode
```

When the brief statement is included at the [**edit system syslog file *filename* structured-data**] hierarchy level, the English text is omitted, as in this example:

```
<165>1 2007-02-15T09:17:15.719Z router1 mgd 3046 UI_DBASE_LOGOUT_EVENT
  [junos@2636.1.1.1.2.18 username="regress"]
```

Table 582 on page 6137 maps the codes that appear in the ***priority-code*** field to facility and severity level.

NOTE: Not all of the facilities and severities listed in Table 582 on page 6137 can be included in statements at the [**edit system syslog**] hierarchy level (some are used by internal processes). For a list of the facilities and severity levels that can be included in the configuration, see "Specifying the Facility and Severity of Messages to Include in the Log" on page 6141.

Table 582: Facility and Severity Codes in the priority-code Field

Facility (number)	Severity emergency	alert	critical	error	warning	notice	info	debug
kernel (0)	1	1	2	3	4	5	6	7
user (1)	8	9	10	11	12	13	14	15
mail (2)	16	17	18	19	20	21	22	23
daemon (3)	24	25	26	27	28	29	30	31
authorization (4)	32	33	34	35	36	37	38	39
syslog (5)	40	41	42	43	44	45	46	47
printer (6)	48	49	50	51	52	53	54	55
news (7)	56	57	58	59	60	61	62	63
uucp (8)	64	65	66	67	68	69	70	71

Table 582: Facility and Severity Codes in the priority-code Field *(continued)*

Facility (number)	Severity emergency	alert	critical	error	warning	notice	info	debug
clock (9)	72	73	74	75	76	77	78	79
authorization-private (10)	80	81	82	83	84	85	86	87
ftp (11)	88	89	90	91	92	93	94	95
ntp (12)	96	97	98	99	100	101	102	103
security (13)	104	105	106	107	108	109	110	111
console (14)	112	113	114	115	116	117	118	119
local0 (16)	128	129	130	131	132	133	134	135
dfc (17)	136	137	138	139	140	141	142	143
local2 (18)	144	145	146	147	148	149	150	151
firewall (19)	152	153	154	155	156	157	158	159
pfe (20)	160	161	162	163	164	165	166	167
conflict-log (21)	168	169	170	171	172	173	174	175
change-log (22)	176	177	178	179	180	181	182	183
interactive-commands (23)	184	185	186	187	188	189	190	191

Interpreting Messages Generated in Standard Format

The syntax of a standard-format message generated by a Junos OS process or subroutine library depends on whether it includes priority information:

- When the **explicit-priority** statement is included at the [**edit system syslog file *filename***] or [**edit system syslog host *hostname***] hierarchy level, a system log message has the following syntax:

  ```
  timestamp  message-source: %facility-severity-TAG: message-text
  ```

- When directed to the console or to users, or when the **explicit-priority** statement is not included for files or remote hosts, a system log message has the following syntax:

  ```
  timestamp  message-source: TAG: message-text
  ```

Table 583 on page 6139 describes the message fields.

Table 583: Fields in Standard-Format Messages

Field	Description
timestamp	Time at which the message was logged.
message-source	Identifier of the process or component that generated the message and the routing platform on which the message was logged. This field includes two or more subfields: hostname, process and process ID (PID). If the process does not report its PID, the PID is not displayed. The message source subfields are displayed in the following format: `hostname process[process-ID]`
facility	Code that specifies the facility to which the system log message belongs. For a mapping of codes to facility names, see Table: **Facility Codes Reported in Priority Information** in "Including Priority Information in System Log Messages" on page 6132.
severity	Numerical code that represents the severity level assigned to the system log message. For a mapping of codes to severity names, see Table: **Numerical Codes for Severity Levels Reported in Priority Information** in "Including Priority Information in System Log Messages" on page 6132.
TAG	Text string that uniquely identifies the message, in all uppercase letters and using the underscore (_) to separate words. The tag name begins with a prefix that indicates the generating software process or library. The entries in this reference are ordered alphabetically by this prefix. Not all processes on a routing platform use tags, so this field does not always appear.
message-text	Text of the message.

Specifying Log File Size, Number, and Archiving Properties

To prevent log files from growing too large, by default the Junos system logging utility writes messages to a sequence of files of a defined size. The files in the sequence are referred to as *archive* files to distinguish them from the *active* file to which messages are currently being written. The default maximum size depends on the platform type:

- 128 kilobytes (KB) for EX Series switches and J Series routers
- 1 megabyte (MB) for M Series, MX Series, and T Series routers
- 10 MB for TX Matrix or TX Matrix Plus routers
- 1 MB for the QFX Series

When an active log file called ***logfile*** reaches the maximum size, the logging utility closes the file, compresses it, and names the compressed archive file ***logfile*.0.gz**. The logging utility then opens and writes to a new active file called ***logfile***. This process is also known as file rotation. When the new ***logfile*** reaches the configured maximum size, ***logfile*.0.gz** is renamed ***logfile*.1.gz**, and the new ***logfile*** is closed, compressed, and renamed ***logfile*.0.gz**. By default, the logging utility creates up to 10 archive files in this manner. When the maximum number of archive files is reached and when the size of the active file reaches the configured maximum size, the contents of the last archived file are overwritten by the current active file. The logging utility by default also limits the users who can read log files to the **root** user and users who have the Junos OS **maintenance** permission.

Junos OS provides a configuration statement **log-rotate-frequency** that configures the system log file rotation frequency by configuring the time interval for checking the log file size. The frequency can be set to a value of 1 minute through 59 minutes. The default frequency is 15 minutes.

To configure the log rotation frequency, include the **log-rotate-frequency** statement at the **[edit system syslog]** hierarchy level.

You can include the **archive** statement to change the maximum size of each file, how many archive files are created, and who can read log files.

To configure values that apply to all log files, include the **archive** statement at the **[edit system syslog]** hierarchy level:

archive <files *number*> <size *size*> <world-readable | no-world-readable>;

To configure values that apply to a specific log file, include the **archive** statement at the **[edit system syslog file *filename*]** hierarchy level:

archive <archive-sites (*ftp-url* <password *password*>)> <files *number*> <size *size*>
<start-time "*YYYY-MM-DD.hh:mm*"> <transfer-interval *minutes*> <world-readable |
no-world-readable> ;

archive-sites *site-name* specifies a list of archive sites that you want to use for storing files. The ***site-name*** value is any valid FTP URL to a destination. If more than one site name is configured, a list of archive sites for the system log files is created. When a file is archived, the router or switch attempts to transfer the file to the first URL in the list, moving to the next site only if the transfer does not succeed. The log file is stored at the archive site with the specified log filename. For information about how to specify valid FTP URLs, see "Format for Specifying Filenames and URLs in Junos OS CLI Commands" on page 57.

binary-data Mark file as containing binary data. This allows proper archiving of binary files, such as WTMP files (login records for UNIX based systems). To restore the default setting, include the **no-binary-data** statement.

files *number* specifies the number of files to create before the oldest file is overwritten. The value can be from 1 through 1000.

size *size* specifies the maximum size of each file. The value can be from 64 KB (64k) through 1 gigabyte (1g); to represent megabytes, use the letter **m** after the integer. There is no space between the digits and the **k**, **m**, or **g** units letter.

start-time "*YYYY-MM-DD.hh:mm*" defines the date and time in the local time zone for a one-time transfer of the active log file to the first reachable site in the list of sites specified by the **archive-sites** statement.

transfer-interval *interval* defines the amount of time the current log file remains open (even if it has not reached the maximum possible size) and receives new statistics before it is closed and transferred to an archive site. This interval value can be from 5 through 2880 minutes.

world-readable enables all users to read log files. To restore the default permissions, include the **no-world-readable** statement.

Related Documentation

- *Single-Chassis System Logging Configuration Overview*
- *Examples: Configuring System Logging*
- Overview of Single-Chassis System Logging Configuration on page 6069
- *Routing Matrix with a TX Matrix Plus Router Solutions Page*

Specifying the Facility and Severity of Messages to Include in the Log

Each system log message belongs to a *facility*, which is a group of messages that are either generated by the same software process or concern a similar condition or activity (such as authentication attempts). Each message is also preassigned a *severity level*, which indicates how seriously the triggering event affects router functions.

When you configure logging for a facility and destination, you specify a severity level for each facility. Messages from the facility that are rated at that level or higher are logged to the destination:

```
[edit system syslog]
(console | file filename | host destination | user username) {
  facility severity;
}
```

Related Documentation

- Junos OS System Logging Facilities and Message Severity Levels on page 6141
- *Single-Chassis System Logging Configuration Overview*
- *Examples: Configuring System Logging*
- Overview of Single-Chassis System Logging Configuration on page 6069

Junos OS System Logging Facilities and Message Severity Levels

Table 584 on page 6141 lists the Junos system logging facilities that you can specify in configuration statements at the **[edit system syslog]** hierarchy level.

Table 584: Junos OS System Logging Facilities

Facility	Type of Event or Error
any	All (messages from all facilities)
authorization	Authentication and authorization attempts
change-log	Changes to the Junos OS configuration
conflict-log	Specified configuration is invalid on the router type

Table 584: Junos OS System Logging Facilities *(continued)*

Facility	Type of Event or Error
daemon	Actions performed or errors encountered by system processes
dfc	Events related to dynamic flow capture
firewall	Packet filtering actions performed by a firewall filter
ftp	Actions performed or errors encountered by the FTP process
interactive-commands	Commands issued at the Junos OS command-line interface (CLI) prompt or by a client application such as a Junos XML protocol or NETCONF XML client
kernel	Actions performed or errors encountered by the Junos OS kernel
pfe	Actions performed or errors encountered by the Packet Forwarding Engine
user	Actions performed or errors encountered by user-space processes

Table 585 on page 6142 lists the severity levels that you can specify in configuration statements at the **[edit system syslog]** hierarchy level. The levels from **emergency** through **info** are in order from highest severity (greatest effect on functioning) to lowest.

Unlike the other severity levels, the **none** level disables logging of a facility instead of indicating how seriously a triggering event affects routing functions. For more information, see "Disabling the System Logging of a Facility" on page 6131.

Table 585: System Log Message Severity Levels

Severity Level	Description
any	Includes all severity levels
none	Disables logging of the associated facility to a destination
emergency	System panic or other condition that causes the router to stop functioning
alert	Conditions that require immediate correction, such as a corrupted system database
critical	Critical conditions, such as hard errors
error	Error conditions that generally have less serious consequences than errors at the emergency, alert, and critical levels
warning	Conditions that warrant monitoring
notice	Conditions that are not errors but might warrant special handling

Table 585: System Log Message Severity Levels *(continued)*

Severity Level	Description
info	Events or nonerror conditions of interest

Related Documentation

- *Single-Chassis System Logging Configuration Overview*
- Overview of Single-Chassis System Logging Configuration on page 6069
- *Examples: Configuring System Logging*

System Log Default Facilities for Messages Directed to a Remote Destination

Table 586 on page 6143 lists the default alternative facility name next to the Junos OS-specific facility name for which it is used. For facilities that are not listed, the default alternative name is the same as the local facility name.

Table 586: Default Facilities for Messages Directed to a Remote Destination

Junos OS–specific Local Facility	Default Facility When Directed to Remote Destination
change-log	local6
conflict-log	local5
dfc	local1
firewall	local3
interactive-commands	local7
pfe	local4

Related Documentation

- *Single-Chassis System Logging Configuration Overview*
- Overview of Single-Chassis System Logging Configuration on page 6069

Junos OS System Log Alternate Facilities for Remote Logging

Table 587 on page 6143 lists the facilities that you can specify in the **facility-override** statement.

Table 587: Facilities for the facility-override Statement

Facility	Description
authorization	Authentication and authorization attempts
daemon	Actions performed or errors encountered by system processes

Table 587: Facilities for the facility-override Statement *(continued)*

Facility	Description
ftp	Actions performed or errors encountered by the FTP process
kernel	Actions performed or errors encountered by the Junos OS kernel
local0	Local facility number 0
local1	Local facility number 1
local2	Local facility number 2
local3	Local facility number 3
local4	Local facility number 4
local5	Local facility number 5
local6	Local facility number 6
local7	Local facility number 7
user	Actions performed or errors encountered by user-space processes

We do not recommend including the **facility-override** statement at the **[edit system syslog host other-routing-engine]** hierarchy level. It is not necessary to use alternative facility names when directing messages to the other Routing Engine, because its Junos OS system logging utility can interpret the Junos OS-specific names.

Related Documentation

- *Examples: Assigning an Alternative Facility*
- *Single-Chassis System Logging Configuration Overview*
- Overview of Single-Chassis System Logging Configuration on page 6069

Changing the Alternative Facility Name for Remote System Log Messages

Some facilities assigned to messages logged on the local router or switch have Junos OS-specific names (see Table 584 on page 6141). In the recommended configuration, a remote machine designated at the **[edit system syslog host *hostname*]** hierarchy level is not a Juniper Networks router or switch, so its syslogd utility cannot interpret the Junos OS-specific names. To enable the standard syslogd utility to handle messages from these facilities when messages are directed to a remote machine, a standard **local*X*** facility name is used instead of the Junos OS-specific facility name.

Table 586 on page 6143 lists the default alternative facility name next to the Junos OS-specific facility name it is used for.

The syslogd utility on a remote machine handles all messages that belong to a facility in the same way, regardless of the source of the message (the Juniper Networks router or switch or the remote machine itself). For example, the following statements in the configuration of the router called **local-router** direct messages from the **authorization** facility to the remote machine *monitor.mycompany.com*:

```
[edit system syslog]
host monitor.mycompany.com {
   authorization info;
}
```

The default alternative facility for the local **authorization** facility is also **authorization**. If the syslogd utility on **monitor** is configured to write messages belonging to the **authorization** facility to the file **/var/log/auth-attempts**, then the file contains the messages generated when users log in to **local-router** and the messages generated when users log in to **monitor**. Although the name of the source machine appears in each system log message, the mixing of messages from multiple machines can make it more difficult to analyze the contents of the **auth-attempts** file.

To make it easier to separate the messages from each source, you can assign an alternative facility to all messages generated on **local-router** when they are directed to **monitor**. You can then configure the syslogd utility on **monitor** to write messages with the alternative facility to a different file from messages generated on **monitor** itself.

To change the facility used for all messages directed to a remote machine, include the **facility-override** statement at the **[edit system syslog host *hostname*]** hierarchy level:

```
[edit system syslog host hostname]
facility severity;
facility-override facility;
```

In general, it makes sense to specify an alternative facility that is not already in use on the remote machine, such as one of the **local*X*** facilities. On the remote machine, you must also configure the syslogd utility to handle the messages in the desired manner.

Table 587 on page 6143 lists the facilities that you can specify in the **facility-override** statement.

We do not recommend including the **facility-override** statement at the **[edit system syslog host other-routing-engine]** hierarchy level. It is not necessary to use alternative facility names when directing messages to the other Routing Engine, because its Junos OS system logging utility can interpret the Junos OS-specific names.

The following example shows how to log all messages generated on the local router at the error level or higher to the local0 facility on the remote machine called monitor.mycompany.com:

```
[edit system syslog]
host monitor.mycompany.com {
   any error;
   facility-override local0;
}
```

The following example shows how to configure routers located in California and routers located in New York to send messages to a single remote machine called central-logger.mycompany.com. The messages from California are assigned to alternative facility local0 and the messages from New York are assigned to alternative facility local2.

- Configure California routers to aggregate messages in the local0 facility:

```
[edit system syslog]
host central-logger.mycompany.com {
  change-log info;
  facility-override local0;
}
```

- Configure New York routers to aggregate messages in the local2 facility:

```
[edit system syslog]
host central-logger.mycompany.com {
  change-log info;
  facility-override local2;
}
```

On central-logger, you can then configure the system logging utility to write messages from the local0 facility to the file **change-log** and the messages from the local2 facility to the file **new-york-config**.

Related Documentation

- Table 586 on page 6143
- Junos OS System Log Alternate Facilities for Remote Logging on page 6143
- *Examples: Assigning an Alternative Facility*
- Examples: Assigning an Alternative Facility on page 6075

Using Regular Expressions to Refine the Set of Logged Messages

The predefined facilities group together related messages, but you can also use regular expression matching to specify more exactly which messages from a facility are logged to a file, a user terminal, or a remote destination.

To specify the text string that must (or must not) appear in a message for the message to be logged to a destination, include the **match** statement and specify the regular expression which the text string must match:

match "*regular-expression*";

You can include this statement at the following hierarchy levels:

- **[edit system syslog file *filename*]** (for a file)
- **[edit system syslog user (*username* | *)]** (for a specific user session or for all user sessions on a terminal)
- **[edit system syslog host (*hostname* | other-routing-engine)]** (for a remote destination)

In specifying the regular expression, use the notation defined in POSIX Standard 1003.2 for extended (modern) UNIX regular expressions. Explaining regular expression syntax is beyond the scope of this document, but POSIX standards are available from the Institute of Electrical and Electronics Engineers (IEEE, http://www.ieee.org).

Table 588 on page 6147 specifies which character or characters are matched by some of the regular expression operators that you can use in the match statement. In the descriptions, the term term refers to either a single alphanumeric character or a set of characters enclosed in square brackets, parentheses, or braces.

NOTE: **The match statement is not case-sensitive.**

Table 588: Regular Expression Operators for the match Statement

Operator	Matches
. (period)	One instance of any character except the space.
* (asterisk)	Zero or more instances of the immediately preceding term.
+ (plus sign)	One or more instances of the immediately preceding term.
? (question mark)	Zero or one instance of the immediately preceding term.
| (pipe)	One of the terms that appears on either side of the pipe operator.
! (exclamation point)	Any string except the one specified by the expression, when the exclamation point appears at the start of the expression. Use of the exclamation point is Junos OS-specific.
^ (caret)	Start of a line, when the caret appears outside square brackets. One instance of any character that does not follow it within square brackets, when the caret is the first character inside square brackets.
$ (dollar sign)	End of a line.
[ ] (paired square brackets)	One instance of one of the enclosed alphanumeric characters. To indicate a range of characters, use a hyphen (-) to separate the beginning and ending characters of the range. For example, [a-z0-9] matches any letter or number.
( ) (paired parentheses)	One instance of the evaluated value of the enclosed term. Parentheses are used to indicate the order of evaluation in the regular expression.

Using Regular Expressions

Filter messages that belong to the **interactive-commands** facility, directing those that include the string **configure** to the terminal of the root user:

```
[edit system syslog]
user root {
 interactive-commands any;
 match ".*configure.*";
}
```

Messages like the following appear on the **root** user's terminal when a user issues a **configure** command to enter configuration mode:

```
timestamp router-name mgd[PID]: UI_CMDLINE_READ_LINE: User 'user', command
   'configure private'
```

Filter messages that belong to the **daemon** facility and have a severity of **error** or higher, directing them to the file **/var/log/process-errors**. Omit messages generated by the SNMP process (snmpd), instead directing them to the file **/var/log/snmpd-errors**:

```
[edit system syslog]
file process-errors {
 daemon error;
 match "!(.*snmpd.*)";
}
file snmpd-errors {
 daemon error;
 match ".*snmpd.*";
}
```

Related Documentation

- *Single-Chassis System Logging Configuration Overview*
- Overview of Single-Chassis System Logging Configuration on page 6069
- *Examples: Configuring System Logging*
- Examples: Configuring System Logging on page 6073

Configuration Statements for Network Management

connection-limit

Syntax connection-limit *limit*;

Hierarchy Level [edit system services finger],
[edit system services ftp],
[edit system services netconf ssh],
[edit system services ssh],
[edit system services telnet],
[edit system services xnm-clear-text],
[edit system services xnm-ssl]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the maximum number of connections sessions for each type of system services (finger, ftp, ssh, telnet, xnm-clear-text, or xnm-ssl) per protocol (either IPv6 or IPv4).

Options *limit*—(Optional) Maximum number of established connections per protocol (either IPv6 or IPv4).

Range: 1 through 250

Default: 75

NOTE: The actual number of maximum connections depends on the availability of system resources, and might be fewer than the configured connection-limit value if the system resources are limited.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring clear-text or SSL Service for Junos XML Protocol Client Applications*
- *Configuring DTCP-over-SSH Service for the Flow-Tap Application*
- *Configuring Finger Service for Remote Access to the Router*
- *Configuring FTP Service for Remote Access to the Router or Switch*
- Configuring SSH Service for Remote Access to the Router or Switch on page 1243
- *Configuring Telnet Service for Remote Access to a Router or Switch*

destination-override

Syntax

```
destination-override {
  syslog host ip-address;
}
```

Hierarchy Level [edit system tracing]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Override the system-wide configuration of the switch at the **[edit system tracing]** hierarchy level. This statement has no effect if system tracing is not configured.

Options **syslog**—System process log files to send to the remote tracing host.

- **syslog**—System process log files to send to the remote tracing host.
- **host *ip-address***—IP address to which to send tracing information.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Understanding Tracing and Logging Operations on page 5979
- tracing on page 304

no-remote-trace

Syntax no-remote-trace

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the switch to disable remote tracing after remote tracing has been enabled.

Default Remote tracing is disabled.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- tracing on page 304

protocol-version

Syntax protocol-version *version*;

Hierarchy Level [edit system services ssh]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the secure shell (SSH) protocol version.

Default **v2**—SSH protocol version 2 is the default, introduced in Junos OS Release 11.4.

Options ***version***—SSH protocol version: **v1**, **v2**, or both.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation

- Configuring the SSH Protocol Version on page 1244

rate-limit

Syntax rate-limit *limit*;

Hierarchy Level
[edit system services finger],
[edit system services ftp],
[edit system services netconf ssh],
[edit system services ssh],
[edit system services telnet],
[edit system services xnm-clear-text],
[edit system services xnm-ssl]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the maximum number of connections attempts per protocol (either IPv6 or IPv4) on an access service.

Default 150 connections

Options **rate-limit** ***limit***—(Optional) Maximum number of connection attempts allowed per minute, per IP protocol (either IPv4 or IPv6).

Range: 1 through 250

Default: 150

Required Privilege Level
system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation
- *Configuring clear-text or SSL Service for Junos XML Protocol Client Applications*

ssh

Syntax

```
ssh {
  ciphers [ cipher-1 cipher-2 cipher-3 ...];
  client-alive-count-max seconds;
  client-alive-interval seconds;
  connection-limit limit;
  hostkey-algorithm <algorithm|no-algorithm>;
  key-exchange <algorithm>;
  macs <algorithm>;
  max-sessions-per-connection <number>;
  no-tcp-forwarding;
  protocol-version [v1 v2];
  rate-limit limit;
  root-login (allow | deny | deny-password);
}
```

Hierarchy Level [edit system services]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
client-alive-interval and **client-alive-max-count** statements introduced in Junos OS Release 12.2.

Description Allow SSH requests from remote systems to the local router or switch.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Configuring SSH Service for Remote Access to the Router or Switch on page 1243

telnet

Syntax

```
telnet {
  connection-limit limit;
  rate-limit limit;
}
```

Hierarchy Level [edit system services]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Provide Telnet connections from remote systems to the local router or switch.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Configuring Telnet Service for Remote Access to a Router or Switch*

tracing

Syntax

```
tracing {
  destination-override syslog host ip-address;
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the switch to enable remote tracing to a specified host IP address.

NOTE: **The tracing statement is not supported on the QFX3000 QFabric system.**

The following processes are supported:

- **chassisd**—Chassis-control process
- **eventd**—Event-processing process
- **cosd**—Class-of-service process

If you enabled remote tracing but wish to disable it for specific processes on the switch, use the **no-remote-trace** statement at the **[edit system *process-name* traceoptions]** hierarchy level.

Default Remote tracing is disabled by default.

Options **destination-override syslog host *ip-address***—Overrides the global configuration for system tracing and has no effect if the **tracing** statement is not configured.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Understanding Tracing and Logging Operations on page 5979
- **destination-override on page 245**

Configuration Statements for Automation

allow-transients

Syntax allow-transients;

Hierarchy Level [edit system scripts commit]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, enable transient configuration changes to be committed.

Default Transient changes are disabled by default. If you do not include the **allow-transients** statement, and an enabled script generates transient changes, the command-line interface (CLI) generates an error message and the commit operation fails.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation
- *Generating a Persistent or Transient Change*
- *Creating a Macro to Read the Custom Syntax and Generate Related Configuration Statements*

apply-macro

Syntax

```
apply-macro apply-macro-name {
  parameter-name parameter-value;
}
```

Hierarchy Level All hierarchy levels

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description With commit script macros, use custom syntax in your configuration.

Macros work by locating **apply-macro** statements that you include in the candidate configuration and using the values specified in the **apply-macro** statement as parameters to a set of instructions (the macro) defined in a commit script. The commit script alters your configuration from one that contains custom syntax into a full configuration containing standard Junos OS statements.

In effect, your custom configuration syntax serves a dual purpose. The syntax allows you to simplify your configuration tasks, and it provides data (or *hooks*) that are used by commit script macros.

You can include the **apply-macro** statement at any level of the configuration hierarchy. You can include multiple **apply-macro** statements at each level of the configuration hierarchy; however, each must have a unique name.

Options *apply-macro-name*—Name of the **apply-macro** statement.

parameter-name—One or more parameters. Parameters can be any text you want to include in your configuration.

parameter-value—A value that corresponds to the parameter name. Parameter values can be any text you want to include in your configuration.

Required Privilege Level configure—To enter configuration mode; other required privilege levels depend on where the statement is located in the configuration hierarchy.

Related Documentation

- *Overview of Creating Custom Configuration Syntax with Macros*

checksum

Syntax checksum (md5 | sha-256 | sha1) *hash*;

Hierarchy Level [edit event-options event-script file *filename*],
[edit system scripts commit file *filename*],
[edit system scripts op file *filename*]

Release Information Statement introduced in Junos OS Release 9.5.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts and op scripts, specify the MD5, SHA-1, or SHA-256 checksum hash. When it executes a local event, commit, or op script, Junos OS verifies the authenticity of the script by using the configured checksum hash.

Options **md5** ***hash***—MD5 checksum of this script.

sha-256 ***hash***—SHA-256 checksum of this script.

sha1 ***hash***—SHA-1 checksum of this script.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Configuring Checksum Hashes for a Commit Script*
- *Configuring Checksum Hashes for an Event Script*
- *Configuring Checksum Hashes for an Op Script*
- *Executing an Op Script from a Remote Site*
- file checksum md5 on page 336 command in the *System Basics and Services Command Reference*
- file checksum sha-256 on page 338 command in the *System Basics and Services Command Reference*
- file checksum sha1 on page 337 command in the *System Basics and Services Command Reference*

command

Syntax command *filename-alias*;

Hierarchy Level [edit system scripts op file *filename*]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS op scripts, configure a filename alias for the script file. This allows you to run the script by referencing either the script filename or the filename alias.

Options ***filename-alias***—Alias for the script file.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Enabling an Op Script and Defining a Script Alias*

commit

Syntax

```
commit {
  allow-transients;
  direct-access;
  file filename {
    checksum (md5 | sha-256 | sha1) hash;
    optional;
    refresh;
    refresh-from url;
    source url;
  }
  max-datasize
  refresh;
  refresh-from url;
  traceoptions {
    file <filename> <files number> <size size> <world-readable | no-world-readable>;
    flag flag;
    no-remote-trace;
  }
}
```

Hierarchy Level [edit system scripts]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, configure the commit-time scripting mechanism.

Options The statements are explained separately.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation
- *Storing and Enabling Scripts*

description

Syntax description *descriptive-text*;

Hierarchy Level [edit system scripts op file *filename*]
[edit system scripts op file *filename* arguments *argument-name*]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS op scripts, provide a help-text string that appears in the command-line interface (CLI).

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Configuring Help Text for Op Scripts*
- *Declaring Arguments in Op Scripts*
- file (Op Scripts) on page 6163

direct-access

Syntax direct-access;

Hierarchy Level [edit system scripts commit]

Release Information Statement introduced in Junos OS Release 9.1.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify that commit scripts read input configurations directly from the database when inspecting these scripts for errors.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Executing Large Commit Scripts*

file (Commit Scripts)

Syntax

```
file filename {
  checksum (md5 | sha-256 | sha1) hash;
  optional;
  refresh;
  refresh-from url;
  source url;
}
```

Hierarchy Level [edit system scripts commit]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, enable a commit script that is located in the **/var/db/scripts/commit** directory.

Options ***filename***—Name of an Extensible Stylesheet Language Transformations (XSLT) or Stylesheet Language Alternative Syntax (SLAX) file containing a commit script.

The remaining statements are explained separately.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Controlling Execution of Commit Scripts During Commit Operations*

file (Op Scripts)

Syntax

```
file filename {
  arguments {
    argument-name {
      description descriptive-text;
    }
  }
  checksum (md5 | sha-256 | sha1) hash;
  command filename-alias;
  description descriptive-text;
  refresh;
  refresh-from url;
  source url;
}
```

Hierarchy Level [edit system scripts op]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS op scripts, enable an op script that is located in the **/var/db/scripts/op** directory.

Options *filename*—The name of an Extensible Stylesheet Language Transformations (XSLT) or Stylesheet Language Alternative Syntax (SLAX) file containing an op script.

The statements are explained separately.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Enabling an Op Script and Defining a Script Alias*

no-allow-url

Syntax	no-allow-url;
Hierarchy Level	[edit system scripts op]
Release Information	Statement introduced in Junos OS Release 10.0. Statement introduced in Junos OS Release 11.1 for the QFX Series.
Description	For Junos OS op scripts, prohibit the remote execution of scripts. When you include this configuration statement, the **op url** operational mode command generates an error and does not permit you to execute the op script from a remote site.
Required Privilege Level	maintenance—To view this statement in the configuration. maintenance-control—To add this statement to the configuration.
Related Documentation	• file (Op Scripts) on page 6163 • *Executing an Op Script from a Remote Site*

op

Syntax

```
op {
  file filename {
    arguments {
      argument-name {
        description descriptive-text;
      }
    }
    checksum (md5 | sha-256 | sha1) hash;
    command filename-alias;
    description descriptive-text;
    max-datasize
    refresh;
    refresh-from url;
    source url;
  }
  no-allow-url
  refresh;
  refresh-from url;
  traceoptions {
    file <filename> <files number> <size size> <world-readable | no-world-readable>;
    flag flag;
    no-remote-trace;
  }
}
```

Hierarchy Level [edit system scripts]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS op scripts, configure an operation scripting mechanism.

Options The statements are explained separately.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation
- *Storing and Enabling Scripts*

optional

Syntax optional;

Hierarchy Level [edit system scripts commit file *filename*]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, allow a commit operation to succeed even if the script specified in the **file** statement is missing from the **/var/db/scripts/commit** directory on the device.

NOTE: On the QFabric system, commit scripts are stored in the **/pbdata/mgd_shared/*partition-ip*/var/db/scripts/commit/** directory on the Director device.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Controlling Execution of Commit Scripts During Commit Operations*

refresh (Commit Scripts)

Syntax refresh;

Hierarchy Level [edit system scripts commit],
[edit system scripts commit file *filename*]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, overwrite the local copy of all enabled commit scripts or a single enabled script located in the **/var/db/scripts/commit** directory with the copy located at the source URL, as specified in the **source** statement at the same hierarchy level.

The update operation occurs as soon as you issue the **set refresh** configuration mode command. Issuing the **set refresh** command does not add the **refresh** statement to the configuration. Thus the command behaves like an operational mode command by executing an operation, instead of adding a statement to the configuration.

NOTE: On the QFabric system, commit scripts are stored in the **/pbdata/mgd_shared/*partition-ip*/var/db/scripts/commit/** directory on the Director device.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Using a Master Source Location for a Script*
- refresh-from (Commit Scripts) on page 6169
- source (Commit Scripts) on page 6172

refresh (Op Scripts)

Syntax refresh;

Hierarchy Level [edit system scripts op],
[edit system scripts op file *filename*]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 11.1 on the QFX Series.

Description For Junos OS op scripts, overwrite the local copy of all enabled op scripts or a single enabled script located in the **/var/db/scripts/op** directory with the copy located at the source URL, specified in the **source** statement at the same hierarchy level.

The update operation occurs as soon as you issue the **set refresh** configuration mode command. Issuing the **set refresh** command does not add the **refresh** statement to the configuration. Thus the command behaves like an operational mode command by executing an operation, instead of adding a statement to the configuration.

NOTE: On the QFabric system, op scripts are stored in the /pbdata/mgd_shared/*partition-ip*/var/db/scripts/op/ directory on the Director device.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Using a Master Source Location for a Script*
- refresh-from (Op Scripts) on page 6170
- source (Op Scripts) on page 6173

refresh-from (Commit Scripts)

Syntax refresh-from *url*;

Hierarchy Level [edit system scripts commit],
[edit system scripts commit file *filename*]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, overwrite the local copy of all enabled commit scripts or a single enabled script located in the **/var/db/scripts/commit** directory with the copy located at a URL other than the URL specified in the **source** statement.

The update operation occurs as soon as you issue the **set refresh-from *url*** configuration mode command. Issuing the **set refresh-from** command does not add the **refresh-from** statement to the configuration. Thus the command behaves like an operational mode command by executing an operation, instead of adding a statement to the configuration.

NOTE: This statement is not supported on the QFabric system.

Options *url*—The source specified as a Hypertext Transfer Protocol (HTTP) URL, FTP URL, or secure copy (scp)-style remote file specification.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Using an Alternate Source Location for a Script*
- refresh (Commit Scripts) on page 6167
- source (Commit Scripts) on page 6172

refresh-from (Op Scripts)

Syntax refresh-from *url*;

Hierarchy Level [edit system scripts op],
[edit system scripts op file *filename*]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 11.1 on the QFX Series.

Description For Junos OS op scripts, overwrite the local copy of all enabled op scripts or a single enabled script located in the **/var/db/scripts/op** directory with the copy located at a URL other than the URL specified in the **source** statement.

The update operation occurs as soon as you issue the **set refresh-from *url*** configuration mode command. Issuing the **set refresh-from** command does not add the **refresh-from** statement to the configuration. Thus the command behaves like an operational mode command by executing an operation, instead of adding a statement to the configuration.

NOTE: This statement is not supported on the QFabric system.

Options *url*—Source specified as a Hypertext Transfer Protocol (HTTP) URL, FTP URL, or secure copy (scp)-style remote file specification.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Using an Alternate Source Location for a Script*
- refresh (Op Scripts) on page 6168
- source (Op Scripts) on page 6173

scripts

Syntax

```
scripts {
  commit {
    allow-transients;
    direct-access;
    file filename {
      checksum (md5 | sha-256 | sha1) hash;
      optional;
      refresh;
      refresh-from url;
      source url;
    }
    max-datasize
    refresh;
    refresh-from url;
    traceoptions {
      file <filename> <files number> <size size> <world-readable | no-world-readable>;
      flag flag;
      no-remote-trace;
    }
  }
  load-scripts-from-flash;
  op {
    file filename {
      arguments {
        argument-name {
          description descriptive-text;
        }
      }
      checksum (md5 | sha-256 | sha1) hash;
      command filename-alias;
      description descriptive-text;
      max-datasize
      refresh;
      refresh-from url;
      source url;
    }
    no-allow-url
    refresh;
    refresh-from url;
    traceoptions {
      file <filename> <files number> <size size> <world-readable | no-world-readable>;
      flag flag;
      no-remote-trace;
    }
  }
  synchronize;
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit or op scripts, configure scripting mechanisms.

NOTE: **The traceoptions statement is not supported on QFabric systems.**

Options The statements are explained separately.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Storing and Enabling Scripts*

source (Commit Scripts)

Syntax source *url*;

Hierarchy Level [edit system scripts commit file *filename*]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS commit scripts, specify the location of the source file for an enabled script located in the **/var/db/scripts/commit** directory. When you include the **refresh** statement at the same hierarchy level and commit the configuration, the local copy is overwritten by the version stored at the specified URL.

NOTE: On the QFabric system, commit scripts are stored in the **/pbdata/mgd_shared/*partition-ip*/var/db/scripts/op/** directory on the Director device.

Options *url*—The source specified as an HTTP URL, FTP URL, or scp-style remote file specification.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Using a Master Source Location for a Script*
- *Overview of Updating Scripts from a Remote Source*
- refresh (Commit Scripts) on page 6167
- refresh-from (Commit Scripts) on page 6169

source (Op Scripts)

Syntax source *url*;

Hierarchy Level [edit system scripts op file *filename*]

Release Information Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description For Junos OS op scripts, specify the location of the source file for an enabled script located in the **/var/db/scripts/op** directory. When you include the **refresh** statement at the same hierarchy level, the local copy is overwritten by the version stored at the specified URL.

NOTE: On the QFabric system, commit scripts are stored in the **/pbdata/mgd_shared/*partition-ip*/var/db/scripts/op/** directory on the Director device.

Options *url*—Master source file for an op script specified as an HTTP URL, FTP URL, or scp-style remote file specification.

Required Privilege Level maintenance—To view this statement in the configuration.
maintenance-control—To add this statement to the configuration.

Related Documentation

- *Using a Master Source Location for a Script*
- refresh (Op Scripts) on page 6168
- refresh-from (Op Scripts) on page 6170

Configuration Statements for Network Analytics

address (Analytics Collector)

Syntax

```
address ip-address {
  port number {
    transport protocol {
      export-profile profile-name;
    }
  }
}
```

Hierarchy Level [edit services analytics collector]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure the address of a remote server to receive streamed analytics (queue and traffic statistics) data.

NOTE: **The address statement is available in Junos OS Release 13.2X51-D15 or later.**

Options ***ip-address***—IP address of the remote server receiving the streamed data.

port *number*—Port number of the remote server receiving the streaming data.

export-profile *profile-name*—Name of the export profile containing the parameters for the analytics data being streamed.

transport *protocol*—A transport protocol used to stream data to the port.

Values:

- **tcp**—Transmission Control Procol (TCP)
- **udp**—User Datagram Protocol (UDP)

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176
- show analytics collector on page 6353

analytics

Syntax *Junos OS Release 13.2X51-D15 and later:*

```
analytics {
  collector {
    local {
      file filename {
        size size;
        files number;
      }
    }
    address ip-address {
      port number {
        transport protocol {
          export-profile profile-name;
        }
      }
    }
  }
  export-profiles {
    profile-name {
      interface {
        information;
        statistics {
          queue;
          traffic;
        }
        status {
          link;
          queue;
          traffic;
        }
      }
      stream-format format;
      system {
        information;
        status {
          queue;
          traffic;
        }
      }
    }
  }
  resource {
    interfaces {
      interface-name {
        resource-profile name;
      }
    }
    system {
      polling-interval {
        queue-monitoring interval;
        traffic-monitoring interval;
      }
```

```
            resource-profile name;
        }
    }
    resource-profiles {
        profile-name {
            depth-threshold {
                high number;
                low number;
            }
            latency-threshold {
                high number;
                low number;
            }
            no-queue-monitoring;
            no-traffic-monitoring;
            queue-monitoring;
            traffic-monitoring;
        }
    }
    traceoptions {
        file filename {
            files number;
            size size;
        }
    }
}
```

Junos OS Release 13.2X50-D15 and 13.2X51-D10 only:

```
analytics {
  interfaces {
    all {
      depth-threshold high number low number;
      latency-threshold high number low number;
      queue-statistics;
      no-queue-statistics;
      traffic-statistics;
      no-traffic-statistics;
    }
    interface-name {
      depth-threshold high number low number;
      latency-threshold high number low number;
      queue-statistics;
      no-queue-statistics;
      traffic-statistics;
      no-traffic-statistics;
    }
  }
  queue-statistics {
    file filename {
      files number-of-files;
      size size;
    }
    interval interval;
  }
  streaming-servers {
    address ip-address {
      port number {
        stream-format format;
        stream-type type
      }
    }
  }
  traceoptions {
    file filename {
      files number;
      size size;
    }
  }
  traffic-statistics {
    file filename {
      files number-of-files;
      size size;
    }
    interval interval;
  }
}
```

Hierarchy Level [edit services]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure the network analytics feature that includes monitoring for traffic and queue statistics. The network analytics processes running on the Packet Forwarding Engine and Routing Engine collect and analyze the data, and generate reports that may be saved in log files or sent as streaming data to remote servers.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- **show analytics traffic-statistics on page 6365**
- **show analytics streaming-servers on page 6363**
- **show analytics status on page 6360**
- **show analytics queue-statistics on page 6358**
- **show analytics configuration on page 6355**

collector (Analytics)

Syntax

```
collector {
  local {
    file filename {
      size size;
      files number;
    }
  }
  address ip-address {
    port number {
      transport protocol {
        export-profile profile-name;
      }
    }
  }
}
```

Hierarchy Level [edit services analytics]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure a local file for storing network analytics statistics and/or a remote server for receiving streamed statistics data.

NOTE: **The collector statement is available in Junos OS Release 13.2X51-D15 or later.**

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000

depth-threshold

Syntax

```
depth-threshold {
  high number;
  low number;
}
```

Hierarchy Level

[edit services analytics interfaces]
[edit services analytics resource-profiles]

Release Information

Statement introduced in Junos OS Release 13.2 for the QFX Series.
Statement in the **[edit services analytics resource-profiles]** hierarchy level introduced in Junos OS Release 13.2X51-D15.

Description

If network analytics queue statistics monitoring is enabled, specify the high and low values (in bytes) of the queue depth (buffer) threshold. If you configure a depth threshold, you cannot configure the latency threshold. You can configure the depth threshold for one interface or all interfaces. Specify the high and low queue depth threshold numbers:

NOTE: **The configuration for a specific interface supersedes the global configuration for all interfaces.**

Options

high *number*—Specify the maximum value for the depth threshold.

Range: 1 to 1,250,000,000 bytes

Default:

- Junos OS Release 13.2X51-D10 or later—0 bytes
- Junos OS Release 13.2X50-D15—14,680,064 bytes (14 MB)

low *number*—Specify the minimum value for the depth threshold.

Range: 1 to 1,250,000,000 bytes

Default:

- Junos OS Release 13.2X51-D10 or later—0 bytes
- Junos OS Release 13.2X50-D15—1024 bytes (1 KB)

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176
- latency-threshold on page 6189
- resource-profiles (Analytics) on page 6193

export-profiles

Syntax

```
export-profiles {
  profile-name {
    interface {
      information;
      statistics {
        queue;
        traffic;
      }
      status {
        link;
        queue;
        traffic;
      }
    }
    stream-format format;
    system {
      information;
      status {
        queue;
        traffic;
      }
    }
  }
}
```

Hierarchy Level [edit services analytics]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure an profile to specify the network analytics data being streamed to remote servers. Each profile is a template that defines the type of data being streamed.

NOTE: **The export-profile statement is available in Junos OS Release 13.2X51-D15 or later.**

Options *profile-name*—Name of the export profile containing the configuration of the data being streamed.

stream-format *format*—Format of the streaming data being sent to a server. Only one format can be sent to each port on a server.

Values:

- **csv**—Comma-separated Values (CSV). Data sent in this format is newline separated, and each record contains one stream type (queue or traffic data) per interface.Each record contains either a “q” for a queue statistics, or a “t” for a traffic statistics.

- **gpb**—Google Protocol Buffers (GPB). Data sent in this format has a hierachical format, and is categorized by resource type (system or interfaces), which is specified in the message header. You can generate data formatted in other formats (CSV, TSV, and JSON) from GPB-encoded data.

  Each message includes a 8-byte header containing the following information:

  - Bytes 0 to 3—Length of the message.
  - Byte 4—Message version.
  - Bytes 5 to 7—Reserved for future use.

  NOTE: **A schema file called analytics.proto containing the definitions of the GPB messages is available for downloading from the following location:**

  http://www.juniper.net/techpubs/en_US/junos13.2/information-products/pathway-pages/qfx-series/network-mgmt.html

- **json**—JavaScript Object Notation (JSON). Data sent in this format is newline separated, and each record contains one stream type (queue or traffic data) per interface. Each record contains either “queue-statistics” or “traffic-statistics” in the “record type” field.
- **tsv**—Tab-separated Values (TSV). Data sent in this format is newline separated, and each record contains one stream type (queue or traffic data) per interface. Each record contains a “q” for a queue statistics, or a “t” for a traffic statistics.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**

file (Analytics)

Syntax

```
file filename {
  files number-of-files;
  size size;
}
```

Hierarchy Level

[edit services analytics collector local]
[edit services analytics queue-statistics]
[edit services analytics traffic-statistics]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Enable the logging of queue or traffic monitoring statistics in a local file. This statement does not enable monitoring.

Default This feature is disabled by default.

Options ***filename***—Specify a filename for storing queue and traffic monitoring statistics in the Comma-separated Values (CSV) format. The file is stored in the **/var/log/** directory of your device.

If you do not specify a filename, the data is not stored in a file.

NOTE: **In Junos OS Release 13.2X51-D15 or later, you configure a single filename to store both queue and traffic monitoring statistics. In Junos OS Release 13.2X51-D10 and earlier, you configure separate files for storing monitoring data, one for queue statistics, and another for traffic statistics.**

files *number-of-files*—Specify the number of files to store locally. After the number of files with the maximum file size is reached, the system starts over and writes the data to the first file.

Range: 2 to 1,000 files.

size *size*—Configure the file size in megabytes (MB).

Syntax: ***x*m** to specify MB.

Range: 10 to 4095 MB

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**

interface (Export Profiles)

Syntax

```
interface {
  information;
  statistics {
    queue;
    traffic;
  }
  status {
    link;
    queue;
    traffic;
  }
}
```

Hierarchy Level [edit services analytics export-profiles]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure an export profile for streaming network analytics data for a specific interface to remote servers. Each profile is a template that defines the type of data being streamed for that interface.

NOTE: **The interface statement is available in Junos OS Release 13.2X51-D15 or later.**

Options **information**—Information for the specified interface.

statistics—Type of monitoring statistics to be streamed.

Values:

- **queue**
- **traffic**

status—Status information about the interface to be streamed.

Values:

- **link**
- **queue**
- **traffic**

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176

interfaces (Analytics Resource)

Syntax

```
interfaces {
  interface-name {
    resource-profile profile-name;
  }
}
```

Hierarchy Level [edit services analytics resource]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Apply the network analytics resource profile to an interface for which you wish to enable queue or traffic statistics monitoring. The resource profile is a template that specifies the parameters for queue and traffic monitoring, as well as for the depth and latency thresholds.

NOTE: **The interfaces statement in the [edit services analytics resource] hierarchy is available in Junos OS Release 13.2X51-D15 or later.**

Options ***interface-name***—Name of the interface for which a resource profile has been configured.

resource-profile ***profile-name***—Name of a resource profile containing the analytics parameters that have been specified for interfaces. Information contained in a resource profile includes the configuration of queue and traffic monitoring (whether enabled or disabled), and values for the depth and latency thresholds (if applicable).

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176

interfaces (Analytics)

Syntax

```
interfaces {
  all {
    depth-threshold high number low number;
    latency-threshold high number low number;
    queue-statistics;
    no-queue-statistics;
    traffic-statistics;
    no-traffic-statistics;
  }
  interface-name {
    depth-threshold high number low number;
    latency-threshold high number low number;
    queue-statistics;
    no-queue-statistics;
    traffic-statistics;
    no-traffic-statistics;
  }
}
```

Hierarchy Level [edit services analytics]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure physical interfaces for monitoring traffic and queue statistics by the network analytics processes running on the Packet Forwarding Engine and Routing Engine. You may specify one interface or all interfaces in your configuration.

NOTE: The configuration for a specific interface supersedes the global configuration for all interfaces. You can configure traffic and queue monitoring for physical interfaces only; logical interfaces and Virtual Chassis port (VCP) interfaces are not supported.

NOTE: Disabling the queue or traffic monitoring (using the **no-queue-statistics** or **no-traffic-statistics** configuration statements) supersedes the configuration (enabling) of the feature.

Options **all**—Configure all interfaces on the device for high-frequency monitoring.

interface-name—Name of the interface to configure for high-frequency monitoring.

no-queue-statistics—Disable the collection of queue statistics.

NOTE: The **no-queue-statistics** statement supersedes the **queue-statistics** statement.

no-traffic-statistics—Disable the collection of traffic statistics.

NOTE: The **no-traffic-statistics** statement supersedes the **traffic-statistics** statement.

queue-statistics—Enable the collection of queue statistics for a specific interface or all interfaces.

traffic-statistics—Enable the collection of traffic statistics for a specific interface or all interfaces.

The remaining statements are explained separately.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**

latency-threshold

Syntax

```
latency-threshold {
  high number;
  low number;
}
```

Hierarchy Level

[edit services analytics interfaces]
[edit services analytics resource-profiles]

Release Information

Statement introduced in Junos OS Release 13.2 for the QFX Series.
Statement in the **[edit services analytics resource-profiles]** hierarchy level introduced in Junos OS Release 13.2X51-D15.

Description

If network analytics queue statistics monitoring is enabled, specify the high and low values (in microseconds) of the latency threshold of the queue. If you configure a latency threshold, you cannot configure the depth threshold. You can configure the latency threshold for one interface or all interfaces. Specify the high and low latency threshold numbers:

NOTE: **The configuration for a specific interface supersedes the global configuration for all interfaces.**

Options

high ***number***—Specify the maximum value for the latency threshold.

Range:

- Junos OS Release 13.2X51-D15 or later—1 to 100,000,000 nanoseconds (0.001 to 100,000 microseconds)
- Junos OS Release 13.2X51-D10 or earlier—1 to 100,000 microseconds

Default:

- Junos OS Release 13.2X51-D15 or later—1,000,000 nanoseconds (1000 microseconds or 1 millisecond)
- Junos OS Release 13.2X51-D10—1000 microseconds
- Junos OS Release 13.2X50-D15—900 microseconds

low ***number***—Specify the minimum value for the latency threshold.

Range:

- Junos OS Release 13.2X51-D15 or later—1 to 100,000,000 nanoseconds
- Junos OS Release 13.2X51-D10 or earlier—1 to 100,000 microseconds

Default:

- Junos OS Release 13.2X51-D15 or later—100 nanoseconds (0.1 microseconds)
- Junos OS Release 13.2X51-D10—50 microseconds

- Junos OS Release 13.2X50-D15—300 microseconds

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176
- depth-threshold on page 6181

local (Analytics Collector)

Syntax

```
local {
  file filename {
    size size;
    files number;
  }
}
```

Hierarchy Level [edit services analytics collector]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure a local file for logging network analytics (queue and traffic) statistics.

NOTE: The local statement is available in Junos OS Release 13.2X51-D15 or later.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- collector (Analytics) on page 6180

queue-statistics

Syntax

```
queue-statistics {
  file filename {
    files number-of-files;
    size size;
  }
  interval interval;
}
```

Hierarchy Level [edit services analytics]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Enable the logging of queue statistics in a local file. This statement does not enable queue statistics monitoring.

To enable queue monitoring, you must specify the **queue-statistics** configuration statement at the **[edit services analytics interfaces]** hierarchy level.

Default This feature is disabled by default.

Options **interval** ***interval***—Configure the polling interval in milliseconds.

NOTE: You can configure the polling interval for queue statistics globally for all interfaces only. Due to limitations and variations in the hardware capability of different devices, you might see a difference in value between the actual interval and configured interval.

Range:

- Junos OS Release 13.2X50-D15—8 to 1000 milliseconds (8 milliseconds to 1 second)
- Junos OS Release 13.2X51-D10 or later—10 to 1000 milliseconds (10 milliseconds to 1 second)

NOTE: In Junos OS Release 13.2X51-D10 or later, if you configured an interval of less than 10 milliseconds, the following warning messages appear during the commit process: **Queue statistics polling interval can not be less than 10 milliseconds** and **Setting Queue statistics polling interval to 10 milliseconds**. These messages do not stop the commit operation, but the interval is automatically set to 10 milliseconds.

Default:

- Junos OS Release 13.2X50-D15—8 milliseconds
- Junos OS Release 13.2X51-D10 or later—10 milliseconds

The remaining statements are explained separately.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176

resource (Analytics)

Syntax

```
resource {
  interfaces {
    interface-name {
      resource-profile profile-name;
    }
  }
  system {
    polling-interval {
      queue-monitoring interval;
      traffic-monitoring interval;
    }
    resource-profile profile-name;
  }
}
```

Hierarchy Level [edit services analytics]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure network analytics resources such as resource profiles (for interfaces and system), and polling intervals (for queue and traffic monitoring).

NOTE: **The resource statement is available in Junos OS Release 13.2X51-D15 or later.**

The remaining statements are explained separately.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176

resource-profiles (Analytics)

Syntax

```
resource-profiles {
  profile-name {
    depth-threshold {
      high number;
      low number;
    }
    latency-threshold {
      high number;
      low number;
    }
    no-queue-monitoring;
    no-traffic-monitoring;
    queue-monitoring;
    traffic-monitoring;
  }
}
```

Hierarchy Level [edit services analytics]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure resource profiles that are used as templates for specifying network analytics parameters. You use resource profiles to enable and disable queue and traffic monitoring, and specify depth and latency thresholds as applicable. Once you have defined a resource profile, you can apply it specifically to individual interfaces, or globally to a system.

NOTE: **The resource-profiles statement is available in Junos OS Release 13.2X51-D15 or later.**

The remaining statements are explained separately.

Options ***profile-name***—Specify a name for the resource profile.

no-queue-monitoring—Disable queue monitoring.

no-traffic-monitoring—Disable traffic monitoring.

queue-monitoring—Enable queue monitoring.

traffic-monitoring—Enable traffic monitoring.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176

streaming-servers

Syntax

```
streaming-servers {
  address ip-address {
    port number {
      stream-format format;
      stream-type type
    }
  }
}
```

Hierarchy Level [edit services analytics]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure remote servers to receive streaming output for the network analytics monitoring of traffic and queue statistics. The streaming function supports TCP connections only, and sends records separated by a newline character.

NOTE: **Before you use the remote server to receive streaming data, you must set up the TCP server software to process records that are separated by the newline character (\n).**

You can configure multiple servers and multiple ports on each server to receive the streaming data. You can configure different streaming data types and formats for different ports on a server, but you can configure only one streaming type and one format for each port on a server.

Options **address *ip-address***—IP address of the remote server receiving the streaming data.

port *number*—Port number of the remote server receiving the streaming data.

stream-format *format*—Format of the streaming data being sent to a server. Only one format can be sent to each port on a server.

Values:

- **csv**—Comma-separated Values (CSV). Records sent in this format contain a “q” for a queue statistics, or a “t” for a traffic statistics.
- **json**—JavaScript Object Notification (JSON). Records sent in this format contain “queue-statistics” or “traffic-statistics” in the “record type” field.
- **tsv**—Tab-separated Values (TSV). Records sent in this format contain a “q” for a queue statistics, or a “t” for a traffic statistics.

stream-type *type*—Type of streaming data sent to a port. You can specify different types of streaming data to be sent to different ports on the same server.

Values:

- **queue-statistics**

- **traffic-statistics**

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- Understanding Network Analytics Streaming Data on page 6008
- **analytics on page 6176**

system (Analytics Resource)

Syntax

```
system {
  polling-interval {
    queue-monitoring interval;
    traffic-monitoring interval;
  }
  resource-profile profile-name;
}
```

Hierarchy Level [edit services analytics resource]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Apply a network analytics resource profile to a system for which you wish to enable queue or traffic monitoring. The resource profile is a template that specifies the parameters for queue and traffic monitoring, as well as for the depth and latency thresholds.

NOTE: **The system statement in the [edit services analytics resource]** hierarchy is available in Junos OS Release 13.2X51-D15 or later.

Options **polling-interval**—Configure the polling interval for queue and traffic monitoring:

- **queue-monitoring *polling-interval***—Configure the queue monitoring interval in milliseconds.

  Range: 1 to 1000 milliseconds (1 millisecond to 1 second)

- **traffic-monitoring *polling-interval***—Configure the traffic monitoring interval in seconds.

  Range: 1 to 300 seconds (1 second to 5 minutes)

resource-profile *profile-name*—Name of a resource profile containing the global analytics parameters that have been configured for the system. Information contained in a resource profile includes the configuration of queue and traffic monitoring (whether enabled or disabled), and values for the depth and latency thresholds (if applicable).

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**

system (Export Profiles)

Syntax

```
system {
  information;
  status {
    queue;
    traffic;
  }
}
```

Hierarchy Level [edit services analytics export-profiles]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure a system-wide export profile for streaming network analytics data to remote servers. Each profile is a template that defines the type of data being streamed for that system.

NOTE: **The system statement is available in Junos OS Release 13.2X51-D15 or later.**

Options **information**—Information for the system.

status—System status information to be streamed.

Values:

- **queue**
- **traffic**

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**

traceoptions (Analytics)

Syntax

```
traceoptions {
  file filename;
  files number-of-files;
  size size;
}
```

Hierarchy Level [edit services analytics]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Configure traceoptions for the network analytics daemon (analyticsd) running on the Routing Engine.

Options

file ***filename***—Specify a filename for storing the traceoptions data. The file is stored in the **/var/log/** directory of your device.

If you do not specify a filename, the data is not stored in a file.

files ***number-of-files***—Specify the number of files to store locally. After the number files witsh the maximum file size is reached, the system starts over and writes the data to the first file.

Range: 2 to 1,000 files.

size ***size***—Configure the file size in megabytes (MB).

Syntax: ***x*m** to specify MB.

Range: 10 to 4095 MB

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**

traffic-statistics

Syntax

```
traffic-statistics {
  file filename {
    files number-of-files;
    size size;
  }
  interval interval;
}
```

Hierarchy Level [edit services analytics]

Release Information Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description Enable the logging of traffic statistics in a local file. This statement does not enable traffic statistics monitoring.

To enable the monitoring of traffic statistics, configure the **traffic-statistics** configuration statement at the **[edit services analytics interfaces]** hierarchy level.

Default This feature is disabled by default.

Options **file *filename***—Specify a filename for storing the traffic statistics in the JavaScript Object Notification (JSON) format. The file is stored in the **/var/log/** directory of your device.

If you do not specify a filename, the data is not stored in a file.

files *number-of-files*—Specify the number of files to store locally. After the number files with the maximum file size is reached, the system starts over and writes the data to the first file.

Range: 2 to 1,000 files.

interval *interval*—Configure the polling interval in seconds.

NOTE: You can configure the polling interval for traffic statistics globally for all interfaces only. Due to limitations and variations in the hardware capability of different devices, you might see a difference in value between the actual interval and configured interval.

Range:

- Junos OS Release 13.2X51-D10 or later—2 to 300 seconds (2 seconds to 5 minutes)
- Junos OS Release 13.2X50-D15—1 to 300 seconds (1 second to 5 minutes)

NOTE: In Junos OS Release 13.2X51-D10 or later, if you configured an interval of less than 2 seconds, the following warning messages appear during the commit process:

Traffic statistics polling interval can not be less than 2 seconds, and

Setting Traffic statistics polling interval to 2 seconds.

These messages do not stop the commit operation, but the interval is automatically set to 2 seconds.

Default:

- Junos OS Release 13.2X50-D15—1 second
- Junos OS Release 13.2X51-D10 or later—2 seconds

size *size*—Configure the file size in megabytes (MB).

Syntax: ***x*m** to specify MB.

Range: 10 to 4095 MB

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**

Configuration Statements for sFlow Technology

agent-id

Syntax agent-id *ip-address*;

Hierarchy Level [edit protocols sflow]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the IP address of the sFlow agent. If you do not configure the sFlow agent ID, the IP address for the agent is dynamically created using the IP address of an interface configured on the QFX Series device.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring sFlow Technology on page 6108
- **sflow on page 6205**

collector (sFlow Technology)

Syntax

```
collector ip-address {
    udp-port port-number;
}
```

Hierarchy Level [edit protocols sflow]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure a remote collector for sFlow network traffic monitoring. The device sends sFlow UDP datagrams to the configured collector for analysis. You can configure up to four collectors on the device. You specify the IP address for each collector you configure.

The remaining statement is explained separately.

Options *ip-address*—IP address of the collector.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring sFlow Technology on page 6108
- Example: Monitoring Network Traffic Using sFlow Technology on page 6079

interfaces (sFlow)

Syntax

```
interfaces interface-name {
  polling-interval seconds;
  sample-rate number;
}
```

Hierarchy Level [edit protocols sflow]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure sFlow network traffic monitoring on the specified interface on the device. You can configure sFlow parameters (polling interval, sample rate) with different values on different interfaces.

The remaining statements are explained separately.

Options *interface-name*—Name of the interface on which to configure sFlow parameters.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring sFlow Technology on page 6108
- Example: Monitoring Network Traffic Using sFlow Technology on page 6079

polling-interval

Syntax polling-interval *seconds*;

Hierarchy Level [edit protocols sflow],
[edit protocols sflow interfaces *interface-name*]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the rate (in seconds) at which successive samples of interface statistics (counters) are taken.

Default If no polling interval is configured for a particular interface, the device uses the global polling interval configured at the **[edit protocols sflow]** hierarchy level. If no global interval is configured, the device uses the default polling interval of 20 seconds.

Options *seconds*—Number of seconds between successive samples of interface statistics. Specifying a value of **0** (zero) disables the polling.

Range: 0 through 3600 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring sFlow Technology on page 6108
- Example: Monitoring Network Traffic Using sFlow Technology on page 6079

sample-rate

Syntax sample-rate *number*;

Hierarchy Level [edit protocols sflow],
[edit protocols sflow interfaces *interface-name*]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Specify the denominator (***number***) of the ratio that is the sample rate in sFlow traffic monitoring. For example, to configure a sample rate of 1 in 1000 packets, you specify a ***number*** of 1000.

Default If no sample rate is configured for a particular interface, the device uses the global sample rate configured at the **[edit protocols sflow]** hierarchy level. If no global rate is configured, the device uses the default sample rate of 1 in 2000 packets.

Options *number*—Denominator of the ratio representing the sample rate (one packet out of *number*).

Range: 1 through 16,777,215

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring sFlow Technology on page 6108
- Example: Monitoring Network Traffic Using sFlow Technology on page 6079

sflow

Syntax

```
sflow {
  agent-id ip-address;
  collector ip-address {
    udp-port port-number;
  }
  interfaces interface-name {
    polling-interval number;
    sample-rate {
      egress number;
      ingress number;
    }
  }
  polling-interval number;
  sample-rate {
    egress number;
    ingress number;
  }
  source-ip ip-address;
  traceoptions {
    file filename <files number> <no-stamp> <replace> <size size> <world-readable |
      no-world-readable>;
    flag flag;
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure sFlow technology to monitor traffic continuously on specified interfaces simultaneously. sFlow data can be used to characterize network activity.

The remaining statements are explained separately.

Default The sFlow protocol is disabled by default.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring sFlow Technology on page 6108
- Example: Monitoring Network Traffic Using sFlow Technology on page 6079

source-ip

Syntax source-ip *ip-address*;

Hierarchy Level [edit protocols sflow]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the source IP address to be used for sFlow datagrams. If you do not configure a source IP address, it is dynamically created based on the IP address of an Ethernet interface configured on the QFX Series device.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring sFlow Technology on page 6108
- **sflow on page 6205**

traceoptions (sFlow Technology)

Syntax

```
traceoptions {
  file filename <files number> <no-stamp> <replace> <size size> <world-readable |
    no-world-readable>;
  flag flag;
}
```

Hierarchy Level [edit protocols sflow]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Define tracing operations for sFlow technology.

Default The **traceoptions** feature is disabled.

Options

file *filename*—Name of the file to receive the tracing operation output. Enclose the name in quotation marks. Output files are located in the **/var/log/** directory.

files *number*—(Optional) Maximum number of trace files. When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**. Incoming trace file data is logged in the now empty **trace-file**. When **trace-file** again reaches its maximum size, **trace-file.0** is renamed **trace-file.1** and **trace-file** is renamed **trace-file.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify the maximum number of files, you must also specify the maximum file size using the **size** option.

Range: 2 through 1000 files

Default: 1 trace file

flag *flag*—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

- all—Trace all sFlow monitoring events.
- client-server—Trace sFlow monitoring client-server events.
- configuration—Trace sFlow monitoring configuration events.
- interface—Trace sFlow monitoring interface events.
- rtsock—Trace routing socket code events.

no-stamp—(Optional) Do not place timestamp information at the beginning of each line in the trace file.

no-world-readable—(Optional) Prevent any user from reading the trace file.

replace—(Optional) Replace an existing trace file if there is one.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**. Incoming trace file data is logged in the now empty **trace-file**. When **trace-file** again reaches its maximum size, **trace-file.0** is renamed **trace-file.1** and **trace-file** is renamed **trace-file.0**. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you must also specify a maximum number of trace files with the files option.

Syntax: **xk** to specify KB, **xm** to specify MB, or **xg** to specify GB

Range: 10 KB through the maximum file size of 4 GB

Default: 128 KB

world-readable—(Optional) Allow any user to read the trace file.

Required Privilege Level
routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation
- *Overview of sFlow Technology*

udp-port

Syntax udp-port *port-number*;

Hierarchy Level [edit protocols sflow collector]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the UDP port for a remote collector for sFlow network traffic monitoring. The device sends sFlow UDP datagrams to the collector for analysis.

Default Port 6343

Options *port-number*—UDP port number for this collector.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring sFlow Technology on page 6108
- Example: Monitoring Network Traffic Using sFlow Technology on page 6079

Configuration Statements for SNMP

access (SNMP)

Syntax

```
access {
  group group-name {
    (default-context-prefix | context-prefix context-prefix) {
      security-model (any | usm | v1 | v2c) {
        security-level (authentication | none | privacy) {
          notify-view view-name;
          read-view view-name;
          write-view view-name;
        }
      }
    }
  }
}
```

Hierarchy Level [edit snmp v3 vacm]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set SNMP access limits.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

address (SNMP)

Syntax address *address*;

Hierarchy Level [edit snmp v3 target-address *target-address-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the SNMP target address for receiving traps or informs.

Options *address*—IPv4 address of the system to receive traps or informs. You must specify an address, not a hostname.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Understanding the Implementation of SNMP on the QFabric System on page 6023
- Configuring SNMP on page 1237
- Example: Configuring SNMP on page 6083

address-mask

Syntax address-mask *address-mask*;

Hierarchy Level [edit snmp v3 target-address *target-address-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 on the QFX Series.

Description Define and verify the source addresses for a group of target addresses for SNMP traps and informs.

Options ***address-mask***—Define a range of addresses.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Address Mask*

agent-address

Syntax agent-address outgoing-interface;

Hierarchy Level [edit snmp trap-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the agent address of all SNMPv1 traps generated by this router or switch. Currently, the only option is **outgoing-interface**, which sets the agent address of each SNMPv1 trap to the address of the outgoing interface of that trap.

Options **outgoing-interface**—Value of the agent address of all SNMPv1 traps generated by this router or switch. The **outgoing-interface** option sets the agent address of each SNMPv1 trap to the address of the outgoing interface of that trap.

Default: Disabled (the agent address is not specified in SNMPv1 traps).

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Agent Address for SNMP Traps*

alarm (SNMP RMON)

Syntax

```
alarm index {
  description description;
  falling-event-index index;
  falling-threshold integer;
  falling-threshold-interval seconds;
  interval seconds;
  request-type (get-next-request | get-request | walk-request);
  rising-event-index index;
  rising-threshold integer;
  sample-type (absolute-value | delta-value);
  startup-alarm (falling-alarm | rising-alarm | rising-or-falling alarm);
  syslog-subtag syslog-subtag;
  variable oid-variable;
}
```

Hierarchy Level [edit snmp rmon]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure RMON alarm entries.

Options *index*—Identifies this alarm entry as an integer.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring an Alarm Entry and Its Attributes*
- *event (SNMP)*
- Configuring RMON Alarms and Events on page 6117
- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

authentication-md5

Syntax

```
authentication-md5 {
  authentication-password authentication-password;
}
```

Hierarchy Level

[edit snmp v3 usm local-engine user *username*],
[edit snmp v3 usm remote-engine *engine-id* user username]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure MD5 as the authentication type for the SNMPv3 user.

NOTE: You can only configure one authentication type for each SNMPv3 user.

The remaining statement is explained separately.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring MD5 Authentication*

authentication-none

Syntax authentication-none;

Hierarchy Level [edit snmp v3 usm local-engine user *username*],
[edit snmp v3 usm remote-engine *engine-id* user *username*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure that there should be no authentication for the SNMPv3 user.

NOTE: You can configure only one authentication type for each SNMPv3 user.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring No Authentication*

authentication-password

Syntax authentication-password *authentication-password*;

Hierarchy Level [edit snmp v3 usm local-engine user *username* authentication-md5],
[edit snmp v3 usm local-engine user *username* authentication-sha],
[edit snmp v3 usm remote-engine *engine-id* user *username* authentication-md5],
[edit snmp v3 usm remote-engine *engine-id* user *username* authentication-sha]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the password for user authentication.

Options *authentication-password*—Password that a user enters. The password is then converted into a key that is used for authentication.

SNMPv3 has special requirements when you create plain-text passwords on a router or switch:

- The password must be at least eight characters long.
- The password can include lowercase letters, uppercase letters, numbers, and the following special characters:

  , . / \ < > ; : ' [ ] { } ~ ! @ # $ % ^ * _ + = - `

  In addition, the following special characters are also supported, but you must enclose them within quotation marks (“”) if you enter them on the CLI; if you use a Network Management System to enter the password, the quotation marks are not required:

  | & ( ) ?

  Control characters—entered by simultaneously pressing the Ctrl key and additional keys—are not supported.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring MD5 Authentication*
- *Configuring SHA Authentication*

authentication-sha

Syntax

```
authentication-sha {
  authentication-password authentication-password;
}
```

Hierarchy Level

[edit snmp v3 usm local-engine user *username*],
[edit snmp v3 usm remote-engine *engine-id* user *username*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure the secure hash algorithm (SHA) as the authentication type for the SNMPv3 user.

NOTE: You can configure only one authentication type for each SNMPv3 user.

The remaining statement is explained separately.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring SHA Authentication*

authorization

Syntax authorization *authorization*;

Hierarchy Level [edit snmp community *community-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the access authorization for SNMP **Get**, **GetBulk**, **GetNext**, and **Set** requests.

Options *authorization*—Access authorization level:

- **read-only**—Enable **Get**, **GetNext**, and **GetBulk** requests.
- **read-write**—Enable all requests, including **Set** requests. You must configure a view to enable **Set** requests.

NOTE: **The read-write option is not supported on the QFX3000 QFabric system.**

Default: read-only

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring the SNMP Community String on page 6113

bucket-size

Syntax bucket-size *number*;

Hierarchy Level [edit snmp rmon history *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the sampling of Ethernet statistics for network fault diagnosis, planning, and performance tuning.

Default 50

Options *number*—Number of discrete samples of Ethernet statistics requested.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

categories

Syntax

```
categories {
  category;
}
```

Hierarchy Level [edit snmp trap-group *group-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define the types of traps that are sent to the targets of the named trap group.

Default If you omit the **categories** statement, all trap types are included in trap notifications.

Options *category*—Name of a trap type: **authentication**, **chassis**, **configuration**, **link**, **remote-operations**, **rmon-alarm**, or **startup**.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring SNMP Trap Groups on page 6114

client-list

Syntax

```
client-list client-list-name {
  ip-addresses;
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define a list of SNMP clients.

Options ***client-list-name***—Name of the client list.

ip-addresses—IP addresses of the SNMP clients to be added to the client list,

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Adding a Group of Clients to an SNMP Community on page 6115

client-list-name

Syntax client-list-name *client-list-name*;

Hierarchy Level [edit snmp community *community-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Add a client list or prefix list to an SNMP community.

Options ***client-list-name***—Name of the client list or prefix list.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Adding a Group of Clients to an SNMP Community on page 6115

clients

Syntax

```
clients {
  address <restrict>;
}
```

Hierarchy Level [edit snmp community *community-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the IPv4 or IPv6 addresses of the SNMP client hosts that are authorized to use this community.

Default If you omit the **clients** statement, all SNMP clients using this community string are authorized to access the switch.

Options ***address***—Address of an SNMP client that is authorized to access this switch. You must specify an address, not a hostname. To specify more than one client, include multiple ***address*** options.

restrict—(Optional) Do not allow the specified SNMP client to access the switch.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the SNMP Community String*

commit-delay

Syntax commit-delay *seconds*;

Hierarchy Level [edit snmp nonvolatile]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the timer for the SNMP **Set** reply and start of the commit.

Options ***seconds***—Delay between an affirmative SNMP **Set** reply and start of the commit operation.

Default: 5 seconds

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Commit Delay Timer*

community (SNMP)

Syntax

```
community community-name {
  authorization authorization;
  client-list-name client-list-name;
  clients {
    address restrict;
  }
  view view-name;
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define an SNMP community. An SNMP community authorizes SNMP clients based on the source IP address of incoming SNMP request packets. A community also defines which MIB objects are available and the operations (read-only or read-write) allowed on those objects.

NOTE: **The authorization read-write option is not supported on the QFX3000 QFabric system.**

The SNMP client application specifies an SNMP community name in **Get**, **GetBulk**, **GetNext**, and **Set** SNMP requests.

Default If you omit the **community** statement, all SNMP requests are denied.

Options *community-name*—Community string. If the name includes spaces, enclose it in quotation marks (" ").

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring the SNMP Community String on page 6113

community (RMON)

Syntax community *community-name*;

Hierarchy Level [edit snmp rmon event *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the SNMP trap group that is used when generating a trap (if the eventType object is configured to send traps). If that trap group has the rmon-alarm trap category configured, a trap is sent to all the targets configured for that trap group. The community string in the trap matches the name of the trap group (and hence, the value of eventCommunity). If nothing is configured, traps are sent to each group that has the rmon-alarm category configured.

The event community is not the same as an SNMP community.

Options ***community-name***—Name of the trap group that is used when generating a trap if the event is configured to send traps.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

community-name (SNMP)

Syntax community-name *community-name*;

Hierarchy Level [edit snmp v3 snmp-community *community-index*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11. for the QFX Series.

Description Define an SNMP community to authorize SNMPv1 or SNMPv2c clients in an SNMPv3 system. When you configure a community in SNMPv3, you can also specify a security name. The access privileges associated with the security name determine which MIB objects are available and which operations (read, write, or notify) are allowed on those objects.

Options ***community-name***—Community string for an SNMPv1 or SNMPv2c community. If unconfigured, it is the same as the community index. If the name includes spaces, enclose the name in quotation marks (" ").

NOTE: Community names must be unique. You cannot configure the same community name at the **[edit snmp community]** and **[edit snmp v3 snmp-community *community-index*]** hierarchy levels.

The community name at the **[edit snmp v3 snmp-community *community-index*]** hierarchy level is encrypted and not displayed in the command-line interface (CLI).

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the SNMPv3 Community*

contact

Syntax contact *contact*;

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define the value of the MIB II **sysContact** object, which is the contact person for the managed system.

Options ***contact***—Name of the contact person. If the name includes spaces, enclose it in quotation marks (" ").

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the System Contact on a Device Running Junos OS*

description (SNMP)

Syntax description *description*;

Hierarchy Level [edit snmp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define the value of the MIB II **sysDescription** object, which is the description of the system being managed.

Options ***description***—System description. If the name includes spaces, enclose it in quotation marks (" ").

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the System Description on a Device Running Junos OS*

description (RMON)

Syntax description *description*;

Hierarchy Level [edit snmp rmon alarm *index*],
[edit snmp rmon event *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Text description of alarm or event.

Options *description*—Text description of an alarm or event entry. If the description includes spaces, enclose it in quotation marks (" ").

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

destination-port (SNMP)

Syntax destination-port *port-number*;

Hierarchy Level [edit snmp trap-group]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Assign a trap port number other than the default.

Default If you omit this statement, the default port is 162.

Options *port-number*—SNMP trap port number.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring SNMP Trap Groups on page 6114

engine-id

Syntax

```
engine-id {
  (local engine-id-suffix | use-default-ip-address | use-mac-address);
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define a unique identifier for an SNMPv3 engine by configuring the suffix of the engine ID. The engine ID is used for identification only and not for addressing. There are two parts of an engine ID: the prefix and the suffix. The prefix is formatted according to the specifications defined in RFC 3411, *An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks* and cannot be configured. The suffix is configured here.

NOTE: SNMPv3 authentication and encryption keys are generated based on the associated user passwords and the engine ID. If you configure or change the engine ID, you must commit the user passwords and new engine ID before you configure SNMPv3 users, or the authentication will fail.

By default, the engine ID suffix is configured with the MAC address of the management interface (the **use-mac-address** option) on the QFX Series. You can override this configuration by using the **local** ***engine-id-suffix*** or **use-default-ip-address** option.

Default **use-mac-address**

Options **local** ***engine-id-suffix***—The engine ID suffix is set based on the data entered.

use-default-ip-address—The engine ID suffix is generated from the default IP address.

use-mac-address—The engine ID suffix is generated from the MAC address of the management interface on the switch.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- SNMPv3 Overview on page 6031
- Configuring SNMP on page 1237
- Minimum SNMPv3 Configuration on a Device Running Junos OS on page 6032

event

Syntax

event *index* {
  community *community-name*;
  description *description*;
  type (RMON Notification) *type*;
}

Hierarchy Level

[edit snmp rmon]

Release Information

Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure RMON event entries.

Options

index—Identifier for a specific event entry.

The remaining statements are explained separately.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

falling-event-index (RMON)

Syntax falling-event-index *index*;

Hierarchy Level [edit snmp rmon alarm *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the index number of the event entry that is used when a falling threshold is crossed. You specify the falling-event index when you configure an SNMP RMON alarm. If this value is zero, no event is triggered.

Options *index*—Index of the event entry that is used when a falling threshold is crossed.

Range: 0 through 65,535

Default: 0

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

falling-threshold (Health Monitor)

Syntax falling-threshold *percentage*;

Hierarchy Level [edit snmp health-monitor]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the lower threshold for the monitored object when you configure a health monitor alarm. By setting a rising and a falling threshold for a monitored variable, you can be alerted whenever the value of the variable falls outside the allowable operational range.

Options ***percentage***—Lower threshold for the alarm entry.

Range: 1 through 100

Default: 70 percent of the maximum possible value

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- **rising-threshold on page 1331**
- Configuring Health Monitoring on page 6119

falling-threshold (RMON)

Syntax falling-threshold *integer*;

Hierarchy Level [edit snmp rmon alarm *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the lower threshold for the sampled variable (monitored object) when you configure an SNMP RMON alarm. By setting a rising and a falling threshold for a variable, you can be alerted whenever the value of the variable falls outside the allowable operational range.

Options *integer*—Lower threshold for the alarm entry.

Range: –2,147,483,648 through 2,147,483,647

Default: 20 percent less than the **rising-threshold** value

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033

- *Junos OS Network Management Configuration Guide*

falling-threshold-interval

Syntax falling-threshold-interval *seconds*;

Hierarchy Level [edit snmp rmon alarm *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the interval between samples after the rising threshold is exceeded and the value of the sample starts to drop. If the value of the sample drops and exceeds the falling threshold, the regular sampling interval is used.

Options ***interval***—Time between samples, in seconds.

Range: 1 through 2,147,483,647 seconds

Default: 60 seconds

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

filter-duplicates

Syntax filter-duplicates;

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Filter duplicate **Get**, **GetNext**, or **GetBulk** SNMP requests.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Understanding the Implementation of SNMP on the QFabric System on page 6023
- Example: Configuring SNMP on page 6083

filter-interfaces

Syntax

```
filter-interfaces {
  all-internal-interfaces;
  interfaces interface
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Filter out information related to specific interfaces from the output of SNMP **Get** and **GetNext** requests performed on interface-related MIBs.

Options **all-internal-interfaces**—Filter out information from SNMP **Get** and **GetNext** requests for all internal interfaces.

interfaces—Filter out information from SNMP **Get** and **GetNext** requests for the specified interface.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Filtering Interface Information Out of SNMP Get and GetNext Output*

group (Associating a Security Name)

Syntax group *group-name*;

Hierarchy Level [edit snmp v3 vacm security-to-group security-model (usm | v1 | v2c) security-name *security-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Associate a security name with a group composed of users with the same access privileges. The security name is used during authentication of SNMP messages, and is mapped to a username.

Options ***group-name***—Collection of SNMP security names that share the same SNMPv3 access privileges.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Group*

group (Configuring Access Privileges)

Syntax

```
group group-name {
  (default-context-prefix | context-prefix context-prefiix){
    security-model (any | usm | v1 | v2c) {
      security-level (authentication | none | privacy) {
        notify-view view-name;
        read-view view-name;
        write-view view-name;
      }
    }
  }
}
```

Hierarchy Level

[edit snmp v3 vacm access]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Assign the security name to a group, and specify the SNMPv3 context applicable to the group. The **default-context-prefix** statement, when included, adds all the contexts configured on the device to the group, whereas the **context-prefix *context-prefix*** statement enables you to specify a context and to add that particular context to the group.

(Not applicable to the QFX Series.) When the context prefix is specified as default (for example, **context-prefix default**), the context associated with the master routing instance is added to the group. To specify a routing instance that is part of a logical system, specify it as **logical system/routing instance**. For example, to specify routing instance ri1 in logical system ls1, include **context-prefix ls1/ri1**.

The remaining statements under this hierarchy are explained separately.

Options

group-name—SNMPv3 group name created for the SNMPv3 group.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Group*

health-monitor

Syntax

```
health-monitor {
  falling-threshold percentage;
  interval seconds;
  rising-threshold percentage;
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure health monitoring.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring Health Monitoring on page 6119
- Understanding Health Monitoring on page 6037

history

Syntax

```
history history-index {
  bucket-size number;
  interface interface-name;
  interval seconds;
  owner owner-name;
}
```

Hierarchy Level [edit snmp rmon]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure RMON history group entries. This RMON feature can be used with the Simple Network Management Protocol (SNMP) agent on the network to monitor all the traffic flowing among devices on all connected LAN segments. The RMON history feature collects statistics in accordance with user-configurable parameters.

The history group controls the periodic statistical sampling of data from various types of networks. This group contains configuration entries that specify an interface, polling period, and other parameters. If you use the **history** statement, you must also configure the **interface** ***interface-name*** statement.

Options *history-index*—Provide a number for this history entry.

Range: 1 through 655535

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp–control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

interface (SNMP)

Syntax interface [*interface-names*];

Hierarchy Level [edit snmp]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the interfaces on which SNMP requests can be accepted.

Default If you omit this statement, SNMP requests entering the router or switch through any interface are accepted.

Options *interface-names*—Names of one or more logical interfaces.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring the Interfaces on Which SNMP Requests Can Be Accepted on page 6116

interface (RMON)

Syntax interface *interface-name*;

Hierarchy Level [edit snmp rmon history *history-index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the interface to be monitored in the specified RMON history entry.

Only one interface can be specified for a particular RMON history index. There is a one-to-one relationship between the interface and the history index. The interface must be specified in order for the RMON history to be created.

Options ***interface-name***—Specify the interface to be monitored within the specified entry of the RMON history of Ethernet statistics.

Required Privilege Level snmp—To view this statement in the configuration.
snmp–control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

interval (Health Monitor)

Syntax interval *seconds*;

Hierarchy Level [edit snmp health-monitor]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the interval between sampling of the object being monitored by the health monitor.

Options ***seconds***—Time between samples, in seconds.

Range: **1** through **2147483647** seconds

Default: **300** seconds

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring Health Monitoring on page 6119

interval (RMON)

Syntax interval *seconds*;

Hierarchy Level [edit snmp rmon alarm *index*],
[edit snmp rmon history *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the interval over which data is to be sampled for the specified alarm or interface.

Default **60 sec** for alarm sampling.

1800 sec for history sampling.

Options ***seconds***—Interval at which data is to be sampled for the specified alarm or interface.

Required Privilege Level snmp—To view this statement in the configuration.
snmp–control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

local-engine

Syntax

```
local-engine {
  user username {
    authentication-md5 {
      authentication-password authentication-password;
    }
    authentication-none;
    authentication-sha {
      authentication-password authentication-password;
    }
    privacy-aes128 {
      privacy-password privacy-password;
    }
    privacy-des {
      privacy-password privacy-password;
    }
    privacy-3des {
      privacy-password privacy-password;
    }
    privacy-none {
      privacy-password privacy-password;
    }
  }
}
```

Hierarchy Level [edit snmp v3 usm]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure local engine information for the user-based security model (USM).

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Creating SNMPv3 Users on page 6120

location

Syntax location *location*;

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define the value of the MIB II **sysLocation** object, which is the physical location of the managed system.

Options *location*—Location of the local system. You must enclose the name within quotation marks (" ").

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the System Location for a Device Running Junos OS*

message-processing-model

Syntax message-processing-model (v1 | v2c | v3);

Hierarchy Level [edit snmp v3 target-parameters *target-parameter-name* parameters]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the message processing model to be used when generating SNMP notifications.

Options **v1**—SNMPv1 message process model.

v2c—SNMPv2c message process model.

v3—SNMPv3 message process model.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the Message Processing Model*

name

Syntax name *name*;

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the system name from the command-line interface.

Options *name*—System name override.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the System Name*

nonvolatile

Syntax

```
nonvolatile {
  commit-delay seconds;
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure options for SNMP **Set** requests.

The statement is explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Commit Delay Timer*
- *commit-delay*

notify

Syntax

```
notify name {
  tag tag-name;
  type (trap | inform);
}
```

Hierarchy Level [edit snmp v3]

Release Information Statement introduced before Junos OS Release 7.4.
type inform option added in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Select management targets for SNMPv3 notifications as well as the type of notifications. Notifications can be either traps or informs.

Options ***name***—Name assigned to the notification.

tag-name—Notifications are sent to all targets configured with this tag.

type—Notification type is **trap** or **inform**. Traps are unconfirmed notifications. Informs are confirmed notifications.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Inform Notification Type and Target Address*
- *Configuring the SNMPv3 Trap Notification*

notify-filter (Applying to the Management Target)

Syntax notify-filter *profile-name*;

Hierarchy Level [edit snmp v3 target-parameters *target-parameters-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the notify filter applied to a specific set of SNMPv3 target parameters. Target parameters are the message processing and security parameters for notifications sent to a target SNMP manager.

Options ***profile-name***—Name of the notify filter to apply to notifications.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Applying the Trap Notification Filter*

notify-filter (Configuring the Profile Name)

Syntax

```
notify-filter profile-name {
  oid oid (include | exclude);
}
```

Hierarchy Level [edit snmp v3]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify a group of MIB objects for which you define access. The notify filter limits the type of traps or informs sent to the network management system.

Options ***profile-name***—Name assigned to the notify filter.

The remaining statement is explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the Trap Notification Filter*
- *oid (SNMP)*

notify-view

Syntax notify-view *view-name*;

Hierarchy Level [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*) security-model (any | usm | v1 | v2c) security-level (authentication | none | privacy)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Associate the notify view with a community (for SNMPv1 or SNMPv2c clients) or a group name (for SNMPv3 clients).

Options ***view-name***—Name of the view to which the SNMP user group has access.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring MIB Views on page 6116
- *Configuring the Notify View*

oid

Syntax oid *object-identifier* (exclude| include);

Hierarchy Level [edit snmp view *view-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify an object identifier (OID) used to represent a subtree of MIB objects.

Options **exclude**—Exclude the subtree of MIB objects represented by the specified OID.

include—Include the subtree of MIB objects represented by the specified OID.

object-identifier—OID used to represent a subtree of MIB objects. All MIB objects represented by this statement have the specified OID as a prefix. You can specify the OID using either a sequence of dotted integers or a subtree name.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring MIB Views on page 6116

oid (SNMPv3)

Syntax oid *oid* (include | exclude);

Hierarchy Level [edit snmp v3 notify-filter *profile-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify an object identifier (OID) used to represent a subtree of MIB objects. This OID is a prefix that the represented MIB objects have in common.

Options **exclude**—Exclude the subtree of MIB objects represented by the specified OID.

include—Include the subtree of MIB objects represented by the specified OID.

oid—Object identifier used to represent a subtree of MIB objects. All MIB objects represented by this statement have the specified OID as a prefix. You can specify the OID using either a sequence of dotted integers or a subtree name.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- SNMPv3 Overview on page 6031
- Minimum SNMPv3 Configuration on a Device Running Junos OS on page 6032
- Configuring SNMP on page 1237
- *Configuring the SNMPv3 Trap Notification*

owner

Syntax owner *owner-name*;

Hierarchy Level [edit snmp rmon history *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the user or group responsible for this RMON history configuration.

Options *owner-name*—User or group responsible for this configuration.

Range: 0 through 32 alphanumeric characters

Required Privilege Level snmp—To view this statement in the configuration.
snmp–control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

parameters

Syntax

```
parameters {
  message-processing-model (v1 | v2c | v3);
  security-level (none | authentication | privacy);
  security-model (usm | v1 | v2c);
  security-name security-name;
}
```

Hierarchy Level [edit snmp v3 target-parameters *target-parameters-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a set of target parameters for message processing and security.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Defining and Configuring the Trap Target Parameters*

port (SNMP)

Syntax port *port-number*;

Hierarchy Level [edit snmp v3 target-address *target-address-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a UDP port number for an SNMP target.

Default If you omit this statement, the default port is 162.

Options ***port-number***—Port number for the SNMP target.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the Port*

privacy-3des

Syntax

```
privacy-3des {
  privacy-password privacy-password;
}
```

Hierarchy Level

[edit snmp v3 usm local-engine user *username*],
[edit snmp v3 usm remote-engine *engine-id* user *username*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure the triple Data Encryption Standard (3DES) as the privacy type for the SNMPv3 user.

Options

privacy-password ***privacy-password***—Password that a user enters. The password is then converted into a key that is used for encryption.

SNMPv3 has special requirements when you create plain-text passwords on a router or switch:

- The password must be at least eight characters long.
- The password can include alphabetic, numeric, and special characters, but it cannot include control characters.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Encryption Type*

privacy-aes128

Syntax

```
privacy-aes128 {
  privacy-password privacy-password;
}
```

Hierarchy Level

[edit snmp v3 usm local-engine user *username*],
[edit snmp v3 usm remote-engine *engine-id* user *username*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure the Advanced Encryption Standard encryption algorithm (CFB128-AES-128 Privacy Protocol) for the SNMPv3 user.

Options

privacy-password ***privacy-password***—Password that a user enters. The password is then converted into a key that is used for encryption.

SNMPv3 has special requirements when you create plain-text passwords on a router or switch:

- The password must be at least eight characters long.
- The password can include alphabetic, numeric, and special characters, but it cannot include control characters.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Encryption Type*

privacy-des

Syntax

```
privacy-des {
  privacy-password privacy-password;
}
```

Hierarchy Level

[edit snmp v3 usm local-engine user *username*],
[edit snmp v3 usm remote-engine *engine-id* user *username*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure the Data Encryption Standard (DES) as the privacy type for the SNMPv3 user.

Options

privacy-password ***privacy-password***—Password that a user enters. The password is then converted into a key that is used for encryption.

SNMPv3 has special requirements when you create plain-text passwords on a router or switch:

- The password must be at least eight characters long.
- The password can include alphabetic, numeric, and special characters, but it cannot include control characters.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Encryption Type*

privacy-none

Syntax

```
privacy-none;
```

Hierarchy Level

[edit snmp v3 usm local-engine user *username*],
[edit snmp v3 usm remote-engine *engine-id* user *username*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure that no encryption be used for the SNMPv3 user.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Encryption Type*

privacy-password

Syntax privacy-password *privacy-password*;

Hierarchy Level [edit snmp v3 usm local-engine user *username* privacy-3des],
[edit snmp v3 usm local-engine user *username* privacy-aes128],
[edit snmp v3 usm local-engine user *username* privacy-des],
[edit snmp v3 usm remote-engine *engine-id* user *username* privacy-3des],
[edit snmp v3 usm remote-engine *engine-id* user *username* privacy-aes128],
[edit snmp v3 usm remote-engine *engine-id* user *username* privacy-des]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a privacy password for the SNMPv3 user.

Options *privacy-password*—Password that a user enters. The password is then converted into a key that is used for encryption.

SNMPv3 has special requirements when you create plain-text passwords on a router or switch:

- The password must be at least eight characters long.
- The password can include alphabetic, numeric, and special characters, but it cannot include control characters.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Encryption Type*

read-view

Syntax read-view *view-name*;

Hierarchy Level [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*) security-model (any | usm | v1 | v2c) security-level (authentication | none | privacy)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Associate the read-only view with a community (for SNMPv1 or SNMPv2c clients) or a group name (for SNMPv3 clients).

Options ***view-name***—The name of the view to which the SNMP user group has access.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Read View*
- Configuring MIB Views on page 6116

remote-engine

Syntax

```
remote-engine engine-id {
  user username {
    authentication-md5 {
      authentication-password authentication-password;
    }
    authentication-none;
    authentication-sha {
      authentication-password authentication-password;
    }
    privacy-aes128 {
      privacy-password privacy-password;
    }
    privacy-des {
      privacy-password privacy-password;
    }
    privacy-3des {
      privacy-password privacy-password;
    }
    privacy-none {
      privacy-password privacy-password;
    }
  }
}
```

Hierarchy Level [edit snmp v3 usm]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the remote engine information for the user-based security model (USM). To send inform messages to an SNMPv3 user on a remote device, you must configure the engine identifier for the SNMP agent on the remote device where the user resides.

Options *engine-id*—Specify engine identifier in hexadecimal format. Used to compute the security digest for authenticating and encrypting packets sent to a user on the remote host.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Remote Engine and Remote User*

request-type

Syntax request-type (get-next-request | get-request | walk-request);

Hierarchy Level [edit snmp rmon alarm *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Extend monitoring to a specific SNMP object instance (get-request), to all object instances belonging to a MIB branch (walk-request), or to the next object instance after the instance specified in the configuration (get-next-request).

Default **walk-request**

Options **get-next-request**—Perform an SNMP get next request.

get-request—Perform an SNMP get request.

walk-request—Perform an SNMP walk request.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033

- *Junos OS Network Management Configuration Guide*

retry-count (SNMPv3)

Syntax retry-count *number*;

Hierarchy Level [edit snmp v3 target-address *target-address-name*]

Release Information Statement introduced in Junos OS Release 7.4.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the retry count for SNMP informs.

Options *number*—Maximum number of times the inform is transmitted if no acknowledgment is received. If no acknowledgment is received after the inform is transmitted the maximum number of times, the inform message is discarded.

Default: 3 times

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring SNMP Informs on page 6125
- *timeout*

rising-event-index

Syntax rising-event-index *index*;

Hierarchy Level [edit snmp rmon alarm *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the index of the event entry that is used when a rising alarm threshold is exceeded. The rising-event index is specified when you configure an SNMP RMON alarm. If this value is zero, no event is triggered.

Options *index*—Index of the event entry that is used when a rising threshold is exceeded.

Range: 0 through 65,535

Default: 0

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

rising-threshold (Health Monitor)

Syntax rising-threshold *percentage*;

Hierarchy Level [edit snmp health-monitor]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the upper threshold for the monitored object when you configure a health monitor alarm. By setting a rising and a falling threshold for a monitored object, you can be alerted whenever the value of the variable falls outside the allowable operational range.

Options ***percentage***—Upper threshold for the alarm entry.

Range: **1** through **100**

Default: **80** percent of the maximum possible value

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring Health Monitoring on page 6119
- **falling-threshold on page 1296**

rising-threshold (RMON)

Syntax rising-threshold *integer*;

Hierarchy Level [edit snmp rmon alarm *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the upper threshold for the sampled variable (monitored object) when you configure an SNMP RMON alarm. By setting a rising and a falling threshold for a variable, you can be alerted whenever the value of the variable falls outside the allowable operational range.

Options *integer*—Upper threshold for the alarm entry.

Range: –2,147,483,648 through 2,147,483,647

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

rmon

Syntax

```
rmon {
  alarm index {
    description description;
    falling-event-index index;
    falling-threshold integer;
    falling-threshold-interval seconds;
    interval seconds;
    request-type;
    rising-event-index index;
    rising-threshold integer;
    sample-type (absolute-value | delta-value);
    startup-alarm (falling-alarm | rising-alarm | rising-or-falling alarm);
    syslog-subtag syslog-subtag;
    variable oid-variable;
  }
  event index {
    community community-name;
    description description;
    type (RMON Notification) type;
  }
  history history-index {
    bucket-size number;
    interface interface-name;
    interval seconds;
    owner owner-name;
  }
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Provide comprehensive network fault diagnosis, planning, and performance tuning information. RMON delivers this information in nine groups of monitoring elements, each providing specific sets of data to meet common network monitoring requirements. Each group is optional, so that vendors do not need to support all the groups within the MIB.

Junos OS supports the RMON statistics, history, alarm, and event groups.

The remaining statements are explained separately.

Default Disabled.

Required Privilege Level snmp—To view this statement in the configuration.
snmp–control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033

- *Junos OS Network Management Configuration Guide*

sample-type

Syntax sample-type (absolute-value | delta-value);

Hierarchy Level [edit snmp rmon alarm *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the method of sampling the selected variable (monitored object). When you configure an SNMP RMON alarm, you can specify the sample type.

Options **absolute-value**—Actual value of the selected variable is used when comparing against the thresholds.

delta-value—Difference between samples of the selected variable is used when comparing against the thresholds.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

security-level (Defining Access Privileges)

Syntax

```
security-level (authentication | none | privacy) {
  notify-view view-name;
  read-view view-name;
  write-view view-name;
}
```

Hierarchy Level [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*) security-model (any | usm | v1 | v2c)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define the security level used for access privileges.

Default none

Options **authentication**—Provide authentication but no encryption.

none—No authentication and no encryption.

privacy—Provide authentication and encryption.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Security Level*

security-level (Generating SNMP Notifications)

Syntax security-level (authentication | none | privacy);

Hierarchy Level [edit snmp v3 target-parameters *target-parameters-name* parameters]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the security level to use when generating SNMP notifications.

Default none

Options **authentication**—Provide authentication but no encryption.

none—No authentication and no encryption.

privacy—Provide authentication and encryption.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Security Level*

security-model (Access Privileges)

Syntax security-model (usm | v1 | v2c);

Hierarchy Level [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the security model for an SNMPv3 group. The security model is used to determine access privileges for the group.

Options **usm**—SNMPv3 security model.

v1—SNMPv1 security model.

v2c—SNMPv2c security model.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the Security Model*

security-model (Group)

Syntax

```
security-model (usm | v1 | v2c) {
  security-name security-name {
    group group-name;
  }
}
```

Hierarchy Level

[edit snmp v3 vacm security-to-group]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Define a security model for an SNMPv3 group and associate the security name of a user with the group. All users in the group have the same access privileges.

Options

usm—SNMPv3 security model.

v1—SNMPv1 security model.

v2c—SNMPv2c security model.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Security Model*

security-model (SNMP Notifications)

Syntax security-model (usm | v1 | v2c);

Hierarchy Level [edit snmp v3 target-parameters *target-parameters-name* parameters]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the security model for an SNMPv3 group. The security model is used for SNMP notifications.

Options **usm**—SNMPv3 security model.

v1—SNMPv1 security model.

v2c—SNMPv2c security model.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the Security Model*

security-name (Community String)

Syntax security-name *security-name*;

Hierarchy Level [edit snmp v3 snmp-community *community-index*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Associate a community string with the security name of a user. The community string, which is used for SNMPv1 and SNMPv2c clients in an SNMPv3 system, is configured at the **[edit snmp v3 snmp-community *community-index*]** hierarchy level.

Options ***security-name***—Name that is used for messaging security and user access control.

NOTE: The security name must match the configured security name at the [edit snmp v3 target-parameters *target-parameters-name* parameters] hierarchy level when you configure traps or informs.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Security Names*

security-name (Security Group)

Syntax

security-name *security-name* {
  group *group-name*;
}

Hierarchy Level [edit snmp v3 vacm security-to-group security-model (usm | v1 | v2c)]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Associate the security name of a user (for SNMPv3 clients) or a community string (for SNMPv1 and SNMPv2c clients) with a configured security group.

Options *security-name*—SNMPv3 secure username configured at the **[edit snmp v3 usm local-engine user *username*]** hierarchy level that is used for messaging security. For SNMPv1 and SNMPv2c, the security name is the community string configured at the **[edit snmp v3 snmp-community *community-index*]** hierarchy level.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Assigning Security Names to Groups*
- Assigning a Security Name to a Group on page 6123

security-name (SNMP Notifications)

Syntax security-name *security-name*;

Hierarchy Level [edit snmp v3 target-parameters *target-parameters-name* parameters]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the security name used when generating SNMP notifications.

Options ***security-name***—If the SNMPv3 USM security model is used, identify the user when generating the SNMP notification. If the v1 or v2c security models are used, identify the SNMP community used when generating the notification.

NOTE: The access privileges for the group associated with this security name must allow this notification to be sent.

If you are using the v1 or v2 security models, the security name at the **[edit snmp v3 vacm security-to-group]** hierarchy level must match the security name at the **[edit snmp v3 snmp-community *community-index*]** hierarchy level.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Security Name*

security-to-group

Syntax

```
security-to-group {
  security-model (usm | v1 | v2c) {
    group group-name;
    security-name security-name;
  }
}
```

Hierarchy Level [edit snmp v3 vacm]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the group to which a specific SNMPv3 security name belongs. The security name is used for messaging security.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Assigning Security Model and Security Name to a Group*

snmp

Syntax

```
snmp {
  client-list client-list-name {
    ip-addresses;
  }
  community community-name {
    authorization authorization;
    client-list-name client-list-name;
    clients {
      address restrict;
    }
    logical-system logical-system-name {
      routing-instance routing-instance-name {
        clients {
        addresses;
        }
      }
    }
    routing-instance routing-instance-name {
      clients {
      addresses;
      }
    }
    view view-name;
  }
  contact contact;
  description description;
  filter-duplicates;
  filter-interfaces;
  health-monitor {
    falling-threshold integer;
    interval seconds;
    rising-threshold integer;
  }
  interface [ interface-names ];
  location location;
  name name;
  nonvolatile {
    commit-delay seconds;
  }
  rmon {
    alarm index {
      description description;
      falling-event-index index;
      falling-threshold integer;
      falling-threshold-interval seconds;
      interval seconds;
      request-type;
      rising-event-index index;
      rising-threshold integer;
      sample-type (absolute-value | delta-value);
      startup-alarm (falling-alarm | rising-alarm | rising-or-falling alarm);
      syslog-subtag syslog-subtag;
```

```
            variable oid-variable;
        }
        event index {
            community community-name;
            description description;
            type type;
        }
        history history-index {
            bucket-size number;
            interface interface-name;
            interval seconds;
            owner owner-name;
        }
    }
    traceoptions {
        file filename <files number> <size size> <world-readable | no-world-readable> <match
            regular-expression>;
        flag flag;
    }
    trap-group group-name {
        categories {
            category;
        }
        destination-port port-number;
        routing-instance routing-instance-name;
        targets {
            address;
        }
        version (all | v1 | v2);
    }
    trap-options {
        agent-address outgoing-interface;
        source-address address;
    }
    v3 {
        notify name {
            tag tag-name;
            type trap;
        }
        notify-filter profile-name {
            oid object-identifier (include | exclude);
        }
        snmp-community community-index {
            community-name community-name;
            security-name security-name;
            tag tag-name;
        }
        target-address target-address-name {
            address address;
            address-mask address-mask;
            logical-system logical-system;
            port port-number;
            retry-count number;
            routing-instance routing-instance-name;
            tag-list tag-list;
            target-parameters target-parameters-name;
```



```
    timeout seconds;
}
target-parameters target-parameters-name {
    notify-filter profile-name;
    parameters {
        message-processing-model (v1 | v2c | V3);
        security-level (authentication | none | privacy);
        security-model (usm | v1 | v2c);
        security-name security-name;
    }
}
usm {
    local-engine {
        user username {
            authentication-sha {
                authentication-password authentication-password;
            }
            authentication-md5 {
                authentication-password authentication-password;
            }
            authentication-none;
            privacy-aes128 {
                privacy-password privacy-password;
            }
            privacy-des {
                privacy-password privacy-password;
            }
            privacy-3des {
                privacy-password privacy-password;
            }
            privacy-none;
        }
    }
    remote-engine engine-id {
        user username {
            authentication-sha {
                authentication-password authentication-password;
            }
            authentication-md5 {
                authentication-password authentication-password;
            }
            authentication-none;
            privacy-aes128 {
                privacy-password privacy-password;
            }
            privacy-des {
                privacy-password privacy-password;
            }
            privacy-3des {
                privacy-password privacy-password;
            }
            privacy-none {
                privacy-password privacy-password;
            }
        }
    }
```

```
        }
        vacm {
          access {
            group group-name {
              (default-context-prefix | context-prefix context-prefix) {
                security-model (any | usm | v1 | v2c) {
                  security-level (authentication | none | privacy) {
                    notify-view view-name;
                    read-view view-name;
                    write-view view-name;
                  }
                }
              }
            }
          }
          security-to-group {
            security-model (usm | v1 | v2c) {
              security-name security-name {
                group group-name;
              }
            }
          }
        }
      }
      view view-name {
        oid object-identifier (include | exclude);
      }
    }
    }
```

Hierarchy Level [edit]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure SNMP.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp–control—To add this statement to the configuration.

Related Documentation

- Understanding the Implementation of SNMP on page 6021
- Configuring SNMP on page 1237

snmp-community

Syntax

```
snmp-community community-index {
  community-name community-name;
  security-name security-name;
  tag tag-name;
}
```

Hierarchy Level [edit snmp v3]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the SNMP community which authorizes SNMPv1 or SNMPv2c clients in an SNMPv3 system.

Options ***community-index***—(Optional) String that identifies an SNMP community.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the SNMPv3 Community*

source-address (SNMP)

Syntax source-address *address*;

Hierarchy Level [edit snmp trap-options]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the source address of every SNMP trap packet sent by this switch to a single address regardless of the outgoing interface. If the source address is not specified, the default is to use the address of the outgoing interface as the source address.

Options ***address***—Source address of SNMP traps. You can configure the source address of trap packets two ways: **lo0** or a valid IPv4 address configured on one of the interfaces. The value **lo0** indicates that the source address of all SNMP trap packets is set to the lowest loopback address configured at interface **lo0**.

Default: Disabled. (The source address is the address of the outgoing interface.)

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the Source Address for SNMP Traps*

startup-alarm

Syntax startup-alarm (falling-alarm | rising-alarm | rising-or-falling-alarm);

Hierarchy Level [edit snmp rmon alarm *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set an initial alarm that is sent after the configured SNMP RMON alarm becomes active.

Default **rising-or-falling-alarm**

Options **falling-alarm**—Generated if the first sample after the alarm becomes active is equal to or greater than the falling threshold.

rising-alarm—Generated if the first sample after the alarm becomes active is equal to or greater than the rising threshold.

rising-or-falling-alarm—Generated if the first sample after the alarm entry becomes active is equal to or greater than either the rising threshold or the falling threshold.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

syslog-subtag

Syntax syslog-subtag *syslog-subtag*;

Hierarchy Level [edit snmp rmon alarm *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Add the **syslog-subtag** tag to the system log message. The tag should not exceed 80 uppercase characters.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

tag (Configuring Notification Targets)

Syntax tag *tag-name*;

Hierarchy Level [edit snmp v3 notify *name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a set of target addresses to receive SNMP traps or informs (for IPv4 packets only).

Options ***tag-name***—Define the target addresses to which an SNMP notification is sent. Target addresses containing the same tag in their tag list are sent the same notification. The ***tag-name*** is not included in the notification.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- SNMPv3 Overview on page 6031
- Minimum SNMPv3 Configuration on a Device Running Junos OS on page 6032
- Configuring SNMP on page 1237
- *Configuring the SNMPv3 Trap Notification*

tag (Configuring the SNMP Community)

Syntax tag *tag-name*;

Hierarchy Level [edit snmp v3 snmp-community *community-index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure a set of SNMP managers that are authorized to use a community string.

Options ***tag-name***—Identify the set of addresses for the SNMP managers authorized to use the community string.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- SNMPv3 Overview on page 6031
- Minimum SNMPv3 Configuration on a Device Running Junos OS on page 6032
- Configuring SNMP on page 1237
- *Configuring the SNMPv3 Trap Notification*

tag-list

Syntax tag-list *tag-list*;

Hierarchy Level [edit snmp v3 target-address *target-address-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure an SNMP tag list used to select target addresses.

Options ***tag-list***—Define sets of target addresses (tags). To specify more than one tag, specify the tag names as a space-separated list enclosed within double quotes.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Configuring the Trap Target Address*

target-address

Syntax

```
target-address target-address-name {
  address address;
  address-mask address-mask;
  port port-number;
  retry-count number;
  tag-list tag-list;
  target-parameters target-parameters-name;
  timeout seconds;
}
```

Hierarchy Level [edit snmp v3]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the address of an SNMP management application and the parameters to be used in sending notifications.

Options ***target-address-name***—String that identifies the target address.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Understanding the Implementation of SNMP on page 6021
- SNMP MIBs Support on page 6038
- SNMP Traps Support on page 6054
- **snmp on page 1334**
- Configuring SNMP on page 1237
- Monitoring SNMP on page 1351
- Example: Configuring SNMP on page 6083

target-parameters

Syntax

At the **[edit snmp v3]** hierarchy level:

```
target-parameters target-parameters-name {
  profile-name;
  parameters {
    message-processing-model (v1 | v2c | V3);
    security-level (authentication | none | privacy);
    security-model (usm | v1 | v2c);
    security-name security-name;
  }
}
```

At the **[edit snmp v3 target-address *target-address-name*]** hierarchy level:

```
target-parameters target-parameters-name;
```

Hierarchy Level

[edit snmp v3]
[edit snmp v3 target-address *target-address-name*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure the message processing and security parameters for sending notifications to a particular management target. The target parameters are configured at the **[edit snmp v3]** hierarchy level. The remaining statements at this level are explained separately.

Then apply the target parameters configured at the **[edit snmp v3 target-parameters *target-parameters-name*]** hierarchy level to the target address configuration at the **[edit snmp v3]** hierarchy level.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Defining and Configuring the Trap Target Parameters*
- *Applying Target Parameters*

targets

Syntax

```
targets {
  address;
}
```

Hierarchy Level [edit snmp trap-group *group-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure one or more systems to receive SNMP traps.

Options ***address***—IPv4 or IPv6 address of the system to receive traps. You must specify an address, not a hostname.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring SNMP Trap Groups on page 6114

timeout

Syntax timeout *seconds*;

Hierarchy Level [edit snmp v3 target-address *target-address-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the timeout period (in seconds) for SNMP informs.

Default 15 seconds

Options ***seconds***—Number of seconds to wait for an inform acknowledgment. If no acknowledgment is received within the timeout period, the inform is retransmitted.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Understanding the Implementation of SNMP on page 6021
- Configuring SNMP Informs on page 6125
- **retry-count (SNMPv3) on page 6257**

traceoptions (SNMP)

Syntax

```
traceoptions {
  file filename <files number> <match regular-expression> <size size> <world-readable |
    no-world-readable>;
  flag flag;
  no-remote-trace;
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Track the activities of SNMP agents on the switch and record the information in log files.

NOTE: **The traceoptions statement is not supported on the QFabric system.**

The output of the tracing operations is placed into log files in the **/var/log** directory. Each log file is named after the SNMP agent that generates it. The following logs are created in the **/var/log** directory when the **traceoptions** statement is used:

- chassisd
- craftd
- ilmid
- mib2d
- rmopd
- serviced
- snmpd

Options **file *filename***—By default, the name of the log file that records trace output is the name of the process being traced (for example, mib2d or snmpd). Use this option to specify another name.

files *number*—(Optional) Maximum number of trace files per SNMP subagent. When a trace file (for example, snmpd) reaches its maximum size, it is archived by being renamed to snmpd.0. The previous snmpd.1 is renamed to snmpd.2, and so on. The oldest archived file is deleted.

Range: 2 through 1000 files

Default: 10 files

flag *flag*—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements:

- **all**—Log all SNMP events.

- **configuration**—Log reading of configuration at the **[edit snmp]** hierarchy level.
- **database**—Log events involving storage and retrieval in the events database.
- **events**—Log important events.
- **general**—Log general events.
- **interface-stats**—Log physical and logical interface statistics.
- **nonvolatile-sets**—Log nonvolatile SNMP set request handling.
- **pdu**—Log SNMP request and response packets.
- **policy**—Log policy processing.
- **protocol-timeouts**—Log SNMP response timeouts.
- **routing-socket**—Log routing socket calls.
- **server**—Log communication with processes that are generating events.
- **subagent**—Log subagent restarts.
- **timer-events**—Log internally generated events.
- **varbind-error**—Log variable binding errors.

match ***regular-expression***—(Optional) Refine the output to include lines that contain the regular expression.

size ***size***—(Optional) Maximum size, in kilobytes (KB), of each trace file before it is closed and archived.

Range: 10 KB through 1 GB

Default: 1000 KB

world-readable | no-world-readable—(Optional) By default, log files can be accessed only by the user who configures the tracing operation. The **world-readable** option enables any user to read the file. To explicitly set the default behavior, use the **no-world-readable** option.

Required Privilege Level

snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Understanding Tracing and Logging Operations on page 5979
- Tracing SNMP Activity on a Device Running Junos OS on page 6327

trap-group

Syntax

```
trap-group group-name {
  categories {
    category;
  }
  destination-port port-number;
  targets {
    address;
  }
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for QFX Series switches.

Description Create a named group of hosts to receive the specified trap notifications. The name of the trap group is embedded in SNMP trap notification packets as one variable binding (varbind) known as the community name. At least one trap group must be configured for SNMP traps to be sent.

Options *group-name*—Name of the trap group. If the name includes spaces, enclose it in quotation marks (" ").

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring SNMP Trap Groups on page 6114

trap-options

Syntax

```
trap-options {
  agent-address outgoing-interface;
  source-address address;
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Using SNMP trap options, you can set the source address of every SNMP trap packet sent by the router or switch to a single address, regardless of the outgoing interface. In addition, you can set the agent address of each SNMPv1 trap. For more information about the contents of SNMPv1 traps, see RFC 1157.

The remaining statements are explained separately.

Default Disabled

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring SNMP Trap Options*

type (RMON Notification)

Syntax type *type*;

Hierarchy Level [edit snmp rmon event *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the type of notification generated when a rising or falling threshold is crossed.

Default **log-and-trap**

Options ***type***—Type of notification. It can be one of the following:

- **log**—Add an entry to the **logTable** object.
- **log-and-trap**—Send an SNMP trap and add a log entry.
- **none**—No notifications are sent.
- **snmptrap**—Send an SNMP trap.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

type (SNMPv3)

Syntax type (inform | trap);

Hierarchy Level [edit snmp v3 notify *name*]

Release Information Statement introduced before Junos OS Release 7.4.
inform option added in Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the type of SNMP notification.

Options **inform**—Defines the type of notification as an inform. SNMP informs are confirmed notifications.

trap—Defines the type of notification as a trap. SNMP traps are unconfirmed notifications.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring SNMP Informs on page 6125
- *Configuring the SNMPv3 Trap Notification*

user

Syntax user *username*;

Hierarchy Level [edit snmp v3 usm local-engine],
[edit snmp v3 usm remote-engine *engine-id*]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify a user associated with an SNMPv3 group on a local or remote SNMP engine.

Options ***username***—SNMPv3 user-based security model (USM) username.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Creating SNMPv3 Users on page 6120

usm

Syntax

```
usm {
  local-engine {
    user username {
      authentication-md5 {
        authentication-password authentication-password;
      }
      authentication-none;
      authentication-sha {
        authentication-password authentication-password;
      }
      privacy-aes128 {
        privacy-password privacy-password;
      }
      privacy-des {
        privacy-password privacy-password;
      }
      privacy-3des {
        privacy-password privacy-password;
      }
      privacy-none {
        privacy-password privacy-password;
      }
    }
    remote-engine engine-id {
      user username {
        authentication-md5 {
          authentication-password authentication-password;
        }
        authentication-none;
        authentication-sha {
          authentication-password authentication-password;
        }
        privacy-aes128 {
          privacy-password privacy-password;
        }
        privacy-des {
          privacy-password privacy-password;
        }
        privacy-3des {
          privacy-password privacy-password;
        }
        privacy-none {
          privacy-password privacy-password;
        }
      }
    }
  }
}
```

Hierarchy Level [edit snmp v3]

Release Information Statement introduced before Junos OS Release 7.4.

Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure user-based security model (USM) information.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Creating SNMPv3 Users on page 6120
- *Configuring the Remote Engine and Remote User*

v3

Syntax

```
v3 {
  notify name {
    tag tag-name;
    type trap;
  }
  notify-filter profile-name {
    oid object-identifier (include | exclude);
  }
  snmp-community community-index {
    community-name community-name;
    security-name security-name;
    tag tag-name;
  }
  target-address target-address-name {
    address address;
    address-mask address-mask;
    port port-number;
    retry-count number;
    tag-list tag-list;
    target-parameters target-parameters-name;
    timeout seconds;
  }
  target-parameters target-parameters-name {
    notify-filter profile-name;
    parameters {
      message-processing-model (v1 | v2c | V3);
      security-level (authentication | none | privacy);
      security-model (usm | v1 | v2c);
      security-name security-name;
    }
  }
  usm {
    local-engine {
      user username {
        authentication-md5 {
          authentication-password authentication-password;
        }
        authentication-sha {
          authentication-password authentication-password;
        }
        authentication-none;
        privacy-aes128 {
          privacy-password privacy-password;
        }
        privacy-des {
          privacy-password privacy-password;
        }
        privacy-3des {
          privacy-password privacy-password;
        }
        privacy-none;
      }
```

```
        }
        remote-engine engine-id {
            user username {
                authentication-md5 {
                    authentication-password authentication-password;
                }
                authentication-sha {
                    authentication-password authentication-password;
                }
                authentication-none;
                privacy-aes128 {
                    privacy-password privacy-password;
                }
                privacy-des {
                    privacy-password privacy-password;
                }
                privacy-3des {
                    privacy-password privacy-password;
                }
                privacy-none {
                    privacy-password privacy-password;
                }
            }
        }
    }
    vacm {
        access {
            group group-name {
                (default-context-prefix | context-prefix context-prefix) {
                    security-model (any | usm | v1 | v2c) {
                        security-level (authentication | none | privacy) {
                            notify-view view-name;
                            read-view view-name;
                            write-view view-name;
                        }
                    }
                }
            }
        }
        security-to-group {
            security-model (usm | v1 | v2c) {
                security-name security-name {
                    group group-name;
                }
            }
        }
    }
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure SNMPv3.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Minimum SNMPv3 Configuration on a Device Running Junos OS on page 6032

vacm

Syntax

```
vacm {
  access {
    group group-name {
      (default-context-prefix | context-prefix context-prefix){
        security-model (any | usm | v1 | v2c) {
          security-level (authentication | none | privacy) {
            notify-view view-name;
            read-view view-name;
            write-view view-name;
          }
        }
      }
    }
  }
  security-to-group {
    security-model (usm | v1 | v2c);
    security-name security-name {
      group group-name;
    }
  }
}
```

Hierarchy Level [edit snmp v3]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure view-based access control model (VACM) information, including access privileges such as security model and security level for a group of users.

The remaining statements are explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- *Defining Access Privileges for an SNMP Group*

variable

Syntax variable *oid-variable*;

Hierarchy Level [edit snmp rmon alarm *index*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Set the object identifier (OID) of the MIB object (also called variable) to be monitored when you configure an SNMP RMON alarm. If the value of the monitored variable exceeds the configured rising threshold or falling threshold, an alarm is triggered and a corresponding event may be generated.

Options ***oid-variable***—OID of the MIB variable that is being monitored. The OID can be a dotted decimal (for example, **1.3.6.1.2.1.2.1.2.2.1.10.1**) or the name of the MIB object—for example, **ifInOctets.1**.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Configuring RMON Alarms and Events on page 6117
- Monitoring RMON MIB Tables on page 6323
- Understanding RMON on page 6033
- *Junos OS Network Management Configuration Guide*

version

Syntax version (all | v1 | v2);

Hierarchy Level [edit snmp trap-group *group-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify the version number of SNMP traps.

Default **all**—Send an SNMPv1 and SNMPv2 trap for every trap condition.

Options **all**—Send an SNMPv1 and SNMPv2 trap for every trap condition.

v1—Send SNMPv1 traps only.

v2—Send SNMPv2 traps only.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring SNMP Trap Groups on page 6114

view (Configuring a MIB View)

Syntax

```
view view-name {
  oid object-identifier (include | exclude);
}
```

Hierarchy Level [edit snmp]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Define a MIB view. A MIB view identifies a group of MIB objects. Each MIB object in a view has a common OID prefix. Each object identifier represents a subtree of the MIB object hierarchy. The **view** statement uses a view to specify a group of MIB objects on which to define access. To enable a view, you must associate the view with a community by including the **view** statement at the **[edit snmp community *community-name*]** hierarchy level.

NOTE: To remove an OID completely, use the **delete view all oid oid-number** command but omit the **include** parameter.

Options *view-name*—Name of the view.

The remaining statement is explained separately.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation

- Configuring MIB Views on page 6116
- *Associating MIB Views with an SNMP User Group*
- **community on page 1292**

view (Associating MIB View with a Community)

Syntax view *view-name*;

Hierarchy Level [edit snmp community *community-name*]

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Associate a view with a community. A view represents a group of MIB objects.

Options *view-name*—Name of the view. You must use a view name already configured in the **view** statement at the **[edit snmp]** hierarchy level.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- *Configuring the SNMP Community String*

write-view

Syntax write-view *view-name*;

Hierarchy Level [edit snmp v3 vacm access group *group-name* (default-context-prefix | context-prefix *context-prefix*) security-model (any | usm | v1 | v2c) security-level (authentication | none | privacy)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series switches.

Description Associate the write view with a community (for SNMPv1 or SNMPv2c clients) or a group name (for SNMPv3 clients).

Options *view-name*—Name of the view for which the SNMP user group has write permission.

Required Privilege Level snmp—To view this statement in the configuration.
snmp-control—To add this statement to the configuration.

Related Documentation
- Configuring MIB Views on page 6116
- *Configuring the Write View*

Configuration Statements for System Log Messages

archive (All System Log Files)

Syntax
archive <files *number*> <size *size*> <start-time*time*> <transfer-interval *interval*>
<binary-data | no-binary-data>;
<world-readable | no-world-readable> ;

Hierarchy Level
[edit system syslog]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description
Configure archiving properties for all system log files.

Options

files *number*—Maximum number of archived log files to retain. When the Junos OS logging utility has written a defined maximum amount of data to a log file ***logfile***, it closes the file, compresses it, and renames it ***logfile*.0.gz** (the amount of data is determined by the **size** statement at this hierarchy level). The utility then opens and writes to a new file called ***logfile***. When the new file reaches the maximum size, the ***logfile*.0.gz** file is renamed to ***logfile*.1.gz**, and the new file is closed, compressed, and renamed ***logfile*.0.gz**. By default, the logging facility creates up to ten archive files in this manner. Once the maximum number of archive files exists, each time the active log file reaches the maximum size, the contents of the oldest archive file are lost (overwritten by the next oldest file).

Range: 1 through 1000

Default: 10 files

size *size*—Maximum amount of data that the Junos OS logging utility writes to a log file ***logfile*** before archiving it (closing it, compressing it, and changing its name to ***logfile*.0.gz**). The utility then opens and writes to a new file called ***logfile***.

Syntax: ***x* k** to specify the number of kilobytes, ***x* m** for the number of megabytes, or ***x* g** for the number of gigabytes

Range: 64 KB through 1 GB

Default:

- 128 KB for EX Series switches and J Series routers
- 1 MB for M Series, MX Series, and T Series routers, and the QFX3500 switch
- 10 MB for TX Matrix and TX Matrix Plus routers

binary-data | no-binary-data—Mark file as containing binary data. This allows proper archiving of binary files, such as WTMP files (login records for UNIX based systems)..

Default: **no-binary-data**

world-readable | no-world-readable—Grant all users permission to read archived log files, or restrict the permission only to the **root** user and users who have the Junos OS **maintenance** permission.

Default: **no-world-readable**

Required Privilege Level
system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation
- Specifying Log File Size, Number, and Archiving Properties on page 6139

archive (Individual System Log File)

Syntax archive <archive-sites (*ftp-url* <password *password*>)> <files *number*> <size *size*> <start-time "*YYYY-MM-DD.hh:mm*"> <transfer-interval *minutes*> <world-readable | no-world-readable>;

Hierarchy Level [edit system syslog file *filename*]

Release Information Statement introduced before Junos OS Release 7.4.
start-time and **transfer-interval** statements introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure archiving properties for a specific system log file.

Options **archive-sites** ***site-name***—FTP URL representing the destination for the archived log file (for information about how to specify valid FTP URLs, see "Format for Specifying Filenames and URLs in Junos OS CLI Commands" on page 57). If more than one site name is configured, a list of archive sites for the system log files is created. When a file is archived, the router attempts to transfer the file to the first URL in the list, moving to the next site only if the transfer does not succeed. The log file is stored at the archive site with the filename specified at the **[edit system syslog]** hierarchy level.

files ***number***—Maximum number of archived log files to retain. When the Junos OS logging utility has written a defined maximum amount of data to a log file ***logfile***, it closes the file, compresses it, and renames it ***logfile*.0.gz** (the amount of data is determined by the **size** statement at this hierarchy level). The utility then opens and writes to a new file called ***logfile***. When the new file reaches the maximum size, the ***logfile*.0.gz** file is renamed to ***logfile*.1.gz**, and the new file is closed, compressed, and renamed ***logfile*.0.gz**. By default, the logging facility creates up to ten archive files in this manner. Once the maximum number of archive files exists, each time the active log file reaches the maximum size, the contents of the oldest archive file are lost (overwritten by the next oldest file).

Range: 1 through 1000

Default: 10 files

password ***password***—Password for authenticating with the site specified by the **archive-sites** statement.

size ***size***—Maximum amount of data that the Junos OS logging utility writes to a log file ***logfile*** before archiving it (closing it, compressing it, and changing its name to ***logfile*.0.gz**). The utility then opens and writes to a new file called ***logfile***.

Syntax: ***x*k** to specify the number of kilobytes, ***x*m** for the number of megabytes, or ***x*g** for the number of gigabytes

Range: 64 KB through 1 GB

Default: 128 KB for J Series routers; 1 MB for M Series, MX Series, and T Series routers, and the QFX3500 switch; 10 MB for TX Matrix and TX Matrix Plus routers

start-time "*YYYY-MM-DD.hh:mm*"—Date and time in the local time zone for a one-time transfer of the active log file to the first reachable site in the list of sites specified by the **archive-sites** statement.

transfer-interval *interval*—Interval at which to transfer the log file to an archive site.

Range: 5 through 2880 minutes

world-readable | no-world-readable—Grant all users permission to read archived log files, or restrict the permission only to the **root** user and users who have the Junos OS **maintenance** permission.

Default: no-world-readable

Required Privilege Level
system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation
- Specifying Log File Size, Number, and Archiving Properties on page 6139

archive (QFabric System)

Syntax
```
archive {
  size size;
}
```

Hierarchy Level [edit system syslog file *filename*]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the archiving properties for the system message log file.

Options
size *size*—Maximum amount of system log message data that the QFabric system stores in the log file.

Syntax: *x*k to specify the number of kilobytes, *x*m for the number of megabytes, or *x*g for the number of gigabytes

Range: 65 KB through 1 GB

Required Privilege Level
system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation
- syslog on page 6315

console (System Logging)

Syntax

```
console {
  facility severity;
}
```

Hierarchy Level [edit system syslog]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the logging of system messages to the system console.

Options ***facility***—Class of messages to log. To specify multiple classes, include multiple ***facility severity*** statements. For a list of the facilities, see Table 584 on page 6141.

severity—Severity of the messages that belong to the facility specified by the paired ***facility*** name. Messages with severities of the specified level and higher are logged. For a list of the severities, see Table 585 on page 6142.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Directing System Log Messages to the Console on page 6130
- *Junos OS System Log Messages Reference*

explicit-priority

Syntax explicit-priority;

Hierarchy Level [edit logical-systems *logical-system-name* system syslog file *filename*],
[edit logical-systems *logical-system-name* system syslog host],
[edit system syslog file *filename*],
[edit system syslog host]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Record the priority (facility and severity level) in each standard-format system log message directed to a file or remote destination.

When the **structured-data** statement is also included at the **[edit system syslog file *filename*]** hierarchy level, this statement is ignored for the file.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Including Priority Information in System Log Messages on page 6132
- *Junos OS System Log Messages Reference*
- **structured-data on page 6312**

facility-override

Syntax facility-override *facility*;

Hierarchy Level [edit system syslog host]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Substitute an alternate facility for the default facilities used when messages are directed to a remote destination.

Options ***facility***—Alternate facility to substitute for the default facilities. For a list of the possible facilities, see Table 587 on page 6143.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Changing the Alternative Facility Name for Remote System Log Messages on page 6144
- *Junos OS System Log Messages Reference*

file (QFabric System)

Syntax

```
file filename {
  archive {
    size maximum-file-size;
  }
  explicit-priority;
  facility severity;
  match "regular-expression";
  structured-data {
    brief;
  }
}
```

Hierarchy Level [edit system syslog]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure the logging of system messages to a file.

Options ***facility***—Class of messages to log. To specify multiple classes, include multiple ***facility severity*** statements.

filename—Filename that you specify with the **show log** command.

Default: Filename **messages**

severity—Severity of the messages that belong to the facility specified by the paired *facility* name. Messages with severities at the specified level and higher are logged.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- syslog on page 6315

file (System Logging)

Syntax

```
file filename {
  facility severity;
  archive {
    files number;
    size size;
    (no-world-readable | world-readable);
  }
  explicit-priority;
  match "regular-expression";
  structured-data {
    brief;
  }
}
```

Hierarchy Level [edit system syslog]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the logging of system messages to a file.

Options *facility*—Class of messages to log. To specify multiple classes, include multiple ***facility severity*** statements. For a list of the facilities, see Table 584 on page 6141.

file ***filename***—File in the **severity** directory in which to log messages from the specified facility. To log messages to more than one file, include more than one **file** statement.

severity—Severity of the messages that belong to the facility specified by the paired ***facility*** name. Messages with severities of the specified level and higher are logged. For a list of the severities, see Table 585 on page 6142.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Directing System Log Messages to a Log File on page 6128
- *Junos OS System Log Messages Reference*

files

Syntax
files *number*;

Hierarchy Level
[edit system syslog archive],
[edit system syslog file *filename* archive]

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for QFX Series switches.

Description
Configure the maximum number of archived log files to retain. When the Junos OS logging utility has written a defined maximum amount of data to a log file ***logfile***, it closes the file, compresses it, and renames it to ***logfile*.0.gz** (for information about the maximum file size, see **size**). The utility then opens and writes to a new file called ***logfile***. When the new file reaches the maximum size, the ***logfile*.0.gz** file is renamed to ***logfile*.1.gz**, and the new file is closed, compressed, and renamed ***logfile*.0.gz**. By default, the logging facility creates up to ten archive files in this manner. Once the maximum number of archive files exists, each time the active log file reaches the maximum size, the contents of the oldest archive file are lost (overwritten by the next oldest file).

Options
number—Maximum number of archived files.

Range: 1 through 1000

Default: 10 files

Required Privilege Level
system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Specifying Log File Size, Number, and Archiving Properties on page 6139
- *Junos OS System Log Messages Reference*
- size on page 6311

host (System)

Syntax

```
host (hostname | other-routing-engine) {
  facility severity;
  exclude-hostname
  explicit-priority;
  facility-override facility;
  log-prefix string;
  match "regular-expression";
  source-address source-address;
  structured-data {
    brief;
  }
}
```

QFX Series

```
host (hostname {
  facility severity;
  explicit-priority;
  facility-override facility;
  log-prefix string;
  match "regular-expression";
  port;
  source-address source-address;
}
```

TX Matrix Router and EX Series Switches

```
host (hostname | other-routing-engine | scc-master) {
  facility severity;
  explicit-priority;
  facility-override facility;
  log-prefix string;
  match "regular-expression";
  port;
  source-address source-address;
}
```

TX Matrix Plus Router

```
host (hostname | other-routing-engine | sfc0-master) {
  facility severity;
  allow-duplicates;
  explicit-priority;
  facility-override facility;
  log-prefix string;
  match "regular-expression";
  port;
  source-address source-address;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* system syslog],
[edit system syslog]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Configure the logging of system messages to a remote destination.

Options

facility—Class of messages to log. To specify multiple classes, include multiple ***facility severity*** statements. For a list of the facilities, see Table 584 on page 6141.

hostname—IPv4 address, IPv6 address, or fully qualified hostname of the remote machine to which to direct messages. To direct messages to multiple remote machines, include a **host** statement for each one.

other-routing-engine—Direct messages to the other Routing Engine on a router or switch with two Routing Engines installed and operational.

NOTE: The other-routing-engine option is not applicable to the QFX Series.

port—Port number of the remote syslog server that can be modified.

scc-master—(TX Matrix routers only) On a T640 router that is part of a routing matrix, direct messages to the TX Matrix router.

severity—Severity of the messages that belong to the facility specified by the paired ***facility*** name. Messages with severities of the specified level and higher are logged. For a list of the severities, see Table 585 on page 6142.

sfc0-master—(TX Matrix Plus routers only) On a T1600 or T4000 router that is part of a routing matrix, direct messages to the TX Matrix Plus router.

The remaining statements are explained separately.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Directing System Log Messages to a Remote Machine or the Other Routing Engine*
- *Directing Messages to a Remote Destination from the Routing Matrix Based on the TX Matrix Router*
- *Directing Messages to a Remote Destination from the Routing Matrix Based on a TX Matrix Plus Router*
- *Junos OS System Log Messages Reference*

log-prefix (System)

Syntax log-prefix *string*;

Hierarchy Level [edit system syslog host]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Include a text string in each message directed to a remote destination.

Options ***string***—Text string to include in each message.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation
- Adding a Text String to System Log Messages on page 6128
- *Junos OS System Log Messages Reference*

match

Syntax match "*regular-expression*";

Hierarchy Level [edit logical-systems *logical-system-name* system syslog file *filename*],
[edit logical-systems *logical-system-name* system syslog user (*username* | *)],
[edit system syslog file *filename*],
[edit system syslog host *hostname* | other-routing-engine| scc-master)],
[edit system syslog user (*username* | *)]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Specify a text string that must (or must not) appear in a message for the message to be logged to a destination.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation
- Using Regular Expressions to Refine the Set of Logged Messages on page 6146

size (System)

Syntax size *size*;

Hierarchy Level [edit system syslog archive],
[edit system syslog file *filename* archive]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the maximum amount of data that the Junos OS logging utility writes to a log file ***logfile*** before archiving it (closing it, compressing it, and changing its name to ***logfile*.0.gz**). The utility then opens and writes to a new file called ***logfile***. For information about the number of archive files that the utility creates in this way, see **files**.

Options ***size***—Maximum size of each system log file, in kilobytes (KB), megabytes (MB), or gigabytes (GB).

Syntax: ***x*k** to specify the number of kilobytes, ***x*m** for the number of megabytes, or ***x*g** for the number of gigabytes

Range: 64 KB through 1 GB

Default: 1 MB for MX Series routers and the QFX Series

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Specifying Log File Size, Number, and Archiving Properties on page 6139
- *Junos OS System Log Messages Reference*
- **files on page 6307**

structured-data

Syntax

```
structured-data {
  brief;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* system syslog file *filename*],
[edit system syslog file *filename*]

Release Information

Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

Write system log messages to the log file in structured-data format, which complies with Internet draft draft-ietf-syslog-protocol-23, *The syslog Protocol* (http://tools.ietf.org/html/draft-ietf-syslog-protocol-23).

NOTE: When this statement is included, other statements that specify the format for messages written to the file are ignored (the **explicit-priority** statement at the **[edit system syslog file *filename*]** hierarchy level and the **time-format** statement at the **[edit system syslog]** hierarchy level).

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Logging Messages in Structured-Data Format*
- *Junos OS System Log Messages Reference*
- explicit-priority on page 6304
- time-format on page 6316

syslog (System)

Syntax

```
syslog {
  archive {
    (binary-data| no-binary-data);
    files number;
    size maximum-file-size;
    start-time "YYYY-MM-DD.hh:mm";
    transfer-interval minutes;
    (world-readable | no-world-readable);
  }
  console {
    facility severity;
  }
  file filename {
    facility severity;
    explicit-priority;
    match "regular-expression";
    archive {
      (binary-data| no-binary-data);
      files number;
      size maximum-file-size;
      start-time "YYYY-MM-DD.hh:mm";
      transfer-interval minutes;
      (world-readable | no-world-readable);
    }
    structured-data {
      brief;
    }
  }
  host (hostname | other-routing-engine | scc-master) {
    facility severity;
    explicit-priority;
    facility-override facility;
    log-prefix string;
    match "regular-expression";
    source-address source-address;
    structured-data {
      brief;
    }
    port port number;
  }
  log-rotate-frequency frequency;
  server server name;
  source-address source-address;
  time-format(millisecond | year | year millisecond);
  user (username | *) {
    facility severity;
    match "regular-expression";
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* system],
[edit system]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Support at the **[edit logical-systems *logical-system-name* system]** hierarchy level introduced in Junos OS Release 11.4.

Description

Configure the types of system log messages to send to files, to a remote destination, to user terminals, or to the system console.

The remaining statements are explained separately.

Options

archive—Define parameters for archiving log messages.

console—Send log messages of a specified class and severity to the console.

file—Send log messages to a named file.

host —Remote location to be notified of specific log messages.

log-rotate-frequency—Configure the interval for checking logfile size and archiving messages.

server—Name of the system log server in the inet.0 routing instance.

source-address—Include a specified address as the source address for log messages.

time-format—Additional information to include in the system log time stamp.

user—Notify a specific user of the log event.

Required Privilege Level

system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- *Junos OS System Log Configuration Overview*
- *Junos OS System Log Messages Reference*
- Overview of Single-Chassis System Logging Configuration on page 6069

syslog (QFabric System)

Syntax

```
syslog {
  file filename {
    archive {
      size maximum-file-size;
    }
    explicit-priority;
    facility severity;
    match "regular-expression";
    structured-data;
  }
  filter all {
    facility severity;
    match "regular-expression";
  }
  host hostname {
    explicit-priority;
    facility severity;
    facility-override facility;
    log-prefix string;
    match "regular-expression";
    structured-data;
  }
}
```

Hierarchy Level [edit system]

Release Information Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description Configure system log messages for the QFabric system.

The remaining statements are explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Understanding the Implementation of System Log Messages on the QFabric System on page 6070
- Directing System Log Messages to a Remote Machine on page 6129

time-format

Syntax time-format (year | millisecond | year millisecond);

Hierarchy Level [edit system syslog]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Include the year, the millisecond, or both, in the timestamp on every standard-format system log message. The additional information is included for messages directed to each destination configured by a **file**, **console**, or **user** statement at the **[edit system syslog]** hierarchy level. As of Junos OS Release 11.4, the additional time information is also sent to destinations configured by a **host** statement.

By default, the timestamp specifies the month, date, hour, minute, and second when the message was logged—for example, **Aug 21 12:36:30**. However, the timestamp for traceoption messages is specified in milliseconds by default, and is independent of the **[edit system syslog time-format]** statement.

NOTE: When the **structured-data** statement is included at the **[edit system syslog file *filename*]** hierarchy level, this statement is ignored for the file.

Options **millisecond**—Include the millisecond in the timestamp.

year—Include the year in the timestamp.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Including the Year or Millisecond in Timestamps on page 157
- *Junos OS System Log Messages Reference*
- **structured-data on page 6312**

user (System Logging)

Syntax

```
user (username | *) {
  facility severity;
  match "regular-expression";
}
```

Hierarchy Level [edit system syslog]

Release Information Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description Configure the logging of system messages to user terminals.

Options ***** (the asterisk)—Log messages to the terminal sessions of all users who are currently logged in.

facility—Class of messages to log. To specify multiple classes, include multiple ***facility severity*** statements. For a list of the facilities, see Table 584 on page 6141.

severity—Severity of the messages that belong to the facility specified by the paired ***facility*** name. Messages with severities the specified level and higher are logged. For a list of the severities, see Table 585 on page 6142.

username—Junos OS login name of the user whose terminal session is to receive system log messages. To log messages to more than one user's terminal session, include more than one **user** statement.

The remaining statement is explained separately.

Required Privilege Level system—To view this statement in the configuration.
system-control—To add this statement to the configuration.

Related Documentation

- Directing System Log Messages to a User Terminal on page 6130
- Junos OS System Logging Facilities and Message Severity Levels on page 6141

- *Junos OS System Log Messages Reference*

CHAPTER 68

Administration

Monitoring Tasks

Displaying a Log File from a Single-Chassis System

To display a log file stored on a single-chassis system such as the QFX3500 switch, enter Junos OS CLI operational mode and issue the following commands:

user@switch> **show log** *log-filename*
user@switch> **file show** *log-file-pathname*

By default, the commands display the file stored on the local Routing Engine.

The following example shows the output from the **show log messages** command:

```
user@switch1> show log messages
Nov  4 11:30:01 switch1 newsyslog[2283]: logfile turned over due to size>128K
Nov  4 11:30:01 switch1 newsyslog[2283]: logfile turned over due to size>128K
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 1
```

```
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 2
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 3
...
Nov  4 11:52:53  switch1 snmpd[944]: SNMPD_HEALTH_MON_INSTANCE: Health Monitor:
jroute daemon memory usage (Management
process): new instance detected (variable: sysApplElmtRunMemory.5.6.2293)
Nov  4 11:52:53  switch1 snmpd[944]: SNMPD_HEALTH_MON_INSTANCE: Health Monitor:
jroute daemon memory usage (Command-line
interface): new instance detected (variable: sysApplElmtRunMemory.5.8.2292)
...
Nov  4 12:08:30  switch1 rpdf[957]: task_connect: task BGP_100.10.10.1.6+179 addr
 10.10.1.6+179: Can't assign requested
address
Nov  4 12:08:30  switch1 rpdf[957]: bgp_connect_start: connect 10.10.1.6 (Internal
 AS 100): Can't assign requested address
Nov  4 12:10:24  switch1 mgd[2293]: UI_CMDLINE_READ_LINE: User 'jsmith', command
 'exit '
Nov  4 12:10:27  switch1 mgd[2293]: UI_DBASE_LOGOUT_EVENT: User 'jsmith' exiting
 configuration mode
Nov  4 12:10:31  switch1 mgd[2293]: UI_CMDLINE_READ_LINE: User 'jsmith', command
 'show log messages
```

The following example shows the output from the **file show** command. The file in the pathname **/var/log/processes** has been previously configured to include messages from the daemon facility.

```
user@switch1> file show /var/log/processes
Feb 22 08:58:24 switch1 snmpd[359]: SNMPD_TRAP_WARM_START: trap_generate_warm:
SNMP trap: warm start
Feb 22 20:35:07 switch1 snmpd[359]: SNMPD_THROTTLE_QUEUE_DRAINED:
trap_throttle_timer_handler: cleared all throttled traps
Feb 23 07:34:56 switch1 snmpd[359]: SNMPD_TRAP_WARM_START: trap_generate_warm:
SNMP trap: warm start
Feb 23 07:38:19 switch1 snmpd[359]: SNMPD_TRAP_COLD_START: trap_generate_cold:
SNMP trap: cold start
...
```

Related Documentation

- Interpreting Messages Generated in Standard Format on page 6138
- Interpreting Messages Generated in Structured-Data Format on page 6135

Monitoring Traffic Through the Router or Switch

To help with the diagnosis of a problem, display real-time statistics about the traffic passing through physical interfaces on the router or switch.

To display real-time statistics about physical interfaces, perform these tasks:

1. Displaying Real-Time Statistics About All Interfaces on the Router or Switch on page 6320
2. Displaying Real-Time Statistics About an Interface on the Router or Switch on page 6321

Displaying Real-Time Statistics About All Interfaces on the Router or Switch

Purpose Display real-time statistics about traffic passing through all interfaces on the router or switch.

Action To display real-time statistics about traffic passing through all interfaces on the router or switch:

user@host> **monitor interface traffic**

Sample Output

```
user@host> monitor interface traffic
host name                    Seconds: 15             Time: 12:31:09
Interface     Link  Input packets        (pps)    Output packets        (pps)
 so-1/0/0     Down              0          (0)                 0          (0)
 so-1/1/0     Down              0          (0)                 0          (0)
 so-1/1/1     Down              0          (0)                 0          (0)
 so-1/1/2     Down              0          (0)                 0          (0)
 so-1/1/3     Down              0          (0)                 0          (0)
 t3-1/2/0     Down              0          (0)                 0          (0)
 t3-1/2/1     Down              0          (0)                 0          (0)
 t3-1/2/2     Down              0          (0)                 0          (0)
 t3-1/2/3     Down              0          (0)                 0          (0)
 so-2/0/0       Up         211035          (1)             36778          (0)
 so-2/0/1       Up         192753          (1)             36782          (0)
 so-2/0/2       Up         211020          (1)             36779          (0)
 so-2/0/3       Up         211029          (1)             36776          (0)
 so-2/1/0       Up         189378          (1)             36349          (0)
 so-2/1/1     Down              0          (0)             18747          (0)
 so-2/1/2     Down              0          (0)             16078          (0)
 so-2/1/3       Up              0          (0)             80338          (0)
 at-2/3/0       Up              0          (0)                 0          (0)
 at-2/3/1     Down              0          (0)                 0          (0)
Bytes=b, Clear=c, Delta=d, Packets=p, Quit=q or ESC, Rate=r, Up=^U, Down=^D
```

Meaning The sample output displays traffic data for active interfaces and the amount that each field has changed since the command started or since the counters were cleared by using the **C** key. In this example, the **monitor interface** command has been running for 15 seconds since the command was issued or since the counters last returned to zero.

Displaying Real-Time Statistics About an Interface on the Router or Switch

Purpose Display real-time statistics about traffic passing through an interface on the router or switch.

Action To display traffic passing through an interface on the router or switch, use the following Junos OS CLI operational mode command:

user@host> **monitor interface** ***interface-name***

Sample Output

```
user@host> monitor interface so-0/0/1
Next='n', Quit='q' or ESC, Freeze='f', Thaw='t', Clear='c', Interface='i'
R1
Interface: so-0/0/1, Enabled, Link is Up
Encapsulation: PPP, Keepalives, Speed: OC3 Traffic statistics:
  Input bytes:                  5856541 (88 bps)
  Output bytes:                 6271468 (96 bps)
  Input packets:                 157629 (0 pps)
  Output packets:                157024 (0 pps)
Encapsulation statistics:
```



```
  Input keepalives:                 42353
  Output keepalives:                42320
  LCP state: Opened
Error statistics:
  Input errors:                         0
  Input drops:                          0
  Input framing errors:                 0
  Input runts:                          0
  Input giants:                         0
  Policed discards:                     0
  L3 incompletes:                       0
  L2 channel errors:                    0
  L2 mismatch timeouts:                 0
  Carrier transitions:                  1
  Output errors:                        0
  Output drops:                         0
  Aged packets:                         0
Active alarms : None
Active defects: None
SONET error counts/seconds:
  LOS count                             1
  LOF count                             1
  SEF count                             1
  ES-S                                 77
  SES-S                                77
SONET statistics:
  BIP-B1                                0
  BIP-B2                                0
  REI-L                                 0
  BIP-B3                                0
  REI-P                                 0
Received SONET overhead:  F1       : 0x00  J0        : 0xZ
```

Meaning The sample output shows the input and output packets for a particular SONET interface (**so-0/0/1**). The information can include common interface failures, such as SONET/SDH and T3 alarms, loopbacks detected, and increases in framing errors. For more information, see *Checklist for Tracking Error Conditions*.

To control the output of the command while it is running, use the keys shown in Table 589 on page 6322.

Table 589: Output Control Keys for the monitor interface Command

Action	Key
Display information about the next interface. The **monitor interface** command scrolls through the physical or logical interfaces in the same order that they are displayed by the **show interfaces terse** command.	**N**
Display information about a different interface. The command prompts you for the name of a specific interface.	**I**
Freeze the display, halting the display of updated statistics.	**F**
Thaw the display, resuming the display of updated statistics.	**T**

Table 589: Output Control Keys for the monitor interface Command *(continued)*

Action	Key
Clear (zero) the current delta counters since **monitor interface** was started. It does not clear the accumulative counter.	**C**
Stop the **monitor interface** command.	**Q**

See the CLI Explorer for details on using match conditions with the **monitor traffic** command.

Monitoring RMON MIB Tables

Purpose Monitor remote monitoring (RMON) alarm, event, and log tables.

Action To display the RMON tables:

```
user@switch> show snmp rmon
Alarm
Index  Variable description                           Value State

     5 monitor
       jnxOperatingCPU.9.1.0.0                            5 falling threshold

Event
Index  Type                      Last Event
    1  log and trap              2010-07-10 11:34:17 PDT
Event Index: 1
    Description: Event 1 triggered by Alarm 5, rising threshold (90) crossed,
(variable: jnxOperatingCPU.9.1.0.0, value: 100)
    Time: 2010-07-10 11:34:07 PDT
    Description: Event 1 triggered by Alarm 5, falling threshold (75) crossed,
(variable: jnxOperatingCPU.9.1.0.0, value: 5)
    Time: 2010-07-10 11:34:17 PDT
```

Meaning The display shows that an alarm has been defined to monitor jnxRmon MIB object jnxOperatingCPU, which represents the CPU utilization of the Routing Engine. The alarm is configured to generate an event that sends an SNMP trap and adds an entry to the logTable in the RMON MIB. The log table shows that two occurrences of the event have been generated—one for rising above a threshold of 90 percent, and one for falling below a threshold of 75 percent.

Related Documentation

- Configuring RMON Alarms and Events on page 6117
- **show snmp rmon on page 6395**
- **show snmp rmon history on page 6399**
- **clear snmp statistics on page 6375**
- **clear snmp history on page 6374**

Monitoring SNMP

There are several commands that you can access in Junos OS operational mode to monitor SNMP information. Some of the commands are:

- **show snmp health-monitor**, which displays the health monitor log and alarm information.
- **show snmp mib**, which displays information from the MIBs, such as device and system information.
- **show snmp statistics**, which displays SNMP statistics such as the number of packets, silent drops, and invalid output values.
- **show snmp rmon**, which displays the RMON alarm, event, history, and log information

The following example provides sample output from the **show snmp health-monitor** command:

user@switch> show snmp health-monitor

```
Alarm
Index  Variable description                          Value State

 32768 Health Monitor: root file system utilization
       jnxHrStoragePercentUsed.1                        58 active

 32769 Health Monitor: /config file system utilization
       jnxHrStoragePercentUsed.2                         0 active

 32770 Health Monitor: RE 0 CPU utilization
       jnxOperatingCPU.9.1.0.0                           0 active

 32773 Health Monitor: RE 0 Memory utilization
       jnxOperatingBuffer.9.1.0.0                       35 active

 32775 Health Monitor: jkernel daemon CPU utilization
       Init daemon                                       0 active
       Chassis daemon                                   50 active
       Firewall daemon                                   0 active
       Interface daemon                                  5 active
       SNMP daemon                                      11 active
       MIB2 daemon                                      42 active
       ...
```

The following example provides sample output from the **show snmp mib** command:

user@switch> show snmp mib walk system

```
sysDescr.0    = Juniper Networks, Inc. qfx3500s internet router, kernel
JUNOS 11.1-20100926.0 #0: 2010-09-26 06:17:38 UTC builder@abc.juniper.net:
/volume/build/junos/11.1/production/20100926.0/obj-xlr/bsd/sys/compile/JUNIPER-xxxxx

Build date: 2010-09-26 06:00:10 U
sysObjectID.0 = jnxProductQFX3500
sysUpTime.0   = 24444184
sysContact.0  = J Smith
sysName.0     = Lab QFX3500
sysLocation.0 = Lab
sysServices.0 = 4
```

The following example provides sample output from the **show snmp statistics** command:

user@switch> show snmp statistics

```
SNMP statistics:
  Input:
    Packets: 0, Bad versions: 0, Bad community names: 0,
    Bad community uses: 0, ASN parse errors: 0,
    Too bigs: 0, No such names: 0, Bad values: 0,
    Read onlys: 0, General errors: 0,
    Total request varbinds: 0, Total set varbinds: 0,
    Get requests: 0, Get nexts: 0, Set requests: 0,
    Get responses: 0, Traps: 0,
    Silent drops: 0, Proxy drops: 0, Commit pending drops: 0,
    Throttle drops: 0, Duplicate request drops: 0
    Output:
    Packets: 0, Too bigs: 0, No such names: 0,
    Bad values: 0, General errors: 0,
    Get requests: 0, Get nexts: 0, Set requests: 0,
    Get responses: 0, Traps: 0
```

Related Documentation

- health-monitor on page 1297
- show snmp mib on page 6392
- show snmp statistics on page 1379

Monitoring System Log Messages

Purpose Display system log messages about the QFX Series. By looking through a system log file for any entries pertaining to the interface that you are interested in, you can further investigate a problem with an interface on the switch.

Action To view system log messages:

user@switch1> **show log messages**

Sample Output

```
Nov  4 11:30:01 switch1 newsyslog[2283]: logfile turned over due to size>128K
Nov  4 11:30:01 switch1 newsyslog[2283]: logfile turned over due to size>128K
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 1
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 2
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 3
...
Nov  4 11:52:53  switch1 snmpd[944]: SNMPD_HEALTH_MON_INSTANCE: Health Monitor:
jroute daemon
memory usage (Management process): new instance detected (variable:
sysApplElmtRunMemory.5.6.2293)
Nov  4 11:52:53  switch1 snmpd[944]: SNMPD_HEALTH_MON_INSTANCE: Health Monitor:
jroute daemon
memory usage (Command-line interface): new instance detected (variable:
sysApplElmtRunMemory.5.8.2292)
...
Nov  4 12:10:24  switch1 mgd[2293]: UI_CMDLINE_READ_LINE: User 'jsmith', command
```

```
 'exit '
Nov  4 12:10:27  switch1 mgd[2293]: UI_DBASE_LOGOUT_EVENT: User 'jsmith' exiting
 configuration mode
Nov  4 12:10:31  switch1 mgd[2293]: UI_CMDLINE_READ_LINE: User 'jsmith', command
 'show log messages
```

Meaning The sample output shows the following entries in the **messages** file:

- A new log file was created when the previous file reached the maximum size of 128 kilobytes (KB).
- The fan speed for Fan 1, 2, and 3 is set at 65 percent.
- Health monitoring activity is detected.
- CLI commands were entered by the user jsmith.

Related Documentation

- Overview of Junos OS System Log Messages on page 6068
- Understanding the Implementation of System Log Messages on the QFabric System on page 6070
- Example: Configuring System Log Messages on page 6076
- **clear log on page 324**
- **show log on page 846**
- **syslog on page 287**

Pinging Hosts

Purpose Use the CLI **ping** command to verify that a host can be reached over the network. This command is useful for diagnosing host and network connectivity problems. The switch sends a series of Internet Control Message Protocol (ICMP) echo (ping) requests to a specified host and receives ICMP echo responses.

Action To use the **ping** command to send four requests (ping count) to host3:

ping *host* count *number*

Sample Output

ping host3 count 4

```
user@switch> ping host3 count 4
PING host3.site.net (176.26.232.111): 56 data bytes
64 bytes from 176.26.232.111: icmp_seq=0 ttl=122 time=0.661 ms
64 bytes from 176.26.232.111: icmp_seq=1 ttl=122 time=0.619 ms
64 bytes from 176.26.232.111: icmp_seq=2 ttl=122 time=0.621 ms
64 bytes from 176.26.232.111: icmp_seq=3 ttl=122 time=0.634 ms

--- host3.site.net ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.619/0.634/0.661/0.017 ms
```

Meaning

- The **ping** results show the following information:

- Size of the ping response packet (in bytes).
- IP address of the host from which the response was sent.
- Sequence number of the ping response packet. You can use this value to match the ping response to the corresponding ping request.
- Time-to-live (ttl) hop-count value of the ping response packet.
- Total time between the sending of the ping request packet and the receiving of the ping response packet, in milliseconds. This value is also called round-trip time.
- Number of ping requests (probes) sent to the host.
- Number of ping responses received from the host.
- Packet loss percentage.
- Round-trip time statistics: minimum, average, maximum, and standard deviation of the round-trip time.

Related Documentation

- Troubleshooting Overview on page 6413
- Understanding Troubleshooting Resources on page 6411

Tracing SNMP Activity on a Device Running Junos OS

SNMP tracing operations track activity for SNMP agents and record the information in log files. The logged error descriptions provide detailed information to help you solve problems faster.

By default, Junos OS does not trace any SNMP activity. If you include the **traceoptions** statement at the **[edit snmp]** hierarchy level, the default tracing behavior is:

- Important activities are logged in files located in the **/var/log** directory. Each log is named after the SNMP agent that generates it. Currently, the following log files are created in the **/var/log** directory when the **traceoptions** statement is used:
  - chassisd
  - craftd
  - ilmid
  - mib2d
  - rmopd
  - serviced
  - snmpd
- When a trace file named ***filename*** reaches its maximum size, it is renamed ***filename*.0**, then ***filename*.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten. (For more information about how log files are created, see the *Junos OS System Log Messages Reference*.)

- Log files can be accessed only by the user who configured the tracing operation.

You cannot change the directory (**/var/log**) in which trace files are located. However, you can customize the other trace file settings by including the following statements at the **[edit snmp]** hierarchy level:

```
[edit snmp]
traceoptions {
  file <files number> <match regular-expression> <size size> <world-readable |
    no-world-readable>;
  flag flag;
  no-remote-trace;
}
```

These statements are described in the following sections:

- Configuring the Number and Size of SNMP Log Files on page 6328
- Configuring Access to the Log File on page 6328
- Configuring a Regular Expression for Lines to Be Logged on page 6329
- Configuring the Trace Operations on page 6329

Configuring the Number and Size of SNMP Log Files

By default, when the trace file reaches 128 kilobytes (KB) in size, it is renamed ***filename*.0**, then ***filename*.1**, and so on, until there are three trace files. Then the oldest trace file (***filename*.2**) is overwritten.

You can configure the limits on the number and size of trace files by including the following statements at the **[edit snmp traceoptions]** hierarchy level:

```
[edit snmp traceoptions]
file files number size size;
```

For example, set the maximum file size to 2 MB, and the maximum number of files to 20. When the file that receives the output of the tracing operation (***filename***) reaches 2 MB, ***filename*** is renamed ***filename*.0**, and a new file called ***filename*** is created. When the new ***filename*** reaches 2 MB, ***filename*.0** is renamed ***filename*.1** and ***filename*** is renamed ***filename*.0**. This process repeats until there are 20 trace files. Then the oldest file (***filename*.19**) is overwritten by the newest file (***filename*.0**).

The number of files can be from 2 through 1000 files. The file size of each file can be from 10 KB through 1 gigabyte (GB).

Configuring Access to the Log File

By default, log files can be accessed only by the user who configured the tracing operation.

To specify that any user can read all log files, include the **file world-readable** statement at the **[edit snmp traceoptions]** hierarchy level:

```
[edit snmp traceoptions]
file world-readable;
```

To explicitly set the default behavior, include the **file no-world-readable** statement at the **[edit snmp traceoptions]** hierarchy level:

```
[edit snmp traceoptions]
file no-world-readable;
```

Configuring a Regular Expression for Lines to Be Logged

By default, the trace operation output includes all lines relevant to the logged activities.

You can refine the output by including the **match** statement at the **[edit snmp traceoptions file *filename*]** hierarchy level and specifying a regular expression (regex) to be matched:

```
[edit snmp traceoptions]
file filename match regular-expression;
```

Configuring the Trace Operations

By default, only important activities are logged. You can specify which trace operations are to be logged by including the following **flag** statement (with one or more tracing flags) at the **[edit snmp traceoptions]** hierarchy level:

```
[edit snmp traceoptions]
flag {
  all;
  configuration;
  database;
  events;
  general;
  interface-stats;
  nonvolatile-sets;
  pdu;
  policy;
  protocol-timeouts;
  routing-socket;
  server;
  subagent;
  timer;
  varbind-error;
}
```

Table 590 on page 6329 describes the meaning of the SNMP tracing flags.

Table 590: SNMP Tracing Flags

Flag	Description	Default Setting
all	Log all operations.	Off
configuration	Log reading of the configuration at the **[edit snmp]** hierarchy level.	Off
database	Log events involving storage and retrieval in the events database.	Off
events	Log important events.	Off

Table 590: SNMP Tracing Flags *(continued)*

Flag	Description	Default Setting
general	Log general events.	Off
interface-stats	Log physical and logical interface statistics.	Off
nonvolatile-set	Log nonvolatile SNMP set request handling.	Off
pdu	Log SNMP request and response packets.	Off
policy	Log policy processing.	Off
protocol-timeouts	Log SNMP response timeouts.	Off
routing-socket	Log routing socket calls.	Off
server	Log communication with processes that are generating events.	Off
subagent	Log subagent restarts.	Off
timer	Log internal timer events.	Off
varbind-error	Log variable binding errors.	Off

To display the end of the log for an agent, issue the **show log *agent*d | last** operational mode command:

```
[edit]
user@host# run show log agentd | last
```

where ***agent*** is the name of an SNMP agent.

Related Documentation

- *Configuring SNMP on a Device Running Junos OS*
- *Configuration Statements at the [edit snmp] Hierarchy Level*
- *Example: Tracing SNMP Activity*
- Configuring SNMP on page 1237

Using the Enterprise-Specific Utility MIB to Enhance SNMP Coverage

Even though the Junos OS has built-in performance metrics and monitoring options, you might need to have customized performance metrics. To make it easier for you to monitor such customized data through a standard monitoring system, the Junos OS provides you with an enterprise-specific Utility MIB that can store such data and thus extend SNMP support for managing and monitoring the data of your choice.

The enterprise-specific Utility MIB provides you with container objects of the following types: **32-bit counters**, **64-bit counters**, **signed integers**, **unsigned integers**, and **octet strings**.

You can use these container MIB objects to store the data that are otherwise not supported for SNMP operations. You can populate data for these objects either by using CLI commands or with the help of Op scripts and an RPC API that can invoke the CLI commands.

The following CLI commands enable you to set and clear Utility MIB object values:

- **request snmp utility-mib set instance *name* object-type <counter | counter 64 | integer | string | unsigned integer> object-value *value***
- **request snmp utility-mib clear instance *name* object-type <counter | counter 64 | integer | string | unsigned integer>**

The **instance *name*** option of the **request snmp utility-mib <set | clear>** command specifies the name of the data instance and is the main identifier of the data. The **object-type <counter | counter 64 | integer | string | unsigned integer>** option enables you specify the object type, and the **object-value *value*** option enables you to set the value of the object.

To automate the process of populating Utility MIB data, you can use a combination of an event policy and event script. The following examples show the configuration for an event policy to run **show system buffers** every hour and to store the **show system buffers** data in Utility MIB objects by running an event script (**check-mbufs.slax**).

Event Policy Configuration

To configure an event policy that runs the **show system buffers** command every hour and invokes **check-mbufs.slax** to store the **show system buffers** data into Utility MIB objects, include the following statements at the [**edit**] hierarchy level:

```
event-options {
   generate-event {
      1-HOUR time-interval 3600;
   }
   policy MBUFS {
      events 1-HOUR;
      then {
         event-script check-mbufs.slax; # script stored at /var/db/scripts/event/
      }
   }
   event-script {
      file check-mbufs.slax;
   }
}
```

check-mbufs.slax Script

The following example shows the **check-mbufs.slax** script that is stored under **/var/db/scripts/event/**:

```
------ script START ------
version 1.0;

ns junos = "http://xml.juniper.net/junos/*/junos";
ns xnm = "http://xml.juniper.net/xnm/1.1/xnm";
ns jcs = "http://xml.juniper.net/junos/commit-scripts/1.0";
ns ext = "http://xmlsoft.org/XSLT/namespace";

match / {
    <op-script-results>{
```

```
 var $cmd = <command> "show system buffers";
        var $out = jcs:invoke($cmd);

     var $lines = jcs:break_lines($out);
     for-each ($lines) {
         if (contains(., "current/peak/max")) {
             var $pattern = "([0-9]+)/([0-9]+)/([0-9]+) mbufs";
             var $split = jcs:regex($pattern, .);
             var $result = $split[2];

             var $rpc = <request-snmp-utility-mib-set> {
                 <object-type> "integer";
                 <instance> "current-mbufs";
                 <object-value> $result;
             }
             var $res = jcs:invoke($rpc);
                }
        }
    }
}
------ script END ------
```

You can run the following command to check the data stored in the Utility MIB as a result of the event policy and script shown in the preceding examples:

```
user@host> show snmp mib walk jnxUtilData ascii jnxUtilIntegerValue."current-mbufs"
= 0 jnxUtilIntegerTime."current-mbufs" = 07 da 05 0c 03 14 2c 00 2d 07 00
regress@caramels>
```

NOTE: The **show snmp mib walk** command is not available on the QFabric system, but you can use external SNMP client applications to perform this operation.

Related Documentation

- Understanding the Implementation of SNMP on the QFabric System on page 6023

Displaying Commit Script Output

Table 591 on page 6332 summarizes the Junos OS command-line interface (CLI) commands you can use to monitor and troubleshoot commit scripts. For more information about the **cscript.log** file, see *Tracing Commit Script Processing*.

NOTE: Tracing commit script processing, including the **cscript.log** file, is not supported on the QFX3000-G QFabric system.

Table 591: Commit Script Configuration and Operational Mode Commands

Task	Command
Configuration Mode Commands	
Display errors and warnings generated by commit scripts.	**commit** or **commit check**

Table 591: Commit Script Configuration and Operational Mode Commands *(continued)*

Task	Command
Display detailed information.	**commit | display detail**
Display the underlying Extensible Markup Language (XML) data.	**commit | display xml**
Display the postinheritance contents of the configuration database. This view includes transient changes, but does not include changes made in configuration groups.	**show | display commit-scripts**
Display the postinheritance contents of the configuration database. This view excludes transient changes.	**show | display commit-scripts no-transients**
Display the postinheritance configuration in XML format. Viewing the configuration in XML format can be helpful when you are writing XML Path Language (XPath) expressions and configuration element tags.	**show | display commit-scripts view**
Display the postinheritance configuration in XML format, but exclude transient changes.	**show | display commit-scripts view | display commit-scripts no-transients**
Display all configuration groups data, including script-generated changes to the groups.	**show groups | display commit-scripts**
Display a particular configuration group, including script-generated changes to the group.	**show groups *group-name* | display commit-scripts**
Operational Mode Commands	
Display logging data associated with all commit script processing.	**show log cscript.log**
Display processing for only the most recent commit operation.	**show log cscript.log | las**t
Display processing for script errors.	**show log cscript.log | match error**
Display processing for a particular script.	**show log cscript.log | match *filename***

Related Documentation

- *Tracing Commit Script Processing*

Commands for General Monitoring

- monitor traffic
- ping

monitor traffic

Syntax

monitor traffic
<brief | detail | extensive>
<absolute-sequence>
<count *count*>
<interface *interface-name*>
<layer2-headers>
<matching *matching*>
<no-domain-names>
<no-promiscuous>
<no-resolve>
<no-timestamp>
<print-ascii>
<print-hex>
<resolve-timeout>
<size *size*>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display packet headers or packets received and sent from the Routing Engine.

NOTE:

- Using the **monitor-traffic** command can degrade router or switch performance.
- Delays from DNS resolution can be eliminated by using the **no-resolve** option.

NOTE: This command is not supported on the QFabric system.

Options

none—(Optional) Display packet headers transmitted through **fxp0**. On a TX Matrix Plus router, display packet headers transmitted through **em0**.

brief | detail | extensive—(Optional) Display the specified level of output.

absolute-sequence—(Optional) Display absolute TCP sequence numbers.

count *count*—(Optional) Specify the number of packet headers to display (0 through 1,000,000). The monitor traffic command quits automatically after displaying the number of packets specified.

interface *interface-name*—(Optional) Specify the interface on which the **monitor traffic** command displays packet data. If no interface is specified, the **monitor traffic** command displays packet data arriving on the lowest-numbered interface.

layer2-headers—(Optional) Display the link-level header on each line.

matching *matching*—(Optional) Display packet headers that match a regular expression. Use matching expressions to define the level of detail with which the **monitor traffic** command filters and displays packet data.

no-domain-names—(Optional) Suppress the display of the domain portion of hostnames. With the **no-domain-names** option enabled, the **monitor traffic** command displays only **team** for the hostname **team.company.net**.

no-promiscuous—(Optional) Do not put the interface into promiscuous mode.

no-resolve—(Optional) Suppress reverse lookup of the IP addresses.

no-timestamp—(Optional) Suppress timestamps on displayed packets.

print-ascii—(Optional) Display each packet in ASCII format.

print-hex—(Optional) Display each packet, except the link-level header, in hexadecimal format.

resolve-timeout *timeout*—(Optional) Amount of time the router or switch waits for each reverse lookup before timing out. You can set the timeout for 1 through 4,294,967,295 seconds. The default is 4 seconds. To display each packet, use the **print-ascii**, **print-hex**, or **extensive** option.

size *size*—(Optional) Read but do not display up to the specified number of bytes for each packet. When set to **brief** output, the default packet size is 96 bytes and is adequate for capturing IP, ICMP, UDP, and TCP packet data. When set to **detail** and **extensive** output, the default packet size is 1514. The **monitor traffic** command truncates displayed packets if the matched data exceeds the configured size.

Additional Information

In the **monitor traffic** command, you can specify an expression to match by using the **matching** option and including the expression in quotation marks:

```
monitor traffic matching "expression"
```

Replace ***expression*** with one or more of the match conditions listed in Table 592 on page 6337.

Table 592: Match Conditions for the monitor traffic Command

Match Type	Condition	Description
Entity	**host [*address* | *hostname*]**	Matches packets that contain the specified address or hostname. The protocol match conditions **arp**, **ip**, or **rarp**, or any of the directional match conditions can be prepended to the **host** match condition.
	net *address*	Matches packets with source or destination addresses containing the specified network address.
	net *address* mask *mask*	Matches packets containing the specified network address and subnet mask.
	port (*port-number* | *port-name*)	Matches packets containing the specified source or destination TCP or UDP port number or port name. In place of the numeric port address, you can specify a text synonym, such as **bgp** (179), **dhcp** (67), or **domain** (53) (the port numbers are also listed).
Directional	**dst**	Matches packets going to the specified destination. This match condition can be prepended to any of the entity type match conditions.
	src	Matches packets from a specified source. This match condition can be prepended to any of the entity type match conditions.
	src and **dst**	Matches packets that contain the specified source and destination addresses. This match condition can be prepended to any of the entity type match conditions.
	src or **dst**	Matches packets containing either of the specified addresses. This match condition can be prepended to any of the entity type match conditions.
Packet Length	**less *value***	Matches packets shorter than or equal to the specified value, in bytes.
	greater *value*	Matches packets longer than or equal to the specified value, in bytes.

Table 592: Match Conditions for the monitor traffic Command *(continued)*

Match Type	Condition	Description
Protocol	**amt**	Matches all AMT packets. Use the extensive level of output to decode the inner IGMP packets in addition to the AMT outer packet.
	arp	Matches all ARP packets.
	ether	Matches all Ethernet packets.
	ether (broadcast | multicast)	Matches broadcast or multicast Ethernet frames. This match condition can be prepended with**src** and **dst**.
	ether ***protocol*** **(*address* | (arp | ip | rarp))**	Matches packets with the specified Ethernet address or Ethernet packets of the specified protocol type. The **ether protocol** arguments **arp**, **ip**, and **rarp** are also independent match conditions, so they must be preceded by a backslash (\) when used in the **ether protocol** match condition.
	icmp	Matches all ICMP packets.
	ip	Matches all IP packets.
	ip (broadcast | multicast)	Matches broadcast or multicast IP packets.
	ip protocol (*address* | (icmp | igrp | tcp | udp))	Matches packets with the specified address or protocol type. The **ip protocol** arguments **icmp**, **tcp**, and **udp** are also independent match conditions, so they must be preceded by a backslash (\) when used in the **ip protocol** match condition.
	isis	Matches all IS-IS routing messages.
	rarp	Matches all RARP packets.
	tcp	Matches all TCP datagrams.
	udp	Matches all UDP datagrams.

To combine expressions, use the logical operators listed in Table 593 on page 6338.

Table 593: Logical Operators for the monitor traffic Command

Logical Operator (Highest to Lowest Precedence)	Description
!	Logical NOT. If the first condition does not match, the next condition is evaluated.

Table 593: Logical Operators for the monitor traffic Command *(continued)*

Logical Operator (Highest to Lowest Precedence)	Description
&&	Logical AND. If the first condition matches, the next condition is evaluated. If the first condition does not match, the next condition is skipped.
||	Logical OR. If the first condition matches, the next condition is skipped. If the first condition does not match, the next condition is evaluated.
( )	Group operators to override default precedence order. Parentheses are special characters, each of which must be preceded by a backslash (\).

You can use relational operators to compare arithmetic expressions composed of integer constants, binary operators, a length operator, and special packet data accessors. The arithmetic expression matching condition uses the following syntax:

monitor traffic matching "ether[0] & 1 != 0"*"arithmetic_expression relational_operator arithmetic_expression"*

The packet data accessor uses the following syntax:

protocol [byte-offset <*size*>]

The optional *size* field represents the number of bytes examined in the packet header. The available values are **1**, **2**, or **4** bytes. The following sample command captures all multicast traffic:

user@host> **monitor traffic matching "ether[0] & 1 != 0"**

To specify match conditions that have a numeric value, use the arithmetic and relational operators listed in Table 594 on page 6340.

NOTE: Because the Packet Forwarding Engine removes Layer 2 header information before sending packets to the Routing Engine:

- The **monitor traffic** command cannot apply match conditions to inbound traffic.
- The **monitor traffic interface** command also cannot apply match conditions for Layer 3 and Layer 4 packet data, resulting in the **match** pipe option (**| match**) for this command for Layer 3 and Layer 4 packets not working either. Therefore, ensure that you specify match conditions as described in this command summary. For more information about match conditions, see Table 592 on page 6337.
- The 802.1Q VLAN tag information included in the Layer 2 header is removed from all inbound traffic packets. Because the **monitor traffic interface ae[***x***]** command for aggregated Ethernet interfaces (such as **ae0**) only shows inbound traffic data, the command does not show VLAN tag information in the output.

Table 594: Arithmetic and Relational Operators for the monitor traffic Command

Arithmetic or Relational Operator	Description
Arithmetic Operator	
+	Addition operator.
-	Subtraction operator.
/	Division operator.
&	Bitwise AND.
*	Bitwise exclusive OR.
|	Bitwise inclusive OR.
Relational Operator (Highest to Lowest Precedence)	
<=	If the first expression is less than or equal to the second, the packet matches.
>=	If the first expression is greater than or equal to the second, the packet matches.
<	If the first expression is less than the second, the packet matches.
>	If the first expression is greater than the second, the packet matches.
=	If the compared expressions are equal, the packet matches.
!=	If the compared expressions are unequal, the packet matches.

Required Privilege Level

trace
maintenance

List of Sample Output

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

monitor traffic count

```
user@host> monitor traffic count 2
listening on fxp0
04:35:49.814125  In my-server.home.net.1295 > my-server.work.net.telnet: . ack
4122529478 win 16798 (DF)
04:35:49.814185
Out my-server.work.net.telnet > my-server.home.net.1295: P
1:38(37) ack 0 win 17680 (DF) [tos 0x10]
```

monitor traffic detail count

```
user@host> monitor traffic detail count 2
listening on fxp0
04:38:16.265864  In my-server.home.net.1295 > my-server.work.net.telnet: . ack
4122529971 win 17678 (DF) (ttl 121, id 6812)
04:38:16.265926
Out my-server.work.net.telnet.telnet > my-server.home.net.1295: P 1:38(37) ack 0
 win 17680 (DF) [tos 0x10]  (ttl 6)
```

monitor traffic extensive (Absolute Sequence)

```
user@host> monitor traffic extensive no-domain-names no-resolve no-timestamp count 20
matching "tcp" absolute-sequence
listening on fxp0
 In 207.17.136.193.179 > 192.168.4.227.1024: . 4042780859:4042780859(0)
ack 1845421797 win 16384 <nop,nop,timestamp 4935628 965951> [tos 0xc0]  (ttl )
 In 207.17.136.193.179 > 192.168.4.227.1024: P 4042780859:4042780912(53)
ack 1845421797 win 16384
<nop,nop,timestamp 4935628 965951>:
BGP [|BGP UPDAT)
In 192.168.4.227.1024 > 207.17.136.193.179:
P 1845421797:1845421852(55) ack 4042780912 win 16384 <nop,nop,timestamp 965951
4935628>: BGP [|BGP UPDAT)
...
```

monitor traffic extensive (Relative Sequence)

```
user@host> monitor traffic extensive no-domain-names no-resolve no-timestamp count 20
matching "tcp"
listening on fxp0
 In 172.24.248.221.1680 > 192.168.4.210.23: . 396159737:396159737(0)
ack 1664980689 win 17574 (DF) (ttl 121, id 50003)
Out 192.168.4.210.23 > 172.24.248.221.1680: P 1:40(39)
ack 0 win 17680 (DF) [tos 0x10]  (ttl 64, id 5394)
 In 207.17.136.193.179 > 192.168.4.227.1024: P 4042775817:4042775874(57)
ack 1845416593 win 16384 <nop,nop,timestamp 4935379 965690>: BGP [|BGP UPDAT)
...
```

monitor traffic extensive count

```
user@host>  monitor traffic extensive count 5 no-domain-names no-resolve
listening on fxp013:18:17.406933
In 192.168.4.206.2723610880 > 172.17.28.8.2049:
40 null (ttl 64, id 38367)13:18:17.407577
In 172.17.28.8.2049 > 192.168.4.206.2723610880:
```

```
reply ok 28 null (ttl 61, id 35495)13:18:17.541140
In 0:e0:1e:42:9c:e0 0:e0:1e:42:9c:e0 9000 60:
0000 0100 0000 0000
0000 0000 0000 0000
0000 0000 0000 0000
0000 0000 0000 0000
0000 0000 0000 0000
0000 0000 000013:18:17.591513
In 172.24.248.156.4139 > 192.168.4.210.23:
3556964918:3556964918(0)
ack 295526518 win 17601 (DF)
(ttl 121, id 14)13:18:17.591568
Out 192.168.4.210.23 >
172.24.248.156.4139: P 1:40(39)
ack 0 win 17680 (DF) [tos 0x10]
(ttl 64, id 52376)
```

monitor traffic interface

```
user@host> monitor traffic interface fxp0
listening on fxp0.0
18:17:28.800650  In server.home.net.723 > host1-0.lab.home.net.log
18:17:28.800733 Out host2-0.lab.home.net.login > server.home.net.7
18:17:28.817813  In host30.lab.home.net.syslog > host40.home0
18:17:28.817846  In host30.lab.home.net.syslog > host40.home0
...
```

monitor traffic matching

```
user@host> monitor traffic matching "net 192.168.1.0/24"
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Address resolution is ON. Use <no-resolve> to avoid any reverse lookup delay.
Address resolution timeout is 4s.
Listening on fxp0, capture size 96 bytes

Reverse lookup for 192.168.1.255 failed (check DNS reachability).
Other reverse lookup failures will not be reported.
Use no-resolve to avoid reverse lookups on IP addresses.

21:55:54.003511  In IP truncated-ip - 18 bytes missing!
192.168.1.17.netbios-ns > 192.168.1.255.netbios-ns: UDP, length 50
21:55:54.003585 Out IP truncated-ip - 18 bytes missing!
192.168.1.17.netbios-ns > 192.168.1.255.netbios-ns: UDP, length 50
21:55:54.003864  In arp who-has 192.168.1.17 tell 192.168.1.9
...
```

monitor traffic (TX Matrix Plus Router)

```
user@host> monitor traffic
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Address resolution is ON. Use <no-resolve> to avoid any reverse lookup delay.
Address resolution timeout is 4s.
Listening on em0, capture size 96 bytes
04:11:59.862121 Out IP truncated-ip - 25 bytes missing!
summit-em0.englab.juniper.net.syslog > sv-log-01.englab.juniper.net.syslog:
SYSLOG kernel.info, length: 57
04:11:59.862303
Out IP truncated-ip - 25 bytes missing!
summit-em0.englab.juniper.net.syslog >
sv-log-02.englab.juniper.net.syslog: SYSLOG kernel.info, length: 57
04:11:59.923948
In IP aj-em0.englab.juniper.net.65235 >
```

```
summit-em0.englab.juniper.net.telnet: .
ack 1087492766 win 33304 <nop,nop,timestamp 42366734 993490>
04:11:59.923983 Out IP truncated-ip - 232 bytes missing!
summit-em0.englab.juniper.net.telnet > aj-em0.englab.juniper.net.65235: P
1:241(240) ack 0 win 33304
<nop,nop,timestamp 993590 42366734>
04:12:00.022900
In IP aj-em0.englab.juniper.net.65235 >
summit-em0.englab.juniper.net.telnet: . ack 241 win 33304 <nop,nop,timestamp
42366834 993590>
04:12:00.141204
In IP truncated-ip - 40 bytes missing!
ipg-lnx-shell1.juniper.net.46182 > summit-em0.englab.juniper.net.telnet: P
2950530356:2950530404(48) ack 485494987 win 63712
<nop,nop,timestamp 1308555294 987086>
04:12:00.141345
Out IP summit-em0.englab.juniper.net.telnet >
ipg-lnx-shell1.juniper.net.46182: P 1:6(5)
ack 48 win 33304
<nop,nop,timestamp 993809 1308555294>
04:12:00.141572
In IP ipg-lnx-shell1.juniper.net.46182 >
summit-em0.englab.juniper.net.telnet: .
ack 6 win 63712
<nop,nop,timestamp 1308555294 993809>
04:12:00.141597
Out IP summit-em0.englab.juniper.net.telnet >
ipg-lnx-shell1.juniper.net.46182: P 6:10(4) ack 48 win 33304
<nop,nop,timestamp 993810 1308555294>
04:12:00.141821
In IP ipg-lnx-shell1.juniper.net.46182 >
summit-em0.englab.juniper.net.telnet: .
ack 10 win 63712 <nop,nop,timestamp 1308555294 993810>
04:12:00.141837 Out IP truncated-ip - 2 bytes missing!
summit-em0.englab.juniper.net.telnet >
ipg-lnx-shell1.juniper.net.46182: P 10:20(10) ack 48 win 33304
<nop,nop,timestamp 993810 1308555294>
04:12:00.142072
In IP ipg-lnx-shell1.juniper.net.46182 >
summit-em0.englab.juniper.net.telnet: . ack 20 win 63712
<nop,nop,timestamp 1308555294 993810>
04:12:00.142089 Out IP summit-em0.englab.juniper.net.telnet >
ipg-lnx-shell1.juniper.net.46182: P 20:28(8) ack 48 win 33304 <nop,nop,timestamp
 993810 1308555294>
04:12:00.142321
In IP ipg-lnx-shell1.juniper.net.46182 >
summit-em0.englab.juniper.net.telnet: .
ack 28 win 63712 <nop,nop,timestamp 1308555294 993810>
04:12:00.142337
Out IP truncated-ip - 1 bytes missing!
summit-em0.englab.juniper.net.telnet >
ipg-lnx-shell1.juniper.net.46182: P 28:37(9) ack 48 win 33304 <nop,nop,timestamp
 993810 1308555294>
...
```

monitor traffic (QFX3500 Switch)

```
user@switch> monitor traffic
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Address resolution is ON. Use <no-resolve> to avoid any reverse lookup delay.
Address resolution timeout is 4s.
```

```
Listening on me4, capture size 96 bytes
Reverse lookup for 172.22.16.246 failed (check DNS reachability).
Other reverse lookup failures will not be reported.
Use <no-resolve> to avoid reverse lookups on IP addresses.
16:35:32.240873 Out IP truncated-ip - 112 bytes missing!
labqfx-me0.lab4.juniper.net.ssh >
172.22.16.246.telefinder: P 4200727624:4200727756(132) ack 2889954831 win 65535
16:35:32.240900 Out IP truncated-ip - 176 bytes missing!
labqfx-me0.lab4.juniper.net.ssh >
172.22.16.246.telefinder: P 132:328(196) ack 1 win 65535
...
```


ping

Syntax

ping *host*
<bypass-routing>
<count *requests*>
<detail>
<do-not-fragment>
<inet | inet6>
<interface *source-interface*>
<interval *seconds*>
<logical-system *logical-system-name*>
<loose-source *value*>
<mac-address *mac-address*>
<no-resolve>
<pattern *string*>
<rapid>
<record-route>
<routing-instance *routing-instance-name*>
<size *bytes*>
<source *source-address*>
<strict >
<strict-source *value*.>
<tos *type-of-service*>
<ttl *value*>
<verbose>
<vpls *instance-name*>
<wait *seconds*>

Syntax (QFX Series)

ping *host*
<bypass-routing>
<count *requests*>
<detail>
<do-not-fragment>
<inet>
<interface *source-interface*>
<interval *seconds*>
<logical-system *logical-system-name*>
<loose-source *value*>
<mac-address *mac-address*>
<no-resolve>
<pattern *string*>
<rapid>
<record-route>
<routing-instance *routing-instance-name*>
<size *bytes*>
<source *source-address*>
<strict>
< strict-source *value*>
<tos *type-of-service*>
<ttl *value*>
<verbose>
<wait *seconds*>

Release Information Command introduced before Junos OS Release 7.4.

Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Check host reachability and network connectivity. The **ping** command sends Internet Control Message Protocol (ICMP) ECHO_REQUEST messages to elicit ICMP ECHO_RESPONSE messages from the specified host. Press Ctrl+c to interrupt a ping command.

Options ***host***—IP address or hostname of the remote system to ping.

bypass-routing—(Optional) Bypass the normal routing tables and send ping requests directly to a system on an attached network. If the system is not on a directly attached network, an error is returned. Use this option to ping a local system through an interface that has no route through it.

count *requests*—(Optional) Number of ping requests to send. The range of values is **1** through **2,000,000,000**. The default value is an unlimited number of requests.

detail—(Optional) Include in the output the interface on which the ping reply was received.

do-not-fragment—(Optional) Set the do-not-fragment (DF) flag in the IP header of the ping packets. For IPv6 packets, this option disables fragmentation.

NOTE: In Junos OS Release 11.1 and later, when issuing the **ping** command for an IPv6 route with the **do-not-fragment** option, the maximum ping packet size is calculated by subtracting 48 bytes (40 bytes for the IPV6 header and 8 bytes for the ICMP header) from the MTU. Therefore, if the ping packet size (including the 48-byte header) is greater than the MTU, the ping operation might fail.

inet—(Optional) Ping Packet Forwarding Engine IPv4 routes.

inet6—(Optional) Ping Packet Forwarding Engine IPv6 routes.

interface *source-interface*—(Optional) Interface to use to send the ping requests.

interval *seconds*—(Optional) How often to send ping requests. The range of values, in seconds, is **1** through infinity. The default value is **1**.

logical-system *logical-system-name*—(Optional) Name of logical system from which to send the ping requests.

Alternatively, enter the **set cli logical-system *logical-system-name*** command and then run the **ping** command. To return to the main router or switch, enter the **clear cli logical-system** command.

loose-source *value*—(Optional) Intermediate loose source route entry (IPv4). Open a set of values.

mac-address ***mac-address***—(Optional) Ping the physical or hardware address of the remote system you are trying to reach.

no-resolve—(Optional) Do not attempt to determine the hostname that corresponds to the IP address.

pattern ***string***—(Optional) Specify a hexadecimal fill pattern to include in the ping packet.

rapid—(Optional) Send ping requests rapidly. The results are reported in a single message, not in individual messages for each ping request. By default, five ping requests are sent before the results are reported. To change the number of requests, include the **count** option.

record-route—(Optional) Record and report the packet's path (IPv4).

routing-instance ***routing-instance-name***—(Optional) Name of the routing instance for the ping attempt.

size ***bytes***—(Optional) Size of ping request packets. The range of values, in bytes, is **0** through **65,468**. The default value is **56**, which is effectively 64 bytes because 8 bytes of ICMP header data are added to the packet.

source ***source-address***—(Optional) IP address of the outgoing interface. This address is sent in the IP source address field of the ping request. If this option is not specified, the default address is usually the loopback interface (**lo.0**).

strict—(Optional) Use the strict source route option (IPv4).

strict-source ***value***—(Optional) Intermediate strict source route entry (IPv4). Open a set of values.

tos ***type-of-service***—(Optional) Set the type-of-service (ToS) field in the IP header of the ping packets. The range of values is **0** through **255**.

If the device configuration includes the **dscp-code-point** ***value*** statement at the **[edit class-of-service host-outbound-traffic]** hierarchy level, the configured DSCP value overrides the value specified in this command option. In this case, the ToS field of ICMP echo request packets sent on behalf of this command carries the DSCP value specified in the **dscp-code-point** configuration statement instead of the value you specify in this command option.

ttl ***value***—(Optional) Time-to-live (TTL) value to include in the ping request (IPv6). The range of values is **0** through **255**.

verbose—(Optional) Display detailed output.

vpls ***instance-name***—(Optional) Ping the instance to which this VPLS belongs.

wait ***seconds***—(Optional) Maximum wait time, in seconds, after the final packet is sent. If this option is not specified, the default delay is **10** seconds. If this option is used without the count option, a default count of **5** packets is used.

Required Privilege Level
network

Related Documentation
- *Configuring the Junos OS ICMPv4 Rate Limit for ICMPv4 Routing Engine Messages*

List of Sample Output

Output Fields
When you enter this command, you are provided feedback on the status of your request. An exclamation point (**!**) indicates that an echo reply was received. A period (**.**) indicates that an echo reply was not received within the timeout period. An **x** indicates that an echo reply was received with an error code. These packets are not counted in the received packets count. They are accounted for separately.

Sample Output

ping hostname

```
user@host> ping skye
PING skye.net (192.168.169.254): 56 data bytes
64 bytes from 192.168.169.254: icmp_seq=0 ttl=253 time=1.028 ms
64 bytes from 192.168.169.254: icmp_seq=1 ttl=253 time=1.053 ms
64 bytes from 192.168.169.254: icmp_seq=2 ttl=253 time=1.025 ms
64 bytes from 192.168.169.254: icmp_seq=3 ttl=253 time=1.098 ms
64 bytes from 192.168.169.254: icmp_seq=4 ttl=253 time=1.032 ms
64 bytes from 192.168.169.254: icmp_seq=5 ttl=253 time=1.044 ms
^C [abort]
```

ping hostname rapid

```
user@host> ping skye rapid
PING skye.net (192.168.169.254): 56 data bytes
!!!!!
--- skye.net ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.956/0.974/1.025/0.026 ms
```

ping hostname size count

```
user@host> ping skye size 200 count 5
PING skye.net (192.168.169.254): 200 data bytes
208 bytes from 192.168.169.254: icmp_seq=0 ttl=253 time=1.759 ms
208 bytes from 192.168.169.254: icmp_seq=1 ttl=253 time=2.075 ms
208 bytes from 192.168.169.254: icmp_seq=2 ttl=253 time=1.843 ms
208 bytes from 192.168.169.254: icmp_seq=3 ttl=253 time=1.803 ms
208 bytes from 192.168.169.254: icmp_seq=4 ttl=253 time=17.898 ms

--- skye.net ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 1.759/5.075/17.898 ms
```

Commands for Network Analytics

- show analytics configuration
- show analytics queue-statistics
- show analytics status
- show analytics streaming-servers
- show analytics traffic-statistics

monitor start (Analytics)

Syntax monitor start *filename*

Release Information Command introduced in Junos OS Release 13.2 for the QFX Series.

Description Start the display of the queue statistics or traffic statistics file if you had enabled queue or traffic monitoring on your device. The output is displayed in the JavaScript Object Notation (JSON) format.

Options *filename*—Name of the queue statistics or traffic statistics file.

Required Privilege Level trace

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176

List of Sample Output

monitor start Using the Local Analytics File (Junos OS Release 13.2X51-D15 or Later) on page 6351
monitor start Using the Queue Statistics File (Junos OS Release 13.2X51-D10) on page 6351
monitor start Using the Queue Statistics File (Junos OS Release 13.2X50-D15) on page 6351
monitor start Using the Traffic Statistics File (Junos OS Release 13.2X51-D10) on page 6352
monitor start Using the Traffic Statistics File (Junos OS Release 13.2X50-D15) on page 6352

Output Fields Table 595 on page 6350 describes the output fields for the **monitor start** command. Output fields are listed in the approximate order in which they appear.

Table 595: monitor start Command Output Fields

Field	Description
hostname (used in Junos OS Release 13.2X50-D15 only)	Name of the network analytics host device.
record type	Type of statistics. May be queue statistics or traffic statistics.
time	Time at which the statistics were captured.
router-id	ID of the network analytics host device.
latency	For queue statistics only. Traffic queue latency in milliseconds.
port	Name of the physical port configured for network analytics.
queue depth	For queue statistics only. Depth of the traffic queue in bytes.

Table 595: monitor start Command Output Fields *(continued)*

Field	Description
rxpkt	For traffic statistics monitoring only. Total packets received.
rxpps	For traffic statistics monitoring only. Total packets received per second.
rxbyte	For traffic statistics monitoring only. Total bytes received.
rxbps	For traffic statistics monitoring only. Total bytes received per second.
rxdrop	For traffic statistics monitoring only. Total incoming packets dropped.
rxerr	For traffic statistics monitoring only. Total packets with errors.
rxutil (in Junos OS Release 13.2X50-D15 only)	For traffic statistics monitoring only. Total percent of traffic utilization for incoming traffic.
txpkt	For traffic statistics monitoring only. Total packets transmitted.
txpps	For traffic statistics monitoring only. Total packets transmitted per second.
txbyte	For traffic statistics monitoring only. Total bytes transmitted.
txbps	For traffic statistics monitoring only. Total bytes transmitted per second.
txdrop	For traffic statistics monitoring only. Total transmitted bytes dropped.
txerr	For traffic statistics monitoring only. Total transmitted packets with errors (dropped).
txutil (in Junos OS Release 13.2X50-D15 only)	For traffic statistics monitoring only. Total percent of traffic utilization for outgoing traffic.

Sample Output

monitor start Using the Local Analytics File (Junos OS Release 13.2X51-D15 or Later)

```
user@host> monitor start analytics.stats
```

monitor start Using the Queue Statistics File (Junos OS Release 13.2X51-D10)

```
user@host> monitor start analytics.qs
{"record-type":"queue-stats","time":"2013 Nov 3 4:40:42.840",
"router-id":"qfx5100-switch","port":"xe-0/0/18","latency":0,"queue-depth":208}

{"record-type":"queue-stats","time":"2013 Nov 3 4:40:44.887",
"router-id":"qfx5100-switch","port":"xe-0/0/18","latency": 1110,"queue-depth":
1387568}
```

monitor start Using the Queue Statistics File (Junos OS Release 13.2X50-D15)

```
user@host> monitor start analytics.qs
{"hostname":"sw-la-pb-03","latency":566,"port":xe-0/0/9,"queue depth":708656,
"record type":"queue-stats","time":"Apr 11 20:18:40.329"}
```

Sample Output

monitor start Using the Traffic Statistics File (Junos OS Release 13.2X51-D10)

user@host> **monitor start analytics.ts**


```
{"record-type":"traffic-stats","time":"2013 Nov 3 4:39:53.910",
"router-id":"qfx5100-switch","port":"xe-0/0/18","rxpkt":23193749091,"rxpps":8299889,

"rxbyte":2968799876957,"rxbps":824002992,"rxdrop":0,"rxerr":0,"txpkt":1029323986,
"txpps":82671,"txbyte":131753470470,"txbps":85598256,"txdrop":0,"txerr":0}
```


monitor start Using the Traffic Statistics File (Junos OS Release 13.2X50-D15)

user@host> **monitor start analytics.ts**


```
{"hostname":"sw-la-pb-03","port":"xe-0/0/9","record type":"traffic-statistics",
"time":"Apr 11 20:13:48.545", "rxpkt":601024640, "rxpps": 840315,
"rxbyte":76931153920,
"rxbps":863997032, "rxdrop":0, "rxerr":0, "rxutil":8.32,"txpkt":336551380309,
"txpps":405395,"txbyte":23369872265951,"txbps":3240000976,"txdrop":1010566660824,
"txerr":69920099883860,"txutil":32.76}
```

show analytics collector

Syntax show analytics collector

Release Information Command introduced in Junos OS Release 13.2 for the QFX Series.

Description Show the list of network analytics remote collectors and related information. Remote collectors can be configured to receive streaming output for queue statistics and traffic statistics from the network analytics process (Analyticsd) running on the Routing Engine.

NOTE: **The show analytics collector command is available in Junos OS Release 13.2X51-D15 or later.**

Required Privilege Level interface-control

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176
- address (Analytics Collector) on page 6175

List of Sample Output show analytics collector on page 6354

Output Fields Table 596 on page 6353 describes the output fields for the **show analytics collector** command.

Table 596: show analytics collector Command Output Fields

Field	Description
Address	IP Address of the collector that is configured for receiving the streaming data.
Port	Port number of the collector receiving the streaming data.
Transport	Transport protocol: • tcp—Transmission Control Protocol • udp—User Datagram Protocol
Stream format	Format of the data that is sent to the server: • csv—Comma-separated values • gpb—Google Protocol Buffers • json—JavaScript Object Notation • tsv—Tab-separated values
State	Connection state of the streaming server.
Sent	Number of bytes sent to the streaming server.

Sample Output

show analytics collector

```
user@host> show analytics collector
Address         Port   Transport  Stream format  State            Sent
10.94.184.25    50013  udp        gpb            n/a              8710
10.94.184.25    50040  tcp        gpb            Not initialized  0
10.94.184.25    50050  tcp        gpb            Established      405
10.94.184.62    50010  tcp        csv            Established      18
10.94.184.62    50020  udp        json           n/a              17
```


show analytics configuration

Syntax show analytics configuration

Release Information Command introduced in Junos OS Release 13.2 for the QFX Series.

Description Show the network analytics configuration details for the global and interface configurations.

Required Privilege Level interface-control

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176

List of Sample Output show analytics configuration on page 6356

Output Fields Table 597 on page 6355 describes the output fields for the **show analytics configuration** command.

Table 597: show analytics configuration Command Output Fields

Field	Descriptions
Global Configurations	
Traffic statistics	Settings are Auto, Enabled, or Disabled. If **Auto** is displayed, traffic statistics monitoring is not enabled.
Poll interval (traffic statististics)	Interval for traffic statistics polling in seconds. If the output displays a setting of 0 seconds, the polling interval was not configured, and the default interval applies. NOTE: The default interval is 1 second in Junos OS Release 13.2X50-D15, and 2 seconds in Junos OS Release 13.2X51-D10 or later. NOTE: Due to limitations and variations in hardware capability in different devices, there might be a difference in value between the actual interval and configured interval.
Queue statistics	Settings are Auto, Enabled, or Disabled. If **Auto** is displayed, queue statistics monitoring is not enabled.
Poll interval (queue statististics)	Interval for queue statistics polling in milliseconds. NOTE: The default interval is 8 milliseconds in Junos OS Release 13.2X50-D15, and 10 milliseconds in Junos OS Release 13.2X51-D10 or later. NOTE: Due to limitations and variations in hardware capability in different devices, there might be a difference in value between the actual interval and configured interval.

Table 597: show analytics configuration Command Output Fields *(continued)*

Field	Descriptions
Depth threshold high	Upper limit of the depth threshold configuration in number of bytes. If **0** is displayed, depth threshold is not enabled.
Depth threshold low	Lower limit of the depth threshold configuration in number of bytes. If **0** is displayed, depth threshold is not enabled.
Latency threshold high	Upper limit of the latency threshold configuration in microseconds. If **0** is displayed, latency threshold is not enabled.
Latency threshold low	Lower limit of the latency threshold configuration in microseconds. If **0** is displayed, latency threshold is not enabled.
Interface Configurations	
Interface	Name of interface that is configured for network analytics. The interface configuration overrides the global network analytics configuration.
Traffic Statistics	Settings are Enabled or Disabled for the interface.
Queue Statistics	Settings are Enabled or Disabled for the interface.
Depth-threshold High	Upper limit of the depth threshold configuration in number of bytes. If **0** is displayed, depth threshold is not enabled.
Depth-threshold Low	Lower limit of the depth threshold configuration in number of bytes. If **0** is displayed, depth threshold is not enabled.
Latency-threshold High	Upper limit of the latency threshold configuration in microseconds. If **0** is displayed, latency threshold is not enabled.
Latency-threshold Low	Lower limit of the latency threshold configuration in microseconds. If **0** is displayed, latency threshold is not enabled.

Sample Output

show analytics configuration

```
user@host> show analytics configuration
Global configurations:
   Traffic statistics: Enabled, Poll interval: 2 seconds
   Queue statistics: Auto, Poll interval: 10 milliseconds
   Depth threshold high: 0 bytes, low: 0 bytes
   Latency threshold high: 0 microseconds, low: 0 microseconds
Interface     Traffic       Queue        Depth-threshold      Latency-threshold
```

```
                  Statistics    Statistics      High      Low           High      Low
                                                   (bytes)              (microseconds)
      xe-0/0/0     Auto          Auto           204800    10            0         0
```

show analytics queue-statistics

Syntax

show analytics queue-statistics
<interface *interface-name*>

Release Information

Command introduced in Junos OS Release 13.2 for the QFX Series.

Description

Show the queue statistics (queue length and latency) that are collected for all interfaces that are enabled for network analytics on a device. Optionally, if you wish to see the queue statistics for one interface only, you may specify the interface.

Options

interface ***interface-name***—(Optional) Display the queue statistics for the specified interface only.

Required Privilege Level

interface-control

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**

List of Sample Output

Output Fields

Table 598 on page 6358 describes the output fields for the **show analytics queue-statistics** command.

Table 598: show analytics queue-statistics Command Output Fields

Field	Description
Time	Date and time at which the queue statistics are collected.
Interface	Name of the interface at which the queue statistics are collected.
Queue-length (bytes)	Queue length in number of bytes.
Latency (μs)	Queue depth in microseconds.

Sample Output

show analytics queue-statistics (Junos OS Release 13.2X51-D15 or later)

```
user@host> show analytics queue-statistics
CLI issued at 2014-01-07 17:20:29.978561
Time                    Interface       Queue-depth     Latency
                                        (bytes)         (nanoseconds)
00:00:00.870058 ago     xe-0/0/19       1369680         1095744
00:00:01.875049 ago     xe-0/0/19       1381952         1105561
00:00:02.875053 ago     xe-0/0/19       1387776         1110220
00:00:03.876047 ago     xe-0/0/19       1387568         1110054
```

```
00:00:04.873045 ago        xe-0/0/19        1388192            1110553
00:00:05.871044 ago        xe-0/0/19        1385904            1108723
00:00:06.873354 ago        xe-0/0/19        1371552            1097241
```

show analytics queue-statistics (Junos OS Release 13.2X51-D10)

```
user@host> show analytics queue-statistics
Time                  Interface  Queue-length (bytes)   Latency (us)
2013 Nov 3 3:52:26.272 xe-0/0/9        208                   0
2013 Nov 3 3:52:26.292 xe-0/0/9        208                   0
2013 Nov 3 3:52:26.372 xe-0/0/9        208                   0
2013 Nov 3 3:52:26.392 xe-0/0/9        208                   0
2013 Nov 3 3:52:26.432 xe-0/0/9        208                   0
2013 Nov 3 3:52:26.492 xe-0/0/9        208                   0
2013 Nov 3 3:52:26.572 xe-0/0/9        208                   0
2013 Nov 3 4:30:24.584 xe-0/0/9    1387152                1109
2013 Nov 3 4:30:24.604 xe-0/0/9    1372384                1097
2013 Nov 3 4:30:24.624 xe-0/0/9    1384864                1107
```

Sample Output

show analytics queue-statistics (Junos OS Release 13.2X50-D15)

```
user@host> show analytics queue-statistics
Time                  Interface   Queue-length (bytes)   Latency (us)
Apr 6 0:17:18.224  xe-0/0/9           1043952            835
Apr 6 0:17:18.234  xe-0/0/9           1053520            842
Apr 6 0:17:18.244  xe-0/0/9           1055184            844
```

show analytics status

Syntax

show analytics status
<global>

Release Information Command introduced in Junos OS Release 13.2 for the QFX Series.

Description Show the status of the network analytics components that are configured on a device.

Options **none**—Show the global and interface status for network analytics.

global—Show the global status only for network analytics.

NOTE: The **global** option is available in Junos OS Release 13.2X51-D15 or later.

Required Privilege Level interface-control

Related Documentation

- Network Analytics Overview on page 6000
- analytics on page 6176

List of Sample Output

show analytics status (Junos OS Release 13.2X51-D15 or Later) on page 6361
show analytics status global (Junos OS Release 13.2X51-D15 or Later) on page 6362
show analytics status (Junos OS Release 13.2X50-D15 and 13.2X51-D10) on page 6362

Output Fields Table 599 on page 6360 describes the output fields for the **show analytics status** command.

Table 599: show analytics status Command Output Fields

Field	Descriptions
Global Configurations	
Traffic statistics or Traffic monitoring status	Settings are Auto, Enabled, or Disabled. If **Auto** is displayed, traffic statistics monitoring is not enabled. NOTE: The Disabled setting always supersedes the Enabled setting.
Poll interval or Traffic monitoring polling interval	Interval for traffic statistics polling in seconds. NOTE: Due to limitations and variations in the hardware capability of different devices, you might see a difference in value between the actual interval and configured interval.
Queue statistics or Queue monitoring status	Can be Auto, Enabled, or Disabled. If **Auto** is displayed, queue statistics monitoring is not enabled. NOTE: The Disabled setting always supersedes the Enabled setting.

Table 599: show analytics status Command Output Fields *(continued)*

Field	Descriptions
Poll interval or Queue monitoring polling interval	Interval for queue statistics polling in milliseconds. NOTE: Due to limitations and variations in the hardware capability of different devices, you might see a difference in value between the actual interval and configured interval.
Depth threshold high or Queue depth high threshold	Upper limit of the depth threshold configuration in number of bytes. If **0** is displayed, depth threshold is not configured.
Depth threshold low or Queue depth low threshold	Lower limit of the depth threshold configuration in number of bytes. If **0** is displayed, depth threshold is not configured.
Latency threshold high	Upper limit of the latency threshold configuration in microseconds. If **0** is displayed, latency threshold is not configured.
Latency threshold low	Lower limit of the latency threshold configuration in microseconds. If **0** is displayed, latency threshold is not configured.
Interface Configurations	
Interface	Name of an interface that is configured for network analytics. The interface configuration overrides the global network analytics configuration.
Traffic Statistics	Settings are Enabled or Disabled for the interface. NOTE: The Disabled setting always supersedes the Enabled setting.
Queue Statistics	Settings are Enabled or Disabled for the interface. NOTE: The Disabled setting always supersedes the Enabled setting.
Depth-threshold High	Upper limit of the depth threshold configuration in number of bytes.
Depth-threshold Low	Lower limit of the depth threshold configuration in number of bytes.
Latency-threshold High	Upper limit of the latency threshold configuration in microseconds.
Latency-threshold Low	Lower limit of the latency threshold configuration in microseconds.

Sample Output

show analytics status (Junos OS Release 13.2X51-D15 or Later)

```
user@host> show analytics status
Traffic monitoring status is auto
Traffic monitoring polling interval : 5 seconds
Queue monitoring status is enabled
Queue monitoring status polling interval : 1000 milliseconds
Queue depth high threshold : 1000000000 bytes
```



```
Queue depth low threshold : 99 bytes

Interface      Traffic       Queue         Queue depth              Latency
             Statistics    Statistics       threshold              threshold
                                          High         Low          High       Low
                                             (bytes)               (nanoseconds)
xe-0/0/16      enabled      enabled       1000000000   99          n/a        n/a
xe-0/0/18      disabled     enabled       1000000000   99          n/a        n/a
xe-0/0/19      enabled      enabled       1000000000   99          n/a        n/a
```

show analytics status global (Junos OS Release 13.2X51-D15 or Later)

```
user@host> show analytics status global

Traffic monitoring status is auto
Traffic monitoring polling interval : 5 seconds
Queue monitoring status is enabled
Queue monitoring status polling interval : 1000 milliseconds
Queue depth high threshold : 1000000000 bytes
Queue depth low threshold : 99 bytes
```

show analytics status (Junos OS Release 13.2X50-D15 and 13.2X51-D10)

```
user@host> show analytics status
Global configurations:
   Traffic statistics: Auto, Poll interval: 2 seconds
   Queue statistics: Auto, Poll interval: 10 milliseconds
   Depth threshold high: 0 bytes, low: 0 bytes
   Latency threshold high: 1000 microseconds, low: 50 microseconds
Interface      Traffic       Queue         Depth-threshold        Latency-threshold
             Statistics    Statistics       High       Low          High       Low
                                               (bytes)             (microseconds)
xe-0/0/6      Enabled       Enabled        0          0            1000       50
xe-0/0/7      Enabled       Enabled        204800     10           0          0
xe-0/0/8      Enabled       Enabled        0          0            1000       50
```

show analytics streaming-servers

Syntax show analytics streaming-servers

Release Information Command introduced in Junos OS Release 13.2 for the QFX Series.

Description Show the list of streaming servers that are configured for network analytics. Streaming servers receive streaming output for queue statistics and traffic statistics from the network analytics process (Analyticsd) running on the Routing Engine.

NOTE: The **show analytics streaming-servers** command is available in Junos OS Release 13.2X50-D15 and 13.2X51-D10 only.

Required Privilege Level interface-control

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**
- **show analytics collector on page 6353**

List of Sample Output **show analytics streaming-servers on page 6364**

Output Fields Table 600 on page 6363 describes the output fields for the **show analytics streaming-servers** command.

Table 600: show analytics streaming-servers Command Output Fields

Field	Description
Address	IP Address of the streaming server that is configured for receiving the streaming data.
Port	Port number of the streaming server receiving the streaming data.
Stream-Format	Format of the data that is sent to the server. Values are: • csv—Comma-separated values. • json—JavaScript Object Notification. • tsv—Tab-separated values.
Stream-Type	Type of data that is sent to the a port on the streaming server: • QS—Queue statistics. • TS—Traffic statistics.
State	Connection state of the streaming server.
Sent	Number of bytes sent to the streaming server.

Sample Output

show analytics streaming-servers

```
user@host> show analytics streaming-servers
Address         Port     Stream-Format     Stream-Type   State         Sent
10.94.198.14    50001    json              QS            Established   0
10.94.198.14    50005    csv               TS            Established   1185
172.17.28.28    50005    tsv               TS/QS         In Progress   0
```

show analytics traffic-statistics

Syntax
show analytics traffic-statistics
<interface *interface-name*>

Release Information
Command introduced in Junos OS Release 13.2 for the QFX Series.

Description
Show the traffic statistics that are collected for all interfaces that are enabled for network analytics on a device. Optionally, if you wish to see the traffic statistics for one interface only, you may specify the interface.

Options
interface *interface-name*—(Optional) Display the traffic statistics for the specified interface only.

Required Privilege Level
interface-control

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**

List of Sample Output

show analytics traffic-statistics (Junos OS Release 13.2X51-D15 or Later) on page 6366
show analytics traffic-statistics (Junos OS Release 13.2X51-D10) on page 6366
show analytics traffic-statistics (Junos OS Release 13.2X50-D15) on page 6366

Output Fields
Table 601 on page 6365 describes the output fields for the **show analytics traffic-statistics** command.

Table 601: show analytics traffic-statistics Command Output Fields

Field	Description
Time	The date and time at which the traffic statistics are generated.
Physical interface	Name of the interface at which the traffic statistics are collected.
Total octets	Total number of octets that are received and transmitted.
Total packet	Total number of packets that are received and transmitted.
Octets per second	Number of octets received and transmitted per second.
Packet per second	Number of packets received and transmitted per second.
Octets dropped	Number of octets dropped.
Packet dropped	Number of packets dropped.

Sample Output

show analytics traffic-statistics (Junos OS Release 13.2X51-D15 or Later)

```
user@host> show analytics traffic-statistics
CLI issued at 2014-01-07 17:22:28.952677
Time: 00:00:03.480244 ago, Physical interface: xe-0/0/19
  Traffic Statistics:                    Receive             Transmit
  Total octets:                    3929946593792      393001011519232
  Total packets:                     30702707784        3070320402462
  Unicast packet:                    30702707784        3070320402462
  Multicast packets:                           0                    0
  Broadcast packets:                           0                    0
  Octets per second:                    86407016             59044064
  Packets per second:                      84787              8469688
  Octets dropped:                              0      392986110751744
  Packets dropped:                             0        3070203990248
```

show analytics traffic-statistics (Junos OS Release 13.2X51-D10)

```
user@host> show analytics traffic-statistics
Time: 2013 Nov 3 4:36:55.542, Physical interface: xe-0/0/8
  Traffic Statistics:                    Receive          Transmit
  Total octets:                    2777524779008      101855533467
  Total packet:                      21699412289         795746503
  Octets per second:                   904001272                 0
  Packet per second:                     8399574                 0
  Octets dropped:                              0                 0
  Packet dropped:                              0                 0
Time: 2013 Nov 3 4:36:57.559, Physical interface: xe-0/0/10
  Traffic Statistics:                    Receive          Transmit
  Total octets:                    2777546444381      129840936198
  Total packet:                      21699581650        1014382311
  Octets per second:                    90400211          86403728
  Packet per second:                     8400382             84438
  Octets dropped:                              0                 0
  Packet dropped:                              0                 0
```

show analytics traffic-statistics (Junos OS Release 13.2X50-D15)

```
user@host> show analytics traffic-statistics
Time: Apr 5 19:52:48.549, Physical interface: xe-0/0/8
  Traffic Statistics:                    Receive          Transmit
  Total octets:                    4797548752936      408886273632
  Total packet:                       5658257464        3190613435
  Octets per second:                           0                 0
  Packet per second:                           0                 0
  Octets dropped:                              0         252901000
  Packet dropped:                              0            252901
  Utilization:                              0.0%              0.0%
Time: Apr 5 19:52:48.549, Physical interface: xe-0/0/10
  Traffic Statistics:                    Receive          Transmit
  Total octets:                    4790866253100         477139024
  Total packet:                       5624473639            477944
  Octets per second:                           0                 0
  Packet per second:                           0                 0
  Octets dropped:                              0         166582000
  Packet dropped:                              0            166582
  Utilization:                              0.0%              0.0%
```

Commands for sFlow Technology

clear sflow collector statistics

Syntax clear sflow collector statistics

Release Information Command introduced in Junos OS Release 11.3 for the QFX Series.

Description Clear the sample counters for all sFlow collectors.

Required Privilege Level view

Related Documentation

- Example: Monitoring Network Traffic Using sFlow Technology on page 6079
- Configuring sFlow Technology on page 6108
- show sflow collector on page 6371

List of Sample Output clear sflow collector statistics on page 6368

Sample Output

clear sflow collector statistics

The following example shows two output examples for the **show sflow collector** command, one before and one after the **clear sflow collector statistics** command was issued.

```
user@host> show sflow collector
Collector         Udp-port     No. of samples
   address
   10.1.1.1             6343        3174
   10.1.2.1             6343        3562

user@host> clear sflow collector statistics

user@host> show sflow collector
Collector         Udp-port     No. of samples
   address
   10.1.1.1              6343        0
   10.1.2.1              6343        0
```


show sflow

Syntax

show sflow
<collector>
<interface>

Release Information Command introduced in Junos OS Release 11.3 for the QFX Series.

Description Display sFlow configuration information.

Options

none—Display all sFlow configuration information.

collector—(Optional) Display a list of configured sFlow collectors and their properties.

interface—(Optional) Display the interfaces on which sFlow technology is enabled and the sampling parameters.

Required Privilege Level view

Related Documentation

- show sflow interface on page 6372
- show sflow collector on page 6371
- clear sflow collector statistics on page 6368
- Example: Monitoring Network Traffic Using sFlow Technology on page 6079
- Configuring sFlow Technology on page 6108

List of Sample Output show sflow on page 6370

Output Fields Table 602 on page 6369 lists the output fields for the **show sflow** command. Output fields are listed in the approximate order in which they appear.

Table 602: show sflow Output Fields

Field Name	Field Description	Level of Output
sFlow	Status of the feature: **Enabled** or **Disabled**.	All levels
Sample limit	Number of packets sampled per second. This sample limit cannot be configured and is set to 300 packets per second.	All levels
Polling interval	Interval at which the sFlow agent polls the interface.	All levels
Sample rate egress	Rate at which egress packets are sampled.	All levels
Sample rate ingress	Rate at which ingress packets are sampled.	All levels
Agent ID	IP address assigned to the sFlow agent.	All levels
Source IP address	Source IP address for the sFlow packets.	All levels

Sample Output

show sflow

```
user@host> show sflow

sFlow                     : Enabled
Sample limit              : 300 packets/second
Polling interval          : 20 second
Sample rate egress        : 1:2048: Disabled
Sample rate ingress       : 1:1000: Enabled
Agent ID                  : 10.93.54.7
Source IP address         : 10.93.54.7
```

show sflow collector

Syntax show sflow collector

Release Information Command introduced in Junos OS Release 11.3 for the QFX Series.

Description Display a list of configured sFlow collectors and their properties.

Required Privilege Level view

Related Documentation

- clear sflow collector statistics on page 6368
- show sflow on page 6369
- show sflow interface on page 6372
- Example: Monitoring Network Traffic Using sFlow Technology on page 6079
- Configuring sFlow Technology on page 6108

List of Sample Output show sflow collector on page 6371

Output Fields Table 603 on page 6371 lists the output fields for the **show sflow collector** command. Output fields are listed in the approximate order in which they appear.

Table 603: show sflow collector Output Fields

Field Name	Field Description	Level of Output
Collector address	IP address of the collector.	All levels
UDP-Port	UDP port number of the collector.	All levels
No. of samples	Number of samples collected.	All levels

Sample Output

show sflow collector

```
user@host> show sflow collector

Collector         Udp-port    No. of samples
 address
10.204.32.46       6343         1000
100.204.32.76     3400       1000
```

show sflow interface

Syntax show sflow interface

Release Information Command introduced in Junos OS Release 11.3 for the QFX Series.

Description Display the interfaces on which sFlow is enabled and the sampling parameters for the interface.

Required Privilege Level view

Related Documentation

- show sflow on page 6369
- show sflow collector on page 6371
- Example: Monitoring Network Traffic Using sFlow Technology on page 6079
- Configuring sFlow Technology on page 6108

List of Sample Output show sflow interface (QFX3500 Switch in Standalone Mode) on page 6372
show sflow interface (QFabric System) on page 6373

Output Fields Table 604 on page 6372 lists the output fields for the **show sflow interface** command. Output fields are listed in the approximate order in which they appear.

Table 604: show sflow interface Output Fields

Field Name	Field Description	Level of Output
Interface	Interface on which sFlow technology is enabled.	All levels
Status Egress	Indicates whether an egress sample rate is enabled.	All levels
Status Ingress	Indicates whether an ingress sample rate is enabled.	All levels
Sample rate Egress	Rate at which egress packets are sampled.	All levels
Sample rate Ingress	Rate at which ingress packets are sampled.	All levels
Adapted sample rate Egress	Adapted rate at which egress packets are sampled.	All levels
Adapted sample rate Ingress	Adapted rate at which ingress packets are sampled.	All levels
Polling-interval	Interval at which the sFlow agent polls the interface.	All levels

Sample Output

show sflow interface (QFX3500 Switch in Standalone Mode)

`user@host>` **show sflow interface**


```
Interface   Status          Sample rate    Adapted sample rate   Polling-interval
               Egress Ingress   Egress Ingress   Egress Ingress
xe-0/0/0.0     Enabled  Disabled  1000     2048     1000      2048            20
xe-1/0/1.0     Enabled  Disabled  1000     2048     1000      2048            20
```

Sample Output

show sflow interface (QFabric System)

```
user@host> show sflow interface
Interface   Status          Sample rate    Adapted sample rate   Polling-interval
               Egress Ingress   Egress Ingress   Egress Ingress
node1:xe-0/0/0.0    Enabled  Disabled  1000     2048     1000      2048
20
node2:xe-1/0/1.0    Enabled  Disabled  1000     2048     1000      2048
20
node4:xe-1/0/0.0    Enabled  Disabled  1000     2048     1000      2048
20
```

Commands for SNMP

- clear snmp history
- clear snmp statistics
- request snmp spoof-trap
- request snmp utility-mib clear instance
- request snmp utility-mib set instance
- show snmp health-monitor
- show snmp inform-statistics
- show snmp mib
- show snmp rmon
- show snmp rmon history
- show snmp statistics
- show snmp v3

clear snmp history

Syntax clear snmp history (*index* | all)

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Delete the samples of Ethernet statistics collected for a history group.

Options **all**—Clear all the entries in the history index.

index—Clear the contents of the specified entry in the history index.

Required Privilege Level clear

Related Documentation

- clear snmp statistics on page 6375

clear snmp statistics

Syntax clear snmp statistics

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Clear Simple Network Management Protocol (SNMP) statistics.

Options This command has no options.

Required Privilege Level clear

Related Documentation

- show snmp statistics on page 1379

List of Sample Output clear snmp statistics on page 6375

Output Fields See show snmp statistics for an explanation of output fields.

Sample Output

clear snmp statistics

In the following example, SNMP statistics are displayed before and after the **clear snmp statistics** command is issued:

```
user@host> show snmp statistics
SNMP statistics:
  Input:
    Packets: 8, Bad versions: 0, Bad community names: 0,
    Bad community uses: 0, ASN parse errors: 0,
    Too bigs: 0, No such names: 0, Bad values: 0,
    Read onlys: 0, General errors: 0,
    Total request varbinds: 8, Total set varbinds: 0,
    Get requests: 0, Get nexts: 8, Set requests: 0,
    Get responses: 0, Traps: 0,
    Silent drops: 0, Proxy drops 0
  Output:
    Packets: 2298, Too bigs: 0, No such names: 0,
    Bad values: 0, General errors: 0,
    Get requests: 0, Get nexts: 0, Set requests: 0,
    Get responses: 8, Traps: 2290

user@host> clear snmp statistics

user@host> show snmp statistics
SNMP statistics:
  Input:
    Packets: 0, Bad versions: 0, Bad community names: 0,
    Bad community uses: 0, ASN parse errors: 0,
    Too bigs: 0, No such names: 0, Bad values: 0,
    Read onlys: 0, General errors: 0,
```



```
  Total request varbinds: 0, Total set varbinds: 0,
  Get requests: 0, Get nexts: 0, Set requests: 0,
  Get responses: 0, Traps: 0,
  Silent drops: 0, Proxy drops 0
Output:
  Packets: 0, Too bigs: 0, No such names: 0,
  Bad values: 0, General errors: 0,
  Get requests: 0, Get nexts: 0, Set requests: 0,
  Get responses: 0, Traps: 0
```

request snmp spoof-trap

Syntax

request snmp spoof-trap
<*trap*> variable-bindings <*object*> <*instance*> <*value*>

Release Information

Command introduced in Junos OS Release 8.2.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Spoof (mimic) the behavior of a Simple Network Management Protocol (SNMP) trap.

Options

<*trap*>—Name of the trap to spoof.

variable-bindings <*object*> <*instance*> <*value*>—(Optional) List of variables and values to include in the trap. Each variable binding is specified as an object name, the object instance, and the value (for example, **ifIndex[14] = 14**). Enclose the list of variable bindings in quotation marks (“ “) and use a comma to separate each object name, instance, and value definition (for example, **variable-bindings “ifIndex[14] = 14, ifAdminStatus[14] = 1, ifOperStatus[14] = 2”**). Objects included in the trap definition that do not have instances and values specified as part of the command are included in the trap and spoofed with automatically generated instances and values.

<*dummy name*>—A dummy trap name to display the list of available traps.

Question mark (?)—Question mark **?** to display possible completions.

Required Privilege Level

request

List of Sample Output

request snmp spoof-trap (with Variable Bindings) on page 6377
request snmp spoof-trap (Illegal Trap Name) on page 6377
request snmp spoof-trap (Question Mark ?) on page 6381

Sample Output

request snmp spoof-trap (with Variable Bindings)

```
user@host> request snmp spoof-trap linkUp variable-bindings “ifIndex[14] = 14, ifAdminStatus[14] = 1, ifOperStatus[14] = 2”
Spoof trap request result: trap sent successfully
```

request snmp spoof-trap (Illegal Trap Name)

```
user@host> request snmp spoof-trap xx
Spoof trap request result: trap not found

Allowed Traps:
adslAtucInitFailureTrap
  adslAtucPerfESsThreshTrap
  adslAtucPerfLofsThreshTrap
  adslAtucPerfLolsThreshTrap
  adslAtucPerfLossThreshTrap
  adslAtucPerfLprsThreshTrap
  adslAtucRateChangeTrap
  adslAturPerfESsThreshTrap
```

```
adslAturPerfLofsThreshTrap
adslAturPerfLossThreshTrap
adslAturPerfLprsThreshTrap
adslAturRateChangeTrap
apsEventChannelMismatch
apsEventFEPLF
apsEventModeMismatch
apsEventPSBF
apsEventSwitchover
authenticationFailure
bfdSessDown
bfdSessUp
bgpBackwardTransition
bgpEstablished
coldStart
dlswTrapCircuitDown
dlswTrapCircuitUp
dlswTrapTConnDown
dlswTrapTConnPartnerReject
dlswTrapTConnProtViolation
dlswTrapTConnUp
dsx1LineStatusChange
dsx3LineStatusChange
entConfigChange
fallingAlarm
frDLCIStatusChange
ggsnTrapChanged
ggsnTrapCleared
ggsnTrapNew
gmplsTunnelDown
ifMauJabberTrap
ipv6IfStateChange
isisAreaMismatch
isisAttemptToExceedMaxSequence
isisAuthenticationFailure
isisAuthenticationTypeFailure
isisCorruptedLSPDetected
isisDatabaseOverload
isisIDLenMismatch
isisLSPTooLargeToPropagate
isisManualAddressDrops
isisMaxAreaAddressesMismatch
isisOriginatingLSPBufferSizeMismatch
isisOwnLSPPurge
isisProtocolsSupportedMismatch
isisRejectedAdjacency
isisSequenceNumberSkip
isisVersionSkew
jnxAccessAuthServerDisabled
jnxAccessAuthServerEnabled
jnxAccessAuthServiceDown
jnxAccessAuthServiceUp
jnxBfdSessDetectionTimeHigh
jnxBfdSessTxIntervalHigh
jnxBgpM2BackwardTransition
jnxBgpM2Established
jnxCmCfgChange
jnxCmRescueChange
jnxCollFlowOverload
jnxCollFlowOverloadCleared
jnxCollFtpSwitchover
```



```
jnxCollMemoryAvailable
jnxCollMemoryUnavailable
jnxCollUnavailableDest
jnxCollUnavailableDestCleared
jnxCollUnsuccessfulTransfer
jnxDfcHardMemThresholdExceeded
jnxDfcHardMemUnderThreshold
jnxDfcHardPpsThresholdExceeded
jnxDfcHardPpsUnderThreshold
jnxDfcSoftMemThresholdExceeded
jnxDfcSoftMemUnderThreshold
jnxDfcSoftPpsThresholdExceeded
jnxDfcSoftPpsUnderThreshold
jnxEventTrap
jnxExampleStartup
jnxFEBSwitchover
jnxFanFailure
jnxFanOK
jnxFruCheck
jnxFruFailed
jnxFruInsertion
jnxFruOK
jnxFruOffline
jnxFruOnline
jnxFruPowerOff
jnxFruPowerOn
jnxFruRemoval
jnxHardDiskFailed
jnxHardDiskMissing
jnxJsAvPatternUpdateTrap
jnxJsChassisClusterSwitchover
jnxJsFwAuthCapacityExceeded
jnxJsFwAuthFailure
jnxJsFwAuthServiceDown
jnxJsFwAuthServiceUp
jnxJsNatAddrPoolThresholdStatus
jnxJsScreenAttack
jnxJsScreenCfgChange
jnxLdpLspDown
jnxLdpLspUp
jnxLdpSesDown
jnxLdpSesUp
jnxMIMstCistPortLoopProtectStateChangeTrap
jnxMIMstCistPortRootProtectStateChangeTrap
jnxMIMstErrTrap
jnxMIMstGenTrap
jnxMIMstInvalidBpduRxdTrap
jnxMIMstMstiPortLoopProtectStateChangeTrap
jnxMIMstMstiPortRootProtectStateChangeTrap
jnxMIMstNewRootTrap
jnxMIMstProtocolMigrationTrap
jnxMIMstRegionConfigChangeTrap
jnxMIMstTopologyChgTrap
jnxMacChangedNotification
jnxMplsLdpInitSesThresholdExceeded
jnxMplsLdpPathVectorLimitMismatch
jnxMplsLdpSessionDown
jnxMplsLdpSessionUp
jnxOspfv3IfConfigError
jnxOspfv3IfRxBadPacket
jnxOspfv3IfStateChange
```

```
jnxOspfv3LsdbApproachingOverflow
jnxOspfv3LsdbOverflow
jnxOspfv3NbrRestartHelperStatusChange
jnxOspfv3NbrStateChange
jnxOspfv3NssaTranslatorStatusChange
jnxOspfv3RestartStatusChange
jnxOspfv3VirtIfConfigError
jnxOspfv3VirtIfRxBadPacket
jnxOspfv3VirtIfStateChange
jnxOspfv3VirtNbrRestartHelperStatusChange
jnxOspfv3VirtNbrStateChange
jnxOtnAlarmCleared
jnxOtnAlarmSet
jnxOverTemperature
jnxPMonOverloadCleared
jnxPMonOverloadSet
jnxPingEgressJitterThresholdExceeded
jnxPingEgressStdDevThresholdExceeded
jnxPingEgressThresholdExceeded
jnxPingIngressJitterThresholdExceeded
jnxPingIngressStddevThresholdExceeded
jnxPingIngressThresholdExceeded
jnxPingRttJitterThresholdExceeded
jnxPingRttStdDevThresholdExceeded
jnxPingRttThresholdExceeded
jnxPortBpduErrorStatusChangeTrap
jnxPortLoopProtectStateChangeTrap
jnxPortRootProtectStateChangeTrap
jnxPowerSupplyFailure
jnxPowerSupplyOK
jnxRedundancySwitchover
jnxRmonAlarmGetFailure
jnxRmonGetOk
jnxSecAccessIfMacLimitExceeded
jnxSecAccessdsRateLimitCrossed
jnxSonetAlarmCleared
jnxSonetAlarmSet
jnxSpSvcSetCpuExceeded
jnxSpSvcSetCpuOk
jnxSpSvcSetZoneEntered
jnxSpSvcSetZoneExited
jnxStormEventNotification
jnxSyslogTrap
jnxTemperatureOK
jnxVccpPortDown
jnxVccpPortUp
jnxVpnIfDown
jnxVpnIfUp
jnxVpnPwDown
jnxVpnPwUp
jnxl2aldGlobalMacLimit
jnxl2aldInterfaceMacLimit
jnxl2aldRoutingInstMacLimit
linkDown
linkUp
lldpRemTablesChange
mfrMibTrapBundleLinkMismatch
mplsLspChange
mplsLspDown
mplsLspInfoChange
mplsLspInfoDown
```



```
  mplsLspInfoPathDown
  mplsLspInfoPathUp
  mplsLspInfoUp
  mplsLspPathDown
  mplsLspPathUp
  mplsLspUp
  mplsNumVrfRouteMaxThreshExceeded
  mplsNumVrfRouteMidThreshExceeded
  mplsNumVrfSecIllglLblThrshExcd
  mplsTunnelDown
  mplsTunnelReoptimized
  mplsTunnelRerouted
  mplsTunnelUp
  mplsVrfIfDown
  mplsVrfIfUp
  mplsXCDown
  mplsXCUp
  msdpBackwardTransition
  msdpEstablished
  newRoot
  ospfIfAuthFailure
  ospfIfConfigError
  ospfIfRxBadPacket
  ospfIfStateChange
  ospfLsdbApproachingOverflow
  ospfLsdbOverflow
  ospfMaxAgeLsa
  ospfNbrStateChange
  ospfOriginateLsa
  ospfTxRetransmit
  ospfVirtIfAuthFailure
  ospfVirtIfConfigError
  ospfVirtIfRxBadPacket
  ospfVirtIfStateChange
  ospfVirtIfTxRetransmit
  ospfVirtNbrStateChange
  pethMainPowerUsageOffNotification
  pethMainPowerUsageOnNotification
  pethPsePortOnOffNotification
  pingProbeFailed
  pingTestCompleted
  pingTestFailed
  ptopoConfigChange
  risingAlarm
  rpMauJabberTrap
  sdlcLSStatusChange
  sdlcPortStatusChange
  topologyChange
  traceRoutePathChange
  traceRouteTestCompleted
  traceRouteTestFailed
  vrrpTrapAuthFailure
  vrrpTrapNewMaster
  warmStart
```

request snmp spoof-trap (Question Mark ?)

```
user@host> request snmp spoof-trap ?
Possible completions:
  <trap>               The name of the trap to spoof
  adslAtucInitFailureTrap
```

```
  adslAtucPerfESsThreshTrap
  adslAtucPerfLofsThreshTrap
  adslAtucPerfLolsThreshTrap
  adslAtucPerfLossThreshTrap
  adslAtucPerfLprsThreshTrap
  adslAtucRateChangeTrap
  adslAturPerfESsThreshTrap
  adslAturPerfLofsThreshTrap
  adslAturPerfLossThreshTrap
  adslAturPerfLprsThreshTrap
  adslAturRateChangeTrap
  apsEventChannelMismatch
  apsEventFEPLF
  apsEventModeMismatch
  apsEventPSBF
  apsEventSwitchover
  authenticationFailure
  bfdSessDown
  bfdSessUp
  bgpBackwardTransition
  bgpEstablished
  coldStart
  dlswTrapCircuitDown
  dlswTrapCircuitUp
---(more 10%)---
```

request snmp utility-mib clear instance

Syntax

request snmp utility-mib clear instance *name*
object-type *type*

Release Information

Command introduced in Junos OS Release 12.2 for the QFX Series.

Description

Clear the data stored in the specified container object in the SNMP Utility MIB.

Options

name—Name of the SNMP instance that is used to identify the data stored in the container object.

object-type *type*—Type of container object in which the data is stored. The following container object types are supported:

- **counter**—Stores a 32-bit counter value.
- **counter64**—Stores a 64-bit counter value.
- **integer**—Stores a 32-bit signed integer value.
- **unsigned-integer**—Stores a 32-bit unsigned integer value.

Required Privilege Level

clear

Related Documentation

- Utility MIB on page 6030
- Understanding the Implementation of SNMP on the QFabric System on page 6023
- **request snmp utility-mib set instance on page 6384**

request snmp utility-mib set instance

Syntax

request snmp utility-mib set instance *name*
object-type *type*
object-value *value*

Release Information

Command introduced in Junos OS Release 12.2 for the QFX Series.

Description

Store data in the specified container object in the SNMP Utility MIB. The data may be retrieved by SNMP operations.

Options

name—Name of the SNMP instance that is used to identify the data stored in the container object.

object-type ***type***—Type of container object in which to store data. The following container object types are supported:

- **counter**—Stores a 32-bit counter value.
- **counter64**—Stores a 64-bit counter value.
- **integer**—Stores a 32-bit signed integer value.
- **unsigned-integer**—Stores a 32-bit unsigned integer value.
- **string**—Stores an octet string value.

object-value ***value***—Data that is stored in the container object.

Required Privilege Level

request

Related Documentation

- Utility MIB on page 6030
- Understanding the Implementation of SNMP on the QFabric System on page 6023
- **request snmp utility-mib clear instance on page 6383**

show snmp health-monitor

Syntax

show snmp health-monitor
<alarms (brief | detail) | logs>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display information about Simple Network Management Protocol (SNMP) health monitor alarms and logs.

Options

none—Display information about all health monitor alarms and logs.

alarms (brief | detail)—(Optional) Display information about health monitor alarms. Optionally, specify brief or detailed information about the alarms.

logs—(Optional) Display information about health monitor logs.

Required Privilege Level

view

Related Documentation

- Understanding Health Monitoring on page 6037
- Configuring Health Monitoring on page 6119

List of Sample Output

show snmp health-monitor on page 6387
show snmp health-monitor alarms detail on page 6387

Output Fields

Table 605 on page 6385 describes the output fields for the **show snmp health-monitor** command. Output fields are listed in the approximate order in which they appear.

Table 605: show snmp health-monitor Output Fields

Field Name	Field Description	Level of Output
Alarm Index	Alarm identifier.	All levels
Variable description	Description of the health monitor object instance being monitored.	All levels
Variable name	Name of the health monitor object instance being monitored.	All levels
Value	Current value of the monitored variable in the most recent sample interval.	All levels

Table 605: show snmp health-monitor Output Fields *(continued)*

Field Name	Field Description	Level of Output

State	State of the alarm or event entry:
	• Alarms:
	  ◦ active—Entry is fully configured and activated.
	  ◦ falling threshold crossed—Value of the variable has crossed the lower threshold limit.
	  ◦ rising threshold crossed—Value of the variable has crossed the upper threshold limit.
	  ◦ under creation—Entry is being configured and is not yet activated.
	  ◦ startup—Alarm is waiting for the first sample of the monitored variable.
	  ◦ object not available—Monitored variable of that type is not available to the health monitor agent.
	  ◦ instance not available—Monitored variable's instance is not available to the health monitor agent.
	  ◦ object type invalid—Monitored variable is not a numeric value.
	  ◦ object processing errored—An error occurred when the monitored variable was processed.
	  ◦ unknown—State is not one of the above.
		All levels

Variable OID	Object ID to which the variable name is resolved. The format is x.x.x.x.	detail
Sample type	Method of sampling the monitored variable and calculating the value to compare against the upper and lower thresholds. It can have the value *absolute value* or *delta value*.	detail

Startup alarm	Alarm that might be sent when this entry is first activated, depending on the following criteria:
	• Alarm is sent when one of the following situations exists:
	  ◦ Value of the alarm is above or equal to the rising threshold and the startup type is either rising alarm or rising or falling alarm. *falling alarm*
	  ◦ Value of the alarm is below or equal to the falling threshold and the startup type is either *falling alarm* or *rising or falling alarm*.
	• Alarm is *not* sent when one of the following situations exists:
	  ◦ Value of the alarm is above or equal to the rising threshold and the startup type is *falling alarm*.
	  ◦ Value of the alarm is below or equal to the falling threshold and the startup type is *rising alarm*.
	  ◦ Value of the alarm is between the thresholds.
		detail

Owner	Name of the entry configured by the user. If the entry was created through the CLI, the owner has **monitor** prepended to it.	detail
Creator	Mechanism by which the entry was configured (Health Monitor).	detail
Sample interval	Time period between samples (in seconds).	detail
Rising threshold	Upper limit threshold value as a percentage of the maximum possible value.	detail

Table 605: show snmp health-monitor Output Fields *(continued)*

Field Name	Field Description	Level of Output
Falling threshold	Lower limit threshold value as a percentage of the maximum possible value.	detail
Rising event index	Index number of the event triggered when the rising threshold is crossed.	detail
Falling event index	Index number of the event triggered when the falling threshold is crossed. Details include the value of the falling event instance and the state of the falling event instance.	detail

Sample Output

show snmp health-monitor

```
user@switch> show snmp health-monitor

Alarm
Index  Variable description                                 Value State

 32768 Health Monitor: root file system utilization
       jnxHrStoragePercentUsed.1                               59 active


 32769 Health Monitor: /config file system utilization
       jnxHrStoragePercentUsed.2                                0 active


 32770 Health Monitor: RE 0 CPU utilization
       jnxOperatingCPU.9.1.0.0                                  9 falling threshold


 32772 Health Monitor: RE 0 memory utilization
       jnxOperatingBuffer.9.1.0.0                              23 active


 32774 Health Monitor: Max Kernel Memory Used (%)
       jnxBoxKernelMemoryUsedPercent.0                          3 active
Event Index: 32768
    Description: Health Monitor: RE 0 CPU utilization crossed falling threshold
70 (value: 5), (variable: jnxOperatingCPU.9.1.0.0)
    Time: 2011-01-09 19:18:35 PST
```

show snmp health-monitor alarms detail

```
user@switch> show snmp health-monitor alarms detail

Alarm Index 32768:
  Variable name                        jnxHrStoragePercentUsed.1
  Variable OID                         1.3.6.1.4.1.2636.3.31.1.1.1.1.1
  Sample type                          absolute value
  Startup alarm                        rising alarm
  Owner                                Health Monitor: root file system
                                       utilization
  Creator                              Health Monitor
  State                                active
  Sample interval                  300 seconds
  Rising threshold                  80
```

```
  Falling threshold               70
  Rising event index           32768
  Falling event index          32768
    Instance Value: 59
    Instance State: active

Alarm Index 32769:
  Variable name                      jnxHrStoragePercentUsed.2
  Variable OID                       1.3.6.1.4.1.2636.3.31.1.1.1.1.2
  Sample type                        absolute value
  Startup alarm                      rising alarm
  Owner                              Health Monitor: /config file system
                                     utilization
  Creator                            Health Monitor
  State                              active
  Sample interval                300 seconds
  Rising threshold                80
  Falling threshold               70
  Rising event index           32768
  Falling event index          32768
    Instance Value: 0
    Instance State: active

Alarm Index 32770:
  Variable name                      jnxOperatingCPU.9.1.0.0
  Variable OID                       1.3.6.1.4.1.2636.3.1.13.1.8.9.1.0.0
  Sample type                        absolute value
  Startup alarm                      rising alarm
  Owner                             Health Monitor: RE 0 CPU utilization

  Creator                            Health Monitor
  State                              active
  Sample interval                300 seconds
  Rising threshold                80
  Falling threshold               70
  Rising event index           32768
  Falling event index          32768
    Instance Value: 9
    Instance State: falling threshold

Alarm Index 32772:
  Variable name                      jnxOperatingBuffer.9.1.0.0
  Variable OID                       1.3.6.1.4.1.2636.3.1.13.1.11.9.1.0.0
  Sample type                        absolute value
  Startup alarm                      rising alarm
  Owner                             Health Monitor: RE 0 memory utilization

  Creator                            Health Monitor
  State                              active
  Sample interval                300 seconds
  Rising threshold                80
  Falling threshold               70
  Rising event index           32768
  Falling event index          32768
    Instance Value: 23
    Instance State: active

Alarm Index 32774:
  Variable name                      jnxBoxKernelMemoryUsedPercent.0
  Variable OID                       1.3.6.1.4.1.2636.3.1.16.0
  Sample type                        absolute value
```

```
Startup alarm                         rising alarm
Owner                                 Health Monitor: Max Kernel Memory Used
                                      (%)
Creator                               Health Monitor
State                                 active
Sample interval                   300 seconds
Rising threshold                   80
Falling threshold                  70
Rising event index              32768
Falling event index             32768
  Instance Value: 3
  Instance State: active
```

show snmp inform-statistics

Syntax show snmp inform-statistics

Release Information Command introduced in Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display information about Simple Network Management Protocol (SNMP) inform requests.

Options This command has no options.

Required Privilege Level view

List of Sample Output show snmp inform-statistics on page 6390

Output Fields Table 606 on page 6390 describes the output fields for the **show snmp inform-statistics** command. Output fields are listed in the approximate order in which they appear.

Table 606: show snmp inform-statistics Output Fields

Field Name	Field Description
Target Name	Name of the device configured to receive and respond to SNMP informs.
Address	IP address of the target device.
Sent	Number of informs sent to the target device and acknowledged by the target device.
Pending	Number of informs held in memory pending a response from the target device.
Discarded	Number of informs discarded after the specified number of retransmissions to the target device were attempted.
Timeouts	Number of informs that did not receive an acknowledgement from the target device within the timeout specified.
Probe Failures	Connection failures that occurred (for example, when the target server returned invalid content or you incorrectly configured the target address).

Sample Output

show snmp inform-statistics

```
user@host> show snmp inform-statistics
Inform Request Statistics:
 Target Name: TA1_v3_md5_none Address: 172.17.20.184
  Sent: 176, Pending: 0
  Discarded: 0, Timeouts: 0, Probe Failures: 0
 Target Name: TA2_v3_sha_none Address: 192.168.110.59
```

```
 Sent: 0, Pending: 4
 Discarded: 84, Timeouts: 0, Probe Failures: 258
Target Name: TA5_v2_none Address: 172.17.20.184
 Sent: 0, Pending: 0
 Discarded: 2, Timeouts: 10, Probe Failures: 0
```


show snmp mib

Syntax show snmp mib (get | get-next | walk) (ascii | decimal) *object-id*

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
ascii and **decimal** options introduced in Junos OS Release 9.6.
ascii and **decimal** options introduced in Junos OS Release 9.6 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display local Simple Network Management Protocol (SNMP) Management Information Base (MIB) object values.

Options **get**—Retrieve and display one or more SNMP object values.

get-next—Retrieve and display the next SNMP object values.

walk—Retrieve and display the SNMP object values that are associated with the requested object identifier (OID). When you use this option, the Junos OS displays the objects below the subtree that you specify.

ascii—Display the SNMP object's string indices as an ASCII-key representation.

decimal—Display the SNMP object values in the decimal (default) format. The **decimal** option is the default option for this command. Therefore, issuing the **show snmp mib (get | get-next | walk) decimal object-id** and the **show snmp mib (get | get-next | walk) object-id** commands display the same output.

object-id—The object can be represented by a sequence of dotted integers (such as **1.3.6.1.2.1.2**) or by its subtree name (such as **interfaces**). When entering multiple objects, enclose the objects in quotation marks.

Required Privilege Level snmp—To view this statement in the configuration.

List of Sample Output
show snmp mib get on page 6393
show snmp mib get (Multiple Objects) on page 6393
show snmp mib get (Layer 2 Policer) on page 6393
show snmp mib get-next on page 6393
show snmp mib get-next (Specify an OID) on page 6393
show snmp mib walk on page 6393
show snmp mib walk (QFX Series) on page 6393
show snmp mib walk decimal on page 6394
show snmp mib walk (ASCII) on page 6394
show snmp mib walk (Multiple Indices) on page 6394
show snmp mib walk decimal (Multiple Indices) on page 6394

Output Fields Table 607 on page 6393 describes the output fields for the **show snmp mib** command. Output fields are listed in the approximate order in which they appear.

Table 607: show snmp mib Output Fields

Field Name	Field Description
name	Object name and numeric instance value.
object value	Object value. The Junos OS translates OIDs into the corresponding object names.

Sample Output

show snmp mib get

```
user@host> show snmp mib get sysObjectID.0
sysObjectID.0 = jnxProductNameM20
```

show snmp mib get (Multiple Objects)

```
user@host> show snmp mib get ?sysObjectID.0 sysUpTime.0?
sysObjectID.0 = jnxProductNameM20
sysUpTime.0 = 1640992
```

show snmp mib get (Layer 2 Policer)

```
user@host> show snmp mib get ifInOctets.25970
ifInOctets.25970 = 7545720
```

show snmp mib get-next

```
user@host> show snmp mib get-next jnxMibs
jnxBoxClass.0 = jnxProductLineM20.0
```

show snmp mib get-next (Specify an OID)

```
user@host> show snmp mib get-next 1.3.6.1
sysDescr.0     = Juniper Networks, Inc. m20 internet router, kernel
Junos OS Release: 2004-1 Build date: build date UTC Copyright (c) 1996-2004 Juniper
 Networks, Inc.
```

show snmp mib walk

```
user@host> show snmp mib walk system
sysDescr.0     = Juniper Networks, Inc. m20 internet router, kernel
Junos OS Release #0: 2004-1 Build date: build date UTC Copyright (c) 1996-2004
Juniper Networks, Inc.
sysObjectID.0 = jnxProductNameM20
sysUpTime.0 = 1640992
sysContact.0 = Your contact
sysName.0 = my router
sysLocation.0 = building 1
sysServices.0 = 4
```

show snmp mib walk (QFX Series)

```
user@switch> show snmp mib walk system
sysDescr.0     = Juniper Networks, Inc. qfx3500s internet router, kernel JUNOS
11.1-20100926.0 #0: 2010-09-26 06:17:38 UTC Build date: 2010-09-26 06:00:10
sysObjectID.0 = jnxProductQFX3500
sysUpTime.0    = 138980301
sysContact.0   = System Contact
```



```
sysName.0     = LabQFX3500
sysLocation.0 = Lab
sysServices.0 = 4
```

show snmp mib walk decimal

```
user@host show snmp mib walk decimal jnxUtilData
jnxUtilCounter32Value.102.114.101.100 = 100
```

show snmp mib walk (ASCII)

```
show snmp mib walk ascii jnxUtilData
jnxUtilCounter32Value."fred" = 100
```

show snmp mib walk (Multiple Indices)

```
show snmp mib walk ascii jnxFWCounterByteCount
jnxFWCounterByteCount."fe-1/3/0.0-i"."CLASS_BE-fe-1/3/0.0-i".2 = 0
jnxFWCounterByteCount."fe-1/3/0.0-i"."CLASS_CC-fe-1/3/0.0-i".2 = 0
jnxFWCounterByteCount."fe-1/3/0.0-i"."CLASS_RT-fe-1/3/0.0-i".2 = 0
.......
```

show snmp mib walk decimal (Multiple Indices)

```
show snmp mib walk ascii jnxFWCounterByteCount
jnxFWCounterByteCount."fe-1/3/0.0-i"."CLASS_BE-fe-1/3/0.0-i".2 = 0
jnxFWCounterByteCount."fe-1/3/0.0-i"."CLASS_CC-fe-1/3/0.0-i".2 = 0
jnxFWCounterByteCount."fe-1/3/0.0-i"."CLASS_RT-fe-1/3/0.0-i".2 = 0
.......
```

show snmp rmon

Syntax

show snmp rmon
<alarms (brief | detail)>
<events (brief | detail)>
<logs>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display information about Simple Network Management Protocol (SNMP) Remote Monitoring (RMON) alarms, events, and logs.

Options

none—Display information about all RMON alarms and events.

brief | detail—(Optional) Display brief or detailed information about RMON alarms or events.

alarms—(Optional) Display information about RMON alarms.

events—(Optional) Display information about RMON events.

logs—(Optional) Display information about RMON monitoring logs.

Required Privilege Level view

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Monitoring RMON MIB Tables on page 6323
- Configuring RMON Alarms and Events on page 6117
- Understanding RMON on page 6033
- clear snmp statistics on page 6375
- clear snmp history on page 6374
- show snmp rmon history on page 6399

List of Sample Output

show snmp rmon on page 6397
show snmp rmon alarms detail on page 6398
show snmp rmon events detail on page 6398
show snmp rmon logs on page 6398

Output Fields Table 608 on page 6395 describes the output fields for the **show snmp rmon** command. Output fields are listed in the approximate order in which they appear.

Table 608: show snmp rmon Output Fields

Field Name	Field Description	Level of Output
Alarm Index	Alarm identifier.	All levels

Table 608: show snmp rmon Output Fields *(continued)*

Field Name	Field Description	Level of Output
State	State of the alarm or event entry: Alarms: • **active**—Entry is fully configured and activated. • **falling threshold crossed**—Value of the variable has crossed the lower threshold limit. • **rising threshold crossed**—Value of the variable has crossed the upper threshold limit. • **under creation**—Entry is being configured and is not yet activated. • **startup**—Alarm is waiting for the first sample of the monitored variable. • **object not available**—Monitored variable of that type is not available to the SNMP agent. • **instance not available**—Monitored variable's instance is not available to the SNMP agent. • **object type invalid**—Monitored variable is not a numeric value. • **object processing errored**—An error occurred when the monitored variable was processed. • **unknown**—State is not one of the above. Events: • **active**—Entry has been fully configured and activated. • **under creation**—Entry is being configured and is not yet activated. • **unknown**—State is not one of the above.	All levels
Variable name	Name of the SNMP object instance being monitored.	All levels
Event Index	Event identifier.	All levels
Type	Type of notification made when an event is triggered. It can be one of the following: • **log**—A system log message is generated and an entry is made to the log table. • **snmptrap**—An SNMP trap is sent to the configured destination. • **log and trap**—A system log message is generated, an entry is made to the log table, and an SNMP trap is sent to the configured destination. • **none**—Neither log nor trap will be sent.	**detail**
Last Event	Date and time of the last event. It has the format *yyyy-mm-dd hh:mm:ss timezone*.	**brief**
Community	Trap group used for sending the SNMP trap.	**detail**
Variable OID	Object ID to which the variable name is resolved. The format is **x.x.x.x**.	**detail**
Sample type	Method of sampling the monitored variable and calculating the value to compare against the upper and lower thresholds. It can have the value of **absolute value** or **delta value**.	**detail**

Table 608: show snmp rmon Output Fields *(continued)*

Field Name	Field Description	Level of Output

Startup alarm	Alarm that might be sent when this entry is first activated, depending on the following criteria:
	• Alarm is sent when one of the following situations exists:
	  • Value of the alarm is above or equal to the rising threshold and the startup type is either **rising alarm** or **rising or falling alarm.**
	  • Value of the alarm is below or equal to the falling threshold and the startup type is either **falling alarm** or **rising or falling alarm**.
	• Alarm is *not* sent when one of the following situations exists:
	  • Value of the alarm is above or equal to the rising threshold and the startup type is **falling alarm**.
	  • Value of the alarm is below or equal to the falling threshold and the startup type is **rising alarm**.
	  • Value of the alarm is between the thresholds.
		detail

Owner	Name of the entry configured by the user. If the entry was created through the CLI, the owner has **monitor** prepended to it.	**detail**
Creator	Mechanism by which the entry was configured (**CLI** or **SNMP**).	**detail**
Sample interval	Time period between samples (in seconds).	**detail**
Rising threshold	Upper limit threshold value configured by the user.	**detail**
Falling threshold	Lower limit threshold value configured by the user.	**detail**
Rising event index	Event triggered when the rising threshold is crossed.	**detail**
Falling event index	Event triggered when the falling threshold is crossed.	**detail**
Current value	Current value of the monitored variable in the most recent sample interval.	**detail**

Sample Output

show snmp rmon

```
user@host> show snmp rmon
Alarm
Index  Variable description                           Value State

     5 monitor
       jnxOperatingCPU.9.1.0.0                            5 falling threshold

Event
Index  Type                       Last Event
    1  log and trap               2009-07-10 11:34:17 PDT
Event Index: 1
    Description: Event 1 triggered by Alarm 5, rising threshold (90) crossed,
(variable: jnxOperatingCPU.9.1.0.0, value: 100)
    Time: 2009-07-10 11:34:07 PDT
```

```
    Description: Event 1 triggered by Alarm 5, falling threshold (75) crossed,
(variable: jnxOperatingCPU.9.1.0.0, value: 5)
    Time: 2009-07-10 11:34:17 PDT
```

show snmp rmon alarms detail

```
user@host> show snmp rmon alarms detail
Alarm Index 5:
  Variable name                         jnxOperatingCPU.9.1.0.0
  Variable OID                          1.3.6.1.4.1.2636.3.1.13.1.8.9.1.0.0
  Sample type                           absolute value
  Startup alarm                         rising or falling alarm
  Owner                                 monitor

  Creator                               CLI
  State                                 active
  Sample interval                     5 seconds
  Rising threshold                   90
  Falling threshold                  75
  Rising event index                  1
  Falling event index                 1
    Instance Value: 4
    Instance State: falling threshold
```

show snmp rmon events detail

```
user@host> show snmp rmon events detail
Event Index 1:
  Description                          rmon event
  Type                                 log and trap
  Community                            rmon-trap-group
  Last event                           2009-07-10 11:34:17 PDT
  Creator                              CLI
  State                                active
```

show snmp rmon logs

```
user@host> show snmp rmon logs
Event Index: 1
    Description: Event 1 triggered by Alarm 5, rising threshold (90) crossed,
(variable: jnxOperatingCPU.9.1.0.0, value: 100)
    Time: 2009-07-10 11:34:07 PDT
    Description: Event 1 triggered by Alarm 5, falling threshold (75) crossed,
(variable: jnxOperatingCPU.9.1.0.0, value: 5)
    Time: 2009-07-10 11:34:17 PDT
```


show snmp rmon history

Syntax

show snmp rmon history
<*history-index*>
sample-index <*sample-index*>

Release Information Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display the contents of the RMON history group.

Options

none—Display all the entries in the RMON history group.

history-index—(Optional) Display the contents of the specified entry in the RMON history group.

sample-index *sample-index*—(Optional) Display the statistics collected for the specified sample within the specified entry in the RMON history group.

Required Privilege Level view

Related Documentation

- RMON MIB Event, Alarm, Log, and History Control Tables on page 6035
- Monitoring RMON MIB Tables on page 6323
- Configuring RMON Alarms and Events on page 6117
- Understanding RMON on page 6033
- **clear snmp statistics on page 6375**
- **clear snmp history on page 6374**
- **show snmp rmon on page 6395**

show snmp statistics

Syntax show snmp statistics

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.

Description Display statistics about Simple Network Management Protocol (SNMP) packets sent and received by the router or switch.

Options This command has no options.

Required Privilege Level view

Related Documentation

- clear snmp statistics on page 6375

List of Sample Output show snmp statistics on page 6403

Output Fields Table 117 on page 1379 describes the output fields for the **show snmp statistics** command. Output fields are listed in the approximate order in which they appear.

Table 609: show snmp statistics Output Fields

Field Name	Field Description
Input	Information about received packets: • **Packets(snmpInPkts)**—Total number of messages delivered to the SNMP entity from the transport service. • **Bad versions—(snmpInBadVersions**) Total number of messages delivered to the SNMP entity that were for an unsupported SNMP version. • **Bad community names—(snmpInBadCommunityNames)** Total number of messages delivered to the SNMP entity that used an SNMP community name not known to the entity. • **Bad community uses—(snmpInBadCommunityUses)** Total number of messages delivered to the SNMP entity that represented an SNMP operation that was not allowed by the SNMP community named in the message. • **ASN parse errors—(snmpInASNParseErrs)** Total number of ASN.1 or BER errors encountered by the SNMP entity when decoding received SNMP messages. • **Too bigs—(snmpInTooBigs)** Total number of SNMP PDUs delivered to the SNMP entity with an error status field of **tooBig**. • **No such names—(snmpInNoSuchNames)** Total number of SNMP PDUs delivered to the SNMP entity with an error status field of **noSuchName**. • **Bad values—(snmpInBadValues)** Total number of SNMP PDUs delivered to the SNMP entity with an error status field of **badValue**. • **Read onlys—(snmpInReadOnlys)** Total number of valid SNMP PDUs delivered to the SNMP entity with an error status field of **readOnly**. Only incorrect implementations of SNMP generate this error.

Table 609: show snmp statistics Output Fields *(continued)*

Field Name	Field Description
Input (continued)	• **General errors—(snmpInGenErrs)** Total number of SNMP PDUs delivered to the SNMP entity with an error status field of **genErr**. • **Total requests varbinds—(snmpInTotalReqVars)** Total number of MIB objects retrieved successfully by the SNMP entity as a result of receiving valid SNMP **GetRequest** and **GetNext** PDUs. • **Total set varbinds—(snmpInSetVars)** Total number of MIB objects modified successfully by the SNMP entity as a result of receiving valid SNMP **SetRequest** PDUs. • **Get requests—(snmpInGetRequests)** Total number of SNMP **GetRequest** PDUs that have been accepted and processed by the SNMP entity. • **Get nexts—(snmpInGetNexts)** Total number of SNMP **GetNext** PDUs that have been accepted and processed by the SNMP entity. • **Set requests—(snmpInSetRequests)** Total number of SNMP **SetRequest** PDUs that have been accepted and processed by the SNMP entity. • **Get responses—(snmpInGetResponses)** Total number of SNMP **GetResponse** PDUs that have been accepted and processed by the SNMP entity. • **Traps—(snmpInTraps)** Total number of SNMP traps generated by the SNMP entity. • **Silent drops—(snmpSilentDrops)** Total number of **GetRequest**, **GetNextRequest**, **GetBulkRequest**, **SetRequests**, and **InformRequest** PDUs delivered to the SNMP entity that were silently dropped because the size of a reply containing an alternate response PDU with an empty variable-bindings field was greater than either a local constraint or the maximum message size associated with the originator of the requests. • **Proxy drops—(snmpProxyDrops)** Total number of **GetRequest**, **GetNextRequest**, **GetBulkRequest**, **SetRequests**, and **InformRequest** PDUs delivered to the SNMP entity that were silently dropped because the transmission of the message to a proxy target failed in such a way (other than a timeout) that no response PDU could be returned. • **Commit pending drops**—Number of SNMP packets for **Set** requests dropped because of a previous pending SNMP **Set** request on the committed configuration. • **Throttle drops**—Number of SNMP packets for any requests dropped reaching the throttle limit.

Table 609: show snmp statistics Output Fields *(continued)*

Field Name	Field Description
V3 Input	Information about SNMP version 3 packets: • **Unknown security models—(snmpUnknownSecurityModels)** Total number of packets received by the SNMP engine that were dropped because they referenced a security model that was not known to or supported by the SNMP engine. • **Invalid messages—(snmpInvalidMsgs)** Number of packets received by the SNMP engine that were dropped because there were invalid or inconsistent components in the SNMP message. • **Unknown pdu handlers—(snmpUnknownPDUHandlers)** Number of packets received by the SNMP engine that were dropped because the PDU contained in the packet could not be passed to an application responsible for handling the PDU type. • **Unavailable contexts—(snmpUnavailableContexts)** Number of requests received for a context that is known to the SNMP engine, but is currently unavailable. • **Unknown contexts—(snmpUnknownContexts)** Total number of requests received for a context that is unknown to the SNMP engine. • **Unsupported security levels—(usmStatsUnsupportedSecLevels)** Total number of packets received by the SNMP engine that were dropped because they requested a security level unknown to the SNMP engine (or otherwise unavailable). • **Not in time windows—(usmStatsNotInTimeWindows)** Total number of packets received by the SNMP engine that were dropped because they appeared outside the authoritative SNMP engine's window. • **Unknown user names—(usmStatsUnknownUserNames)** Total number of packets received by the SNMP engine that were dropped because they referenced a user that was not known to the SNMP engine. • **Unknown engine ids—(usmStatsUnknownEngineIDs)** Total number of packets received by the SNMP engine that were dropped because they referenced an SNMP engine ID that was not known to the SNMP engine. • **Wrong digests—(usmStatsWrongDigests)** Total number of packets received by the SNMP engine that were dropped because they did not contain the expected digest value. • **Decryption errors—(usmStatsDecryptionErrors)** Total number of packets received by the SNMP engine that were dropped because they could not be decrypted.

Table 609: show snmp statistics Output Fields *(continued)*

Field Name	Field Description
Output	Information about transmitted packets: • **Packets—(snmpOutPkts)** Total number of messages passed from the SNMP entity to the transport service. • **Too bigs—(snmpOutTooBigs)** Total number of SNMP PDUs generated by the SNMP entity with an error status field of **tooBig**. • **No such names—(snmpOutNoSuchNames)** Total number of SNMP PDUs delivered to the SNMP entity with an error status field of **noSuchName**. • **Bad values—(snmpOutBadValues)** Total number of SNMP PDUs generated by the SNMP entity with an error status field of **badValue**. • **General errors—(snmpOutGenErrs)** Total number of SNMP PDUs generated by the SNMP entity with an error status field of **genErr**. • **Get requests—(snmpOutGetRequests)** Total number of SNMP **GetRequest** PDUs generated by the SNMP entity. • **Get nexts—(snmpOutGetNexts)** Total number of SNMP **GetNext** PDUs generated by the SNMP entity. • **Set requests—(snmpOutSetRequests)** Total number of SNMP **SetRequest** PDUs generated by the SNMP entity. • **Get responses—(snmpOutGetResponses)** Total number of SNMP **GetResponse** PDUs generated by the SNMP entity. • **Traps—(snmpOutTraps)** Total number of SNMP traps generated by the SNMP entity.

Sample Output

show snmp statistics

```
user@host> show snmp statistics
SNMP statistics:
  Input:
    Packets: 246213, Bad versions: 12, Bad community names: 12,
    Bad community uses: 0, ASN parse errors: 96,
    Too bigs: 0, No such names: 0, Bad values: 0,
    Read onlys: 0, General errors: 0,
    Total request varbinds: 227084, Total set varbinds: 67,
    Get requests: 44942, Get nexts: 190371, Set requests: 10712,
    Get responses: 0, Traps: 0,
    Silent drops: 0, Proxy drops: 0, Commit pending drops: 0,
    Throttle drops: 0,
  V3 Input:
    Unknown security models: 0, Invalid messages: 0
    Unknown pdu handlers: 0, Unavailable contexts: 0
    Unknown contexts: 0, Unsupported security levels: 1
    Not in time windows: 0, Unknown user names: 0
    Unknown engine ids: 44, Wrong digests: 23, Decryption errors: 0
  Output:
    Packets: 246093, Too bigs: 0, No such names: 31561,
    Bad values: 0, General errors: 2,
    Get requests: 0, Get nexts: 0, Set requests: 0,
    Get responses: 246025, Traps: 0
```

show snmp v3

Syntax

show snmp v3
<access <brief | detail> | community | general | groups | notify <filter> | target <address | parameters> | users>

Release Information

Command introduced in Junos OS Release 11.1 for the QFX Series.

Description

Display the Simple Network Management Protocol version 3 (SNMPv3) operating configuration.

Options

none—Display all of the SNMPv3 operating configuration.

access—(Optional) Display SNMPv3 access information.

brief | detail—(Optional) Display brief or detailed information about SNMPv3 access information.

community—(Optional) Display SNMPv3 community information.

general—(Optional) Display SNMPv3 general information.

groups—(Optional) Display SNMPv3 security-to-group information.

notify <filter>—(Optional) Display SNMPv3 notify information and, optionally, notify filter information.

target <address | parameters>—(Optional) Display SNMPv3 target information and, optionally, either target address or target parameter information.

users—(Optional) Display SNMPv3 user information.

Additional Information

To edit the default display of the **show snmp v3** command, specify options in the **show** statement at the **[edit snmp v3]** hierarchy level.

Required Privilege Level

view

Related Documentation

- SNMPv3 Overview on page 6031
- Minimum SNMPv3 Configuration on a Device Running Junos OS on page 6032
- Configuring Access Privileges for a Group on page 6121

List of Sample Output

show snmp v3 on page 6405

Output Fields

Table 610 on page 6405 describes the output fields for the **show snmp v3** command. Output fields are listed in the approximate order in which they appear.

Table 610: show snmp v3 Output Fields

Field Name	Field Description
Local engine	Information about the local SNMP engine configuration: • **Local engine ID**—Unique Identifier of the local SNMPv3 engine. • **Engine boots**—Number of times the local SNMPv3 engine has rebooted or reinitialized since this engine ID was configured. • **Engine time**—Number of seconds since the local SNMPv3 engine was last rebooted or reinitialized. • **Max msg size**—Maximum message size the sender can accommodate.
Engine ID (local engine)	Information about the local SNMP engine ID and the associated users: • **User**—SNMPv3 username. • **Auth/Priv**—Authentication and encryption algorithm that is configured for the user. • **Storage**—Indicates whether a username is saved to the configuration file (nonvolatile) or not saved (volatile). Applies only to users with active status. • **Status**—Status of the user as listed in the SNMPv3 user table. Only rows with an active status in the table are used by the SNMPv3 engine.
Engine ID (remote engine)	Information about a remote SNMP engine, associated users, user groups, and user access policies: • **User**—SNMPv3 username. • **Auth/Priv**—Authentication and encryption algorithm that is configured for the user. • **Storage**—Indicates whether a username is saved to the configuration file (nonvolatile) or not (volatile). Applies only to users with active status. • **Status**—Status of a new user that has been activated. Only users with an active status can use SNMPv3. • **Group name**—Name of a group of users for which the configured access privileges apply. • **Security model**—Security model (such as **usm**, **v1**, **v2c**, or **any**) that is configured for the group. The security model is used with the security name to ensure messaging security. • **Security name**—Security name that is associated with a user, and which is used with the security model to ensure messaging security. • **Storage type**—Indicates whether a username is saved to the configuration file (nonvolatile) or not saved (volatile). Applies only to users with active status. • **Status**—Status of a user in a group. Only users with an active status can use SNMPv3.
Access control	Information about access control: • **Group name**—Name of a group of users for which the configured access privileges apply. • **Context prefix**—SNMPv3 context for which the configured access privileges apply. • **Security model/level**—Security model and security level combination that is configured for user access privileges. • **Read view**—Identifies the MIB view used for SNMPv3 read operations. • **Write view**—Identifies the MIB view used for SNMPv3 write operations. • **Notify view**—Identifies the MIB view used for outbound SNMP notifications.

Sample Output

show snmp v3

```
user@host> show snmp v3
```

```
Local engine ID: 80 00 0a 4c e04 31 32 33 34
Engine boots:          38
Engine time:        64583 seconds
Max msg size:        2048 bytes

Engine ID: local
    User                            Auth/Priv   Storage      Status
    user1                            md5/des    nonvolatile  active
    user2                            sha/none   nonvolatile  active
    user3                           none/none   nonvolatile  active

Engine ID: 81 00 0a 4c 04 64 64 64 64
    User                            Auth/Priv   Storage      Status
    UNEW                             md5/none   nonvolatile  active
Group name           Security  Security              Storage      Status
                     model     name                  type
g1                   usm       user1                 nonvolatile  active
g2                   usm       user2                 nonvolatile  active
g3                   usm       user3                 nonvolatile  active

Access control:
Group                Context Security      Read       Write     Notify
                     prefix  model/level   view       view      view
g1                            usm/privacy  v1         v1
g2                            usm/authent  v1         v1
g3                            usm/none     v1         v1
```

Commands for Syslog

- show log

show log

Syntax

show log
<*filename* | user <*username*>>

Syntax (QFabric System)

show log *filename*
<*device-type (device-id* | *device-alias*)>

Syntax (TX Matrix Routers)

show log
<all-lcc | lcc *number* | scc>
<*filename* | user <*username*>>

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Option *device-type (device-id* | *device-alias*) is introduced in Junos OS Release 13.1 for the QFX Series.

Description

List log files, display log file contents, or display information about users who have logged in to the router or switch.

Options

none—List all log files.

<all-lcc | lcc *number* | scc>—(TX Matrix routers only) (Optional) Display logging information about all T640 routers (or line-card chassis) or a specific T640 router (replace ***number*** with a value from 0 through 3) connected to a TX Matrix router. Or, display logging information about the TX Matrix router (or switch-card chassis).

device-type—(QFabric system only) (Optional) Display log messages for only one of the following device types:

- **director-device**—Display logs for Director devices.
- **infrastructure-device**—Display logs for the logical components of the QFabric system infrastructure, including the diagnostic Routing Engine, fabric control Routing Engine, fabric manager Routing Engine, and the default network Node group and its backup (NW-NG-0 and NW-NG-0-backup).
- **interconnect-device**—Display logs for Interconnect devices.
- **node-device**—Display logs for Node devices.

NOTE: If you specify the **device-type** optional parameter, you must also specify either the **device-id** or **device-alias** optional parameter.

(*device-id* | *device-alias*)—If a device type is specified, display logs for a device of that type. Specify either the device ID or the device alias (if configured).

filename—(Optional) Display the log messages in the specified log file. For the routing matrix, the filename must include the chassis information.

NOTE: The *filename* parameter is mandatory for the QFabric system. If you did not configure a syslog filename, specify the default filename of messages.

user <***username***>—(Optional) Display logging information about users who have recently logged in to the router or switch. If you include ***username***, display logging information about the specified user.

Required Privilege Level trace

List of Sample Output

show log on page 6408
show log filename on page 6408
show log filename (QFabric System) on page 6409
show log user on page 6409

Sample Output

show log

```
user@host> show log
total 57518
-rw-r--r--  1 root  bin      211663 Oct  1 19:44 dcd
-rw-r--r--  1 root  bin      999947 Oct  1 19:41 dcd.0
-rw-r--r--  1 root  bin      999994 Oct  1 17:48 dcd.1
-rw-r--r--  1 root  bin      238815 Oct  1 19:44 rpd
-rw-r--r--  1 root  bin     1049098 Oct  1 18:00 rpd.0
-rw-r--r--  1 root  bin     1061095 Oct  1 12:13 rpd.1
-rw-r--r--  1 root  bin     1052026 Oct  1 06:08 rpd.2
-rw-r--r--  1 root  bin     1056309 Sep 30 18:21 rpd.3
-rw-r--r--  1 root  bin     1056371 Sep 30 14:36 rpd.4
-rw-r--r--  1 root  bin     1056301 Sep 30 10:50 rpd.5
-rw-r--r--  1 root  bin     1056350 Sep 30 07:04 rpd.6
-rw-r--r--  1 root  bin     1048876 Sep 30 03:21 rpd.7
-rw-rw-r--  1 root  bin       19656 Oct  1 19:37 wtmp
```

show log filename

```
user@host> show log rpd
Oct  1 18:00:18 trace_on: Tracing to ?/var/log/rpd? started
Oct  1 18:00:18 EVENT <MTU> ds-5/2/0.0 index 24 <Broadcast PointToPoint Multicast
Oct  1 18:00:18
Oct  1 18:00:19 KRT recv len 56 V9 seq 148 op add Type route/if af 2 addr
13.13.13.21 nhop type local nhop 13.13.13.21
Oct  1 18:00:19 KRT recv len 56 V9 seq 149 op add Type route/if af 2 addr
13.13.13.22 nhop type unicast nhop 13.13.13.22
Oct  1 18:00:19 KRT recv len 48 V9 seq 150 op add Type ifaddr index 24 devindex
43
Oct  1 18:00:19 KRT recv len 144 V9 seq 151 op chnge Type ifdev devindex 44
Oct  1 18:00:19 KRT recv len 144 V9 seq 152 op chnge Type ifdev devindex 45
Oct  1 18:00:19 KRT recv len 144 V9 seq 153 op chnge Type ifdev devindex 46
```

```
Oct  1 18:00:19 KRT recv len 1272 V9 seq 154 op chnge Type ifdev devindex 47
...
```

show log filename (QFabric System)

```
user@qfabric> show log messages
Mar 28 18:00:06 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:06 ED1486
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 1, jnxFruL3Index 0,
jnxFruName PIC: 48x 10G-SFP+ @ 0/0/*, jnxFruType 11, jnxFruSlot 0,
jnxFruOfflineReason 2, jnxFruLastPowerOff 0, jnxFruLastPowerOn 2159)
Mar 28 18:00:07 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:07 ED1486
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 2, jnxFruL3Index 0,
jnxFruName PIC:  @ 0/1/*, jnxFruType 11, jnxFruSlot 0, jnxFruOfflineReason 2,
jnxFruLastPowerOff 0, jnxFruLastPowerOn 2191)
Mar 28 18:00:07 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:07 ED1492
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 1, jnxFruL3Index 0,
jnxFruName PIC: 48x 10G-SFP+ @ 0/0/*, jnxFruType 11, jnxFruSlot 0,
jnxFruOfflineReason 2, jnxFruLastPowerOff 0, jnxFruLastPowerOn 242726)
Mar 28 18:00:07 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:07 ED1492
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 2, jnxFruL3Index 0,
jnxFruName PIC:  @ 0/1/*, jnxFruType 11, jnxFruSlot 0, jnxFruOfflineReason 2,
jnxFruLastPowerOff 0, jnxFruLastPowerOn 242757)
Mar 28 18:00:16 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:16 ED1486
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:00:27 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:27 ED1486
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:00:50 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:50
_DCF_default___NW-INE-0_RE0_ file: UI_COMMIT: User 'root' requested 'commit'
operation (comment: none)
Mar 28 18:00:50 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:50
_DCF_default___NW-INE-0_RE0_ file: UI_COMMIT: User 'root' requested 'commit'
operation (comment: none)
Mar 28 18:00:55 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:00:55 ED1492
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:01:10 qfabric file: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:01:10 ED1492
file: UI_COMMIT: User 'root' requested 'commit' operation (comment: none)
Mar 28 18:02:37 qfabric chassisd: QFABRIC_INTERNAL_SYSLOG: Mar 28 18:02:37 ED1491
 chassisd: CHASSISD_SNMP_TRAP10: SNMP trap generated: FRU power on
(jnxFruContentsIndex 8, jnxFruL1Index 1, jnxFruL2Index 1, jnxFruL3Index 0,
jnxFruName PIC: 48x 10G-SFP+ @ 0/0/*, jnxFruType 11, jnxFruSlot 0,
jnxFruOfflineReason 2, jnxFruLastPowerOff 0, jnxFruLastPowerOn 33809)
```

show log user

```
user@host> show log user
darius   mg2546                   Thu Oct  1 19:37   still logged in
darius   mg2529                   Thu Oct  1 19:08 - 19:36  (00:28)
darius   mg2518                   Thu Oct  1 18:53 - 18:58  (00:04)
root     mg1575                   Wed Sep 30 18:39 - 18:41  (00:02)
root     ttyp2    jun.site.per   Wed Sep 30 18:39 - 18:41  (00:02)
alex     ttyp1    192.168.1.2     Wed Sep 30 01:03 - 01:22  (00:19)
```

CHAPTER 69

Troubleshooting

Troubleshooting Overview

Understanding Troubleshooting Resources

This topic describes some of the troubleshooting resources available for the QFX Series. These resources include tools such as the Junos OS CLI, Junos Space applications, and the Advanced Insight Scripts (AI-Scripts).

Table 611 on page 6411 provides a list of some of the troubleshooting resources.

Table 611: Troubleshooting Resources on the QFX Series

Troubleshooting Resource	Description	Documentation
Chassis alarms	Chassis alarms indicate a failure on the switch or one of its components. A chassis alarm count is displayed on the LCD panel on the front of the switch.	"Chassis Alarm Messages on a QFX3500 Device" on page 6430
Chassis Status LEDs and Fan Tray LEDs	A blinking amber Power, Fan, or Fan Tray LED indicates a hardware component error. A blinking amber Status LED indicates a software error.	*Chassis Status LEDs on a QFX3500 Device*
Interface alarms	A predefined alarm (red or yellow) for an interface type is triggered when an interface of that type goes down.	"Interface Alarm Messages" on page 6433
System alarms	A predefined alarm is triggered by a missing rescue configuration or problem with the software license.	"Understanding Alarms" on page 6429

Table 611: Troubleshooting Resources on the QFX Series *(continued)*

Troubleshooting Resource	Description	Documentation
System log messages	The system log includes details of system and user events, including errors. Specify the severity and type of system log messages you wish to view or save, and configure the output to be sent to local or remote hosts.	• Overview of Single-Chassis System Logging Configuration on page 6069 • Junos OS System Log Configuration Statements on page 6127
Junos OS operational mode commands	Operational mode commands can be used to monitor switch performance and current activity on the network. For example, use the **traceroute monitor** command to locate points of failure in a network.	• Monitoring System Process Information on page 307 • Monitoring System Properties on page 308 • **traceroute monitor**
Junos OS automation scripts (event scripts)	Event scripts can be used to automate network troubleshooting and management tasks.	*Junos OS Automation Library*
Junos OS XML operational tags	XML operational tags are equivalent in function to operational mode commands in the CLI, which you can use to retrieve status information for a device.	*Junos XML API Operational Developer Reference*
NETCONF XML management protocol	The NETCONF XML management protocol defines basic operations that are equivalent to Junos OS CLI configuration mode commands. Client applications use the protocol operations to display, edit, and commit configuration statements (among other operations), just as administrators use CLI configuration mode commands such as **show**, **set**, and **commit** to perform those operations.	*NETCONF XML Management Protocol Developer Guide*
SNMP MIBs and traps	MIBs enable the monitoring of network devices from a central location. For example, use the Traceroute MIB to monitor devices remotely.	• SNMP MIBs Support on page 6038 • SNMP Traps Support on page 6054 • *Using the Traceroute MIB for Remote Monitoring Devices Running Junos OS*
AI-Scripts and Advanced Insight Manager (AIM)	AI-Scripts installed on the switch can automatically detect and monitor faults on the switch, and depending on the configuration on the AIM application, send notifications of potential problems and submit problem reports to Juniper Support Systems.	*Advanced Insight Scripts (AI-Scripts) Release Notes*
Junos Space Service Now	This application enables you to display and manage information about problem events. When problems are detected on the switch by Advanced Insight Scripts (AI-Scripts) that are installed on the switch, the data is collected and sent to Service Now for your review and action.	*Service Automation*

Table 611: Troubleshooting Resources on the QFX Series *(continued)*

Troubleshooting Resource	Description	Documentation
Junos Space Service Insight	This application helps in accelerating operational analysis and managing the exposure to known issues. You can identify devices that are nearing their End Of Life (EOL) and also discover and prevent issues that could occur in your network. The functionality of Service Insight is dependent on the information sent from Service Now.	*Service Automation*
Juniper Networks Knowledge Base	You can search in this database for Juniper Networks product information, including alerts and troubleshooting tips.	http://kb.juniper.net

Troubleshooting Overview

This topic provides a general guide to troubleshooting some typical problems you may encounter on your QFX Series product.

Table 612 on page 6413 provides a list of problem categories, summary of the symptom or problem, and recommended actions with links to the troubleshooting documentation.

Table 612: Troubleshooting on the QFX Series

Problem Category	Symptom or Problem	Recommended Action
Switch hardware components	LCD panel shows a chassis alarm count.	See "Chassis Alarm Messages on a QFX3500 Device" on page 6430.
	Fan tray LED is blinking amber.	See *Fan Tray LED on a QFX3500 Device*.
	Chassis status LED for the power is blinking amber.	See *Chassis Status LEDs on a QFX3500 Device*.
	Chassis status LED for the fan (on the management board) is blinking amber.	Replace the management board as soon as possible. See *Chassis Status LEDs on a QFX3500 Device*.

Table 612: Troubleshooting on the QFX Series *(continued)*

Problem Category	Symptom or Problem	Recommended Action
Port configuration	Cannot configure a port as a Gigabit Ethernet port.	Check whether the port is a valid Gigabit Ethernet port (6 through 41). See *QFX3500 Device Overview*.
	Cannot configure a port as a Fibre Channel port.	Check whether the port is a valid Fibre Channel port (0 through 5 and 42 through 47). See *QFX3500 Device Overview*.
	Cannot configure a port as a 10-Gigabit Ethernet port.	If the port is not a 40-Gbps QSFP+ interface, check whether the port is in the range of 0 through 5 or 42 through 47. If one of the ports in that block (0 through 5 or 42 through 47) is configured as a Fibre Channel port, then all ports in that block must also be configured as Fibre Channel ports. If the port is a 40-Gbps QSFP+ interface. make sure the configuration does not exceed the interface limit. Each 40-Gbps QSFP+ interface can be split into four 10-Gigabit Ethernet interfaces, but because port 0 is reserved, so you can only configure an additional fifteen 10-Gigabit Ethernet interfaces. See *QFX3500 Device Overview*.
	Cannot configure a 40-Gbps QSFP+ interface.	The 40-Gbps QSFP+ interfaces can only be used as 10-Gigabit Ethernet interfaces. Each 40-Gbps QSFP+ interface can be split into four 10-Gigabit Ethernet interfaces using a breakout cable. However, port 0 is reserved, so you can only configure an additional fifteen 10-Gigabit Ethernet interfaces. See *QFX3500 Device Overview*.
External devices (USB devices)	Upgrading software from a USB device results in an upgrade failure, and the system enters an invalid state.	Unplug the USB device and reboot the switch.
Initial device configuration	Cannot configure management Ethernet ports.	Configure the management ports from the console port. You cannot configure the management ports by directly connecting to them. NOTE: The management ports are on the front panel of the QFX3500 switch. They are labeled **C0** and **C1** on the front panel. In the CLI they are referred to as **me0** and **me1**. See "Configuring a QFX3500 Device as a Standalone Switch" on page 151.

Table 612: Troubleshooting on the QFX Series *(continued)*

Problem Category	Symptom or Problem	Recommended Action
Software upgrade and configuration	Failed software upgrade.	See "Recovering from a Failed Software Installation" on page 108.
	Active partition becomes inactive after upgrade.	
	Problem with the active configuration file.	See the following topics: • Loading a Previous Configuration File on page 1136 • Reverting to the Default Factory Configuration on page 163 • Reverting to the Rescue Configuration on page 165 • Performing a Recovery Installation on a QFX Series Device on page 103
	Root password is lost or forgotten.	Recover the root password. See "Recovering the Root Password" on page 1117.
Network interfaces	An aggregated Ethernet interface is down.	See "Troubleshooting an Aggregated Ethernet Interface" on page 1119.
	Interface on built-in network port is down.	See "Troubleshooting Network Interfaces" on page 1118.
	Interface on port in which SFP or SFP+ transceiver is installed in an SFP+ uplink module is down.	
Ethernet switching	A MAC address entry in the Ethernet switching table is not updated after the device with that MAC address has been moved from one interface to another on the switch.	See "Troubleshooting Ethernet Switching" on page 1731.
Firewall filter	Firewall configuration exceeded available Ternary Content Addressable Memory (TCAM) space.	See "Troubleshooting Firewall Filter Configuration" on page 4699.

QFX5100 Switch with Automation Enhancements Frequently Asked Questions

This FAQ addresses questions regarding using QFX5100 switches with automation enhancements, which were introduced at Junos OS Release 13.2X51-D15 .

This FAQ covers the following questions:

Who Should You Contact If You Have Problems with Loading, Installing or Updating Libraries?

Contact Customer Support at http://www.juniper.net/support.

Who Should You Contact If You Have Problems with Puppet for Junos OS?

You can obtain support for Puppet for Junos OS through the J-Net Forum for Puppet at http://forums.juniper.net/t5/Puppet-for-Junos-OS/bd-p/puppet_junos .

Who Should You Contact If You Have Problems with Chef for Junos OS?

You can obtain support for Chef for Junos OS through the J-Net Forum for Chef at http://forums.juniper.net/t5/Chef-for-Junos-OS/bd-p/chef_junos.

What Happens to the User Partition If You Downgrade a QFX5100 Switch That Is Running the jinstall-qfx-5-flex-x.tgz Software Bundle to a QFX Switch That Is Running a Different QFX5100 Software Bundle?

In this case, the user partition remains intact.

NOTE: If you make changes to the user partition while performing a unified in-service software upgrade (unified ISSU), the changes might be lost.

How Do You Recover Junos OS Binaries That You Have Deleted?

You must reinstall the software package.

How Do You Recover from a System Crash?

You must reinstall the software package.

How Can You Verify That a QFX5100 Switch Is Running a jinstall-qfx-5-flex-x.tgz Software Bundle?

You cannot use the **show version** command to verify that a QFX5100 switch is running the jinstall-qfx-5-flex-x.tgz software bundle. However, there are two other ways to verify this.

- Use the **show configuration** command to check that you are running a Layer 3 configuration. See *Installing Junos OS Software with QFX5100 Switch Automation Enhancements*.
- Go to the shell and confirm that you can invoke Python. See “Invoking the Python Interpreter” on page 6104.

Related Documentation

- Overview of QFX5100 Switch Automation Enhancements on page 5981
- *Installing Junos OS Software with QFX5100 Switch Automation Enhancements*
- Invoking the Python Interpreter on page 6104
- Chef for Junos Getting Started Guide
- Puppet for Junos OS Documentation

Troubleshooting Procedures

Recovering from a Failed Software Installation

Problem If the Junos OS appears to have been installed but the CLI does not work, or if the switch has no software installed, you can use this recovery installation procedure to install the Junos OS.

Solution If a Junos OS image already exists on the switch, you can either install the new Junos OS package in a separate partition, in which case both Junos OS images remain on the switch, or you can remove the existing Junos OS image before you start the new installation process.

To perform a recovery installation:

1. Power on the switch. The loader script starts.
2. After the message **Loading /boot/defaults/loader.conf** appears, you are prompted with the following message:

   Hit [Enter] to boot immediately, or space bar for command prompt.

   Press the Spacebar to enter the manual loader. The **loader>** prompt appears.
3. Enter the following command:

   `loader>` **install [– –format] [– –external]** ***source***
   where:

   - **format**—Enables you to erase the installation media before installing the installation package. If you do not include this option, the system installs the new Junos OS in a different partition from that of the most recently installed Junos OS.
   - **external**—Installs the installation package onto external media (a USB stick, for example).

- ***source***—Represents the name and location of the Junos OS package, either on a server on the network or as a file on an external media, as shown in the following two examples:
  - Network address of the server and the path on the server; for example, **tftp://192.17.1.28/junos/jinstall-qfx-11.1R1.5-domestic-signed.tgz**
  - Junos OS package on a USB device (commonly stored in the root drive as the only file), for example, **file:///jinstall-qfx-11.1R1.5-domestic-signed.tgz**).

The installation now proceeds normally and ends with a login prompt.

Loading a Previous Configuration File

You can use the **rollback** <***number*** command to return to a previously committed configuration file. A switch saves the last 50 committed configurations, including the rollback number, date, time, and name of the user who issued the **commit** configuration command.

Syntax

rollback <*number*>

Options

- **none**— Return to the most recently saved configuration.
- *number*—Configuration to return to.
  - **Range**: 0 through 49. The most recently saved configuration is number 0, and the oldest saved configuration is number 49.
  - **Default**: 0

To return to a configuration prior to the most recently committed one:

1. Specify the rollback number (here, 1 is entered and the configuration returns to the previously committed configuration):

```
[edit]
user@switch# rollback 1
load complete
```

2. Activate the configuration you have loaded:

```
[edit]
user@switch# commit
```

Related Documentation

- Configuration File Terms on page 26

Reverting to the Default Factory Configuration

If for any reason the current active configuration fails, you can revert to the default factory configuration. The default factory configuration contains the basic configuration settings.

This is the first configuration of the switch, and it is loaded when the switch is first installed and powered on.

The **load factory default** command is a standard Junos OS configuration command. This configuration command replaces the current active configuration with the default factory configuration.

To revert the switch to the rescue configuration:

1. [edit]
   user@switch# **load factory-default**
   [edit]
   user@switch# **delete system commit factory-settings**
   [edit]
   user@switch# **commit**

Related Documentation

- Understanding Configuration Files on page 1126
- Loading a Previous Configuration File on page 1136
- Reverting to the Rescue Configuration on page 165

Reverting to the Rescue Configuration

If someone inadvertently commits a configuration that denies management access to a QFX Series product and the console port is not accessible, you can overwrite the invalid configuration and replace it with the rescue configuration. The rescue configuration is a previously committed, valid configuration.

To revert the switch to the rescue configuration:

1. Enter the **load override** command.

   [edit]
   user@switch# **load override** *filename*

2. Commit your changes.

   [edit]
   user@switch# **commit** *filename*

Related Documentation

- Setting or Deleting the Rescue Configuration on page 1145
- Reverting to the Default Factory Configuration on page 163
- Configuration File Terms on page 26

Recovering the Root Password

If you forget the root password for the QFX3500 switch, you can use the password recovery procedure to reset the root password.

NOTE: The root password cannot be recovered on a QFabric system.

NOTE: You need console access to the switch to recover the root password.

To recover the root password:

1. Power off the switch by switching off the AC power outlet of the device or, if necessary, by pulling the power cords out of the QFX3500 switch power supplies.
2. Turn off the power to the management device, such as a PC or laptop computer, that you want to use to access the CLI.
3. Plug one end of the Ethernet rollover cable supplied with the switch into the RJ-45–to–DB-9 serial port adapter supplied with the switch.
4. Plug the RJ-45–to–DB-9 serial port adapter into the serial port on the management device.
5. Connect the other end of the Ethernet rollover cable to the console port on the switch.
6. Turn on the power to the management device.
7. On the management device, start your asynchronous terminal emulation application (such as Microsoft Windows Hyperterminal) and select the appropriate **COM** port to use (for example, **COM1**).
8. Configure the port settings as follows:
   - Bits per second: 9600
   - Data bits: 8
   - Parity: None
   - Stop bits: 1
   - Flow control: None
9. Power on the switch by (if necessary) plugging the power cords into the QFX3500 switch power supply, or turning on the power to the device or switch by switching on the AC power outlet the device is plugged into

   The terminal emulation screen on your management device displays the switch's boot sequence.
10. When the following prompt appears, press the Spacebar to access the switch's bootstrap loader command prompt:

    ```
    Hit [Enter] to boot immediately, or space bar for command prompt.
    Booting [kernel] in 9 seconds...
    ```
11. At the following prompt, enter **boot -s** to start up the system in single-user mode.

    ok **boot -s**
12. At the following prompt, enter **recovery** to start the root password recovery procedure.


```
Enter full pathname of shell or 'recovery' for root password recovery or RETURN
for /bin/sh: recovery
```

13. Enter configuration mode in the CLI.
14. Set the root password. For example:

```
user@switch# set system root-authentication plain-text-password
```

15. At the following prompt, enter the new root password. For example:

```
New password: juniper1
Retype new password:
```

16. At the second prompt, reenter the new root password.
17. After you have finished configuring the password, commit the configuration.

```
root@host# commit
commit complete
```

18. Exit configuration mode in the CLI.
19. Exit operational mode in the CLI.
20. At the prompt, enter **y** to reboot the switch.

```
Reboot the system? [y/n] y
```

Related Documentation

- Configuring the Root Password on page 1236

Troubleshooting a Deprecated Network Analytics Configuration

Problem

After a software upgrade to Junos OS Release 13.2X51-D15 from an earlier release, the network analytics configuration is no longer valid and the feature is disabled.

The network analytics configuration used in Junos OS Release 13.2X51-D10 has been deprecated in Release 13.2X51-D15. Issuing the **show services analytics** command results in the following output:

```
root@qfx5100# show services analytics

queue-statistics { ## Warning: 'queue-statistics' is deprecated
    interval 1;
}
```

Cause

Junos OS Release 13.2X51-D15 added enhancements to the network analytics feature, resulting in significant changes in the CLI. The updated **[edit services analytics]** hierarchy level contains some statements that have replaced those that were previously released. As a result, the earlier configuration does not work in the new release.

Solution

Use the new CLI statements to reconfigure the network analytics feature.

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**

PART 21

Troubleshooting

CHAPTER 70

Overview

General Troubleshooting

Understanding Troubleshooting Resources

This topic describes some of the troubleshooting resources available for the QFX Series. These resources include tools such as the Junos OS CLI, Junos Space applications, and the Advanced Insight Scripts (AI-Scripts).

Table 611 on page 6411 provides a list of some of the troubleshooting resources.

Table 613: Troubleshooting Resources on the QFX Series

Troubleshooting Resource	Description	Documentation
Chassis alarms	Chassis alarms indicate a failure on the switch or one of its components. A chassis alarm count is displayed on the LCD panel on the front of the switch.	"Chassis Alarm Messages on a QFX3500 Device" on page 6430
Chassis Status LEDs and Fan Tray LEDs	A blinking amber Power, Fan, or Fan Tray LED indicates a hardware component error. A blinking amber Status LED indicates a software error.	*Chassis Status LEDs on a QFX3500 Device*
Interface alarms	A predefined alarm (red or yellow) for an interface type is triggered when an interface of that type goes down.	"Interface Alarm Messages" on page 6433
System alarms	A predefined alarm is triggered by a missing rescue configuration or problem with the software license.	"Understanding Alarms" on page 6429

Table 613: Troubleshooting Resources on the QFX Series *(continued)*

Troubleshooting Resource	Description	Documentation
System log messages	The system log includes details of system and user events, including errors. Specify the severity and type of system log messages you wish to view or save, and configure the output to be sent to local or remote hosts.	• Overview of Single-Chassis System Logging Configuration on page 6069 • Junos OS System Log Configuration Statements on page 6127
Junos OS operational mode commands	Operational mode commands can be used to monitor switch performance and current activity on the network. For example, use the **traceroute monitor** command to locate points of failure in a network.	• Monitoring System Process Information on page 307 • Monitoring System Properties on page 308 • **traceroute monitor**
Junos OS automation scripts (event scripts)	Event scripts can be used to automate network troubleshooting and management tasks.	*Junos OS Automation Library*
Junos OS XML operational tags	XML operational tags are equivalent in function to operational mode commands in the CLI, which you can use to retrieve status information for a device.	*Junos XML API Operational Developer Reference*
NETCONF XML management protocol	The NETCONF XML management protocol defines basic operations that are equivalent to Junos OS CLI configuration mode commands. Client applications use the protocol operations to display, edit, and commit configuration statements (among other operations), just as administrators use CLI configuration mode commands such as **show**, **set**, and **commit** to perform those operations.	*NETCONF XML Management Protocol Developer Guide*
SNMP MIBs and traps	MIBs enable the monitoring of network devices from a central location. For example, use the Traceroute MIB to monitor devices remotely.	• SNMP MIBs Support on page 6038 • SNMP Traps Support on page 6054 • *Using the Traceroute MIB for Remote Monitoring Devices Running Junos OS*
AI-Scripts and Advanced Insight Manager (AIM)	AI-Scripts installed on the switch can automatically detect and monitor faults on the switch, and depending on the configuration on the AIM application, send notifications of potential problems and submit problem reports to Juniper Support Systems.	*Advanced Insight Scripts (AI-Scripts) Release Notes*
Junos Space Service Now	This application enables you to display and manage information about problem events. When problems are detected on the switch by Advanced Insight Scripts (AI-Scripts) that are installed on the switch, the data is collected and sent to Service Now for your review and action.	*Service Automation*

Table 613: Troubleshooting Resources on the QFX Series *(continued)*

Troubleshooting Resource	Description	Documentation
Junos Space Service Insight	This application helps in accelerating operational analysis and managing the exposure to known issues. You can identify devices that are nearing their End Of Life (EOL) and also discover and prevent issues that could occur in your network. The functionality of Service Insight is dependent on the information sent from Service Now.	*Service Automation*
Juniper Networks Knowledge Base	You can search in this database for Juniper Networks product information, including alerts and troubleshooting tips.	http://kb.juniper.net

Troubleshooting Overview

This topic provides a general guide to troubleshooting some typical problems you may encounter on your QFX Series product.

Table 612 on page 6413 provides a list of problem categories, summary of the symptom or problem, and recommended actions with links to the troubleshooting documentation.

Table 614: Troubleshooting on the QFX Series

Problem Category	Symptom or Problem	Recommended Action
Switch hardware components	LCD panel shows a chassis alarm count.	See “Chassis Alarm Messages on a QFX3500 Device” on page 6430.
	Fan tray LED is blinking amber.	See *Fan Tray LED on a QFX3500 Device*.
	Chassis status LED for the power is blinking amber.	See *Chassis Status LEDs on a QFX3500 Device*.
	Chassis status LED for the fan (on the management board) is blinking amber.	Replace the management board as soon as possible. See *Chassis Status LEDs on a QFX3500 Device*.

Table 614: Troubleshooting on the QFX Series *(continued)*

Problem Category	Symptom or Problem	Recommended Action
Port configuration	Cannot configure a port as a Gigabit Ethernet port.	Check whether the port is a valid Gigabit Ethernet port (6 through 41). See *QFX3500 Device Overview*.
	Cannot configure a port as a Fibre Channel port.	Check whether the port is a valid Fibre Channel port (0 through 5 and 42 through 47). See *QFX3500 Device Overview*.
	Cannot configure a port as a 10-Gigabit Ethernet port.	If the port is not a 40-Gbps QSFP+ interface, check whether the port is in the range of 0 through 5 or 42 through 47. If one of the ports in that block (0 through 5 or 42 through 47) is configured as a Fibre Channel port, then all ports in that block must also be configured as Fibre Channel ports. If the port is a 40-Gbps QSFP+ interface. make sure the configuration does not exceed the interface limit. Each 40-Gbps QSFP+ interface can be split into four 10-Gigabit Ethernet interfaces, but because port 0 is reserved, so you can only configure an additional fifteen 10-Gigabit Ethernet interfaces. See *QFX3500 Device Overview*.
	Cannot configure a 40-Gbps QSFP+ interface.	The 40-Gbps QSFP+ interfaces can only be used as 10-Gigabit Ethernet interfaces. Each 40-Gbps QSFP+ interface can be split into four 10-Gigabit Ethernet interfaces using a breakout cable. However, port 0 is reserved, so you can only configure an additional fifteen 10-Gigabit Ethernet interfaces. See *QFX3500 Device Overview*.
External devices (USB devices)	Upgrading software from a USB device results in an upgrade failure, and the system enters an invalid state.	Unplug the USB device and reboot the switch.
Initial device configuration	Cannot configure management Ethernet ports.	Configure the management ports from the console port. You cannot configure the management ports by directly connecting to them. NOTE: The management ports are on the front panel of the QFX3500 switch. They are labeled **C0** and **C1** on the front panel. In the CLI they are referred to as **me0** and **me1**. See "Configuring a QFX3500 Device as a Standalone Switch" on page 151.

Table 614: Troubleshooting on the QFX Series *(continued)*

Problem Category	Symptom or Problem	Recommended Action
Software upgrade and configuration	Failed software upgrade.	See "Recovering from a Failed Software Installation" on page 108.
	Active partition becomes inactive after upgrade.	
	Problem with the active configuration file.	See the following topics: • Loading a Previous Configuration File on page 1136 • Reverting to the Default Factory Configuration on page 163 • Reverting to the Rescue Configuration on page 165 • Performing a Recovery Installation on a QFX Series Device on page 103
	Root password is lost or forgotten.	Recover the root password. See "Recovering the Root Password" on page 1117.
Network interfaces	An aggregated Ethernet interface is down.	See "Troubleshooting an Aggregated Ethernet Interface" on page 1119.
	Interface on built-in network port is down.	See "Troubleshooting Network Interfaces" on page 1118.
	Interface on port in which SFP or SFP+ transceiver is installed in an SFP+ uplink module is down.	
Ethernet switching	A MAC address entry in the Ethernet switching table is not updated after the device with that MAC address has been moved from one interface to another on the switch.	See "Troubleshooting Ethernet Switching" on page 1731.
Firewall filter	Firewall configuration exceeded available Ternary Content Addressable Memory (TCAM) space.	See "Troubleshooting Firewall Filter Configuration" on page 4699.

Alarms

Understanding Alarms

The QFX Series support different alarm types and severity levels. Table 615 on page 6430 provides a list of alarm terms and definitions that may help you in monitoring the device.

Table 615: Alarm Terms and Definitions

Term	Definition
Alarm	Signal alerting you to conditions that might prevent normal operation. On the device, alarm indicators might include the LCD panel and LEDs on the device. The LCD panel (if present on the device) displays the chassis alarm message count. Blinking amber LEDs indicate yellow alarm conditions for chassis components.
Alarm condition	Failure event that triggers an alarm.

Alarm severity levels	Seriousness of the alarm. The level of severity can be either major (red) or minor (yellow).
	• Major (red)—Indicates a critical situation on the device that has resulted from one of the following conditions. A red alarm condition requires immediate action.
	  ◦ One or more hardware components have failed.
	  ◦ One or more hardware components have exceeded temperature thresholds.
	  ◦ An alarm condition configured on an interface has triggered a critical warning.
	• Minor (yellow or amber)—Indicates a noncritical condition on the device that, if left unchecked, might cause an interruption in service or degradation in performance. A yellow alarm condition requires monitoring or maintenance. For example, a missing rescue configuration generates a yellow system alarm.

Alarm types	Alarms include the following types: • Chassis alarm—Predefined alarm triggered by a physical condition on the device such as a power supply failure or excessive component temperature. • Interface alarm—Alarm you configure to alert you when an interface link is down. Applies to **ethernet**, **fibre-channel**, and **management-ethernet** interfaces. You can configure a red (major) or yellow (minor) alarm for the link-down condition, or have the condition ignored. • System alarm—Predefined alarm that might be triggered by a missing rescue configuration, failure to install a license for a licensed software feature, or high disk usage.

Related Documentation

- *Chassis Alarm Messages on a QFX3008-I Interconnect Device*
- Chassis Alarm Messages on a QFX3500 Device on page 6430
- Interface Alarm Messages on page 6433
- **show chassis alarms on page 466**
- **show system alarms on page 872**

Chassis Alarm Messages on a QFX3500 Device

Chassis alarms indicate a failure on the device or one of its components. Chassis alarms are preset and cannot be modified.

The chassis alarm message count is displayed on the LCD panel on the front of the device. To view the chassis alarm message text remotely, use the **show chassis lcd** CLI command.

Chassis alarms on QFX3500 devices have two severity levels:

- Major (red)—Indicates a critical situation on the device that has resulted from one of the conditions described in Table 616 on page 6431. A red alarm condition requires immediate action.

- Minor (yellow or amber)—Indicates a noncritical condition on the device that, if left unchecked, might cause an interruption in service or degradation in performance. A yellow alarm condition requires monitoring or maintenance.

Table 616 on page 6431 describes the chassis alarm messages on QFX3500 devices.

Table 616: QFX3500 Chassis Alarm Messages

Component	Alarm Type	CLI Message	Recommended Action
Fans	Major (red)	**Fan/Blower Absent**	The fan is missing. Install a fan.
		Fan Failure	Replace the fan and report the failure to customer support.
		Fan I2C Failure	Check the system log for one of the following messages and report the error message to customer support: • **CM ENV Monitor: Get fan speed failed**. • **CM ENV Monitor: Get fan speed failed *Fan-number* is NOT spinning @ correct speed**, where ***fan-number*** may be 1, 2, or 3.
		fan-number **Not Spinning** Fan	Remove and check the fan for obstructions, and then reinsert the fan. If the problem persists, replace the fan.
Power Supplies	Major (red)	**PEM *pem-number* Airflow not matching Chassis Airflow**	The power supply airflow direction is the opposite of the chassis airflow direction. Replace the power supply with a power supply that supports the same airflow direction as the chassis.
		PEM *pem-number* I2C Failure	Check the system log for one of the following messages and report the error message to customer support: • **I2C Read failed for device *number***, where ***number*** may be from 123 to 125. • **PS *number*: Transitioning from online to offline**, where power supply (PS) ***number***may be 1 or 2.
		PEM *pem-number* is not supported	Indicates a power supply problem, or the power supply is not supported on the device. Report the problem to customer support.
		PEM *pem-number* Not OK	Indicates a problem with the incoming AC or outgoing DC power. Replace the power supply.

Table 616: QFX3500 Chassis Alarm Messages *(continued)*

Component	Alarm Type	CLI Message	Recommended Action
	Minor (yellow)	**PEM *pem-number* Absent**	For information only. Indicates the device was powered on with two power supplies installed, but now one is missing. The device can continue to operate with a single power supply. If you wish to remove this alarm message, reboot the device with one power supply.
		PEM *pem-number* is not powered	For information only. Check the power cord connection and reconnect it if necessary.
		PEM *pem-number* Power Supply Type Mismatch	For information only. Indicates that an AC power supply and DC power supply have been installed in the same chassis. If you wish to remove this alarm message, reboot the device with two AC power supplies or two DC power supplies.
		PEM *pem-number* Removed	For information only. Indicates the device was powered on with two power supplies installed, but one has been removed. The device can continue to operate with a single power supply. If you wish to remove this alarm message, reboot the device with one power supply.
Temperature Sensors	Major (red)	***sensor-location* Temp Sensor Fail**	Check the system log for the following message and report it to customer support: **Temp sensor *sensor-number* failed**, where *sensor-number* may range from 1 through 10.
		***sensor-location* Temp Sensor Too Hot**	Check environmental conditions and alarms on other devices. Ensure that environmental factors (such as hot air blowing around the equipment) are not affecting the temperature sensor. If the condition persists, the device may shut down.
	Minor (yellow)	***sensor-location* Temp Sensor Too Warm**	For information only. Check environmental conditions and alarms on other devices. Ensure that environmental factors (such as hot air blowing around the equipment) are not affecting the temperature sensor.

Related Documentation

- *Front Panel of a QFX3500 Device*

- Configuring the Junos OS to Determine Conditions That Trigger Alarms on Different Interface Types on page 138
- alarm on page 2043

Interface Alarm Messages

Interface alarms are alarms that you configure to alert you when an interface is down.

To configure an interface link-down condition to trigger a red or yellow alarm, or to configure the link-down condition to be ignored, use the alarm statement at the [**edit chassis**] hierarchy level. You can specify the **ethernet**, **fibre-channel**, or **management-ethernet** interface type.

NOTE: Fibre Channel alarms are only valid on QFX3500 devices.

By default, major alarms are configured for interface link-down conditions on the control plane and management network interfaces in a QFabric system. The link-down alarms indicate that connectivity to the control plane network is down. You can configure these alarms to be ignored using the alarm statement at the [**edit chassis**] hierarchy level.

NOTE: If you configure a yellow alarm on the QFX3008-I Interconnect device, it will be handled as a red alarm.

Related Documentation

- Understanding Alarms on page 6429

System Utilization Alarms

QFX Series devices provide system alarms that alert you when disk usage in the **/var** partition exceeds acceptable levels.

You can display the messages for these alarms by issuing the **show system alarms** operational mode command if the **/var** partition usage exceeds 75 percent. A usage level between 76 and 90 percent indicates high usage and raises a minor alarm condition, whereas a usage level above 90 percent indicates that the partition is full and raises a major alarm condition.

The following sample output from the **show system alarms** command shows system alarm messages that are displayed when disk usage is exceeded on the switch.

```
user@host> show system alarms
4 alarms currently active
Alarm time               Class  Description
2013-10-08 20:08:20 UTC  Minor  RE 0 /var partition usage is high
2013-10-08 20:08:20 UTC  Major  RE 0 /var partition is full
2013-10-08 20:08:08 UTC  Minor  FPC 1 /var partition usage is high
2013-10-08 20:08:08 UTC  Major  FPC 1 /var partition is full
```


BEST PRACTICE: We recommend that you regularly request a system file storage cleanup to optimize the performance of the switch and prevent generating system alarms.

Related Documentation

- Cleaning Up the System File Storage Space on page 6451
- Understanding Alarms on page 6429
- show system alarms on page 872

Automation

QFX5100 Switch with Automation Enhancements Frequently Asked Questions

This FAQ addresses questions regarding using QFX5100 switches with automation enhancements, which were introduced at Junos OS Release 13.2X51-D15 .

This FAQ covers the following questions:

Who Should You Contact If You Have Problems with Loading, Installing or Updating Libraries?

Contact Customer Support at http://www.juniper.net/support.

Who Should You Contact If You Have Problems with Puppet for Junos OS?

You can obtain support for Puppet for Junos OS through the J-Net Forum for Puppet at http://forums.juniper.net/t5/Puppet-for-Junos-OS/bd-p/puppet_junos .

Who Should You Contact If You Have Problems with Chef for Junos OS?

You can obtain support for Chef for Junos OS through the J-Net Forum for Chef at http://forums.juniper.net/t5/Chef-for-Junos-OS/bd-p/chef_junos.

What Happens to the User Partition If You Downgrade a QFX5100 Switch That Is Running the jinstall-qfx-5-flex-x.tgz Software Bundle to a QFX Switch That Is Running a Different QFX5100 Software Bundle?

In this case, the user partition remains intact.

NOTE: If you make changes to the user partition while performing a unified in-service software upgrade (unified ISSU), the changes might be lost.

How Do You Recover Junos OS Binaries That You Have Deleted?

You must reinstall the software package.

How Do You Recover from a System Crash?

You must reinstall the software package.

How Can You Verify That a QFX5100 Switch Is Running a jinstall-qfx-5-flex-x.tgz Software Bundle?

You cannot use the **show version** command to verify that a QFX5100 switch is running the jinstall-qfx-5-flex-x.tgz software bundle. However, there are two other ways to verify this.

- Use the **show configuration** command to check that you are running a Layer 3 configuration. See *Installing Junos OS Software with QFX5100 Switch Automation Enhancements*.
- Go to the shell and confirm that you can invoke Python. See "Invoking the Python Interpreter" on page 6104.

Related Documentation

- Overview of QFX5100 Switch Automation Enhancements on page 5981
- *Installing Junos OS Software with QFX5100 Switch Automation Enhancements*
- Invoking the Python Interpreter on page 6104
- Chef for Junos Getting Started Guide
- Puppet for Junos OS Documentation

CHAPTER 71

Administration

Routine Monitoring Using the CLI

Monitoring SNMP

There are several commands that you can access in Junos OS operational mode to monitor SNMP information. Some of the commands are:

- **show snmp health-monitor**, which displays the health monitor log and alarm information.
- **show snmp mib**, which displays information from the MIBs, such as device and system information.
- **show snmp statistics**, which displays SNMP statistics such as the number of packets, silent drops, and invalid output values.
- **show snmp rmon**, which displays the RMON alarm, event, history, and log information

The following example provides sample output from the **show snmp health-monitor** command:

user@switch> show snmp health-monitor

```
Alarm
Index  Variable description                          Value State

 32768 Health Monitor: root file system utilization
       jnxHrStoragePercentUsed.1                        58 active

 32769 Health Monitor: /config file system utilization
       jnxHrStoragePercentUsed.2                         0 active
```

```
32770 Health Monitor: RE 0 CPU utilization
      jnxOperatingCPU.9.1.0.0                            0 active

32773 Health Monitor: RE 0 Memory utilization
      jnxOperatingBuffer.9.1.0.0                        35 active

32775 Health Monitor: jkernel daemon CPU utilization
      Init daemon                                        0 active
      Chassis daemon                                    50 active
      Firewall daemon                                    0 active
      Interface daemon                                   5 active
      SNMP daemon                                       11 active
      MIB2 daemon                                       42 active
      ...
```

The following example provides sample output from the **show snmp mib** command:

user@switch> show snmp mib walk system

```
sysDescr.0    = Juniper Networks, Inc. qfx3500s internet router, kernel
JUNOS 11.1-20100926.0 #0: 2010-09-26 06:17:38 UTC builder@abc.juniper.net:
/volume/build/junos/11.1/production/20100926.0/obj-xlr/bsd/sys/compile/JUNIPER-xxxxx

Build date: 2010-09-26 06:00:10 U
sysObjectID.0 = jnxProductQFX3500
sysUpTime.0   = 24444184
sysContact.0  = J Smith
sysName.0     = Lab QFX3500
sysLocation.0 = Lab
sysServices.0 = 4
```

The following example provides sample output from the **show snmp statistics** command:

user@switch> show snmp statistics

```
SNMP statistics:
  Input:
    Packets: 0, Bad versions: 0, Bad community names: 0,
    Bad community uses: 0, ASN parse errors: 0,
    Too bigs: 0, No such names: 0, Bad values: 0,
    Read onlys: 0, General errors: 0,
    Total request varbinds: 0, Total set varbinds: 0,
    Get requests: 0, Get nexts: 0, Set requests: 0,
    Get responses: 0, Traps: 0,
    Silent drops: 0, Proxy drops: 0, Commit pending drops: 0,
    Throttle drops: 0, Duplicate request drops: 0
    Output:
    Packets: 0, Too bigs: 0, No such names: 0,
    Bad values: 0, General errors: 0,
    Get requests: 0, Get nexts: 0, Set requests: 0,
    Get responses: 0, Traps: 0
```

Related Documentation

- health-monitor on page 1297
- show snmp mib on page 6392
- show snmp statistics on page 1379

Tracing SNMP Activity on a Device Running Junos OS

SNMP tracing operations track activity for SNMP agents and record the information in log files. The logged error descriptions provide detailed information to help you solve problems faster.

By default, Junos OS does not trace any SNMP activity. If you include the **traceoptions** statement at the **[edit snmp]** hierarchy level, the default tracing behavior is:

- Important activities are logged in files located in the **/var/log** directory. Each log is named after the SNMP agent that generates it. Currently, the following log files are created in the **/var/log** directory when the **traceoptions** statement is used:
  - chassisd
  - craftd
  - ilmid
  - mib2d
  - rmopd
  - serviced
  - snmpd
- When a trace file named ***filename*** reaches its maximum size, it is renamed ***filename*.0**, then ***filename*.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten. (For more information about how log files are created, see the *Junos OS System Log Messages Reference*.)
- Log files can be accessed only by the user who configured the tracing operation.

You cannot change the directory (**/var/log**) in which trace files are located. However, you can customize the other trace file settings by including the following statements at the **[edit snmp]** hierarchy level:

```
[edit snmp]
traceoptions {
  file <files number> <match regular-expression> <size size> <world-readable |
    no-world-readable>;
  flag flag;
  no-remote-trace;
}
```

These statements are described in the following sections:

Configuring the Number and Size of SNMP Log Files

By default, when the trace file reaches 128 kilobytes (KB) in size, it is renamed ***filename*.0**, then ***filename*.1**, and so on, until there are three trace files. Then the oldest trace file (***filename*.2**) is overwritten.

You can configure the limits on the number and size of trace files by including the following statements at the **[edit snmp traceoptions]** hierarchy level:

```
[edit snmp traceoptions]
file files number size size;
```

For example, set the maximum file size to 2 MB, and the maximum number of files to 20. When the file that receives the output of the tracing operation (***filename***) reaches 2 MB, ***filename*** is renamed ***filename*.0**, and a new file called ***filename*** is created. When the new ***filename*** reaches 2 MB, ***filename*.0** is renamed ***filename*.1** and ***filename*** is renamed ***filename*.0**. This process repeats until there are 20 trace files. Then the oldest file (***filename*.19**) is overwritten by the newest file (***filename*.0**).

The number of files can be from 2 through 1000 files. The file size of each file can be from 10 KB through 1 gigabyte (GB).

Configuring Access to the Log File

By default, log files can be accessed only by the user who configured the tracing operation.

To specify that any user can read all log files, include the **file world-readable** statement at the **[edit snmp traceoptions]** hierarchy level:

```
[edit snmp traceoptions]
file world-readable;
```

To explicitly set the default behavior, include the **file no-world-readable** statement at the **[edit snmp traceoptions]** hierarchy level:

```
[edit snmp traceoptions]
file no-world-readable;
```

Configuring a Regular Expression for Lines to Be Logged

By default, the trace operation output includes all lines relevant to the logged activities.

You can refine the output by including the **match** statement at the **[edit snmp traceoptions file *filename*]** hierarchy level and specifying a regular expression (regex) to be matched:

```
[edit snmp traceoptions]
file filename match regular-expression;
```

Configuring the Trace Operations

By default, only important activities are logged. You can specify which trace operations are to be logged by including the following **flag** statement (with one or more tracing flags) at the **[edit snmp traceoptions]** hierarchy level:

```
[edit snmp traceoptions]
flag {
  all;
```

```
    configuration;
    database;
    events;
    general;
    interface-stats;
    nonvolatile-sets;
    pdu;
    policy;
    protocol-timeouts;
    routing-socket;
    server;
    subagent;
    timer;
    varbind-error;
  }
```

Table 590 on page 6329 describes the meaning of the SNMP tracing flags.

Table 617: SNMP Tracing Flags

Flag	Description	Default Setting
all	Log all operations.	Off
configuration	Log reading of the configuration at the **[edit snmp]** hierarchy level.	Off
database	Log events involving storage and retrieval in the events database.	Off
events	Log important events.	Off
general	Log general events.	Off
interface-stats	Log physical and logical interface statistics.	Off
nonvolatile-set	Log nonvolatile SNMP set request handling.	Off
pdu	Log SNMP request and response packets.	Off
policy	Log policy processing.	Off
protocol-timeouts	Log SNMP response timeouts.	Off
routing-socket	Log routing socket calls.	Off
server	Log communication with processes that are generating events.	Off
subagent	Log subagent restarts.	Off
timer	Log internal timer events.	Off

Table 617: SNMP Tracing Flags *(continued)*

Flag	Description	Default Setting
varbind-error	Log variable binding errors.	Off

To display the end of the log for an agent, issue the **show log *agent*d | last** operational mode command:

[edit]
user@host# **run show log *agent*d | last**

where ***agent*** is the name of an SNMP agent.

Related Documentation

- *Configuring SNMP on a Device Running Junos OS*
- *Configuration Statements at the [edit snmp] Hierarchy Level*
- *Example: Tracing SNMP Activity*
- Configuring SNMP on page 1237

Monitoring RMON MIB Tables

Purpose Monitor remote monitoring (RMON) alarm, event, and log tables.

Action To display the RMON tables:

```
user@switch> show snmp rmon
Alarm
Index  Variable description                            Value State

     5 monitor
       jnxOperatingCPU.9.1.0.0                             5 falling threshold

Event
Index  Type                        Last Event
    1  log and trap                2010-07-10 11:34:17 PDT
Event Index: 1
    Description: Event 1 triggered by Alarm 5, rising threshold (90) crossed,
(variable: jnxOperatingCPU.9.1.0.0, value: 100)
    Time: 2010-07-10 11:34:07 PDT
    Description: Event 1 triggered by Alarm 5, falling threshold (75) crossed,
(variable: jnxOperatingCPU.9.1.0.0, value: 5)
    Time: 2010-07-10 11:34:17 PDT
```

Meaning The display shows that an alarm has been defined to monitor jnxRmon MIB object jnxOperatingCPU, which represents the CPU utilization of the Routing Engine. The alarm is configured to generate an event that sends an SNMP trap and adds an entry to the logTable in the RMON MIB. The log table shows that two occurrences of the event have been generated—one for rising above a threshold of 90 percent, and one for falling below a threshold of 75 percent.

Related Documentation

- Configuring RMON Alarms and Events on page 6117
- **show snmp rmon on page 6395**

- show snmp rmon history on page 6399
- clear snmp statistics on page 6375
- clear snmp history on page 6374

Displaying a Log File from a Single-Chassis System

To display a log file stored on a single-chassis system such as the QFX3500 switch, enter Junos OS CLI operational mode and issue the following commands:

user@switch> **show log** *log-filename*
user@switch> **file show** *log-file-pathname*

By default, the commands display the file stored on the local Routing Engine.

The following example shows the output from the **show log messages** command:

```
user@switch1> show log messages
Nov  4 11:30:01 switch1 newsyslog[2283]: logfile turned over due to size>128K
Nov  4 11:30:01 switch1 newsyslog[2283]: logfile turned over due to size>128K
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 1
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 2
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 3
...
Nov  4 11:52:53  switch1 snmpd[944]: SNMPD_HEALTH_MON_INSTANCE: Health Monitor:
jroute daemon memory usage (Management
process): new instance detected (variable: sysApplElmtRunMemory.5.6.2293)
Nov  4 11:52:53  switch1 snmpd[944]: SNMPD_HEALTH_MON_INSTANCE: Health Monitor:
jroute daemon memory usage (Command-line
interface): new instance detected (variable: sysApplElmtRunMemory.5.8.2292)
...
Nov  4 12:08:30  switch1 rpdf[957]: task_connect: task BGP_100.10.10.1.6+179 addr
 10.10.1.6+179: Can't assign requested
address
Nov  4 12:08:30  switch1 rpdf[957]: bgp_connect_start: connect 10.10.1.6 (Internal
 AS 100): Can't assign requested address
Nov  4 12:10:24  switch1 mgd[2293]: UI_CMDLINE_READ_LINE: User 'jsmith', command
 'exit '
Nov  4 12:10:27  switch1 mgd[2293]: UI_DBASE_LOGOUT_EVENT: User 'jsmith' exiting
 configuration mode
Nov  4 12:10:31  switch1 mgd[2293]: UI_CMDLINE_READ_LINE: User 'jsmith', command
 'show log messages
```

The following example shows the output from the **file show** command. The file in the pathname **/var/log/processes** has been previously configured to include messages from the daemon facility.

```
user@switch1> file show /var/log/processes
Feb 22 08:58:24 switch1 snmpd[359]: SNMPD_TRAP_WARM_START: trap_generate_warm:
SNMP trap: warm start
Feb 22 20:35:07 switch1 snmpd[359]: SNMPD_THROTTLE_QUEUE_DRAINED:
trap_throttle_timer_handler: cleared all throttled traps
Feb 23 07:34:56 switch1 snmpd[359]: SNMPD_TRAP_WARM_START: trap_generate_warm:
SNMP trap: warm start
Feb 23 07:38:19 switch1 snmpd[359]: SNMPD_TRAP_COLD_START: trap_generate_cold:
```

```
SNMP trap: cold start
...
```

Related Documentation

- Interpreting Messages Generated in Standard Format on page 6138
- Interpreting Messages Generated in Structured-Data Format on page 6135

Monitoring System Log Messages

Purpose Display system log messages about the QFX Series. By looking through a system log file for any entries pertaining to the interface that you are interested in, you can further investigate a problem with an interface on the switch.

Action To view system log messages:

user@switch1> **show log messages**

Sample Output

```
Nov  4 11:30:01 switch1 newsyslog[2283]: logfile turned over due to size>128K
Nov  4 11:30:01 switch1 newsyslog[2283]: logfile turned over due to size>128K
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 1
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 2
Nov  4 11:30:06  switch1 chassism[952]: CM ENV Monitor: set fan speed is 65 percent
 for Fan 3
...
Nov  4 11:52:53  switch1 snmpd[944]: SNMPD_HEALTH_MON_INSTANCE: Health Monitor:
jroute daemon
memory usage (Management process): new instance detected (variable:
sysApplElmtRunMemory.5.6.2293)
Nov  4 11:52:53  switch1 snmpd[944]: SNMPD_HEALTH_MON_INSTANCE: Health Monitor:
jroute daemon
memory usage (Command-line interface): new instance detected (variable:
sysApplElmtRunMemory.5.8.2292)
...
Nov  4 12:10:24  switch1 mgd[2293]: UI_CMDLINE_READ_LINE: User 'jsmith', command
 'exit '
Nov  4 12:10:27  switch1 mgd[2293]: UI_DBASE_LOGOUT_EVENT: User 'jsmith' exiting
 configuration mode
Nov  4 12:10:31  switch1 mgd[2293]: UI_CMDLINE_READ_LINE: User 'jsmith', command
 'show log messages
```

Meaning The sample output shows the following entries in the **messages** file:

- A new log file was created when the previous file reached the maximum size of 128 kilobytes (KB).
- The fan speed for Fan 1, 2, and 3 is set at 65 percent.
- Health monitoring activity is detected.
- CLI commands were entered by the user jsmith.

Related Documentation

- Overview of Junos OS System Log Messages on page 6068
- Understanding the Implementation of System Log Messages on the QFabric System on page 6070
- Example: Configuring System Log Messages on page 6076
- clear log on page 324
- show log on page 846
- syslog on page 287

Monitoring Traffic Through the Router or Switch

To help with the diagnosis of a problem, display real-time statistics about the traffic passing through physical interfaces on the router or switch.

To display real-time statistics about physical interfaces, perform these tasks:

1. Displaying Real-Time Statistics About All Interfaces on the Router or Switch on page 6445
2. Displaying Real-Time Statistics About an Interface on the Router or Switch on page 6446

Displaying Real-Time Statistics About All Interfaces on the Router or Switch

Purpose Display real-time statistics about traffic passing through all interfaces on the router or switch.

Action To display real-time statistics about traffic passing through all interfaces on the router or switch:

```
user@host> monitor interface traffic
```

Sample Output

```
user@host> monitor interface traffic
host name                    Seconds: 15               Time: 12:31:09
Interface     Link  Input packets       (pps)     Output packets       (pps)
 so-1/0/0     Down              0         (0)                  0         (0)
 so-1/1/0     Down              0         (0)                  0         (0)
 so-1/1/1     Down              0         (0)                  0         (0)
 so-1/1/2     Down              0         (0)                  0         (0)
 so-1/1/3     Down              0         (0)                  0         (0)
 t3-1/2/0     Down              0         (0)                  0         (0)
 t3-1/2/1     Down              0         (0)                  0         (0)
 t3-1/2/2     Down              0         (0)                  0         (0)
 t3-1/2/3     Down              0         (0)                  0         (0)
 so-2/0/0       Up         211035         (1)              36778         (0)
 so-2/0/1       Up         192753         (1)              36782         (0)
 so-2/0/2       Up         211020         (1)              36779         (0)
 so-2/0/3       Up         211029         (1)              36776         (0)
 so-2/1/0       Up         189378         (1)              36349         (0)
 so-2/1/1     Down              0         (0)              18747         (0)
 so-2/1/2     Down              0         (0)              16078         (0)
 so-2/1/3       Up              0         (0)              80338         (0)
 at-2/3/0       Up              0         (0)                  0         (0)
```

```
 at-2/3/1     Down              0          (0)                  0          (0)
Bytes=b, Clear=c, Delta=d, Packets=p, Quit=q or ESC, Rate=r, Up=^U, Down=^D
```

Meaning The sample output displays traffic data for active interfaces and the amount that each field has changed since the command started or since the counters were cleared by using the **C** key. In this example, the **monitor interface** command has been running for 15 seconds since the command was issued or since the counters last returned to zero.

Displaying Real-Time Statistics About an Interface on the Router or Switch

Purpose Display real-time statistics about traffic passing through an interface on the router or switch.

Action To display traffic passing through an interface on the router or switch, use the following Junos OS CLI operational mode command:

user@host> **monitor interface** *interface-name*

Sample Output

```
user@host> monitor interface so-0/0/1
Next='n', Quit='q' or ESC, Freeze='f', Thaw='t', Clear='c', Interface='i'
R1
Interface: so-0/0/1, Enabled, Link is Up
Encapsulation: PPP, Keepalives, Speed: OC3 Traffic statistics:
  Input bytes:                  5856541 (88 bps)
  Output bytes:                 6271468 (96 bps)
  Input packets:                 157629 (0 pps)
  Output packets:                157024 (0 pps)
Encapsulation statistics:
  Input keepalives:               42353
  Output keepalives:              42320
  LCP state: Opened
Error statistics:
  Input errors:                       0
  Input drops:                        0
  Input framing errors:               0
  Input runts:                        0
  Input giants:                       0
  Policed discards:                   0
  L3 incompletes:                     0
  L2 channel errors:                  0
  L2 mismatch timeouts:               0
  Carrier transitions:                1
  Output errors:                      0
  Output drops:                       0
  Aged packets:                       0
Active alarms : None
Active defects: None
SONET error counts/seconds:
  LOS count                           1
  LOF count                           1
  SEF count                           1
  ES-S                               77
  SES-S                              77
SONET statistics:
  BIP-B1                              0
  BIP-B2                              0
```

```
  REI-L                              0
  BIP-B3                             0
  REI-P                              0
Received SONET overhead:   F1         : 0x00   J0         : 0xZ
```

Meaning The sample output shows the input and output packets for a particular SONET interface (**so-0/0/1**). The information can include common interface failures, such as SONET/SDH and T3 alarms, loopbacks detected, and increases in framing errors. For more information, see *Checklist for Tracking Error Conditions*.

To control the output of the command while it is running, use the keys shown in Table 589 on page 6322.

Table 618: Output Control Keys for the monitor interface Command

Action	Key
Display information about the next interface. The **monitor interface** command scrolls through the physical or logical interfaces in the same order that they are displayed by the **show interfaces terse** command.	N
Display information about a different interface. The command prompts you for the name of a specific interface.	I
Freeze the display, halting the display of updated statistics.	F
Thaw the display, resuming the display of updated statistics.	T
Clear (zero) the current delta counters since **monitor interface** was started. It does not clear the accumulative counter.	C
Stop the **monitor interface** command.	Q

See the CLI Explorer for details on using match conditions with the **monitor traffic** command.

Pinging Hosts

Purpose Use the CLI **ping** command to verify that a host can be reached over the network. This command is useful for diagnosing host and network connectivity problems. The switch sends a series of Internet Control Message Protocol (ICMP) echo (ping) requests to a specified host and receives ICMP echo responses.

Action To use the **ping** command to send four requests (ping count) to host3:

ping ***host*** **count** ***number***

Sample Output

ping host3 count 4

```
user@switch> ping host3 count 4
PING host3.site.net (176.26.232.111): 56 data bytes
64 bytes from 176.26.232.111: icmp_seq=0 ttl=122 time=0.661 ms
64 bytes from 176.26.232.111: icmp_seq=1 ttl=122 time=0.619 ms
```



```
64 bytes from 176.26.232.111: icmp_seq=2 ttl=122 time=0.621 ms
64 bytes from 176.26.232.111: icmp_seq=3 ttl=122 time=0.634 ms

--- host3.site.net ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.619/0.634/0.661/0.017 ms
```

Meaning

- The **ping** results show the following information:
  - Size of the ping response packet (in bytes).
  - IP address of the host from which the response was sent.
  - Sequence number of the ping response packet. You can use this value to match the ping response to the corresponding ping request.
  - Time-to-live (ttl) hop-count value of the ping response packet.
  - Total time between the sending of the ping request packet and the receiving of the ping response packet, in milliseconds. This value is also called round-trip time.
  - Number of ping requests (probes) sent to the host.
  - Number of ping responses received from the host.
  - Packet loss percentage.
  - Round-trip time statistics: minimum, average, maximum, and standard deviation of the round-trip time.

Related Documentation

- Troubleshooting Overview on page 6413
- Understanding Troubleshooting Resources on page 6411

CHAPTER 72

Troubleshooting

Configuration and File Management

Loading a Previous Configuration File

You can use the **rollback** <*number* command to return to a previously committed configuration file. A switch saves the last 50 committed configurations, including the rollback number, date, time, and name of the user who issued the **commit** configuration command.

Syntax

rollback <*number*>

Options

- **none**— Return to the most recently saved configuration.
- *number*—Configuration to return to.

- **Range**: 0 through 49. The most recently saved configuration is number 0, and the oldest saved configuration is number 49.
- **Default**: 0

To return to a configuration prior to the most recently committed one:

1. Specify the rollback number (here, 1 is entered and the configuration returns to the previously committed configuration):

   ```
   [edit]
   user@switch# rollback 1
   load complete
   ```

2. Activate the configuration you have loaded:

   ```
   [edit]
   user@switch# commit
   ```

Related Documentation

- Configuration File Terms on page 26

Reverting to the Default Factory Configuration

If for any reason the current active configuration fails, you can revert to the default factory configuration. The default factory configuration contains the basic configuration settings. This is the first configuration of the switch, and it is loaded when the switch is first installed and powered on.

The **load factory default** command is a standard Junos OS configuration command. This configuration command replaces the current active configuration with the default factory configuration.

To revert the switch to the rescue configuration:

1. ```
   [edit]
   user@switch# load factory-default
   [edit]
   user@switch# delete system commit factory-settings
   [edit]
   user@switch# commit
   ```

Related Documentation

- Understanding Configuration Files on page 1126
- Loading a Previous Configuration File on page 1136
- Reverting to the Rescue Configuration on page 165


   ```

## Reverting to the Rescue Configuration

If someone inadvertently commits a configuration that denies management access to a QFX Series product and the console port is not accessible, you can overwrite the invalid configuration and replace it with the rescue configuration. The rescue configuration is a previously committed, valid configuration.

To revert the switch to the rescue configuration:

1. Enter the **load override** command.

   [edit]
   user@switch# **load override** *filename*

2. Commit your changes.

   [edit]
   user@switch# **commit** *filename*

**Related Documentation**


- Setting or Deleting the Rescue Configuration on page 1145
- Reverting to the Default Factory Configuration on page 163
- Configuration File Terms on page 26


## Cleaning Up the System File Storage Space

**Problem** The system file storage space on the switch is full. Rebooting the switch does not solve the problem.

The following error message is displayed during a typical operation on the switch after the file storage space is full.

user@switch% **cli**
user@switch> **configure**
**/var: write failed, filesystem is full**

**Solution** Clean up the file storage on the switch by deleting system files.

1. Request to delete system files on the switch.

   user@switch> **request system storage cleanup**

   The list of files to be deleted is displayed.

```
List of files to delete:

         Size Date   Name
   11B Jul 26 20:55 /var/jail/tmp/alarmd.ts
  124B Aug 4 18:05 /var/log/default-log-messages.0.gz
 1301B Jul 26 20:42 /var/log/install.0.gz
  387B Jun 3 14:37 /var/log/install.1.gz
 4920B Aug 4 18:05 /var/log/messages.0.gz
 20.0K Jul 26 21:00 /var/log/messages.1.gz
 16.3K Jun 25 13:45 /var/log/messages.2.gz
  804B Aug 4 18:05 /var/log/security.0.gz
 16.8K Aug 3 11:15 /var/log/security.1.gz
```

```
      487B Aug  4 18:04 /var/log/wtmp.0.gz
      855B Jul 29 22:54 /var/log/wtmp.1.gz
      920B Jun 30 16:32 /var/log/wtmp.2.gz
       94B Jun  3 14:36 /var/log/wtmp.3.gz
   353.2K Jun  3 14:37 /var/sw/pkg/jloader-qfx-11.2I20110303_1117_dc-builder.tgz

   124.0K Jun  3 14:30 /var/tmp/gres-tp/env.dat
       0B Apr 14 16:20 /var/tmp/gres-tp/lock
       0B Apr 14 17:37 /var/tmp/if-rtsdb/env.lck
    12.0K Jul 26 20:55 /var/tmp/if-rtsdb/env.mem
  2688.0K Jul 26 20:55 /var/tmp/if-rtsdb/shm_usr1.mem
   132.0K Jul 26 20:55 /var/tmp/if-rtsdb/shm_usr2.mem
  2048.0K Jul 26 20:55 /var/tmp/if-rtsdb/trace.mem
     155B Jul 26 20:55 /var/tmp/krt_gencfg_filter.txt
       0B Jul 26 20:55 /var/tmp/rtsdb/if-rtsdb
  1400.6K Aug  3 10:13 /var/tmp/sfid.core.0.gz
  1398.9K Aug  3 17:01 /var/tmp/sfid.core.1.gz
  Delete these files ? [yes,no] (no)
```

2. Enter **yes** to delete the files.

3. Reboot the switch.

BEST PRACTICE: We recommend that you regularly request a system file storage cleanup to optimize the performance of the switch.

Related Documentation

- request system storage cleanup on page 435

Ethernet Switching

Troubleshooting Ethernet Switching

Problem Sometimes a MAC address entry in the switch's Ethernet switching table is not updated after the device with that MAC address has been moved from one interface to another on the switch. Typically, the switch does not wait for a MAC address expiration when a MAC move operation occurs. As soon as the switch detects the MAC address on the new interface, it immediately updates the table. Many network devices send a gratuitous ARP packet when switching an IP address from one device to another. The switch updates its ARP cache table after receipt of such gratuitous ARP messages, and then it also updates its Ethernet switching table.

Sometimes silent devices, such as syslog servers or SNMP trap receivers that receive UDP traffic but do not return acknowledgment (ACK) messages to the traffic source, fail to send gratuitous ARP packets when a device moves. If such a move occurs when the system administrator is not available to explicitly clear the affected interfaces by issuing the **clear ethernet-switching table** command, the entry for the moved device in the Ethernet switching table is not updated.

Solution Set up the switch to handle unattended MAC address switchovers.

1. Reduce the system-wide ARP aging timer. (By default, the ARP aging timer is set at 20 minutes. The range of the ARP aging timer is from 1 through 240 minutes.)

```
[edit system arp]
user@switch# set aging-timer 3
```

2. Set the MAC aging timer to the same value as the ARP timer. (By default, the MAC aging timer is set to 300 seconds. The range is 15 to 1,000,000 seconds.)

```
[edit vlans]
user@switch# set vlans sales mac-table-aging-time 180
```

The ARP entry and the MAC address entry for the moved device expire within the times specified by the aging timer values. After the entries expire, the switch sends a new ARP message to the IP address of the device. The device responds to the ARP message, thereby refreshing the entries in the switch's ARP cache table and Ethernet switching table.

Related Documentation

- *arp*
- mac-table-aging-time on page 1621

Troubleshooting Layer 2 Protocol Tunneling

Drop Threshold Statistics Might Be Incorrect

Problem L2PT processing is done by the CPU, and L2PT traffic to the CPU is rate limited to a maximum of 1000 pps. If traffic is received at a rate faster than this limit, the rate limit causes the traffic to be dropped before it hits the threshold and the dropped packets will not be reported in L2PT statistics. This can also occur if you configure a drop threshold that is less than 1000 pps but traffic is received at a faster rate. For example, if you configure a drop threshold of 900 pps and the VLAN receives traffic at rate of 1100 pps, L2PT statistics will show that 100 packets were dropped. The 100 packets dropped because of the rate limit are not reported. Similarly, if you do not configure a drop threshold and the VLAN receives traffic at rate of 1100 pps, the 100 packets dropped because of the rate limit are not reported.

Solution This is expected behavior.

Egress Filtering of L2PT Traffic Not Supported

Problem Egress filtering of L2PT traffic is not supported on the QFX3500 switch. That is, if you configure L2PT to tunnel a protocol on an interface, you cannot also use a firewall filter to filter traffic for that protocol on that interface in the output direction. If you commit a configuration for this purpose, the firewall filter is not applied to the L2PT-tunneled traffic.

Solution This is expected behavior.

Related Documentation

- *Understanding Layer 2 Protocol Tunneling*
- *Configuring Layer 2 Protocol Tunneling*

Troubleshooting Private VLANs

Use the following information to troubleshoot a private VLAN configuration.

Limitations of Private VLANs

The following constraints apply to private VLAN configurations:

- IGMP snooping is not supported with private VLANs.
- Routed VLAN interfaces are not supported on private VLANs
- Routing between secondary VLANs in the same primary VLAN is not supported.

Forwarding with Private VLANs

Problem

- When isolated VLAN or community VLAN tagged traffic is received on a PVLAN trunk port, MAC addresses are learned from the primary VLAN. This means that output from the **show ethernet-switching table** command shows that MAC addresses are learned from the primary VLAN and replicated to secondary VLANs. This behavior has no effect on forwarding decisions.
- If a packet with a secondary VLAN tag is received on a promiscuous port, it is accepted and forwarded.
- If a packet is received on a PVLAN trunk port and meets both of the conditions listed below, it is dropped.
  - The packet has a community VLAN tag.
  - The packet is destined to a unicast MAC address or multicast group MAC address that was learned on an isolated VLAN.
- If a packet is received on a PVLAN trunk port and meets both of the conditions listed below, it is dropped.
  - The packet has an isolated VLAN tag.

- The packet is destined to a unicast MAC address or multicast group MAC address that was learned on a community VLAN.

- If a packet with a primary VLAN tag is received by a secondary (isolated or community) VLAN port, the secondary port forwards the packet.
- If you configure a community VLAN on one device and configure another community VLAN on a second device and both community VLANs use the same VLAN ID, traffic for one of the VLANs can be forwarded to the other VLAN. For example, assume the following configuration:
  - Community VLAN comm1 on switch 1 has VLAN ID 50 and is a member of primary VLAN pvlan100.
  - Community VLAN comm2 on switch 2 also has VLAN ID 50 and is a member of primary VLAN pvlan200.
  - Primary VLAN pvlan100 exists on both switches.

  If traffic for comm1 is sent from switch 1 to switch 2, it will be sent to the ports participating in comm2. (The traffic will also be forwarded to the ports in comm1, as you would expect.)

Solution These are expected behaviors.

Egress Firewall Filters with Private VLANs

Problem If you apply a firewall filter in the output direction to a primary VLAN, the filter also applies to the secondary VLANs that are members of the primary VLAN when the traffic egresses with the primary VLAN tag or isolated VLAN tag, as listed below:

- Traffic forwarded from a secondary VLAN trunk port to a promiscuous port (trunk or access)
- Traffic forwarded from a secondary VLAN trunk port that carries an isolated VLAN to a PVLAN trunk port.
- Traffic forwarded from a promiscuous port (trunk or access) to a secondary VLAN trunk port
- Traffic forwarded from a PVLAN trunk port. to a secondary VLAN trunk port
- Traffic forwarded from a community port to a promiscuous port (trunk or access)

If you apply a firewall filter in the output direction to a primary VLAN, the filter does *not* apply to traffic that egresses with a community VLAN tag, as listed below:

- Traffic forwarded from a community trunk port to a PVLAN trunk port
- Traffic forwarded from a secondary VLAN trunk port that carries a community VLAN to a PVLAN trunk port
- Traffic forwarded from a promiscuous port (trunk or access) to a community trunk port
- Traffic forwarded from a PVLAN trunk port. to a community trunk port

If you apply a firewall filter in the output direction to a community VLAN, the following behaviors apply:

- The filter is applied to traffic forwarded from a promiscuous port (trunk or access) to a community trunk port (because the traffic egresses with the community VLAN tag).
- The filter is applied to traffic forwarded from a community port to a PVLAN trunk port (because the traffic egresses with the community VLAN tag).
- The filter is *not* applied to traffic forwarded from a community port to a promiscuous port (because the traffic egresses with the primary VLAN tag or untagged).

Solution These are expected behaviors. They occur only if you apply a firewall filter to a private VLAN in the output direction and do not occur if you apply a firewall filter to a private VLAN in the input direction.

Egress Port Mirroring with Private VLANs

Problem If you create a port-mirroring configuration that mirrors private VLAN (PVLAN) traffic on egress, the mirrored traffic (the traffic that is sent to the analyzer system) has the VLAN tag of the ingress VLAN instead of the egress VLAN. For example, assume the following PVLAN configuration:

- Promiscuous trunk port that carries primary VLANs pvlan100 and pvlan400.
- Isolated access port that carries secondary VLAN isolated200. This VLAN is a member of primary VLAN pvlan100.
- Community port that carries secondary VLAN comm300. This VLAN is also a member of primary VLAN pvlan100.
- Output interface (monitor interface) that connects to the analyzer system. This interface forwards the mirrored traffic to the analyzer.

If a packet for pvlan100 enters on the promiscuous trunk port and exits on the isolated access port, the original packet is untagged on egress because it is exiting on an access port. However, the mirror copy retains the tag for pvlan100 when it is sent to the analyzer.

Here is another example: If a packet for comm300 ingresses on the community port and egresses on the promiscuous trunk port, the original packet carries the tag for pvlan100 on egress, as expected. However, the mirrored copy retains the tag for comm300 when it is sent to the analyzer.

Solution This is expected behavior.

Related Documentation

- *Understanding Private VLANs*
- *Understanding Secondary VLAN Trunk Ports and Promiscuous Access Ports on PVLANs*
- *Creating a Private VLAN on a Single Switch*
- *Creating a Private VLAN Spanning Multiple Switches*

- *Example: Configuring PVLANs with Secondary VLAN Trunk Ports and Promiscuous Access Ports*

Troubleshooting Q-in-Q and VLAN Translation Configuration

Firewall Filter Match Condition Not Working with Q-in-Q Tunneling

Problem If you create a firewall filter that includes a match condition of **dot1q-tag** or **dot1q-user-priority** and apply the filter on input to a trunk port that participates in a service VLAN, the match condition does not work if the Q-in-Q EtherType is not 0x8100. (When Q-in-Q tunneling is enabled, trunk interfaces are assumed to be part of the service provider or data center network and therefore participate in service VLANs.)

Solution This is expected behavior. To set the Q-in-Q EtherType to 0x8100, enter the **set dot1q-tunneling ethertype 0x8100** statemen at the **[edit ethernet-switching-options]** hierarchy level. You must also configure the other end of the link to use the same Ethertype.

Egress Port Mirroring with VLAN Translation

Problem If you create a port-mirroring configuration that mirrors customer VLAN (CVLAN) traffic on egress and the traffic undergoes VLAN translation before being mirrored, the VLAN translation does not apply to the mirrored packets. That is, the mirrored packets retain the service VLAN (SVLAN) tag that should be replaced by the CVLAN tag on egress. The original packets are unaffected—on these packets VLAN translation works properly, and the SVLAN tag is replaced with the CVLAN tag on egress.

Solution This is expected behavior.

Related Documentation

- *Understanding Q-in-Q Tunneling and VLAN Translation*
- *Example: Setting Up Q-in-Q Tunneling*

High Availability

Troubleshooting VRRP

Problem If you configure multiple VRRP groups on an interface (using multiple VLANs), traffic for some of the groups might be briefly dropped if a failover occurs. This can happen because the new master must send gratuitous ARP replies for each VRRP group to update the ARP tables in the connected devices, and there is a short delay between each gratuitous ARP reply. Traffic sent by devices that have not yet received the gratuitous ARP reply is dropped (until the device receives the reply and learns the MAC address of the new master).

Solution Configure a failover delay so that the new master delays sending gratuitous ARP replies for the period that you set. This allows the new master to send the ARP replies for all of the VRRP groups simultaneously.

Related Documentation

- failover-delay on page 1783

Interfaces

Troubleshooting an Aggregated Ethernet Interface

Problem The **show interfaces terse** command shows that the LAG is down.

Solution Check the following:

- Verify that there is no configuration mismatch.
- Verify that all member ports are up.
- Verify that a LAG is part of family ethernet-switching (Layer 2 LAG) or family inet (Layer 3 LAG).
- Verify that the LAG member is connected to the correct LAG at the other end.
- Verify that the LAG members belong to the same switch.

Related Documentation

- Verifying the Status of a LAG Interface on page 2148
- Example: Configuring Link Aggregation Between a QFX Series Product and an Aggregation Switch on page 1896

Troubleshooting Network Interfaces

The interface on the port in which an SFP or SFP+ transceiver is installed in an SFP or SFP+ module is down

Problem The QFX Series has an SFP or SFP+ module installed. The interface on the port in which an SFP or SFP+ transceiver is installed is down.

When you check the status with the CLI command **show interfaces *interface-name*** , the disabled port is not listed.

Cause By default, the SFP or SFP+ module operates in the 10-Gigabit Ethernet mode and supports only SFP or SFP+ transceivers. The operating mode for the module is incorrectly set.

Solution Only SFP or SFP+ transceivers can be installed in SFP or SFP+ modules. You must configure the operating mode of the SFP or SFP+ module to match the type of transceiver you want to use. For SFP+ transceivers, configure 10-Gigabit Ethernet operating mode.

Troubleshooting Multichassis Link Aggregation

Use the following information to troubleshoot multichassis link aggregation configuration.

MAC Addresses Learned on MC-AE Interfaces Are Not Removed from the MAC Address Table

Problem When both of the mulitchassis aggregated Ethernet (MC-AE) interfaces on both connected multichassis link aggregation group (MC-LAG) peers are down, the MAC addresses learned on the MC-AE interfaces are not removed from the MAC address table.

For example, if you disable the MC-AE interface (ae0) on both MC-LAG peers by issuing the **set interfaces ae0 disable** command and commit the configuration, the MAC table still shows the MAC addresses as being learned on the MC-AE interfaces of both MC-LAG peers:

```
user@switchA> show ethernet-switching table
Ethernet-switching table: 6 entries, 2 learned, 0 persistent entries
  VLAN              MAC address       Type         Age Interfaces
  v10                *                 Flood          - All-members
  v10                00:10:94:00:00:01 Learn(L)     3:55 ae0.0 (MCAE)
  v10                00:10:94:00:00:02 Learn(R)        0 xe-0/0/9.0
  v20                *                 Flood          - All-members
  v30                *                 Flood          - All-members
  v30                84:18:88:de:b1:2e Static         - Router
```

```
user@switchB> show ethernet-switching table
Ethernet-switching table: 6 entries, 2 learned, 0 persistent entries
  VLAN              MAC address       Type         Age Interfaces
  v10                *                 Flood          - All-members
  v10                00:10:94:00:00:01 Learn(R)        0 ae0.0 (MCAE)
  v10                00:10:94:00:00:02 Learn         40 xe-0/0/10.0
  v20                *                 Flood          - All-members
  v30                *                 Flood          - All-members
  v30                84:18:88:df:83:0a Static         - Router
```

Solution This is expected behavior.

MC-LAG Peer Does Not Go into Standby Mode

Problem A multichassis link aggregation group (MC-LAG) peer does not go into standby mode if the MC-LAG peer IP address specified in the Interchassis Control Protocol (ICCP) configuration and the IP address specified in the multichassis protection configuration are different.

Solution To prevent failure to enter standby mode, make sure the peer IP address in the ICCP configurations and the IP address in multichassis protection configurations are the same.

Secondary MC-LAG Peer with Status Control Set to Standby Becomes Inactive

Problem When the interchassis control link-protection link (ICL-PL) and multichassis aggregated Ethernet (MC-AE) interfaces go down on the primary multichassis link aggregation group (MC-LAG) peer, the secondary MC-LAG peer's MC-AE interfaces with status control set to standby become inactive instead of active.

Solution This is expected behavior.

Redirect Filters Take Priority over User-Defined Filters

Problem Multichassis link aggregation group (MC-LAG) implicit failover redirection filters take precedence over user-configured explicit filters. This is expected behavior.

Solution This is expected behavior.

Operational Command Output Is Wrong

Problem After you deactivate the Interchassis Control Protocol (ICCP), the **show iccp** operational command output still shows registered client daemons, such as mcsnoopd, lacpd, and eswd.

For example:

```
user@switch> show iccp
Client Application: MCSNOOPD
  Redundancy Group IDs Joined: None

Client Application: lacpd
  Redundancy Group IDs Joined: 1

Client Application: eswd
  Redundancy Group IDs Joined: 1
```

The **show iccp** command output always shows registered modules regardless of whether or not ICCP peers are configured.

Solution This is expected behavior.

ICCP Connection Might Take Up to 60 Seconds to Become Active

Problem When the Interchassis Control Protocol (ICCP) configuration and the routed VLAN interface (RVI) configuration are committed together, the ICCP connection might take up to 60 seconds to become active.

Solution This is expected behavior.

MAC Address Age Learned on an MC-AE Interface Is Reset to Zero

Problem When you activate and then deactivate an interchassis control link-protection link (ICL-PL), the MAC address age learned on the multichassis aggregated Ethernet (MC-AE) interface is reset to zero. The next-hop interface changes trigger MAC address updates in the hardware, which then triggers aging updates in the Packet Forwarding Engine (PFE). The result is that the MAC address age is updated to zero.

For example, the ICL-PL has been deactivated, and the **show ethernet-switching table** command output shows that the MAC addresses have an age of 0.

```
user@switch> show ethernet-switching table
Ethernet-switching table: 3 entries, 2 learned, 0 persistent entries
  VLAN              MAC address       Type         Age Interfaces
  v100              *                 Flood          - All-members
  v100              00:10:00:00:00:01 Learn(L)     0 ae0.0 (MCAE)
  v100              00:10:00:00:00:02 Learn(L)     0 ae0.0 (MCAE)
```

Solution This is expected behavior.

MAC Address Is Not Learned Remotely in a Default VLAN

Problem If a multichassis link aggregation group (MC-LAG) peer learns a MAC address in the default VLAN, the Interchassis Control Protocol (ICCP) does not synchronize the MAC address with the MAC address of the other MC-LAG peer.

Solution This is expected behavior.

Snooping Entries Learned on MC-AE Interfaces Are Not Removed

Problem When multichassis aggregated Ethernet (MC-AE) interfaces are configured on a VLAN that is enabled for multicast snooping, the membership entries learned on the MC-AE interfaces on the VLAN are not cleared when the MC-AE interfaces go down. This is done to speed up convergence time when the interfaces come up, or come up and go down.

Solution This is expected behavior.

ICCP Does Not Come Up After You Add or Delete an Authentication Key

Problem The Interchassis Control Protocol (ICCP) connection is not established when you add an authentication key and then delete it only at the global ICCP level. However, authentication works correctly at the ICCP peer level.

Solution Delete the ICCP configuration , and then add the ICCP configuration.

Local Status Is Standby When It Should Be Active

Problem If the multichassis aggregated Ethernet (MC-AE) interface is down when the state machine is in a synchronized state, the multichassis link aggregation group (MC-LAG) peer local status is standby. If the MC-AE interface goes down after the state machine is in an active state, then the local status remains active, and the local state indicates that the interface is down.

Solution This is expected behavior.

Packets Loop on the Server When ICCP Fails

Problem When you enable backup liveness detection for a multichassis link aggregation group (MC-LAG), and the backup liveness detection packets are lost because of a temporary failure on the MC-LAG, then both of the peers in the MC-LAG remain active. If this happens, both of the MC-LAG peers send packets to the connected server.

Solution This is expected behavior.

Both MC-LAG Peers Use the Default System ID After a Reboot or an ICCP Configuration Change

Problem After a reboot or after a new Interchassis Control Protocol (ICCP) configuration has been committed, and the ICCP connection does not become active, the Link Aggregation Control Protocol (LACP) messages transmitted over the multichassis aggregated Ethernet (MC-AE) interfaces use the default system ID. The configured system ID is used instead of the default system ID only after the MC-LAG peers synchronize with each other.

Solution This is expected behavior.

No Commit Checks Are Done for ICL-PL Interfaces

Problem There are no commit checks on the interface being configured as an interchassis control link-protection link (ICL-PL), so you must provide a valid interface name for the ICL-PL.

Solution This is expected behavior.

Double Failover Scenario

Problem If the following events happen in this exact order—the Interchassis Control Protocol (ICCP) goes down, and the multichassis aggregated Ethernet (MC-AE) interface on the multichassis link aggregation group (MC-LAG) peer in active mode goes down—a double failover occurs. In this scenario, the MC-LAG peer in standby mode does not detect what happens on the active MC-LAG peer. The MC-LAG peer in standby mode operates as if the MC-AE interface on the MC-LAG in active mode were up and blocks the interchassis control protocol-protection link (ICL-PL) traffic. The ICL-PL traffic is not forwarded.

Solution This is expected behavior.

Multicast Traffic Floods the VLAN When the ICL-PL Interface Goes Down and Up

Problem When the interchassis control link-protection link (ICL-PL) goes down and up, multicast traffic is flooded to all of the interfaces in the VLAN. The Packet Forwarding Engine (PFE) flag Ip4McastFloodMode for the VLAN is changed to MCAST_FLOOD_ALL. This problem only occurs when a multichassis link aggregation group (MC-LAG) is configured for Layer 2.

Solution This is expected behavior.

Layer 3 Traffic Sent to the Standby MC-LAG Peer Is Not Redirected to Active MC-LAG Peer

Problem When the Interchassis Control Protocol (ICCP) is down, the status of a remote MC-LAG peer is unknown. Even if the MC-LAG peer is configured as standby, the traffic is not redirected to this peer because it is assumed that this peer is down.

Solution This is expected behavior.

AE Interfaces Go Down

Problem When a multichassis aggregated Ethernet (MC-AE) interface is converted to an aggregated Ethernet (AE) interface, it retains some MC-AE properties. For example, the AE interface might retain the administrative key of the MC-AE. When this happens, the AE interface goes down.

Solution Restart the Link Aggregation Control Protocol (LACP) on the multichassis link aggregation group (MC-LAG) peer hosting the AE interface to bring up the AE interface. Restarting LACP removes the MC-AE properties of the AE interface.

Flooding of Upstream Traffic

Problem When MAC synchronization is enabled, the multichassis link aggregation group (MC-LAG) peer can resolve Address Resolution Protocol (ARP) entries for the MC-LAG routed VLAN interface (RVI) with either of the MC-LAG peer MAC addresses. If the downstream traffic is sent with one MAC address (MAC1) but the peer has resolved the MAC address with a different MAC address (MAC2), the MAC2 address might not be learned by any of the access layer switches. Flooding of the upstream traffic for the MAC2 address might then occur.

Solution Make sure that downstream traffic is sent from the MC-LAG peers periodically to prevent the MAC addresses from aging out.

Related Documentation

- Understanding Multichassis Link Aggregation on page 1853
- Example: Configuring Multichassis Link Aggregation on page 1904
- Configuring Multichassis Link Aggregation on page 2022

Junos OS Basics

Rebooting and Halting a QFX Series Product

To reboot the switch, issue the **request system reboot** command.

```
user@switch> request system reboot ?
Possible completions:
  <[Enter]>             Execute this command
  at                    Time at which to perform the operation
  in                    Number of minutes to delay before operation
  media                 Boot media for next boot
```

```
  message               Message to display to all users
  |                     Pipe through a command
```

```
user@switch> request system reboot
Reboot the system ? [yes,no] (no) yes
Rebooting switch
```

Similarly, to halt the switch, issue the **request system halt** command.

CAUTION: Before entering this command, you must have access to the switch's console port in order to bring up the Routing Engine.

```
user@switch> request system halt ?
Possible completions:
  <[Enter]>             Execute this command
  at                    Time at which to perform the operation
  in                    Number of minutes to delay before operation
  media                 Boot media for next boot
  message               Message to display to all users
  |                     Pipe through a command
```

NOTE: When you issue this command on an individual component in a QFabric system, you will receive a warning that says "Hardware-based members will halt, Virtual Junos Routing Engines will reboot." If you want to halt only one member, use the **member** option. You cannot issue this command from the QFabric CLI.

Issuing the **request system halt** command on the switch halts the Routing Engine. To reboot a Routing Engine that has been halted, you must connect through the console.

Related Documentation

- clear system reboot on page 329
- request system reboot on page 387
- request system halt on page 373
- request system power-off on page 383

- *Connecting a QFX Series Device to a Management Console*

Recovering from a Failed Software Installation

Problem If the Junos OS appears to have been installed but the CLI does not work, or if the switch has no software installed, you can use this recovery installation procedure to install the Junos OS.

Solution If a Junos OS image already exists on the switch, you can either install the new Junos OS package in a separate partition, in which case both Junos OS images remain on the switch, or you can remove the existing Junos OS image before you start the new installation process.

To perform a recovery installation:

1. Power on the switch. The loader script starts.
2. After the message **Loading /boot/defaults/loader.conf** appears, you are prompted with the following message:

   Hit [Enter] to boot immediately, or space bar for command prompt.

   Press the Spacebar to enter the manual loader. The **loader>** prompt appears.
3. Enter the following command:

   `loader>` **install [– –format] [– –external]** ***source***
   where:

   - **format**—Enables you to erase the installation media before installing the installation package. If you do not include this option, the system installs the new Junos OS in a different partition from that of the most recently installed Junos OS.
   - **external**—Installs the installation package onto external media (a USB stick, for example).
   - ***source***—Represents the name and location of the Junos OS package, either on a server on the network or as a file on an external media, as shown in the following two examples:
     - Network address of the server and the path on the server; for example, **tftp://192.17.1.28/junos/jinstall-qfx-11.1R1.5-domestic-signed.tgz**
     - Junos OS package on a USB device (commonly stored in the root drive as the only file), for example, **file:///jinstall-qfx-11.1R1.5-domestic-signed.tgz**).

   The installation now proceeds normally and ends with a login prompt.

Recovering the Root Password

If you forget the root password for the QFX3500 switch, you can use the password recovery procedure to reset the root password.

NOTE: The root password cannot be recovered on a QFabric system.

NOTE: You need console access to the switch to recover the root password.

To recover the root password:

1. Power off the switch by switching off the AC power outlet of the device or, if necessary, by pulling the power cords out of the QFX3500 switch power supplies.
2. Turn off the power to the management device, such as a PC or laptop computer, that you want to use to access the CLI.

3. Plug one end of the Ethernet rollover cable supplied with the switch into the RJ-45–to–DB-9 serial port adapter supplied with the switch.
4. Plug the RJ-45–to–DB-9 serial port adapter into the serial port on the management device.
5. Connect the other end of the Ethernet rollover cable to the console port on the switch.
6. Turn on the power to the management device.
7. On the management device, start your asynchronous terminal emulation application (such as Microsoft Windows Hyperterminal) and select the appropriate **COM** port to use (for example, **COM1**).
8. Configure the port settings as follows:
   - Bits per second: 9600
   - Data bits: 8
   - Parity: None
   - Stop bits: 1
   - Flow control: None
9. Power on the switch by (if necessary) plugging the power cords into the QFX3500 switch power supply, or turning on the power to the device or switch by switching on the AC power outlet the device is plugged into

   The terminal emulation screen on your management device displays the switch's boot sequence.
10. When the following prompt appears, press the Spacebar to access the switch's bootstrap loader command prompt:

    ```
    Hit [Enter] to boot immediately, or space bar for command prompt.
    Booting [kernel] in 9 seconds...
    ```
11. At the following prompt, enter **boot -s** to start up the system in single-user mode.

    ```
    ok boot -s
    ```
12. At the following prompt, enter **recovery** to start the root password recovery procedure.

    ```
    Enter full pathname of shell or 'recovery' for root password recovery or RETURN
    for /bin/sh: recovery
    ```
13. Enter configuration mode in the CLI.
14. Set the root password. For example:

    ```
    user@switch# set system root-authentication plain-text-password
    ```
15. At the following prompt, enter the new root password. For example:

    ```
    New password: juniper1
    Retype new password:
    ```
16. At the second prompt, reenter the new root password.
17. After you have finished configuring the password, commit the configuration.

    ```
    root@host# commit
    commit complete
    ```

18. Exit configuration mode in the CLI.
19. Exit operational mode in the CLI.
20. At the prompt, enter **y** to reboot the switch.

```
Reboot the system? [y/n] y
```

Related Documentation

- Configuring the Root Password on page 1236

Creating an Emergency Boot Device for a QFX Series Device

If Junos OS on the QFX Series is damaged in some way that prevents the software from loading properly, you can use an emergency boot device to repartition the primary disk and load a fresh installation of Junos OS. Use the following procedure to create an emergency boot device.

Before you begin, you need to download the installation media image for your device and Junos OS release from http://www.juniper.net/customers/support/ .

> NOTE: In the following procedure, we assume that you are creating the emergency boot device on a QFX device. You can create the emergency boot device on another Juniper Networks switch or router, or any PC or laptop that supports Linux. The steps you take to create the emergency boot device vary, depending on the device.

To create an emergency boot device from a QFX device:

1. Use FTP to copy the installation media image into the **/var/tmp** directory on the QFX device.
2. Insert a USB device into the USB port.
3. From the Junos OS command-line interface (CLI), start the shell:

   ```
   user@device> start shell
   %
   ```
4. Switch to the root account using the **su** command:

   ```
   % su
   Password: password
   ```

   > NOTE: The password is the root password for the QFX device. If you logged in to the device as root, you do not need to perform this step.
5. Enter the following command on the QFX3500, QFX3600, and QFX3600-I devices:

   ```
   root@device% dd if=/var/tmp/filename of=/dev/da1 bs=16k
   ```

   The device writes the installation media image to the USB device:

   ```
   root@device% dd if=/var/tmp/install-media-qfx3500.junos_11.1 of=/dev/da1 bs=16k
   11006+1 records in
   ```



```
11006+1 records out
180332544 bytes transferred in 71.764266 secs (2512846 bytes/sec)
```

6. Enter the following command on the QFX5100 device:

   `root@device%` **dd if=/var/tmp/*filename* of=/dev/da0 bs=1048576**

   The device writes the installation media image to the USB device:

```
root@device% dd if=/var/tmp/jinstall-vjunos-usb-13.2.img of=/dev/da0 bs=1048576
11006+1 records in
11006+1 records out
180332544 bytes transferred in 71.764266 secs (2512846 bytes/sec)
```

7. Log out of the shell:

```
root@device% exit
% exit
user@device>
```

Related Documentation

- *USB Port Specifications for the QFX Series*
- Performing a Recovery Installation on a QFX Series Device on page 103
- Performing a QFabric System Recovery Installation on the Director Group on page 6471
- Performing a Recovery Installation on a QFX5100 Switch on page 105

Performing a Recovery Installation on a QFX Series Device

If Junos OS on your device is damaged in some way that prevents the software from loading correctly, you may need to perform a recovery installation using an emergency boot device (for example, a USB flash drive) to restore the default factory installation. Once you have recovered the software, you need to restore the device configuration. You can either create a new configuration as you did when the device was shipped from the factory, or if you saved the previous configuration, you can simply restore that file to the device.

If at all possible, you should try to perform the following steps before you perform the recovery installation:

1. Ensure that you have an emergency boot device to use during the installation. See "Creating an Emergency Boot Device for a QFX Series Device" on page 153 for information on how to create an emergency boot device.
2. Copy the existing configuration in the file **/config/juniper.conf.gz** from the device to a remote system, such as a server, or to an emergency boot device. For extra safety, you can also copy the backup configurations (the files named **/config/juniper.conf.*n***, where *n* is a number from 0 through 9) to a remote system or to an emergency boot device.

   WARNING: **The recovery installation process completely overwrites the entire contents of the internal flash storage.**

3. Copy any other stored files to a remote system as desired.

To reinstall Junos OS:

1. Insert the emergency boot device into the QFX Series device.
2. Reboot the QFX Series device.

   NOTE: **Do not power off the device if it is already on.**

   [edit system]
   user@device> **request system reboot**

   If you do not have access to the CLI, power cycle the QFX Series device.

   The emergency boot device (external USB install media) is detected. At this time, you can load the Junos OS from the emergency boot device onto the internal flash storage.

3. The software prompts you with the following options:

```
External USB install media detected.
You can load Junos from this media onto an internal drive.
Press 'y' to proceed, 'f' to format and install, or 'n' to abort.
Do you wish to continue ([y]/f/n)? f
```


4. Type **f** to format the internal flash storage and install the Junos OS on the emergency boot device onto the internal flash storage.

   If you do no want to format the internal flash storage, type **y**.

   The following messages are displayed:

```
Installing packages from external USB drive da1
Packages will be installed to da0, media size: 8G

Processing format options
Fri September  4 01:18:44 UTC 2012

-- IMPORTANT INFORMATION --
Installer has detected settings to format system boot media.
This operation will erase all data from your system.

Formatting installation disk .. this will take a while, please wait
Disabling platform watchdog - threshold 12 mins

Determining installation slice
Fri September  4 01:27:07 UTC 2012
```

5. The device copies the software from the emergency boot device, occasionally displaying status messages. Copying the software can take up to 12 minutes.

   When the device is finished copying the software, you are presented with the following prompt:

```
*** Fri September  4 01:19:00 UTC 2012***
Installation successful..
Please select one of the following options:
Reboot to installed Junos after removing install media (default) ... 1
Reboot to installed Junos by disabling install media .............. 2
Exit to installer debug shell ..................................... 3
Install Junos to alternate slice .................................. 4
Your choice: 4
NOTE: System installer will now install Junos to alternate slice
Do not power off or remove the external installer media or
interrupt the installation mechanism.
```

6. Select **4** to install Junos OS to the alternate slice of the partition, and then press Enter.
7. Remove the emergency boot device when prompted and then press Enter. The device then reboots from the internal flash storage on which the software was just installed. When the reboot is complete, the device displays the login prompt.
8. Create a new configuration as you did when the device was shipped from the factory, or restore the previously saved configuration file to the device.

Related Documentation

- Creating an Emergency Boot Device for a QFX Series Device on page 153

Performing a QFabric System Recovery Installation on the Director Group

If the software on your QFabric system is damaged in some way that prevents the software from loading correctly, or you need to upgrade the software on your QFabric system, you may need to perform a recovery installation on the Director group.

If possible, perform the following steps before you perform the recovery installation:

1. Ensure that you have an emergency boot device (for example, an external USB flash drive) for each of your Director devices to use during the recovery installation.

   You can either use the external USB flash drive containing the software supplied by Juniper Networks, or you can use an external USB flash drive supplied by Juniper Networks on which you install the QFabric system install media.

2. Because the recovery installation process completely overwrites the entire contents of the Director device, make sure you back up any configuration files and initial setup information on a different external USB flash drive before you begin a recovery installation. You will need to restore this information as part of recovery process.

   Use the **request system software configuration-backup** command to back up your configuration files and initial setup information:

   `user@switch>` **request system software configuration-backup** ***path***

NOTE: To recover the Director group, you must upgrade both Director devices in parallel. If you are recovering only one Director device in a Director group, and the software version will remain the same between the two Director devices, make sure that the other Director device is powered on and operational. If the software version of the Director device you are recovering will be different, make sure that the other Director device is powered off and is not operational.

- (Optional) Creating an Emergency Boot Device Using a Juniper Networks External Blank USB Flash Drive on page 6472
- Performing a Recovery Installation Using a Juniper Networks External USB Flash Drive with Preloaded Software on page 6474

(Optional) Creating an Emergency Boot Device Using a Juniper Networks External Blank USB Flash Drive

If you do not have an external USB flash drive preloaded with the software from Juniper Networks to use as an emergency boot device, you can create your own, using a blank external USB flash drive provided by Juniper Networks. Download the install media from the Juniper Networks Support website onto your UNIX workstation, uncompress and untar the software, and then burn the software image onto your Juniper Networks external USB (4-gigabyte) flash drive. Make sure you create two emergency boot devices, one for each Director device, so you can perform a recovery installation in parallel.

1. Using a Web browser, navigate to the http://www.juniper.net/support .
2. Click **Download Software**.
3. In the **Switching** box, click **Junos OS Platforms**.
4. In the **QFX Series** section, click the name of the platform for which you want to download software.

5. Click the **Software** tab and select the release number from the **Release** drop-down list.
6. Select the complete install media you want to download in the **QFabric System Install Media** section.

   A login screen appears.
7. Enter your name and password and press **Enter**.
8. Read the End User License Agreement, click the **I agree** radio button, and then click **Proceed**.
9. Log in and save the install media file to your UNIX workstation.
10. Use FTP to access the UNIX workstation where the install media resides.

    ftp ftp://*hostname/pathname install-media-qfabric-<version>*.img.tgz
11. When prompted, enter your username and password.
12. Make sure you are in binary mode by entering **binary** at the prompt.

    binary
13. Use the **get** command to transfer the installation package from the FTP host to your UNIX workstation.

    get *install-media-qfabric-<version>*.img.tgz
14. Close the FTP session:

    bye
15. Untar the *install-media-qfabric-<version>* .img.tgz file on your UNIX workstation.

```
tar -xvzf install-media-qfabric-11.3X30.6.img.tgz
```
16. Insert a blank external USB (4-gigabyte) flash drive supplied by Juniper Networks into your UNIX workstation.
17. Burn the software image you just downloaded to your UNIX workstation onto your external USB flash drive using the **dd** command:

    dd if=install-media-qfabric-11.3X30.6.img of=/dev/sdb bs=16k

```
250880+0 records in
250880+0 records out
4110417920 bytes (4.1 GB) copied, 5.10768 seconds, 805 MB/s
```
18. Perform the steps in "Performing a Recovery Installation Using a Juniper Networks External USB Flash Drive with Preloaded Software" on page 6474 to continue with the recovery installation.

Performing a Recovery Installation Using a Juniper Networks External USB Flash Drive with Preloaded Software

This procedure describes how to perform a recovery installation using an external USB flash drive that contains Junos OS software.

NOTE: Since the recovery installation process completely overwrites the entire contents of the Director device, you will need to restore the required configuration files and initial setup information. The following procedure assumes you previously saved these backup files with the **request system software configuration-backup** command. Ensure that you have these backup files available on an external USB flash drive before you perform the following steps.

1. Insert the external USB flash drive into the Director device.
2. Perform one of the following tasks:
   - If you have access to the default partition, reboot the Director device by issuing the **request system reboot director-group** command.
   - If you do not have access to the default partition, power cycle the Director device.

   The following menu appears on the Director device console when the Director device boots up:

   ```
   Juniper Networks QFabric Director Install/Recovery Media
   -  To boot from the local disk, wait 10 seconds or press the Enter key.
   -  To reinstall the QFabric software on this Director device, type: install
   ```
3. Type **install** and then press **Enter** to install the software on the Director device.

   Once the installation process is complete, the Director device reboots, and the following menu appears on the Director device console:

   ```
   Juniper Networks QFabric Director Install/Recovery Media
   -  To boot from the local disk, wait 10 seconds or press the Enter key.
   -  To reinstall the QFabric software on this Director device, type: install
   ```
4. Press **Enter**.

   The Director device reboots from the local disk on which the software was just installed.
5. Log in as root on the Director device.

   The following menu appears on the Director device console:

   ```
   Before you can access the QFabric system, you must complete the initial setup
    of the Director group by using the steps that follow.
   If the initial setup procedure does not complete successfully, log out of the
    Director device and then log back in to restart
    this setup menu.

   Continue?[y/n]
   ```

6. Enter **n** to bypass the initial setup script and enter the Director device root directory, where you can mount the external USB flash drive containing the configuration files and initial setup information.

7. Issue the **ls /mnt** command to list the **mount** directory.

   `root@dg0 ~]#` **ls /mnt**

8. Issue the **mkdir** command to create a directory within the mount directory.

   `root@dg0 ~]#` **mkdir /mnt/myusb**

9. Issue the **mount /dev/sdb2 /mnt/myusb/** command to mount the external USB flash drive to the local drive of the Director device.

   `root@dg0 ~]#` **mount /dev/sdb2 /mnt/myusb/**

10. Issue the **ls -la /mnt/myusb/** command to verify the contents of your mounted external USB flashdrive.

```
root@dg0 ~]# ls -la /mnt/myusb/
total 1770884
drwxr-xr-x 2 root root       4096 Sep  7 05:16 .
drwxr-xr-x 3 root root       4096 Sep  7 10:15 ..
-rw-r--r-- 1 root root       4249 Sep  7 03:52 mybackup-20110907
```

11. Exit the Director device and log back in as root on the Director device.

    The following menu appears:

```
Before you can access the QFabric system, you must complete the initial setup
 of the Director group by using the steps that follow.
If the initial setup procedure does not complete successfully, log out of the
 Director device and then log back in to restart
 this setup menu.

Continue?[y/n] y
Initial Configuration

You may enter the configuration manually or restore from a backup.

Specify a backup file? [y/n] : y
Please specify the full path of the configuration backup file. :
/mnt/myusb/mybackup-20110907
```

12. Enter **y** to continue.

13. Enter **y** and specify the path to the backup configuration file located on the external USB flash drive.

    `/mnt/myusb/mybackup-20110907`

    The following messages appear:

```
Saving temporary configuration...
Configuring peer...
connect error for 1.1.1.2:9001
Configuring local interfaces...
Configuring interface eth0 with [10.49.213.163/24:10.49.213.254]
Configured interface eth0 with [10.49.213.163/24:10.49.213.254]
Configuring QFabric software with initial pool of 4000 MAC addresses
[00:10:00:00:00:00 - 00:10:00:00:0f:3b]
Configuring QFabric address [10.49.213.50]
Reconfiguring QFabric software static configuration
Applying the new Director Device password
Applying the QFabric component password
```

```
First install initial configuration, generating and sharing SSH keys.
First install initial configuration, generating SSH keys.
connect error for 1.1.1.2:9001
Shared SSH keys.
Configuration complete. Director Group services will auto start within 30
seconds.
```

The Director device reboots from the local disk on which the software was just installed. Exit the Director device session and log in to the QFabric default partition CLI.

14. Issue the **request system software configuration-restore** command and specify the path to the backup configuration file located on the external USB flash drive to load the previously saved QFabric system configuration.

15. From the default partition, issue the **request system reboot node-group all** command to reboot all of the Node groups in the QFabric system to ensure that all Node devices are running the same version of software as the Director-group.

    `user@switch>` **request system reboot node-group all**

16. From the default partition, issue the **request system reboot fabric** command to reboot the Interconnect devices and the other components in the fabric in the QFabric system to ensure that Interconnect devices are running the same version of software as the Director group.

    `user@switch>` **request system reboot fabric**

17. Log in to the default partition and issue the **show version component all** command to verify that all components are running the same version of software.

```
user@switch> show version component all
dg1:
-
Hostname: qfabric
Model: qfx3100
JUNOS Base Version [11.3X30.6]

dg0:
-
Hostname: qfabric
Model: qfx3100
JUNOS Base Version [11.3X30.6]

NW-NG-0:
-
Hostname: qfabric
Model: qfx-jvre
JUNOS Base OS boot [11.3X30.6]
JUNOS Base OS Software Suite [11.3X30.6]
JUNOS Kernel Software Suite [11.3X30.6]
JUNOS Crypto Software Suite [11.3X30.6]
JUNOS Online Documentation [11.3X30.6]
JUNOS Enterprise Software Suite [11.3X30.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3X30.6]
JUNOS Routing Software Suite [11.3X30.6]

FC-0:
-
Hostname: qfabric
Model: qfx-jvre
JUNOS Base OS boot [11.3X30.6]
JUNOS Base OS Software Suite [11.3X30.6]
```



```
JUNOS Kernel Software Suite [11.3X30.6]
JUNOS Crypto Software Suite [11.3X30.6]
JUNOS Online Documentation [11.3X30.6]
JUNOS Enterprise Software Suite [11.3X30.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3X30.6]
JUNOS Routing Software Suite [11.3X30.6]

FC-1:
Hostname: qfabric
Model: qfx-jvre
JUNOS Base OS boot [11.3X30.6]
JUNOS Base OS Software Suite [11.3X30.6]
JUNOS Kernel Software Suite [11.3X30.6]
JUNOS Crypto Software Suite [11.3X30.6]
JUNOS Online Documentation [11.3X30.6]
JUNOS Enterprise Software Suite [11.3X30.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3X30.6]
JUNOS Routing Software Suite [11.3X30.6]

DRE-0:
-
Hostname: dre-0
Model: qfx-jvre
JUNOS Base OS boot [11.3X30.6]
JUNOS Base OS Software Suite [11.3X30.6]
JUNOS Kernel Software Suite [11.3X30.6]
JUNOS Crypto Software Suite [11.3X30.6]
JUNOS Online Documentation [11.3X30.6]
JUNOS Enterprise Software Suite [11.3X30.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3X30.6]
JUNOS Routing Software Suite [11.3X30.6]

FM-0:
-
Hostname: qfabric
Model: qfx-jvre
JUNOS Base OS boot [11.3X30.6]
JUNOS Base OS Software Suite [11.3X30.6]
JUNOS Kernel Software Suite [11.3X30.6]
JUNOS Crypto Software Suite [11.3X30.6]
JUNOS Online Documentation [11.3X30.6]
JUNOS Enterprise Software Suite [11.3X30.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3X30.6]
JUNOS Routing Software Suite [11.3X30.6]

nodedevice1:
-
Hostname: qfabric
Model: QFX3500
JUNOS Base OS boot [11.3X30.6]
JUNOS Base OS Software Suite [11.3X30.6]
JUNOS Kernel Software Suite [11.3X30.6]
JUNOS Crypto Software Suite [11.3X30.6]
JUNOS Online Documentation [11.3X30.6]
JUNOS Enterprise Software Suite [11.3X30.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3X30.6]
JUNOS Routing Software Suite [11.3X30.6]

interconnectdevice1:
-
Hostname: qfabric
```

```
Model: QFX3108
JUNOS Base OS boot [11.3X30.6]
JUNOS Base OS Software Suite [11.3X30.6]
JUNOS Kernel Software Suite [11.3X30.6]
JUNOS Crypto Software Suite [11.3X30.6]
JUNOS Online Documentation [11.3X30.6]
JUNOS Enterprise Software Suite [11.3X30.6]
JUNOS Packet Forwarding Engine Support (QFX RE) [11.3X30.6]
JUNOS Routing Software Suite [11.3X30.6]
warning:  from interconnectdevice0: Disconnected
```

Related Documentation

- *Performing the QFabric System Initial Setup on a QFX3100 Director Group*
- *Upgrading Software on a QFabric System*
- *request system software configuration-backup*
- *request system software configuration-restore*

Layer 3 Protocols

Troubleshooting Virtual Routing Instances

Direct Routes Not Leaked Between Routing Instances

Problem Direct routes are not exported (leaked) between virtual routing instances For example, consider the following scenario:

- QFX switch with two virtual routing instances:
  - Routing instance 1 connects to downstream device through interface xe-0/0/1.
  - Routing instance 2 connects to upstream device through interface xe-0/0/2.

If you enable route leaking between the routing instances (by using the **rib-group** statement, for example), the downstream device cannot connect to the upstream device because the QFX switch connects to the upstream device over a direct route and these routes are not leaked between instances.

NOTE: You can see a route to the upstream device in the routing table of the downstream device, but this route is not functional.

Indirect routes *are* leaked between routing instances, so the downstream device can connect to any upstream devices that are connected to the QFX switch over indirect routes.

Solution This is expected behavior.

Related Documentation

- Understanding Virtual Router Routing Instances on page 2304
- Configuring Virtual Router Routing Instances on page 2313
- **rib-group on page 2421**

Network Management

Troubleshooting a Deprecated Network Analytics Configuration

Problem After a software upgrade to Junos OS Release 13.2X51-D15 from an earlier release, the network analytics configuration is no longer valid and the feature is disabled.

The network analytics configuration used in Junos OS Release 13.2X51-D10 has been deprecated in Release 13.2X51-D15. Issuing the **show services analytics** command results in the following output:

```
root@qfx5100# show services analytics

queue-statistics { ## Warning: 'queue-statistics' is deprecated
    interval 1;
}
```

Cause Junos OS Release 13.2X51-D15 added enhancements to the network analytics feature, resulting in significant changes in the CLI. The updated **[edit services analytics]** hierarchy level contains some statements that have replaced those that were previously released. As a result, the earlier configuration does not work in the new release.

Solution Use the new CLI statements to reconfigure the network analytics feature.

Related Documentation

- Network Analytics Overview on page 6000
- **analytics on page 6176**

Security

Troubleshooting Firewall Filter Configuration

Use the following information to troubleshoot your firewall filter configuration.

Firewall Filter Configuration Returns a No Space Available in TCAM Message

Problem When a firewall filter configuration exceeds the amount of available Ternary Content Addressable Memory (TCAM) space, the system returns the following **syslogd** message:

```
No space available in tcam.
Rules for filter filter-name will not be installed.
```

A switch returns this message during the commit operation if the firewall filter that has been applied to a port, VLAN, or Layer 3 interface exceeds the amount of space available in the TCAM table. The filter is not applied, but the commit operation for the firewall filter configuration is completed in the CLI module.

Solution When a firewall filter configuration exceeds the amount of available TCAM table space, you must configure a new firewall filter with fewer filter terms so that the space requirements for the filter do not exceed the available space in the TCAM table.

You can perform either of the following procedures to correct the problem:

To delete the filter and its binding and apply the new smaller firewall filter to the same binding:

1. Delete the filter and its binding to ports, VLANs, or Layer 3 interfaces. For example:

   ```
   [edit]
   user@switch# delete firewall family ethernet-switching filter ingress-vlan-rogue-block
   user@switch# delete vlans employee-vlan description "filter to block rogue devices on
   employee-vlan"
   user@switch# delete vlans employee-vlan filter input ingress-vlan-rogue-block
   ```
2. Commit the changes:

   ```
   [edit]
   user@switch# commit
   ```
3. Configure a smaller filter with fewer terms that does not exceed the amount of available TCAM space. For example:

   ```
   [edit]
   user@switch# set firewall family ethernet-switching filter new-ingress-vlan-rogue-block ...
   ```
4. Apply (bind) the new firewall filter to a port, VLAN , or Layer 3 interface. For example:

   ```
   [edit]
   user@switch# set vlans employee-vlan description "filter to block rogue devices on
   employee-vlan"
   user@switch# set vlans employee-vlan filter input new-ingress-vlan-rogue-block
   ```
5. Commit the changes:

   ```
   [edit]
   ```



```
user@switch# commit
```

To apply a new firewall filter and overwrite the existing binding but not delete the original filter:

1. Configure a firewall filter with fewer terms than the original filter:

```
[edit]
user@switch# set firewall family ethernet-switching filter new-ingress-vlan-rogue-block...
```

2. Apply the firewall filter to the port, VLAN, or Layer 3 interfaces to overwrite the binding of the original filter—for example:

```
[edit]
user@switch# set vlans employee-vlan description "smaller filter to block rogue devices on employee-vlan"
user@switch# set vlans employee-vlan filter input new-ingress-vlan-rogue-block
```

Because you can apply no more than one firewall filter per VLAN per direction, the binding of the original firewall filter to the VLAN is overwritten with the new firewall filter **new-ingress-vlan-rogue-block**.

3. Commit the changes:

```
[edit]
user@switch# commit
```

NOTE: **The original filter is not deleted and is still available in the configuration.**

Filter Counts Previously Dropped Packet

Problem If you configure two or more filters in the same direction for a physical interface and one of the filters includes a counter, the counter will be incorrect if the following circumstances apply:

- You configure the filter that is applied to packets first to discard certain packets. For example, imagine that you have a VLAN filter that accepts packets sent to 10.10.1.0/24 addresses and implicitly discards packets sent to any other addresses. You apply the filter to the **admin** VLAN in the output direction, and interface xe-0/0/1 is a member of that VLAN.
- You configure a subsequent filter to accept and count packets that are dropped by the first filter. In this example, you have a port filter that accepts and counts packets sent to 192.168.1.0/24 addresses that is also applied to xe-0/0/1 in the output direction.

The egress VLAN filter is applied first and correctly discards packets sent to 192.168.1.0/24 addresses. The egress port filter is applied next and counts the discarded packets as matched packets. The packets are not forwarded, but the counter displayed by the egress port filter is incorrect.

Remember that the order in which filters are applied depends on the direction in which they are applied, as indicated here:

Ingress filters:

1. Port (Layer 2) filter
2. VLAN filter
3. Router (Layer 3) filter

Egress filters:

1. Router (Layer 3) filter
2. VLAN filter
3. Port (Layer 2) filter

Solution This is expected behavior.

Matching Packets Not Counted

Problem If you configure two egress filters with counters for a physical interface and a packet matches both of the filters, only one of the counters includes that packet.

For example:

- You configure an egress port filter with a counter for interface xe-0/0/1.
- You configure an egress VLAN filter with a counter for the **admin**VLAN, and interface xe-0/0/1 is a member of that VLAN.
- A packet matches both filters.

In this case, the packet is counted by only one of the counters even though it matched both filters.

Solution This is expected behavior.

Counter Reset When Editing Filter

Problem If you edit a firewall filter term, the value of any counter associated with any term in the same filter is set to 0, including the implicit counter for any policer referenced by the filter. Consider the following examples:

- Assume that your filter has **term1**, **term2**, and **term3**, and each term has a counter that has already counted matching packets. If you edit any of the terms in any way, the counters for all the terms are reset to 0.
- Assume that your filter has **term1** and **term2**. Also assume that **term2** has a **policer** action modifier and the implicit counter of the policer has already counted 1000 matching packets. If you edit **term1** or **term2** in any way, the counter for the policer referenced by **term2** is reset to 0.

Solution This is expected behavior.

Cannot Include loss-priority and policer Actions in Same Term

Problem You cannot include both of the following actions in the same firewall filter term in a QFX Series switch:

- **loss-priority**
- **policer**

If you do so, you see the following error message when you attempt to commit the configuration: “cannot support policer action if loss-priority is configured.”

Solution This is expected behavior.

Cannot Egress Filter Certain Traffic Originating on QFX Switch

Problem On a QFX Series switch, you cannot filter certain traffic with a firewall filter applied in the output direction if the traffic originates on the QFX switch. This limitation applies to control traffic for protocols such as ICMP (ping), STP, LACP, and so on.

Solution This is expected behavior.

Firewall Filter Match Condition Not Working with Q-in-Q Tunneling

Problem If you create a firewall filter that includes a match condition of **dot1q-tag** or **dot1q-user-priority** and apply the filter on input to a trunk port that participates in a service VLAN, the match condition does not work if the Q-in-Q EtherType is not 0x8100. (When Q-in-Q tunneling is enabled, trunk interfaces are assumed to be part of the service provider or data center network and therefore participate in service VLANs.)

Solution This is expected behavior. To set the Q-in-Q EtherType to 0x8100, enter the **set dot1q-tunneling ethertype 0x8100** statemen at the **[edit ethernet-switching-options]** hierarchy level. You must also configure the other end of the link to use the same Ethertype.

Egress Firewall Filters with Private VLANs

Problem If you apply a firewall filter in the output direction to a primary VLAN, the filter also applies to the secondary VLANs that are members of the primary VLAN when the traffic egresses with the primary VLAN tag or isolated VLAN tag, as listed below:

- Traffic forwarded from a secondary VLAN trunk port to a promiscuous port (trunk or access)
- Traffic forwarded from a secondary VLAN trunk port that carries an isolated VLAN to a PVLAN trunk port.
- Traffic forwarded from a promiscuous port (trunk or access) to a secondary VLAN trunk port

- Traffic forwarded from a PVLAN trunk port. to a secondary VLAN trunk port
- Traffic forwarded from a community port to a promiscuous port (trunk or access)

If you apply a firewall filter in the output direction to a primary VLAN, the filter does *not* apply to traffic that egresses with a community VLAN tag, as listed below:

- Traffic forwarded from a community trunk port to a PVLAN trunk port
- Traffic forwarded from a secondary VLAN trunk port that carries a community VLAN to a PVLAN trunk port
- Traffic forwarded from a promiscuous port (trunk or access) to a community trunk port
- Traffic forwarded from a PVLAN trunk port. to a community trunk port

If you apply a firewall filter in the output direction to a community VLAN, the following behaviors apply:

- The filter is applied to traffic forwarded from a promiscuous port (trunk or access) to a community trunk port (because the traffic egresses with the community VLAN tag).
- The filter is applied to traffic forwarded from a community port to a PVLAN trunk port (because the traffic egresses with the community VLAN tag).
- The filter is *not* applied to traffic forwarded from a community port to a promiscuous port (because the traffic egresses with the primary VLAN tag or untagged).

Solution These are expected behaviors. They occur only if you apply a firewall filter to a private VLAN in the output direction and do not occur if you apply a firewall filter to a private VLAN in the input direction.

Egress Filtering of L2PT Traffic Not Supported

Problem Egress filtering of L2PT traffic is not supported on the QFX3500 switch. That is, if you configure L2PT to tunnel a protocol on an interface, you cannot also use a firewall filter to filter traffic for that protocol on that interface in the output direction. If you commit a configuration for this purpose, the firewall filter is not applied to the L2PT-tunneled traffic.

Solution This is expected behavior.

Cannot Drop BGP Packets in Certain Circumstances

Problem BGP packets with a time-to-live (TTL) value greater than 1 cannot be discarded using a firewall filter applied to a loopback interface or applied on input to a Layer 3 interface. BGP packets with TTL value of 1 or 0 can be discarded using a firewall filter applied to a loopback interface or applied on input to a Layer 3 interface.

Solution This is expected behavior.

Invalid Statistics for Policer

Problem If you apply a single-rate two-color policer in more than 128 terms in a firewall filter, the output of the **show firewall** command displays incorrect data for the policer.

Solution This is expected behavior.

Policers can Limit Egress Filters

Problem The number of egress policers that you configure can affect the total number of allowed egress firewall filters. Every policer has two implicit counters that consume two entries in a 1024-entry TCAM that is used for counters, including counters that are configured as action modifiers in firewall filter terms. (Policers consume two entries because one is used for green packets and one is used for nongreen packets regardless of policer type.) If the TCAM becomes full, you cannot commit any more egress firewall filters that have terms with counters. For example, if you configure and commit 512 egress policers (two-color, three-color, or a combination of both policer types), all of the memory entries for counters are used up. If later in your configuration file you insert additional egress firewall filters with terms that also include counters, *none* of the terms in those filters are committed because there is no available memory space for the counters.

Here are some additional examples:

- Assume that you configure egress filters that include a total of 512 policers and no counters. Later in your configuration file you include another egress filter with 10 terms, 1 of which has a counter action modifier. None of the terms in this filter are committed because there is not enough TCAM space for the counter.
- Assume that you configure egress filters that include a total of 500 policers, so 1000 TCAM entries are occupied. Later in your configuration file you include the following two egress filters:
  - Filter A with 20 terms and 20 counters. All the terms in this filter are committed because there is enough TCAM space for all the counters.
  - Filter B comes after Filter A and has five terms and five counters. *None* of the terms in this filter are committed because there is not enough memory space for *all* the counters. (Five TCAM entries are required but only four are available.)

Solution You can prevent this problem by ensuring that egress firewall filter terms with counter actions are placed earlier in your configuration file than terms that include policers. In this circumstance, Junos OS commits policers even if there is not enough TCAM space for the implicit counters. For example, assume the following:

- You have 1024 egress firewall filter terms with counter actions.
- Later in your configuration file you have an egress filter with 10 terms. None of the terms have counters but one has a policer action modifier.

You can successfully commit the filter with 10 terms even though there is not enough TCAM space for the implicit counters of the policer. The policer is committed without the counters.

Related Documentation

- Understanding FIP Snooping, FBF, and MVR Filter Scalability on page 4872
- Configuring Firewall Filters on page 4531
- Verifying That Firewall Filters Are Operational on page 4672

Troubleshooting Policer Configuration

Incomplete Count of Packet Drops

Problem Under certain circumstances, Junos OS might display a misleading number of packets dropped by an ingress policer.

If packets are dropped because of ingress admission control, policer statistics might not show the number of packet drops you would expect by calculating the difference between ingress and egress packet counts. This might happen if you apply an ingress policer to multiple interfaces, and the aggregate ingress rate of those interfaces exceeds the line rate of a common egress interface. In this case, packets might be dropped from the ingress buffer. These drops are not included in the count of packets dropped by the policer, which causes policer statistics to underreport the total number of drops.

Solution This is expected behavior.

Counter Reset When Editing Filter

Problem If you edit a firewall filter term, the value of any counter associated with any term in the same filter is set to 0, including the implicit counter for any policer referenced by the filter. Consider the following examples:

- Assume that your filter has **term1**, **term2**, and **term3**, and each term has a counter that has already counted matching packets. If you edit any of the terms in any way, the counters for all the terms are reset to 0.
- Assume that your filter has **term1** and **term2**. Also assume that **term2** has a **policer** action modifier and the implicit counter of the policer has already counted 1000

matching packets. If you edit **term1** or **term2** in any way, the counter for the policer referenced by **term2** is reset to 0.

Solution This is expected behavior.

Invalid Statistics for Policer

Problem If you apply a single-rate two-color policer in more than 128 terms in a firewall filter, the output of the **show firewall** command displays incorrect data for the policer.

Solution This is expected behavior.

Egress Policers on QFX3500 Devices Might Allow More Throughput Than Is Configured

Problem If you configure a policer to rate-limit throughput and apply it on egress to multiple interfaces on a QFX3500 switch or Node, the measured aggregate policed rate might be twice the configured rate, depending on which interfaces you apply the policer to. The doubling of the policed rate occurs if you apply a policer to multiple interfaces and *both* of the following are true:

- There is at least one policed interface in the range xe-0/0/0 to xe-0/0/23 or the range xe-0/1/1 to xe-0/1/7.
- There is at least one policed interface in the range xe-0/0/24 to xe-0/0/47 or the range xe-0/1/8 to xe-0/1/15.

For example, if you configure a policer to rate-limit traffic at 1 Gbps and apply the policer (by using a firewall filter) to xe-0/0/0 and xe-0/0/24 in the output direction, each interface is rate-limited at 1 Gbps, for a total allowed throughput of 2 Gbps. The same behavior occurs if you apply the policer to xe-0/1/1 and xe-0/0/24—each interface is rate-limited at 1 Gbps.

If you apply the same policer on egress to multiple interfaces in these groups, each *group* is rate-limited at 1 Gbps. For example, if you apply the policer to xe-0/0/0 through xe-0/0/4 (five interfaces) and xe-0/0/24 through xe-0/0/33 (ten interfaces), each group is rate-limited at 1 Gbps, for a total allowed throughput of 2 Gbps.

Here is another example: If you apply the policer to xe-0/0/0 through xe-0/0/4 and xe-0/1/1 through xe-0/1/5 (a total of ten interfaces), that group is rate-limited at 1 Gbps in aggregate. If you also apply the policer to xe-0/0/24, that one interface is rate-limited at 1 Gbps while the other ten are still rate-limited at 1 Gbps in aggregate.

Interfaces xe-0/1/1 through xe-0/1/15 are physically located on the QSFP+ uplink ports, according to the following scheme:

- xe-0/1/1 through xe-0/1/3 are on Q0.
- xe-0/1/4 through xe-0/1/7 are on Q1.

- xe-0/1/8 through xe-0/1/11 are on Q2.
- xe-0/1/2 through xe-0/1/15 are on Q3.

The doubling of the policed rate occurs only if the policer is applied in the output direction. If you configure a policer as described above but apply it in the input direction, the total allowed throughput for all interfaces is 1 Gbps.

Solution This is expected behavior.

Filter-Specific Egress Policers on QFX3500 Devices Might Allow More Throughput Than Is Configured

Problem You can configure policers to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. When you do this, rate limiting is applied in aggregate, so if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, the total bandwidth allowed by the filter is 1 Gbps. However, the behavior of a filter-specific policer is affected by how the firewall filter terms that reference the policer are stored in ternary content addressable memory (TCAM). If you create a filter-specific policer and reference it in multiple firewall filter terms, the policer allows more traffic than expected if the terms are stored in different TCAM slices. For example, if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms that are stored in three separate memory slices, the total bandwidth allowed by the filter is 3 Gbps, not 1 Gbps.

Solution To prevent this unexpected behavior, use the information about TCAM slices presented in "Planning the Number of Firewall Filters to Create" on page 4435 to organize your configuration file so that all the firewall filter terms that reference a given filter-specific policer are stored in the same TCAM slice.

Policers Can Limit Egress Filters

Problem The number of egress policers that you configure can affect the total number of allowed egress firewall filters. Every policer has two implicit counters that consume two entries in a 1024-entry TCAM that is used for counters, including counters that are configured as action modifiers in firewall filter terms. (Policers consume two entries because one is used for green packets and one is used for nongreen packets regardless of policer type.) If the TCAM becomes full, you cannot commit any more egress firewall filters that have terms with counters. For example, if you configure and commit 512 egress policers (two-color, three-color, or a combination of both policer types), all of the memory entries for counters are used up. If later in your configuration file you insert additional egress firewall filters with terms that also include counters, *none* of the terms in those filters are committed because there is no available memory space for the counters.

Here are some additional examples:

- Assume that you configure egress filters that include a total of 512 policers and no counters. Later in your configuration file you include another egress filter with 10 terms, 1 of which has a counter action modifier. None of the terms in this filter are committed because there is not enough TCAM space for the counter.

- Assume that you configure egress filters that include a total of 500 policers, so 1000 TCAM entries are occupied. Later in your configuration file you include the following two egress filters:
  - Filter A with 20 terms and 20 counters. All the terms in this filter are committed because there is enough TCAM space for all the counters.
  - Filter B comes after Filter A and has five terms and five counters. *None* of the terms in this filter are committed because there is not enough memory space for *all* the counters. (Five TCAM entries are required but only four are available.)

Solution You can prevent this problem by ensuring that egress firewall filter terms with counter actions are placed earlier in your configuration file than terms that include policers. In this circumstance, Junos OS commits policers even if there is not enough TCAM space for the implicit counters. For example, assume the following:

- You have 1024 egress firewall filter terms with counter actions.
- Later in your configuration file you have an egress filter with 10 terms. None of the terms have counters but one has a policer action modifier.

You can successfully commit the filter with 10 terms even though there is not enough TCAM space for the implicit counters of the policer. The policer is committed without the counters.

Services

Troubleshooting Port Mirroring

Port Mirroring Constraints and Limitations

Local and Remote Port Mirroring

The following constraints and limitations apply to local and remote port mirroring with the QFX Series:

- You can create a total of four port-mirroring configurations on a QFX Series standalone switch.

- You can create a total of four port-mirroring configurations on each Node group in a QFabric system, subject to the following constraints:
  - As many as four of the configurations can be for local port mirroring.
  - As many as three of the configurations can be for remote port mirroring.
- Regardless of whether you are configuring a standalone switch or a Node group, the following limits apply:
  - There can be no more than two configurations that mirror ingress traffic. (If you configure a firewall filter to send traffic to a port mirror—that is, you use the **analyzer** action modifier in a filter term—this counts as an ingress mirroring configuration for switch or Node group on which the filter is applied.)
  - There can be no more than two configurations that mirror egress traffic.

NOTE: **On QFabric systems, there is no system-wide limit on the total number of mirror sessions.**

- You can configure no more than one type of output in one port-mirroring configuration. That is, you can use no more than one of the following to complete a **set analyzer *name* output** statement:
  - **interface**
  - **ip-address**
  - **vlan**
- If you configure Junos OS to mirror egress packets, do not configure more than 2000 VLANs on a QFX3500 device or QFabric system. If you do so, some VLAN packets might contain incorrect VLAN IDs. This applies to any VLAN packets—not only the mirrored copies.
- The **ratio** and **loss-priority** options are not supported.
- Packets with physical layer errors are filtered out and are not sent to the output port or VLAN.
- If you use sFlow monitoring to sample traffic, it does not sample the mirror copies when they exit from the output interface.
- You cannot mirror packets exiting or entering the following ports:
  - Dedicated Virtual Chassis interfaces
  - Management interfaces (me0 or vme0)
  - Fibre Channel interfaces
  - Routed VLAN interfaces
- An aggregated Ethernet interface cannot be an output interface.

- Do not include an 802.1Q subinterface that has a unit number other than 0 in a port mirroring configuration. Port mirroring does not work with subinterfaces if their unit number is not 0. (You configure 802.1Q subinterfaces using the **vlan-tagging** statement.)
- When packet copies are sent out the output interface, they are not modified for any changes that are normally applied on egress, such as CoS rewriting.
- An interface can be the input interface for only one mirroring configuration. Do not use the same interface as the input interface for multiple mirroring configurations.
- CPU-generated packets (such as ARP, ICMP, BPDU, and LACP packets) cannot be mirrored on egress.
- VLAN-based mirroring is not supported for STP traffic.
- (QFabric systems only) If you configure a QFabric analyzer to mirror egress traffic and the input and output interfaces are on different Node devices, the mirrored copies have incorrect VLAN IDs. This limitation does not apply if you configure a QFabric analyzer to mirror egress traffic and the input and output interfaces are on the *same* Node device. In this case the mirrored copies have the correct VLAN IDs (as long as you do not configure more than 2000 VLANs on the QFabric system).

Remote Port Mirroring Only

The following constraints and limitations apply to remote port mirroring with the QFX Series:

- If you configure an output IP address, the address cannot be in the same subnetwork as any of the switch’s management interfaces.
- If you create virtual routing instances and also create an analyzer configuration that includes an output IP address, the output address belongs to the default virtual routing instance (inet.0 routing table).
- An output VLAN cannot be a private VLAN or VLAN range.
- An output VLAN cannot be shared by multiple **analyzer** statements.
- An output VLAN interface cannot be a member of any other VLAN.
- An output VLAN interface cannot be an aggregated Ethernet interface.
- On the source (monitored) switch, only one interface can be a member of the analyzer VLAN.

Egress Port Mirroring with VLAN Translation

Problem If you create a port-mirroring configuration that mirrors customer VLAN (CVLAN) traffic on egress and the traffic undergoes VLAN translation before being mirrored, the VLAN translation does not apply to the mirrored packets. That is, the mirrored packets retain the service VLAN (SVLAN) tag that should be replaced by the CVLAN tag on egress. The original packets are unaffected—on these packets VLAN translation works properly, and the SVLAN tag is replaced with the CVLAN tag on egress.

Solution This is expected behavior.

Egress Port Mirroring with Private VLANs

Problem If you create a port-mirroring configuration that mirrors private VLAN (PVLAN) traffic on egress, the mirrored traffic (the traffic that is sent to the analyzer system) has the VLAN tag of the ingress VLAN instead of the egress VLAN. For example, assume the following PVLAN configuration:

- Promiscuous trunk port that carries primary VLANs pvlan100 and pvlan400.
- Isolated access port that carries secondary VLAN isolated200. This VLAN is a member of primary VLAN pvlan100.
- Community port that carries secondary VLAN comm300. This VLAN is also a member of primary VLAN pvlan100.
- Output interface (monitor interface) that connects to the analyzer system. This interface forwards the mirrored traffic to the analyzer.

If a packet for pvlan100 enters on the promiscuous trunk port and exits on the isolated access port, the original packet is untagged on egress because it is exiting on an access port. However, the mirror copy retains the tag for pvlan100 when it is sent to the analyzer.

Here is another example: If a packet for comm300 ingresses on the community port and egresses on the promiscuous trunk port, the original packet carries the tag for pvlan100 on egress, as expected. However, the mirrored copy retains the tag for comm300 when it is sent to the analyzer.

Solution This is expected behavior.

Related Documentation

- Understanding Port Mirroring on page 4713
- Example: Configuring Port Mirroring for Local Analysis on page 4721
- Example: Configuring Port Mirroring for Remote Analysis on page 4726

Storage

Troubleshooting Dropped FCoE Traffic

Problem Fibre Channel over Ethernet (FCoE) traffic for which you want guaranteed delivery is dropped.

Cause There are several possible causes of dropped FCoE traffic (the list numbers of the possible causes correspond to the list numbers of the solutions in the *Solution* section.):

1. Priority-based flow control (PFC) is not enabled on the FCoE priority (IEEE 802.1p code point) in both the input and output stanzas of the congestion notification profile.
2. The FCoE traffic is not classified correctly at the ingress interface. FCoE traffic should either use the default **fcoe** forwarding class and classifier configuration (maps the **fcoe** forwarding class to IEEE 802.1p code point 011) or be mapped to a lossless forwarding class and to the code point enabled for PFC on the input and output interfaces.
3. The congestion notification profile that enables PFC on the FCoE priority is not attached to the interface.
4. The forwarding class set (priority group) used for guaranteed delivery traffic does not include the forwarding class used for FCoE traffic.
5. Insufficient bandwidth has been allocated for the FCoE queue or for the forwarding class set to which the FCoE queue belongs.
6. If you are using Junos OS Release 12.2, the **fcoe** forwarding class has been explicitly configured instead of using the default **fcoe** forwarding class configuration (forwarding-class-to-queue mapping).

   NOTE: If you are using Junos OS Release 12.2, use the default forwarding-class-to-queue mapping for the lossless **fcoe** and **no-loss** forwarding classes. If you explicitly configure the lossless forwarding classes, the traffic mapped to those forwarding classes is treated as lossy (best effort) traffic and does *not* receive lossless treatment.

7. If you are using Junos OS Release 12.3 or later and you are not using the default **fcoe** forwarding class configuration, the forwarding class used for FCoE is not configured with the **no-loss** packet drop attribute. In Junos OS 12.3 or later, explicit forwarding classes configurations must include the **no-loss** packet drop attribute to be treated as lossless forwarding classes.

Solution The list numbers of the possible solutions correspond to the list numbers of the causes in the *Cause* section.

1. Check the congestion notification profile (CNP) to see if PFC is enabled on the FCoE priority (the correct IEEE 802.1p code point) on both input and output interfaces. Use the **show class-of-service congestion-notification** operational command to show the code points that are enabled for PFC in each CNP.

   If you are using the default configuration, FCoE traffic is mapped to code point 011 (priority 3). In this case, the input stanza of the CNP should show that PFC is enabled on code point 011, and the output stanza should show that priority 011 is mapped to flow control queue 3.

   If you explicitly configured a forwarding class for FCoE traffic, ensure that:

   - You specified the **no-loss** packet drop attribute in the forwarding class configuration
   - The code point mapped to the FCoE forwarding class in the ingress classifier is the code point enabled for PFC in the CNP input stanza
   - The code point and output queue used for FCoE traffic are mapped to each other in the CNP output stanza (if you are not using the default priority and queue, you must explicitly configure each output queue that you want to respond to PFC messages)

   For example, if you explicitly configure a forwarding class for FCoE traffic that is mapped to output queue 5 and to code point 101 (priority 5), the output of the **show class-of-service congestion-notification** looks like:

   ```
   Name: fcoe_p5_cnp, Index: 12183
   Type: Input
   Cable Length: 100 m
     Priority     PFC          MRU
     000          Disabled
     001          Disabled
     010          Disabled
     011          Disabled
     100          Disabled
     101          Enabled      2500
     110          Disabled
     111          Disabled
   Type: Output
     Priority     Flow-Control-Queues
     101
                  5
   ```

2. Use the **show class-of-service classifier type ieee-802.1p** operational command to check if the classifier maps the forwarding class used for FCoE traffic to the correct IEEE 802.1p code point.

3. Ensure that the congestion notification profile and classifier are attached to the correct ingress interface. Use the operational command **show configuration class-of-service interfaces *interface-name***.

4. Check that the forwarding class set includes the forwarding class used for FCoE traffic. Use the operational command **show configuration class-of-service forwarding-class-sets** to show the configured priority groups and their forwarding classes.

5. Verify the amount of bandwidth allocated to the queue mapped to the FCoE forwarding class and to the forwarding class set to which the FCoE traffic queue belongs. Use the **show configuration class-of-service schedulers *scheduler-name*** operational command (specify the scheduler for FCoE traffic as the ***scheduler-name***) to see the minimum guaranteed bandwidth (**transmit-rate**) and maximum bandwidth (**shaping-rate**) for the queue.

   Use the **show configuration class-of-service traffic-control-profiles *traffic-control-profile*** operational command (specify the traffic control profile used for FCoE traffic as the ***traffic-control-profile***) to see the minimum guaranteed bandwidth (**guaranteed-rate**) and maximum bandwidth (**shaping-rate**) for the forwarding class set.

6. Delete the explicit FCoE forwarding-class-to-queue mapping so that the system uses the default FCoE forwarding-class-to-queue mapping. Include the **delete forwarding-classes class fcoe queue-num 3** statement at the **[edit class-of-service]** hierarchy level to remove the explicit configuration. The system then uses the default configuration for the FCoE forwarding class and preserves the lossless treatment of FCoE traffic.

7. Use the **show class-of-service forwarding-class** operational command to display the configured forwarding classes. The *No-Loss* column shows whether lossless transport is enabled or disabled for each forwarding class. If the forwarding class used for FCoE traffic is not enabled for lossless transport, include the **no-loss** packet drop attribute in the forwarding class configuration (**set class-of-service forwarding-classes class *fcoe-forwarding-class-name* queue-num *queue-number* no-loss**).

See “Example: Configuring CoS PFC for FCoE Traffic” on page 4921 for step-by-step instructions on how to configure PFC for FCoE traffic, including classifier, interface, congestion notification profile, PFC, and bandwidth scheduling configuration.

Related Documentation

- **show class-of-service congestion-notification on page 5825**
- **show class-of-service forwarding-class-set on page 5833**
- Configuring CoS PFC (Congestion Notification Profiles) on page 5685
- Example: Configuring CoS PFC for FCoE Traffic on page 4921
- Overview of CoS Changes Introduced in Junos OS Release 12.2 on page 5304
- Understanding CoS Flow Control (Ethernet PAUSE and PFC) on page 4885

Troubleshooting Fibre Channel Interface Deletion

Problem You deleted a Fibre Channel (FC) interface at the **[edit interfaces]** hierarchy level, but the commit check fails so the interface is not deleted.

Cause You must first delete the FC interface from the FC fabric on the QFX Series before you can delete the FC interface at the **[edit interfaces]** hierarchy level. You must perform both operations to delete a FC interface.

Solution First delete the interface from the FC fabric and then delete the interface from the QFX Series:

1. Delete the FC interface from the FC fabric to which it belongs:

   ```
   [edit]
   user@switch# delete fc-fabrics fabric-name interface interface-name
   ```

   For example, to delete the FC interface **fc-0/0/3.0** from an FC fabric named **sanfab1**:

   ```
   [edit]
   user@switch# delete fc-fabrics sanfab1 interface fc-0/0/3.0
   ```
2. Delete the FC interface at the **[edit interfaces]** hierarchy level:

   ```
   [edit]
   user@switch: delete interfaces interface-name
   ```

   For example, to delete the interface **fc-0/0/3.0** from the switch:

   ```
   [edit]
   user@switch: delete interfaces fc-0/0/3.0
   ```

Related Documentation

- fc-fabrics on page 5113
- interface on page 5120
- interfaces on page 2075
- Understanding Interfaces on an FCoE-FC Gateway on page 4829

Troubleshooting Dropped FIP Traffic

Problem Fibre Channel over Ethernet (FCoE) Initialization Protocol (FIP) traffic such as FIP VLAN discovery and notification frames is dropped on the QFX Series.

Cause The interface on which the FIP traffic is dropped does not have a native VLAN configured. FIP VLAN discovery and notification messages are exchanged as untagged packets on the native VLAN. (After the FCoE session with the Fibre Channel switch is established, FCoE traffic uses the FCoE VLAN.)

Solution Check to ensure that every 10-Gigabit Ethernet interface that connects to an FCoE device includes a native VLAN. Configure a native VLAN on all 10-Gigabit Ethernet interfaces that connect to FCoE devices.

NOTE: **Make sure that the native VLAN you are using on the QFX Series is the same native VLAN that the FCoE devices use for Ethernet traffic.**

The procedure for configuring a native VLAN on an interface is different on switches that use the original CLI than on switches that use the Enhanced Layer 2 Software (ELS) CLI. This topic provides the configuration procedure for each CLI.

Configuring a Native VLAN on Switches Using the Original CLI

To configure a native VLAN on an interface:

1. Set the interface port mode to **tagged-access** if you have not already done so:

   [edit]
   user@switch# **set interfaces *interface* unit *unit* family ethernet-switching port-mode tagged-access**

   For example, to set the port mode to **tagged-access** for interface **xe-0/0/6.0**:

   [edit]
   user@switch# **set interfaces xe-0/0/6 unit 0 family ethernet-switching port-mode tagged-access**

2. Configure the native VLAN if it does not already exist:

   [edit]
   user@switch# **set vlans *vlan-name* vlan-id *vlan-id***

   For example, to name the native VLAN **native** and use the VLAN ID **1**:

   [edit]
   user@switch# **set vlans native vlan-id 1**

3. Configure the native VLAN on the interface:

   [edit]
   user@switch# **set interfaces *interface* unit *unit* family ethernet-switching native-vlan-id *vlan-id***

   For example, to configure a native VLAN with the VLAN ID **1** on interface **xe-0/0/6.0**:

   [edit]
   user@switch# **set interfaces xe-0/0/6 unit 0 family ethernet-switching native-vlan-id 1**

Configuring a Native VLAN on Switches Using the ELS CLI

To configure a native VLAN on an interface:

1. Set the interface mode to **trunk** if you have not already done so:

   [edit]
   user@switch# **set interfaces *interface* unit *unit* family ethernet-switching interface-mode trunk**

   For example, to set the interface mode to **trunk** for interface **xe-0/0/6.0**:

   [edit]
   user@switch# **set interfaces xe-0/0/6 unit 0 family ethernet-switching interface-mode trunk**

2. Configure the native VLAN if it does not already exist:

   [edit]
   user@switch# **set vlans *vlan-name* vlan-id *vlan-id***

   For example, to name the native VLAN **native** and use the VLAN ID **1**:

   [edit]
   user@switch# **set vlans native vlan-id 1**

3. Configure the native VLAN on the physical Ethernet interface:

```
[edit]
user@switch# set interfaces interface native-vlan-id vlan-id
```

For example, to configure a native VLAN with the VLAN ID **1** on interface **xe-0/0/6.0**:

```
[edit]
user@switch# set interfaces xe-0/0/6 native-vlan-id 1
```

4. Configure the Ethernet interface as a member of the native VLAN:

```
[edit]
user@switch# set interfaces interface unit unit family ethernet-switching vlan members
vlan-name
```

For example, to configure an Ethernet interface as a member of a native VLAN with the VLAN ID **1** on interface **xe-0/0/6.0**:

```
[edit]
user@switch# set interfaces xe-0/0/6 unit 0 family ethernet-switching vlan members native
```

Related Documentation

- **interfaces on page 2075**
- **vlans on page 1639**
- Understanding FIP Functions on page 4817
- Configuring VLAN Interfaces for FCoE Traffic on an FCoE Transit Switch on page 5066

Traffic Management

Troubleshooting Egress Bandwidth That Exceeds the Configured Maximum Bandwidth

Problem The maximum bandwidth of a queue when measured at the egress port exceeds the maximum bandwidth (shaping rate) configured for the queue.

Cause When you configure bandwidth for a queue or a priority group, the switch accounts for the configured bandwidth as data only. The switch does not rate-shape the preamble and the interframe gap (IFG) associated with frames, so the switch does not account for the bandwidth consumed by the preamble and the IFG in its maximum bandwidth calculations.

The measured egress bandwidth can exceed the configured maximum bandwidth when small packet sizes (64 or 128 bytes) are transmitted because the preamble and the IFG are a larger percentage of the total traffic. For larger packet sizes, the preamble and IFG overhead are a small portion of the total traffic, and the effect on egress bandwidth is minor.

Solution When you calculate the bandwidth requirements for queues on which you expect a significant amount of traffic with small packet sizes, consider the shaping rate as the maximum bandwidth for the data only. Add sufficient bandwidth to your calculations to account for the preamble and IFG so that the port bandwidth is sufficient to handle the combined maximum data rate (shaping rate) and the preamble and IFG.

If the maximum bandwidth measured at the egress port exceeds the amount of bandwidth that you want to allocate to the queue, reduce the shaping rate for that queue.

Related Documentation

- **shaping-rate on page 5777**
- Example: Configuring Maximum Output Bandwidth on page 5526
- Example: Configuring Queue Schedulers on page 5511
- Understanding CoS Output Queue Schedulers on page 5371

Troubleshooting Egress Bandwidth That Exceeds the Configured Minimum Bandwidth

Problem The minimum bandwidth of a queue or a priority group when measured at the egress port exceeds the minimum bandwidth configured for the queue (transmit-rate) or for the priority group (guaranteed-rate).

Cause When you configure bandwidth for a queue or a priority group, the switch accounts for the configured bandwidth as data only. The switch does not include the preamble and the interframe gap (IFG) associated with frames, so the switch does not account for the bandwidth consumed by the preamble and the IFG in its minimum bandwidth calculations.

The measured egress bandwidth can exceed the configured minimum bandwidth when small packet sizes (64 or 128 bytes) are transmitted because the preamble and the IFG are a larger percentage of the total traffic. For larger packet sizes, the preamble and IFG overhead are a small portion of the total traffic, and the effect on egress bandwidth is minor.

NOTE: **The sum of the queue transmit rates in a priority group should not exceed the guaranteed rate for the priority group. (You cannot guarantee a minimum bandwidth for the queues that is greater than the minimum bandwidth guaranteed for the entire set of queues.)**

Solution When you calculate the bandwidth requirements for queues and priority groups on which you expect a significant amount of traffic with small packet sizes, consider the transmit rate and the guaranteed rate as the minimum bandwidth for the data only. Add sufficient bandwidth to your calculations to account for the preamble and IFG so that the port bandwidth is sufficient to handle the combined minimum data rate and the preamble and IFG.

If the minimum bandwidth measured at the egress port exceeds the amount of bandwidth that you want to allocate to a queue or to a priority group, reduce the transmit rate for that queue and reduce the guaranteed rate of the priority group that contains the queue.

Related Documentation

- **guaranteed-rate on page 5749**
- **transmit-rate on page 5784**
- Example: Configuring Minimum Guaranteed Output Bandwidth on page 5521
- Example: Configuring Queue Schedulers on page 5511
- Understanding CoS Output Queue Schedulers on page 5371

Troubleshooting Egress Queue Bandwidth Impacted by Congestion

Problem Congestion on an egress port causes egress queues to receive less bandwidth than expected. Egress port congestion can impact the amount of bandwidth allocated to queues on the congested port and, in some cases, on ports that are not congested.

Cause Egress queue congestion can cause the ingress port buffer to fill above a certain threshold and affect the flow to the queues on the egress port. One queue receives its configured bandwidth, but the other queues on the egress port are affected and do not receive their configured share of bandwidth.

Solution The solution is to configure a drop profile to apply weighted random early detection (WRED) to the queue or queues on the congested ports.

Configure a drop profile on the queue that is receiving its configured bandwidth. This queue is preventing the other queues from receiving their expected bandwidth. The drop profile prevents the queue from affecting the other queues on the port.

To configure a tail-drop profile using the CLI:

- Name the drop profile and set the drop start point, drop end point, minimum drop rate, and maximum drop rate for the drop profile:

  `[edit class-of-service]`
  `user@switch#` **set drop-profile** ***drop-profile-name*** **interpolate fill-level** ***percentage*** **fill-level** ***percentage*** **drop-probability 0 drop-probability** ***percentage***

Related Documentation

- **drop-profile on page 5732**
- Example: Configuring Tail-Drop Profiles on page 5501
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474
- Understanding CoS Tail-Drop Profiles on page 5409

Troubleshooting an Unexpected Rewrite Value

Problem Traffic from one or more forwarding classes on an egress port is assigned an unexpected rewrite value.

NOTE: **For packets that carry both an inner VLAN tag and an outer VLAN tag, the rewrite rules rewrite only the outer VLAN tag.**

Cause If you configure a rewrite rule for a forwarding class on an egress port but you do not configure a rewrite rule for every forwarding class on that egress port, then the forwarding classes that do not have a configured rewrite rule are assigned random rewrite values.

For example:

1. Configure forwarding classes **fc1**, **fc2**, and **fc3**.
2. Configure rewrite rules for forwarding classes **fc1** and **fc2**, but not for forwarding class **fc3**.
3. Assign forwarding classes **fc1**, **fc2**, and **fc3** to a port.

When traffic for these forwarding classes flows through the port, traffic for forwarding classes **fc1** and **fc2** is rewritten correctly. However, traffic for forwarding class **fc3** is assigned a random rewrite value.

Solution If any forwarding class on an egress port has a configured rewrite rule, then all forwarding classes on that egress port must have a configured rewrite rule. Configuring a rewrite rule for any forwarding class that is assigned a random rewrite value solves the problem.

TIP: **If you want the forwarding class to use the same code point value assigned to it by the ingress classifier, specify that value as the rewrite rule value. For example, if a forwarding class has the IEEE 802.1 ingress classifier code point value 011, configure a rewrite rule for that forwarding class that uses the IEEE 802.1p code point value 011.**

NOTE: **There are no default rewrite rules. You can bind one rewrite rule for each type (DSCP and IEEE 802.1) to a given interface. A rewrite rule can contain multiple forwarding-class-to-rewrite-value associations.**

1. Assign a rewrite value to a forwarding class. Add the new rewrite value to the same rewrite rule as the other forwarding classes on the port:

```
[edit class-of-service rewrite-rules]
```

```
user@switch# set (dscp | ieee-802.1) rewrite-name forwarding-class class-name loss-priority priority code-point (alias | bits)
```

For example, if the other forwarding classes on the port use rewrite values defined in the rewrite rule **custom-rw**, the forwarding class **fcoe** is being randomly rewritten, and you want to use IEEE 802.1 code point **011** for the **fcoe** forwarding class:

```
[edit class-of-service rewrite-rules]
user@switch# set ieee-802.1 custom-rw forwarding-class fcoe loss-priority high code-point 011
```

2. Enable the rewrite rule on an interface if it is not already enabled on the desired interface:

```
[edit]
user@switch# set class-of-service interfaces interface-name unit unit rewrite-rules (dscp | ieee-802.1) rewrite-rule-name
```

For example, to enable the rewrite rule **custom-rw** on interface **xe-0/0/24.0**:

```
[edit]
user@switch# set class-of-service interfaces xe-0/0/24 unit 0 rewrite-rules ieee-802.1 custom-rw
```

Related Documentation

- interfaces on page 5757
- rewrite-rules on page 5772
- Defining CoS Rewrite Rules on page 5693
- Monitoring CoS Rewrite Rules on page 5812

Troubleshooting a Port Reset on QFabric Systems When a Queue Stops Transmitting Traffic

Problem In QFabric systems, if any queue that contains outgoing packets does not transmit packets for 12 consecutive seconds, the port automatically resets.

Cause Failure of a queue to transmit packets for 12 consecutive seconds may be due to:

- A strict-high priority queue consuming all of the port bandwidth
- Several queues consuming all of the port bandwidth
- Any queue or port receiving continuous priority-based flow control (PFC) or 802.3x Ethernet PAUSE messages (received PFC and PAUSE messages prevent a queue or a port, respectively, from transmitting packets because of network congestion)
- Other conditions that prevent a queue from obtaining port bandwidth for 12 consecutive seconds

Solution If the cause is a strict-high priority queue or other queues consuming all of the port bandwidth, you can use rate shaping to configure a maximum rate for the queues that are using all of the port bandwidth and preventing other queues from obtaining bandwidth on the port. You configure a maximum rate by creating a scheduler, using a scheduler map to apply it to a forwarding class (which maps to an output queue), and applying the scheduler map to the port using a forwarding class set and a traffic control profile.

To configure rate shaping using the CLI:

1. Name the existing scheduler or create a scheduler and define the maximum bandwidth as a rate or as a percentage:

   ```
   [edit class-of-service]
   user@switch# set schedulers scheduler-name shaping-rate (rate | percent percentage)
   ```

2. Configure a scheduler map to associate the scheduler with the forwarding class (queue) that is consuming all of the port bandwidth:

   ```
   [edit class-of-service]
   user@switch# set scheduler-maps scheduler-map-name forwarding-class
   forwarding-class-name scheduler scheduler-name
   ```

3. Associate the scheduler map with a traffic control profile:

   ```
   [edit class-of-service]
   user@switch# set traffic-control-profiles traffic-control-profile-name scheduler-map
   scheduler-map-name
   ```

4. Associate the traffic control profile (and thus the scheduler map that contains the rate shaping queue scheduler) with a forwarding class set and apply them to the interface that is being reset:

   ```
   [edit class-of-service]
   user@switch# set interfaces interface-name forwarding-class-set fc-set-name
   output-traffic-control-profile traffic-control-profile-name
   ```

For example, a strict-high priority queue is using all of the bandwidth on interface **shpnode:xe-0/0/10** and preventing other queues from transmitting for 12 consecutive seconds. You decide to set a maximum rate of 7 Gbps on the strict-high priority queue to ensure that at least 3 Gbps of the port bandwidth is available to service other queues. Table 553 on page 5971 shows the topology for this example:

Table 619: Components of the Rate Shaping Troubleshooting Example

Component	Settings
Affected interface	**shpnode:xe-0/0/10**
Scheduler (strict-high priority scheduler)	Name: **shp-sched** Shaping rate: **7g** Priority: **strict-high** NOTE: This example assumes that the scheduler already exists and has been configured as **strict-high** priority, but that rate shaping to prevent the strict-high priority traffic from using all of the port bandwidth has not been applied.
Scheduler map	Name: **shp-map** Forwarding class to associate with the **shp-sched** scheduler: **strict-high** NOTE: This example assumes that a strict-high priority forwarding class has been configured and assigned the name **strict-high**.
Traffic control profile	Name: **shp-tcp** NOTE: This example does not describe how to define a complete traffic control profile.

Table 619: Components of the Rate Shaping Troubleshooting Example *(continued)*

Component	Settings
Forwarding class set	Name: **shp-pg**

To configure the scheduler, map it to the strict-high priority forwarding class, and apply it to interface **shpnode:xe-0/0/10** using the CLI:

1. Specify the scheduler for the strict-high priority queue (**shp-sched**) with a maximum bandwidth of 7 Gbps:

```
[edit class-of-service schedulers]
user@switch# set shp-sched shaping-rate 7g
```

2. Configure a scheduler map (**shp-map**) that associates the scheduler (**shp-sched**) with the forwarding class (**strict-high**):

```
[edit class-of-service scheduler-maps]
user@switch# set shp-map forwarding-class strict-high scheduler shp-sched
```

3. Associate the scheduler map **shp-map** with a traffic control profile (**shp-tcp**):

```
[edit class-of-service traffic-control-profiles]
user@switch# set shp-tcp scheduler-map shp-map
```

4. Associate the traffic control profile **shp-tcp** with a forwarding class set (**shp-pg**) and the affected interface (**shpnode:xe-0/0/10**):

```
[edit class-of-service]
user@switch# set interfaces shpnode:xe-0/0/10 forwarding-class-set shp-pg
output-traffic-control-profile shp-tcp
```

Related Documentation

- Understanding CoS Output Queue Schedulers on page 5371
- Defining CoS Queue Scheduling Priority on page 5682
- Example: Configuring Queue Schedulers on page 5511
- Example: Configuring Traffic Control Profiles (Priority Group Scheduling) on page 5519
- Example: Configuring Forwarding Class Sets on page 5508
- Example: Configuring CoS Hierarchical Port Scheduling (ETS) on page 5474

